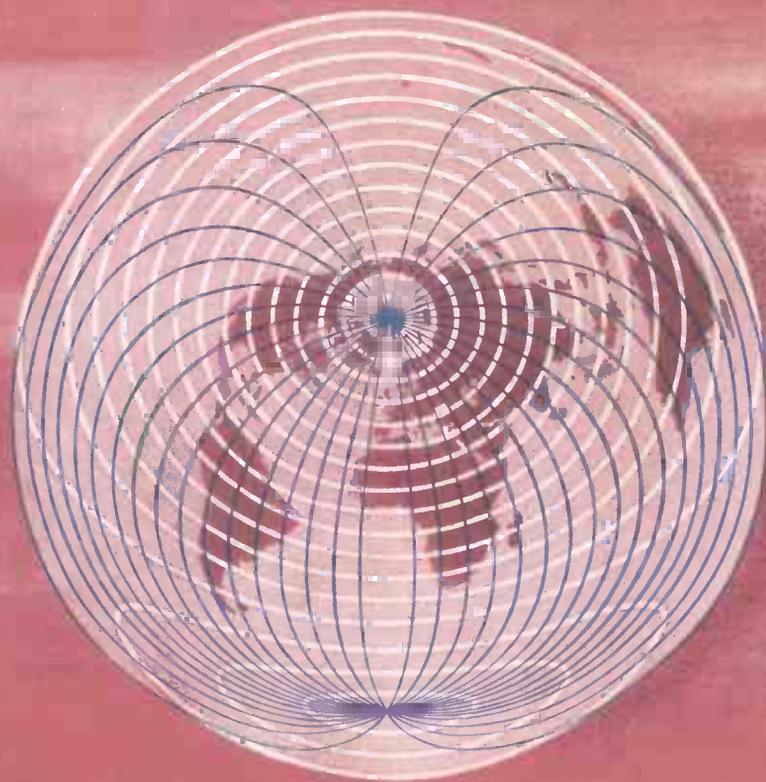


FEBRUARY 1955

TWO SHILLINGS

# Wireless World

Radio · Electronics · Television



**FORTY-FOURTH YEAR OF PUBLICATION**



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21 BLOOMSBURY STREET, LONDON, W.C.1

# Wireless World

RADIO, TELEVISION, ELECTRONICS

Managing Editor:  
HUGH S. POCOCK, M.I.E.E

Editor:  
H. F. SMITH.

FEBRUARY 1955

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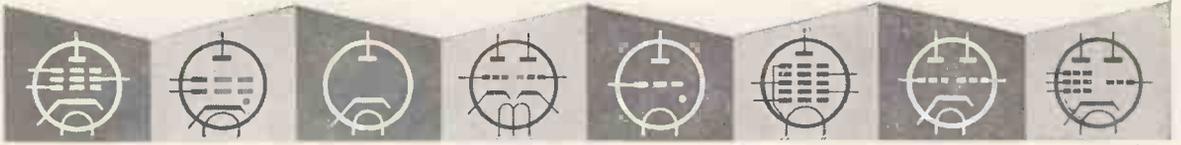
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# VALVES, TUBES & CIRCUITS

## 26. Additional Applications of the PCF80

The Mullard PCF80 was designed primarily as an additive mixer for front end stages in Band I and Band III television receivers and converters in association with the PCC84. This application has been discussed in *Valves, Tubes, and Circuits* Nos. 15, 16, and 17 (available as reprints with additional notes). The low interelectrode capacitances and short grid base of the valve make it suitable for a number of other applications in which the EF80, ECL80, ECC82, and other valves have hitherto been used.

In television receivers the triode and pentode section of one PCF80 can, with certain limitations, be used to perform separate functions. The performances of the two sections in various audio and video circuits are briefly discussed below. A chart, indicating the permissibility of a large number of combinations of function, will be included in the reprint of this advertisement.

When the triode and pentode of the PCF80 are to be used in different circuits in a television receiver, the advisability of a particular combination is determined by the internal coupling between the sections, especially if the signal levels are widely different, or if the pentode is to be the first valve of a high gain cascade circuit. Use in such a cascade circuit is inadvisable unless the total gain of the stage, or the source impedance, is very low. With a low source impedance, moreover, hum becomes a limiting factor.

The internal coupling has two components: the cross capacitances, and the leakage paths across them. The leakage paths are negligible in all but the most critical combinations of function. The most important capacitive coupling is that between the anode of the triode and the first grid of the pentode. Its maximum value is 0.16pF plus the valveholder capacitance of 0.15 to 0.4pF. The capacitances from the pentode to the triode grid are less than 0.02pF.

The use of the triode in audio applications is restricted by the leakage paths, which will make operation impossible at low audio levels when the pentode is used in a video or timebase circuit. Conversely, the combined effect of the cross capacitances and their shunt resistances prevents the use of the pentode as an audio valve when the triode is used in a video or timebase circuit. The power output of a single triode or even of two in push-pull is insufficient for use in the audio output stage.

With the pentode as a sound or vision i.f. amplifier, the triode may be operated in timebase, video i.f., or audio circuits. It is necessary to minimise hum by effectively earthing the pentode grid or at least by providing the lowest possible impedance to earth. The impedance should not exceed 40kΩ at low frequencies, and it should be still less at higher frequencies. Capacitive decoupling of

the earthy end of the i.f. coil is obtained with 0.1μF min. for a 50 c/s interfering signal and 0.001μF min. for 10 kc/s. The most stringent of the combinations in this respect is with the pentode as sound i.f. amplifier and the triode as a timebase or video valve.

The pentode may be used as a video amplifier in place of the EF80 with a slightly reduced gain but a greater peak-to-peak output; or as a synchronising pulse separator with a low screen grid voltage and a high value of anode load to obtain a very short grid base. The triode may be used as a frame pulse clipper or as a conventional frame blocking oscillator.

Both sections may be used in a multivibrator circuit to produce a line scanning waveform. A resonant circuit in the triode anode circuit can help to stabilise the natural frequency of the oscillator, if it is locked by a flywheel synchronising system. This can be achieved by returning the control grid of the pentode to a source of controlling bias. In this application no interference is seen if either section of the valve is used for synchronising pulse separation or clipping. But with the pentode in this multivibrator circuit and the triode acting as a frame timebase blocking oscillator, some interaction between line and frame scanning occurs. This combination is not recommended.

In fringe areas, 405-line operation under noisy conditions is considerably improved by flywheel synchronisation. The line timebase coincidence detector which is necessary can incorporate the PCF80 pentode with the two coincident pulses applied to the control and screen grids. The triode can then act as the separate pulse amplifier. In this application the triode or the pentode may be transferred to any of the other scanning applications already discussed without undesirable stray coupling effects.

*Circuits for the recommended applications will be published in a future advertisement in this series.*

*Reprints of this advertisement, with additional notes consisting of a comprehensive application chart, are available without charge from the address below.*



MULLARD LTD., Technical Service Department, Century House, Shaftesbury Avenue, W.C.2

MVM 313

# Wireless World

FEBRUARY 1955

VOL. 61 No. 2

## *As She Is Spoke*

**E**VER since wireless telegraphy became practicable, the tongue that Shakespeare spoke has proved short of words for the clear expression of ideas connected with the new method of communication. True, the long-forgotten journalist who wrote, at the turn of the century, about "the message being flashed" was inspired. That phrase, though never quite to the taste of the professional, conveyed to the layman (at least in the days of spark transmitters) a vivid and not inaccurate impression of what really happened. But, after 50 years or more, messages are still being flashed, and the public seems sadly in need of a new phrase.

Of course, it was not until broadcasting came that radio made a big impact on the public at large. We then had an unrivalled opportunity to start off on the right foot. The word "broadcasting" itself was a first-rate example of figurative English, derived in accordance with the best tradition. It is with shame that we admit ignorance of the true paternity of this heaven-sent word. Was it of American origin? Anyway, "broadcasting" was at once adopted by the professional, but, with a queer lack of good taste, the man in the street showed a strange preference for "the wireless" and later for "the radio."

Each new development brought its own inept phraseology. Television was no sooner established than the expression "radio and television" began to trip off the lay tongue (and sometimes, alas, the professional one as well). A nice puzzle it must make for a foreign visitor with a mainly academic knowledge of English, who may reasonably guess that our television is transmitted pneumatically! We were not surprised to see the other day the headline "British Radio and V.H.F." in a lay journal.

The latest innovation in sound reproduction—ready-recorded magnetic tapes—might easily become the next victim of our genius for choosing the confusing name. They have been referred to as "pre-recorded tapes," which might mean virgin tapes, and "tape recordings," which might mean anything. Fortunately, there is some hope here that a reasonably clear and descriptive name will prevail. E.M.I., the pioneers of these new rivals to disc records,

assure us they are to be known as "tape records."

The B.B.C. has not, we fear, proved itself a zealous guardian of the language of its own medium of communication. Some time ago a correspondent drew attention in our columns to the absurdity of that favourite B.B.C. expression "pre-recorded" by enquiring about the meaning of "post-recorded." We believe there is some subtle significance in such variants as "the programme was recorded," "pre-recorded" and "from a recording," but nobody seems to know the code. Then there is the most abominable of all B.B.C. words "tele-recording" which seems utterly unnecessary in any imaginable context. Why "tele-," when, in most cases, distance is not an essential factor? Unless the Corporation mends its ways, abominations like "the telly" will soon become respectable and accepted.

## *Anarchy in the Ether*

**R**ECENT newspaper stories about experimental transmissions from the so-called "Europe No. 1" station on the Felsberg make sad reading, and serve to emphasize the chaotic state of congestion on the medium and long-wave broadcasting bands. The station has been transmitting test signals on various frequencies between 238 and 255 kc/s. Naturally enough, as all the channels in that band are already occupied, severe interference has been caused, and protests have been made by the authorities concerned. The Saar has no allocation in the long-wave band, and so it is difficult to see any excuse for these attempts on the part of the station to find a niche for itself.

The Copenhagen Plan is almost a dead letter. For example, under it the two German Republics and Austria are allowed between them 15 medium-wave stations, but have actually 65, plus 37 stations run by the occupying Powers. Clearly, the only solution lies in drastic reduction of the number of medium-wave stations, with supplementary reinforcing services on v.h.f. To evolve a new plan on this basis must be the first task as soon as the international climate is favourable for a conference.

# Television Society's Exhibition

**A**N annual event of importance to television enthusiasts, the Television Society's Exhibition, was held this year on January 6th-8th. Marconi's had a camera chain in operation, which provided shots of the exhibition itself, and Belling-Lee arranged the distribution of the signal and also of the B.B.C. programme to exhibitors demonstrating apparatus. Belling-Lee also had a demonstration of the effects of interference suppressors in television reception in Bands I and III. Under the conditions of test a Band I suppressor in the leads to a small motor proved very effective in eliminating interference on Band I, but was quite ineffective on Band III. It was shown that to obtain suppression here a special suppressor had to be mounted inside the motor frame close to the brushes. Dubilier showed inductors and capacitors for suppression, the inductors being miniature dust-core types which it is recommended should be connected in series with the motor field windings close to the brushes.

The effect of the form of modulation upon ignition interference was demonstrated by the G.E.C. A signal with positive or negative modulation was fed, with interference, to a receiver which could be appropriately switched to deal with either type of modulation. The superiority of positive modulation was most evident. Although the black spots of interference with negative modulation were in themselves less evident than the white spots with positive modulation, the synchronizing was so greatly affected that the picture was useless, whereas with positive modulation the synchronizing was hardly affected at all.

Interference is, of course, a matter of major importance in fringe areas, and a scheme which may well reduce it and also permit a useful signal to be obtained in screened locations was shown by J. S. Fielden. This is a three-valve pre-amplifier designed for mounting on an aerial pole and powered by a 50-c/s supply which can be fed to it through the same coaxial cable that is used for the signal. It is intended for use where it is possible to take advantage of neighbouring high ground to erect an effective aerial, perhaps at some distance from the receiver. The repeater 2000/S5 has a bandwidth of 10 Mc/s and can be used with solid-dielectric coaxial cable at distances up to 500 yards or with semi-air spaced cable up to 1,000 yards. It operates on Band I. For Band III a convertor unit will be available which will be pre-set to change the frequency of the Band III signal to a Band I channel adjacent to the normal Band I signal, so that the repeater will handle both signals.

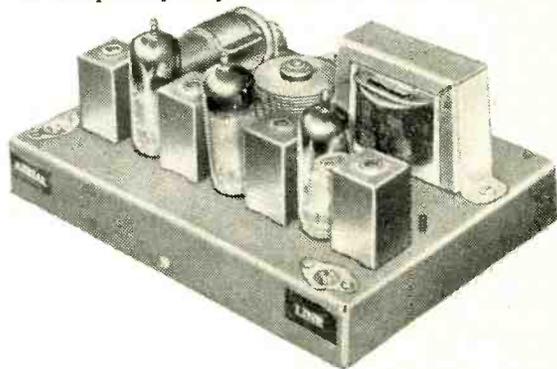
Another kind of repeater, intended as a line amplifier for a television relay system, was shown by G.E.C. The interesting thing about this was the use of transistors instead of valves. The advantages of transistors for this type of application are, of course, their small size, robustness and need for only one supply of low-voltage power. The amplifier actually uses experimental point types, and it works at a centre frequency of 5 Mc/s with a bandwidth of 3 Mc/s. A gain of 32 db is obtained and the frequency response is flat to within  $\pm 0.5$  db over the 3-Mc/s band.

Test apparatus naturally formed a large section of

the exhibition, and of particular interest was the equipment developed by Bush Radio for the testing and alignment of television sets in production. The heart of the instrument is a swept-frequency oscillator covering about 33-39 Mc/s for i.f. alignment using a cathode-ray display. Spot frequencies are also available for sound-channel rejector adjustment and checking.

The i.f. sweep can be heterodyned to the video range and the resulting video sweep used to modulate r.f. carriers in Bands I and III. Complete television signals, both sound and vision, are provided on three channels in each band, and the vision signal is modulated in alternate "lines" by the video sweep and by a 5- $\mu$ sec pulse. The receiver output is displayed on a double time-base tube to show the overall video response and the pulse response. Final alignment and adjustment can then be carried out in an overall test. The outputs are "piped" around the factory to the test positions.

A swept-frequency oscillator of the serviceman's



Television pre-amplifier by J. S. Fielden; for a remote aerial.



Band III convertor (below) for the type 1320 Cossor Tele-check swept-frequency oscillator (above).

type was shown by Cossor. This is the 1322 Telecheck which covers Bands I and III and gives a 10-Mc/s sweep on its fundamental and proportionally more on its harmonics. The fundamental range is 10-22 Mc/s. A crystal-controlled marker generator is included. A Band III convertor, model 1321, for the older 1320 Telecheck, which covered Band I only, was shown. It is arranged to screw on to the 1320 instrument.

Amongst an interesting selection of American test gear shown by Livingston Laboratories was an oscilloscope designed for maintenance and adjustment of television transmitter and studio equipment—the Tektronix type 524-D. It can be used for observing the waveforms of complete television frames or single lines or portions of lines. The Y amplifier has a maximum frequency of 10 Mc/s and is flat to 5 Mc/s, while the timebase rate is continuously variable from 0.01 sec per centimetre to 0.1  $\mu$ sec per centimetre. Special features include variable sweep delay, sweep expansion (for magnifying detail), an amplitude calibrator and time markers at intervals of 1  $\mu$ sec, 0.1  $\mu$ sec and 0.05  $\mu$ sec.

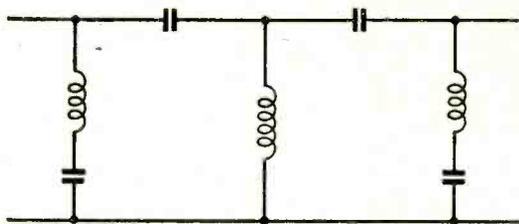
Radio-Aids showed a small three-stage i.f. amplifier feeding a crystal detector and microammeter. It is available pre-tuned to any Band I channel and calibrated to measure signal inputs up to 1 mV. It is intended for use in aerial and feeder testing and, with a known aerial, for determining the field strength so that a dealer may decide beforehand what sort of aerial it will be necessary to erect.

Apparatus for the measurement of oscillator drift on Band III was shown by Ferguson. A crystal-controlled signal is fed into the receiver under test and the i.f. output is mixed with another crystal-controlled oscillator. The initial adjustment is to zero beat. Oscillator drift then causes the beat frequency to rise and this is recorded by a Servograph.

Printed-circuit technique is developing rapidly and T.C.C. showed many examples. One of considerable importance for the future was the basis of a Band III tuner and well showed the advantage of the technique in securing uniformity of lead length in production. Another example was an aerial filter, intended for receivers using a 34.65 Mc/s i.f., to prevent i.f. breakthrough. With the circuit of Fig. 1, the coils and capacitors are all printed. The insertion loss is 2 db and at all frequencies below about 41 Mc/s the insertion loss is never less than 20 db and reaches a maximum of 34 db at 38 Mc/s.

There was very little evidence of work on colour television except in the field of cathode-ray tubes. 20th Century Electronics had modified one of their four-gun oscilloscope tubes so that the screen was divided into four quarters, one having an ordinary white phosphor and the others having red, green and blue phosphors respectively. The four electron guns were arranged in a corresponding pattern, with one directed on each phosphor, so that it was possible to display white, red, green and blue television pictures simultaneously. Each gun had its own electrostatic deflection plates and these were fed from the common scanning generators through blocking capacitors so that individual shift voltages could be applied. It was also possible to control the brightness and contrast of each picture separately.

On the Mullard stand were some 14-inch experimental c.r. tubes with coloured phosphors, intended for use in colour-picture monitors of the type in which the three coloured images are combined optically by dichroic or half-silvered mirrors. The tubes, which



T.C.C. printed "i.f. breakthrough" filter.

are electrically identical and operate with 12 kV on the final anode, are the types 36CDD12-3, -4 and -5, having blue, green and red phosphors respectively. Another new experimental tube shown by Mullard was the 4MK13 flying-spot scanner, intended for use at the transmitting end for scanning coloured slides and films. To obtain the necessary high level of brightness the anode of the triode gun operates at 25 kV, while the 5-inch screen is claimed to give a substantially panchromatic light output.

Various colour phosphors were demonstrated in Ferranti cathode-ray tubes by the chemical manufacturers Derby & Co., and here the difficulty of producing a good red-emitting phosphor was very evident. Most of the colour television demonstrations so far have, in fact, given rather poor colour rendering in this particular component.

## TELEVISION STANDARDS CONVERSION

### *Possibility of Direct Electronic Method*

By H. A. FAIRHURST\*

**S**TANDARDS conversion in television is by no means new, but it is probably not common knowledge that there is a possible alternative to the "brute force" method (of a camera viewing a c.r.t. monitor) used during the "Eurovision" programme exchanges. Whether this alternative could be developed into a system capable of giving acceptable results is not known, but it has a sound theoretical basis and has been proved to work on the bench.

The fundamental principle of the alternative system is that selected lines of picture information at the higher definition are stretched in time until each occupies the line duration of the lower definition system. This is performed by feeding the selected picture line into a delay line of sufficient delay to accommodate the whole slice of information at once, and then switching the characteristics of the delay line while the information is still all inside the line so that when it does emerge it does so at the new desired rate.

Because the higher definition lines occur at a greater rate than those at the lower definition, some of them must be sacrificed, but from the point of view of the lower definition user he will not miss what he has never had, and as the system is theoretically capable

\* Murphy Radio.

of giving full horizontal definition his picture should be fully up to standard.

The system works in its simplest form if certain fixed relationships are preserved between the two standards. For example, it is assumed that the frame frequency is the same in the two cases. It is also assumed that the line frequencies are related in some simple manner—2:1, 3:2, 5:3, etc. This can be argued to be a definite disadvantage of the system, for these particular ratios, assuming 405 lines to be the lower definition standard, call for 405 lines, 50 frames, sequentially scanned, 607½ lines interlaced, and 675 lines interlaced, respectively, in the corresponding higher definition systems.

A 405-line non-interlaced system is a case by itself and will not be further considered here, while 607½- and 675-line systems do not appear anywhere as accepted standards. However, of these three, it can be shown that only the 675-line system is an acceptable higher definition to be linked by electronic standards conversion to 405 lines, and this because of the desirability of preserving the interlaced scan.

For the purposes of illustration, the 675-405 line case is shown in Fig. 1, which indicates the sequence of lines chosen from the higher definition (numbered) to make the consecutive lines at the lower definition (broken lines). Three delay lines are required to handle the information without overlap, and the form and timing of the delay line switching pulses are shown. Owing to the need to use three only out of every five high-definition lines, and to the consecutive nature of the lower definition lines, there will be a regular

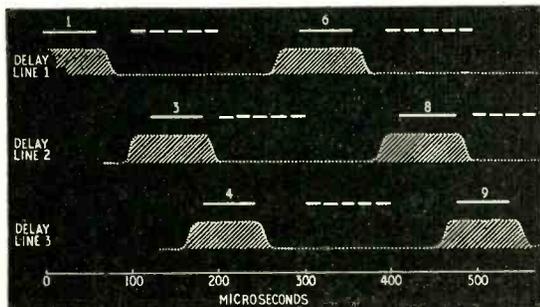


Fig. 1. Showing how the high-definition lines (numbered) are selected and distributed in sequence to the three delay lines, where they are stretched in time to produce the lower-definition lines (broken lines) which follow continuously upon each other. The waveform of the delay-changing current is shown for each delay line.

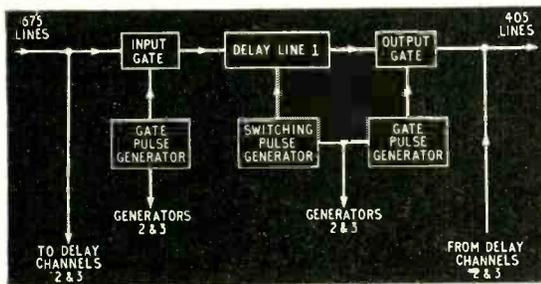


Fig. 2. Simplified block diagram of one of the delay channels. The input gating generators are controlled by the 675-line sync pulses and the output gates by a 5:3 count-down circuit operated by these pulses.

slight deformation of the picture in a vertical direction, but this can be shown to be a fixed pattern and normally invisible.

As three delay lines are required to handle the conversion, it is necessary to provide switching and gating circuits to switch the desired picture lines into the correct sections and also to sample the three outputs in turn so as to combine them into the lower definition signal. At the same time means must be provided for switching the constants of the delay lines at the correct times and for the correct durations. Fig. 2 is a simplified block diagram of one of the delay channels.

What of the delay lines themselves? The criterion here is that their constants must be capable of being switched to change the velocity of propagation through them. This could be done by winding the elements of the line on closed ferrite cores which can be saturated magnetically by current flowing through an additional winding. One arrangement successfully tried was to wind each element of the delay line as a toroid on a small ferrite ring and then to string them all on to a copper rod through which was passed the saturating current. Such a coil wound on a grade of ferrite suitable for the frequencies involved has its inductance reduced to nearly one-sixth when the core is saturated, so the smaller change required for the conversion process is easily obtained with quite practicable saturating currents.

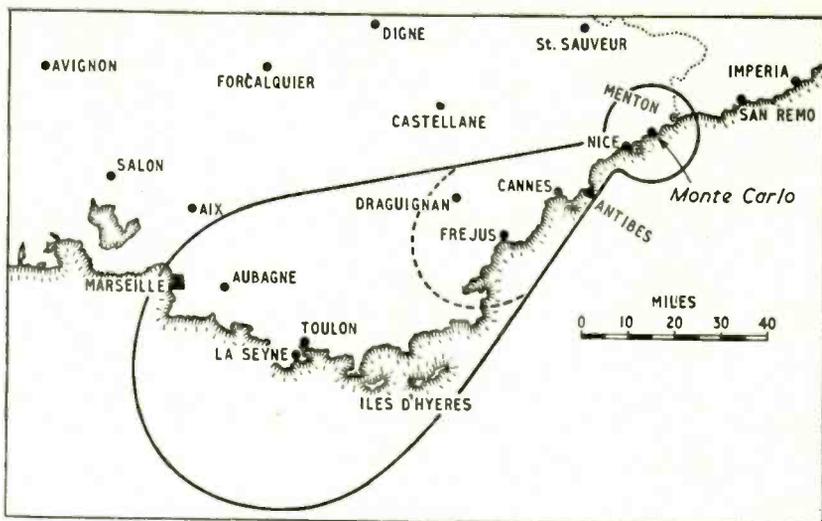
Further removed, perhaps, from the bounds of possibility is the number of elements required in each line to obtain the requisite delay. It will obviously be a large number, and will depend a lot on the phase characteristic that can be maintained, but if a cut-off frequency of 20 Mc/s is assumed, with the values of  $L=25\mu\text{H}$  and  $C=10\text{pF}$  the number works out to be over 6,000. This would present a pretty problem for the designer, but it is no doubt not insoluble.

Fig. 2 is very much simplified and gives little hint of the complexity of circuitry which may be involved. It does not indicate, for example, that means must be provided for obtaining an exact timing of the outgoing information and for matching the outputs of the three delay lines. Fortunately the time intervals allow the saturating current pulse to be shifted a few microseconds either way, and this facility could provide a micrometer adjustment on the time the information spends in the line and, therefore, of the instant it begins to emerge. Control of the duration of the outgoing line of information can be achieved by varying the actual amplitude of the saturating current pulse. In this connection it must be noted that the saturating current must have a d.c. component in order to prevent any tendency to saturate the cores in both directions.

Bench experiments with short sections of line have demonstrated the stretching of a pulse and also the various other effects that would be expected on theoretical grounds when the constants of a line carrying a signal are switched. These experiments have shown that to develop such a standards convertor would be a major undertaking, but they have not shown it to be impracticable.

A system of conversion such as this offers one kind of solution to the problem of compatibility in colour television. It would make possible, for example, the transmission on 405 lines of monochrome versions of colour pictures which were being put out on some higher definition system—or, indeed, the transmission of coloured 405-line versions of these higher definition colour pictures.

Estimated polar diagram for the transmitter when it is on full power. The dotted line shows the present estimated coverage.



By

**CHARLES B. BOVILL**

A.M.I.E.E., M.Brit.I.R.E.

## MONTE CARLO TELEVISION STATION

**W**ITH several different standards being used for television in Europe, it was inevitable that eventually the problem of a transmitter located on a "standards frontier" should arise, and it is therefore of interest to examine what has been done in the case of the Monte Carlo television station which was recently put into service.

This station, which is the second commercial television station to be opened in Europe (the other is in the Saar), is situated on Mont Agel, a 3,500-ft mountain overlooking the Principality of Monaco and only some 10 miles from the Franco-Italian frontier.

Since the station is sponsored commercially, and the sponsors are French and handling the publicity for French merchandise, the role of the station is to serve the thickly populated area lying between Menton to the east and Toulon and Marseille to the south west. As Italian television standards differ from the French 819-line system the transmissions would not normally be receivable in Italy. Special receivers will soon be available for this area, however, so that programmes intended for Italian viewers will also be possible.

The design of the station therefore called for the maximum cover towards the south east, and adequate cover for the Principality and French towns extending to the Italian frontier. It will also be appreciated that there is no requirement for any cover over the sea over an arc of about 150 degrees to the south east and south west, nor for cover over the almost uninhabited Alpine region to the north.

The rather special cover requirements have enabled the designers and manufacturers of the station, the Société Radio Industrie, to construct a most economical and effective installation by the use of directional high-gain aeriels. The aeriels, which are of batwing type, provide a main lobe with a horizontal width of about 45 degrees which provides the main Riviera cover towards Nice, Cannes and Toulon. Very small secondary or side lobes—usually a serious problem to eliminate in directional aerial design—provide, with slight modification to the aerial array, the necessary cover for the nearby towns towards Italy. The aerial

arrangement incorporates radiators for video and for sound, each having a power gain of about 10, the effective radiation on the video frequency of 199.7 Mc/s being 50 kW and on sound 12.5 kW at a frequency of 188.55 Mc/s. The polarization is horizontal for both video and sound and the French 819-line standard is used, requiring of the aeriels a bandwidth in excess of 10 Mc/s. The standard arrangement for France of single sideband transmission is retained.

Next year the power will be increased and the coverage improved as a result.

Preliminary reports of reception indicate very satisfactory results, with clear and steady pictures at St. Tropez, 50 miles from the transmitter. Since the signal travels partly over water to some of the towns to be served by the main lobe, this result is probably to be expected, but it is also reported that good reception is obtained at inland towns such as Draguignan, at which position the signal path is over soil which is notorious for its poor conductivity.

The studios from which the programmes originate are situated in the town of Monte Carlo some 3,000ft below and two miles from the transmitter aeriels. In order to avoid the use of buried coaxial cables and their attendant expense for installation and maintenance, and in order to avoid phase distortion in the cables, a duplicated 4-cm radio link conveys the modulations to the transmitters.

The sponsors of the Monte Carlo television station are the "Images and Sound" group, which also operates the Saar television station and which will shortly put into service the extra high-power sound broadcast station for sponsored programmes at Felsberg.

The commercial programme policy of this group is original and differs from that practised in the U.S.A. in several respects. As an example, the group themselves arrange and compose the programmes which are acquired by the publicity organization and the advertising matter is integrated into the programme in a restrained way. Also, the publicity is restricted to one minute every quarter of an hour.

# WORLD OF WIRELESS

Colour Prospects ♦ Anglo-French TV Link ♦

B.B.C. Band II Frequencies ♦ Another "Festival of Sound"

## Television News

RECENT pronouncements on the possibilities of the introduction of colour television by the B.B.C. within the next two years have been clarified by E. L. E. Pawley (head of Engineering Services). He points out that the decision has yet to be made by the Government (with the advice of the T.A.C.) whether or not we are to have a compatible system. The B.B.C. Research Station is in fact experimenting with the American N.T.S.C. compatible system adapted to our 405 lines with a 5 Mc/s bandwidth, but is also working on a non-compatible system. This would require a greater bandwidth and, therefore, could not be accommodated in the present channels in Bands I and III. Sir George Barnes, B.B.C. director of television, thinks a decision may be reached by the end of the year.

As part of the permanent cross-channel television link to be established by the Post Office a two-way cable link between London and St. Margarets Bay is to be rented permanently by the B.B.C. Presumably the Post Office will be able to provide similar facilities for the I.T.A. should they be required. Until the permanent stations for the cross-channel link are set up in about three years' time the cable will be extended from St. Margarets Bay to Swingate, near Dover (a distance of about two miles), where the B.B.C.'s temporary radio link with Cassel is installed.

Test transmissions from the temporary low-power television transmitter at Tacolneston, 10 miles south west of Norwich, started on January 17th. It is planned to bring the station into regular service on February 1st. Operating in Channel 3 (carriers 56.75 Mc/s vision and 53.25 Mc/s sound, slightly offset) with horizontal polarization, the temporary station will serve an area bounded by Aylsham, East Dereham, Watton, Diss, Beccles and Acle. Vision signals from Alexandra Palace will be picked up near Bury St. Edmunds and relayed by radio to the transmitter site. Sound will be conveyed from Alexandra Palace by line.

For testing Band III aeriels and receivers under practical conditions a test-pattern vision signal is to be radiated from a temporary 1-kW transmitter near the site of the I.T.A. South London station. The transmissions, which are due to start on April 1st, are to be conducted by Belling & Lee.

## Baird Memorial

AN appeal for funds for a Baird memorial has been launched by the Royal Technical College, Glasgow, where Baird was a student from 1906 to 1910. It is proposed by the governors of the college to establish an annual memorial lecture on developments in television and related fields and to provide a Baird prize in the Department of Electrical Engineering. Donations to the Baird Memorial Fund should be sent to the Secretary/Treasurer, Royal Technical College, George Street, Glasgow, C.1.

## V.H.F. Broadcasting

WITH the announcement of the P.M.G.'s approval of an additional v.h.f. station at Wenvoe—making 10 so far approved by the Government—the B.B.C. has made known the frequencies to be used by the 30 transmitters at these stations. The frequencies, together with the e.r.p. for each transmitter, are given in the table below. Incidentally, with the exception of those for Holme Moss and Blaen Plwy, the frequencies conform to the plan for Band II drawn up at Stockholm in 1952. The frequencies given for Wenvoe, however, have yet to be confirmed by the Post Office.

	Home (Mc/s)	Light (Mc/s)	Third (Mc/s)	E.R.P. (kW)
Wrotham (Kent)...	93.5	89.1	91.3	120
Pontop Pike (Co. Durham) ...	92.9	88.5	90.7	60
Divis (N. Ireland)	94.5	90.1	92.3	60
Meldrum (Aberdeenshire) ...	93.1	88.7	90.9	60
N. Hessary Tor (S. Devon) ...	92.5	88.1	90.3	60
Sutton Coldfield (Warwicks.) ...	92.7	88.3	90.5	120
Norwich ...	94.1	89.7	91.9	120
Blaen Plwy (Cardigan) ...	93.1	88.7	90.9	60
Holme Moss (Yorks.) ...	93.7	89.3	91.5	120
Wenvoe (Glam.)...	94.3	89.9	92.1	120

When announcing the inclusion of Wenvoe in the first batch of v.h.f. stations, scheduled to be completed by the end of 1956, the P.M.G. stated that the Television Advisory Committee had recommended the adoption of the B.B.C.'s long-term plans for v.h.f. development. We understand that these provide for a total of 26 stations, at most of which there will be three transmitters or even a fourth where a station serves two regions.

## Repeat Performance

AS announced in December, G. A. Briggs, of Wharfedale Wireless, is giving another lecture-demonstration on sound reproduction at the Royal Festival Hall, London, on May 21st. Tickets are priced 5s 6d and 3s 6d. Within a few days of the announcement of prices, all the tickets for the cheaper seats were sold, but as we go to press there are still some 5s 6d tickets available from "hi-fi" dealers in London.

Mr. Briggs is also giving a similar demonstration in St. George's Hall, Bradford, on April 1st, at 7.30. Tickets at 3s 6d and 2s are available from J. Wood & Sons, Sunbridge Road, Bradford.

## Valve "Balance of Trade"

WHILE the exports of valves and c.r. tubes continue to decrease imports of these accessories have increased by over 100 per cent during the past year.

Exports of valves during the first eleven months of 1954 (the latest analysed figures available) totalled £1,743,692, and cathode-ray tubes £122,729, whereas the comparative figures for 1953 were £1,867,079 and £147,590. The actual numbers of valves and cathode-ray tubes exported were 4,447,548 compared with 4,643,005 in 1953.

Figures for the first eleven months of 1954 compared with the same period in 1953 show an increase of 131 per cent in the number of valves imported and 66 per cent in the number of c.r. tubes coming into the country. The total value of these imports was £3,075,419 compared with £1,679,352 the previous year.

## "Wireless World" Index

THE index to the material published in *Wireless World* during 1954 is now available from our Publishers, price 1s (postage 2d). It includes both general and classified indexes. Cloth binding cases are also obtainable with index, price 6s 5d by post. The binding of readers' own issues can be undertaken by our Publishers, the cost, including binding case and index, being 17s 6d plus 1s 4d postage on the bound volume.

## NEW YEAR HONOURS

Among those receiving decorations in the New Year Honours List are:—

### C.M.G.

R. C. McCall, assistant director of television, B.B.C.

### O.B.E.

J. Clarricoats, general secretary, Radio Society of Great Britain. (See "Personalities.")

V. M. Roberts, manager, electronic sales department, B.T.H. (See "Personalities.")

### M.B.E.

S. W. Brown, chief radio officer (I.M.R.C.) of s.s. *Scythia*.

D. Fairweather, chief of crystal production, Marconi's W.T. Company.

H. L. Peddle, signals officer, telecommunications department, Ministry of Transport and Civil Aviation.

J. J. Sarche, chief inspector, Ultra Electric, Ltd. (See "Personalities.")

### B.E.M.

R. Carter, laboratory mechanic, Royal Navy Signal School.

C. W. Jacobs, chargehand (mechanic), Radar Research Establishment, M.o.S.

## PERSONALITIES

**B. G. H. Rowley**, M.A.(Oxon), A.M.I.E.E., Marconi's technical representative in the U.S.A. and Canada since 1950, has been appointed manager of Marconi's Maritime Division in succession to **G. R. Tyler**, who, although having reached retiring age, is continuing with the company as its representative in West Africa. Mr. Rowley was concerned with the development of marine radar at R.N. Signal School at the beginning of the war and was subsequently appointed to the staff of the British Admiralty delegation in Washington. From the end of the war until joining Marconi's he was staff radar officer (Lt. Cdr.) with the Joint Services Mission in America.

**Dr. W. J. Thomas**, Ph.D., B.Sc., A.M.Brit.I.R.E., has left the Norwood Technical College where he has been since 1947—for the last four years as principal. He has been appointed one of H.M. Inspectors of Schools, the major part of his work being concerned with technical colleges in South Wales. It was largely due to his interest that the Television Society's experimental transmitter was installed in the college, which also houses the society's museum. For a short period at the beginning of the war Dr. Thomas was education officer at the R.A.F. Radio School, Cranfield, and from 1942 until the end of the war was senior instructor at the Army Radio School, Petersham, Surrey.

**John Clarricoats**, G6CL, the well-known general secretary of the Radio Society of Great Britain, who is appointed an O.B.E. in the New Year Honours, recently completed 25 years' service with the society. In addition to receiving a gift from the members, mentioned last month, he was also awarded the R.S.G.B. Calcutta Key "in recognition of his outstanding service to the cause of international friendship through the medium of amateur radio."

**Vernon M. Roberts**, B.Sc., A.M.I.E.E., appointed an O.B.E. in the New Year Honours, has been with B.T.H. since 1924, when on graduating at the University of Wales he started a three-year student apprenticeship. During the war he was concerned with the development and production of radar equipment. He is now manager of the company's electronic sales department and a director of Multi-Broadcast (Engineering) Ltd. Mr. Roberts has for some years represented B.T.H. on the Radio Communication and Electronic Engineering Association, of which he was chairman in 1950.

**J. J. Sarche**, who has been appointed an M.B.E., has been with Ultra Electric, Ltd., for 33 years. He is now chief inspector at the company's Western Avenue factory, having previously been assistant chief engineer.

**F. E. Debenham**, the new manager of the Service Department of Mullard's Valve Division, at Waddon, Surrey, has been with the Mullard group of companies since 1929. For some years during the war he was production manager at the Mullard valve factory at Blackburn. He succeeds **E. B. Rogers**, who has retired after 28 years with the Service Department.



J. CLARRICOATS, O.B.E.



V. M. ROBERTS, O.B.E.



J. J. SANCHE, M.B.E.



F. E. DEBENHAM

**David L. Davies**, B.Sc., Grad.I.E.E., has been appointed chief electronics engineer of Winston Electronics, Ltd., of Hampton Hill, Middlesex. Graduating at University College, Swansea, in 1948, he joined the staff of the Engineering Department of Edinburgh University, where he was lecturer in electrical engineering for three years. Immediately prior to joining Winston Electronics last January, at the age of 26, he had been working on guided missiles with English Electric.

**E. J. Gargini**, author of the article "Piped Scanning Waveforms" in this issue, received his technical training at Southall Technical College. After a short period as a trainee at the E.M.I. and Philco organizations he served in the R.A.F. during the war. He rejoined the E.M.I. Group in 1945, where he has been concerned in the design of cinema sound equipment, multi-channel radio-frequency relay systems, and wired television distribution equipment. He has been recently seconded to the research organization to work on domestic colour television.

**Arthur W. Wayne**, who describes a simple wave-shaper elsewhere in this issue, is both a professional engineer and a professional musician, a combination which he finds invaluable as a designer of sound-reproducing equipment. He has been a consultant dealing chiefly with acoustics for some years and last year formed Shirley Laboratories, Ltd., of Worthing, for the manufacture of amplifiers, tuners and electronic instruments.

## IN BRIEF

The annual I.E.E. **Faraday Lecture**, which is "designed to appeal to the layman," is this year being given by **T. B. D. Terroni**, B.Sc., manager and chief engineer of the Transmission Division of the Automatic Telephone and Electric Company. His subject is "Courier to Carrier in Communications." The lecture will be delivered at the Central Hall, Westminster, on January 27th, at 6.0. Tickets must be obtained from the I.E.E., Savoy Place, London, W.C.2.

The demand for admission to the laboratory course in **Pulse Techniques** to be held at the Borough Polytechnic, Borough Road, London, S.E.1, on twelve Wednesday evenings, beginning on February 23rd, has been so great that it is to be repeated. It will be given on Monday afternoons from April 18th and again on Wednesday evenings from April 20th. The fee is 2 guineas.

A **Spanish Edition** of Scroggie's "Foundations of Wireless" has been published with the title "Fundamentos de Radioelectricidad." It has been produced by Editorial Alhambra, S.A., of Madrid, and costs 195 pesetas.

**North America's** third distant early warning (DEW) radar chain will be within the Arctic Circle. The first, now almost complete, runs across southern Canada, and the second is on the 55th parallel.

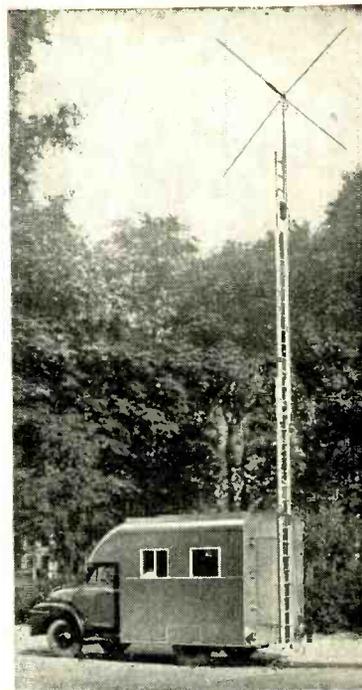
**Soviet Colour Television.**—Experimental transmissions of field-sequential colour television have recently been radiated from the Moscow television centre. An additional mast has been erected at the centre and a specially equipped studio is to be provided.

## CLUB NEWS

**Birmingham.**—At the meeting of the Slade Radio Society on February 18th at 7.45 at the Church House, High Street, Erdington, R. Rew (G3HAZ) will give a lecture demonstration on "Equipment for Seventy Centimetres."

**Cleckheaton.**—Two *Wireless World* contributors will be giving lectures to the Spen Valley and District Radio and Television Society in February. On the 9th at the Temperance Hall, Cleckheaton, Dr. K. A. Exley will speak on audio reproduction, and on the 22nd at the Bradford Technical College, Dr. G. N. Patchett will deal with transistors. Both meetings begin at 7.30.

**MOBILE v.h.f. test unit, with aerial mounted on a 40-ft extensible ladder, has been brought in to service by Philips for field-strength measurements. Interchangeable aeri- als are carried and these are electrically rotated.**



**Newark.**— "Transistor Circuitry" is the subject of the talk to be given by **C. L. Wright** (G3CCA) to the Newark and District Amateur Radio Society at 7.0 on February 6th at the Northern Hotel, Newark.

**Windsor.**—In response to requests from past and present students of the East Berkshire College, a radio society has recently been formed and meets on Thursdays at 7.0 at the Royal Albert Institute, Windsor. Details of the facilities provided by the club, which has its own transmitter, G3KAL, are obtainable from **F. H. Rickards**, East Berks College, Royal Albert Institute, Windsor.

**Leicester.**—A member of the Leicester Radio Society will speak on power supplies at the meeting on February 14th. A fortnight later the chairman will deal with grid-dip oscillators; their construction and application to amateur radio. Meetings are held at 7.30 at the Club Room, Holly Bush Hotel, Belgrave Gate, Leicester.

## BUSINESS NOTES

**Baird-Ambassador Merger.**—Hartley Baird, Ltd. (formerly Baird Television), of 37, Thurloe Street, South Kensington, London, S.W.7, manufacturers of television receivers and tape recorders, has acquired Ambassador Radio, the well-known manufacturers of domestic radio and television sets. **R. N. Fitton**, managing director of Ambassador, has joined the board of Hartley Baird as director in charge of radio and television. Ambassador will continue to operate as a separate company.

A contract has been awarded to **Nash and Thompson, Ltd.**, Tolworth, Surrey, for the electrical, physical and mechanical testing of electronic components, excluding valves, to the requirements and under the direction of the Radio Components Standardization Committee. Claimed to be the first of its kind to be granted to a commercial undertaking it supplements the testing and proving of newly designed equipment carried out by the Government research establishments.

The "Martinet" automatic steering device for small craft developed by **Hartley Electromotives, Ltd.**, will be produced at their Shrewsbury factory, but the **Marconi Marine Company** will be the sole concessionaires. The device was shown for the first time on the joint Marconi-Hartley stand at the recent National Boat Show at Olympia.

The name of Blick Engineering, Ltd., of Bedesway, Bede Trading Estate, Jarrow, Co. Durham, has been changed to **Blickvac Engineering, Ltd.** The company, which manufactures high-vacuum impregnators, potting resin impregnating and casting plant and other high-vacuum equipment, has a London technical representative at the offices of the associated company, Blick Time Recorders, Ltd., 96-100, Aldersgate Street, London, E.C.1 (Tel. Monarch 6256).

A new prefabricated factory building is being erected at Shepperton for **Winston Electronics, Ltd.**, who develop and manufacture electronic equipment for the Services, for many diverse branches of industry and for telecommunications.

The London sales office of **Pye Marine, Ltd.** (formerly Rees Mace Marine) at 11, Hinde Street, W.1, is now closed and the London area sales and service headquarters are at Galleons Works, Yabsley Street, E.14 (Tel. East 4216). The office of R. I. T. Falkner, the sales director, is now 157, Regent Street, London, W.1 (Tel. Regent 2712).

**Excel Sound Services**, manufacturers of the Celsonic tape recorder, were given the task of recording the Bradford Festival Choral Society's recent concert and from the tape produced discs of the programme highlights for members of the society.

Two British aircraft manufacturers—de Havilland and Bristol—are now using miniature **Pye Industrial TV** cameras for research purposes. In one case the equipment is being used to detect the presence of flame in a new engine being tried out in the bomb bay of a test aircraft. The camera is focused on to the engine (which is in complete darkness) through a heat-resistant glass panel. While the monitor on the pilot's dashboard is blank he knows that all is well.

The reconstructed premises of the **G.E.C.** in Wellington Street, Leeds, destroyed by fire two years ago, were reopened in December.

## FOREIGN TRADE

Each of the 40 Vickers-Armstrong Viscount aircraft ordered by Capital Airlines (U.S.A.) is to be fitted with **Marconi** automatic direction finders. The standard Marconi radio compass has been modified for operation in North America.

**U.S. Import Tariff.**—A three-fold increase in the import tariff on radio and electronic equipment is called for by the American Radio-Electronic-Television Manufacturers' Association. The duty was reduced from 35 per cent to 12.5 per cent in 1951. The R.E.T.M.A. states in a report quoted by the *Financial Times* that imports from the U.K. in the first eight months of last year totalled \$607,000, compared with \$463,000 for the whole of 1953. During the same periods imports from Germany were \$295,000 and \$109,000, respectively.

**S.T.C.** and **Marconi's** have jointly been awarded a contract for supplying radio-telephony and telegraphy equipment for a new external telecommunications station being built in Addis Ababa, Ethiopia. S.T.C.'s share of the contract includes two 4-kW transmitters; telephone terminal equipment providing two simultaneous telephone channels and voice-frequency telegraph equipment providing two telegraph channels. Marconi's will be responsible for the receiving equipment and aerial installations.

The Near East Arab Broadcasting Station at Limassol, Cyprus, from which commercial programmes are broadcast to the Arabic speaking countries, is being equipped with a 100-kW medium-wave transmitter and a 20-kW short-wave transmitter by **Marconi's**. Twin 350-foot directional mast radiators have been erected by **B.I. Callenders**. The station operates on 635 kc/s and in the 25, 31 and 49 metre bands.

## PUBLICATION DATE

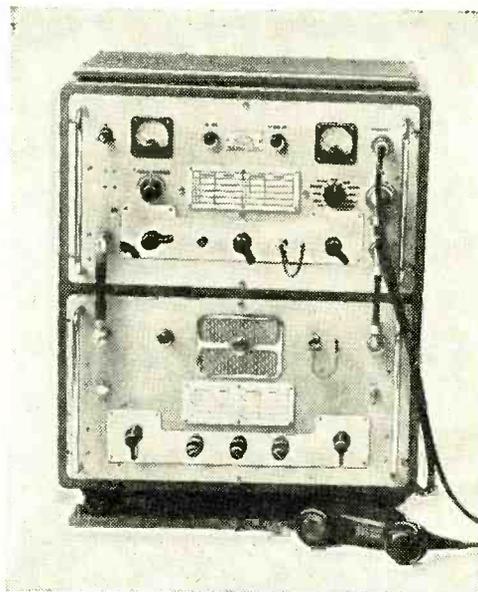
As already announced *Wireless World* now appears on the fourth Tuesday of the month preceding that for which it is dated. The March issue will, therefore, be published on February 22nd

Radel, Ltd., of Strand Road, Ashar, Basrah, are interested in acting as **Iraq Agents** for British radio and electronic equipment and are also seeking tenders for the supply of 500 domestic receivers. They require wired chassis with accessories but with a "prefabricated cabinet to be assembled on site." The universal 5-valve receiver must cover two short- and one medium-wave band, operate on 230 V and have Arabic characters on the tuning scale. Interested manufacturers should communicate in the first place with the company's British representative, L. C. Jenkins, 460, Wilbraham Road, Manchester, 21 (Tel. Chorlton 1801).

**Cossor's** have supplied four medium-power communications installations (No. 53) to the ruler of Kuwait, Persian Gulf. The equipment, which can be operated as a mobile or fixed station, has facilities for c.w., m.c.w. and R/T, and can be remotely controlled.

## MERCHANT SHIPPING R/T

UNDER the Merchant Shipping (Radio) Rules, 1952, it is compulsory for all vessels between 500 and 1,600 tons (which class includes small coasters, tramps, tugs and large fishing craft) to carry radio-telephone equipment. These rules came into force on November 19th last year, and the first transmitter-receiver to be granted the G.P.O./M.O.T. Certificate of Approval as meeting the specification laid down in the rules is the **Pye Marine "Swordfish."** The 50-watt transmitter is crystal-controlled on eight spot frequencies (between 1,600 and 3,900 kc/s) which are switch selected. The receiver



oscillator is also crystal-controlled, and in addition to covering the same frequency range as the transmitter the set provides for reception on 200 kc/s (Droitwich). The combined set measures 24in high x 20in wide x 10in deep.

# INTRODUCTION TO Transistor

## I—Physical Basis of Conduction in Semi-Conductors

**T**HE object of this article is to give the reader as clear a working picture of transistor electronics as he has about valve electronics. It is inevitable that such a working picture should be incomplete: in these days theories which deal with all the known facts—where they exist at all—can be expressed only with the aid of mathematics. What is needed, therefore, is a theory which expresses clearly and accurately facts of interest to the engineer rather than those which are needed by the research physicist.

This article is concerned mainly with what happens within the crystal itself and not with transistor circuits. The theory of conduction in semi-conductors (the class in which the germanium crystal falls) is discussed first. This requires an explanation of the structure of these crystals and of the effects due to the presence of certain impurities. These impurities are essential to the production not only of the transistor action but also of the rectifying effects which make the germanium diode possible.

**Conduction in Semi-Conductors.**—The name semi-conductor applies to a group of elements of crystalline structure, which conduct electricity poorly in general, but which may, in association with discontinuities in the material, have different conductivity for currents flowing in opposite directions. The atoms of the group with which we are concerned have four valency bonds and four electrons in their outer orbits. Carbon and silicon are the commonest of these elements; germanium is rather less abundant. Until recently, in fact, germanium was a rather rare chemical curiosity of little importance, which formed a small proportion of the flue dust which collects in chimneys.

Germanium and silicon form symmetrical crystals, the atomic structure of which is represented in Fig. 1.

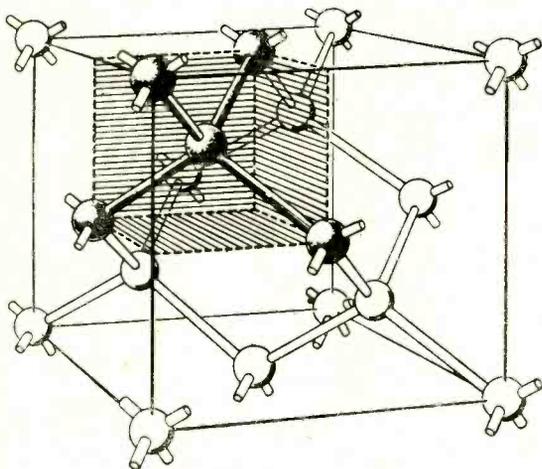


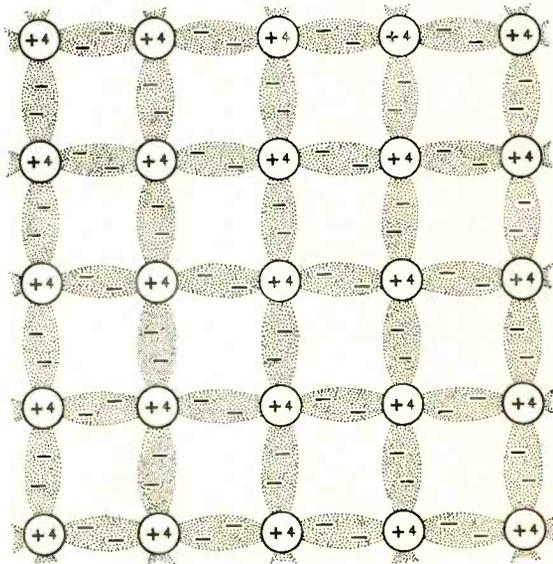
Fig. 1. Atomic structure of a germanium crystal.

Fig. 2. (Right) Representation of valency bonds in silicon or germanium.

All the valency bonds are used in forming the structure, each bond being an electron pair. In this perfect crystalline structure there are no free electrons and conduction in the ordinary sense, such as in a metal, by free circulation of electrons, is not possible. A crystal of this nature does, however, conduct some current, and for both germanium and silicon, this current is affected by light falling on the crystal and also by its temperature.

Fig. 2 shows a diagram of the four-valency structure, suitably flattened to two dimensions for simplified illustration. All the valency bonds are satisfied and all nuclear charges neutralized. As it stands there is no form of "carrier" for any electric current. But both thermal energy due to temperature and the radiant energy of light (and higher-frequency radiations) disturb this quiescent state. Either may be imagined to shake the structure; and under certain conditions one of the valency electrons may fly off. This, as seen in Fig. 3, leaves an incomplete bond—a resultant positive charge—which is called a "hole."

It is not difficult to see that a number of electrons so shaken off may become an electrical current if a potential difference exists across the crystal; but it is not so easy to picture holes as being very nearly as effective carriers of electric charges. Surprising as it may seem, a hole has very much the same order of mobility as an electron, though it appears to move in the opposite direction. An explanation of the process is simple enough. When subject to an electric field the stress on a neighbouring valency electron causes it to "jump" into the hole, leaving another hole where it came from; this causes the next one to do likewise, and so on. The hole appears then



# Electronics

By H. K. MILWARD, B.Sc., A.M.I.E.E.

to move from the positive end to the negative. What is most surprising is not that this happens but that it happens so quickly.

One might imagine that electrons moving this way and holes moving that way would frequently "collide" and neutralize each other. While this happens to some extent it does so in a well-regulated and orderly fashion. Experiments have shown that in general hole-and-electron pairs are generated (and may recombine) only at specific points in the crystalline structure. Irregularities in the crystal structure are an example of such points, though the exact condition necessary for the formation of a generation-and-recombination centre are as yet by no means completely investigated. There would be little point in discussing the present theory here, for it is possible to get a fairly accurate action picture of the transistor from what has been found by experiment. The theory leads straight into quantum mechanics and to realms where simple analogies are quite unusable.

An electron or a hole may be "trapped" in such a centre, where it is held until a hole or an electron comes near enough to be attracted and to combine. Since neither production nor recombination of hole-and-electron pairs is entirely indiscriminate, their lifetime is perhaps rather longer than might be expected.

The conductivity of a semi-conductor depends upon the number of free electrons and holes present, and upon their mobility. The number present depends upon equilibrium between the rate of production and the rate of recombination of such pairs. The rate of production is dependent on incident light or ambient temperature and the rate of recombination, being statistically related to the number which arrive at the recombination centres, depends upon the density of the electrons and holes. Any equilibrium state requires the rate of production and recombination to be the same. Thus the conditions

which produce a greater rate of production also cause a higher density of carriers, and, therefore, a higher conductivity. An indication of the dependence of the recombination rate on the density has been given by an experiment which measures conductivity in comparison with incident light; this also shows that the die-away of conductivity, after the light has been shut off, is exponential.

When a hole and free electron are formed by thermal or photo action they move in a random way, similar to the motion of a very small particle in a liquid due to Brownian movement. A number of holes and electrons formed or introduced at a point in the crystal structure diffuse throughout at a rate governed by this random movement, which is itself dependent on temperature. The diffusion rate for an electron in germanium is  $93 \text{ cm}^2/\text{sec}$  and for a hole  $43 \text{ cm}^2/\text{sec}$ . The rate is dependent on temperature and the figures quoted are for  $300^\circ\text{K}$  ( $27^\circ\text{C}$ ) and for fairly pure samples of germanium. The most surprising thing is to find that holes and electrons have mobilities which are not very far different.

The conductivity of a semi-conductor is conditioned by temperature and by incident light, but certain impurities in the structure have a much greater effect. For example, "impurity atoms" with five valency electrons fit more or less perfectly in the structure, except that for each impurity atom there is a shortage of one electron. Fig. 4 shows this effect. The atomic nucleus has five units of positive charge and, therefore, is an attracting force for the electron which has been left out of the four-valency structure; but the energy due to temperature is normally enough to cause the electron to diffuse throughout the structure, and not to remain near its parent atom. This is much aided by the reduction of attractive force due to the dielectric constant of the material, which for germanium is 16. Each "spare" electron is, therefore, a potential carrier of electric current. The density of such carriers in a sample is equal to the

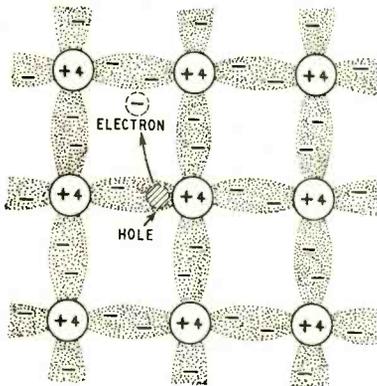
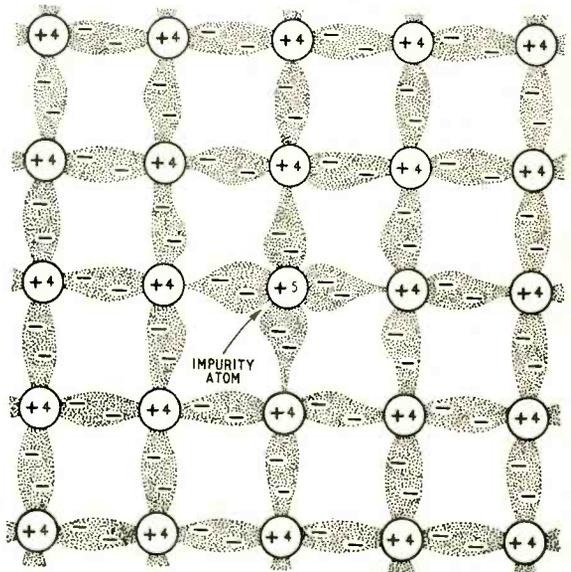


Fig. 3. "Hole" left by electron having "jumped" out of its place, due to thermal or photo effects.

Fig. 4. Illustration of a donor atom in the structure. The effect of the dielectric polarization due to the extra positive charge on the nucleus is shown. The extra electron is assumed to have diffused away from the parent atom and is not shown.



density of impurity atoms, and the overall conductivity is proportional to the total density of such carriers in the sample.

Such an impurity atom is called a donor. Arsenic and antimony are typical donors for germanium and silicon. A concentration of one donor atom to  $10^8$  of pure germanium is sufficient to increase very greatly the conductivity at ordinary temperature; and although hole-and-electron pairs are still formed as in pure germanium, conduction is due mainly to the donated free electrons.

Germanium which has donor impurity atoms is called negative or *n*-type, because the conduction through it is by means of negative carriers.

There is another sort of impurity which has an equally marked effect on conductivity, and that is the atom with three valency electrons. Examples of this are aluminium, gallium, and boron. These also fit into the crystalline structure without disarranging it,

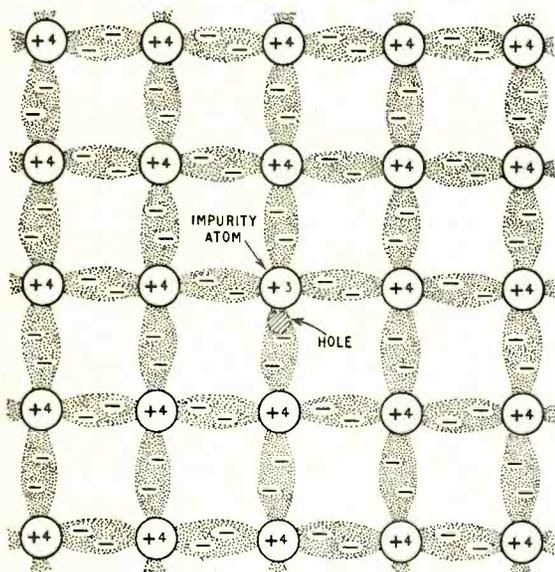


Fig. 5. An acceptor atom shown in the structure. The "hole" diffuses away from the parent atom leaving it with four orbital electrons. In these circumstances, which are normal, the acceptor atoms have a resultant negative charge.

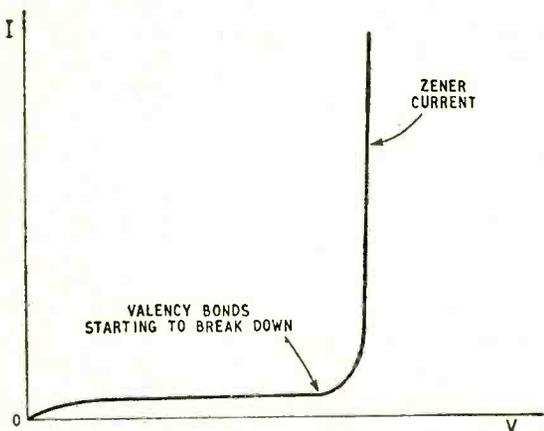


Fig. 6. Zener current in a pure sample of germanium.

but in this case there is an electron missing, instead of one too many. In addition, a nuclear positive charge is missing. The incomplete bond in the structure causes a hole, as seen in Fig. 5. It is perhaps surprising that this sort of hole moves as freely as one caused by light or thermal energy, and diffuses away from the parent atom in a similar way to the donated electron in the previous case. Such an impurity is called an acceptor and the material is then called positive or *p*-type, because the current carriers are holes.

A remarkable effect is shown when the two types of impurity are mixed. The free electrons given by the donor atoms fill the holes from the acceptor atoms, and the balance of holes or electrons remaining carry any current which flows. It is clear, therefore, that if the acceptors and donors are present in equal quantities there are no carriers left, except the hole-and-electron pairs which are generated spontaneously in germanium anyway: the conductivity of the material is then no higher than that of the pure material. Because a small excess of one or other of the impurity atoms causes such a marked change in conductivity the exact proportion to produce this sort of equality is difficult to control in manufacture.

Where both acceptors and donors are present the charge distribution throughout the crystal is uneven when viewed on an "atomic" scale. Each acceptor atom which has had its hole filled represents a resultant negative charge and each donor atom which has lost its fifth electron is a positive charge. There are, therefore, a number of opposite charges fixed in the structure, though the whole is electrically neutral by reason of the mobile charges.

There is one further effect which must be mentioned before the action of the crystal diode and triode can be understood. This is the effect of a large electric field on the production of holes and electrons. When the potential gradient reaches a certain value (the actual value being dependent to some extent on the impurity content of the material) the valency bonds of the structure begin to break up. The effect of such a breaking-up is for a hole to make off towards the negative end and the corresponding electron to the positive end.

All the valency electrons are at more or less the same energy level and in general it would be true to say that a potential gradient sufficient to cause one bond to break up would be sufficient to cause this effect in all other bonds. In practice this is not quite true because of the random thermal energy present, and because the applied potential gradient is modified by the presence of the atoms and electrons. When the potential gradient is not quite high enough to cause spontaneous breaking-up a few bonds will rupture owing to the chance "gift" of some extra thermal energy. The higher the gradient the more likely this is to happen; hence the current due to this effect, known as Zener current, does not start as abruptly as at first it might be imagined. Fig. 6 shows the effect graphically. The bend in the curve is where the first few bonds are torn apart, when the electrical energy plus the thermal energy chance to be sufficient. As the potential gradient is increased more and more valency electrons are able to acquire sufficient energy to break away. The steep part of the curve represents the state in which the electric field supplies nearly all the energy and most of the valency electrons have sufficient energy to break away.

Fig. 7. Presentation of acceptors and donors in the crystalline structure of germanium or silicon.

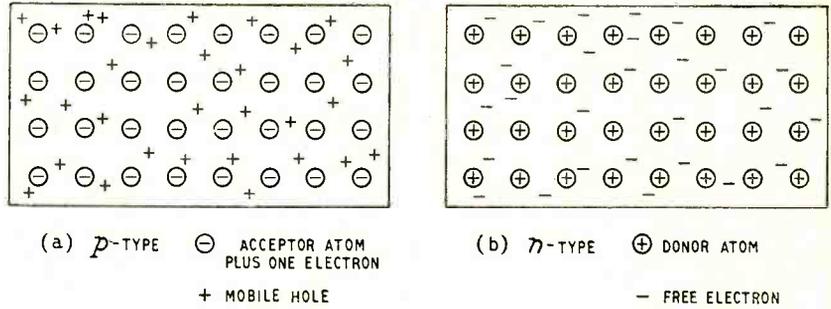
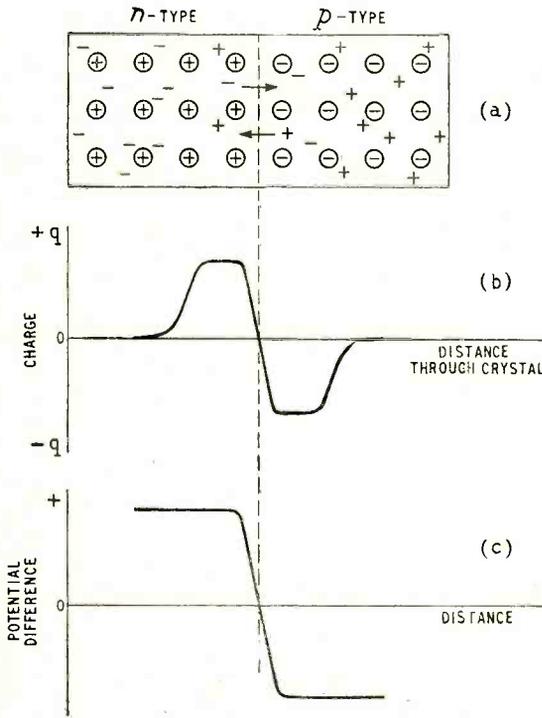


Fig. 8 (Below). Junction under conditions of thermal equilibrium.



this layer acceptors are in the majority: on the other side donors.

For the purpose of illustration *p*-type and *n*-type crystal structure is represented by showing only the acceptor or donor atoms in the structure and the consequent mobile holes or electrons. Fig. 7 (a) shows the *p*-type material and Fig. 7 (b) the *n*-type. The acceptor atoms are fixed in the crystalline structure and have the extra valency electrons to which they are not really entitled, hence they have a resultant negative charge. The holes which have wandered away from the parent atoms have an equal positive charge. The material is, therefore, electrically neutral as a whole although throughout the material there are these discrete charges, both fixed and mobile. The donor atoms are similarly fixed but have a positive charge because the fifth electron has wandered away.

When two different materials meet in a junction such as that described above, the holes in the *p*-type material and the electrons in the *n*-type material, diffusing in the normal way, cross the boundary into the other sort of material. As we have seen, each side starts electrically neutral, but as holes cross from the *p*-type to the *n*-type and electrons go the other way, the *n*-type material acquires holes and loses electrons, thus becoming positively charged; while the *p*-type does the opposite and becomes negatively charged. An illustration of the structure is given in Fig. 8 (a). A standing potential difference is produced between the two materials, and the size of this is regulated by the rate of diffusion across the boundary, the production and recombination rates, and the current of holes or electrons in the reverse direction due to the generation of holes in the *n*-material and electrons in the *p*-material. The potential difference is opposed to the diffusion current and equilibrium is eventually reached when the diffusion current is no larger than the reverse current due to the spontaneous generation.

Fig. 8 (b) shows the distribution of charge over the

It might at first be supposed that this Zener current would disrupt the crystal structure physically, but this is not so. A current produced in this way is quite stable and the point at which the sharp increase occurs is not particularly temperature-sensitive.

**p-n Junctions.**—Having seen something of what happens in pure and impure material, it is possible to examine the effects at a junction between *p*-type and *n*-type material in a single crystal. A possible method of producing such a junction is easy enough to imagine. Arsenic, for example, will diffuse into a germanium crystal which is made hot enough. If one face of a crystal (having already an acceptor impurity such as aluminium) were exposed to arsenic and heated sufficiently, the arsenic could diffuse into the crystal from one end. We have already seen that the material is *p*- or *n*-type according to the majority impurity. In this case the *p*-type material becomes *n*-type from one end and a dividing layer must, therefore, exist which is "neutral," having an equal concentration of acceptors and donors. On one side of

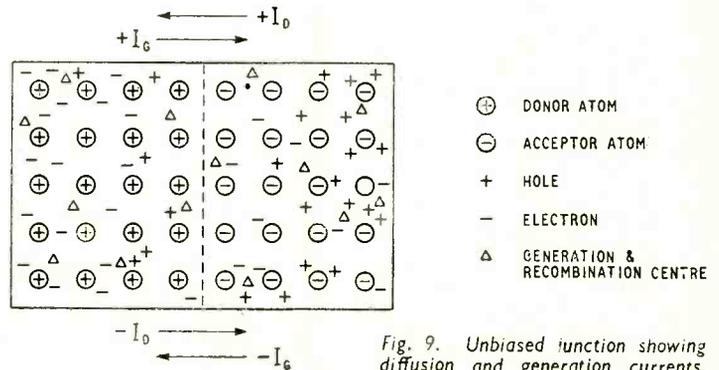


Fig. 9. Unbiased junction showing diffusion and generation currents.

junction when equilibrium has been reached. This is caused by the repulsion of the free electrons in the *n*-type material by the negative potential of the *p*-type, and *vice versa*. The mobile current carriers are, therefore, repelled from the vicinity of the junction, leaving only the fixed acceptor atoms on one side and donor atoms on the other. This leads to a high resultant concentration of positive charge on the *n*-side of the junction and an equally high negative charge on the *p*-side. Only the fast electrons or holes are able to cross this "barrier."

The reverse current due to spontaneous generation previously referred to arises from the fact that hole-and-electron pairs are generated thermally or photoelectrically on both sides of the junction. On the *n*-side the electrons merely add to the free electrons produced by the donors, but the holes, if produced close to the junction, "slide down" the potential gradient to the other side. The equilibrium potential is thus automatically adjusted until the diffusion current exactly equals the generation current. This is true of both holes and electrons. Fig. 9 shows this diagrammatically, with a reminder about the presence of production and recombination centres.

When the junction is biased the effects which produce rectification can be seen. If the junction is forward biased, as shown in Fig. 10, the standing potential difference between the *n*- and *p*-materials is reduced. The holes in the *p*-side now find it easier to diffuse to the *n*-side, so that the diffusion current is increased. The reverse generation current is virtually unaltered, because it is controlled by temperature and incident light only. The two currents are, of course, no longer in equilibrium and the difference flows in the outside circuit. A further increase of bias removes the reverse potential gradient at the junction entirely and the *n*-side becomes negative in potential while the *p*-side becomes positive. This means that holes are attracted directly across the junction, as are electrons in the opposite direction. The current is no longer a diffusion current but one in which the carriers

Fig. 10 (Right). Potential gradients with forward bias.

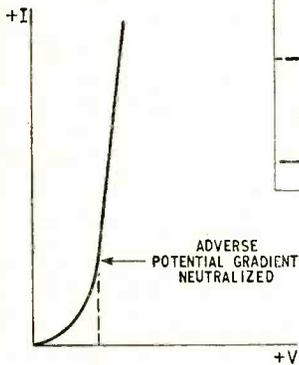
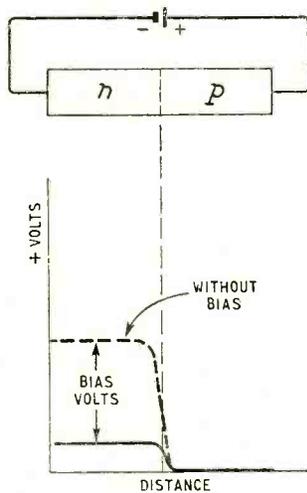


Fig. 11 (Left). Graph of effect of forward bias.

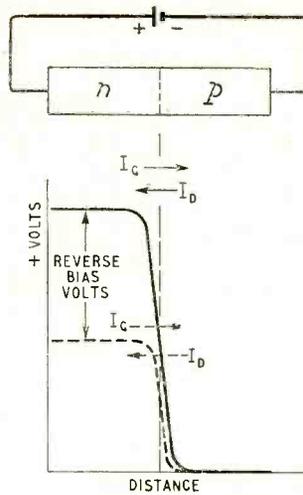


Fig. 12. Reverse bias. Note that the generation current  $I_G$  is virtually unchanged by reverse bias while the diffusion current  $I_D$  is decreased considerably.

Fig. 13. The alteration of  $I_G$  and  $I_D$  is shown graphically. The resultant current is that which flows in the outside circuit.

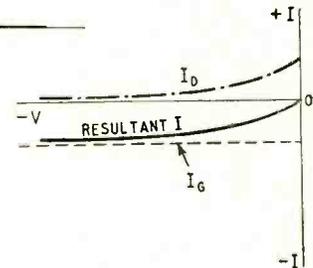
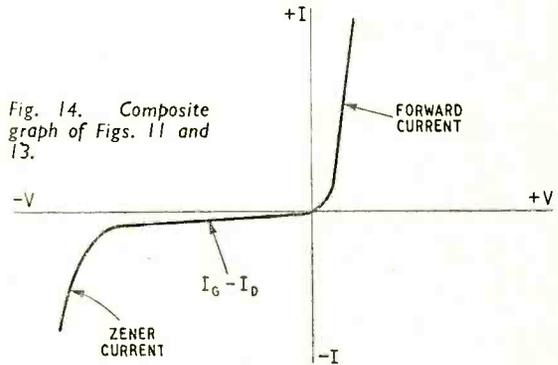


Fig. 14. Composite graph of Figs. 11 and 13.



are moving under the direct influence of a potential gradient. As the potential gradient increases from zero the rise of current is very rapid, an effect seen in Fig. 11.

Biasing in the opposite direction increases the potential difference between the *p*- and *n*-sides. This increase, which is shown in Fig. 12, reduces the diffusion current  $I_D$  but has little or no effect on the generation current  $I_G$ . Again the equilibrium is disturbed and the difference between  $I_D$  and  $I_G$  flows in the outside circuit. Increasing the voltage has the effect of reducing  $I_D$  eventually to zero, but has no effect on  $I_G$ , as seen in Fig. 13.

If this were all, the characteristic curve would be virtually asymptotic to the graph of  $I_G$ , which is nearly constant. But it will be remembered that when the potential gradient reaches a certain critical value the Zener current starts to flow, that is, holes and electrons are generated spontaneously by the breaking up of valency bonds. At a certain point, therefore, the reverse current curve shows a sudden increase, and

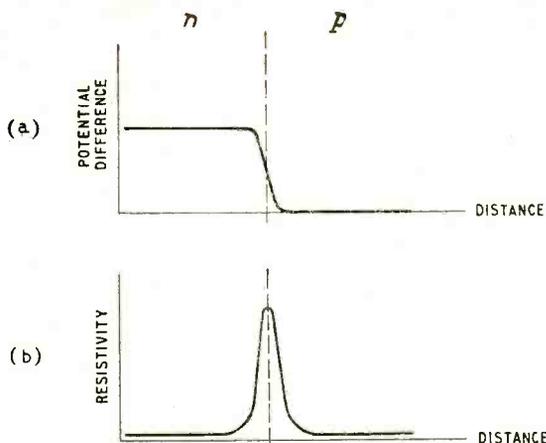


Fig. 15. Graph showing resistivity in different parts of the crystal.

this is shown in the complete characteristic curve at Fig. 14.

It is worth noting that the resistance of the various parts of the crystal may be found very simply by

considering the slopes of the curves in Figs. 10 and 12. The graphs show the voltage plotted against distance through the crystal. If we also know the mean current flowing the resistance of any portion of the crystal, or the whole, may be found easily. Again if the cross-sectional area of the crystal is known the resistivity of different portions of the crystal may also be found. Fig. 15 shows clearly that the resistivity is high wherever the potential gradient is steep; in fact, it is proportional to the potential gradient.

The resistance of the junction is, therefore, dependent on the bias and is high when back biased and low when forward biased.

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*Acknowledgement.*—Figs. 1, 2 and 4 are based on Figs. 1, 3 and 12 respectively of reference 1 above.

(To be continued)

## Historical Valve Collection

ABOUT the year 1920, Robert McVitie Weston, a solicitor with scientific leanings, took to building his own radio receivers and consequently became interested in the various types of valves then available to the amateur constructor—and subsequently in the history of the valve.

His interest spread from current types and soon he was collecting valves of every age and type. A great deal of his time was spent in searching for specimens and many a lunch-hour was devoted to combing junkshops for material. By 1934 he had assembled a collection of several hundred specimens, including one of Fleming's original diodes and a Lee de Forest triode with a descriptive label in Fleming's own handwriting. Housed on the top floor of Mr. Weston's Reigate home, the collection rapidly expanded, following his decision to investigate every possible source of material, both at home and abroad, and by 1938 the exhibits numbered about 2,000.

The war interrupted active collecting, and a change of address necessitated dismantling the museum. After the war, with insufficient time or space to restore it, Mr. Weston felt that the collection was too large and too important for a single person to handle. He therefore decided to hand it over to Standard Telephones and Cables, thereby ensuring not only the preservation of the existing specimens but also the expansion of this unique museum by the addition of new and interesting valves.

This, quite briefly, is the story behind the actual accumulation of the historically priceless selection of valves now assembled in the entrance hall of the Radio Building at the New Southgate works of Standard Telephones and Cables. The company hopes to enrich the McVitie Weston Collection with further examples of really significant valves from every possible source, and to this end welcomes the co-operation of valve manufacturers and others throughout the world in providing suitable items for inclusion. Students of the subject will doubtless appreciate this permanent record of the history of the valve, and it will be possible for them to visit the collection by making application to Standard Telephones and Cables.

A central display cabinet contains only those valves which, for their rarity or other special reasons, are of major and lasting interest. For the rest, it is intended to keep the display flexible and to stage from time to time

special selections illustrating topical aspects of the subject. The main cabinet in the centre of the hall is actually intended to show the general evolution of the valve from the Fleming diode. Outstanding exhibits are two early Fleming diodes; Lee de Forest audions; a Lieben-Reisz gas triode (the only known unused specimen); and diodes used by Marconi at Poldhu.

There are also two corner cabinets, one of which shows the evolution of the water-cooled valve and the other the evolution of forced-air-cooled and radiation-cooled valves. Water-cooled valves include an early example of the Western Electric 220B, the first commercial water-cooled valve and the type with which the 1922 transatlantic radio telephone experiments were carried out. The development is shown continued through the 1929 Standard Telephones 4030A, an early short-wave valve with integral water-jacket, the Marconi CAT14, the first valve of the very high rating, and includes a modern thoriated tungsten filament valve (S.T.C. 30/260E).

The display of forced-air-cooled valves includes the Marconi ACT (an early type) with various more recent types illustrating the development, and also includes early samples of the silica valve developed by the Admiralty and produced by Mullard.

Another cabinet houses a collection of cathode ray tubes including a very early Braun tube dated 1906; a Western Electric ss4A (a genuine Johnson tube); an S.T.C. 4050AG gas-filled c.r. tube; a gas-focused Von Ardenne tube; an Ediswan projection tube (as exhibited at the Physical Society in 1938); and various modern types.

Trends in the development of valves for v.h.f. and higher frequencies are traced from valves with reduced lead lengths: Marconi Mathieu 1930, 500 Mc/s, 3.5 watts; S.T.C. 4304, 400 Mc/s, 50 watts; S.T.C. 4316, 100 Mc/s; the positive-grid oscillator, S.T.C. 4036A, used in the historic cross-Channel microwave radio link in 1931, 1800 Mc/s; the velocity modulated cavity oscillators—klystron and coaxial tube; and the cavity magnetron oscillator and travelling-wave amplifier.

The drive to reduction of size is illustrated by a series of valves of old designs through the octal, loctal, bantam and miniature types, finishing with sub-miniatures of contemporary design.

# Ionosphere Review, 1954

End of a Sunspot Cycle

By T. W. BENNINGTON\*

IT is very interesting at those relatively infrequent epochs which mark the end of a sunspot cycle to look back over the years during which the cycle has run its course and to examine the changes in radio conditions which the varying sunspot activity has occasioned. Or rather (should we say?) to examine the changes in radio wave propagation which have been brought about by the changing ionospheric conditions, the latter having been produced by variations in the ionizing radiations falling upon the atmosphere from the sun, in accordance with the variations in the sun's activity, visible evidence of which has been given by the sunspots which appeared upon it.

We may here consider that the end of a sunspot cycle occurs at the epoch of minimum sunspot activity, although this is not strictly true because the old and new cycles overlap each other to some extent around the minimum. But for radio purposes we are justified in assuming that sunspot minimum represents the end of a cycle. Sunspot minimum apparently occurred during 1954, and it is this fact which occasions the above remarks. But we have to add that it is rather too early to be quite certain about the matter yet, and it is never wise to jump to conclusions when one is dealing with sunspot cycles. However, by the end of 1954 there were several good reasons for thinking that the sunspot minimum might be past.

**General Effect of the Sunspot Cycle:**—Let us now look at Fig. 1, in which the full-line curve is a graph of the twelve-month running average of the monthly values of sunspot number, the latter being the measure in which the degree of sun-spottedness is usually expressed. The monthly value of sunspot

number fluctuates rather erratically, but by taking a twelve-month running average we can smooth out the fluctuations and see the general increase and decrease in sunspot activity throughout the cycle. We see that the activity increased from a minimum at the epoch Feb./March, 1944, to a maximum at that of May/June, 1947, and then decreased so as to reach a minimum at some epoch in 1954 which we shall not attempt to indicate precisely, because the last 12 values are, as yet, only provisional. The curve is of a "saw-tooth" shape, there being a relatively rapid increase from minimum to maximum, and a much slower decrease from maximum to minimum. This is a general feature of all cycles which have a high maximum—and the maximum of 1947 was the highest since that of 1778—whereas the cycles with low maxima are more or less symmetrical about the maximum, i.e., their increasing and decreasing phases are of similar duration. In this cycle the increasing phase occupied 39 months and the decreasing phase about 83 months, the total duration of the cycle thus being about 10.2 years, as compared with the mean duration of 11.1 years for the cycles which have occurred since 1755. But it was in no way remarkable in differing from this mean, for the cycles vary from about 9 years to about 13 years in duration. The decreasing phase of the cycle was marked by very large and erratic fluctuations over periods of a few months, so large indeed that they appear as peaks and troughs and ledges even in the smoothed curve of Fig. 1. Towards the minimum of the cycle the curve "flattened-out"—as is usual—and the month-by-month variation in the activity was

\* British Broadcasting Corporation.

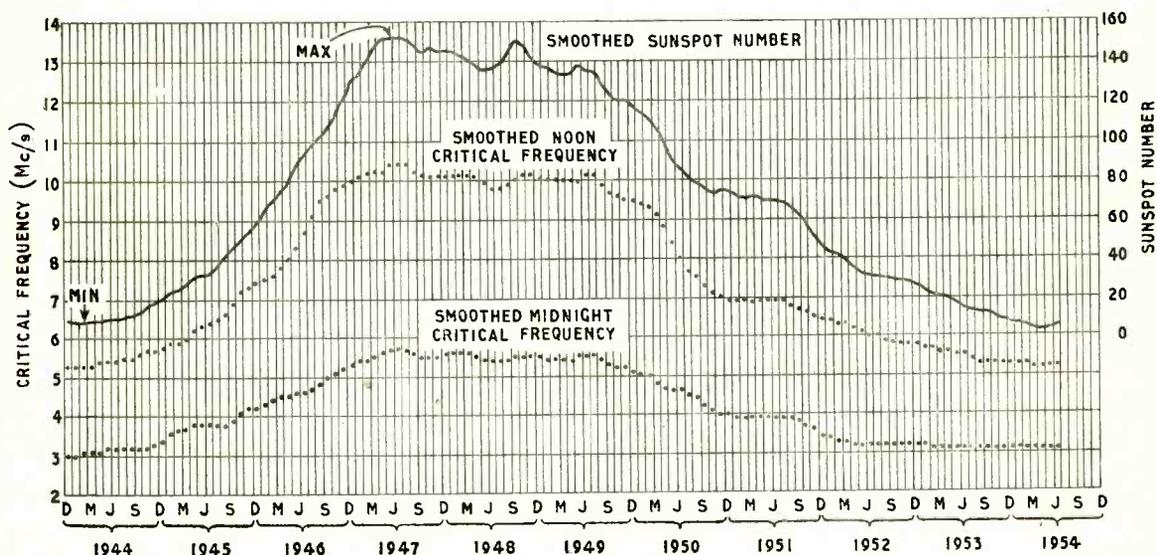


Fig. 1. Twelve-month running average of sunspot numbers and  $f_oF_2$  noon and midnight critical frequencies over the sunspot cycle.

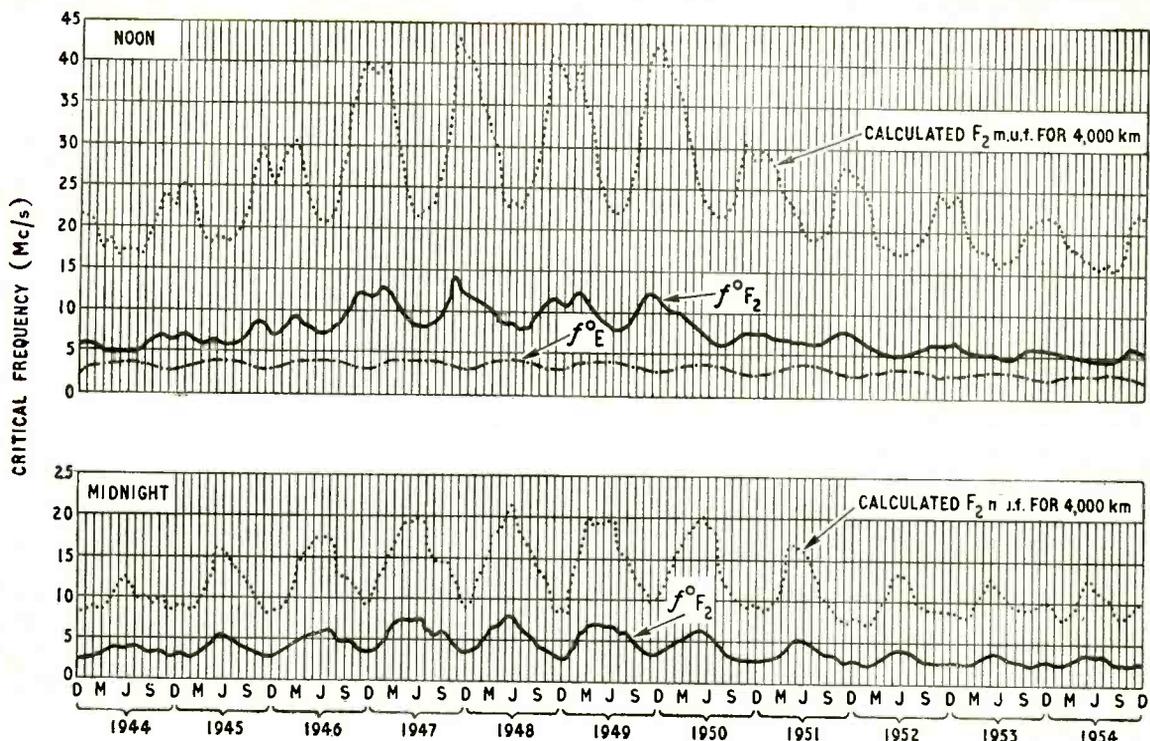


Fig. 2. Monthly mean values of noon E critical frequency, noon and midnight  $F_2$  critical frequencies, and noon and midnight  $F_2$  m.u.f.s over the sunspot cycle.

very small. The value of the 1954 minimum appears to have been lower than that at the 1944 minimum.

The dotted curves of Fig. 1 are from the monthly ionospheric data obtained at the D.S.I.R. ionospheric station at Slough. They are twelve-month running averages of the monthly mean noon and midnight critical frequencies of the  $F_2$  layer, the critical frequency being the highest frequency returned from the layer at vertical incidence. By taking twelve-month running means the large seasonal variations of critical frequency are smoothed out, and the variations due to the changing sunspot activity become more evident.

The object in presenting these curves is to show how the changing sunspot activity affects the frequencies which the ionosphere is capable of reflecting, directly at vertical incidence, and thus by implication, at oblique incidence, as in practical radio communication over a distance. For a variation in the critical frequency at vertical incidence means a corresponding variation in the maximum usable frequency (m.u.f.) for transmission over any given distance.

Both noon and midnight critical frequencies are seen to have followed the variations in the sunspot activity, on this general basis, fairly closely. The noon critical frequency increase with increasing sunspot number was fairly constant until a sunspot number of about 100 was reached, but for higher values of sunspot number the actual frequency increase was less steep, as if a saturation effect in the ionosphere were occurring. It is seen, however, that the general critical frequency variation between sunspot minima and the maximum was of the order of 100% for both noon and midnight, being about

5 Mc/s in the former case and about 3 Mc/s in the latter. The m.u.f.s for short-wave communication would of course undergo corresponding but greater variations than the above, at noon and midnight respectively.

Fig. 1 does show, therefore, how closely the general ionospheric conditions at Slough followed the general level of solar activity, as indicated by sunspot observations. If we were to look at the ionospheric measurements from other ionospheric stations throughout the world we should see the same trends, though the actual values of critical frequency would be different. We now turn to a more detailed examination of the ionospheric variations, again based on the measurements made at Slough.

**Month-by-Month Variations:**—In Fig. 2 are plotted, as full lines, the monthly values of the Slough critical frequencies for the  $F_2$  layer ( $f^\circ F_2$ ) for noon and midnight for the whole period covered by the sunspot cycle. The dot-dashed curve shows the monthly values of the critical frequency of the E layer ( $f^\circ E$ ) for noon.

We may dismiss the latter curve at once by saying that the E layer variations over the sunspot cycle, whilst not without significance, are relatively small. The peaks and troughs in the  $F_2$  layer curves are due to the seasonal variations in critical frequency, which, at noon, are such as to produce low values in midsummer and high values around midwinter, and, at midnight, high values at midsummer and low values at midwinter. This type of variation is now well established, being due, of course, to the variations in the relative position of sun and earth with the seasons.

Superimposed on these seasonal variations, how-

ever, there is an evident long-period variation which is that due to the sunspot cycle, the highest values of both noon and midnight critical frequency occurring near sunspot maximum and the lowest near sunspot minimum. It is regretted that, owing to space considerations, these values have had to be plotted on a rather small scale, so that the variations due to the sunspot cycle are less noticeable than would have been desirable. However, if we examine the dotted curves of Fig. 2 we can see the effect of the cycle upon practical short-wave transmission quite clearly. These dotted curves show the monthly values of  $F_2$  layer m.u.f. for 4,000 kms (the maximum possible distance for one hop), as calculated from the Slough monthly critical frequencies, for noon and midnight respectively. That is to say, they give the monthly values of m.u.f. for a one-hop transmission path, with the  $F_2$  layer over Slough as the apex of the trajectory.

The peculiarities of these curves are rather interesting. At noon in summer the m.u.f. increased between the minima and the maximum from about 16 Mc/s to about 23 Mc/s or by approximately 44%, and in winter from about 22 Mc/s to about 43 Mc/s or approximately 95%. The midnight m.u.f., on the other hand, increased from about 12 Mc/s to 21 Mc/s or 71% in summer, but only from about 8 Mc/s to about 9 Mc/s or 12% in winter. Thus the effect of the sunspot cycle was to increase enormously the m.u.f.s during the winter day, to do so to a lesser extent during the summer night, to an even smaller extent during the summer day and to cause hardly a variation at all during the winter night.

A few words about the reasons for these variations may not be out of place. The sun's effect upon the ionosphere at night is an indirect one and thus the variations due to its changing activity would not be so great as during the day. During the deep winter night—when the direct effect of the sun has been removed for so long—they seem almost to disappear altogether, whereas during the summer night—with little darkness—they are still quite apparent. During the day the sun's effect upon the  $F_2$  layer is not a simple one, for its behaviour is anomalous, in that during the summer the increase in the ionizing power of the sun's rays is more than counteracted by an expansion effect, so that the ionization per unit volume actually decreases, and the critical frequency falls, as compared with the winter. Thus the greatest effect of the changing solar activity occurs during the winter day, and is not so apparent in summer.

But we are, perhaps, more interested in the practical effects of these variations upon short-wave communication and it is interesting to note, from the dotted curves, the changing utility of various frequencies throughout the cycle. In doing this we should remember that we are studying curves for the ionosphere above Slough only, and that for practical purposes the usable frequencies will be much modified by conditions in other parts of the world.

Taking the daytime curves first, the most striking feature is the very high frequencies which would seem to have been usable for long-distance communications during the winter months around the maximum. In fact, the curves indicate that frequencies above 30 Mc/s could have been used during 4 winters, though it is doubtful whether such frequencies were, in fact, put to much use for this purpose. A frequency of 28 Mc/s, it is seen, should have been usable during 6 out of the 11 winter periods, whilst a frequency of 21 Mc/s should have been usable

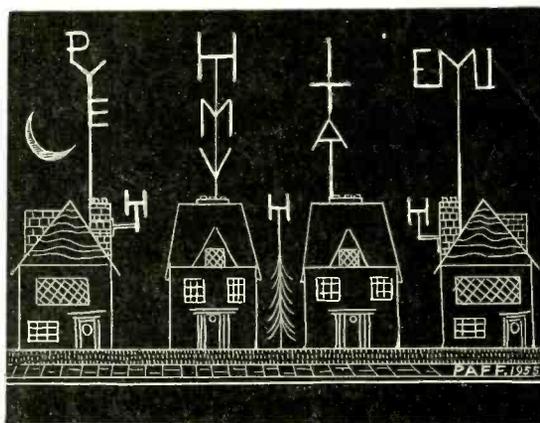
winter and summer alike from 1946 to 1950 inclusive, and to have been too high during the summer periods only of the remaining years. A frequency of 15 Mc/s would have been used throughout the year during the years near the sunspot minimum, but would probably have been too low for years around the maximum. Of course, the daily *periods* of usefulness of different frequencies are not apparent from these curves and would vary from year to year.

The midnight curves indicate that 15 Mc/s would have been usable at night during 6 of the summer periods and 11 Mc/s during the remainder. As to the most suitable frequency for winter night-time use the indications are that 7 Mc/s should have been usable throughout the cycle, and would not need alteration from minimum to maximum. Again it is stressed that some modifications to the above conclusions would be necessary when full account is taken of the actual transmission paths, and of other periods of the night. However, the curves do give us a general indication of the utility of different frequencies, both for daytime and night-time use.

**The New Cycle:**—So much for the old cycle. We learn what we can from the ionospheric measurements taken during its course. But we now desire to know something about the new one, and particularly about how radio conditions are likely to change in the immediate future. Unfortunately, it is here that we are at a loss. For the laws which govern sunspot cycles are not yet known and we are very much in the dark as to how the sunspot activity will vary in the near future. If we only knew that we could well relate our knowledge of radio conditions to it and say how they would most likely change. But we do not know it and so can only speculate, at least for a year or so to come.

For 1955, therefore, it is impossible to forecast what changes may occur. If the new cycle has well begun the sunspot activity may increase somewhat more rapidly than it has been decreasing during the past year. We say this merely because it has *usually* done so in the year following past minima of which there are records. But it seems unlikely that, by the end of the year, it will have reached a value such as to have produced any large variations in the ionosphere, and to have made any very significant changes to the frequencies at present most useful for short-wave communication.

"I see commercial television is here!"



# SIMPLE WAVE-SHAPER

By ARTHUR W. WAYNE\*

*Giving Square-wave Output from Sine-wave Inputs from 100 to 5,000 c/s*

WHILE spot-frequency square-wave generators are useful for general amplifier testing, a continuously variable source is often of value for detailed investigations; for example, of tone control circuits at various settings.

Many types of shaping circuits are available, each with its own particular limitations. The multivibrator is suitable only for spot frequencies, unless accurately matched tandem gain controls are available; and such components are both expensive and difficult to obtain within the required tolerance. Further, the wave shape is unsatisfactory unless passed through a clipper stage, thus adding cost and complication. The transitron circuit is again capable only of spot frequencies, and is apt to be difficult in regard to its power supply. The cathode-coupled clipper is critical of circuit layout, and is better followed by a further clipping stage, while the tetrode limiter needs heavy driving, and does not always produce a satisfactory waveform unless the output be subjected to further clipping.

In fact, all these circuits are at their best only when followed by clippers, and with this in mind, it was decided to make do with a clipper alone, and so arrange the circuit that deficiencies in the clipper could be easily compensated elsewhere. Fortunately, several sine-wave generators were available, so lack of self-contained excitation was not a serious matter. The arrangement finally adopted was that of Fig. 1, and it

proved so satisfactory for its purpose that it is now in production for commercial use.

The circuit is almost self-explanatory, but one or two points are perhaps worthy of comment. In order to keep the clipper independent of external conditions, it was necessary to couple it to the output by a cathode follower; and as a position for this stage had to be provided on the chassis, and only double triodes were immediately available, one half of an ECC33 was used for this purpose, and advantage was taken of the other half to provide an input amplifier.

V2a is an overdriven triode, with component values chosen for very sharp clipping. Operated with zero bias and a very low anode load, excessive grid excitation quickly drives the valve into both the anode bend and saturation regions of the characteristic. V2a is directly coupled to V2b, the grid of V2b being held negative to its cathode by the voltage drop across R<sub>7</sub>. C<sub>4</sub> with R<sub>6</sub> form a high-pass filter to help compensate circuit strays and other deficiencies.

## Variable Time-Constant

The output from V2b is coupled to V1b via C<sub>7</sub> and VR<sub>1</sub>, and in operation the full value of VR<sub>1</sub> is used for the lower frequencies, but is reduced from 3,000 c/s upwards, until at 5,000 c/s only about 25,000 ohms are left in circuit. Unless this reduction in time-constant be made, rounding of the corners occurs at the higher frequencies. When a square-wave is passed through a

\* Shirley Laboratories, Ltd.

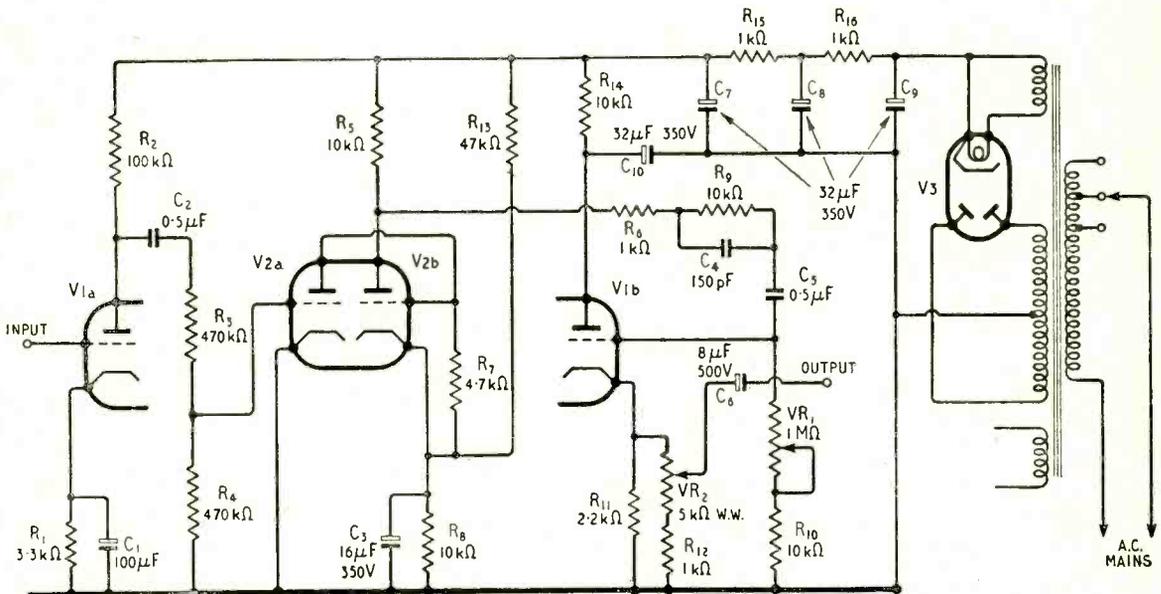


Fig. 1. Circuit diagram of square-wave shaper. All resistors 1-watt except R<sub>15</sub> and R<sub>16</sub> which should be 5-watt. V1, V2, ECC33 or ECC82; V3, GZ30 or EZ80.

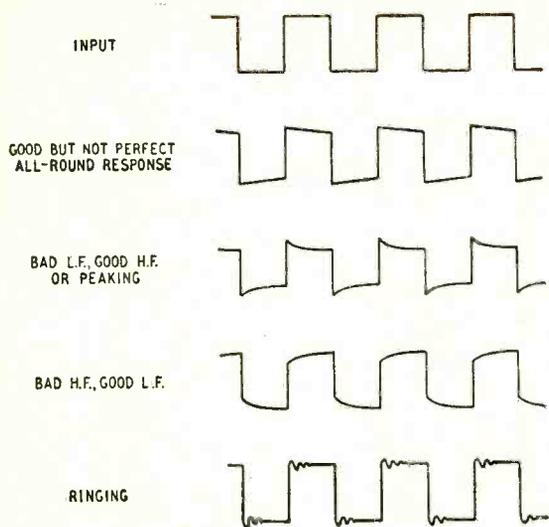


Fig. 2 Typical square-wave distortions and some of the amplifier deficiencies which cause them.

differentiating circuit, as the time-constant is reduced the waveform distorts, the leading edge rising and the trailing edge falling. Advantage is taken of this to compensate for the integrating action of the strays in conjunction with the circuit resistances. While this, admittedly, is a brute-force-and-ignorance method of obtaining results, it does work quite effectively, so *non olet*.

A sine-wave input to the shaper of 4 V r.m.s. is sufficient to ensure satisfactory operation, but some reduction may be necessary from 3,000 c/s upwards. Although a good shape may be obtained from as much as 20 V r.m.s. at 100 c/s, it will be found that between 2 and 6 V r.m.s. is all that can be handled in the higher ranges. In practice, VR, is adjusted to give as sharp a leading corner as possible, and the input is then set to give an equal mark-space ratio on the display. It takes less time to set up than to read about.

### Constructional Latitude

Circuit layout may be anything the constructor chooses or can achieve, from the worst rat's-nest to a highly finished commercial instrument, and component tolerances do not seem to matter at all. In fact, the shaper appears to be quite unconscious of any deficiencies in either of the foregoing respects, although it was found that the ECC33 and ECC82 functioned more satisfactorily than their American counterparts. The original unit was made in about 3 hours, including post-constructional alterations, from first commencing the drawings to the finished article: it should not take the most meticulous amateur constructor more than 4 hours or so. And while it is in no way a laboratory instrument, being designed only

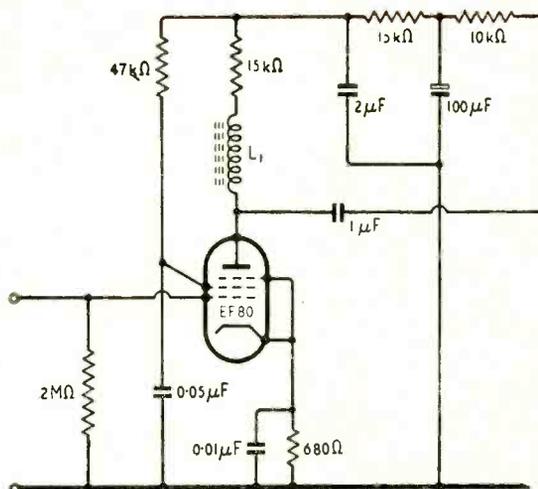


Fig. 3. Wide-band oscilloscope amplifier. A long-wave, dust-cored coil is suitable for  $L_1$ .

for the limited function and coverage described earlier, it does in fact produce a sufficiently satisfactory approximation to a square-wave, from as low as 20 c/s to well above 10,000 c/s.

For the benefit of those who are not accustomed to square-wave testing of amplifiers, a few characteristic displays are given in Fig. 2. Much information can be gained from observing on the oscilloscope screen the effects of deliberately altering the values of circuit components in the amplifier being tested.

Finally, it must be stressed that, when making square-wave tests, the oscilloscope amplifiers must be above suspicion. Not all commercial instruments meet with this requirement, and for those who are doubtful, a circuit for a wide-band amplifier is given in Fig. 3. Power supplies may be taken from the shaper.



Commercial version of the wave shaper made by Shirley Laboratories, Ltd., Worthing.

# LETTERS TO THE EDITOR

The Editor does not necessarily endorse the opinions expressed by correspondents

## Tape Machines

I SUPPORT Harry Crampin's plea (your December, 1954, issue) for higher tape speeds and larger spools. I also agree that the European standard spool (single-cheeked) is preferable to the U.S. and for the following reasons:—

One should aim at uniform tape tension on both sides of the gate, because failure to vary the torque with the radius gives an additive error. In other words, without radius compensation on either side, at the time when the tape is being least assisted from the gate by the take-up spool it is also being most heavily impeded on its journey towards the gate by the higher speed at which the reservoir spool has to rotate. As is well known, the simplest and most reliable way of minimizing both these discrepancies is to employ gravity clutches whose slip varies directly with friction and therefore with the loading, but it is perhaps not always realized that unless the "weight ratio" equals the "diameter ratio" compensation is not achieved. A European standard spool weighs 29oz loaded and 8½oz empty, a ratio of 3.3. Similarly, the effective outer diameter is 11in against the core diameter of 3½in, again a ratio of 3.3, but on no other design of spool has this been so carefully looked after, certainly not on the U.S. which is also much harder to adapt to the domestic 7in centre and vice versa. The demands for larger spools will not diminish the popularity of smaller ones.

A third advantage concerns track discrepancy. On multi-track machines it is of course possible, with double-cheeked spools, to re-play on a different head simply by turning the spool over, but unless the machine is in perfect alignment this will result in loss of top. Such a procedure is impossible with single-sided spools, each track always having to be replayed from the head through which it was recorded. Also the European standard spool is much easier to thread, join and edit and there is less chance of noise from the tape catching on the cheek of a spool.

Last but not least, the capacity is larger and in view of these many advantages I deplore the present tendency for the U.S. standard to oust the European. Reverting to Mr. Crampin's preference for Continental designs, I would stipulate that in addition to being self-reversing it should be in order to switch off the machine merely by breaking the mains connection. Any form of remote control is out of the question with most British designs as the pressure roller would be left in static contact with the capstan, which the makers strongly deprecate. Could one of the rubber or synthetic rubber manufacturers please state whether too much fuss is not being made over static contacts on pressure rollers, at any rate so far as machines in daily use are concerned?

Cleethorpes, Lincs.

R. LEACH.

YOUR correspondent's specification (December, 1954, issue) for an ideal tape recorder reminds me of an R.C.A. wire recorder I had several years ago. This machine was magazine loading like a cine camera, each magazine holding two wires of ¼hr duration each and so arranged that as one was playing the other was rewinding.

The wires were driven at a constant speed by capstans, and a very ingenious spring arrangement between the reels not only kept the wires taut, but also transferred the rotation of the supply reel to the take-up with the necessary compensation for wire build-up. At the end of a reel a notch in a rotating disc (which also served as a footage indicator) tripped over a switch within the machine and reversed the direction of the driving motor and the amplifier connection to the sound heads.

In spite of a bakelite case and 5-in speaker the good design and precision of the mechanism gave a quality and

freedom from "wow" seldom obtained with the average popular-priced tape machine.

Doncaster.

P. STUART.

## Variable High-pass Filters

THE use of variable steep-cutting low-pass filters in domestic high-fidelity amplifiers has become almost standard practice. It is therefore surprising that the use of variable steep-cutting high-pass filters (not fixed rumble filters) appears to be relatively rare. Such a filter is of considerable value in minimizing listener fatigue due to distracting effects associated with the low-frequency end of the spectrum, and only too apparent in reproducers having speaker systems capable of extended bass response.

The immediately apparent advantages of a high-pass filter are:—

1. Reduction of hum and rumble inherent in many discs, particularly of the 1.p. type. This may readily be verified by playing different discs on a high-quality turntable and noting the disc-to-disc variation in reproduced hum and rumble.
2. Reduction of severe non-linearity distortion due to random "cone flutter" in woofers used with amplifiers having useful response down to 2-5 c/s.
3. Reduction of modulation and other hum sometimes presented free of charge in radiated radio programmes.

The preceding advantages are to some extent obtainable from the usual fixed rumble filter. An advantage peculiar to a variable high-pass filter is that it will, in conjunction with the commoner low-pass filter, provide ready adjustment of "frequency-range balance." It is well known that when for some reason the h.f. response has been sharply curtailed it is often necessary to curtail the l.f. response as well in order to maintain an aesthetically pleasant tonal balance. A suitable product for the l.f. and h.f. cut-off frequencies is generally given as 500,000. On this basis the respective nominal cut-off frequencies for two 5-step filters could, for example, be: (a) Filters out (say 25-20,000 c/s); (b) 40-13,000 c/s; (c) 50-10,000 c/s; (d) 70-7,000 c/s; (e) 100-5,000 c/s.

The "straight-line" fanatic will probably pale at or beyond step (b). Nevertheless, step (e) will allow enjoyment from a treasured acoustically recorded disc.

The high-pass filter can conveniently be of the R-C parallel-T feedback loop type outlined by Thiessen (*J. Acous. Soc. Amer.*, Vol. 16, No. 4, April, 1945). If an existing pre-amplifier cannot painlessly be modified to this extent, reasonable results can be had by using a multi-pole switch and several cascaded elementary R-C filters. The latter alternative may in fact find favour with those who look with suspicion on sharp knees in filter curves.

Pretoria, S.A.

M. R. H. MACNAMARA.

## Electronics on the Farm

IT seems to me to be about time that the electronics industry and the farm machinery industry got together on the subject of electric fence units.

The basic electric fence, by now a hoary old stager, is a six-volt battery (usually an old car accumulator) feeding a balance wheel interrupter and thence a transformer, to inject spurts of negligible power but about 10 kilovolts into a fence wire which is carried on insulators.

Since the power demand is extremely low, the chief disadvantages of the accumulator become very obvious. Accordingly several manufacturers have produced models designed to run off the ubiquitous radio h.t. battery. As far as I know most of these have also been modified in the interrupter mechanism; but if I am any judge of the

contents of a sealed box, and the clicks it produces, the interrupter is still a moving contactor. It is true that the improvements in the interrupter mechanism are probably considerable, for salesmen talk glibly of a five-year guarantee; indeed, I suspect that the timebase is a resistance-capacitor circuit and the contactor a reasonably good magnetic relay. However, I submit that for this purpose a neon tube would be far cheaper and more reliable, and that a wholly electronic unit would be superior to any unit containing mechanism.

I admit that I lack complete technical information. It is possible that I am mistaken in believing that a reasonable neon tube will effectively act as a switch and/or carry the power demand, and I suggest that the matter might well be worth examination.

The advantages which I foresee are cheapness and simplicity in first cost and maintenance, lightness and compactness. The neon tube would certainly plug in, presumably the electrolytic capacitor could also be plugged and, although perhaps unusual, the resistor as well. The transformer hardly ever gives any trouble, and therefore maintenance would consist of nothing more than buying a new relatively inexpensive unit and changing it for the old one. It is true that the older farmer might not know which to change, but that idea is becoming out of date.

Another refinement I have yet to meet, except on my own fences, is a neon earth detector on the h.t. side. I have de-capped miniature Philips neon lamps and connected them across the output terminals ( $\frac{1}{2}$  megohm in series) so that they flash if the fence wire is *not* earthed. Few stockmen will shock themselves to find out if the fence is in fact working, and I suspect that our cattle would be "out" a good deal more often without this aid.

It appears that present fences usually have a frequency of about two flashes per second. My present balance wheel units suffer far too much from burnt contacts, and therefore when I overhauled them this last spring I reduced the frequency to about one per second, thereby in effect doubling the working life. So far I have found no disadvantage.

My units, being expensive of their kind, carry a simple, but not nasty, battery voltage indicator with a push-button switch. It is perhaps because the h.t. battery type is alleged to run for five months on one battery that this refinement is invariably omitted. It is not easy to justify a moderately expensive unit which will not be used above twice a year, but I submit that a push-button, a resistance, and a torch type bulb might serve; with instructions that the bulb should be held on for a few moments and will fade rapidly on a worn-out battery.

Hempstead, Essex.

H. G. P. TAYLOR.

### Mathematics

HAVING been cited in the January issue by F. V. Bale as an example of the type of writer who lowers the tone of *Wireless World* by frightening readers off mathematics, may I be allowed to reply?

If indeed I have been guilty of discouraging anybody from the study of mathematics, then I deserve censure. So far from my intention having been that, however, it has been precisely the opposite; namely, to debunk the supposed esoteric nature of mathematics and to break down the mathematicians' "closed shop." In the very article which Mr. Bale quotes I showed how the basic filter equations could be arrived at by schoolboy algebra, and then, having taken the reader to the desired point by presumably familiar ways, revealed the cosh as nothing to be afraid of but rather as a useful tool—"The practical value of the cosh, then, lies in the fact that it enables one to dodge most of the work by looking up tables.... Anybody can do that."

It surely cannot be denied that there are thousands of potential technicians and engineers who do find hyperbolic functions in the abstract a forbidding and largely meaningless subject, and their relationship to filters far

from obvious. The above-quoted article being the example chosen by Mr. Bale to deplore, what alternative treatment does he recommend for these readers?

At the other extreme, my own experience as a wartime radar instructor showed me that graduates in mathematics were not automatically able to apply it to practical uses; most of them had never clearly visualized the physical realities represented by their equations. These, too, surely stand to benefit from an alternative approach.

A crime to which I do quite cheerfully plead guilty is that of lack of respect for the type of author who fills his pages with mathematics and considers it beneath his dignity to explain what it means in words. In this attitude I am glad to be in the company of perhaps the most noted authority on the presentation of technical information—Prof. R. O. Kapp, whose concluding paragraphs in his paper "The First Draft"\* should be taken to heart by the over-mathematical. "CATHODE RAY."

\* Obtainable from the Secretary of the P.T.I. Group, University College, London, W.C.1. price 2s.

### Viewers' Strike?

LIVING on a main road within a few yards of the junction with another main road and receiving a weak signal from the Brighton booster and a still weaker one from the new Rowridge station, I am finding out some things about ignition interference.

Of all the cars passing my door, 90 per cent are un-suppressed and even some of the new cars have either unsatisfactory suppressors or the suppressors have been removed.

It is time that the P.M.G. made the fitting of suppressors to cars compulsory, even if it means supplying the suppressors free. The cost of this could be met from the percentage of broadcast licence fees retained by the G.P.O. If all licence holders got together and refused to renew their licences, I am sure a speedy solution would be found.

Worthing, Sussex.

W. E. NIALL.

### Tape Terms

A LANGUAGE of magnetic tape recording is evolving and, although standardization is yet a toddler as regards technique, some unhappy selections are emerging in the language and seem to have become accepted as standard terms already.

It helps so much to link meaning with function, rather than to blind with slick startlers, that one hopes terms such as "azimuth" will not prevail.

When technicians use that term, the context usually suggests that they mean "head" tilt relative to tape path. "Azimuth" is an ancient astronomical term of different meaning, shortly put as "an arc of the horizon." This is borne out by its origin: Arabic *al* (the) *sumut* (direction). How does it come to be used to suggest a different meaning for which a better word exists, namely, "oblique"; Latin *ob* (before) *liquis* (slanting) defined shortly as "to deviate from the perpendicular?" That, surely, is exactly what is meant.

Bristol Magnetic Recorder Company,  
Bristol, 3.

W. D. ARNOT.

### Overseas Buyers

FREQUENTLY an article advertised in *Wireless World* attracts my attention and I develop an urge to buy it. But I get disturbed about foreign exchange, extra postage for overseas mailing, etc., and I finally decide the product is perhaps not worth all the fuss anyway.

Perhaps this is wrong. Could not your advertisers publish a little bit on how receptive they are to small foreign orders and how to go about it, especially extra payment requirements for overseas mailing?

Yonkers, N.Y., U.S.A.

MARTIN L. KENELY.

# Vector Addition and the Slide Rule

## Rapid Method of Calculation

By A. G. LONDON, B.Sc.(Eng.), Graduate I.L.E.E.

**A** GREAT many calculations in electronics involve working out the value of terms of the form  $\sqrt{(x^2 + y^2)}$ .

Two examples which come readily to mind are:

(i) The magnitude of the resultant of two vectors,  $V_1$  and  $V_2$ , at right angles, is given by:

$$\sqrt{(V_1^2 + V_2^2)}$$

(ii) The magnitude of the impedance of a series-tuned circuit is given by:

$$|Z| = \sqrt{[R^2 + (\omega L - 1/\omega C)^2]}$$

The usual method of calculating the value of a term of this form is to find the squares separately, add them, and find the root again. This is a rather tedious business, particularly if it has to be repeated a number of times. A much quicker and easier method exists, however, which eliminates those little addition sums, done on odd scraps of paper. The whole process can be carried out on a slide rule without "taking off" any figure except the answer. The slide rule can be of the simplest type, one with only the four main scales.

A reminder of the properties of these scales may not be out of place. They are usually called scales A, B, C and D, from top to bottom, A and D being on the stock; B and C on the slide. They are so arranged that if the cursor is set to a number on scale D the square of that number appears under the cursor on scale A. Square roots are found by the reverse process. Scales C and B, respectively, have similar properties.

Now suppose we wish to find the value of the root  $\sqrt{(x^2 + y^2)}$ ,  $y$  being smaller than  $x$ , we proceed as follows.

1. Set the slide rule so that  $y$  on scale C is opposite  $x$  on scale D. (Arrow 1 on Fig. 1.) Then by the ordinary rule for division,  $x/y$  will appear on scale D, opposite the end mark on C. (Arrow 2 on Fig. 1.)

2. Set the cursor to the end mark on scale C. Then, as we have already noted,  $(x/y)^2$  will appear under the cursor on scale A. (Arrow 3 on Fig. 1.)

3. To the value of  $(x/y)^2$ , add 1, and set the cursor to this new figure, still on scale A. (Arrow 4 on Figs. 1 and 2). The cursor now indicates  $(x/y)^2 + 1$  on A; and the square root of this on scale D. (Arrow 5 on Fig. 2.)

4. Now move the slide until the end mark on scale C is set against the cursor.

5. Read  $\sqrt{(x^2 + y^2)}$  on scale D opposite  $y$  on scale C. (Arrow 6 on Fig. 2.) In steps 4 and 5 we have used the ordinary multiplication rule to multiply  $\sqrt{[(x/y)^2 + 1]}$  by  $y$ , and,

$$y \sqrt{[(x/y)^2 + 1]} = \sqrt{y^2[(x^2/y^2) + 1]} = \sqrt{(x^2 + y^2)}$$

In the example shown in the figures,  $x = 4$ ,  $y = 3$ . Then the successive steps are:

1.  $x/y = 1.333$
2.  $(x/y)^2 = 1.78$
3.  $(x/y)^2 + 1 = 2.78$
4.  $\sqrt{[(x/y)^2 + 1]} = 1.667$
5.  $\sqrt{(x^2 + y^2)} = 5$

It is important, in step 3, to keep in mind the position of the decimal point in  $(x/y)^2$ . In the example, the figure 1.78 on scale A actually represents this number, and  $(x/y)^2 + 1 = 2.78$ . However, according to the relation between  $x$  and  $y$ , it might represent 1.78 multiplied by any power of 10; e.g., 0.178 or 17.8. Then  $(x/y)^2 + 1$  would be 1.178 or 18.8 respectively. Care is therefore necessary at this point in the operation.

The process can very simply be adapted to evaluate a root of the form  $\sqrt{(x^2 - y^2)}$ . The only change necessary is that, in step 3, 1 is subtracted from  $(x/y)^2$ , instead of being added, and the cursor is set to this value; i.e.,  $(x/y)^2 - 1$ . The square root is then taken as before, multiplied by  $y$ , and the answer read on scale D. The proof is exactly analogous to the case of  $\sqrt{(x^2 + y^2)}$ . Clearly, this comes in useful, for example, in the series-tuned circuit case mentioned above, if we know the impedance, but the resistance or the reactance is unknown.

$$\text{Then } R = \sqrt{(|Z|^2 - X^2)}$$

While no claim is made that the process described in this article is original, it is a simple and rapid method of solving the particular problem, and deserves to be more widely known. Many readers will, no doubt, be able to find other applications besides those mentioned.

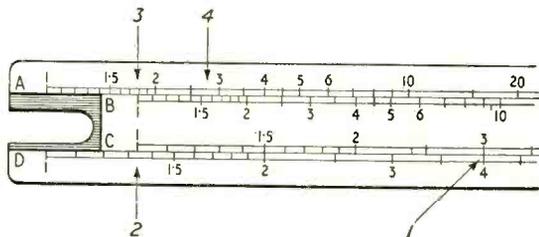


Fig. 1. The first steps in setting the slide rule are shown here, culminating in  $1 + (x/y)^2$  at point 4.

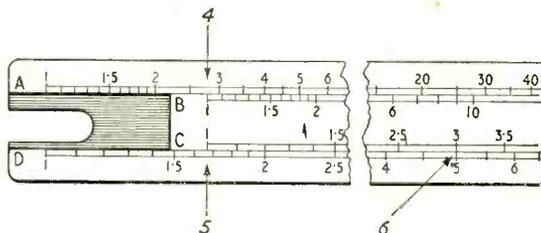


Fig. 2. The final steps are illustrated here, the root appears at point 5 opposite point 4 and multiplying by  $y$  gives the answer at point 6.

# FLUX-CUTTING OR FLUX-LINKING?

## A Controversy on Fundamentals—and a Practical Solution

By "CATHODE RAY"

NOT very long ago there took place at the I.E.E. a discussion on fundamental electromagnetic theory\*. At the end of it the chairman remarked that although it was the normal policy of the I.E.E. to encourage student members to attend its meetings, he was rather glad they hadn't been much in evidence on that particular occasion. Well, certainly, it did seem somewhat unedifying to hear one learned Professor of Electrical Engineering after another disagreeing flatly on the very basic principles of the subject. Quite enough to shake whatever faith students may have in the authorities, and to make one wonder whether there is anything—even Ohm's Law—that can be relied upon to be true.

One of the most discussed things on such occasions is the question of how to reckon induced e.m.f.—whether on a basis of "cutting magnetic lines of force" or some other way. Nearly all the electricity used in the world is generated by electromagnetic induction. And the process is fundamental in radio too, for radio waves would be impossible without it, and so would transformers, chokes and tuning coils. If then the most eminent authorities invariably disagree on the principles of the thing, how can anybody be expected to understand it and make the necessary calculations for designing radio and other electrical systems? Disagreement about how wages are calculated can be relied upon to give rise to trouble; how is it that disagreement about how to calculate induced voltage does not? Or does it?

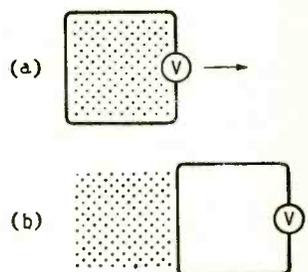
Some while ago† I was rash enough to stick my own neck out into this particular controversy, by advocating the flux-linkage (or flux-threading) idea at the expense of the flux-cutting idea. And now I get a letter from a radio engineer in the Belgian Congo who writes in some concern to report that after gladly accepting my view on this matter, as being in line with that of his one-time professor of electricity, he was dumbfounded on being confronted by a junior colleague with a description of an actual electric generator that by its method of functioning absolutely proved the flux-cutting idea. More shaken faith, presumably! He may be interested to know that at the I.E.E. discussion this particular kind of generator was well in the forefront of the battle, and my shocked ears could hardly believe what they heard when one teacher made the highly immoral suggestion that students should be kept in ignorance of it because it did not square with the official curriculum.

Well, far be it from me to pose as a sort of super-authority to put everyone else right, but it does seem

to me that at least some of this confusion is capable of being dispelled. First of all, for the sake of any readers who are not yet quite "with us," let me explain what the controversy exactly is. It began with Faraday's famous experiments in 1831. He found that an electric current could be magnetically induced in a circuit in two ways: (1) by moving a magnet near the circuit (or, what comes to the same thing, moving the circuit near a magnet); and (2) by moving neither but varying the strength of the magnetism, say by switching the current on and off in a coil of wire producing it. The first of these processes is applied in every rotary electric generator; the second in every transformer and tuning coil. Faraday visualized the magnetism as lines of force in the space around and within the magnet, and regarded the current in the first class of experiments as being induced by these lines cutting across the circuit (or the circuit cutting the lines). He was inclined to think that the results of the second class of experiments could be regarded in the same way, by supposing the lines of force to spring out of the coil as the current was increased, and so to cut across any coupled circuits.

Before generators and transformers could be designed on a proper engineering basis—and certainly before radio equipment could be designed—it was necessary to be precise about the relationship between movement or variation of magnetic field and the voltage of the e.m.f. generated thereby. The strength of a magnetic field can be reckoned by the force it exerts on a small magnet. It was agreed to suppose that a certain force corresponded to so many lines per square centimetre. The total number of lines over a given cross-section was called the flux. It was found that the e.m.f. generated in a circuit was proportional to the rate at which flux was cut by the circuit, or varied within it. In fact, when the amount of flux corresponding to a "line" had been defined, it turned out that in order to generate an e.m.f. of one volt it

Fig. 1. Here is an idealized example of electromagnetic induction. The dots represent an end-on view of  $10^8$  magnetic "lines," uniformly distributed. The square circuit is supposed to move steadily from position (a) to position (b) in one second. What will the voltmeter V read during this process? And why?



\* "A Short Modern Review of Fundamental Electromagnetic Theory," by P. Hammond, *Proc. I.E.E.* Pt. 1, July, 1954.

† *Wireless World*, June, 1953, p. 285 ("Radio Waves").

was necessary to vary the lines at the rate of 100,000,000 ( $=10^8$ ) per second.

Now this is where we get to the controversy. Fig. 1 shows a simple circuit, consisting of a square of wire connected to a voltmeter. So as not to introduce complications caused by the magnetic field due to current in this circuit, let us suppose that the voltmeter has an infinitely high resistance, so that no current flows. The dots are end views of the lines of force produced by a coil not shown, but parallel to the single square turn. To avoid complications again, let us suppose that the return paths of these lines are kept well clear of our picture by means of a high-permeability iron core. Finally let us assume that notwithstanding the fewness of the dots there are actually  $10^8$  lines of force enclosed by the circuit, and that they are distributed uniformly over its area. If now the circuit were moved steadily to the right from position (a) to position (b) at such a speed as just to clear all the lines of force in one second, we can safely assume that during this process the instrument would read one volt.

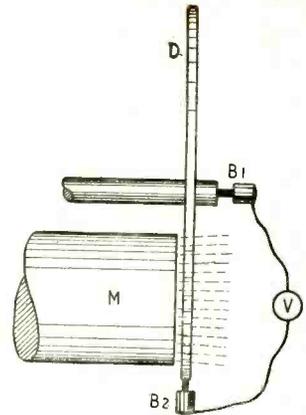
But if you ask a number of engineers to explain this result you will discover two schools of thought. Some will say that three of the four sides of the circuit take no part in the experiment because they cut no lines of force, but that the fourth—the left-hand one—was cutting  $10^8$  lines per second, and that was why an e.m.f. of 1V was generated. Others will say that at the beginning of the operation  $10^8$  lines of force were linked with the circuit, and at the end none were; difference,  $10^8$ ; so magnetic linkages with the circuit were being varied at the rate of  $10^8$  per second, and that was why an e.m.f. of 1V was generated.

### Divided Counsels

Precisely the same result and explanations are forthcoming if the circuit is kept stationary and the field is moved to the left. And precisely the same result is obtained if both are kept stationary and the current in the unseen magnet coil is reduced at such a rate as to bring the field steadily to zero in one second—but this time the explanations will vary. The line-cutting school of thought splits into two: one group will say that of course this is quite a different effect, so cannot be expected to have the same cause; the others stick faithfully to the cutting idea, and adapt it to cover the changed circumstances by saying that the lines can't just come from nowhere, but that when current in the magnet coil is increased or decreased they spring out or flop back, so cutting the circuit and generating an e.m.f. one way or the other around it. This adaptation of the original line-cutting picture may perhaps be accepted, provided that nothing better can be found and that it is consistent with other known facts. But slightly more elaborate experiments show that an e.m.f. is induced in a circuit by growth or collapse of a magnetic field *even when that field is caused by current in that same circuit*, and I for one find it a little difficult and unconvincing to visualize a wire being "cut" by lines of force emerging from itself.

When we come to interrogate the linkage school of thought we find them perfectly happy and pleased with themselves, because their account of the previous (Fig. 1) experiment equally well covers the current-varying or transformer experiment, without involving them in having to explain where the lines come from or where they go. Whether the number of lines

Fig. 2. D is an edge view of a metal disk, rotating in the field of a fixed magnet M. B1 and B2 are brushes making electrical contact with axle and edge of disk. Will the voltmeter V give a reading? If so, why?



linked with the circuit is made to change by moving the field or circuit or both, or by varying the strength of field in a stationary set-up, makes no difference to the e.m.f. induced; so why, they say, adopt an explanation that has to be forced to fit some of the facts, or alternatively use two explanations to cover facts that are obviously related and can perfectly well be covered by one?

This is the psychological moment, when these linkage people are swelling with self-satisfaction, to perform the experiment known as the Faraday disk or the homopolar generator. One form of it is shown in Fig. 2. D is an edgewise view of a copper disk which is rotated steadily. B1 is a brush making contact with its axle, and B2 is another making contact at its rim. M is a fixed magnet arranged so that its lines of force pass through the disk, and the whole circuit is arranged so that no lines link with it. Therefore, according to the linkage school of thought, no e.m.f. can possibly be induced by turning the disk. But unfortunately for them the meter shows that it is. The thing with which my Belgian correspondent was confronted, although different in form, was obviously identical in principle, and was no mere theory or experiment but an actual machine used to generate current for actual electro-plating.

If the line-cutting advocates had been called upon to predict the result of the disk experiment, previously unknown to them, there might have been some hesitation and clearing of throats while they tried to decide whether the part of the circuit formed by the disk was or was not cutting the magnetic field. At first sight it might seem not, since no change in the form of the circuit takes place, and the copper in any one part of the disk is as good as in any other. But if members of this group were electron-minded (as the participants in the I.E.E. discussion apparently were not, for the word "electron" was hardly mentioned) they would realize that turning the disk carried the free electrons in the copper around with it, and so causes them to move in a magnetic field, and by using Fleming's right-hand rule (thumb indicating direction of motion and forefinger direction of field, then second finger shows direction of e.m.f.) they would correctly predict an e.m.f. along the radius of the disk crossed by the field.

Having tactfully allowed the linkage people time to think up a way of talking themselves out of the contradiction between their theory and this experiment, we come back to them and invite their com-

ments on it. The I.E.E. discussion showed what at least one of them would say. He would describe the result as an anomaly, and shamelessly advocate keeping it as dark as possible, lest it confuse his students. I hope we all regard this reply as thoroughly unworthy and unsatisfactory and insist on something less ostrich-like. Pressed thus, some might allow it to be brought to the notice of their students, but only as a "special case" or "exception". But if nothing better can be said than this one would, I should think, be obliged to decide in favour of the line-cutting school, even though that meant accepting their curious pictures of lines cutting wires by springing out of them. Another group, represented in subsequent discussion by at least one very eminent authority†, refuses to be disconcerted by this attack on the linkage position, but shows that the disk experiment is, after all, not an exception to it. They ask one first of all to substitute for the disk a spoked wheel, and then show that the sector-shaped circuits formed by pairs of adjacent spokes and the segments of rim joining them obviously do link with a varying number of magnetic lines as the wheel is rotated, and that a difference of potential is thereby set up between the two brushes. They point out that this state of affairs does not depend on the number of spokes, and that more can be added until finally they are touching one another all the way, and the wheel has become the solid disk of Faraday.

Having re-established the prestige of the linkage

† "Apparent Failures of the Flux-Threading Rule," by C. G. Carrothers and R. O. Kapp, *Bulletin of Electrical Engineering Education*, June, 1954, pp. 7-12.

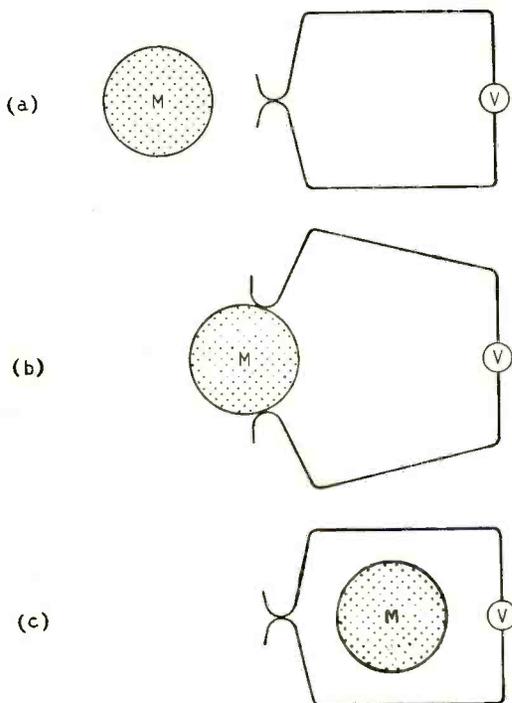


Fig. 3. *M* is a metal bar magnet which is pushed through the jaws of a spring clip forming a closed circuit. *V* is a sensitive voltmeter or galvanometer. Does it give any sign while the magnet is being inserted into the circuit? If not, why not? See Fig. 4.

school (and, we hope, expelled those members of it who disgraced it with their treacherous ostrich policy), they go on to conquer other supposedly fatal objections. One of the most interesting of these is Hering's experiment. It is performed with a circuit consisting of a spring clip, normally closed as in Fig. 3(a). The bar magnet *M* is then forced past the jaws (b) until finally it is inside (c). There is a complete circuit all the time, and clearly a large number of magnetic linkages are introduced into it, yet the most sensitive instrument fails to indicate any e.m.f. This, it is said by some, makes nonsense of the flux linkage idea. It certainly makes nonsense of something, and so it ought, for that something is a misconception of the linkage principle. The fallacy lies in looking at (a) and (c) only, which show an identical circuit with and without a linked field, and forgetting about (b), where the circuit is not identical. As Carrothers and Kapp put it, "the circuit in which one might expect a current to be induced is not there during the time that any inducing could occur."

### When Is a Circuit . . . ?

This matter of change of circuit needs careful watching, for some changes of circuit during a linking or unlinking process do not necessarily affect the observed e.m.f., and the distinction is sometimes rather a subtle one—as it is in the Hering experiment. For example, altering the shape or extending the length of a flexible lead from a transformer coil to a voltmeter doesn't prevent the ordinary linkage rule from being used to predict the voltage correctly. But the change in circuit during the (b) period in Fig. 3 does upset what might seem to be a valid application of the rule. This can perhaps be more easily seen in Fig. 4. The right-hand part of the double wire square at (a) is not linked with the flux passing through the magnet *M*. If now the switch is opened (b) the magnet can be moved through into the right-hand square (c) but doing so does not alter the number of lines linked with the circuit that then exists. If now the switch is closed (d) there is a closed circuit the same as in (a), but linking with flux that was not there before. Yet there was no stage at which one would expect *V* to give a reading.

The fact that in the Hering experiment the switch-over is gradual makes no real difference. The process can be more exactly imitated by the arrangement in Fig. 5, in which the slider is moved from the position shown, where the magnet is not embraced by the circuit (the path through the resistance is dead-short-circuited by the direct path), to the other end, where it is. No one, surely, would expect moving the slider to set up a potential difference between *a* and *b*, such as certainly would be set up if a wire between *a* and *b* were moved across the pole face of the magnet.

Another demonstration in which the number of circuit linkages is increased by a sort of trick, without generating any e.m.f., is Blondel's experiment, shown in Fig. 6. Wire is wound from a metal cylinder, which acts as a short-circuit, to an insulating cylinder fitted with a metal slip-ring, with which contact is made by a brush *B1*. This cylinder is placed in an axial magnetic field. By rotating the cylinder, the number of turns linking with the field is made to increase gradually from none at all up to the maximum provided. Yet no e.m.f. is indicated. Nor should one be expected, for it is a sort of continuous Hering experiment.

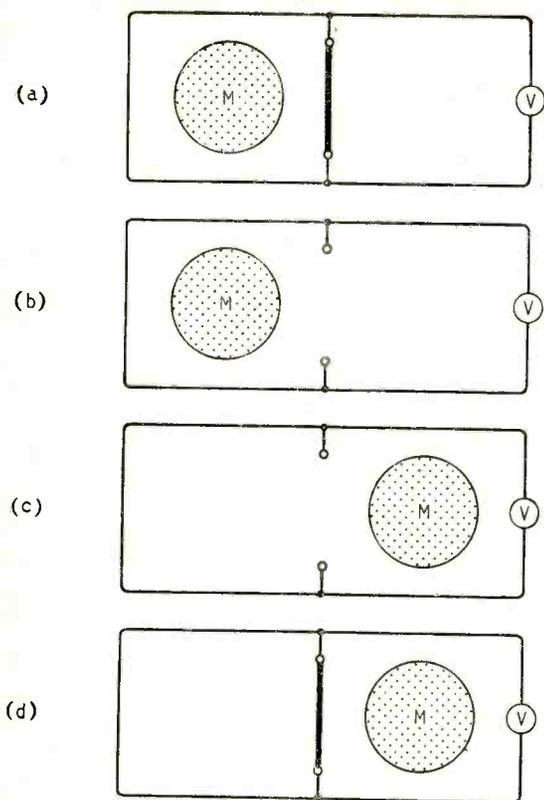
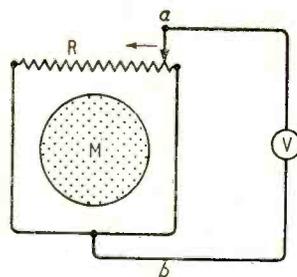


Fig. 4. This variation of the Fig. 3 experiment may make it easier to answer the questions about Fig. 3. If it doesn't, see Fig. 5.

What is the moral of all this? Of the people we questioned, who are right and who are wrong? And what about the people who don't seem to have been represented in our Gallup poll, who refuses to acknowledge the very existence of magnetic fields? Are they like those who hold on to the belief that the earth is flat, regardless of the clear evidence to the contrary? Or are they the only ones who are right?

Before we can answer we shall have to decide what, in this connection, "right" and "wrong" mean. If we think that any rule or theory or idea is—or could be—the right one, we had better think again. In such a question as deciding which of several men in an identification parade stole our wallet last night, it would be possible (whether by luck or good observation) to be right. But in such matters as stating precisely how electromagnetic induction works, nobody can be right, because there are no still more fundamental terms with which to describe the fundamental processes of nature. We can describe the construction and working of a machine, because it is made up of simpler parts that are familiar. But if we press the analysis back to such things as electrons we cannot say what they are made of. If we begin to describe an electron as "a very tiny particle . . ." we are not really describing it, because one should immediately ask "What is a particle?" and the enquiry would never end satisfactorily, because we would be committing the logical sin of defining the obscure in terms of the more obscure. A particle, as commonly understood, is a more complex structure than an electron. If we could start with a knowledge about electrons and such things, then perhaps we could go on to describe

Fig. 5 (right). R is a resistor with a sliding contact which is moved from one end to the other. Do you still feel sure about Fig. 3?



a particle of matter accurately. But even if one day we find that an electron is made of still simpler units, that will only transfer our ignorance from the electron to them.

### A Cloak for Ignorance

It is the same with induction. When we talk about lines of force, flux, and even fields, we are using these terms to hide our complete ignorance of what is really happening. All we know is that when certain conditions are provided certain results invariably follow. And what we do in the science of the subject is to state as precisely as possible the relationship between cause and effect. To assist in this it is necessary for most people to use mental pictures or concepts. The test of such a concept is not whether it corresponds accurately with ultimate reality—we wouldn't know—but whether it is (a) consistent with all observed behaviour, and (b) convenient for its purpose. Of these requirements, (a) might at first sight seem to be essential, but in practice, for the sake of (b), one often uses concepts that only approximately fit the facts, or fit only some of the facts; this apparently unscientific practice is allowable so long as the limitations are clearly understood by all concerned. The position is complicated, however, by (b) being so largely a matter of opinion.

Let's face it—we just don't know how or why it is that pushing a magnet into a coil of wire causes a voltmeter across its terminals to indicate. Probably no one will ever know. But all electrical engineers have to be able to make use of this fact to obtain desired results, such as providing light, heat, and television in our homes. Since it would be difficult to discuss such matters if blanks had to be inserted in place of words wherever our absolute knowledge was lacking, it is necessary to use concepts. To most

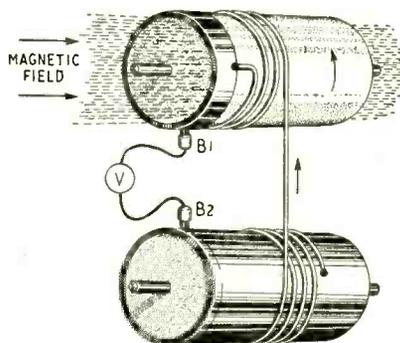


Fig. 6. This is a machine for causing an increasing number of turns to be linked with a magnetic field. Does this process cause V to read? If so, why?

people, the concept of a "field"—a sort of sphere of influence—around a magnet renders it easier to discuss induction and to make the necessary calculations. Calling it a field does not in the very least increase our knowledge of it, or prove that it exists. But even if it could be proved that it does not exist, it might still be a good thing to keep it as a concept.

### Spectacles for All

The concept of just a field is still too vague and shadowy for most people. So lines of force were invented. Now in so far as anything about a magnetic field *can* be known, it is known that lines of force do *not* exist. They are simply a means of showing on diagrams—or visualizing in the mind—the directions in which fields act. They also help to suggest, by their closeness together, the relative strength of the field. As great a mind as Faraday's was not ashamed to use them as a mental aid. In just the same way contour lines on a map help one to visualize the direction and steepness of a slope, but supposing that a magnetic field actually consists of lines is as sensible as supposing that a hillside consists of lines. Yet so firmly does the line idea get one that it is quite difficult not to imagine that if a cylindrical bar magnet were rotated about its axis its lines of force would rotate with it and generate an e.m.f. in a stationary circuit through which they passed. But if we think of the field as we should, as having at any point only magnitude and direction, we realize that turning the magnet does not alter either of these properties anywhere, so is incapable of inducing an e.m.f. in an external circuit (though the stationary field does generate an e.m.f. in the rotating metal of the magnet itself).

Calling the unit of flux a "line," as some people still do, so that magnets are bought and sold on a specification of the number of lines they provide, makes the line idea even more difficult to keep in its proper place. Calling it a maxwell was better, but one couldn't help remembering that 1 maxwell is equal to 1 line. Now that the maxwell has been superseded by the weber, which is equal to  $10^8$  maxwells, there may be a better chance of thinking of flux as a continuous magnitude, like length or inductance.

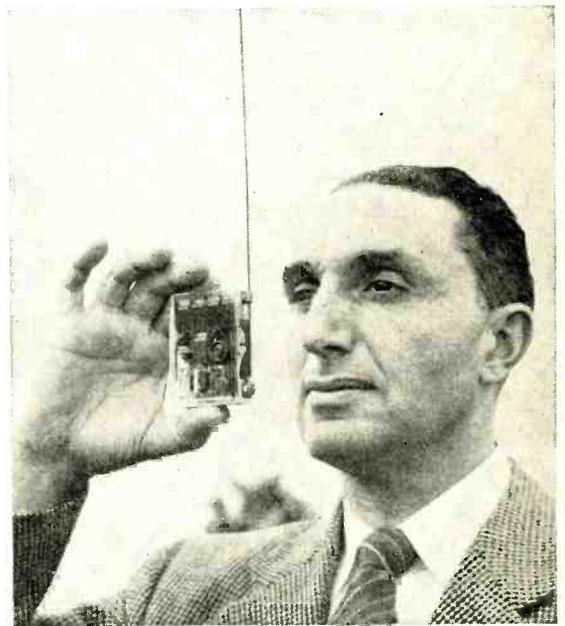
To Clerk Maxwell, Faraday's lines seemed rather quaint; as a mathematician he found a mathematical symbol more appropriate and precise. Mathematical symbols themselves are only concepts, of course, but it must be admitted that they are the most precise and flexible way of stating generalized results of observations. For example, observations on electrons have shown them to have properties that defy any "mechanical model" to imitate, but can be expressed mathematically. Unfortunately only people with exceptionally mathematical minds can get any enlightenment from these expressions. To generalize the observed facts about induction by magnetism, even such a lucid writer as Faraday required a sentence of no fewer than 126 words. Mathematically the same thing can be stated much more precisely thus:

$$\oint \epsilon \cdot dl = - \frac{d}{dt} \iint \mathbf{B} \cdot d\mathbf{a}$$

But there are plenty even of qualified electrical engineers, not to mention elementary students, who fail to appreciate this way of putting it. However, according to the author of the paper discussed at the I.E.E., those who can should escape falling into the silly misunderstandings of those of us who through

mental incapacity are obliged to make do with visual concepts like the cutting or linking of flux lines. He showed that the foregoing equation produces two terms, one corresponding to the transformer or linkage-changing effect, and the other to the motional or cutting effect, and in any particular case one of these effects is often absent. No doubt he always gets the right answers.

But some other mathematician might come along and express what we know about induction in some other way, perhaps without reference at all to magnetic fields, and also get the right answers. We poor morons who haven't a clue to these refined methods, but use either or both of the two flux rules, provided we use them with discretion and beware of trick cases like Hering's, can also get the right answers. Perhaps one day we may meet a Viet Nameese refugee who gets the right answers by manipulation of an abacus and a prayer wheel. The point is that as long as each of us understands what we are doing, and can get the right answers by a process that to us makes sense, it is mistaken zeal to insist that everybody must do it in one particular way, which is the only right way. Agreed that it would be convenient if everybody used the same method. Evidently Carrothers and Kapp think so, for they have expressed the view that it would have been better if the flux-cutting rule had never been thought of! Nevertheless, while like them I find flux-linking the most convenient and reliable way to look at induction problems in general, I am not sure that it is invariably simpler and more natural than flux-cutting. All such concepts are spectacles to aid our limited mental vision. I would hesitate to insist that everyone must use a replica of mine.



ONE way of solving the battery problem—but perhaps more suitable for nomadic Arabs than for stay-at-home Britons—is exemplified by this new transistor transmitter, which is powered entirely by sunlight through the medium of selenium cells. Built by Edward Keonjian (General Electric Company of America), it has a range of about 100ft.

# Measurement of Rise-Time

Simple Circuits for Displaying Pulse Characteristics

By E. G. DANN

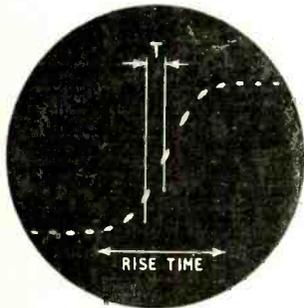


Fig. 1. Time markers derived from the positive half-cycles of a radio-frequency input to the c.r.t. grid.

THE experimenter may on occasions wish to make some observation which is beyond the normal capabilities of his test gear, either as regards the range of measurement or the degree of accuracy available. In these circumstances it is necessary to find some method by which existing equipment may be used to obtain the desired result.

The writer recently needed to make a measurement of the rise-time of the output of a multivibrator, and, while the repetition frequency could be ascertained with a reasonable degree of accuracy, the time-base of the oscilloscope used was insufficiently well calibrated to measure the time of rise of the positive excursion of the square wave.

One well-known method of providing an accurate time scale is to feed a radio frequency to the grid of the cathode-ray tube on which the waveform is displayed. This results in a brightening of the trace over the positive half-cycles of the r.f. wave as shown in Fig. 1. Since the distance between dots corresponds to the periodic time  $T$  of the r.f. wave, a fairly good assessment of the rise-time can be made.

## Sinusoidal R.F. Time-base

A more accurate method of measuring rise-time devised by the writer is one in which the normal time-base of the oscilloscope is replaced by the output of an r.f. generator. Since the leading edge of the waveform under investigation has some pretensions to linearity the resulting pattern is a series of waves with a vertical time axis. Thus, by observation of the number of cycles displayed and from knowledge of

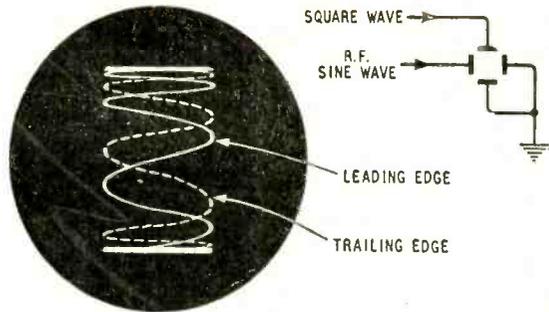
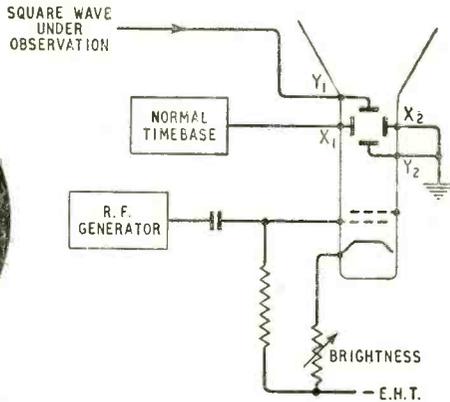


Fig. 2. (Above) Display obtained when a sinusoidal r.f. voltage is applied to the horizontal deflecting plates.



the applied radio frequency, the rise-time may be accurately determined. (See Fig. 2.) For example, if a stationary trace with a convenient number of vertical waves results when the applied frequency is 1.8 Mc/s, the rise time is  $1/1.8N$  microseconds, where  $N$  is the number of whole waves displayed.

Bunching of the cycles at the top of the pattern is an indication of slower rate of rise of the upper portion of the leading edge of the square wave.

A simple pattern of the kind shown in Fig. 2 will result only when there is an integral ratio between the square-wave frequency and the applied radio frequency, as follows from the normal behaviour of Lissajous figures.

The insertion of a filter in the lead to the oscilloscope X plates will improve the purity of the r.f. cycles displayed by elimination of harmonics in the output of the r.f. generator.

Due to the fact that the square wave must necessarily have a negative-going excursion the pattern will ordinarily show a return trace and this will afford observation of the fall-time. If, however, the oscilloscope has provision for blackout of its normal fly-back and remains synchronized with the square wave, the return trace will not normally be displayed.



A PARABOLOID four feet in diameter is mounted on top of this 60-ft mobile extendable mast which the B.B.C. has recently introduced for television outside broadcasts. The aerial, which can be remotely rotated through 360°, can be adjusted to within  $\pm 1^\circ$ . When extended the mast is self supporting but provision is made for stay wires if needed.

# Workshop R-C Bridge

*Incorporating a 1,000-c/s Source and a Protected Sensitive Indicator*

By B. T. GILLING

THE instrument to be described was designed by the writer for quick but searching tests of capacitors and resistors in the workshop. It is actually two test instruments in one, namely a resistance-capacitance bridge and a direct-reading leakage indicator for testing electrolytic capacitors at voltages up to 500. As will become apparent, one of its features is its robustness. Although extremely sensitive the instrument is so designed that there is no possibility of damage by overload, even if it is carelessly used.

The full circuit diagram is shown in Fig. 1 and can be divided into five parts as follows: signal source, bridge, bridge indicator, leakage indicator and power supply. These will be dealt with in turn. It will be seen that only one pair of test terminals is used, the required facility being selected by the three-pole switch, S4.

**Signal Source.**—An alternating-current source is needed, and it is possible to obtain this from a special winding on the mains transformer, but the reactance of capacitors in the picofarad range to 50 c/s is inconveniently large. An R-C oscillator of a very simple design is used in the instrument and the circuit values shown give a frequency of about 1,000 c/s when the voltage at the h.t. decoupling point is 150. The value of the 68-k $\Omega$  decoupling resistor may need modification to obtain this voltage.

The output waveform and amplitude are controlled by the cathode resistor, and some slight adjustment of this may be needed. The output transformer T1 is a small 6:1 intervalve type using the high-inductance winding as primary. Any small transformer of about this ratio is suitable provided that the high-resistance

winding will carry 5 mA. A Wearite transformer Type 262 is actually used and gives an output of 18 volts peak across the 1,000-ohm ratio arms. A transformer T2 of the same type is used at the output of the indicator.

**The Bridge.**—The ratio arms consist of a Colvern 1,000-ohm potentiometer Type CLR 7001/15. The standards are selected by switch S3, their tolerance and the number used is limited only by expense, but the six shown give an adequate coverage. Should a standard other than one of those included be needed at any time it is connected to the "Match" terminals. Cracked-carbon close-tolerance resistors are quite cheap, but really accurate capacitors are, unfortunately, costly. A point to remember when buying them is that a capacitor supplied to a definite value is always expensive, but one close to the desired value and very accurately calibrated is less so. For example, it will be less expensive to accept a capacitor from stock calibrated at, say, 0.0988  $\mu$ F than to insist on one of 0.1  $\mu$ F  $\pm \frac{1}{2}$  per cent. Provided the value is low it can always be made up to the desired value with added capacitance.

The 100-ohm variable resistor in series with the 1- $\mu$ F standard is to enable a sharp balance to be obtained with capacitors having appreciable losses. If desired this control can be calibrated by the experimenter to give an indication of the relative magnitude of the losses.

A decade resistance box must be considered essential for calibrating the ratio arms and the use of one can usually be obtained at a local technical school, or a suitable approach will often get the co-operation of

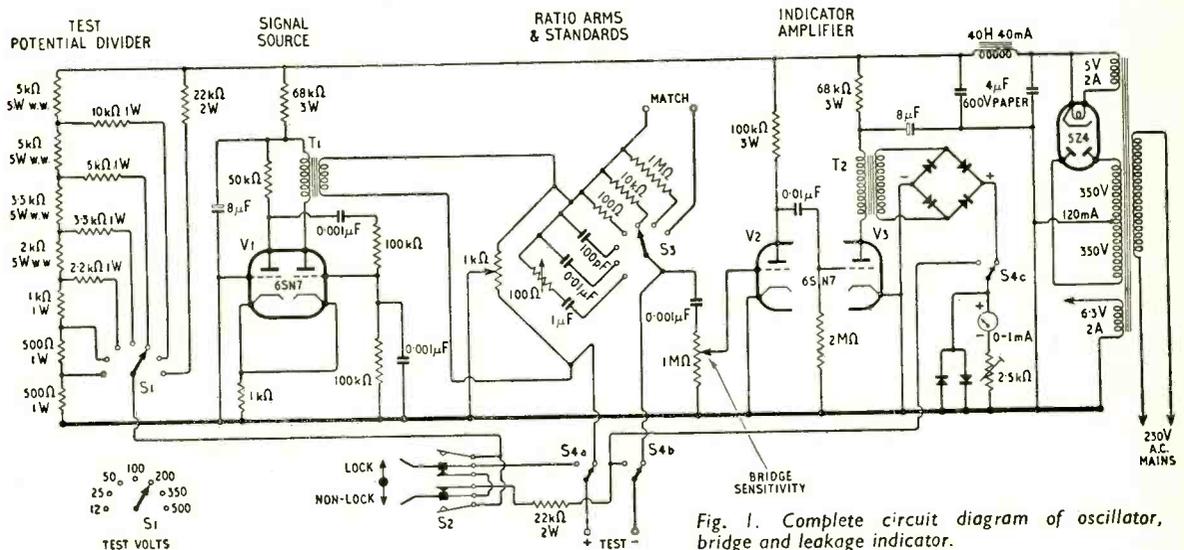


Fig. 1. Complete circuit diagram of oscillator, bridge and leakage indicator.

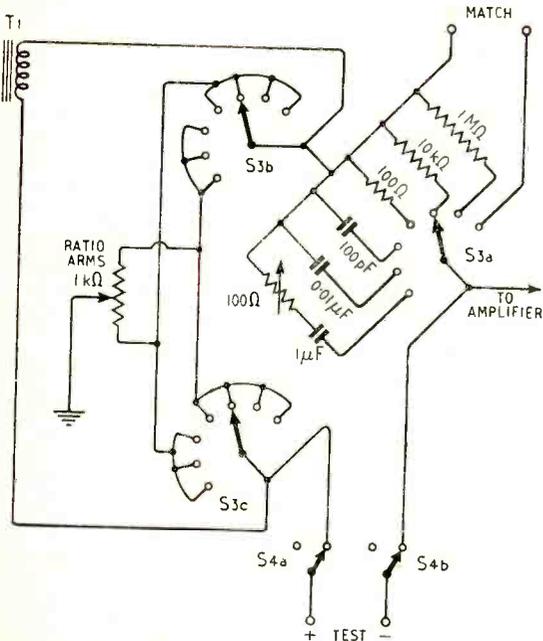


Fig. 2. The addition of two wafers to switch S3 in Fig. 1 permits the use of a single calibration for the ratio-arm scale.

R.E.M.E. or even of a Post Office engineer. At any rate, it is not the insuperable difficulty that it is often made out to be.

The circuit, as set out in Fig. 1, will need two scales on the ratio arms, one the reciprocal of the other, since low resistance and high capacity will be at the same end. Since the resistance element is linear and very evenly wound, the ratio arms can be reversed for capacity measurement and only a single scale will be needed. This is carried into effect as shown in Fig. 2 by using two additional wafers on the standards switch. It is an embellishment well worth incorporating as it simplifies the use of the instrument considerably.

**Indicator.**—The indicator consists of two parts, the amplifier and the meter. The first comprises two valves operated at zero bias. As the ratio arms move away from the null point the signal to V2 increases and when it exceeds a certain amplitude V2 and V3 act as limiters. The output waveform from the limiters is very distorted but this is of no consequence since the important part of the signal is around the point of balance and then its amplitude is too small to overload the valves.

The output from the amplifier is passed through a step-down transformer, of the same type as that used in the oscillator, to a bridge rectifier and thence by switch S4c. to the meter. This meter movement has a full-scale deflection of 1mA and has two half-wave metal rectifiers connected back-to-back across it. These act as a variable shunt. When a low voltage is applied to it a metal rectifier has a fairly high resistance, but as the voltage is increased so the resistance decreases shunting a greater proportion of the current away from the meter. The second rectifier section is to protect the meter from any reverse current which may appear in certain conditions when it is being used as a leakage indicator. The 2,500-ohm variable resistor in series with the

meter is to enable its maximum deflection to be adjusted to full scale when setting up the leakage indicator with 25 mA in the shunted circuit.

The rectifiers are both by Westinghouse, Type 4/1A is used as meter rectifier and Type 2/6A, with its outside ends connected together, as the shunt. Alternatively, rectifiers can be made up from an old copper-oxide unit; the bridge consists of one disc per section and the shunt of six per section with one set reversed. No cooling fins are needed.

Fig. 3 illustrates the action of the limiters and rectifier shunt combined. Balance is assumed at the centre of the ratio arms scale and curve A shows the output with no limiting action when care is taken not to overload the meter. The curve is very open and the null point not at all clearly defined. If the balance is to be made sharper a curve such as B is needed which assumes amplification but no limiting. This gives an excellent indication of balance; but when the arms are away from the null point the meter will be hopelessly overloaded and damage will inevitably result. With the limiters in use curve C is obtained, which has the sharpness of B, but which at no time exceeds the full scale deflection of the meter.

In practice the instrument gives a very sharp balance indeed. With the sensitivity control at maximum, as the ratio arm pointer is swung round the dial the meter remains at nearly its full scale deflection until the point of balance is reached. Then the meter moves from full scale to zero and back to full scale again in a matter of five to ten degrees. The sharpness of balance is maintained on all scales, and at the lower end of the 100-pF one it is easily possible to measure to within 0.5 pF. A point to remember when measuring these low capacities is that the residual capacity of the test leads must first be measured and this figure subtracted from the measured value of the component. On all the scales for ease of searching the sensitivity control needs to be set well back and only increased when a really close balance is required.

The total deflection of the meter in out-of-balance conditions is controlled by the anode voltage of V3,

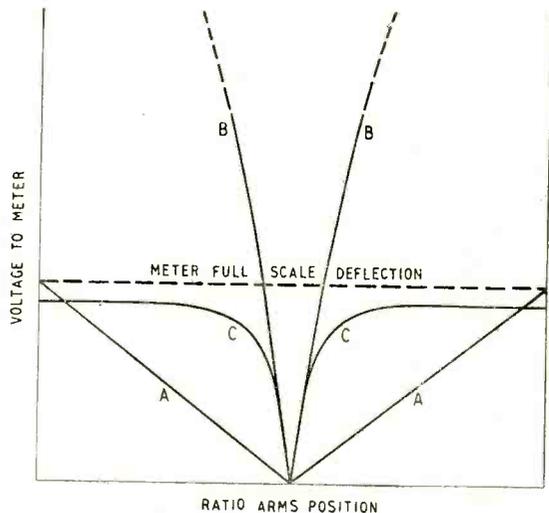


Fig. 3. Indicator response, with meter only (A), with amplification (B), and with amplification and limiting (C).



# "Piped" Scanning Waveforms

Unusual Wired Television System Giving Simpler Receivers

By E. J. GARGINI\*

THE commercial success of sound broadcast relay companies can be attributed to the simplicity, and hence low initial and maintenance costs, of the terminal equipment. The design of television distribution equipment to the same order of simplicity is clearly desirable so long as the sending equipment and network costs do not become limiting factors. The system described here is based on the principle that terminal equipment should not include circuitry which may be transferred to the sending end, although at the same time this transference should be halted when it comes to power distribution.

Fig. 1 is a circuit of a vision terminal unit which embodies this principle. Two r.f. signals are transmitted over the input cable together with sound signals at service level. A choke assembly separates the sound signals (in a separate control unit) which are then applied to the loudspeakers. The higher frequency r.f. signal is a 5.42-Mc/s carrier wave modulated with picture information only. A vestigial sideband transmission is used, the upper sidebands

being suppressed at the sending end. The lower frequency signal is a 1-Mc/s modulated carrier wave, and this effects the double-sideband transmission of a modulated waveform which includes line and frame scanning signals.<sup>1,2</sup>

By passing the demodulated scanning waveform through a low-pass filter a frame scanning waveform is developed, and by passing the demodulated waveform through a high-pass filter a line scanning waveform is obtained. Input filters at the terminal unit separate the two vision signals. The video carrier modulated signal is amplified in the N309 and then applied via a low-impedance coupling circuit (L<sub>1</sub> and L<sub>2</sub>) to the grid of the c.r. tube. Adjustment of the tube bias to the condition that anode current only flows during positive-going carrier pulses results in the display of monochrome pictures at a dot spacing,

\* Electric and Musical Industries. This article is based on a lecture which the author gave recently to the Television Society.

<sup>1</sup> British Patent 704141.

<sup>2</sup> British Patent Application No. 1658/53.

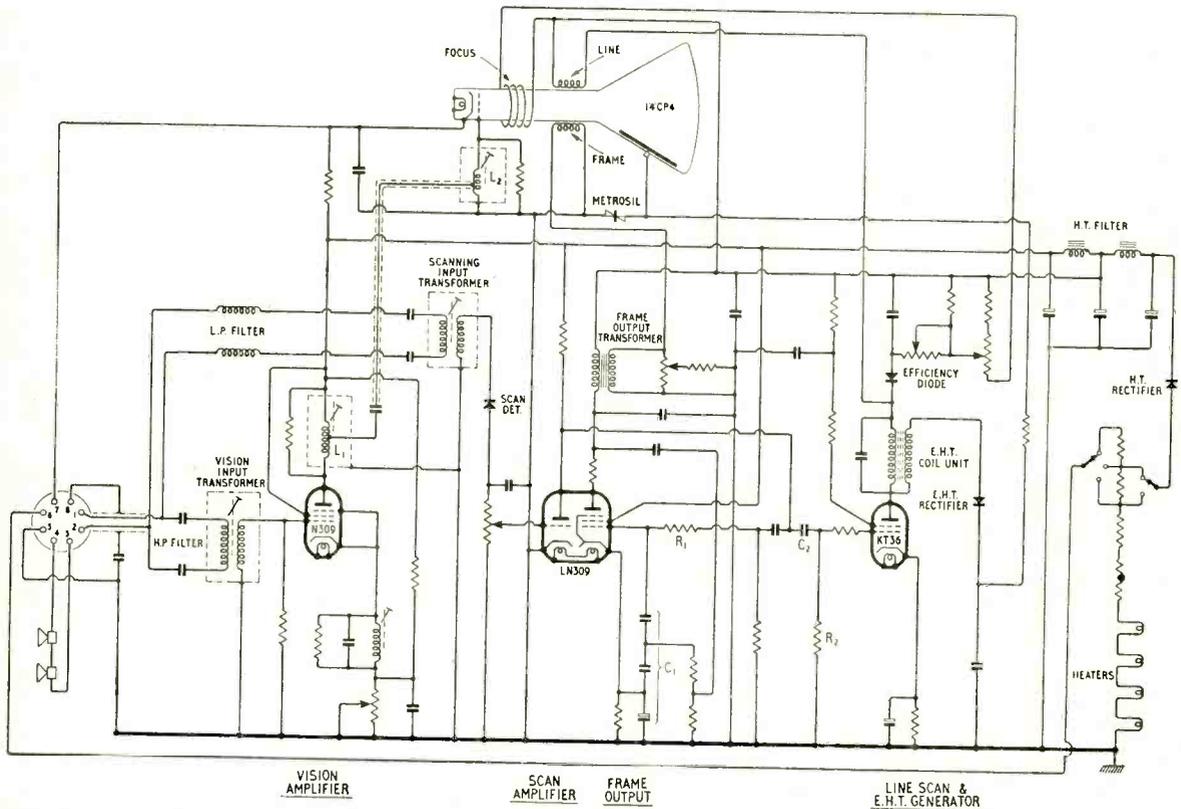


Fig. 1. Circuit of 3-valve subscriber's receiver. The eight contacts of the input plug on the left carry the following: 1 and 2, vision and scanning signals on carriers; 3 and 4, sound at speech-coil level; 5 and 6, mains supply; 7, brightness control voltage; 8, earth connection.

that is, the line is broken up into dots which correspond to the 5.42-Mc/s carrier waves. This tends to render the line structure less prominent.

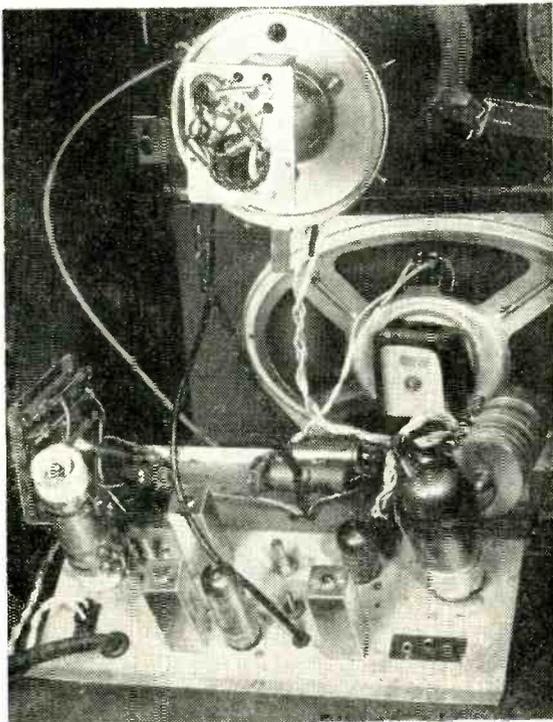
The scanning signals, after rectification at a XT1 crystal diode and amplification by the triode section of the LN309, are applied to the network  $R_1$  and  $C_1$ . The composite signal is integrated by this RC filter and the resulting frame sawtooth is applied to the pentode frame output stage. The composite scanning signal is differentiated by the high-pass filter  $C_2 R_2$  which results in the production of a line-scanning sawtooth waveform. This is applied to the KT36 line output valve.

This output valve has in its anode circuit directly coupled scanning coils which are shunted by an efficiency diode circuit comprising a diode in series with a resistor shunted by a capacitor. The operation of this circuit is conventional. The diode circuit rectifies the negative overshoot which appears at the valve anode at the termination of the long flank of the sawtooth grid potential. The resulting current produces the first part of the line scanning signal through the coils. The initial positive rise of potential is applied to a section of a low-pass filter which, after rectification, provides e.h.t. for the c.r. tube.

### Simple Adjustment

It will be noted that if the unit is constructed for a.c./d.c. mains operation and capacitance-coupled high-impedance frame coils are used, no iron-cored transformers are necessary. Moreover, no synchronizing controls are necessary and the subscriber only has to adjust the focus, contrast and brightness. As the d.c. level is fully maintained and zero carrier can

*Rear view of 14-in cabinet-model subscriber's receiver, showing the 3-valve chassis of which the circuit is given in Fig. 1.*



represent black level, the separate brightness control may in certain circumstances be dispensed with.

This simplification has not been obtained without some complication of the sending and network equipment. Fig. 3 is a block diagram of the main waveform generator at the sending end. Fig. 2 (a) illustrates the envelope shape of the carrier wave when the carrier has been modulated by the frame scanning signals of the composite waveform. They are generally of a pulse-like character with interruptions between the pulses, which reduces the envelope amplitude to about 15% of the peak amplitude of the frame scanning signal. These interruptions correspond to the frame return intervals.

The line scanning signals are shown in Fig. 2 (b). These are of constant amplitude and of a sawtooth character. They comprise a linearly rising portion giving way to a ripple of between 50 and 60 kc/s. Interruptions in the waveform correspond to the line return intervals. When the line and frame signals are combined the line frequency components occurring during the frame flyback period are considerably reduced in amplitude. During the curved portion of the frame waveform the line scanning signals modulate the carrier wave to 90% at the beginning of the portion and to 60% at the end.

In Fig. 3 the input signal is the complete video signal obtained from a receiver at the sending installation. A circuit suppresses the video signals, leaving the sync pulses, which are fed in parallel and with negative polarity to two groups of circuits, one for line waveforms (above) and the other for frame waveforms (below). In the line waveform channel pulses are fed to a valve through a differentiating circuit which produces alternative negative and positive spikes at the beginning and end of the sync pulses. The positive spikes are removed by grid current in the valve, leaving only the negative spikes. The positive spikes produced at the anode of this valve are applied to a delay line with a delay of 90  $\mu$ sec.

Each positive spike at the anode of the valve is followed 90  $\mu$ sec later by a spike of negative polarity. The resultant output waveform at the anode of the valve is applied to the grid of another valve, which removes the positive spikes by grid current limitation and amplifies the negative spikes to produce a positive spike output, 90  $\mu$ sec delayed with respect to the sync pulses received from the vision suppressor. The effect is that the spikes produced are 10  $\mu$ sec in advance of the received pulses. This advance is provided because the video signals are relayed as modulation of a carrier wave of higher frequency than the scanning waveform signal carrier. Consequently the scanning signals are liable to be delayed in the transmission system to a greater extent than the video signals. There may also be relative delays in filter circuits at the terminal unit.

The 10- $\mu$ sec advance represents the greatest relative delay likely to be encountered. The advanced pulses are next fed to a phase discriminating circuit included in a flywheel sync circuit which also includes a cathode-coupled sine-wave oscillator. The voltage output of the discriminator circuit controls a reactance valve and thereby the frequency of the oscillator in such a manner as to obtain accurate frequency tracking between the oscillator and the line frequency of the television programme.

Negative pulses set up at the anode of the oscillator valve are applied to a differentiating circuit. The differentiated output of negative and positive spikes

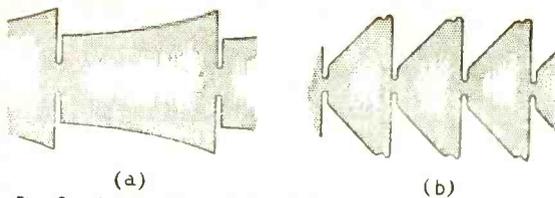
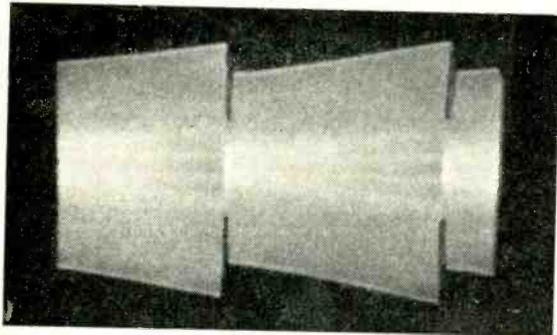


Fig. 2. (a) Envelope shape of the frame scanning signal modulated on its carrier wave, (b) envelope of the line scanning signal on its carrier.



Composite scanning waveform from the sending generator, produced by combining the line and frame waveforms in Fig. 2.

are applied to the grid of a valve forming part of a sawtooth waveform generator. This valve is normally biased off except on the occurrence of positive spikes at its grid. These positive spikes discharge a capacitor in the circuit and generate the short flank of a sawtooth waveform. During conduction of the valve an anode-cathode potential drop produces one of the interruptions in the line scanning signals (Fig. 2 (b)).

The waveform at the anode of the sawtooth oscillator is applied to a shaping circuit which has the effect of providing a relatively sharp transition from the interruption to the linear part. The waveform is then fed through two cathode follower amplifier stages. The output from the first of these is adjustable so that the amplitude of the line scanning signal may be adjusted without introducing waveform distortion. The second cathode follower stage acts as a line and frame combining stage.

### Frame Waveform Generator

Returning now to the vision suppressor, the complete sync pulse train from this circuit is also applied to the first valve in the frame waveform section. This has a delay line in its anode circuit which causes the valve to function as a frame pulse separator. The broad pulses which constitute the frame pulse in the broadcast waveform have superimposed on them reflected pulses from the delay line, but the narrow line sync pulses have not. The output from the first stage is fed to a limiter valve which conducts

only in response to the superimposed pulses. Anode current, therefore, only flows when the frame sync pulse occurs.

The output signal from the limiter is applied to a differentiating circuit and the differentiated pulse is used to fire a blocking oscillator valve. This discharges a capacitor which is charged through a resistor during the interval when the valve is blocked. The capacitor is connected in series with a variable resistor which produces the interruption in the frame scanning signals of Fig. 2 (a). The waveform set up at the anode of the blocking oscillator valve is linearized in a shaping circuit and is finally applied to two cathode follower stages. A common cathode resistor functions as a combining resistor for the cathode follower output stages of the line and frame sections.

A low pass filter connected between the line output stage and the modulator input cuts off in the region of 300 kc/s, and its function is to prevent high harmonics of the line scanning signals from beating with the scanning carrier. A low pass filter following the frame output stage cuts off in the region of 3 kc/s and prevents line signals from passing into the frame circuits.

The combined line and frame scanning signals are now fed to the cathode of an amplifier valve. The output from this stage is connected to the suppressor of a modulator valve which has a carrier oscillation at 984.7 kc/s applied to its grid. This is derived from a conventional crystal oscillator. The scanning signals fed to the suppressor of the modulator valve are of such an amplitude that the anode current is cut off during the interruption in the frame scanning signal. In this way the line scanning signals are suppressed during the flyback time.

The output of modulated carrier frequency signals from the modulator valve is fed by a transformer to an r.f. amplifier stage. The output signal is developed across a tuned circuit which forms part of a wide band filter network. A fraction of this output is taken from a tapping point of the circuit and is applied by a capacitor and inductance to the input of a cathode follower and to a diode. These circuits constitute a  $\pi$ -type filter whose output is rectified by the diode. The load circuit of this diode comprises a low pass filter, the output of which is fed to the control grid of the modulator input valve. The signals fed to this valve are modulation frequency components which provide negative feedback, thereby linearizing the modulation process.

A low pass filter prevents feedback of carrier frequency signals and its pass band is approximately that of the modulation frequency band. The filter begins to attenuate at about 50 kc/s, and the reduction of negative feedback at these frequencies gives pre-

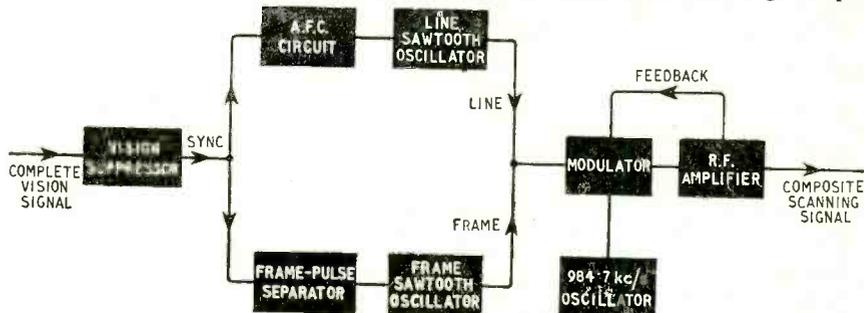
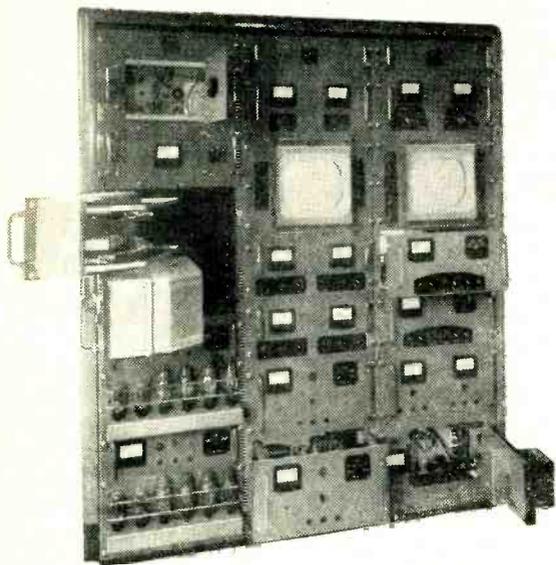


Fig. 3. Simplified block schematic of the waveform generator at the sending installation.



Racks of equipment at the sending installation.

emphasis of the higher frequency components of the line scanning signals. This produces the ripple shown in Fig. 2 (b). A series capacitor reduces the feedback at low frequencies and produces the upward curvature of part of the frame scanning signal in Fig. 2 (a).

The pre-emphasis in the wave shape Fig. 2 (a) of the frame waveform serves to correct for the finite inductance of the practical transformer in the receiver circuit, Fig. 1. The ripple in the line scanning waveform Fig. 2 (b) serves two purposes. It enables more effective use to be made of the scanning carrier and sharpens the cut-off of the KT36 in Fig. 1 produced by the waveform interruption. A sharp cut-off is required to permit the production of high e.h.t.

The ripple in the waveform does not produce "banding" in the picture since it exists only at a time when the KT36 is taking grid current. By virtue of the filters  $R_1C_1$  and  $R_2C_2$  in Fig. 1 the whole of the scanning signal waveform is integrated in the capacitor  $C_1$  (the effective capacitance of all the capacitors in the grid circuit to earth), the line signals having negligible effect on the voltage across it.

The scanning signals from the waveform generator are amplified to a 9-watt level and applied to a low pass filter. Vision signals after demodulation are re-modulated on to a 5.42-Mc/s carrier wave; these signals need contain no sync pulses. They are also amplified to a 9-watt level and are fed through a combining filter network which includes a section to which the scanning signals are applied. The composite signal is then combined with sound signals at service level and applied to the line.

### Safety Devices

Under fault conditions or at the end of a broadcast a d.c. potential is transmitted from the sending equipment to take out of circuit all repeaters and any subscribers' equipments which may have been left switched on. At the subscriber's premises it operates a small relay in the control box. Another safety device is a resistor connected between the grid of the receiver c.r. tube and true earth which serves to inject a con-

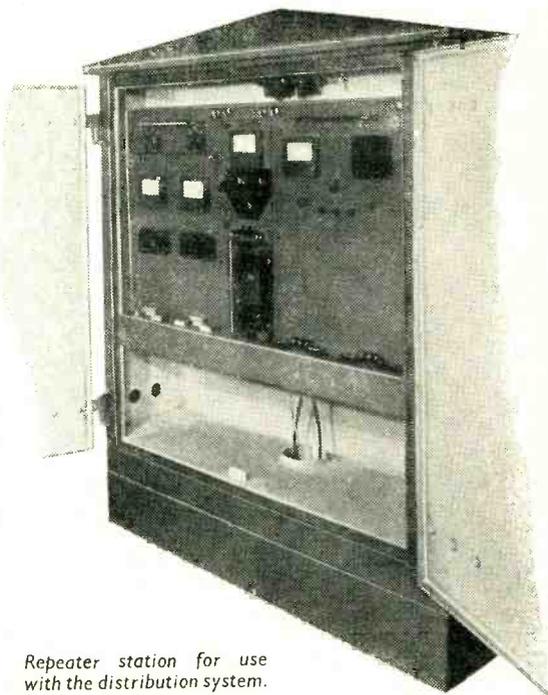
siderable hum into the picture if the subscriber has inserted his mains plug so that the chassis is connected to the live conductor instead of to neutral.

The receiver in Fig. 1 requires at least a 100-mV vision signal and a 200-mV scanning signal. As the sending equipment produces a 30-volt vision signal the total insertion loss must not exceed 50 db. The total effective attenuation of an equalized network using 22 s.w.g. cable is approximately 4 db per 100 yards, which may be taken to include the insertion loss of other subscribers. In the spur cable to the subscriber's down lead transformer, 14 db is the minimum attenuation that can be tolerated without producing a noticeable mismatch. The balance of 36 db may be shared between the transfer loss of the main feeder to spur transformer and the effective cable attenuation. Assuming a transformer loss of 16 db, the remaining 20 db may be accepted as the cable attenuation of a 500-yard cable run and at least six repeaters would be necessary to cover a square mile area.

If the terminal unit sensitivity was 10 mV (on vision) the planning loss would be 70 db and the cable run could be extended to 1,000 yards. At least two repeaters would be required to cover a square mile area. The purpose of this calculation is to show that there must be a cost compromise between terminal unit simplification and the number of repeaters required in a given area.

### Higher Sensitivity Receivers

The position is further complicated by the fact that if the number of subscribers is low the cost of the repeaters becomes the limiting factor. One solution is to adopt the 70 db planning figure, which entails the use of receivers with 10-mV sensitivity over part of the area, and then use low-sensitivity receivers in



Repeater station for use with the distribution system.

the area close to the repeating equipment. A 5-valve receiver was used in North London in a field test of the system and this had a maximum sensitivity of 5 mV at vision frequencies. A receiver of this sensitivity was chosen because it was most likely to indicate the degree of interference from all sources.

The equipment field tested was primarily designed for single-channel operation. A number of proposals have been made for multi-channel operation. The latest high-grade cables have a cross-talk factor of the order of 50 db at 5.42 Mc/s at the end of a 1,000-yard run and are very similar to existing cables, although manufacturing tolerances have been reduced. A modification of the present system for multi-channel operation uses cables of this type. It employs quadrature transmission of vision and scanning signals in

such a way that the resulting cross modulation takes the form of an interfering phase modulation of the desired signal. The effect of this phase modulation is negligible.<sup>3</sup>

All network transformers and equalizers in the system described cover a band between 0.7 Mc/s and 6.5 Mc/s. It is possible that the vacant band between 1.2 Mc/s, the top end of the scanning signal spectrum, and 2.7 Mc/s, the lower end of the vision signal spectrum, could be used later for colour television.

Finally, I wish to thank the engineers of E.M.I. and B.R.S. whose co-operation has made possible the practical investigation of this type of wired television distribution system.

<sup>3</sup> British Patent Application No. 14511/54.

## Lacquer Film Capacitors

### *Development of Sub-Miniature Units for Use with Transistors*

EXTREME miniaturization of capacitors for low-voltage operation for use in equipment employing transistors depends to a large extent on the ability to produce very thin dielectric films which are strong enough to withstand the various processes involved in the manufacture of capacitors.

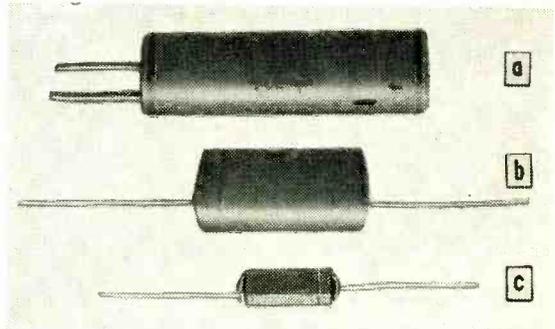
Ceramics of very high dielectric constants, say of several thousand, offer only a partial solution since there are practical limitations to the extent to which such materials can be reduced in thickness and still be usable in capacitors. Generally speaking the upper capacitance limit is about 0.01  $\mu$ F for this type of capacitor, so where larger capacitances are required the wound type, typified by the rolled-paper and metal-foil pattern, offers many advantages.

Recently some work has been done in the Bell Telephone Laboratories in America on the production of extremely thin lacquer films suitable for use in the manufacture of the wound type of capacitor. A paper published in the December, 1954, *Proc.I.R.E.* under the title "Miniature Lacquer Film Capacitors" gives some interesting details of the method employed and of the characteristics of the sub-miniature low-voltage capacitors developed by this means.

The lacquer films are normally too fragile to be self-supporting and to withstand the metallizing, trimming and other processes entailed in the manufacture of the capacitors. The film is therefore formed on a supporting base, or carrier, and remains so supported right up to the final winding process.

The carrier, for which ordinary capacitor paper tissue may be used, is first coated with a "parting layer," the purpose of which is to enable the processed lacquer film to be separated easily from the carrier when the time arrives. If a carrier were used from which the film would naturally strip easily then there would be no need for a "parting layer." When employed, the "parting layer" must consist of a material which is not attacked appreciably by the solvent of the lacquer, or by the lacquer itself.

After depositing the lacquer film on the prepared carrier, it is metallized and the strip is trimmed and cut to the width required. During the final winding process the processed film is separated from the carrier by winding the film on to the capacitor mandrel



Steps in the miniaturization of capacitors. All units are 2  $\mu$ F and (a) is paper and metal foil construction, (b) is metallized paper and (c) is the new metallized lacquer film type. The largest capacitor is  $2\frac{1}{2}$  in long.

and the carrier on to another mandrel of the same winding machine.

Assuming a lacquer film 0.1 mil (one ten-thousandth of an inch) thick is used, it is said to be possible to produce a metallized lacquer film capacitor for low-voltage operation which is only 1/6 to 1/7 the size of the smallest metallized-paper type of the same capacitance.

The illustration, taken from *Proc.I.R.E.*, shows some recent advances in miniaturization of capacitors. All units are of 2  $\mu$ F capacitance and (a) is an early style made from two layers of 0.3-mil paper and aluminium foil, (b) is a 0.3-mil metallized paper capacitor and (c) is the 0.1-mil metallized lacquer-film type described here.

Tests over a period of some 2,000 hours are said to show satisfactory stability for this style of construction, while during the tests a counter circuit detected only a small number of punctures, which, incidentally, are self-sealing as with the metallized-paper type of capacitors. This was with a test voltage of 120 V d.c.; with 80 V d.c. all dielectric break-downs were eliminated so that 50 V d.c. would be a conservative rating for this type of capacitor. It will satisfy all or most present requirements of transistor circuitry.

# RECORDING TOPICS

## Some Factors Influencing the Quality of L.P. Discs

By O. J. RUSSELL, B.Sc., A.Inst.P.

FROM correspondence arising out of my recent comments on recording matters<sup>1</sup>, several interesting points have arisen. Accordingly something of a rider to the previous article appears in order, particularly as interesting information has been supplied by a professional recording engineer, who wishes to remain anonymous.

The first happening of interest is that many firms are adopting a standard playback characteristic. This characteristic, which is not very different from the old A.E.S. playback curve previously given, will be variously known as the "new" A.E.S. curve, the NARTB curve and the R.C.A. "Orthophonic" curve. The playback characteristic is shown in Fig. 1(a), and it is very similar to the "old" A.E.S. curve. Suitable compensating circuits are given in Figs. 1(b) and (c).

This is a valuable measure of standardization, although not as complete as some might wish. Briefly the curve will apply for all American l.p. and "s.p." (78 r.p.m.) recordings, but the EMI group and the Decca group it is understood will continue to use their present characteristics for 78-r.p.m. recordings while using the new playback curve as a basis for l.p. record-

ings. No agreed "zero hour" exists for this change-over, and in fact some firms made the change in December, 1954; during 1955 most of the others will have followed suit. As the new playback characteristic (like the earlier A.E.S. curve) is virtually a "universal" curve, it does in fact compensate satisfactorily for almost all l.p. characteristics previously employed, and also for 78-r.p.m. records employing "top boost," with the possible exception of the Decca "ffrr" 78-r.p.m. characteristic. Thus a single fixed equalizer can be employed in the U.S.A., and with an adjustable tone control would suffice for British records with the exception of some pre-war recordings. However, many virtuoso pre-war recordings have been re-issued in l.p. form, and the recent drastic removal of many noteworthy pre-war recordings from the 78-r.p.m. lists may be an indication that these may be dubbed on to l.p. discs.

Considerable numbers of pre-war recordings have already been dubbed on to l.p. records. The frequent observation that the l.p. dubbing supplies superior quality to the original pressings has been explained by my professional informant. The l.p. discs are frequently made by playing back the actual 78-r.p.m. metallic positives ("mothers") when resurrecting pre-war and pre-tape recordings. Some imperfections of early types of cutting heads may be electrically compensated in the process, and the final l.p. pressing, due to improvements in techniques, may frequently be of superior quality to the original 78-r.p.m. pressings. The very low compliance of the metallic "mothers" increases the frequency of the upper pickup resonance, so that there is presumably less difficulty in extracting high frequencies from the "mother" during the dubbing process. Incidentally, experiments in dubbing from early acoustic "mothers" has shown that frequencies thought to be above the top frequency limit of the acoustic recorders can be recovered. Dubbing has clearly advanced from the days when

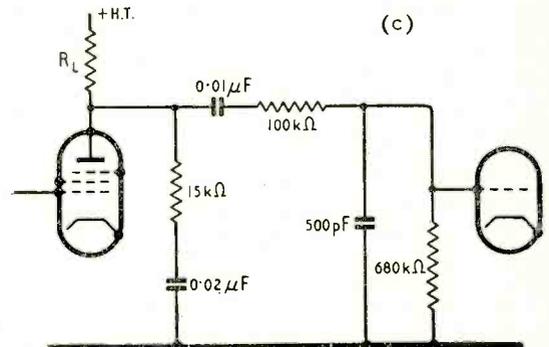
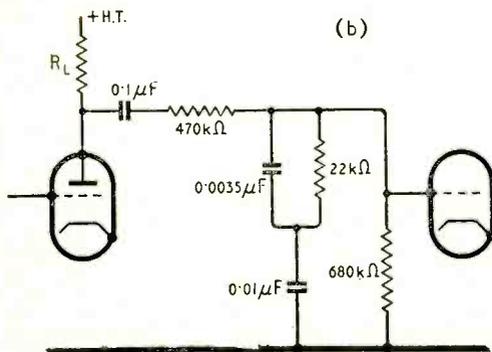
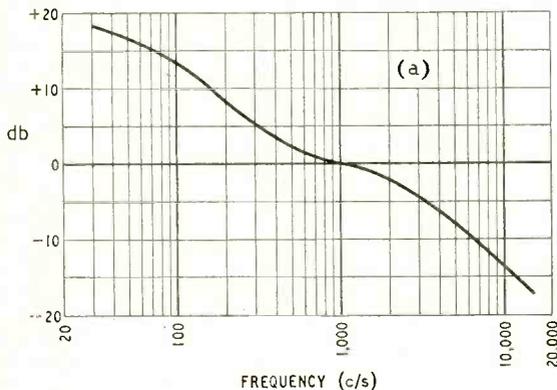


Fig. 1(a) New playback characteristic for long-playing records, with appropriate filter couplings to follow (b) a triode and (c) a pentode.

wax cylinders were duplicated by a pantograph process, although the process described above is basically a mechanical pantograph process electronically refined!

Incidentally, in the past "masters" were burnished, and it has been stated that this burnishing or "polishing" process, while only slightly increasing harmonic distortion, may greatly increase intermodulation distortion.<sup>2</sup> Considerable success in the restoration of early recordings has been obtained when unpolished masters are available.

In view of the many complex processes intervening between the original tape recording and the finished pressing, it is something of a miracle that modern recordings are generally of such superlative quality. Music in particular is a singularly difficult commodity to "can" to the satisfaction of musicians, technicians and critics simultaneously. The added difficulties of l.p. microgroove techniques have in fact resulted in considerable numbers of recordings suffering from technical blemishes. As might be expected the closer groove spacing renders l.p. discs particularly vulnerable to "pre-echo" due to heavy groove modulation distorting the adjoining outer groove, and thus producing the effect of a "pre-echo" as a faint impression of the sound is heard when the stylus traverses the distorted groove preceding the heavily modulated groove. The longer time delay between grooves due to the slower rotation of l.p. records gives the "pre-echo" a better chance of being heard, as it may coincide with a quiet passage prior to a violent crescendo.

## Tape Joins

The impact of technical factors at every point in the overall recording process upon musical quality does not appear to be appreciated in some quarters. However, many technical blemishes in records appear to be directly attributable to the master tape. Tape joins are a particular *bête noire* of the reviewers. Briefly, they account for abrupt changes in quality, noise level, volume and pitch. While tape is a very suitable medium for long continuous recording, it should be noted that for the master tapes a speed of 30 inches per second is used. Thus a 3,600-ft spool lasts just over twenty minutes, and consequently tape joins are frequently inevitable in practice. Abrupt changes are frequently noticeable at tape joins in the finished l.p. discs. An even more horrifying possibility is the allegation that repeats in classical works are sometimes faked by merely playing the tape through again.<sup>3</sup>

Even harsher accusations against recording practices have been made<sup>4</sup>, and it is certainly true that the control engineers play a very important role in the recording process. A simplified diagram of the overall process from studio to the lacquer "cut" is shown in Fig. 2. The acoustic properties of the studio may be adjusted by the use of screens and absorbers, a process in which the recording artists may be expected to have very definite ideas. Pick-up of sound and balancing of orchestral sections may be by the use of several microphones, three to twelve being quite usual. One American recording concern, however, uses only a single microphone for many of its classical recordings. The microphone inputs are individually equalized, mixed and passed through a variable equalizer into a tape recording and playback unit. The microphone outputs are mixed and the variable equalizer adjusted by the engineer until the replay

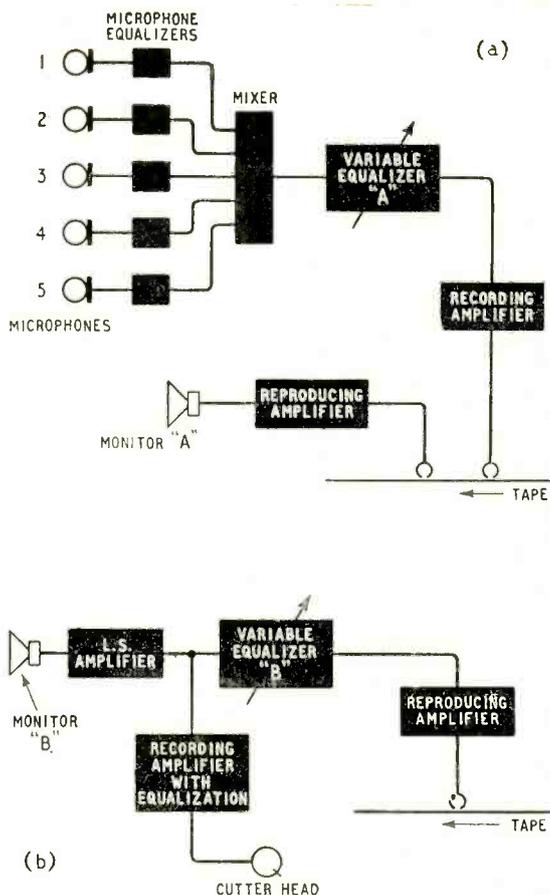


Fig. 2 Stages in the production of a lacquer "cut"; (a) recording the tape master, (b) transcribing from tape to disc.

speaker "A" gives the desired balance in its own particular acoustic environment. While the environment will usually be a familiar one, it may well be a totally unfamiliar one such as the ante-room of a foreign concert hall or theatre.

The lacquer "cut" is made by playing back the edited tape recording, and generally a different machine and a different monitor speaker "B" in a different acoustic environment will be used. A playback equalizer is used, and generally a disc is cut without need for adjustment of the playback equalizer, although tapes from machines of different characteristics may require equalizing adjustments. When a satisfactory playback is achieved, the lacquer disc is cut via a recording amplifier also incorporating an equalizer. Unfortunately, this equalizer cannot be designated as a "black box" imposing the "recording characteristic," tempting as such a description would be.

## Indeterminate Variables

It is clear that so many variables are present, including those variables of the "personal equation" type, that it is pointless to argue over a decibel or two at the extremes of the audio spectrum. This is quite apart from such technical variables as high-frequency playback loss which also enter the picture. Moreover, with the additional technical processes in-

volved in producing the finished pressings, it is clear that perfection in recordings is not easily achieved. Contemplating the overall system from recording studio to the home listener's loudspeaker it is frustrating that overall negative feedback cannot be applied. At present negative feedback is only applied in the broadest cybernetic sense through the activities of critics and the purchasing preferences of the public and the depth of their pockets.

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<sup>3</sup> WARRACK, J., "Chamber Music for All." *Daily Telegraph*, November 8, 1954.

<sup>4</sup> Editorial, *The Gramophone*, October, 1954.

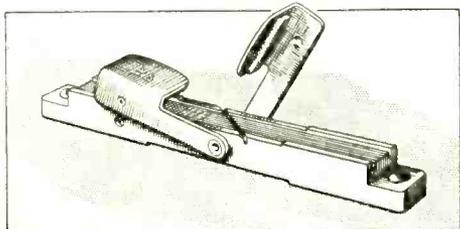
## Recording Tape Splicer

IN theory it is a simple matter to join broken magnetic recording tape, using a pair of scissors or a razor blade and a bit of sticky tape. Those who have tried it will know that in practice it can be very fraying to the temper, and that it is by no means easy to align the ends properly or to produce a joint that will not subsequently hold up in the guides.

The "Bib" tape splicer produced by Multicore Solders, Ltd., Hemel Hempstead, Herts, and used in conjunction with Scotch Boy No. 41 "non-oozing" adhesive tape, produces a perfect joint with the minimum of effort.

The body of the splicer is a brass block grooved to a clearance fit for standard  $\frac{1}{4}$ -inch tape, with cork pressure pads on hinged arms located to hold the ends firmly in line. A transverse slot at an angle of about  $60^\circ$  is provided to guide the cutter when making the scarfed joint, and parallel slots at the edges of the tape guide ensure that the joint is reduced slightly in width when trimmed—actually by the thickness of the razor blade if it is held vertical. Although not mentioned in the instructions, we found that it was important to make the direction of each trimming cut towards the tapering point on each side, otherwise there was a tendency to pull the extreme point out of the joint slightly. With this precaution a perfect splice was obtained every time.

The retail price of the "Bib" splicer is 18s 6d. It is supplied on a flock-sprayed wooden base, but can be removed from this and attached directly to the recorder deck by two screws, if desired. The instruction leaflet contains useful general hints on tape editing.

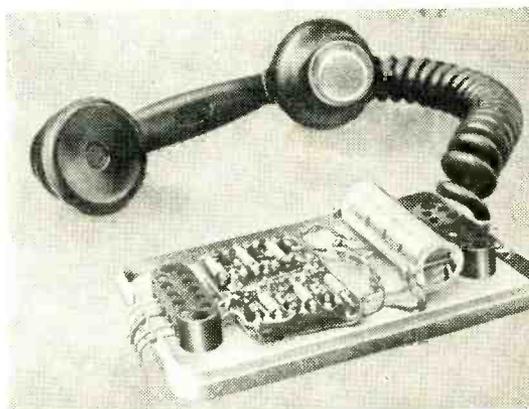


"Bib" splicer for use with  $\frac{1}{4}$ -in standard magnetic recording tape.

## Transistorized Telephone

SHOWN in the illustration is a telephone handset fitted with a microphone designed for use in very noisy locations. It responds only to sounds originating close to the mouthpiece; in consequence, the output is much too low for its use in ordinary telephone systems without pre-amplification.

An amplifier designed around Mullard junction transistors is shown. It comprises two stages for bringing the output of the microphone up to the normal level and a third to give further amplification where a high noise



Noise-cancelling telephone and transistor amplifier.

level prevails at both ends of the line. The amplifiers are operated from hearing-aid type batteries in the plastic tube on the right of the unit.

As transistor equipment can, where necessary, be made very small the amplifier could be incorporated in the handset itself and powered by the low-voltage supply of the normal telephone system.

## Commercial Literature

**Band III Television Converter** with station selector switch, on/off mains switch (which also controls the main receiver) and Band-III station tuning control. May be operated with either a.c. or a.c./d.c. receiver and power consumption is 10 watts. Also a **Television Pre-amplifier**, a **Distribution Unit**, and a **Multi-outlet Box**. Leaflets from Aerialite, Castle Works, Stalybridge, Cheshire.

**Oxidation Insulation** for closely spaced wire-wound resistors. A new process giving a coating of good insulating properties to the nickel-chromium-iron alloy "Brightway B," described in a leaflet from Henry Wiggin & Company, Wiggin Street, Birmingham, 16.

**Capacitance Meter** with range of 0-250pF and facilities for measuring stray capacitances *in situ*. Frequency modulation of a transistor oscillator is changed by capacitance to be measured and the change is detected by a linear discriminator. Also an **A.C. Voltage Regulator**, an **Oscilloscope Camera**, a **Cathode Follower Unit** and various **Pressure Transducers**. Leaflets from J. Langham Thompson, Bushey Heath, Herts.

**Arc Soldering Iron** with one electrode formed by hollow carbon bit and the other by resin-cored solder fed through the centre of it. Contact with work completes the circuit, forms an arc and melts the solder. Current supplied from 4-V or 6-V battery or transformer. Description on a leaflet from C. J. Casey (London), 49, St. James's Street, London, S.W.1.

**Test Gear and Electronic Instruments**. Services offered by Livingston Laboratories as agents for a large number of different makes are explained in a booklet "What We Can Do For You." From Livingston Laboratories, Retcar Street, London, N.19.

# Gramophone and Microphone Pre-Amplifier

(Concluded from page 14 of January, 1955, issue)

## Constructional Recommendations: Test Procedure

By P. J. BAXANDALL, B.Sc.(Eng.)

**I**N building the pre-amplifier, there are several practical matters which must receive attention if first-class results are to be obtained.

To keep the hum level in the input stages as low as possible, the following recommendations should be adopted:—

(a) The wiring, particularly that associated with the grid and cathode circuits, should be arranged so as to avoid forming loops of large area, since hum voltages of appreciable magnitude can be induced in such loops by stray 50-c/s magnetic fields from nearby mains transformers, etc. A good layout for the microphone and mixer stages is shown in Fig. 8.

(b) The valveholders for the EF86's should be made of high-grade dielectric material, ordinary Bakelite being liable to introduce appreciable coupling between heater and grid pins; the holders made by Ediswan-Clix in p.t.f.e. are suitable. (The advent of all-glass valves such as the EF86, with the grid pin diametrically opposite the heater pins and with internal shielding between them, together with special valveholders, has made it possible to obtain extremely low hum levels even when the grid-circuit impedance is high, so that the advice given by the author in an earlier article,<sup>11</sup> always to use top-grid valves for such applications, may now be regarded as out of date.)

(c) Heater wiring should be twisted and the chassis

should not be used as a return lead for heater current. Stray capacitance between the heater leads and grid circuit wiring should be kept as small as possible, a good arrangement being to run the heater supply along the top of the chassis, taking each heater feed down through a hole in the chassis near the valveholder but diametrically opposite the grid pin.

(d) A common heater supply may be used for all

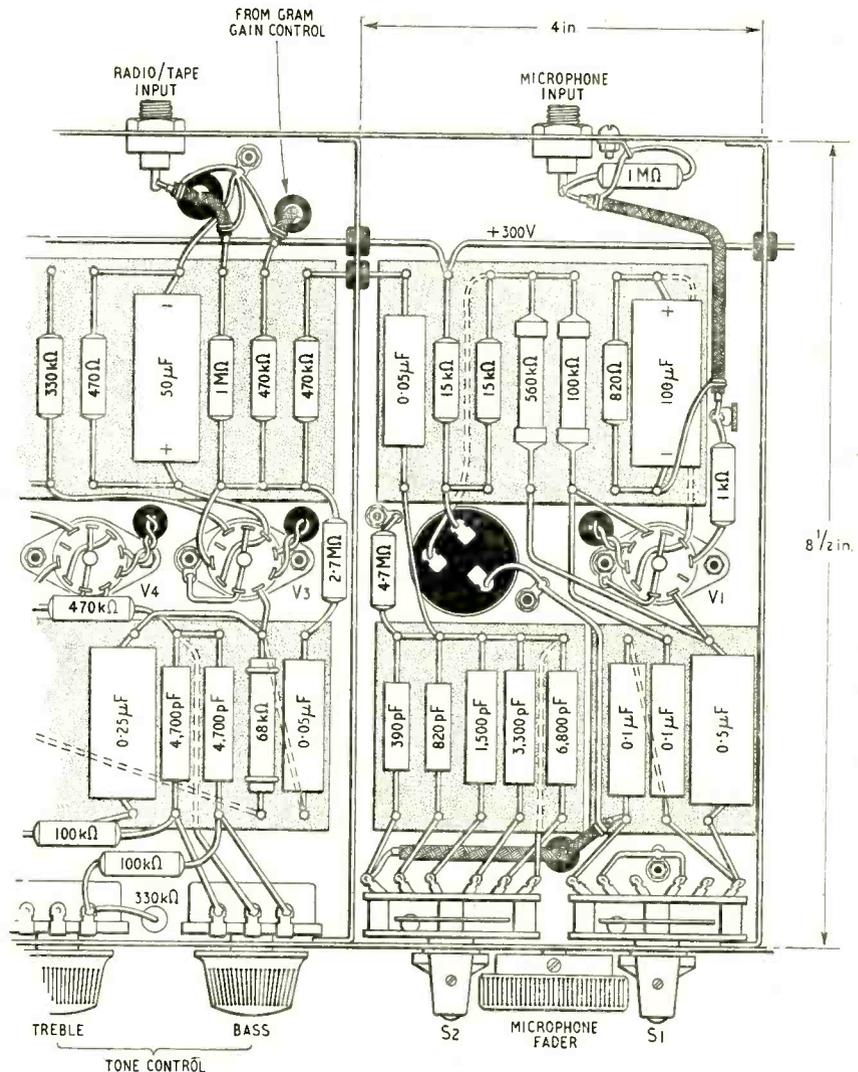


Fig. 8. Underside view of part of the chassis, showing a suitable layout for the microphone and mixer stages.

valves, and should have either a fixed centre-tap, connected to chassis, or, alternatively, a "hum-dinger" potentiometer, of value about  $100\Omega$ , whose slider is connected to chassis. A fixed centre-tap should be quite satisfactory if all other precautions have been taken, but a potentiometer has the advantage of enabling the hum on one particular input stage to be reduced to a specially low value if and when required. (The application of a d.c. bias voltage to the heater supply, as recommended in an earlier article,<sup>14</sup> is unnecessary with modern valves such as the EF86, which have been specially designed for input stages.)

(e) The whole pre-amplifier circuit should be electrostatically screened, by mounting in a metal cabinet or by fitting a base-plate to the chassis.

(f) If a microphone input transformer is used, it should be enclosed in a Mumetal screening box. (The "Bi-limboid" series of astatic input transformers, made by Wright and Weaire Ltd., may be recommended; their hum-cancelling properties enable a screening box to be dispensed with under some circumstances, but when used in conjunction with ribbon microphones, it is usually desirable to employ a screening box.)

Some further practical points, relating to matters other than hum, are as follows:—

(g) It is very desirable that when one input stage is faded right down, but is receiving a large input signal, no audible signals from this channel shall get through to the output *via* unintentional stray couplings. For example, a fraction of a picofarad of stray capacitance between the anode circuit of the input stage in question and the grid circuit of the mixer stage, is sufficient to give very appreciable break-through with the gain control set to zero. Stray capacitance coupling between one input stage and another gives a similar result, except that the volume of the break-through sound is then dependent on the setting of the gain control of the "receiving" stage. In both cases the sound is thin and screechy, due to the greater effectiveness of the stray capacitance coupling at high audio frequencies.

To avoid the above trouble, the components associated with one input stage should be grouped together and a screening partition placed between them and the group of components associated with the next stage. The signal-output lead from each input stage should be screened and taken through to the mixer-stage compartment, where the  $470\text{-k}\Omega$  mixer-input resistors should be mounted.

(h) A further desirable feature is that no appreciable clicks should be heard on operating the switches associated with the low-pass filter or the microphone bass-cut circuit. In the latter case, it has been found that the main precaution necessary is to mount the bass-cut capacitors on a separate group board, as shown in Fig. 8; if they are mounted on a group board which also contains components having applied d.c. voltages, the slight leakage currents flowing in the group board are sufficient to cause the unused capacitors to become charged, resulting in large clicks when they are switched into circuit.

In the low-pass filter, resistors of  $10\text{M}\Omega$  are connected across the switch contacts to ensure that the capacitors are charged to the appropriate voltage before being switched into circuit.

With regard to the general form of construction, the simple scheme depicted in Figs. 8 and 9 is considered to have much in its favour, though the size of

the unit could certainly be reduced by adopting a more advanced layout. Due to the use of miniature valves and double electrolytic capacitors, the overall size is, however, small enough for most applications.

For applications where all the facilities given by the circuit of Fig. 1 are not needed, some of the following simplifications may be made, with consequent reduction in cost:—

(a) Adopt triode connections permanently in the microphone input stage; the gain will then be fully sufficient for all normal purposes when a good moving-coil microphone is used, and enough for many purposes using a ribbon microphone. (Connect anode to  $G_2$ ,  $G_3$  to cathode, and make the anode load and cathode bias resistors  $100\text{k}\Omega$  and  $1\text{k}\Omega$  respectively.)

(b) Omit the bass-cut circuit in the microphone stage, or provide a smaller number of positions.

(c) Omit the gramophone input stage, and employ a crystal pickup feeding directly to the mixer stage.

(d) Use the two halves of an ECC81 (12AT7 or CV455 are equivalent) for the mixer and tone-control stages. The anode loads should be  $68\text{k}\Omega$  and the cathode-bias resistors  $680\Omega$ . Occasional samples of this valve may possibly be too microphonic<sup>6</sup>, but, in view of the reasonably high signal level, little trouble is likely to be experienced.

(e) Omit the master gain control at the output of the pre-amplifier; the facility it provides for fading out two programme sources simultaneously may not be needed.

(f) If the pre-amplifier is to be operated exclusively off a power pack separate from that in the main amplifier, only one stage of decoupling is necessary in the h.t. feed to each input stage. (It is possible, provided suitable precautions are taken with regard to layout and wiring, to obtain a satisfactorily low hum level even if the power pack is built on the same chassis as the pre-amplifier; in particular, the mains transformer should be mounted as far from the input stages as possible and non-magnetic chassis material is desirable. Trouble from hum is, however, much less likely if a power pack well separated from the pre-amplifier is employed.)

**Tests.**—The circuits employed in this pre-amplifier are such that no critical adjustments are normally required in order to obtain the desired performance; but, as with any electronic equipment, it is quite possible that—due to faulty components, wiring errors or unsuitable layout—the correct result may not be obtained straightaway.

It is strongly recommended that, no matter what other tests the reader may wish to make, the first test should be to measure various d.c. voltages with a high-resistance meter such as an "Avometer" Model 8. If a meter of lower resistance be used, allowance should be made for the reduction in voltage caused by connecting the meter.

The h.t. supply voltage should be within the limits 270 V to 330 V, and anode and cathode voltages should then be within the following limits:—

(a) Cathode to earth, on all valves: 1.2 to 1.8 V.

(b) Anode to earth, on all valves except output valve: 60 to 150 V.

(c) Anode to earth, on output valve: 80 to 170 V.

If any of the above voltages are found to be dependent on the settings of one or more of the controls, then wrong connections, faulty components or self-oscillation should be suspected, in that order.

If the pre-amplifier has passed the above d.c. tests, it is reasonably safe to assume that the non-linearity

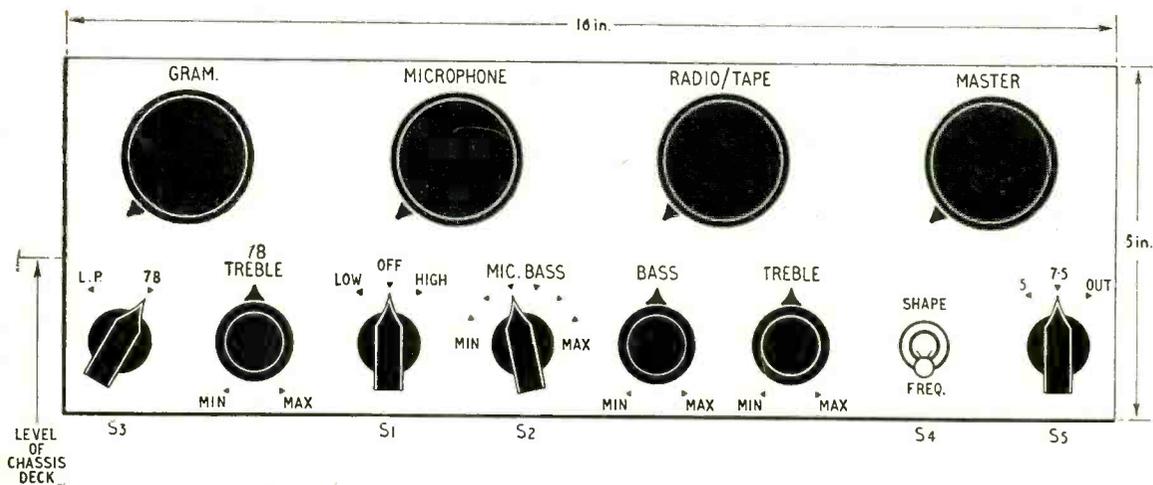


Fig. 9. Suggested front-panel layout corresponding to the under-chassis construction shown in Fig. 8.

distortion will be satisfactorily low and that it will remain low despite normal variations in mains voltage, valve ageing, etc.

Readers possessing, or able to borrow, suitable test gear, will, no doubt, wish to check the frequency response with various control settings. However, the absence of such measuring facilities need not be regarded as an overwhelming handicap, since careful listening tests should be able to indicate whether or not the controls are functioning in approximately the correct ways.

A suitable frequency-response test to start with is to measure the overall response from the microphone-stage input to the final output. The bass and treble tone controls should be set half way between full-lift and full-cut positions, giving a nominally flat response, and the microphone bass-cut and low-pass filter switches should also be set for level response. The effective load on the pre-amplifier output should be 250 k $\Omega$ . The overall response curve should then agree with Fig. 7 within  $\pm 1$  db over the frequency range 40 c/s to 15 kc/s. If satisfactory agreement is not obtained, the responses of the various stages should be measured separately, and the origin of the discrepancy discovered. The following points may be helpful:—

(a) If the two 4700-pF capacitors and the two 100-k $\Omega$  resistors in the main tone-control network are perfectly matched pairs, the gain from the mixer stage input to the tone-control stage output will normally fall by a fraction of a decibel as the frequency is raised from about 400 c/s to about 4000 c/s. Such a small change in gain is really quite unimportant, but it may be eliminated if the 100-k $\Omega$  resistor between the mixer valve anode circuit and the 1 M $\Omega$  bass-control potentiometer is reduced in value by an amount equal to the effective output impedance of the mixer stage, this impedance being just under 10 k $\Omega$  when two input stages are employed. In practice, due to the effects of component tolerances, the fall in gain between 400 c/s and 4000 c/s may appreciably exceed 1 db, or it might conceivably be a rise rather than a fall; in either case the remedy is to shunt an extra resistor across the appropriate 100-k $\Omega$  resistor in the tone-control network.

(b) The frequency response of the mixer stage, when not connected to the tone-control stage, should be flat within a fraction of a decibel up to 15 kc/s. If the response falls off appreciably at the top end, the cause is almost certainly the existence of too much stray capacitance across the 2.7-M $\Omega$  feedback resistor; 4 pF would be sufficient to give a loss of 3 db at 15 kc/s. It is not difficult to arrange the wiring so that the stray capacitance across this resistor is kept down to 1 pF, in which case the top loss will be quite negligible. If, due to unsuitable layout, it is found to be impracticable to obtain a low enough stray capacitance, the resultant top loss may be approximately compensated by connecting a small capacitor across each of the mixer input resistors.

(c) Effects of a similar nature to the above can occur in the output stage, and the wiring should be arranged so as to keep the stray capacitance between anode and grid circuits to a minimum.

(d) The frequency response of the output stage in the 30-c/s to 60-c/s region (see Fig. 7) may be adjusted slightly, if necessary, by altering the value of the 8.2-M $\Omega$  feedback resistor.

(e) The frequency response of the gramophone input stage, on the "78" setting of S3, may be adjusted, over a region similar to that mentioned in (d), by changing the value of the 6.8-M $\Omega$  feedback resistor. In the "LP" (long playing) condition, the response at such low frequencies is determined mainly by the value of the 3.3-M $\Omega$  resistor in the network connected to the "LP" contact of S3.

With the pre-amplifier connected to a power amplifier and loudspeaker, and set for a flat frequency response, the Johnson noise at full gain on a microphone channel, with no signal source connected to the input, should be clearly audible all over the room, and should sound louder than the accompanying hum. If the hum level is undesirably high, and if it cannot be satisfactorily minimized with the "hum-dinger" potentiometer, the first thing to do is to find out whether the hum is due to the a.c. heater supply or not; this is easily done by momentarily disconnecting the heater supply—the valves will continue working for a few seconds on their stored heat. No matter what the cause of the hum, a careful consideration

of the principles outlined previously should enable it to be cured.

**Acknowledgment.**—The manuscript of this article has been carefully scrutinized by E. F. Good, who has also done independent calculations to check the mathematical results. This valuable service is hereby gratefully acknowledged.

**Apology.**—Since the appearance of the negative-feedback tone control article,<sup>2</sup> in October, 1952, so much correspondence has been received that it has, unfortunately, not been possible to reply to all letters. The writer would like to apologize to the readers concerned and to any others who have been inconvenienced by the fact that, due to unexpected curtailment of spare time, the present article has appeared much later than was originally expected and implied.

### REFERENCES

- <sup>1</sup> "High-Quality Amplifier Design" by P. J. Baxandall, *Wireless World*, Jan. 1948. (Also appears in a booklet "High-Quality Audio Amplifiers" available from *Wireless World*.)
- <sup>2</sup> "Negative-Feedback Tone Control" by P. J. Baxandall, *Wireless World*, Oct. 1952.
- <sup>3</sup> "Equipment for Acoustic Measurements—Part 1" by D. E. L. Shorter and D. G. Beadle, *Electronic Engineering*, Sept. 1951.
- <sup>4</sup> "New Equipment for Outside Broadcasts" by A. E. Barrett, C. G. Mayo and H. D. Ellis, *World Radio*, July 21 and 28, 1939.
- <sup>5</sup> "New Equipment for Outside Broadcasts" by S. D. Berry, *B.B.C. Quarterly*, Summer 1952.
- <sup>6</sup> "Newly Developed Amplifiers for the Sound Programme Chain" by S. D. Berry, *B.B.C. Quarterly*, Summer 1954.
- <sup>7</sup> "Microphones," B.B.C. Engineering Training Manual, page 29, published by *Wireless World*.
- <sup>8</sup> "Radio Designer's Handbook," page 730, fourth edition, published by *Wireless World*.
- <sup>9</sup> "High-Quality Amplifier: New Version" by D. T. N. Williamson, *Wireless World*, Nov. 1949.
- <sup>10</sup> "Pickup Input Circuits" by R. L. West and S. Kelly, *Wireless World*, Nov. 1950.

<sup>11</sup> "Filters" by "Cathode Ray," *Wireless World*, Jan. and Feb. 1950.

<sup>12</sup> "The Miller Integrator" by B. H. Briggs, *Electronic Engineering*, Aug., Sept. and Oct. 1948.

<sup>13</sup> "Design of High-Pass, Low-Pass and Band-Pass Filters Using R-C Networks and D.C. Amplifiers with Feedback" by C. C. Schumard, *R.C.A. Review*, Dec. 1950.

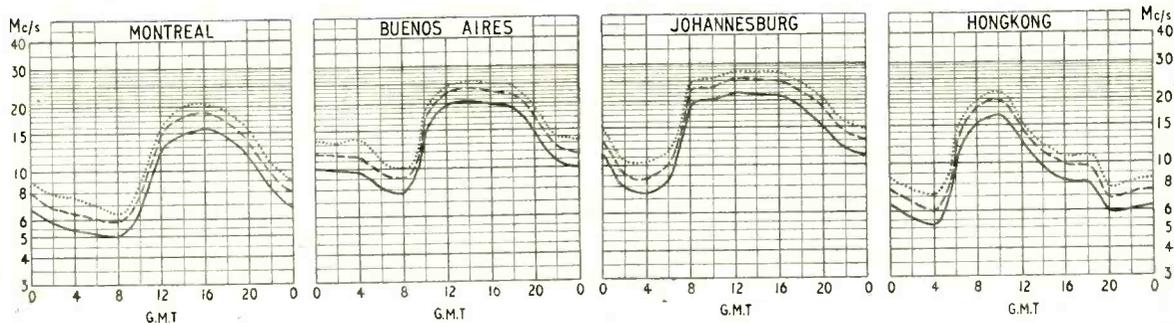
<sup>14</sup> "Hum in High-Gain Amplifiers" by P. J. Baxandall, *Wireless World*, Feb., 1947.



**AUTOMATIC SWITCHING.** Sound broadcast programmes for the B.B.C.'s West Region transmitters are switched to their destinations by a system something like an automatic telephone exchange. It is operated by a single engineer at this control desk, which is the "nerve centre" of a new control room recently installed at the West Region headquarters in Bristol.

## SHORT-WAVE CONDITIONS

### Predictions for February



THE full-line curves given here indicate the highest frequencies likely to be usable at any time of the day or night for reliable communications over four long-distance paths from this country during February.

Broken-line curves give the highest frequencies that will sustain a partial service throughout the same period.

- ..... FREQUENCY BELOW WHICH COMMUNICATION SHOULD BE POSSIBLE FOR 25% OF THE TOTAL TIME
- PREDICTED AVERAGE MAXIMUM USABLE FREQUENCY
- FREQUENCY BELOW WHICH COMMUNICATION SHOULD BE POSSIBLE ON ALL UNDISTURBED DAYS

# Simple Inductance, Capacitance and Resonance Meter

By L. F. SINFIELD

*A Useful Adjunct to a Service Signal Generator*

**T**HE measurement of small inductors and capacitors for use at radio frequencies is quite a problem, as normally a fairly high degree of accuracy is desired and this entails the use of expensive equipment such as a laboratory universal bridge. Such equipment is certainly not economic if measurements are required only occasionally, as is usually the case.

Although the resonance method does not normally give a direct reading of the inductance it is a simple matter to lay a ruler across a resonance "abac" at capacitance and frequency and read off the inductance. A dynatron, transitron or cathode-coupled two terminal oscillator can of course be used, but even if this will oscillate satisfactorily it is rather cumbersome as it requires valves and power supply, and in any case also requires additional apparatus to measure the frequency.

An adaptor was therefore built to work in conjunction with a signal generator so that the generator would resonate coils with a calibrated capacitor and give meter indication of resonance. It was not expected that any very high degree of accuracy would be obtained, but on test inductors of known values have given readings within limits normally required for this range.

Basically the unit consists of a detector and meter to indicate the signal generator output. The tuned circuit is in series with the meter and its high impedance at resonance gives a dip in the meter current.

The generator used was a cheaper grade "servicing" type, and was modified so that the output was obtained via a cathode follower to give a low-impedance output (about 100 ohms) at maximum output through the entire fundamental range of 100 kc/s to 80 Mc/s. Signal generators using a buffer stage, link-coupled output, or both, will be quite suitable and need no modification.

A germanium diode (GD5-OA61 or other equivalent) provides rectification for the meter which is of approximately 50 $\mu$ A full-scale deflection. The exact sensitivity and calibration of the meter are unimportant as it merely indicates dip. An ex-Government oil temperature meter was adapted by the author, but a centre-zero movement from a visual indicator unit (see *Wireless World*, Sept., 1951) could be used. The meter is by-passed by a 0.1 $\mu$ F capacitor and a further 0.001 $\mu$ F mica type, so that as far as r.f. is concerned the meter and the frame of the 0.0005 $\mu$ F tuning capacitor, as well as one side of the inductor, are all earthy.

Actually the meter can be dispensed with entirely and a pair of phones substituted. The signal generator should then be audio-modulated and the tone will be audible in the phones. The unit is then tuned for minimum audio signal. 100-ohm moving-coil and 4,000-ohm moving-iron phones have been tried and both work satisfactorily, but the high-resistance type gives a louder signal. An ideal arrangement would be to fit a closed circuit jack in series with the meter so that high-resistance phones could be inserted in series with the meter to give indications by either method.

## Layout and Calibration

Layout is as shown in Fig. 2 and the overall size about 5in $\times$ 4in $\times$ 2 $\frac{1}{2}$ in. A bakelite panel is used and the whole can be put in a wooden or bakelite box. This is a precaution against increasing the minimum capacity of the tuning capacitor. No trouble has been experienced with hand capacity at any frequency.

Using a known inductance (Wearite PA2-170 $\mu$ H, PA6-37.5 $\mu$ H, PA5-5.5 $\mu$ H) the capacity scale is calibrated. Set the signal input with the generator output control to nearly full scale with the PA2 in place. Set up the following frequencies and calibrate capacitor at each resonant point: 550 kc/s-0.0005 $\mu$ F;

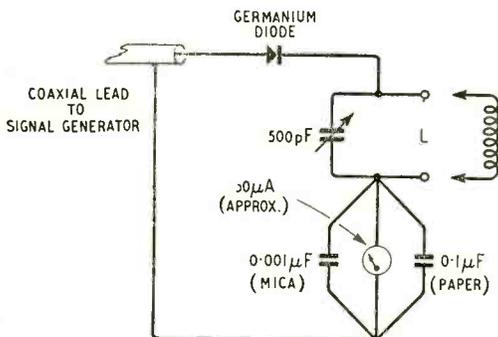
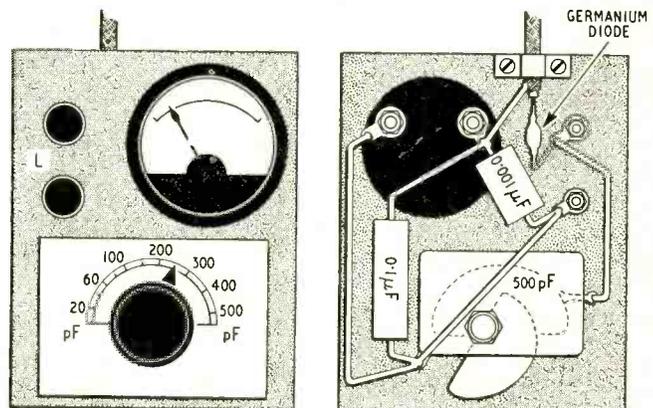


Fig. 1. Basic circuit diagram of inductance capacitance meter.

Fig. 2 (right). The layout and wiring are simple. A non metallic box should be used to keep stray capacitance at a minimum.



610 kc/s - 0.0004 $\mu$ F; 705 k/s - 0.0003 $\mu$ F; 865 kc/s - 0.0002 $\mu$ F.

Below 200pF it is advisable to use a coil having a single layer of spaced turns so that the coil capacity will not appreciably add to the main tuning capacity and cause calibration error. Use now the PA5 type coil and set up as before: 4.8 Mc/s-200pF; 5.5 Mc/s-150pF; 6.75 Mc/s-100pF; 7.5 Mc/s-80pF; 8.7 Mc/s-60pF; 10.7 Mc/s-40pF; 15 Mc/s-20pF.

These are the calibration points used on the original and are satisfactory for most purposes. The lower limit may or may not be obtainable as it will vary within capacitor types.

### Order of Accuracy

As a test of inductance measurement accuracy a number of known inductance coils were measured with following results.

Coil	Capacitance (pF)	Frequency	Calculated L	Actual L
PA3	200	10 Mc/s	1.23 $\mu$ H	1.2 $\mu$ H
PO5	200	5.15 Mc/s	4.7 $\mu$ H	4.8 $\mu$ H
PA5	200	4.9 Mc/s	5.2 $\mu$ H	5.5 $\mu$ H
PO6	200	2.1 Mc/s	28.0 $\mu$ H	27.45 $\mu$ H
PA6	200	1.8 Mc/s	38.5 $\mu$ H	37.5 $\mu$ H
PA7	200	630 kc/s	320 $\mu$ H	310 $\mu$ H
R.F. Choke	200	225 kc/s	2.5 mH	2.5 mH

The capacitor should preferably be kept at a fairly high value in order to swamp coil self-capacity, provided that adequate dip can be obtained. High values of inductance such as i.f. or long-wave coils, unless

pie-wound and of high "Q" may not give a sharp-enough dip for good indication. Also, if such inductors are wound in a single pie the high self-capacity may give a false inductance reading.

It is possible to indicate resonance by either setting a given capacity and varying the frequency or vice versa. If the frequency is varied it is necessary to ensure that the dip is actually a resonance and not a comparatively dead spot in the signal generator output. This can be checked by leaving the generator at that frequency and varying the capacitor, when the dip should again be indicated as the capacity goes through the resonant point.

If the signal generator waveform is not pure and is rich in harmonics there is a probability that the tuned circuit will also resonate at harmonics of the input frequency. The correct actual tuning point is therefore the highest frequency setting of the signal generator at which the dip occurs.

Measurement of small capacitors of up to 480pF is carried out by resonating an inductance with the main tuning capacitor, then connecting the unknown capacity in parallel with the coil and retuning back to the dip. The unknown will then be equal to the difference in the main capacitor settings.

It is not considered that the present layout would permit an exact measurement of inductors of less than 1 $\mu$ H, due to inductance of the internal connections. However, ample dip has been obtained up to the limit of the present set-up (80 Mc/s-20pF-0.2 $\mu$ H). This would indicate an inductance of 0.2 $\mu$ H, but the actual external inductance will in fact be slightly less than this.

## MAGNETIC INDUCTION HEADPHONES

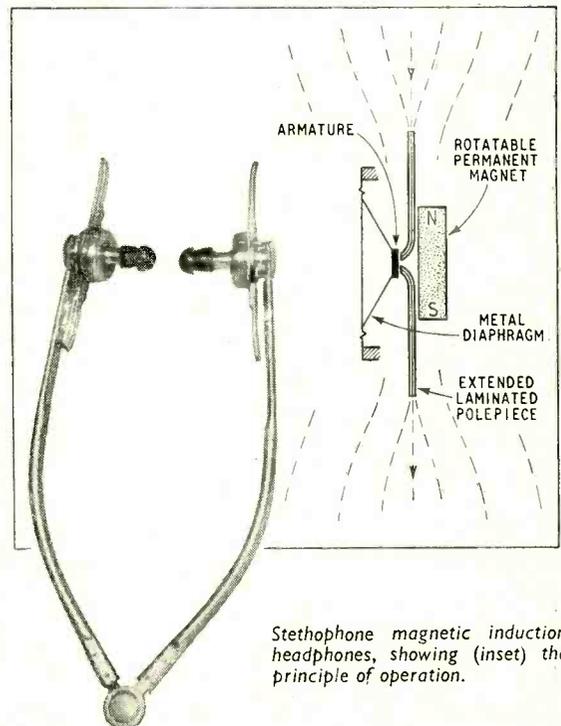
THE method of using a wire loop surrounding a cinema or hospital ward to supply energy to headphones without the inconvenience of connecting leads is by no means new. In general, standard type headphones have been used in conjunction with a small loop to supply them with current by electromagnetic induction.

No electric current is induced in a new type of headphones designed by V. A. Foot, and the forces actuating the diaphragms are purely magnetic. The sketch accompanying the photograph illustrates the principle. Laminated pole pieces of high-permeability material are extended to collect a concentration of flux from the surrounding field, which passes across short air gaps and through a circular armature disc attached to a small conical phosphor bronze diaphragm. As in conventional headphones a polarizing field is necessary, and is supplied by a short permanent magnet which can be rotated to reduce the flux in the air gaps and so to control volume.

The sensitivity is unexpectedly high, and the power required to give good volume in the primary loop surrounding the room is of the order of 10 watts per 1,000 sq ft of floor area.

With no fine wire or wax-impregnated windings to worry about, the phones can be boiled in water or otherwise disinfected, a point which has commended the system to hospital authorities. For hospital use the ear-pieces are rotatable so that the pole extensions can be kept in line with the vertical magnetic field when the patient is lying down. No volume control is provided in this type.

The price of both standard and hospital types is £2 2s per pair and of lorgnette type phones £3 3s each. A matching transformer suitable for supplying a loop from domestic radio receivers costs 12s 6d. The makers are the Magnetic Broadcasting Co., Ltd., 1, Upper Richmond Road, London, S.W.15.



Stethophone magnetic induction headphones, showing (inset) the principle of operation.

## FEBRUARY MEETINGS

### Institution of Electrical Engineers

*London.*—February 7th. Discussion on "The Problem of Radio Interference" opened by C. W. Sowton at 5.30.

February 9th. "A Study of Commercial Time Lost on Transatlantic Radio Circuits Due to Disturbed Ionospheric Conditions" by J. K. S. Jowett and G. O. Evans; and "Performance Characteristics of High-Frequency Radio Telegraph Circuits" by A. M. Humby, C. M. Minnis and R. J. Hitchcock at 5.30.

February 14th. Discussion on "Teaching Faraday's Law of Electro-Magnetic Induction" opened by P. Hammond at 6.0.

February 21st. "The Recent Search for and Salvage of the Comet Aircraft near Elba" by Cdr. C. G. Forsberg, R.N., and G. G. MacNeice at 5.30.

All the above meetings will be held at Savoy Place, W.C.2.

*Cambridge Radio Group.*—February 15th. "Colour Television" by L. C. Jesty at 8.15 at the Cavendish Laboratory, Cambridge.

*North-Eastern Radio & Measurements Group.*—February 7th. "Radio Aids to Marine Navigation" by Capt. F. J. Wylie, R.N. (Ret.), at 6.15 at King's College, Newcastle-upon-Tyne.

*North-Western Radio Group.*—February 16th. "An 8MeV Linear Accelerator for X-ray Therapy" by C. W. Miller at 6.45 at the Engineers' Club, Albert Square, Manchester.

*South Midland Radio Group.*—February 28th. "Thermionic Valves of Improved Quality for Government and Industrial Purposes" by E. G. Rowe, P. Welch and W. W. Wright at 6.0 at the James Watt Memorial Institute, Great Charles Street, Birmingham.

*North Midland Centre.*—February 21st. Faraday lecture "Courier to Carrier in Communications" by T. B. D. Terroni at 7.0 at the Town Hall, Leeds.

*North Staffordshire Sub-Centre.*—February 14th. "A Transatlantic Telephone Cable" by M. J. Kelly, Sir Gordon Radley, G. W. Gilman and R. J. Halsey at 7.0 at Duncan Hall, Stone.

*South-West Scotland Sub-Centre.*—February 2nd. "A Study of Some of the Properties and Materials Affecting Valve Reliability" by E. A. O'Donnell Roberts at 7.0 at the Institution of Engineers & Shipbuilders, 39, Elmbank Crescent, Glasgow, C.2.

*Western Centre.*—February 8th. Faraday lecture "Courier to Carrier in Communications" by T. B. D. Terroni, at 6.30 at Brangwyn Hall, Swansea, and on February 10th at 6.45 at Colston Hall, Bristol.

### British Sound Recording Association

*London.*—February 18th. "Electro-Acoustics of Microphones" by H. A. M. Clark at 7.0 at the Royal Society of Arts, John Adam Street, W.C.2.

*Manchester Centre.*—February 14th. "Reproducing Needles" by L. Rollin at 7.30 at the Engineers' Club, Albert Square, Manchester.

### Radar Association

*London.*—February 23rd. "Airborne Electronic Equipment" by Air Vice-Marshal R. G. Hart at 7.30 in the Anatomy Theatre, University College, Gower Street, W.C.1.

### British Institution of Radio Engineers

*London Section.*—February 23rd. "A Versatile Electronic Engine Indicator" by R. K. Vinycomb (Southern Instruments) at 6.30 at the London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1.

*West Midlands Section.*—February 9th. "Electronic Motor Control Systems" by J. C. Rankin (B.T.H.) at 7.15 at the Wolverhampton and Staffs. Technical College, Wulfruna Street, Wolverhampton.

*North-Eastern Section.*—February 9th. Papers by students at 6.0 at Neville Hall, Westgate Road, Newcastle-upon-Tyne.

*Merseyside Section.*—February 3rd. "Colour Television—Prospects and Problems in the U.K." by D. W. Heightman (English Electric) at 7.15 at the College of Technology, Byrom Street, Liverpool, 3.

*North-Western Section.*—February 3rd. "Recent Developments in Test Gear in the Radio, Television and Radar Fields" by A. G. Wray (Marconi Instruments) at 7.0 at the Reynolds Hall, College of Technology, Sackville Street, Manchester.

*South Wales Section.*—February 23rd. "The Training of Radio Engineers" by H. W. French (H.M. Inspector of Technical Colleges) at 6.30 at the Glamorgan Technical College, Treforest.

*Scottish Section.*—February 10th. "Radio Telephone Systems to the Islands" by T. Moxon (G.P.O.) at 7.0 at the Institution of Engineers and Shipbuilders, 39, Elmbank Crescent, Glasgow, C.2.

### Television Society

*London.*—February 11th. "Television Coverage of Gt. Britain" by R. A. Rowden (B.B.C.) at 7.0 at the Cinematograph Exhibitors' Association, 164, Shaftesbury Avenue, W.C.2.

February 24th. "Modern Microwave Techniques" by R. L. Corke (P.O. Research) at 7.0 at the C.E.A., 164, Shaftesbury Avenue, W.C.2.

### Radio Society of Great Britain

*London.*—February 25th. "Radio Astronomy and the Radio Amateur" by R. C. Jennison (Jodrell Bank Experimental Station) at 6.30 at the I.E.E., Savoy Place, W.C.2.

### Society of Instrument Technology

*Chester Section.*—February 23rd. "Some Useful Electronic Circuits for Measuring Purposes" by E. Higham (Lever Bros.) at 7.0 in the Board Room of the Chester & Dist. Hospital Committee, 5, Kings Buildings, King Street, Chester.

*Fawley Section.*—February 4th. "Electronic Computers" by a member of the staff of Elliott Bros. at 7.0 in Copthorne House, Fawley, Hants.

### Incorporated Practical Radio Engineers

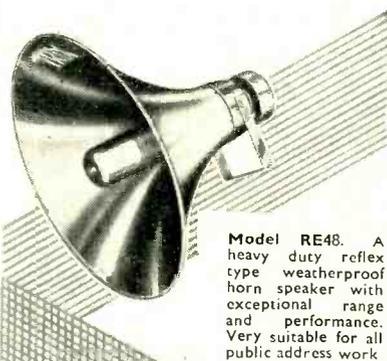
*East Midlands Section.*—February 25th. "Transistors and Their Possible Future Uses" by a member of the staff of the G.E.C. at 7.15 at the Electricity Board Demonstration Theatre, Smithy Row, Nottingham.

*Midlands Section.*—February 22nd. "Cathode Ray Tubes" by a member of Mullard's staff, at 7.30 at the Connaught Room, Imperial Hotel, Temple Street, Birmingham.

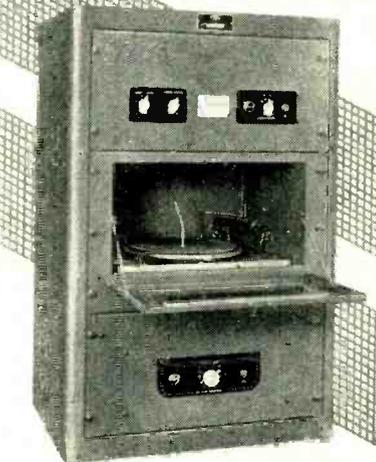
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# RANDOM RADIATIONS

By "DIALLIST"

## Exploring Band III

HIGHLY interesting results should emerge from the Band III reception tests which those enterprising people Belling and Lee are soon to begin. As you probably know, Sutton Coldfield is radiating experimental square-wave transmissions on the 189.75 Mc/s vision carrier frequency which has been allotted to the I.T.A. for its Midland service. The Belling-Lee test unit will first of all balance up the Band I and Band III vision signals from Sutton Coldfield at some convenient spot where both are well received. It will then drive over a large part of the service area and a careful record of the comparative strengths of the two signals will be made. Myself, I believe that in districts which are not of the hill-and-valley kind the range of the Band III transmission will turn out to be a good deal greater than many people think. When Wrotham started its sound transmissions in Band II with an output of around 20kW most of us thought that it wouldn't reach out very far; but at 40 odd miles I get a tremendous signal from it with a simple dipole, provided with neither reflector nor director. I'm told, too, that it is received as far away as Shrivenham, Berks (90 miles). If Band II exceeded expectations in the matter of range, I don't see why Band III shouldn't provide surprises as well.

## Shadows and "Ghosts"

But Band III is likely to present some pretty problems in hilly country, where wireless shadows may abound. The travelling test unit will have plenty of opportunities of finding out, for there are hills galore around Birmingham. I can testify to that, for I'm writing these notes right up in the Lickey Hills, where I've been staying since Christmas. They're only about 10 miles from the middle of the City. Looking out of the window, I can see the Warwickshire Hills to the south-east; and there'd be another lot in view to the south-west if it wasn't for a belt of trees. My bet, then, is that reception of the Midland Band III transmitter will be rather patchy. "Ghosts" may also be a considerable nuisance, for the shorter the wavelength, the more liable is it to reflection. On the

whole, I think that the I.T.A. engineers will have some difficult siting problems; and I doubt whether they'll find the B.B.C.'s aerial masts of much use to them in some places. There'll be some hard thinking, too, for the designers of Band III receiving aerials intended for use in places where "ghosts" abound or the field strength is on the poor side.

## North Hessary Tor and Others

THE B.B.C. didn't expect the low-power temporary transmitter at North Hessary Tor to be of much use to Torquay and parts adjacent. But I've already heard from two friends who live there that it is giving them an excellent signal. In the case of one of them this is a great surprise. His house is towards the Babbacombe end of the town and the ground to north and north-west of it, which lies between it and the transmitter, slopes steeply upward. So steeply, in fact, that you don't have to go far from the back of the house to be on a level with the aerial, which must be a very long way below the line of sight from North Hessary Tor. Rowridge,

I.o.W., seems also to be giving a service at a greater distance than was predicted; in some directions, at any rate. There was a storm of indignation, by the way, on the Island when one of the B.B.C. announcers, when giving details of the impending opening of Rowridge, pronounced the first syllable to rhyme with "blow" instead of with "plough." Five new medium-power TV transmitters should be in full operation with their permanent aerial masts before the end of the year. These are Meldrum, Rowridge, Pontop Pike, Divis and North Hessary Tor. The whole of the B.B.C.'s No. 1 programme system should be completed within the following twelve months by the addition of the medium-power Norwich station and the five low-power transmitters planned.\*

## "Europe No. 1"

THOSE monstrous radio and television stations projected for the Saar and for Monaco are likely to be pretty bad nuisances. So far as this country is concerned, the Saar's 500-kW sound transmissions aren't likely to do much harm, for they are on the

\* These will be at, or near, Dover, Inverness, Londonderry, Towyn, and Carlisle.



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long waves and probably won't interfere with Droitwich. But the TV transmissions may cause havoc, particularly when sporadic E is much in evidence. Interference with television reception here was widespread last year at intervals from early June until December. It's a thousand pities that European countries can't get together over the very important question of sound and vision broadcasting channel allocation.\* If only we could agree to arm an international body with the powers of the United States Federal Communications Commission!

### "Potmeters"

IT'S a queer thing that after all these years we still seem to find it so difficult to make reliable and long-lived controls of the potentiometer type. I'm thinking particularly of those used as volume controls and for the contrast control in TV receivers. Far, far too soon do many volume controls become scratchy and scrappy; far, far too soon do those used for the contrast develop such jumps and jerks that it becomes difficult to adjust the gain exactly to your liking. There are, I know, types which don't behave in this exasperating way; and that makes it all the more puzzling that set manufacturers should be content to use any other sort.

### Overheating

SUFFICIENT attention isn't always paid by designers to the cooling arrangements in broadcast receivers. Yes, I know that when a set starts dripping blobs of waxy stuff on to the table beneath it the cause may often be that its owner has so placed it that its back is jammed tight against the wall. But it isn't always so. I've seen nasty messes made by sets which were standing well away from the wall. And once that sort of thing starts trouble is on the way. Sometimes the ventilating louvres are in the wrong place; sometimes there aren't enough of them; sometimes they're not long enough. They can't be made wider because they must not allow a "standard finger" to be poked in far enough to touch any live part. Adequate cooling is probably made more difficult by the use of miniature valves; for these run very hot and owing to the smallness of their bulbs there is only a restricted area from which heat can be dissipated.

\* Monaco was a signatory to the Stockholm v.h.f. plan under which she is allocated a 50-kW (e.r.p.) television station in each of Bands I and III. The Saar was allocated a 100-kW (e.r.p.) station in Band I.—Ed.

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# UNBIASED

By FREE GRID

## Cuckoo in the Nest

I WAS deeply interested in the Editor's plea in the December and January issues that the control of wireless should be taken out of the hands of the P.M.G. and his all-powerful department. But while desiring to strike the G.P.O. gyves from the wrists of radio he is obviously unable to shake the shackles of editorial caution from himself. In this matter he shows something of a Menshevik mentality rather than the ruthless spirit of the "Old Bolsheviks" which has always characterized his utterances on other matters.

This is clearly shown by the pious hope expressed in the January issue that the Minister who replaces the P.M.G. in assuming parliamentary responsibility for radio will *not* be one who is the head of any of those ministries which are large and greedy users of radio channels. This, surely, is the original argument put forward years ago by the Editor emeritus of *W.W.* against the P.M.G.'s stewardship. Although that argument still stands, it forms only one count in the case against G.P.O. control.

Radio has grown up since the P.M.G. took it over as a puling infant in 1904, and is more than big enough to justify having a ministry of its own to control its multifarious interests. It is, in fact, fast becoming a cuckoo in the nest, as its rate of growth is so prodigious that in a few years it has already crowded out the G.P.O.'s more legitimate interests, and if handed over to another ministry it would eventually do this cuckoo act in its new nest. Distasteful as the idea may sound to many, what we seem to need is a Ministry of Radio.

## Racing by Radio

THERE does not at first sight appear to be much connection between racing and radio, but if certain suspicions of mine are confirmed there will prove to be a very strong connection indeed. As we all know, there are sometimes unexpected results in racing, horses which were considered "dead certs" by the experts being outstripped easily by rank outsiders.

It has been suggested that some of these unexpected results could be accounted for by jockeys receiving pre-race instructions from unscrupulous owners and trainers not to try too hard. The racing correspondent of one national daily writing about this matter at the end of the last "flat" season rather pooh-poohed the

idea. He considered that pre-race instructions were greatly over-rated, but added that if it were possible for an unscrupulous interested party to communicate with a jockey during the progress of the race it would then be a matter for serious concern. When reading this my worst suspicions were aroused, for during the past season there seems—judging by the money I have lost—to have been an exceptionally large number of these "unexpected results."

It would be a perfectly easy matter to design an ultra-compact lightweight receiver which could be carried about a jockey's person; in fact the thing needn't be concealed, for it could be disguised as a hearing



The bowed shape of his legs gave him away.

aid. I find there is nothing in the rules of racing against a jockey wearing an aid to hearing any more than there is against his wearing an aid to clear speech in the form of a well-fitting denture.

At this time of the year jockeys are in normal civilized garb but there is no mistaking one as his small stature and the bowed shape of his legs give him away. Whenever I pass such a figure, as I did the other evening outside a famous club in the Pall Mall, I cannot help regarding him with suspicion although I must confess that so far I have yet to find one wearing a hearing aid.

## Euroscopes

EIGHTEEN YEARS ago when the B.B.C. was giving us M & B transmissions from Alexandra Palace on alternate days, television receivers were provided with a switch to change over from the M to the B system and *vice-versa*. As in the case of the famous tablets each of

the letters M and B is the initial of a well-known man, and they are used instead of their names, to prevent identification which would result in a free advertisement to their respective firms.

Now, this change-over switch meant quite a lot of complication in the receiver for, not only was the lineage different in the two systems but one used interlacing and the other didn't. But all these problems were solved. I feel, therefore, that it should not be too difficult for some enterprising manufacturer to solve similar problems and produce a set having a change-over switch labelled "British" and "French." This would enable those living in the Cinque Ports section of the south coast to receive French programmes when desired.

I put forward this suggestion as I have a friend living on the White Cliffs of Dover who has a French television set and gets better reception from Lille than he does from A.P. on his British set. He has also been getting a goodly number of viewers to see the French programmes at his house with the result that several French sets have been imported, some by people who do not speak French. Surely this shows that some of the French programmes have a greater eye appeal than anything the B.B.C. radiates. It would seem, therefore, that there might be a market for change-over sets in suitable high-ground localities on the south coast and even a bit inland. The Channel Islands might be another suitable locality for these Anglo-Euroscope receivers.

## Tape Recorders

I WAS very interested in a letter published in the December issue in which various shortcomings of tape recorders were pointed out and suggestions made whereby manufacturers could improve them. There was one particular complaint with which I heartily agree and that is the irritating business of loading and threading up. No mention was made, however, of what is, in my opinion, the ideal way of getting rid of this bugbear and that is to follow the technique that has found so much favour with the users of amateur cine cameras.

At one time it was quite a work of art to load an amateur cine camera *quickly* without getting the film all snarled up. Minor improvements were made but the real thing which put joy into the business was the development of cassette loading. It is the work of a moment to slip into the camera specially designed for it a cassette consisting of a tin box containing both spools, with the film all threaded up ready for use.

It would be necessary to redesign the deck of the tape recorder. But eventually the old separate spool recorders would die a natural death.

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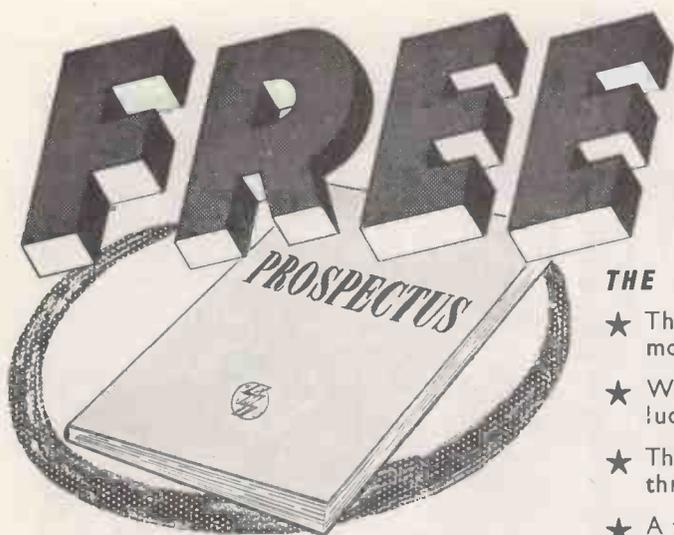
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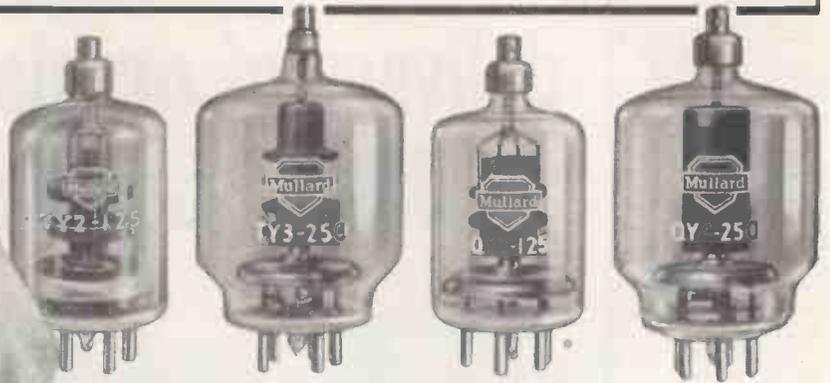
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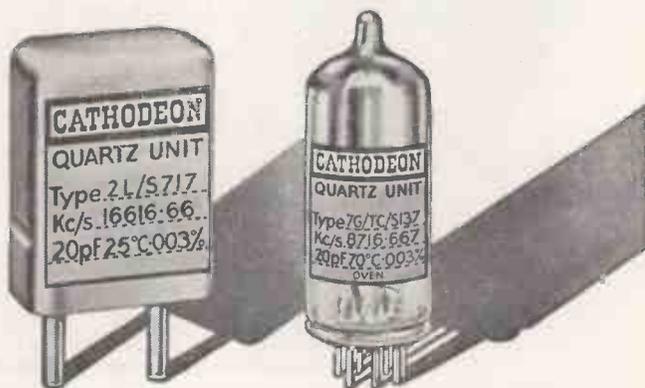
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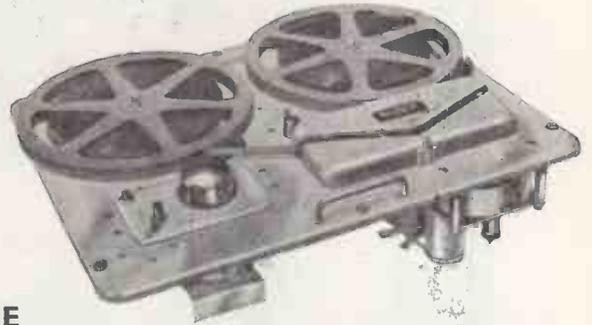
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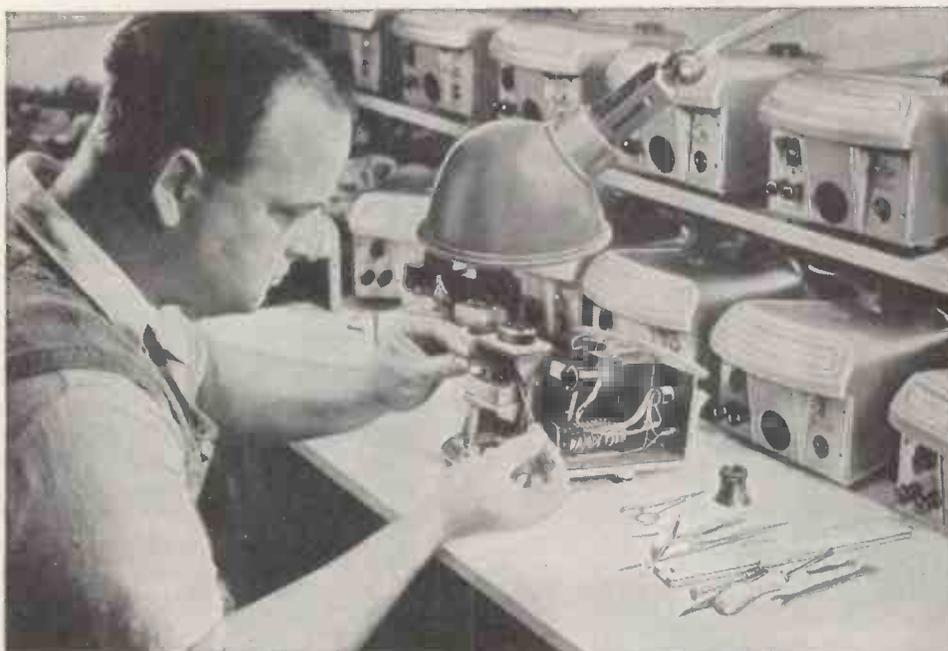


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THE MASTER VALVE

BLACKBURN • FLEETWOOD • GILLINGHAM • HOVE • LYTHAM-ST. ANNES  
MITCHAM • PADIHAM • RAWTENSTALL • WADDON • WANDSWORTH • WHYTELEAF

 MULLARD LTD., CENTURY HOUSE, SHAFTESBURY AVENUE, LONDON, W.C.2

*Use these!*



- Paper Capacitors
- Electrolytic Capacitors
- Metallised Paper Capacitors
- Wire-Wound Resistors
- Composition Resistors
- Potentiometers

*Use*

# DUBILIER

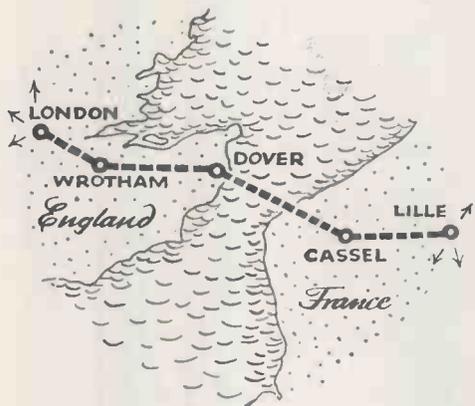
**DUBILIER CONDENSER COMPANY (1925) LIMITED**  
 DUCON WORKS, VICTORIA ROAD, NORTH ACTON, LONDON, W.3  
 Telephone; ACQrn 2241 (5 lines)    Telegrams: Hivolton, Wesphone, London.    Marconi International Code.



# Eurovision

The Wayne Kerr Video Oscillator is used by the B.B.C. Engineers to measure the frequency response of the Link over its full bandwidth.

*(Photographs by courtesy of the B.B.C.)*



**Video Oscillator type 022B** + 10 to -50 db on 1 volt peak to peak from 10 kc/s - 10 Mc/s.  
 Stabilised output. Less than 1% total distortion.  
 This instrument now includes a 50 c/s square wave output for examination of the low frequency characteristics of video networks.

Full details from:

THE WAYNE KERR LABORATORIES LTD., NEW MALDEN, SURREY



*A New* **Marconi Signal Generator**  
 TYPE TF 801B  
**FREQUENCY RANGE 10 to 500 Mc/s**



This, together with other new designs  
 for 1955, is fully described in the 1955 edition  
 of Marconi Instruments Catalogue.

# MARCONI INSTRUMENTS

SIGNAL GENERATORS · BRIDGES · VALVE VOLTMETERS · Q METERS · WAVEMETERS  
 FREQUENCY STANDARDS · WAVE ANALYSERS · BEAT FREQUENCY OSCILLATORS

MARCONI INSTRUMENTS LTD · ST. ALBANS · HERTS · Phone: ST. ALBANS 6160/9

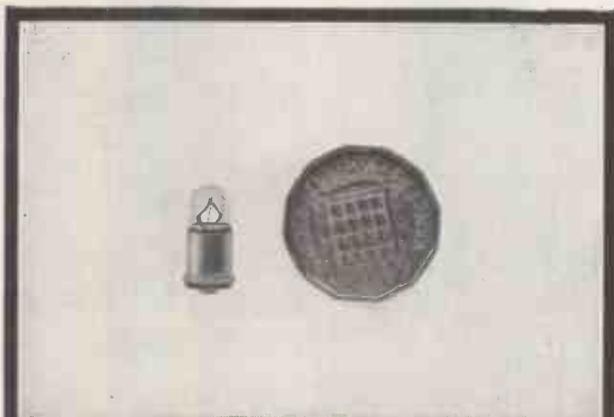
30 Albion Street., Kingston-upon-Hull. Phone: Hull Central 16144.

19 The Parade, Leamington Spa. Phone: 1408

Managing Agents in Export:

MARCONI'S WIRELESS TELEGRAPH CO. LTD · MARCONI HOUSE · STRAND · LONDON, W.C.2

# THORN CONTRIBUTIONS TO space & weight saving IN EQUIPMENT DESIGN

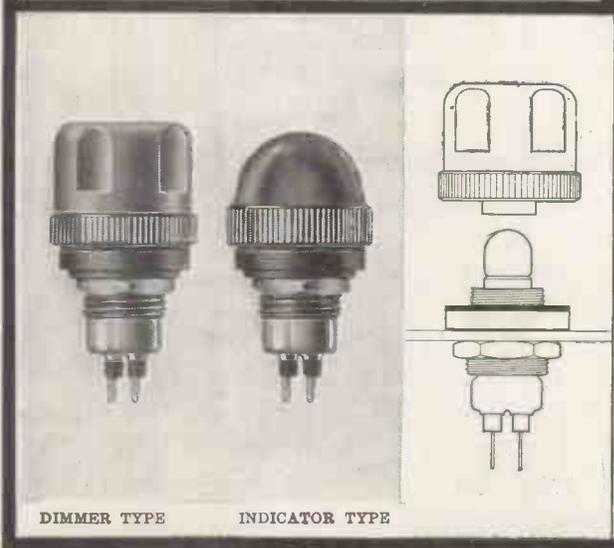


**ATLAS MIDGET PANEL BULB** Overall length: 14.6 mm. Bulb diameter: 6.3 mm. Rating: 28v., 1 watt, 0.04 amp. Also available in 12v., 6v. R.A.E. and S.R.D.E. type approval. Flanged cap and single centre contact for easy replacement.

The need for saving space and weight in modern electronic and panel control equipment is an ever present problem. The Atlas Midget panel bulb was designed with these difficulties particularly in mind. Tiny in size, simply and robustly constructed, its success is confirmed by type approval from the R.A.E., Farnborough, and S.R.D.E., Christchurch.

The development of the Atlas Midget panel bulb made possible the production of the Thorn Miniature Sealed Panel Lampholder, which has been developed specifically for the Armed Services. It is available with dimmer or indicator cap, and will withstand conditions of constant vibration and shock.

Brief details are given below, but further enquiries are invited.



## THORN MINIATURE SEALED PANEL LAMP HOLDERS

Overall length including contacts: 1.43 ins. Dia.: .75". Weights: with Indicator Cap 0.276 ozs., with Dimmer Cap 0.644 ozs. Conform to Radio Components Specs. (Prov.) 201, Humidity Class. H.1. Temperature category 40/100 (-40°C. to +100°C.). Pressure sealed to 20 lbs./square inch.

Completely weatherproof and will withstand conditions of constant vibration and shock. Rotation of the dimmer cap controls the light output from bright to dim by means of an internal metal shutter. Developed originally for A.F.V.'s, Thorn Miniature Sealed Lampholders have many other obvious applications.

The holders are insulated from the panel which can vary from  $\frac{1}{32}$ " to  $\frac{1}{8}$ " thick. Thicker panels may be counterbored. Single hole mounting facilitates fitting. Rotation is prevented by flats on the body. The lamp can be replaced without breaking seals, by unscrewing cap.

DIMMER TYPE

INDICATOR TYPE

## THORN ELECTRICAL INDUSTRIES LTD



AIRCRAFT COMPONENTS DIVISION, 105-109 JUDD STREET, LONDON, W.O.1

# *ELAC closed field...*



## ... LOUDSPEAKERS

These loudspeakers have been designed to provide minimum magnetic interference together with high acoustic efficiency. ELAC Elliptical and round loudspeakers are used in most of the leading Television and Radio receivers.

PRICES INCLUDING P.T. FOR LOUDSPEAKERS LESS TRANSFORMER AS FROM NOV. 1st., 1954.

7" x 4" Elliptical	Flux 6,500 Gauss	<b>21/10</b>	6½" PM. 6G	Flux 6,500 Gauss	<b>21/10</b>
3½" PM. 3G	Flux 6,500 Gauss	<b>19/10</b>	8" PM. 8D	Flux 7,500 Gauss	<b>29/1</b>
5" PM. 5G	Flux 6,500 Gauss	<b>20/6</b>	10" PM. 10D	Flux 7,500 Gauss	<b>34/4</b>



**ELECTRO ACOUSTIC INDUSTRIES LTD.**

Stamford Works, Broad Lane, Tottenham, N.15



*By Appointment to the Professional Engineer*

**PAINTON "MULTICON" SERIES  
6-POLE PLUGS & SOCKETS**

MULTICON—Regd. Trade Mark

PATENT 700999

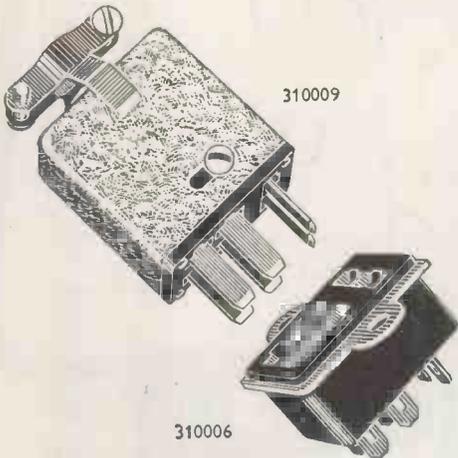
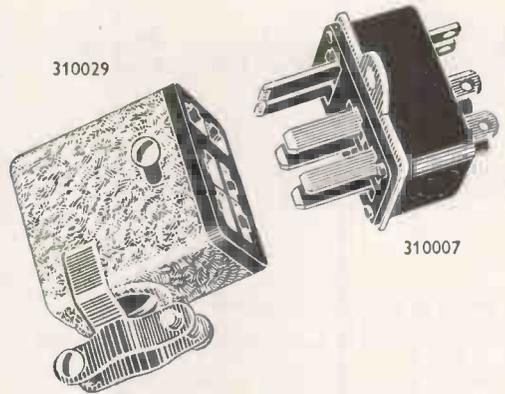
**VOLTAGE RATING** 500 volts  
D.C. or A.C. Peak

**CURRENT CARRYING CAPACITY**  
5 amps, D.C. or A.C. (RMS) per contact

Although in general the new Painton "Multicon" Series of Plugs and Sockets will be interchangeable with the existing Painton range, the 6-pole Plugs and Sockets have two contacts polarised to eliminate the possibility of 'wrong-way-round' insertion. In the 6-pole size (as on all other "Multicon," sizes when available) there is a complete variety of Plugs and Sockets with alternative mounting arrangements, cable fixings and retaining devices. The "Hammer-finish" silver-grey covers will blend with all equipments.

A low and constant contact resistance is achieved with the heavily silver-plated split contacts.

Any possibility of free moisture remaining between the Plug and Socket face is prevented because spacers keep the mating faces slightly apart, even when the Plugs and Sockets are fully engaged. The patented method of securing both the male and female contacts in the mouldings ensures the satisfactory operation of the Painton "Multicon" range under severe tropical and climatic conditions.



PLUG			SOCKET		
Cable Entry Top	Cable Entry Side	With Mounting Flange	Cable Entry Top	Cable Entry Side	With Mounting Flange
310009	310018	310007	310008	310029	310006
FITTED WITH LOCKING CLIP			FITTED WITH LOCKING CLIP		
311291	311292	—	311294	311295	—

**PAINTON**  
*Northampton England*

## A headache for somebody ...

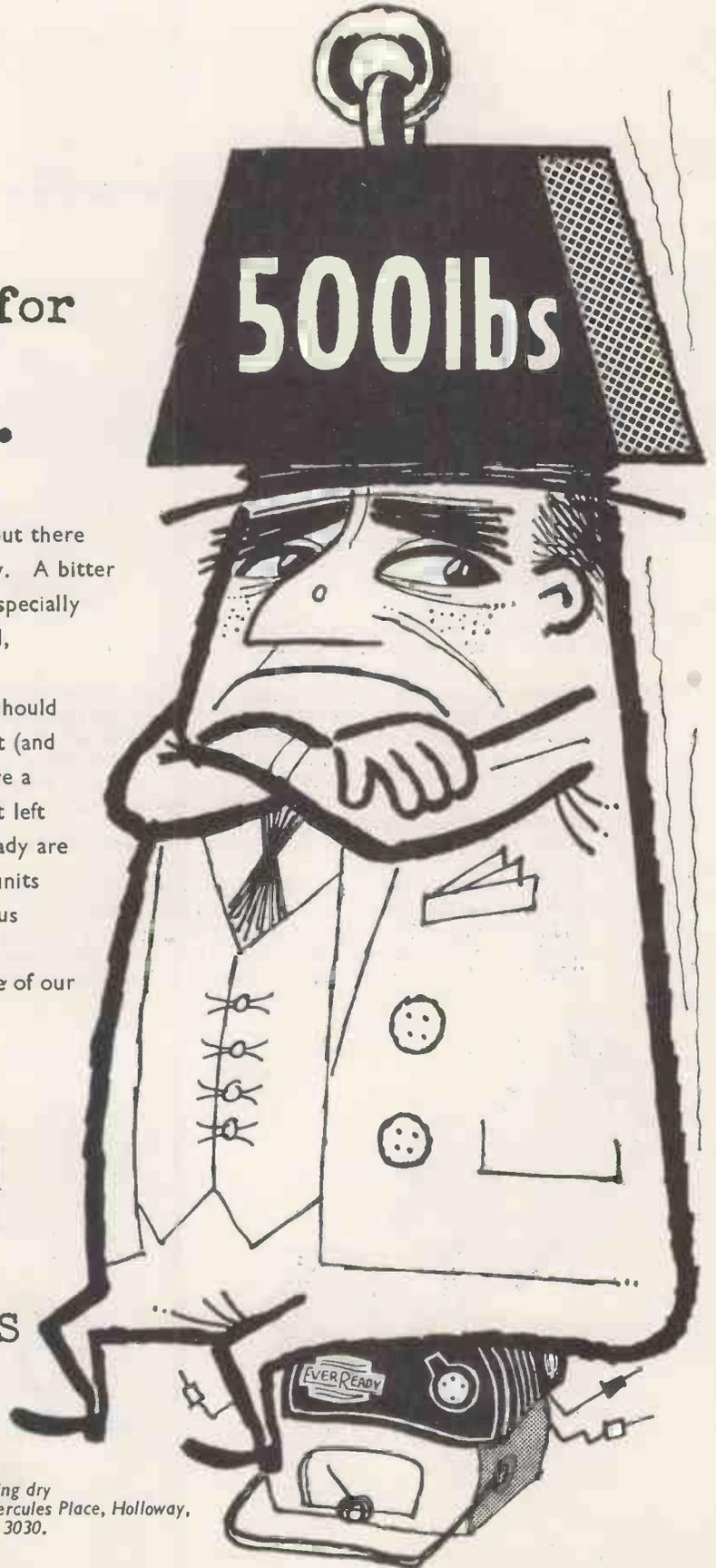
It was a great little portable — but there just wasn't room for the battery. A bitter blow for the designer. Unless specially designed batteries were ordered, he would have to start again.

Designers of battery radio sets should note this dilemma. Time, effort (and money) are wasted if you prepare a design and then find you haven't left room for the battery. Ever Ready are always able to make up special units but it's so much simpler to call us in early so that your set is designed, if possible, to take one of our many standard batteries.

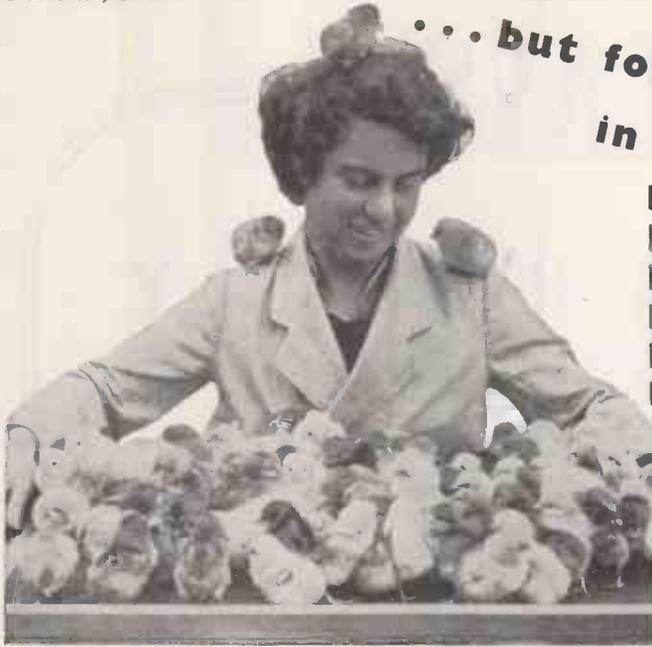


### DRY BATTERIES FOR RADIOS

\* If you have a design problem involving dry batteries, get in touch with us at Hercules Place, Holloway, London, N.7 Telephone: ARChway 3030.

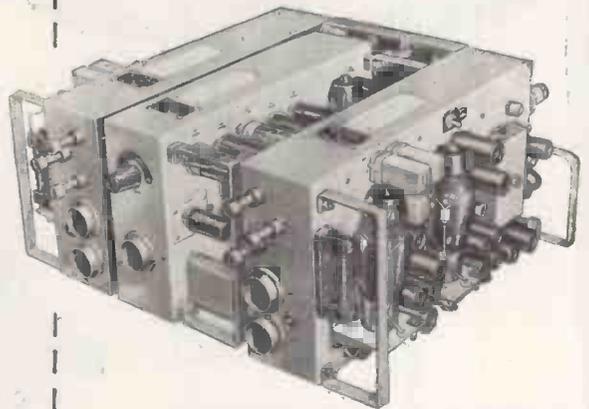


**... but for quantity production  
in electronics ...**



**In the sphere of electronics, whatever you have to produce, whatever its state of development— if you want it produced quickly, in quantity, with commensurate quality; if you want it produced economically—it's a job for Plessey!**

At the Electronics Division of Plessey, a thousand pairs of trained hands can, if need be, nurse a young idea—develop it—and bring it to full or limited production maturity with a thoroughness that would spell costly delay in any organisation less well equipped. The Division is presently engaged on contracts for for such renowned organisations as B.T.H., Decca, I.A.L., Kelvin Hughes, Marconi's Wireless Telegraph Company Ltd., and Laurence Scott & Electromotors Ltd. If your special interests lie in electronics, serve them well by writing for the Plessey publication which sets out the Division's specialised services.



*Part of a particularly compact radar installation made for Marconi's Wireless Telegraph Company Ltd.*

**... you should see**



ELECTRONICS DIVISION · TELEPHONE VALENTINE 8855

THE PLESSEY COMPANY LIMITED · ILFORD

ESSEX



# RELAYS



**SERIES  
595 H**

**COIL:** In all standard voltages up to 110 V. D.C. Working range between plus 10% and minus 20% of rating.

**CONTACT COMBINATIONS:** up to 2 pole changeover.

**BASE:** International octal.

**WEIGHT:**  $3\frac{1}{4}$  ozs.

**DIMENSIONS :**

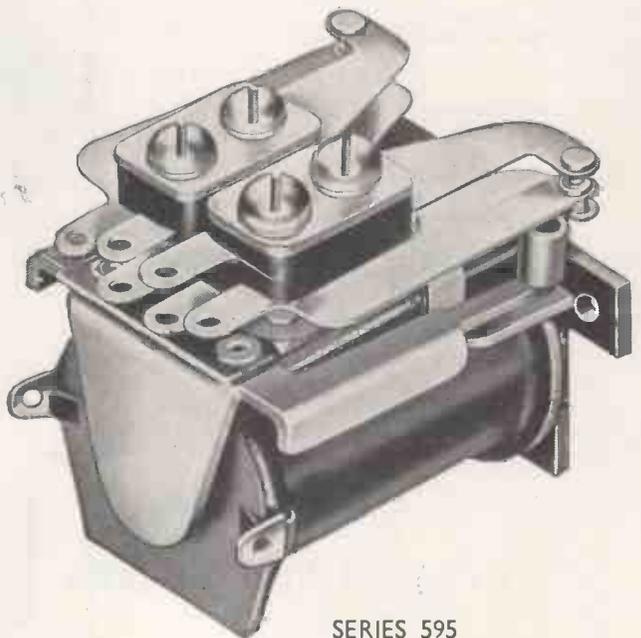
Diameter— $1\frac{1}{16}$ " overall.

Height —  $2\frac{3}{8}$ " overall.

## HERMETICALLY SEALED SERIES 595 H

This is a hermetically sealed version of our series 595 Relay, which is already well known to the aircraft industry.

The armature design reduces the effects of shock, vibration and acceleration ; a spring type armature hinge eliminates backlash, friction and risk of displacement.



**SERIES 595**



**MAGNETIC DEVICES LTD**  
NEWMARKET

MD4A

## A NEW-PRINCIPLE A-C AUTOMATIC VOLTAGE STABILISER



We have now had released to us by a Government Department the design of our "A.C. Mains Regulator, Automatic, Step, Mark II", and are therefore manufacturing this unit for general sale. It ideally fills the need for a cheap, small and light Stabiliser. Although it measures only 8½ in. x 4½ in. x 5 in., weighs as little as 11 lbs., and costs only £24 net, it has a performance fully equal to any similarly rated Automatic Stabiliser of the resonated, saturated core type, without any of the disadvantages.

ASR-1150 has a pure output waveform, is unaffected by changes in mains frequency, and works equally well from no-load to full load, which is 1150 VA. It has a stabilised output at 230V unless otherwise ordered.

Many other Automatic Voltage Stabilisers are now manufactured by us, and all are available for immediate delivery. In some cases the constancy of output is as high as 0.15%. Models are available from 200 VA to 30 kVA, single phase. 3-Phase Stabilisers are also available. Prices are *extremely* competitive.

We can supply from stock all types of American tubes, condensers, valves, potentiometers, etc.

*MEMO: If you are interested in infinitely-variable Transformers, do not forget the almost indispensable "VARIAC" (Reg'd. Trademark). Models are available from 170VA to 21kVA. Our Catalogue V-549 (3rd Edition) tells the whole story and will gladly be mailed free and post free, on request.*

### The NEW "ASR-1150" costs only £24 net

Complete information is obtainable from:

**CLAUDE LYONS LTD., STABILISER DIVISION,**  
HEAD OFFICES & WORKS: 76 OLDHALL STREET, LIVERPOOL 3, LANC.  
SOUTHERN FACTORY: VALLEY WORKS, WARE ROAD, HODDESDON, HERTS.  
(A10 main London/Cambridge Road, at Junction of A602)


**G.E.C.**

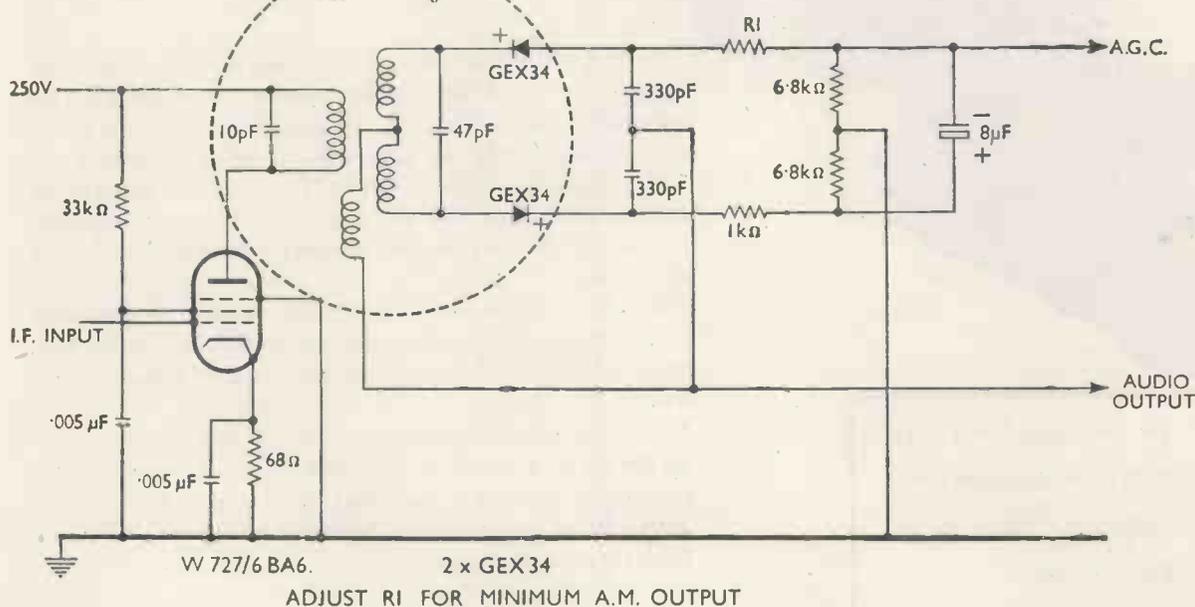
# GERMANIUM DIODES

## GEX 34 in the Ratio Detector



The Ratio Detector has been generally accepted as the most practical form of detector for receivers designed for the new High Quality F. M. Service to be inaugurated next year, since it obviates the need for a separate limiter stage.

The illustration shows the application of two GEX 34 in a typical ratio detector where full advantage has been taken of its small size by enclosing them in the I.F. transformer can. This construction reduces the risk of instability and eliminates the possibility of harmonic feed back via the heater leads.

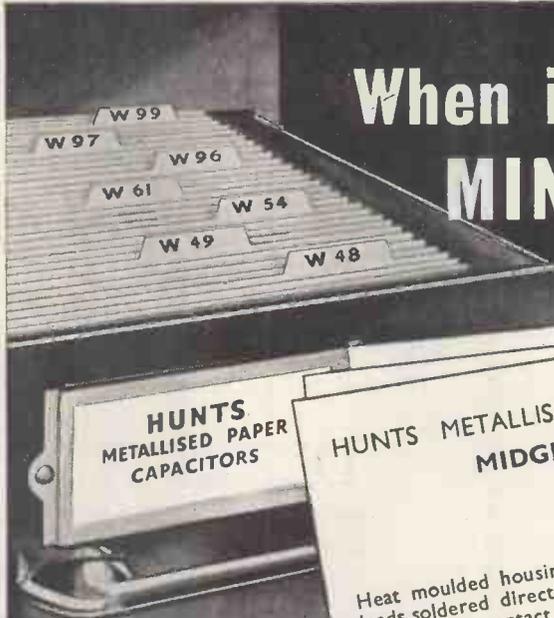


**Transformer Design.** Although the circuit shown above is conventional, an I.F. transformer designed for use with thermionic diodes is not necessarily the most suitable for germanium diodes. A suitable design of transformer has been evolved at The G.E.C. Research Laboratories, details of which are available on request.

Write to The Osram Valve and Electronics Department,

THE GENERAL ELECTRIC CO. LTD., MAGNET HOUSE, KINGSWAY, W.C.2.

# When it's a question of MINIMUM SIZES...



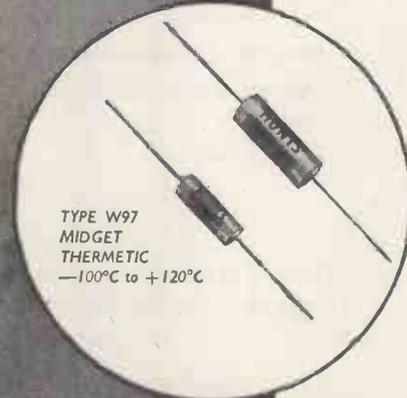
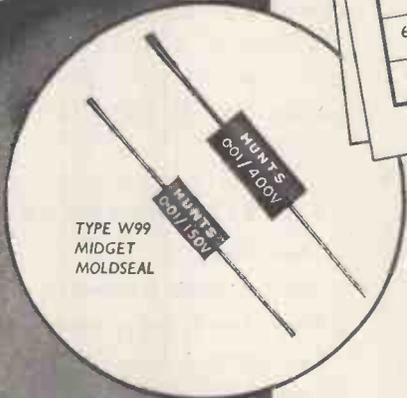
HUNTS METALLISED PAPER CAPACITORS  
MIDGET MOLDSEAL TUBULARS  
**TYPE W99**

**Specification**  
Heat moulded housing ensuring an adequate seal against moisture. Wire leads soldered directly to capacitor unit in a manner ensuring freedom from intermittent contact (strength of joint exceeds tensile strength of wire lead).

RANGES			
Working Voltage	Temperature Range	Capacitance $\mu F$	Size
150 D.C.	-40°C to +71°C	0.004 to 0.01	A
		0.02 to 0.04	B
400 D.C.	-40°C to +85°C	0.001 to 0.003	A
		0.004 to 0.01	B
600 D.C.	-40°C to +85°C	50pf to 0.001	A
		0.002 to 0.004	B
300 A.C.	-40°C to +71°C	50pf to 0.001	A
		0.002 to 0.004	B

SIZES \* A =  $\frac{1}{8}'' \times \frac{1}{8}''$       B =  $\frac{1}{4}'' \times \frac{1}{8}''$

Capacitance Tolerance: Standard  $\pm 20\%$  (Closer tolerance available)  
Insulation Resistance: 20,000 megohm working voltage  
Power Factor: than 2% at 1,000 per second at 20°C



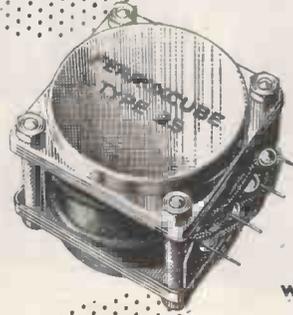
## Look to HUNTS!

For maximum reliability. Hunts capacitors for radio and electronic equipment include many types designed to meet the need of designers for decreased dimensions. Type W99 listed above is just one example taken from Hunts unparalleled range of capacitors for every purpose.

Years of specialisation in nothing but capacitor design and manufacture has enabled us to achieve and maintain that long-lasting reliability, and outstanding performance which characterises every Hunt product.

Please write for leaflet giving full details of types for all applications.





## High Q inductance coils

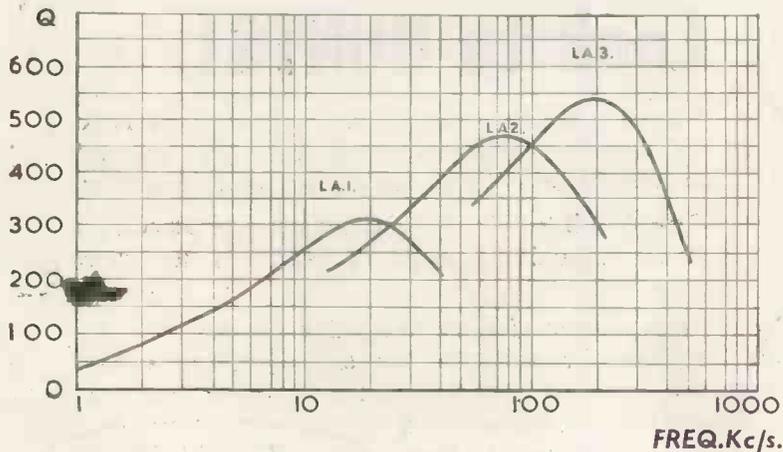
wound on Ferroxcube cores

DESIGNERS of compact and efficient tuned circuits and wave filters are making ever-increasing use of Mullard high Q inductance coils.

Based on Ferroxcube, the world's most advanced magnetic core material, these coils combine small size with an inductance of up to 30 henries over a wide frequency range. Furthermore, their convenient shape and self screening properties facilitate either individual mounting or stacking.

Full details of these and other high grade components now available from Mullard will be gladly supplied on request.

### TYPICAL Q VALUES



### Special Features

- Small size
- Low hysteresis loss factor
- High value of inductance
- Low self capacitance
- Controllable air gap facilitating inductance adjustment
- Self screening
- Controlled temperature coefficient
- Operation over a wide frequency range
- Easily mounted

# Mullard

\*Ticonal\* permanent magnets,  
\*Magnadur\* ceramic magnets,  
Ferroxcube magnetic cores.

**New**

The

**Editor**

**SUPER  
TWO-SPEED  
TAPE RECORDER**



A truly superb British-made recorder, rich in range and tonal qualities, for home and business recording. Its low price brings high fidelity recording within the reach of all. The "Editor Super" is sufficiently powerful to meet any volume requirement—sensitive enough to pick up the faintest whisper.

The "Editor Super's" range of tone, from maximum brilliance to a deep rich bass, IS IDEAL FOR PRE-RECORDED TAPES. It is simple in operation and has an unequalled smooth and reliable control. It is the latest addition to the Editor range of Recorders.

**55 GNS.**

(Carriage and Packing 15/-)

BUY ON THE M.O.S. PERSONAL CREDIT PLAN—10% deposit and balance over 6, 12, 18 or 24 months.

**TECHNICAL SPECIFICATION**

- ★ Recording sense to BSS, therefore suitable for pre-recorded tapes.
- ★ All leather suitcase with "continental" type of gilt locks and fittings. Detachable lid.
- ★ Completely self-contained, portable and compact. Overall size 16 1/2 in. x 12 in. x 5 1/2 in. (with lid 7 in.). Weight 33lb.
- ★ Supplied complete with 1200ft. high sensitivity standard Tape, and RONETTE desk microphone.
- ★ New design super tape deck powered by three recording motors with minimum wow and flutter.
- ★ Twin track recording GIVING TWO HOURS' PLAYING TIME AT 3 1/2 in. per sec.
- ★ Single knob control mechanically and electrically interlocked.
- ★ MIXING AND MONITORING FACILITIES for separate Radio/Gram and microphone inputs.
- ★ Tonal balancing control.
- ★ Amplifier with overall negative feedback uses miniature Mullard valves. May be used independently for P.A. or high fidelity reproduction.
- ★ Recording level meter by magic eye.
- ★ Brilliant reproduction from 5in. high flux P.M. speaker. 4 watts output.
- ★ L.S. Extension sockets and muting switch.
- ★ Uniform frequency response between 40-10,000 c/s. at 7 1/2 in. per sec.
- ★ Fast forward and fast rewind without unclipping tape, and accidental erasure made impossible by simple fully automatic control.
- ★ Drop-in Tape loading.
- ★ Positive and instantaneous servo braking on all functions.
- For A.C. Mains 200-250 v. 50 c/s.

The "EDITOR" at 45 Gns. is still the lowest priced quality tape recorder. Available on the M.O.S. Personal Credit Plan, as above.

**BURGOYNE**

**2-SPEED TAPE DECK**

Here is the heart of your Tape Recorder. If you are building or modernising your own equipment, you MUST have the latest BURGOYNE Tape Deck giving 2 speeds, designed for building into complete recorders.

**BRIEF SPECIFICATION**

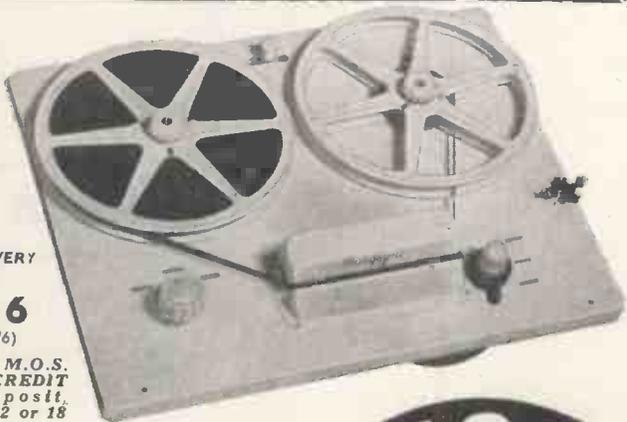
- ★ 2 HOURS' PLAYING TIME.
- ★ Automatic speed change.
- ★ Drop in Tape Loading.
- ★ Instantaneous and positive braking.
- ★ Minimum wow and flutter.
- ★ Frequency range 50/10,000 c/s at 7 1/2 in./sec.
- ★ Powered by 3 high-grade motors.
- ★ Twin-track high impedance heads.
- ★ Fast forward and rewind without unclipping tape.
- ★ Overall size 11 1/2 in. x 14 1/2 in.
- ★ For 200/250 v. A.C. Mains.

IMMEDIATE DELIVERY FROM STOCK

**£13.19.6**

(Carr & packing 7/6)

BUY ON THE M.O.S. PERSONAL CREDIT PLAN—10% deposit, balance over 6, 12 or 18 months.



**MAIL ORDER SUPPLY CO.**

The Radio Centre

33, Tottenham Court Road • London • W.1 • Tel. MUS 6667



## VISUAL VALVE TESTER

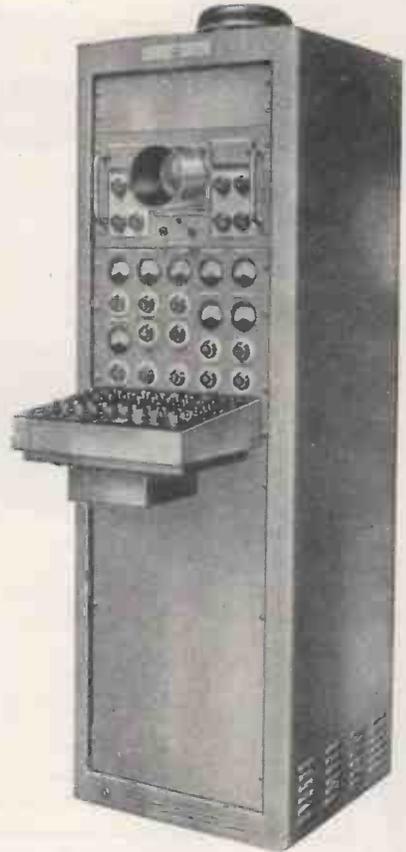
*This equipment displays on a cathode-ray tube a family of  $I_a/V_g$  curves for any receiving type thermionic valve. Eleven curves corresponding to eleven different grid voltages are presented simultaneously and a calibrated graticule permits rapid comparison with published data.*

*Nine standard valve bases are provided, with facilities for connecting others, and the various valve electrodes are connected to the requisite supplies by a multi-button switching board.*

*This permits any electrode to be connected to any supply without damage and also enables electrodes to be paralleled for test purposes.*

*All external parameters  $V_a$ ,  $V_s$ ,  $V_h$ ,  $V_g$ , are continuously variable over a wide range and current and voltage values are metered.*

*Full technical data is available on request.*



## CINEMA TELEVISION LTD

A COMPANY WITHIN THE J. ARTHUR RANK ORGANISATION

WORSLEY BRIDGE ROAD · LONDON · S.E.26  
HITHER GREEN 4600

**SALES AND SERVICING AGENTS:**

Hawnt & Co. Ltd., 59 Moor St. Birmingham, 4

Atkins, Robertson & Whiteford Ltd., 100 Torrissdale Street, Glasgow, S.2

F. C. Robinson & Partners Ltd., 122 Seymour Grove, Old Trafford, Manchester, 16

# FERRANTI

## CATHODE RAY TUBES

A wide range of Cathode Ray Tubes and Valves for industrial and domestic use is manufactured by the Electronics Department. 14" and 17" Rectangular Tetrode Cathode Ray Tubes with Aluminized screens and 6.3 volt, 0.3 amp. heaters are available.

Enquiries to Electronics Dept., Moston, Manchester, 10.



## SMALL HERMETICALLY SEALED INSTRUMENTS

Ferranti 2", 2½" and 3½" Hermetically Sealed Instruments for Service requirements are available in both moving coil and moving iron types for current and voltage measurement.

Enquiries to Instrument Sales Dept., Moston, Manchester, 10.



**FERRANTI LTD · MOSTON · MANCHESTER 10**

Head Office and Works : HOLLINWOOD · LANCs

London Office : KERN HOUSE, 36 KINGSWAY, W.C.2.



# Hi Fi HIGH FIDELITY AMPLIFIER

The PF91 amplifier, with the PF91A remote control unit, is a versatile and practical combination for those who demand realism in sound reproduction from record players, tape recorders, microphones or radio tuners.



Substantially flat frequency range from 20-20,000 c.p.s., up to 12 watt output.

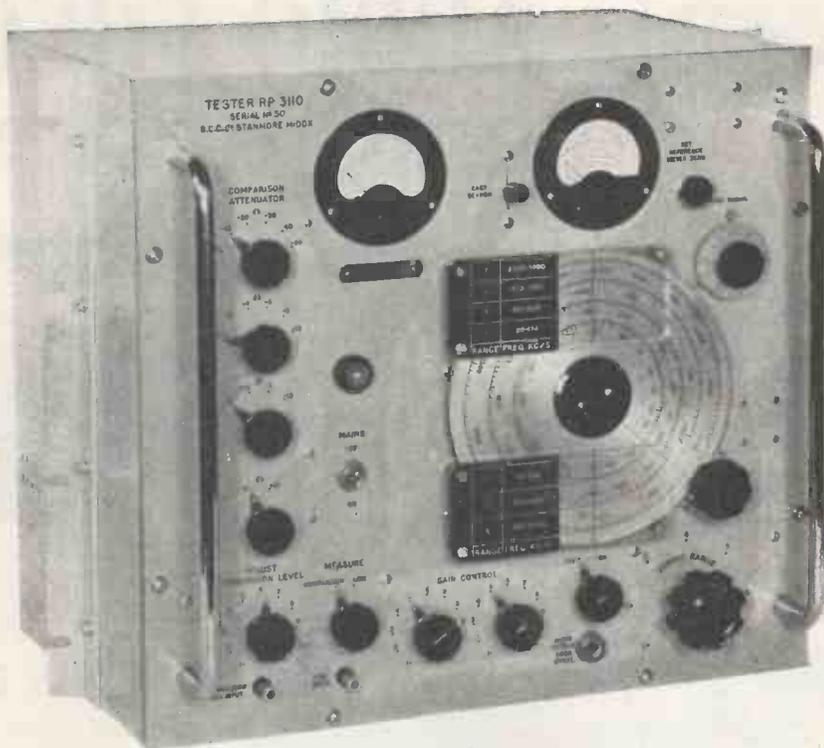
National Physical Laboratory confirms our claims for this amplifier.

Demonstrations of the PF91 can be arranged through Pye Hi-Fi agents. Please write for a fully illustrated booklet to Pye Limited, Box 49, Cambridge.

**MODEL PF91**  
**28 GNS**  
**MODEL PF91A**  
**12 GNS**

# TEST SET R.P. 3110

A transportable and self contained instrument which provides all the facilities required for measuring the level of a selected signal in the presence of signals of different frequencies.



## TECHNICAL DATA

Frequency range: 60 Kc/s to 3,000 Kc/s.

Through or terminated levels, using probe at a point distant from the Tester:—

from +10 db to -61.5 db, reference level 1 mw in 75 ohms.

Terminated levels, signals applied directly to

Tester:—

from +10 db to -81.5 db, reference 1 mw in 75 ohms.

Dimensions: 17" wide, 15½" high, 12" deep.

Weight: 75 lbs.

Power supply: 200-250V. A.C. 50 c.p.s. consumption approx. 70 watts.

AVAILABLE FROM STOCK



**BRITISH COMMUNICATIONS CORPORATION LIMITED**

Second Way, Exhibition Grounds, Wembley, Middlesex

Telephone: Wembley 1212



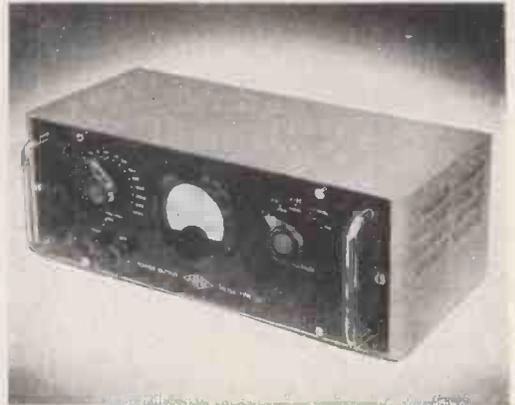
# AUDIO FREQUENCY EQUIPMENT

## POWER OUTPUT METER Type 708

Output powers from 1 milliwatt to 20 watts may be measured by this instrument, in the frequency range 30 c/s to 30 kc/s. No tapped matching transformer is used, and the input impedance remains resistive and constant over the whole frequency range.

**Power Range:** 1 milliwatt to 20 watts in 4 ranges.  
**Frequency Range:** 30 c/s—30 kc/s.  
**Input Impedance:** 2, 4, 7, 10, 15, 20, 40, 75, 100, 140, 250, 400, 600, 1,000, 2,000, 3,000, and 5,000 ohms.  
**Accuracy:**  $\pm 10\%$  of full scale power from 30 c/s to 15 kc/s. The meter reading is approximately 1 db low at 30 kc/s.

**Price and Delivery:** £40 Ex Stock.



## L.F. SIGNAL GENERATOR Type 702

This Signal Generator utilises a resistance-capacitance type of oscillator to provide stable, accurate and easily controlled voltages in the frequency range 30 c/s—30 kc/s. A screened and balanced output transformer and attenuator enable unbalanced, balanced and floating outputs to be obtained from a source of constant 600 ohm impedance.

**Frequency Range:** 30 c/s—300 c/s, 300 c/s—3 kc/s, 3 kc/s—30 kc/s

**Stability:**  $\pm 0.05\%$ ,  $\pm 0.5$  c/s.

**Attenuator:** A 600 ohm constant impedance attenuator provides steps of 20, 40 and 60 db of attenuation under all output conditions.

**Price and Delivery:** £75 Ex Stock.

## FREQUENCY METER Type 726

This instrument indicates directly on a large scale meter, the frequency of any repetitive electrical waveform of amplitude between 0.1 and 20 volts, over the range 20 c/s to 20 kc/s. When used as a tachometer, measurement of speeds of rotary or reciprocating movements may be made up to 1,200,000 r.p.m. without loading the mechanism under test in any way.

**Frequency Range:** 0—200 c/s, 0—12,000 r.p.m.  
 0—2,000 c/s, 0—120,000 r.p.m.  
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**Accuracy:**  $\pm 1\%$  of f.s.d.

**Power Outputs:** Output Voltages are available for operating Airmec Photocell Equipment.

**Price and Delivery:** £65 Ex Stock.



*Full details of these or any other Airmec instruments will be forwarded gladly upon request.*

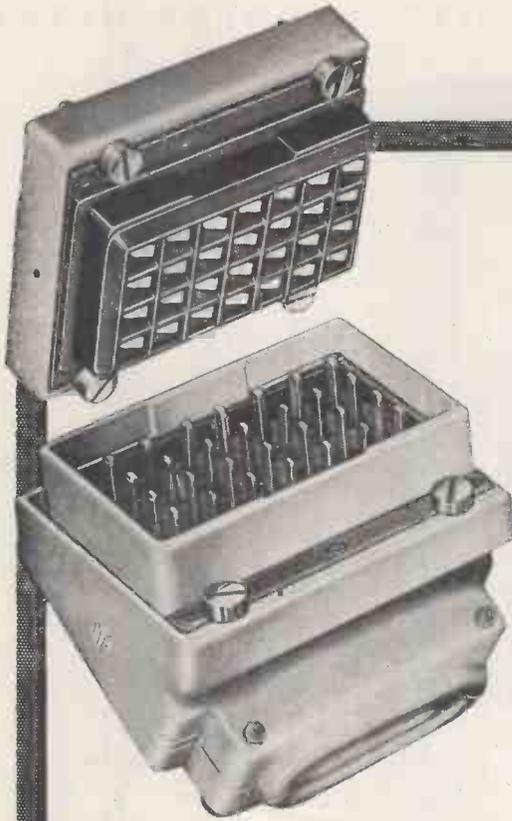
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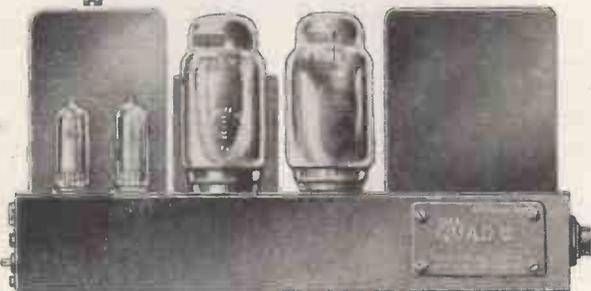


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There are those who consider that there is little to choose in the range of power amplifiers now available—perhaps because the power amplifier is usually considered the “easy” part in the search for audio perfection. Why is it then that leading engineers are so enthusiastic about the QUAD II design?

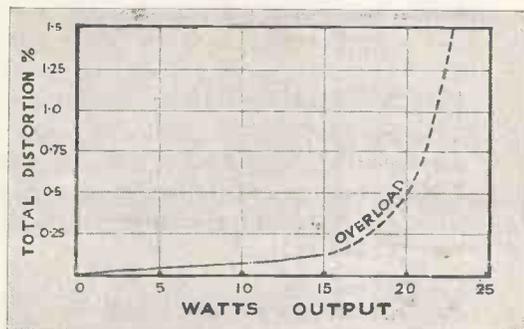
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They like the unique integrated feedback to provide complete stability independent of phase changes in the load current . . . the method used for eliminating the loop gain outside the audio range without prejudice to the input signal . . . the way that feedback is again used to provide optimum design stage by stage and to control the effective time constants. They like its use yet again to provide a unique self-balancing phase changer without the usual asymmetry to the H.T. line. They like, too, the fact that the specification is fully met with commercially tested valves without matching or alignment of any kind. They extol the conservative ratings and restoration from overload (several nation-wide broadcasting corporations officially uprate the output to 20 watts, since with this degree of overload, distortion is still well within their acceptance figures).



Good engineering for the best performance\* also results in greater efficiency. Compare the size of the QUAD with any other amplifier of approaching specification. Note the size of the output transformer which results from optimum choice of flux and core material to suit design requirements.

\* The unique output stage design principles are discussed in *Wireless World*, September, 1952.



Linearity and overload of the QUAD II amplifier

The QUAD II power amplifier is primarily designed as part of the complete QUAD II amplifier. The power amplifier is also supplied separately as a quality standard when with a suitable input transformer it can be fed direct from a 600 ohm line.

The QUAD II is available throughout the world. Fully stocked servicing organisations are now operating in Canada, throughout U.S.A., Panama, Canal Zone, Trinidad, Jamaica, Venezuela, Australia, Malaya, Singapore, Japan, Hong Kong, Burma, India, Ceylon, Pakistan, South Africa, Portugal, Italy, France, Switzerland, Belgium, Norway and Sweden.



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Rear view, power output section showing PA tuning and output coupling unit.



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Prov. Patent 10037/53

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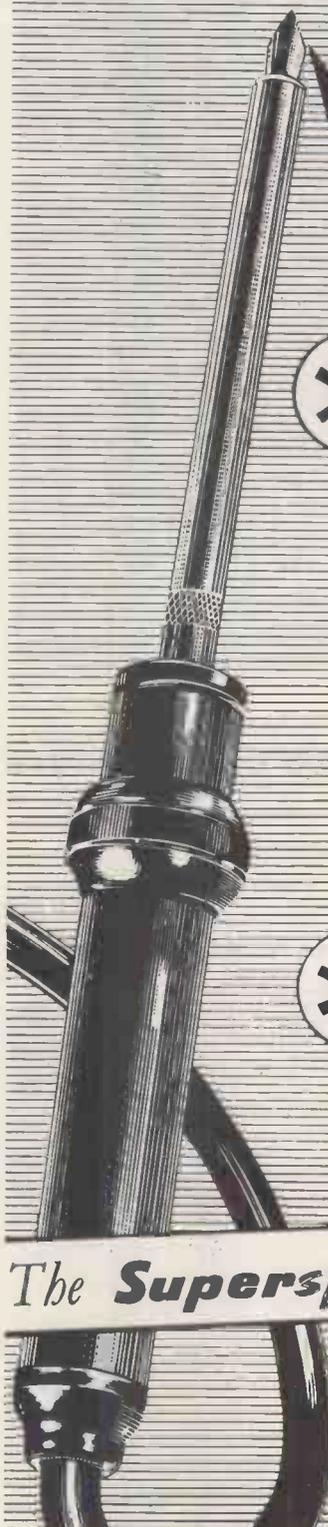
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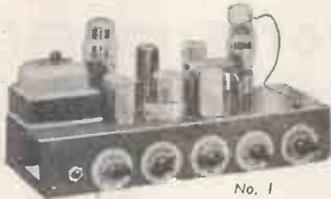
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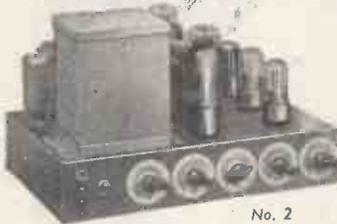
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**No. 1 "SYMPHONY" AMPLIFIER** is a 3-channel 5-watt Gram/Radio Amplifier with astonishingly flexible tone control. You can lift the treble, the bass, or—and here is the unique feature—the middle frequencies to suit your own ear characteristics and the record or radio programme being heard. It is thus possible to arrange the frequency-response of the amplifier to a curve equal and opposite to the resultant curve of the other items in the chain so that what finally registers in the brain is as per original. This flexibility of control is far more important than mere nominal linear response of the amplifier, as the pick-up, speaker, etc., are not linear. Independent Scratch-Cut is also fitted and special negative-feedback circuit employed. The Amplifier can accommodate a wide variety of records from old 78's to new L.P.'s. Input is for all types of pick-up of 0.1 v. output or more and there is full provision (and power) for Radio Tuner. It is available to match 2/3 or 15 ohms speakers. Price: 10 gns. (carriage 5/-). Fitted in portable Steel Cabinet, 35/- extra.



No. 2

**No. 2 "SYMPHONY" AMPLIFIER** as No. 1 but with 10-watt Push-pull triode output and triodes throughout. Woden mains and output transformers and choke. Full provision and power for Tuner. Output tapped 3, 7.5 and 15 ohms. Competes with the most expensive amplifiers on the market yet costs only 15 gns. (carriage 5/-). Fitted in portable Steel Cabinet 2 gns. extra.



**"SYMPHONY" AMPLIFIERS with REMOTE CONTROL.** Both the above model Amplifiers are available with all controls on a separate Control Panel with up to 4 feet flexible cable which simply plugs into the amplifier. Enables the Amplifier proper to be sat in the bottom of a cabinet whilst the controls are mounted conveniently higher up. Extra cost 2 gns.

**"STUDIO SYMPHONY" AMPLIFIERS, Models 1 and 2,** new models specially designed to get the maximum out of the revolutionary new Collaro Studio pick-ups and heads type "P" or Transcription. Specification as per our Standard Symphony models but with high-gain, low-noise, built-in Pre-amplifier stage with separate switched correctors for Std. and L.P. Third position on switch provides input matching for Acos and similar output pick-ups. These remarkable new models thus provide all the facilities and matching of our Standard Symphony Amplifiers PLUS the specialised Collaro matchings. Send for copy of "The Gramophone" review of these instruments. Price: No. 1, 12 gns; No. 2, 17 gns. Carriage 5/-.

**CURRENT GARRARD PRODUCTS AVAILABLE FOR IMMEDIATE DELIVERY FROM STOCK AT PRESENT.**

**MODEL TA** 3-speed unit, but with plug-in turnover head Type G.C.2, £10/16/-, or with Acos HGP 33 or 37 heads, £10/14/-, or with two separate high fidelity Acos HGP35 heads, £12/17/-, Unit less heads, £8/11/-, post 2/6. Heads, 42/3 each, post 1/-.

**MODEL TB** as above, but with long pickup arm. Less heads, £8/11/-, post 2/6. Heads to fit this unit: Decca XMS, 55/-, Decca Crystal, 35/-, Garrard Standard Magnetic, 25/-, miniature magnetic low impedance, 25/-, miniature magnetic high impedance, 35/-. Post on heads 1/-. Unit can be supplied with any combination of above heads and is carefully adjusted for stylus pressure on despatch.

**MODEL RC80M**, less heads, £15/5/-, with new turnover head, £17/9/6, with two separate Acos HGP35 heads, £19/9/-, carriage 5/-.

**COLLARO PICKUPS AND HEADS.** Studio Pickup Arm, 13/10. Studio Pickup head type "O" or "P," £3/0/9. Pickup complete £3/14/7. Studio Transcription Pickup Arm with Studio "P" head, £4/15/9. Ditto with Transcription head, £5/2/5.

**TRANSCRIPTION MOTORS IN STOCK.**

**CONNOISSEUR**, 3-speed motor, £23/8/11.

**SNIP NO. 1**

**GARRARD LATEST MODEL RC80M AUTO-CHANGER.** Fitted with full-length Pick-up Arm to take 3-pin plug-in heads, manufactured end of Oct. 1954. **PRICE LESS HEADS, £15/5/-, plus carriage 5/-.** These extraordinarily versatile units can be supplied fitted with the following combinations of Pickup Heads at the following prices:

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With two Decca Crystal Heads, £18/10/-.

With Decca Crystal for L.P. and Garrard Miniature Mag. for Std. Takes miniature fibre or steel needles. £18/13/-.

With adaptor and two Acos HGP39-I Heads, £20/5/-.

With adaptor and one Acos HGP39-I Head for L.P. and Garrard Miniature Mag High Impedance for Std. Takes miniature fibre or steel needles. £19/17/-.

The above combinations of heads are matched for output and stylus pressure carefully adjusted before despatch. Carriage in each case 5/-.

Above mounted in Portable Cabinet 90/- extra

**IMMEDIATE DELIVERY FROM STOCK**

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Very latest Model "MONARCH" 3 speed **AUTO-CHANGER** fitted with latest ACOS HGP37 turnover Pickup Head for Std. and L.P. Plays 12in., 10in., and 7in. records mixed in any order. Capacity 10 records. Operates on 100/125 and 200/250 v. A.C. 50 c/s. Unit plate measures 12 1/2in. x 10 1/2in. Height above plate required 5 1/2in.; depth below required 2 1/2in. **PRICE COMPLETE £13/10/-, Carriage 5/-.**

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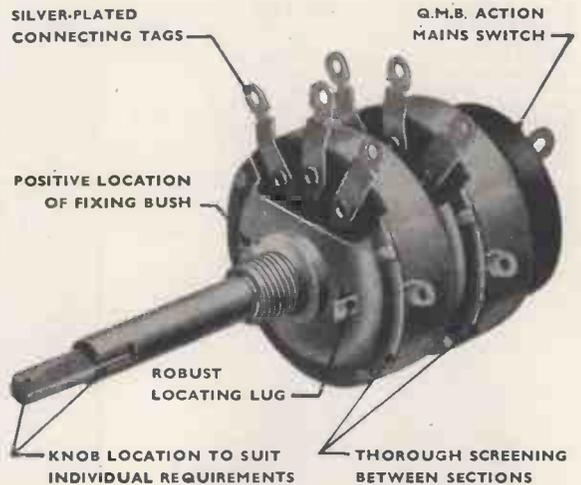
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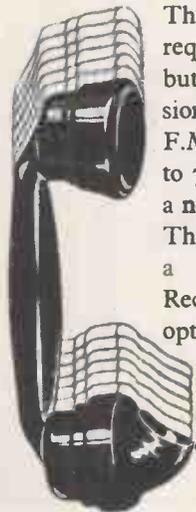
Control spindles can be supplied to suit customers' requirements.

The wide range of EGEN controls includes: Carbon Potentiometers Type 102 • Pre-set Resistors Type 104 • Miniature Carbon Potentiometers Type 105 and 115 • Sub-miniature Volume Controls Type 111, 123 and 125 • T.V. aerial plug and socket • Pre-set potentiometers Type 126/127.

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**Abbreviated Specification**

Frequency range 60—216 mc/s  
 Transmitter output Power 10 watts, or  
 with Amplifier Unit—50 watts  
 Maximum Deviation 50 kc/s

**Overall Transmitter-Receiver Performance**

Frequency Response 300 c/s—6 kc/s  $\pm 3$  db  
 6 kc/s—36 kc/s  $\pm 1$  db  
 Intermodulation Level At least -55 dbm  
 for 2 tones applied each at 0 dbm  
 Receiver Bandwidth 6 db down  $\pm 120$  kc/s



**Telecommunications**

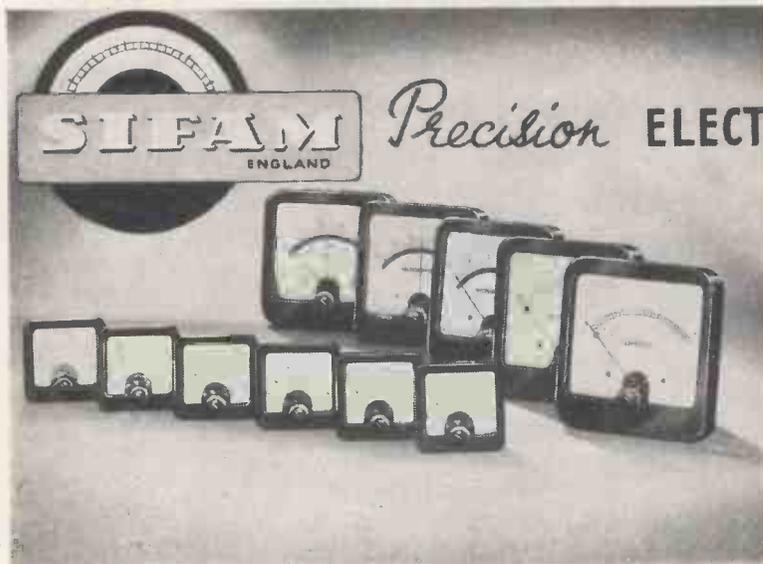
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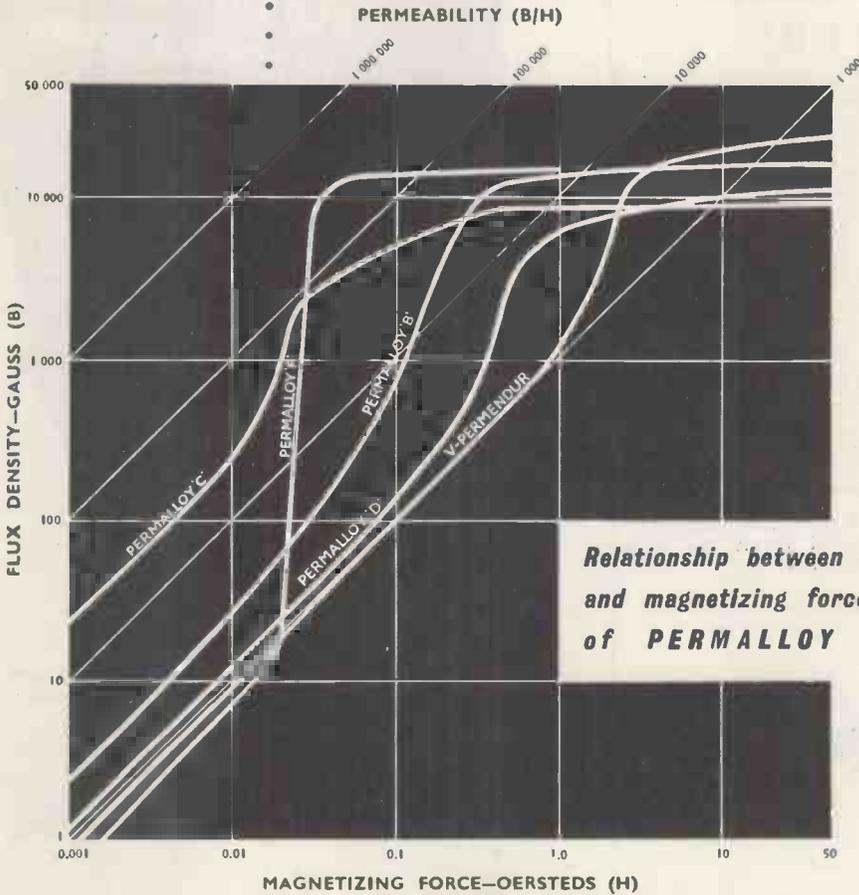
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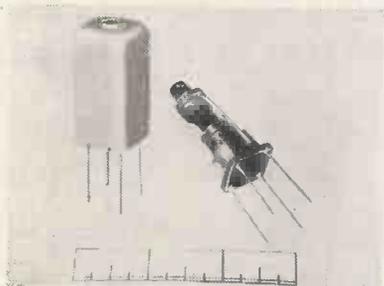
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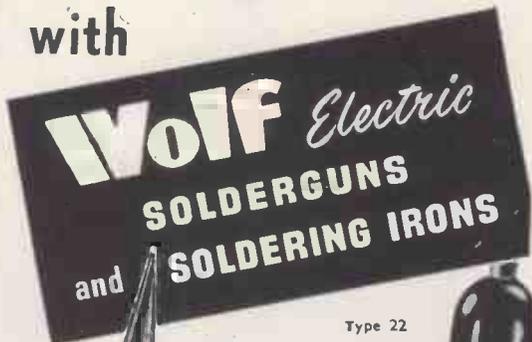
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Power Supply:	110/250 v. 4/100 c/s, 40 watts approx.
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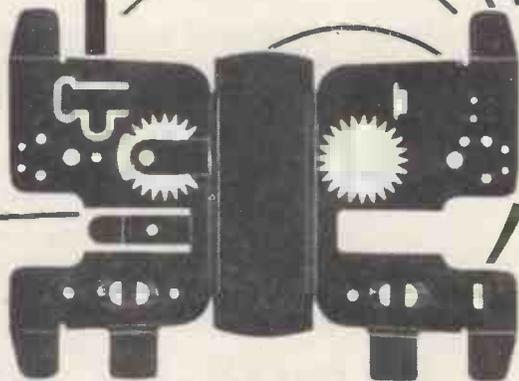
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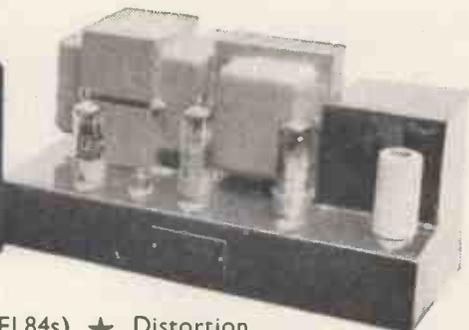
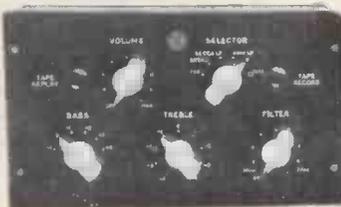
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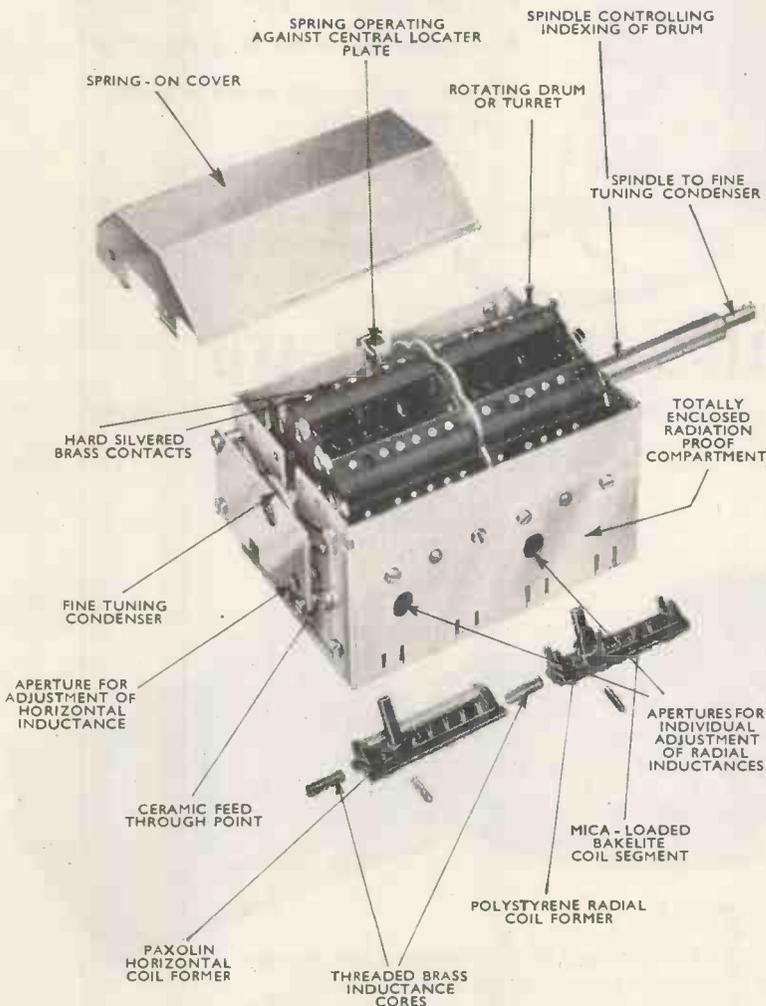
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**2** *All circuits are adjustable with the unit in position in a Television receiver.*

Adjustable cores to all inductances are easily accessible with the tuner in position in a Television receiver. The tuner can, therefore, be set up or re-adjusted in its actual operating position.

**3** *Additional tuned circuits may be added at any time without removing the Tuner from the receiver.*

The Ediswan Clix tuner is designed so that additional coil segments can be added at any time while the tuner is in position in a receiver.

To tune to another channel the serviceman merely clips into position additional coil segments, carrying correctly wound coils, and trims them by the adjustable cores provided.

There is no need to dismantle the tuner or return it to the Factory for any part of this operation.

**4** *Wiring reduced to an absolute minimum thereby eliminating stray capacities.*

Stray capacities between wiring can lead to serious mistuning on the very high frequencies of Television Band 3. The Ediswan Clix Tuner is designed so that wiring is reduced to an absolute minimum and materials are specially selected to overcome the problems of drift and instability encountered on these frequencies.

**5** *Easily accessible for servicing.*

The 'L' section and 'U' section which form the Ediswan Clix tuner are easily parted without removing the drum. This gives easy access to the wiring on the 'L' plate for servicing purposes.

**6** *Suitable for mounting in deep or shallow chassis.*

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T.V. SERVICE PATTERN GENERATOR TYPE GM 2891



(Made in Holland)

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- 3 Video signal both positive and negative
- 4 Simultaneous sound and video carrier
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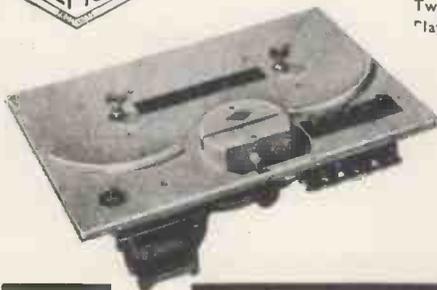
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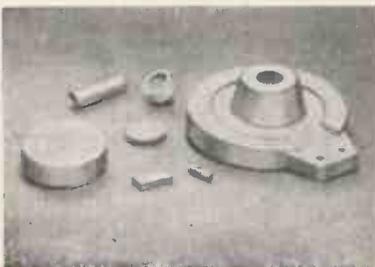
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Frequency coverage ...	80-15,000 c.p.s.
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\* See page 75 for details of the Armstrong A.10 High Fidelity Amplifier.

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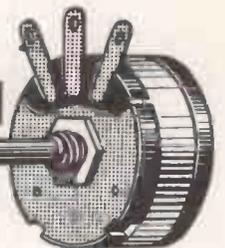
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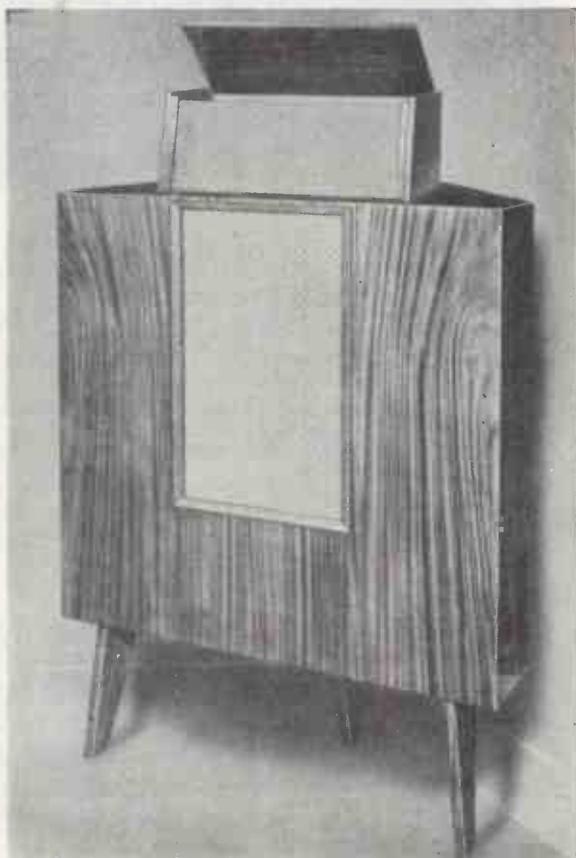
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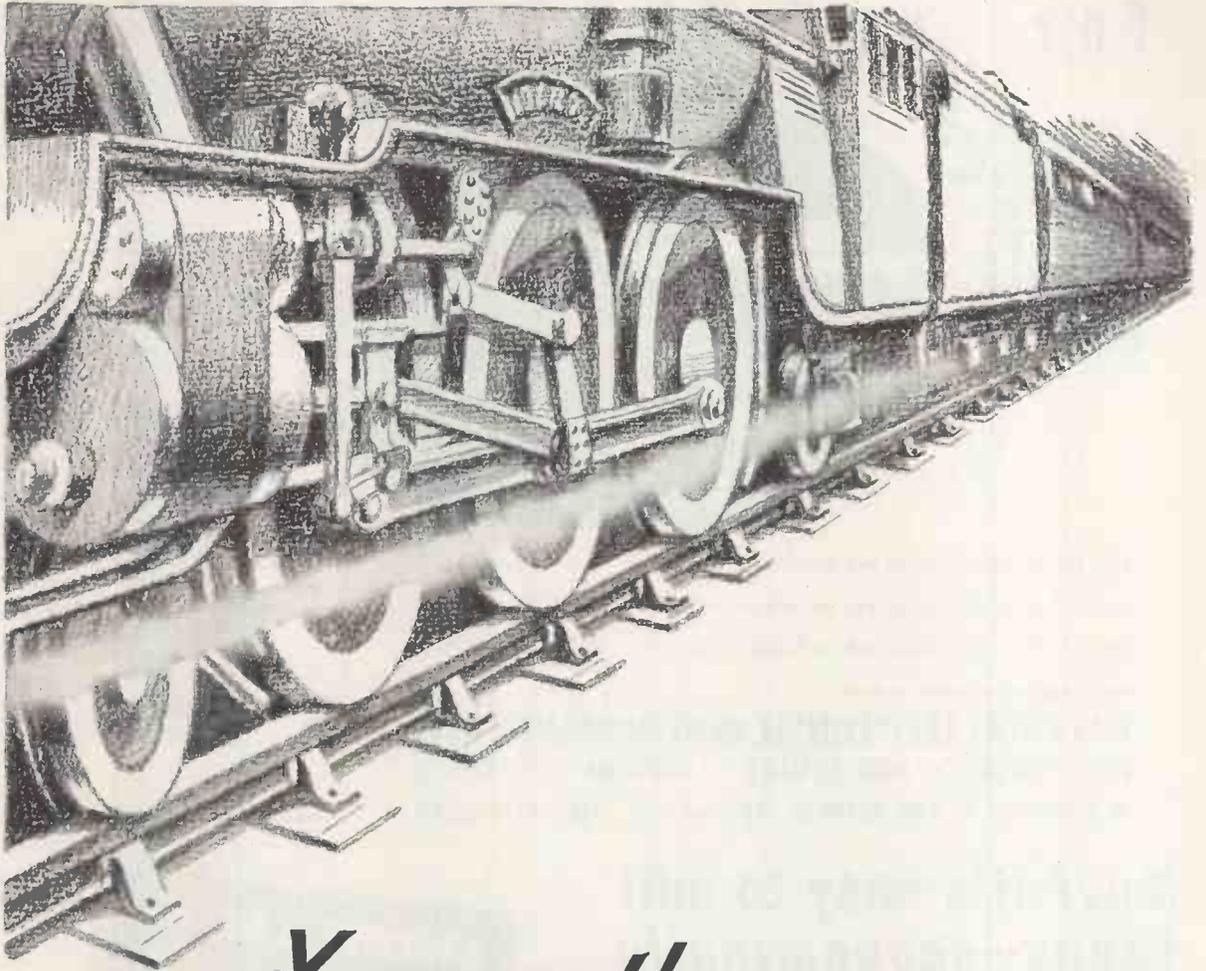
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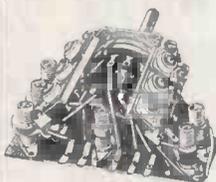
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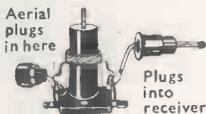
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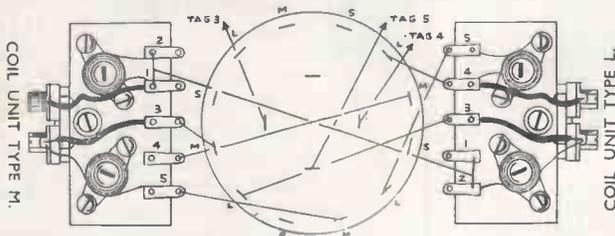
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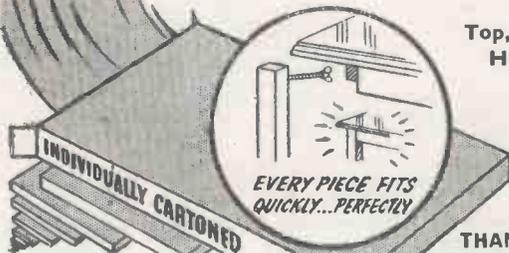
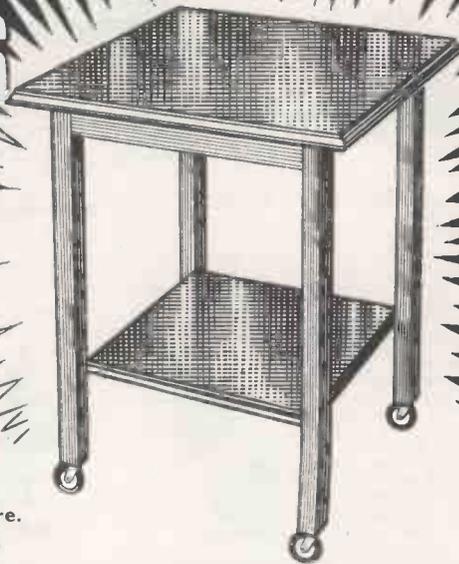
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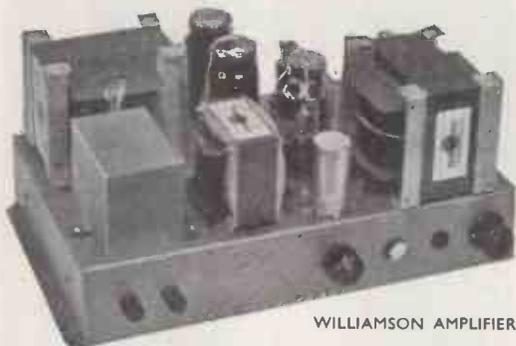
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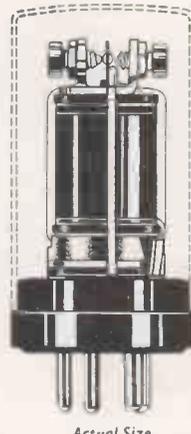


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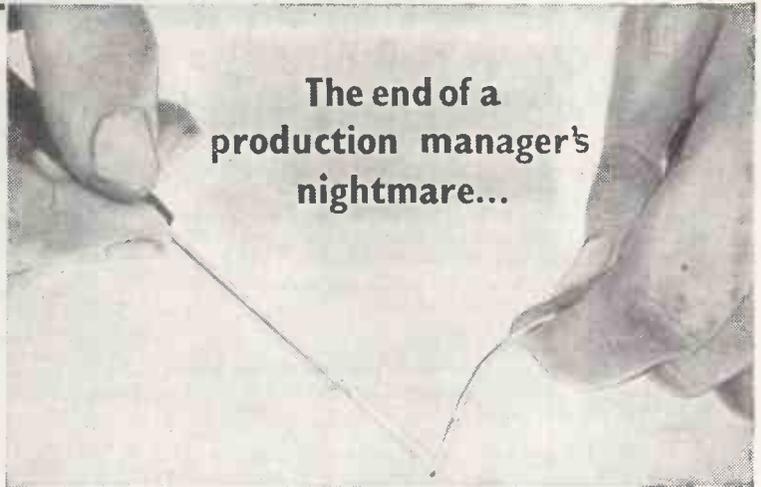
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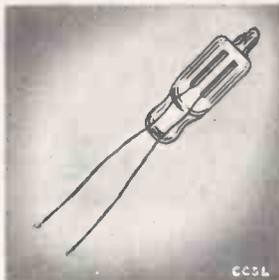
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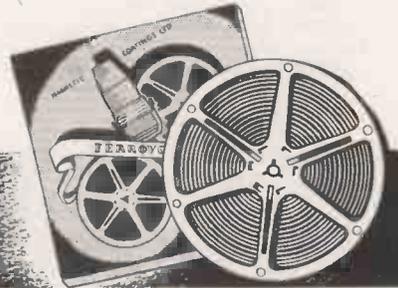
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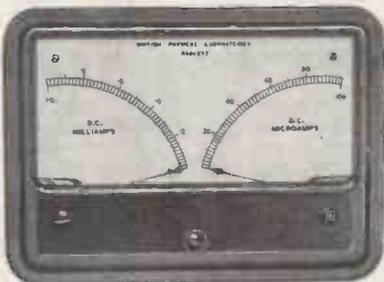
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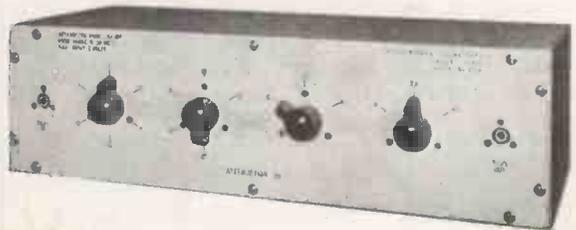
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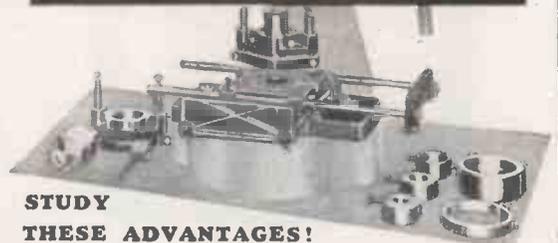
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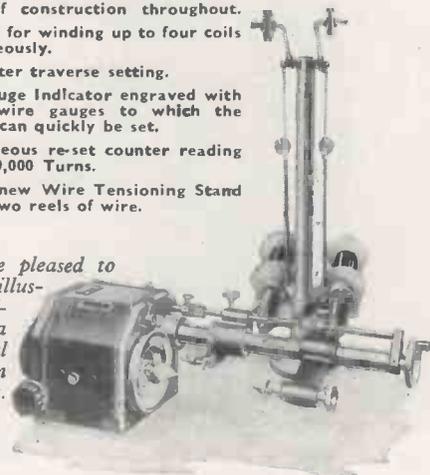
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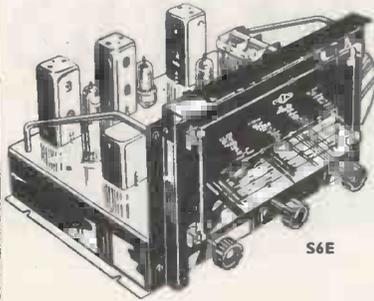
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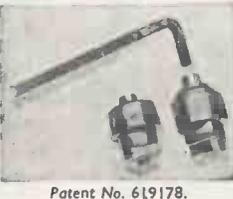
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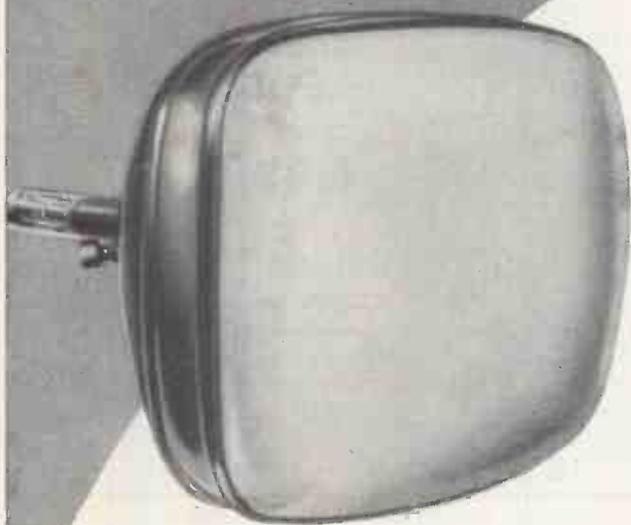
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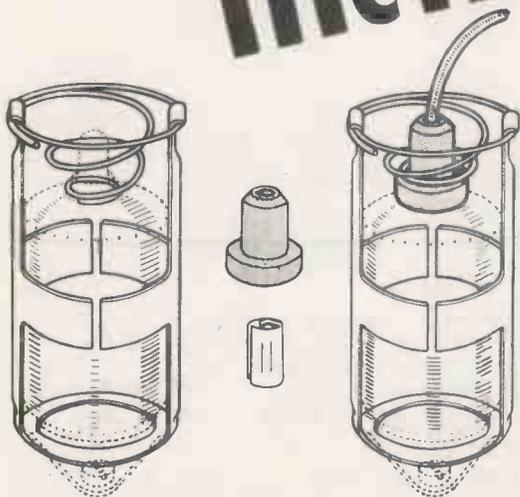
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## B7G and B9A VALVE RETAINERS



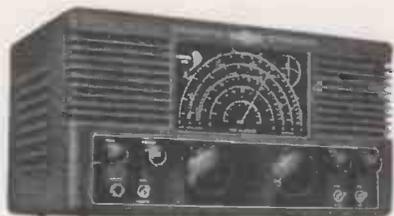
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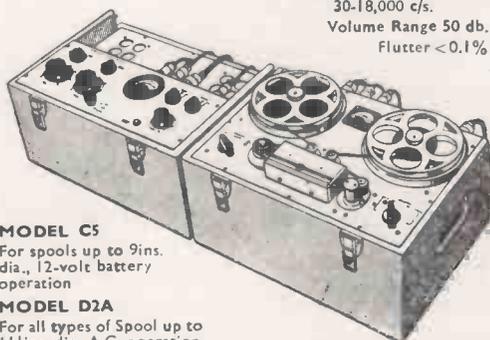
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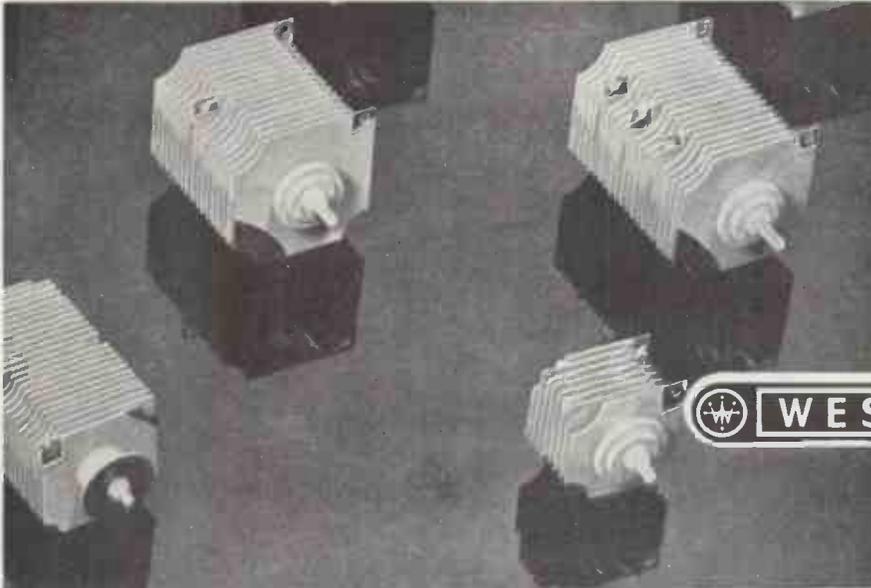
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Including all valves  
(plus cost of CRT)



THE COMPLETE TELEVISOR IS SAFE TO HANDLE, BEING COMPLETELY ISOLATED FROM THE MAINS BY A DOUBLE WOUND MAINS TRANSFORMER. ALL PRESET CONTROLS CAN BE ADJUSTED FROM THE FRONT, MAKING SETTING UP VERY SIMPLE.



## The NEW PREMIER TELEVISOR

SUITABLE FOR USE WITH THE ENGLISH ELECTRIC CATHODE RAY TUBE T901 OR ANY POPULAR WIDE ANGLE TUBE

Brief Technical Details are as follows:

20 valves (plus tube) Superhet Receiver, tunable from 40-68 Mc/s without coil or core changing. Wide Angle scanning Flyback EHT giving 14 kV. Duomag Focalsiser, permanent magnet focusing with simple picture centring adjustments, suitable for any wide angle Tube, may also be used with a 12in. Tube with very minor modifications.

**VISION CIRCUIT.** Common RF Amplifier, single valve frequency changer, two IF stages, Video Detector and Noise Limiter followed by special type of Video Output Valve. ALL COILS PRE-TUNED ASSURING ACCURATE ALIGNMENT AND EXCELLENT BANDWIDTH.

**SOUND CIRCUIT.** Coupling from anode of frequency changer, two IF stages, Double Diode Triode detector and first LF Amplifier, Diode Noise Limiter and Beam type Output Valve, feeding a 10in. Speaker. ALL COILS PRE-TUNED.

**TIME BASES.** 2 valve sync. Separator, giving very firm lock and excellent interlace.

**LINE TIME BASE.** Blocking Oscillator using a pentode driving a high efficiency output stage comprising Ferroxcube Cored Output Transformer with Booster Diode.

**FRAME TIME BASE.** Blocking Oscillator driving a Beam Output Valve coupled through a Transformer to the high efficiency FERROXCUBE Cored Scanning Coils.

**POWER PACK.** Double wound Mains Transformer supplying all L.T. and H.T. using two full-wave Rectifiers.

The Televisor may be constructed in 5 easy stages: (1) Vision, (2) Time Base, (3) Sound, (4) Power Pack, (5) Final Assembly. Each stage is fully covered in the Instruction Book, which includes layout, circuit diagrams and point-to-point wiring instructions.

The Instruction Book also includes full details for converting existing Premier Magnetic Televisors for use with modern wide angle tubes. All components are individually priced.

Instruction book 3/6, Post Free.

## PREMIER TELEVISOR CONSOLE CABINETS

### For 14", 16" and 17" Televisors

A handsome Walnut Cabinet that will be a fitting housing for a first-class Televisor.

Folding doors are fitted to cover the Cathode Ray Tube when not in use. A flap is provided which gives access to the preset controls on the front edge of the Chassis. A baffle board suitable for a 10in. Loudspeaker and all the necessary Tube and Chassis bearers are included. The overall dimensions of the Cabinets are the same: Height 38½in. Width 19in. Depth Top 19in. Depth Bottom 21in.

#### TUBE ESCUTCHEONS

17in. White Moulded .....	21/- (pkg. & post 1/6)
17in. Bronze Moulded, complete with Protective Glass .....	48/- (pkg. & post 2/6)
14in. Black Moulded .....	7/6 (pkg. & post 1/-)
Dark Screen Filter suitable for 14in. Tube .....	21/- (pkg. & post 1/6)
Dark Screen Filter suitable for 16in. and 17in. Tubes .....	25/- (pkg. & post 1/6)
Polystyrene Mask for E.E.T.901 .....	45/4 (pkg. & post 2/6)
Rubber Ring (anti-Corona) for E.E.T.901 .....	6/8
Polystyrene Shroud for E.E.T.901 .....	6/2

PRICE **£13-10-0** PLUS 21/- PKG. & CAR. H.P. TERMS: DEPOSIT £4.10.0 & 12 MONTHLY PAYMENTS OF 16/11

TERMS OF BUSINESS: Cash with order or C.O.D. over £1. Please add 1/- for Post Orders under 10/-, 1/6 under 40/-, unless otherwise stated.

# PREMIER RADIO COMPANY

## Limited supplies of C.R. TUBES

### VCR517C

6 1/2 in. picture. This tube is a replacement for the VCR97 and VCR517. Guaranteed full size picture. Price 35/-, Plus 2/6 pkg., carr., ins.

### VCR516

5 in. blue picture. Heater volts 4 anode 4 kV. In manufacturer's original carton. £1/19/6, plus 5/- pkg., carr., ins.



ALL BRAND NEW

## CABINETS—PORTABLE

### Model PC/1

Brown Rexine covered 22/6  
Overall dimensions 15 in. x 13 1/2 in. x 6 in.  
Clearance under lid when closed 2 1/2 in.

### Model PC/2

Grey Lizard Rexine covered 45/-  
Overall dimensions 15 in. x 13 in. x 6 in.  
Clearance under lid when closed 2 1/2 in.

### Model PC/3

Rexine type covering in various colors 69/6  
Overall dimensions 16 1/2 in. x 14 1/2 in. x 10 1/2 in.  
Clearance under lid when closed 6 1/2 in.  
All the above Cabinets are supplied with Panel, Carrying Handle and Clips.  
Packing and Postage 2/6.



## 5-WATT AMPLIFIER

Enclosed in metal case. Output suitable for 15 ohms and 3 ohms Speakers. Input switched for pickup or microphone. B.V.A. miniature valves. 8 gns. Postage and packing 7/6.

## E.A.R. MULLARD 510 AMPLIFIER

Based on the Mullard circuit. Combined change-over switch for standard, L.P. records and radio. Plug-in filter network. 18 gns. Postage and packing 7/6.

## RECTIFIERS

### E.H.T. Penail Type S.T.C.

Type K3/25	650 v.	1 mA.	4/7
" K3/40	3.2 kV.	1 mA.	6/-
" K3/45	3.6 kV.	1 mA.	8/2
" K3/50	4 kV.	1 mA.	8/8
" K3/100	8 kV.	3 mA.	14/3
" N3/160	12 kV.	1 mA.	21/6
" K3/180	14.4 kV.	1 mA.	24/6

### H.T. Type S.T.C.

Type RM1	125 v.	60 mA.	4/6
" RM2	125 v.	120 mA.	4/6
" RM3	125 v.	125 mA.	5/6
" RM4	250 v.	250 mA.	18/-

### L.T. Type Full Wave

6 v. 1 amp.	4/-
12 v. 1 amp.	8/-
12 v. 2 amp.	10/9
12 v. 4 amp.	15/-

## BATTERY CHARGERS

200-250 v. A.C. Will charge 2 v., 6 v. and 12 v. Car Battery at 1 amp. Housed in strong metal casing. Finished in Green hammered enamel. Size 6 in. long, 3 1/2 in. wide, 3 1/2 in. high. Guaranteed 12 mths. The above unit is manufactured by PREMIER and does not contain Ex-Govt. components. Plus 2/6 P. and P. 39/6



## BATTERY CHARGER KITS

All incorporate metal rectifiers. Transformers are suitable for 200-250 v. A.C. cycle mains. Cat. No. 2002 Charge 6 volt accumulator at 1 amp. Resistor, supplied to charge 2 volt Accumulator 13/6  
2004 Charges 2, 6 and 12 v. accumulators at 1 amp. 19/11

## ALUMINIUM CHASSIS 18 s.w.g.

Substantially made from Bright Aluminium with four sides:

7 x 5 1/2 x 2 1/2 in.	4/-	10 x 9 x 3 in.	7/-
7 x 3 1/2 x 2 in.	3/9	12 x 10 x 3 in.	7/9
9 1/2 x 4 1/2 x 2 in.	4/3	14 x 10 x 3 in.	7/11
10 x 8 x 2 1/2 in.	5/6	16 x 10 x 3 in.	8/3
12 x 9 x 2 1/2 in.	7/-	16 x 8 x 2 1/2 in.	8/-
14 x 9 x 2 1/2 in.	7/6		

## ALUMINIUM PANELS 18 s.w.g.

7 x 6 in.	1/3	7 x 4 in.	1/-
9 1/2 x 6 in.	1/8	9 1/2 x 4 in.	1/5
10 x 9 in.	2/2	10 x 7 in.	1/11
12 x 9 in.	2/8	12 x 7 in.	2/5
14 x 9 in.	3/2	14 x 7 in.	2/11
16 x 9 in.	3/8	16 x 7 in.	3/5
20 x 9 in.	4/8	20 x 7 in.	4/5
22 x 9 in.	5/2	22 x 7 in.	4/11

## SPECIAL OFFER!!

SAVAGE AUTO-TRANSFORMERS INPUTS 110 v., 130 v., 200 v., 230 v., 250 v. and 250 v. Stud switch control. OUTPUTS 110 v. and 230 v. at 1,200 v. nominal, tested 2.4 KVA. 15A. 3 pin sockets and fuses on panel in handsome grey cabinet. Brand new, £7/15/- De Luxe model by Neverlin, £8/15/- P. & P. 10/-.

## A.C.R.I. C.R. TUBES

5 1/2 in. screen. 4 volt Heater. This Electrostatic Tube is recommended as eminently suitable for Television. 15/- plus 2/6 Pkg., carr. and ins. Data sheets supplied.

## GRAMOPHONE PRE-AMPLIFIER

Power requirements 200-250 v., 2 mA., and 6.3 v. 3a., this may be taken off existing radio. All the components to build the above unit, 22/6, plus 1/6 pkg. and postage.

## Famous Manufacturer's Surplus of

## ANTI-INTERFERENCE AERIALS

offered at a fraction of original cost

The aerial is designed for reception of long, medium and short waves, with any ordinary or communications receiver, having an input impedance greater than 1,000 ohms long/medium waves and 150 ohms short waves. The installation discriminates against locally generated electrical interference, especially on the short wave bands. The equipment enables the installation of an 8.3 Mc/s flatly-tuned dipole which operates as a "T" aerial on medium and long waves. The aerial and receiver transformers are intended to be interconnected with a 70 ohms co-axial cable.

## COMPONENT PARTS

Aluminium Aerial Transformer Assembly. Comprising one each: Aluminium transformer. Transformer clip rubber sucker, 1/2 in. x 1/2 in. brass screw, 4AB x 1/2 in. brass bolt, 4BA nut. Receiver Transformer. Complete with insulators, clips, etc.; porcelain insulators 2 each, 60ft. insulated aerial wire, 60ft. screened co-axial down lead. Installation instruction leaflet included. LESS CO-AXIAL CABLE & AERIAL WIRE. 15/- plus 1/6 pkg. and carr. COMPLETE. 35/-, plus 1/6 pkg. and carr.

## QUALITY CRYSTAL PICK-UP

ROTHERMEL TYPE U48 26/- Plus 1/6 Pkg. and Carr.

# The New "PREMIER PORTABLE" TAPE RECORDER

USING THE NEW LANE 2 SPEED TAPE UNIT MARK 6

## COMPLETE 39 GNS CASH

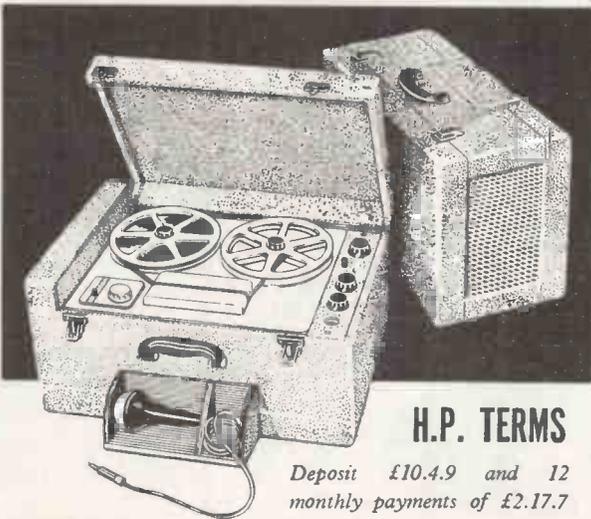
Packing & Carriage 1 gn.

(Including Reel of Scotch Boy Tape and Microphone)

or Complete Kit including All Parts, Valves, Speaker Cabinet, Tape Unit, Reel of Scotch Boy Tape, Rewind Spool and Microphone at **£37.4.0** plus pkg. & carr. 15/-.

## SPECIFICATION

- ★ TWO SPEEDS 7 1/2 in. AND 3 1/2 in. ★ 7 VALVE HIGH QUALITY PER SECOND. AMPLIFIER.
- ★ THREE SPECIALLY DESIGN- ★ INDEPENDENT TREBLE AND ED RECORDING MOTORS. BASS CONTROLS.
- ★ 1,200ft. TAPE REELS PRO- ★ MAGIC EYE RECORD LEVEL VIDING PLAYING TIMES OF 1 HR. AND 2 HRS. INDICATOR.
- ★ DROP IN TAPE LOADING. ★ AMPLIFIER MAY BE USED FOR RECORD REPRODUCTION OF HIGH QUALITY.
- ★ EASY FORWARD OR RE- ★ COMPARTMENT FOR HOUS- WIND WITHOUT REMOVING ing MICROPHONE. TAPE.
- ★ ONE KNOB DECK OPERA- ★ SPECIALLY DESIGNED MIC- TION. ROPHONE BY A LEADING MANUFACTURER.



## H.P. TERMS

Deposit £10.4.9 and 12 monthly payments of £2.17.7

## SEPARATE UNITS CAN BE SUPPLIED AS LISTED BELOW:—

- Amplifier (built, wired and tested with Speaker). £14/15/-, plus postage and carriage 7/6.
- Hire purchase terms, Deposit £3/13/9 and 12 monthly payments of £1 0/9.
- Amplifier Kit (including Speaker). £11/0/- plus packing and carriage 5/-.
- Hire purchase terms, Deposit £2/15/- and 12 monthly payments of 15/6.
- New Lane 2-speed Tape Unit Mark 6 £18/10/- plus packing and carriage 7/6.
- Hire purchase terms, Deposit £4/12/6 and 12 monthly payments of £1/6/-.
- Portable Cabinet (rexine covered). £4/19/6, plus postage and carriage 5/-.
- Microphone, £2/15/-, plus postage and carriage 1/-.
- Reel Scotch Boy Tape MC2-111 (1,200ft.), £1/15/-, plus packing and carriage 1/-.
- Instruction Booklet, 2/6. Post free.

# PREMIER RADIO COMPANY

## WILLIAMSON AMPLIFIER KIT 15 gns.

plus 7/6 p. & p.  
**H.P. Terms Dep. £5.5.0 & 12m'thly p'y'm'ts of 19/9**  
 This Kit is absolutely complete and all components are guaranteed exactly to author's specification.

## WILLIAMSON OUTPUT TRANSFORMER

Author's Specification 3.6 ohms secondaries £4.4.0

## MAINS TRANSFORMER SP425A

(Completely Shrouded)

This Transformer has an additional 6.3 v. 3A and is capable of supplying an extra 50 mA. for Pre-amp or Feeder unit £22.12.6

## WILLIAMSON CHOKES

12ft. 150 mA. Fully shrouded..... 19/6  
 30ft 20mA. Fully shrouded..... 11/9

METERS		
Full Scale Deflection	External Dimensions in.	Movement:
3.5 A. ....	2½ x 2½	R.F. Thermo .. 7/6
30 A. ....	2½ round	M/C ..... 8/6
40 A. ....	2½ round	M/C ..... 8/6
5 mA. ....	2½ x 2½	..... 7/6
500 mA. ....	2½ round	M/C ..... 10/6
30 A. ....	2½ x 2½	M/C ..... 8/6
50 mA. ....	2½ x 2½	M/C ..... 7/6
20 V. ....	2½ x 2½	M/C ..... 8/6
40 V. ....	2½ x 2½	M/C ..... 8/6
1 mA. ....	3 x 2	M/C ..... 17/6
1 mA. ....	2½ round	M/C ..... 22/6
1 mA. ....	2½ round	Desk type M/C 25/-

## H.T. ELIMINATOR AND TRICKLE CHARGER KIT

All parts to construct an eliminator to give an output of 120 volts at 28 mA., and 2 volts to charge an accumulator. Uses metal rectifier, 37/6.

## PREMIER MAINS TRANSFORMERS

All primaries are tapped for 200-230-250 v. mains 40-100 cycles. All primaries are screened.  
 SP175B, 175-0-175, 50 mA., 4 v. @ 1 a., 4 v. @ 2-3 a. 15/-  
 SP350A, 350-0-350, 100 mA., 5 v. @ 2-3 a., 6.3 v. @ 2-3 a. 21/-  
 SP351A, 350-0-350, 150 mA., 4 v. @ 2-3 a., 4 v. @ 3-6 a., 4 v. @ 1-2 a., 4 v. @ 1-2 a. 30/-  
 SP352, 350-0-350, 150 mA., 5 v. @ 2-3 a., 6.3 v. @ 2-3 a., 6.3 v. @ 2-3 a. 30/-  
 SP501A, 500-0-500, 150 mA., 5 v. @ 2-3 a., 6.3 v. @ 2-3 a., 6.3 v. @ 2-3 a. 40/-  
 SP425A, 425-0-425, 200 mA., 6.3 v. @ 2-3 a., 6.3 v. @ 3-5 a., 5 v. @ 2-5 a. 52/6  
 250-0-250, 80 mA., 6.3 v. @ 4 a., 5 v. @ 2 a. 19/6  
 350-0-350, 80 mA., 6.3 v. @ 4 a., 5 v. @ 2 a. 19/6  
 200-250-250 output 3 v.-30 v., @ 2 a. 17/6

E.H.T. TRANSFORMER, primary 210 v., 230 v., 250 v., secondary 4 Kv. and 2 v. £37/6  
 E.H.T. TRANSFORMER, primary 210 v., 230 v., 250 v., secondary 5Kv. and 2 v. £312/3

## Build these NEW PREMIER DESIGNS

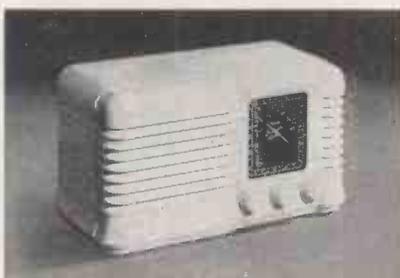
### 3-BAND SUPERHET RECEIVER



MAY BE BUILT FOR **£7.19.6** Plus 2/6 Pk. & Carr.

Latest type Superhet Circuit using 4 valves and metal rectifiers for operation on 200/250 volts A.C. mains. Waveband coverage—short 16-50 metres, medium 180-550 metres, and long 900-2000 metres. Valve line-up 6K8 freq. changer, 6K7, 1F, 6O7 Detector AVC and first AF, 6V6 output. The attractive cabinet to house the Receiver size 12in. long, 6½in. high, 5½in. deep can be supplied in either WALNUT or IVORY BAKELITE or WOOD. Instruction Book 1/- post free, which includes assembly and wiring diagrams, also a detailed stock list of priced components.

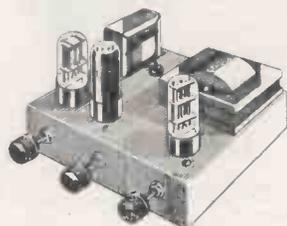
### TRF RECEIVER



MAY BE BUILT FOR **£5.15.0** Plus 2/6 Pkg & Carr.

The circuit is the latest type TRF using 3 valves and Metal Rectifiers for operation on 200/250 A.C. mains. Wave band coverage is 180/550 metres on medium wave and 800/2,000 metres on long wave. The dial is illuminated and the Valve line-up is 6K7 H.F. Pentode 6I7 Detector and 6V6—Output. The attractive Cabinets to house the Receiver size 12in. long, 6½in. high, 5½in. deep, can be supplied in either WALNUT or IVORY BAKELITE or WOOD. INSTRUCTION BOOK 1/- (post free) which includes Assembly and wiring diagrams, also a detailed Stock List of priced components.

### 4-WATT AMPLIFIER



MAY BE BUILT FOR **£4.10.0** Plus 2/6 Pk. & Carr.

Valve line-up 6SL7, 6V6 and 6X5, FOR A.C. MAINS 200/250 VOLTS. The twin triode 6SL7 is used for preamplification and also for a comprehensive tone control circuit, which includes two very wide range and continuously variable tone controls for bass and treble. The output Valve is of the beam type and feeds 4 watts into a specially designed output Transformer which is suitable for either 3 ohm or 15 ohm Speakers. Negative feedback is applied from the secondary of the output Transformer over the whole Amplifier to the input stage giving an excellent frequency response. Due to the high gain and wide range tone controls any type of pick-up may be used. Overall size 9 x 7 x 6in. Price of Amplifier complete, tested and ready for use, £5/5/-, plus 9/6 pkg. and carr.

INSTRUCTION BOOK, 1/- (Post Free) which includes Assembly and wiring diagram, also a detailed Stock List of priced components.

## DECCA MODEL 33A

### DUAL SPEED RECORD PLAYER

Includes crystal pick-up with sapphire stylus and a light-weight plastic spring balanced arm. Heavy gauge pressed steel case with brown enamel finish in good quality for operation on A.C. mains 200/250 v. 50 c.p.s. Supplied complete with single head (either standard or long playing). £4.19.6  
 Extra Head can be supplied. Plus pkg. and carr. 5/-.



## B.S.R. Type GU4A 3-SPEED GRAM UNIT

Fitted with Decca Heads

Single Record Player, 3-speeds 33, 45 and 78 r.p.m. for operation on 100-120 volts or 200-230 volts A.C. Mains. Complete with one standard and one long playing head, crystal or magnetic (please state choice), £7/19/6, pp. & carr. 3/-. Suitable cabinet for above Player type PC/8 at 45/-. See advertisement on previous page.



## MINIATURE TUNING CONDENSERS

2-gang .0005 mfd. with trimmers ..... 6/9

## PREMIER VARIABLE IMPEDANCE "MATCHMAKER" M.O.15 OUTPUT TRANSFORMER

Designed to meet the demand for an efficient variable ratio Output Transformer 11 ratios from 13:1 to 80:1 all centre tapped and can be used to match any output valves either single or push-pull Class "A" "AB1" "AB2" or "B" to any low impedance speech coil or combination thereof. Primary Inductance 50 henries 15 watts audio 100 mA. Price 45/-.

## LOUDSPEAKERS

ELAC—2½in. dia., Moving Coil, 15 ohm imp. ... 15/-  
 PLESSEY—3in. dia., Moving Coil, 3 ohms imp. ... 9/11  
 ELAC—8in. dia., Moving Coil, 3 ohms imp. ... 19/6  
 PLESSEY—8in. dia., Mains Energised, 3 ohms imp. (600 ohms field) with Pentode Transformer 22/6  
 PLESSEY—8in. dia., Mains Energised, 3 ohms imp. (600 ohms field) ..... 19/6  
 PLESSEY—10in. dia., Moving Coil, 3 ohms imp. ... 23/6  
 GOODMANS—12in. dia., Moving Coil, 15 ohms. Plus 5/- packing and carriage ..... 28/12/6  
 VITAVOX—K12/20 12in. dia., Moving Coil, 15 ohms imp. .... £11/11  
 Plus 5/- packing and carriage.

## CRYSTAL MICROPHONE INSERTS

Ideal for tape recording and amplifiers. No Matching transformer required, 3/6 post free.

## ACCUMULATORS

2 volt 10 amp. (by famous maker) ..... 4/11  
 2 volt 16 amp. .... 5/11

## MOVING COIL METER

A super quality Moving Coil Meter basic movement 2 mA and 4 mA Scale dimensions 2½in. Overall dimensions 2½in. dia. 1½in. deep. Bakelite Case projecting type. In recent scaled 1 amp. E.F. By removing thermo couple, reversing scale and recalibrating the meter, a high grade test instrument with any range above the basic F.S.D. may be built up. Price 2 mA., 5/9, 4 mA., 4/9.

## MICROPHONES

LUSTRAPHONE: Moving Coil; High Impedance, Stand Type: £5/15/6—Hand Mike £6/6/-.  
 RONETTE—Crystal Mike Inexp. the Filter Cell Insert: High Imp. Ball Type. £2/10/-.  
 CRYSTAL MICROPHONE—Bothermel 2AD56. Especially recommended. £2.15.0 Table stands for all the above 10/6 and 17/6.  
 ACOS. High Impedance Crystal Microphones, type 35-1, 25/-.  
 ACOS. High Impedance Crystal Microphone, type 33-1 £2/10/-.  
 ACOS. "MIO 30" impedance Crystal Microphone £2/10/- (This Microphone can be used as either Hand or Desk type).

## CRYSTAL MICROPHONE

An entirely insulated crystal microphone which can be safely used on A.C./D.C. amplifiers. High impedance. No background noise, really natural tone. The ideal Mike for tape, wire and sound projectors, price 19/6.

## MAINS NOISE ELIMINATOR KIT

Two specially designed chokes with three smoothing condensers with circuit diagrams. Cuts out all mains noise. Can be assembled inside existing receiver, 4/11, plus 6d. pkg. and carr.

Germanium Crystal Diodes. G.E.O. wire ended, 2/6. 24/- doz.

# PREMIER RADIO COMPANY

## 1155 RECEIVER UNIT

In original cases complete with 10 valves. Frequency range 15.5 Mc/s. 75 Kc/s. in 5 wave bands. £11/19/6. Plus 10/6 packing and carriage.



Hire Purchase Terms: £2/19/11 Deposit and 22 monthly payments of 16/10.

## POWER SUPPLY UNIT

for above, incorporating output stage. Supplies an output of 250 volts at 80 mA. which is ample for the B1155 with the output stage.



Jones plugs for connecting the Power Pack to the Receiver are included. The 6V6 output stage complete with Output Transformer and 6in. speaker is built into the unit. Price £5/5/-, plus 5/- packing and carriage. The two above Units together on Hire Purchase Terms: £4/6/2 Deposit and 12 monthly payments of £1/4/2.

**PUSH-PULL OUTPUT TRANSFORMERS.** 2 x 6V6 into 2/3 ohms., 5/6. post free.

**T.1154. BRAND NEW COMPLETE WITH VALVES,** £3/19/6. post and carriage 7/6.

**METER RECTIFIERS.** Miniature type with leads 1-5 mA., 6/8. post paid.

**AMPLIFIER TYPE A1134A.** Battery operated 9 valves. type VR.21 and VR.35, 9/11. postage and carriage 1/6.

**SLIDER RESISTANCE.** Geared adjustment, 2.5 ohms, 4 a., 12/6. postage and carriage 1/6.

**HEAVY DUTY POWER RESISTANCE.** 17.5 ohms, 8 a. with adjustable tapping 19in. long, 2 1/2in. diameter, 10/- postage and carriage 2/-.

**HEAVY DUTY L.T. TRANSFORMER.** Primary tapped 180-230 volts, 50 cycles. Secondaries 4.2 v. 10 a. 4.2 v. 10 a., 25/-, postage and carriage 2/6.

**ROTARY RESISTANCE.** Wire wound heavy duty 14 k. ohms, 7/6. postage and carriage 1/-.

**VACUUM PUMPS.** For model makers etc. Ex-B.A.F. Type B3-Mk. III, 22/6. postage and carriage 2/-.

## SPECIAL OFFER

### 5-VALVE SUPERHET RADIO RECEIVER

PRICE  
**£10.19.6**

Pkg. & Car. 10.-

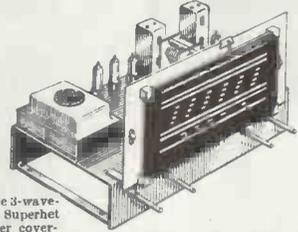


In highly polished walnut cabinet. Built to high standards ensuring quality reception. Specifications:

**VALVE LINE-UP:** 7B7, 7B7, 7C6, 7C5, 7Y4, 3 WAVE-BANDS, Long, Medium and Short. **CONTROLS** Tuning, wave change, volume tone control on/off Gram Position on Switch. Pick-up and Extension Speaker Sockets incorporated. For use on 200/250 v. A.C. mains. **DIMENSIONS:** Width, 16 1/2in. Height 13 1/2in., depth 8 1/2in.

H.P. Terms: £2/14/11 deposit, and 12 monthly payments of 15/8.

## RADIOGRAM CHASSIS



5 Valve 3-wave-band Superhet Receiver covering short, medium and long waves. Using the latest miniature all glass valves, overall chassis size 13 1/2in. x 7 1/2in. high x 6in. deep, dial aperture 10in. x 4 1/2in. **BRAND NEW, READY FOR USE AND GUARANTEED.** **£10-5-0** Packing and postage 10/- Or on Hire Purchase Terms, deposit £2/11/3 and 12 monthly payments of 14/5.

**CABINET** available for above Chassis in figured walnut, lined with white sycamore, size 3ft. wide, 2ft. 8in. high, 1ft. 5in. deep, £15/15/- Or on Hire Purchase terms, deposit £3/18/9 and 12 monthly payments of £1/8/2. Packing and Carriage extra

### COMPONENTS AVAILABLE FOR THE MULLARD AND OSRAM DESIGNS

#### FREQUENCY MODULATION

All components for the Denro F.M. Unit, less Valves ... **£4-16-1** Packing and postage 1/6.

#### GARRARD S5 UNIT

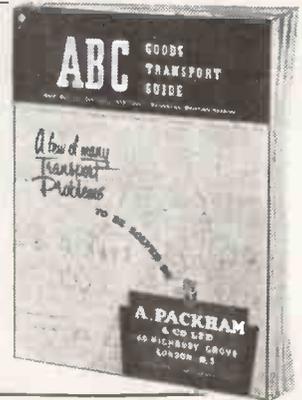
Garrard rim drive 78 r.p.m. complete with magnetic pickup and turntable. Postage and packing 2/6. **£4-19-6**

All components supplied for our Radio and T.V. Designs are guaranteed for a period of 12 months (Valves carry the usual Maker's 3 months' guarantee).

Send 2yd stamp for our 1955 Catalogue

# Transport Managers Despatch Managers and Consignors

— to send anything anywhere, consult the **ABC** GOODS TRANSPORT GUIDE



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AUTOMATIC RECORD CHANGER



BIRMINGHAM SOUND REPRODUCERS LIMITED, OLD HILL, STAFFS

# Wireless World

RADIO, TELEVISION, ELECTRONICS

Managing Editor:  
HUGH S. POCOCK, M.I.E.E

Editor:  
H. F. SMITH.

FEBRUARY 1955

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VOLUME 61 NO. 2

PRICE: TWO SHILLINGS

FORTY-FOURTH YEAR  
OF PUBLICATION

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# VALVES, TUBES & CIRCUITS

## 26. Additional Applications of the PCF80

The Mullard PCF80 was designed primarily as an additive mixer for front end stages in Band I and Band III television receivers and converters in association with the PCC84. This application has been discussed in *Valves, Tubes, and Circuits* Nos. 15, 16, and 17 (available as reprints with additional notes). The low interelectrode capacitances and short grid base of the valve make it suitable for a number of other applications in which the EF80, ECL80, ECC82, and other valves have hitherto been used.

In television receivers the triode and pentode section of one PCF80 can, with certain limitations, be used to perform separate functions. The performances of the two sections in various audio and video circuits are briefly discussed below. A chart, indicating the permissibility of a large number of combinations of function, will be included in the reprint of this advertisement.

When the triode and pentode of the PCF80 are to be used in different circuits in a television receiver, the advisability of a particular combination is determined by the internal coupling between the sections, especially if the signal levels are widely different, or if the pentode is to be the first valve of a high gain cascade circuit. Use in such a cascade circuit is inadvisable unless the total gain of the stage, or the source impedance, is very low. With a low source impedance, moreover, hum becomes a limiting factor.

The internal coupling has two components: the cross capacitances, and the leakage paths across them. The leakage paths are negligible in all but the most critical combinations of function. The most important capacitive coupling is that between the anode of the triode and the first grid of the pentode. Its maximum value is 0.16pF plus the valveholder capacitance of 0.15 to 0.4pF. The capacitances from the pentode to the triode grid are less than 0.02pF.

The use of the triode in audio applications is restricted by the leakage paths, which will make operation impossible at low audio levels when the pentode is used in a video or timebase circuit. Conversely, the combined effect of the cross capacitances and their shunt resistances prevents the use of the pentode as an audio valve when the triode is used in a video or timebase circuit. The power output of a single triode or even of two in push-pull is insufficient for use in the audio output stage.

With the pentode as a sound or vision i.f. amplifier, the triode may be operated in timebase, video i.f., or audio circuits. It is necessary to minimise hum by effectively earthing the pentode grid or at least by providing the lowest possible impedance to earth. The impedance should not exceed 40kΩ at low frequencies, and it should be still less at higher frequencies. Capacitive decoupling of

the earthy end of the i.f. coil is obtained with 0.1μF min. for a 50 c/s interfering signal and 0.001μF min. for 10 kc/s. The most stringent of the combinations in this respect is with the pentode as sound i.f. amplifier and the triode as a timebase or video valve.

The pentode may be used as a video amplifier in place of the EF80 with a slightly reduced gain but a greater peak-to-peak output; or as a synchronising pulse separator with a low screen grid voltage and a high value of anode load to obtain a very short grid base. The triode may be used as a frame pulse clipper or as a conventional frame blocking oscillator.

Both sections may be used in a multivibrator circuit to produce a line scanning waveform. A resonant circuit in the triode anode circuit can help to stabilise the natural frequency of the oscillator, if it is locked by a flywheel synchronising system. This can be achieved by returning the control grid of the pentode to a source of controlling bias. In this application no interference is seen if either section of the valve is used for synchronising pulse separation or clipping. But with the pentode in this multivibrator circuit and the triode acting as a frame timebase blocking oscillator, some interaction between line and frame scanning occurs. This combination is not recommended.

In fringe areas, 405-line operation under noisy conditions is considerably improved by flywheel synchronisation. The line timebase coincidence detector which is necessary can incorporate the PCF80 pentode with the two coincident pulses applied to the control and screen grids. The triode can then act as the separate pulse amplifier. In this application the triode or the pentode may be transferred to any of the other scanning applications already discussed without undesirable stray coupling effects.

*Circuits for the recommended applications will be published in a future advertisement in this series.*

*Reprints of this advertisement, with additional notes consisting of a comprehensive application chart, are available without charge from the address below.*



MULLARD LTD., Technical Service Department, Century House, Shaftesbury Avenue, W.C.2

MVM 313

# Build your own MODERN 5-CHANNEL large screen TV

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## EASY to BUILD



and reduces home construction to the simplest possible proportions. Anyone with previous experience in the construction of radio receivers, and an elementary knowledge of the principles of TV circuitry, can build it.

### Ask for this booklet

—its popularity has necessitated the issue of a

#### THIRD EDITION

A number of circuit modifications have been introduced to give improved performance. The text has been re-written and new drawings and photographs have been prepared. The first step towards building this outstandingly modern TV Receiver is to fill in the application form and post it NOW.



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TELETUBES

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# Longer Life

## for LONG PLAYING RECORDS

Recording techniques have made such strides over the last two years that if you are to get the really superb reproduction made possible by the latest L.P. records you need one of the Acos "Hi-g" Pick-ups. These have been specially designed to meet the very exacting demands of the new records with their shallow groove and microscopic sound "track". This special design is necessary on two scores — firstly to do justice to the brilliant recording, and secondly to ensure the longest possible life from L.P. records. Such records are expensive; even a single playing with an unsuitable pick-up can cause irreparable harm.

If you want the best reproduction and value from *your* radiogram or record player and L.P. records ask your dealer (*or post the coupon below*) for details of the "plug-in" ACOS "Hi-g" Pick-ups — specially designed to replace existing pick-ups on most famous makes of record playing equipment. The cost? 32/6d. (plus 10/5d. P.T.)

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... always well ahead

### NUMBER PLEASE!

The new restricted form of London Telephone Directory no longer includes subscribers, like Cosmocord, in "fringe" areas. Please note therefore that our number is: **ENFIELD 4022.**

To: COSMOCORD LIMITED, ENFIELD, MIDDLESEX.

Please send me details of ACOS "Hi-g" replacement pick-up heads

NAME .....

ADDRESS .....

WW

## "BELLING-LEE" NOTES

These notes have been contributed by our senior research engineer, and introduce a very interesting basis of comparison for aerials, and can, of course, be applied to aerials of any manufacture.

### Goodness Factor For Aerials

It has been often stated that aerials for use in fringe areas should have the maximum possible forward gain, thus ensuring that as much signal as possible is available at the receiver. This is undoubtedly the condition required for reception in areas where local interference can be ignored, and where the signal is limited by the noise generated in the receiver itself.

In some areas the picture is marred by local interference, by motor cars, etc., while in others an otherwise perfect picture is spoiled by ghost reflections. In both these cases the directional characteristic of the aerial is important. This is the property of the aerial which enables it to distinguish between the wanted and unwanted signals.

If we now consider the fringe area in which interference is present, we are faced with a problem of how to describe an aerial as neither the forward gain nor the polar diagram give a complete picture of its performance. A Goodness Factor can, however, be defined, but the validity of this Factor can only be tested by practical observation of pictures under a wide range of conditions. We are considering the use of Goodness Factor F, defined by the equation  $F = \frac{V}{A}$  where V is the voltage gain of the aerial relative to a half-wave dipole and A is the total area under the polar diagram, assuming the area under a dipole polar diagram, to be unity, and the amplitude of the diagram in the forward direction to be the same for all areas.

It can now be seen that F includes both the forward gain and the directional characteristics of the aerial and increase in either of these is improved. As an example the Goodness Factor of various "Belling-Lee" aerials is as follows.

<b>BROADSIDE—3 element array,</b>	<b>5.2</b>
Junior Mult.	3.3
Senior H	2.5
Junior H	2.7
Kayrod	2.3
Dipole	1.0

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**BELLING & LEE LTD.**

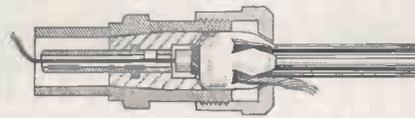
Great Cambridge Rd., Enfield, Middx.

Written 14th December 1954

# A UNIVERSAL LOADING PLUG

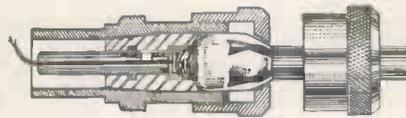
*Tip or back solder  
or crimp—as you please...*

*Tip soldered with braid as pigtail through  
collet and nut*



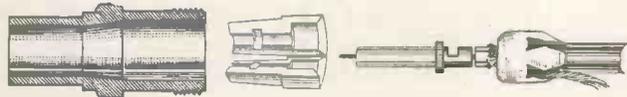
CLAMPING NUT  
ONLY REMOVED  
FROM BODY HOUSING

*Tip soldered with braid bunched up against  
collet*

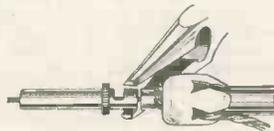


CLAMPING NUT AND  
COLLET ONLY  
REMOVED FROM  
BODY HOUSING

*Back soldered with braid as pigtail or bunched*



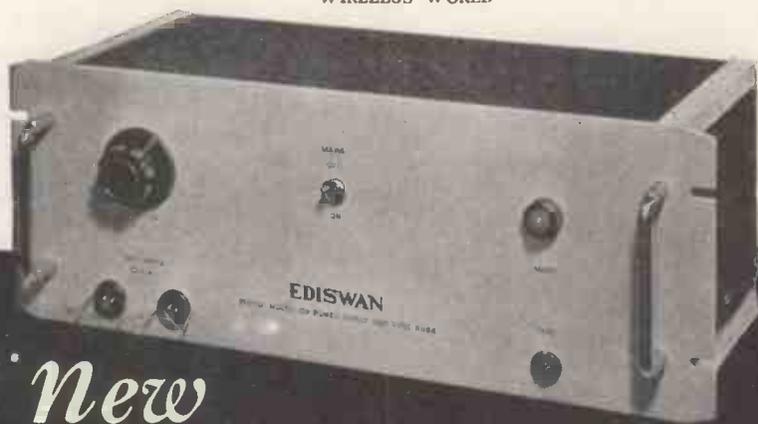
*or crimped*



● We have now modified our L.1329 coaxial plug to include a hole through the length of the pin so that this can be tip soldered as an alternative to back soldering or crimping. In view of the marked preference for tip soldering, we have also re-instated our all-metal L.734/P coaxial plug.

These two types will now be interchangeable, and by supplying both types we believe we have met most needs that can arise, particularly the requirements both of those who prefer to load the plug without completely dismantling it, and those who dismantle the plug completely before soldering. Both plugs are also suitable for use as a temporary connection, without either crimping or soldering, but this is very bad practice.

**BELLING & LEE LTD**  
GREAT CAMBRIDGE RD., ENFIELD, MIDDX., ENGLAND



*a New*

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Ediswan now have available a new stabilised power supply unit which has been specially designed to feed Photo-Multipliers. It is particularly suitable as a supply unit for Ediswan Mazda Photo-Multipliers type 27.M1, 27.M2 and 27.M3.

### BRIEF SPECIFICATION

INPUT	OUTPUT	STABILITY	OUTPUT RESISTANCE	RIPPLE
200-250 v., 40-100 c.p.s.	High stability low ripple D.C. supply variable between 300 and 1,100 volts. Max. current 2 mA. Pos. or neg. may be earthed.	A 10% change in mains input voltage results in a change of less than 0.1% between 1,100 volts and 600 volts output.	Approximately 1,500 ohms.	Less than 0.01% R.M.S.
<p><b>MOUNTING</b> The Unit is suitable for standard rack mounting or for bench use. Bench Stands are available.</p>				



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*Further information is available on request*

# EDISWAN

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*Member of the A.E.I. Group of Companies*

# CONVECTION HEATING

## FORCED OR NATURAL?

Broadly speaking, there are two types of convection heater: the *natural* convection heater, which depends for its operation solely on the physical difference in the density of warm and cold air, and the *forced* convection heater, in which a fan is used to force warmed air downwards and forwards, away from the heater.

Although natural convectors have their uses—for example in halls, landings or passages, which are not normally occupied for lengthy periods—forced convectors are much more efficient and economical in operation.

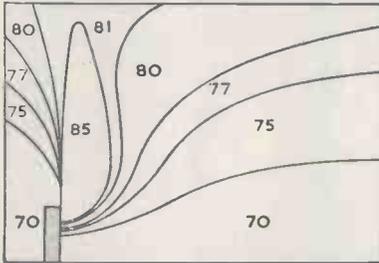


Fig. 1 Diagram showing the heat zones produced by a typical 1 kW natural convection heater. The upwards and outwards path of the warm air is quite clearly indicated. If the power of the heater were increased to 2 kW, temperatures in the particular zones would increase, but the general disposition of the zones would remain the same. The air at floor level would therefore be noticeably colder. (Temperatures in both illustrations are in degrees Fahrenheit.)

A natural convector warms only the air passing through it and in its immediate vicinity, and this warmed air, being much lighter than the main body of air in the room, rises rapidly towards the ceiling, where most of the heat is dissipated. Although there will be at times a certain amount of mixing of small portions of rising warmed air with the general body of colder air, due to movement of persons in the room, the fact remains that in general the warmest air will be at ceiling level, and the colder air at floor level.

Thus, before the occupants of a room heated by natural convection feel very much benefit, the temperature of the air at ceiling level has to be increased considerably. Obviously, overall room temperature increases very slowly, and power consumption, and therefore costs, are increased.

The steep temperature gradient created by this method of heating often gives the occupants of a room the impression of draughts around the feet and a feeling of "headiness." This arises because, while the human body can withstand a higher temperature around the feet and legs, it cannot, with comfort, tolerate an atmosphere in which there is an upper zone of much warmer air. This warm upper zone, being semi-static in nature, also tends to act as a barrier to rising tobacco smoke and other fumes, thereby worsening the general atmospheric condition. A further disadvantage of natural convection heating is the soiling of the walls and ceiling immediately above the heater caused by the uprising air current becoming dust laden.

Much time and effort have been expended on natural convectors in attempts to overcome these disadvantages, all of which arise from the very low velocity of the warmed air emerging from the heater outlet. In spite of these efforts, experiments show that the maximum distance the warmed air can be projected from the outlet of this type of heater is about 6 inches.

With the *forced* air convection heater the effects are the opposite of those occurring with the natural convector. By using a suitable blower system the warmed air is forced, against its natural tendency, downwards and outwards into the room. This stream of warmed air is given sufficient velocity to project it some ten to fourteen feet from the heater.

Unlike the natural convection heater, the forced air convection heater produces the warmer air zone at floor level. The temperature gradient throughout the room is very much less than with a natural convector: the difference in temperature being as little as 5°F between floor level and ceiling.

Thus, with forced convection heating, the warmed air is circulated throughout the entire room and rapidly increases the overall temperature; there is no draughtiness around the occupants' feet, and since the upper air is at a slightly lower temperature than the air at floor level, there is no feeling of "headiness." Other advantages of the forced convector lie in better physical design. In order to get maximum air velocity natural convection heaters are usually tall in relation to their width and depth: not always an ideal shape from the points of view of stability and convenience in placing in a room. Forced convectors can be designed to much more stable dimensions, and can be made compact enough to fit unobtrusively into any convenient position. Furthermore, forced convectors will

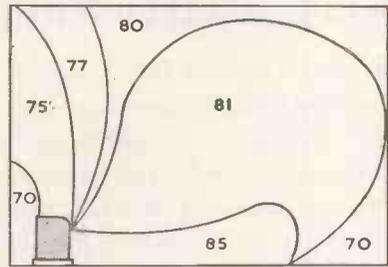


Fig. 2 Heat zones produced by a forced convection heater, the "H.M.V." 2 kW Cavendish Heater. Note the even temperature gradient throughout the entire room, with the warmer air zone at floor level. These figures were plotted from actual tests taken in a room measuring 14' x 11' 3" x 8' high (1,265 cu. ft.), with a semi-circular bay containing 5 windows.

operate with unimpaired efficiency even when sited below a window. Cold air currents in the vicinity of the window gravitate towards the floor, where instead of creating a draught as they would normally do, they are warmed by the heater and circulated into the room. Similarly, cool fresh air entering the room through the window will be warmed by the heater and will help to keep the air within the room fresh and clean.

# H M V

## HOUSEHOLD APPLIANCES

# E·M·I ELECTRONIC EQUIPMENT

FOR RESEARCH, DEVELOPMENT and TESTING



## PORTABLE OSCILLOSCOPE TYPE WM.3.B.

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### DISTRIBUTED AMPLIFIER TYPE 2B 50 c/s — 100 Mc/s

A unit designed for use with high speed Oscilloscopes to provide amplification over a very wide frequency spectrum at high output voltage levels. The amplifier is extensively used in the study of high speed waveforms having rise times in the milli-microsecond range. It is being widely used with scintillation and coincidence counters, high speed scalars, and signal generators.

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#### SPECIFICATION

C.R.T. E.H.T. 0.8 & 1.2 kV.

'Y' Amplifier D.C. - 6 Mc/s.

MAX. SENSITIVITY  
350 mm/V (at reduced bandwidth)

VOLTAGE MEASUREMENT  
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 $\pm 2\frac{1}{2}\%$  F.S.D.

TIME MEASUREMENT  
0.25 microseconds - 40 milliseconds

SWEEP DRIVE  
Triggered or recurrent, phase and frequency selected

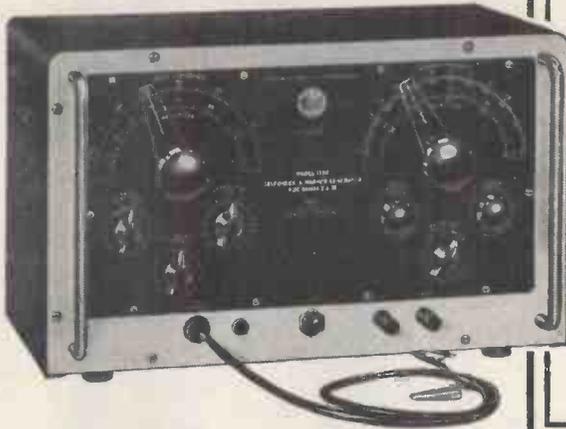
WRITING SPEED  
6 milli-seconds/cm - 0.5 microsecond/cm

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EP. JS



**BE READY  
FOR TOMORROW  
— TODAY!  
WITH THESE TWO NEW  
COSSOR INSTRUMENTS**

## COSSOR Model 1322

## Telecheck and Marker Generator for Bands I and III

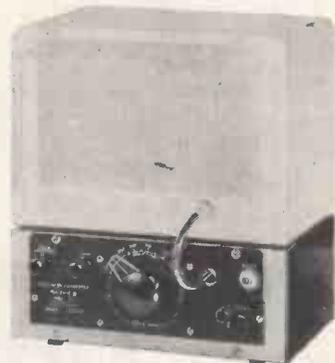
Model 1322 — used in conjunction with a cathode ray oscillograph — provides equipment for the display, measurement and correct adjustment of RF and IF response curves of television receivers. This entirely new instrument comprises a swept oscillator covering the Television BANDS I and III (5-75 Mc/s. and 155-255 Mc/s.) and a frequency marker oscillator so that precise calibration of the oscillograph display may be made; accuracy of the frequency of the marker pips being verified by reference to an internal crystal. The

alignment oscillator is set to the video carrier to which the receiver is tuned and the sweep (either 1 Mc/s. or 10 Mc/s.) is automatically derived from the time base voltage of the display oscillograph. The response of the "strip" under test to the frequency band applied is then presented on the screen of the cathode ray tube. The RF output of Model 1322 is available at 75 ohms and is adjustable from a maximum of 40 millivolts to a minimum of 10 microvolts through a coarse and fine attenuator.

### TELECHECK CONVERTER FOR BAND III

### Model 1321

This adaptor provides owners of Model 1320 "Telecheck" with an extension of the frequency range of the original instrument into the BAND III television channel. Thus, alignment procedures adopted for BAND I RF/IF "strips" are available also for BAND III receivers. A selection of the desired BAND is made by means of a switch. Pattern generator facilities for picture time base linearity checks have been retained. Model 1321 Adaptor is designed for permanent attachment to the standard "Telecheck" providing a neat, light and compact unit. Mounting is effected by four screws and the inter-connecting wiring is carried in a single insulating sleeve.



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Write for illustrated leaflets about both these instruments :

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G.I.60

F

# Marconi VHF Multi-Channel Equipment

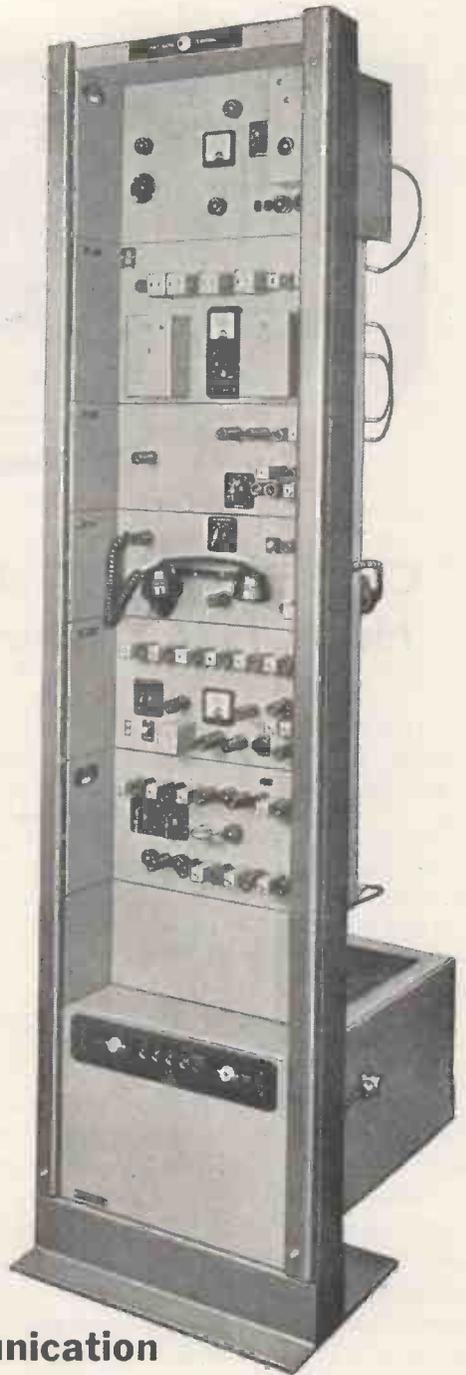
## TYPE HM 181

Multi-channel radio links are not only recognised economic alternatives to line and cable routes wherever the latter are costly because of intensive urban development or the wild nature of the terrain; they are frequently preferable in their own right. The type HM 181 equipment has been designed for comparatively simple schemes using two terminals working point-to-point or with a limited number of repeaters. It operates in the frequency range 150-200 M/cs, employs frequency modulation and gives high performance with low distortion.

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*Partners in progress with The 'ENGLISH ELECTRIC' Company Ltd.*

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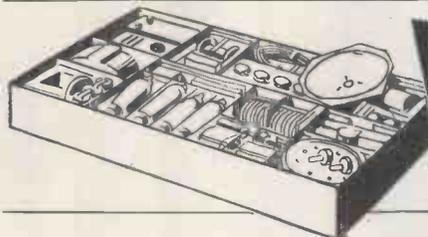
With these outfits, which you receive upon enrolment, you are instructed how to build basic Electronic Circuits (Amplifiers, Oscillators, Power Units, etc.) leading to complete Radio and Television Receiver Testing and Servicing.



#### 1 BEGINNER'S RADIO OUTFITS

— For carrying out basic practical work in Radio and Electronics, from first principles and leading to the design and building of simple Receivers.

ALL EQUIPMENT SUPPLIED  
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#### 2

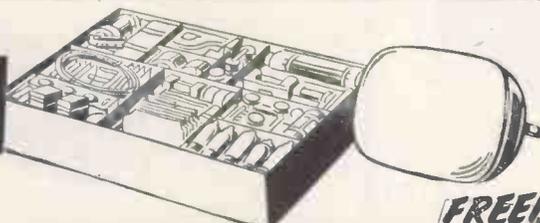
#### ADVANCED RADIO OUTFITS

— With this equipment, you are instructed in the design, construction, testing and servicing of complete modern TRS. Superhet Radio Receivers.

#### TELEVISION

Outfit No. 3 —  
With this equipment you are instructed in the design, construction, servicing and testing of a modern high-quality 15" Television Receiver.

#### 3



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# SenTerCel H.T. rectifiers

from 125V 30mA  
to 250V 300mA

Specially designed for use in domestic Radio & Television receivers, these miniature rectifier stacks have an established position with manufacturers to whom reliability, small dimensions and low costs are important.

### FEATURES

- Instant starting — no warming-up period
- Unlimited instantaneous overload
- No limit to size of reservoir capacitor
- Simple mounting—no valve holder
- Withstand overloads such as charging current of de-formed electrolytic capacitors
- Low heat dissipation
- Practically indestructible in service
- Simple wiring—two connectors only
- Small size . . . low weight
- Low cost

TYPE	RM0	RM1	RM2	RM3	RM4	*RM5
Maximum ambient temperature	35°C	35°C	35°C	35°C	40°C	40°C
Maximum output current (mean)	30mA	60mA	100mA	120mA	250mA	300mA
Maximum input voltage (r.m.s.)	125V	125V	125V	125V	250V	250V
Maximum peak inverse voltage	350V	350V	350V	350V	700V	700V
Max. instantaneous peak current	Unlimited	Unlimited	Unlimited	Unlimited	Unlimited	Unlimited
Weight	0.82 oz.	1 oz.	1.4 oz.	2 oz.	4.5 oz.	4.75 oz.

\* For use in voltage doubler circuits the peak inverse and maximum input voltages are halved, current output being as for half wave operation.



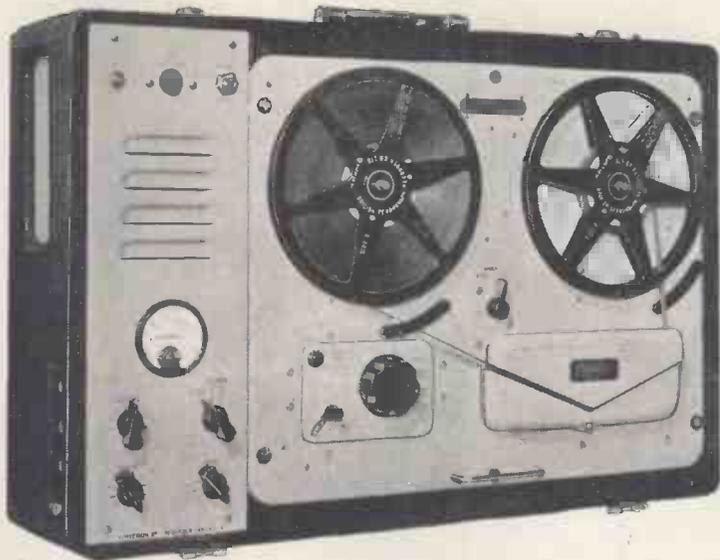
## Standard Telephones and Cables Limited

Registered Office: Connaught House, Aldwych, London, W.C.2

RECTIFIER DIVISION: Edinburgh Way, Harlow, Essex.

Telephone: Harlow 26811

# VORTEXION TAPE RECORDER



The amplifier, speaker and case, with detachable lid, measures 8½ in. x 22½ in. x 15¾ in. and weighs 30 lb.

**PRICE, complete with WEARITE TAPE DECK** ..... £84 0 0

★ The noise level is extremely low and audibly the hum level and Johnson noise of the amplifier and deck are approximately equal. Only 25% of this small amount of hum is given by the amplifier alone.

★ Extremely low distortion and background noise, with a frequency response of 50 c/s.—10 Kc/s., plus or minus 1.5 db. A meter is fitted for the measurement of signal level and bias level.

★ Sufficient power is available for recording on disc, either direct or from the tape, without additional amplifiers.

★ A heavy mu-metal shielded microphone transformer is built in for 15-30 ohms balanced and screened line, and requires only 7 micro-volts approximately to fully load.

★ The .5 megohm input is fully loaded by 18 millivolts and is suitable for crystal P.U.s, microphone or radio inputs.

★ A power plug is provided for a radio feeder unit, etc. Variable bass and treble controls are fitted for control of the play back signal.

★ The power output is 3.5 watts heavily damped by negative feedback and an oval internal speaker is built in for monitoring purposes.

★ Facilities are provided for using the amplifier alone and using power output or headphones while recording or to drive additional amplifiers.

★ The unit may be left running on record or play back even with 1,750 ft. reels with the lid closed.

**POWER SUPPLY UNIT** to work from 12 volt Battery with an output of 230 v., 120 watts, 50 cycles within 1%. Suppressed for use with Tape Recorder. **PRICE** £18 0 0.

## FOUR CHANNEL ELECTRONIC MIXER

is almost essential for the professional or semi-professional where a number of different items have to be mixed on one tape recording.

It is recommended by a number of tape recorder manufacturers for this purpose.

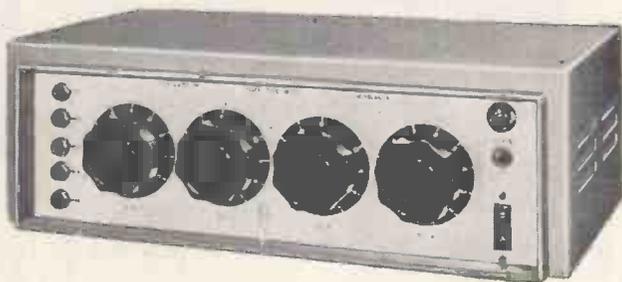
Any normal input impedance can be supplied to order, balanced or unbalanced, the standard being 15-30 ohms balanced.

The normal output is 0.5 volt on 20,000 ohms or less, but 600 ohms is available as an alternative.

The steel stove enamelled case is polished and fitted with an engraved white panel suitable for making temporary pencil notes.

An internal screened power pack and selenium rectifier feed the five low noise non-microphonic valves.

Used in many hundreds of large public address installations and recording studios throughout the world.



**PRICE** £36 15 0.

*Manufactured by*

**VORTEXION LIMITED, 257-263, The Broadway, Wimbledon, London, S.W.19**

Telephones: LIBerty 2814 and 6242-3

Telegrams: "Vortexion, Wimble, London."

# The Cultured Voice of Quality

## SOUND SALES PHASE INVERTER SPEAKER

For its size, this is one of the most attractive loudspeaker combinations I have yet come across . . . "the standard of reproduction obtainable must be heard to be believed." Not only is there a good, clean treble, well distributed by the diffusers on the front of cabinet; there is also a very firm, clear bass which extends below 50 c/s. Clarity is indeed the most noteworthy characteristic of this speaker. It was this quality that impressed itself on several visitors I had on the day when I was putting the speaker through its paces. That extra half octave above about 12 kc/s. and the corresponding one below about 30 c/s usually cost an awful lot of money. The range here is audible from below 30 up to above 13,000 c/s!

TECHNICAL REPORT by P. WILSON, M.A.,  
of "THE GRAMOPHONE"

Price **£14.10.0**  
complete with cabinet



OBTAINABLE FROM ALL LEADING STOCKISTS

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**SOUND SALES LIMITED**

Manufacturers of Electronic Equipment

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The demand of Industry and the Ministries for our trained students is still far greater than we can supply. For top-grade technologists we offer:

### THREE-YEAR COURSE in Telecommunication Engineering

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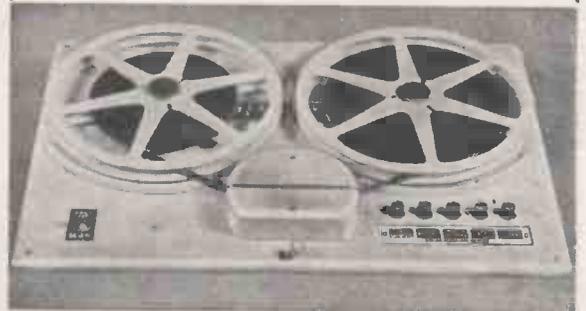
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TWO SPEED—SIMPLE PUSH BUTTON  
CONTROL

### THE NEW K6 UNIT

List Price **19 GNS.**

SEE AND HEAR IT AT  
YOUR LOCAL DEALER

**MODERN TECHNIQUES**

138-144 Petherton Road, London, N.5

Tel.: Canonbury 5896

# Sales up 300%!

with the NEW



**TL/10** AMPLIFIER &  
**"POINT-ONE"**  
 PRE-AMPLIFIER



**27 GNS**  
**COMPLETE**

A price made possible  
 only by  
 WORLD-WIDE SALES

★  
 Make this  
**THE HEART**  
 of your  
**HI-FI EQUIPMENT**

## and this is why

From long experience and by extreme attention to design details during development work on the pre-production models, we enable our labour force to achieve a high output per man-hour. The labour costs thus saved offset the increased costs incurred for high-grade materials, components and finishes, and this together with quantity production (made possible only by a world-wide market) explains how quality products may be sold at reasonable prices. The results obtainable with the new Leak TL/10 and "Point One" are indistinguishable from those obtained with the TL/12 model—a fact easily proved by an instantaneous changeover test. The new TL/10 has been used since its introduction for all our public demonstrations, including those at the New York Audio Fair. These are some of the reasons why sales of the TL/10 and "Point One," since their introduction in April last year, are three times as great as for the famous TL/12 in the corresponding months of 1953—and why the size of our factory has been more than doubled to cope with this increased demand.

### TL/10 POWER AMPLIFIER

This 10 watt amplifier maintains, in every respect, the world renowned Leak reputation for precision engineering, fine appearance and fastidious wiring.

### SPECIFICATION

#### Circuitry

A triple loop feedback circuit based on the famous TL/12. The output transformer is the same size as in the TL/12.

Maximum power output: 10 watts.

Frequency Response:  $\pm 1$  db 20 c/s to 20,000 c/s.

Harmonic Distortion: 0.1%, 1,000 c/s, 7.5 watts output.

Feedback Magnitude: 26 db, main loop.

Damping Factor: 25.

Hum: — 80 db referred to 10 watts.

Loudspeaker Impedances: 16 ohms, 8 ohms, and 4 ohms.

### "POINT ONE" PRE-AMPLIFIER

The handsome gold escutcheon plate contributes to the elegant appearance, and blends with all woods.

#### ★ Pickup

The pre-amplifier will operate from any pickup generally available in the world. A continuously variable input attenuator at the rear of the pre-amplifier permits the instantaneous use of crystal, moving-iron and moving-coil pickups.

#### ★ Radio

The radio input sockets at the rear permit the connection of the LEAK V.S. tuner unit. An input attenuator is fitted. H.T. and filament supplies are available from the pre-amplifier.

#### ★ Distortion

Of the order of 0.1%.

#### ★ Hum

Negligible, due to the use of recently developed valves and special techniques.

#### ★ Input selector

Radio, tape, records; any and all records can be accurately equalised.

#### ★ Treble

Continuously variable, + 9 db to — 15 db at 10,000 c/s.

#### ★ Bass

Continuously variable, + 12 db to — 13 db at 40 c/s.

#### ★ Volume Control and Switch

The switch controls the power supply to the TL/10 power amplifier.

#### ★ Tape Recording Jacks

An exclusive feature. Readily accessible jacks are provided on the front panel for instantaneous use with Tape Recorders which have built-in (low level) amplifiers.

★ Write for leaflet W ★

**H. J. LEAK & CO. LTD., BRUNEL ROAD, WESTWAY FACTORY ESTATE, ACTON, W.3**

Phone: SHEpherds Bush 1173/4/5

Telegrams: Sinusoidal, Ealux, London

Cables: Sinusoidal, London



**CHASSIS ASSEMBLY**

3 colour, 3 waveband scale covering standard, Long, Medium, and Short wavebands, scale pan, chassis punched for standard 5-valve superhet, pulley driving head, springs, etc., to suit. Scale size 14 1/2 in. x 3 1/2 in. Chassis size 15 in. x 5 1/2 in. x 2 1/2 in. deep. Price 15/-, plus 1/6 post Note.—This is the one that fits our 39/6 table cabinet.

**RADIO SCALES, 4/- DOZEN**



An exceptional bargain this month is our assorted parcel of radio scales. A most useful collection for all who make up experimental or other radios. We offer twelve assorted scales mostly in two or three colours for 4/-, plus 9d. post and packing. Limited quantity only.

**RESISTORS**



50 assorted 1/2 and 1 watt resistors. Ranging between 10 ohm. and 10 megohm. (Our selection.) Price 5/- pkt. Ditto, 1 watt, 7/6.

**EX-ROYAL NAVY SOUND POWERED TELEPHONE**

These require no batteries, and will go for long periods without attention. Complete with generator and sounder which gives a high pitched note, easily heard above any other noise. Also fitted with an indicator lamp which in quiet situations can be used instead of the sounder, or where several are used together will indicate which one is being called. Size 7 1/2 in. x 9 in. x 7 1/2 in. wall mounting, designed for ships' use, but very suitable for home, office, warehouse, factory, garage, etc. Price 57/6 each, plus 4/6 carriage.

**INSTANT HEAT CONVECTOR**

The heater with the lowest possible thermal capacity, 4ft. long; made from heavy gauge sheet steel (galvanised), 1 kW., suitable A.C. or D.C. Price only 22/-, with thermostat 23/15/-. Note.—The thermostat controls separately and will control up to three heaters.

**CLEVELAND CAR BATTERY CHARGER**

Gives 1 1/2 amp. charge—uses everlasting metal rectifier and robust double wound mains transformer in metal carrying case with leads and croc. clips. Price, 6 volt, 29/6; 6 and 12 volts, 39/6, post 2/6.

**1in. MICROMETER**

Exceptional purchase enables us to offer a 1in. precision micrometer at the very low price of 10/-. A micrometer is an essential part of an engineer's equipment. You will have found the need for one on many occasions in the past for measuring wire gauge, etc. Price 10/-, post free. Note.—We now have a waiting list for this, orders in rotation.

**OSRAM 912**

The constructional data for this Hi-Fi amplifier is available, price 3/6, which amount will be credited to you if you buy the components later. One '912 Shopping List' will be included with the booklet.

**GENUINE HALF-PRICE OFFER**

**BEETHOVEN CHASSIS**



Extremely well built on chassis size approx. 9 1/2 x 7 1/2 x 8 1/2, using only first-class components, fully aligned and tested, 110-240-volt A.C. mains operation. Three wave bands covering medium and two shorts. Complete with five valves, frequency changer, double diode triode, pentode output and full wave rectifier. Special cash-with-order price this month, 25/19/6, carriage and insurance 7/6.



**GRAMOPHONE AUTO-CHANGER**

Latest type by all famous makers are invariably in stock at competitive prices.



**BARGAIN FOR CONSTRUCTORS**

Modern style cabinet in contrasting veneers, with metal chassis, three knobs, coloured scale, and pointer. Price 29/6, post, etc., 2/-. All other components to build 2-waveband superhet. Price 25. Data, 1/6 (free with components.)

**COILS—T.R.F. AND SUPERHET**

T.R.F. long and medium wave with circuit diagram, 5/6. Superhet long, medium, and short wave, aerial and oscillator coils, e.g., set of six coils with circuit, 10/6.

**HEATING TRANSFORMER**

2 1/2 volts at 400 amps. Continuous rating; suitable for unfreezing water pipes setting of resins during casting, setting of glues during cabinet making, edge veneering, etc., etc. Complete in metal case with carrying handle, price 21/2, carriage and packing 5/-.

**LIGHTWEIGHT REFLECTORS**

Ideally suitable for all purposes where the intensification of electric illumination or Infra Red is required. The material used is lightweight aluminium, highly polished. All are pierced for Standard Lamp-holders.

STAR, 7 1/2 in. dia. by 6 in. deep. Price 7/6 each. Post, etc., 1/3.

SENIOR, 1 1/2 in. dia. by 4 in. deep. Price 13/6 each. Post, etc., 1/3.

JUNIOR, 6 1/2 in. dia. by 3 1/2 in. deep. Price 7/3 each. Post, etc., 1/3.

BIJOU, 5 1/2 in. dia. by 2 in. deep. Price 6/6 each. Post, etc., 1/3.

BELL, 5 1/2 in. dia. 5 in. deep. Price 6/3 each. Post, etc., 1/3.

**THE "WINDSOR 5"**

This is a 5-valve A.C. superhet covering the usual long, medium and short wave bands. It has a particularly fine clear dial with an extra long pointer travel. The latest type local valves are used and the chassis is complete and ready to operate. Chassis size 15 1/2 in. x 6 in. x 6 in. Price 29/19/6 complete with 8 in. speaker. Carriage and insurance 10/-. H.P. terms if required.

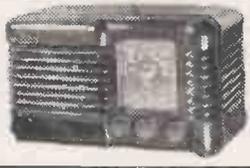


**TABLE RADIO CABINET**

Due to a special purchase, we are able to offer this very fine cabinet, size approx. 15 1/2 x 8 1/2 in. Walnut veneered and satin finished, 39/6, carriage and packing 3/6. Note.—This cabinet is the correct one for the Windsor chassis above with 6 1/2 in. speaker.

**TERRIFIC NEW CIRCUIT**

OCASIONAL 55—we have evolved a new T.R.F. circuit and have had utterly amazing results, equal in fact to many superhets. You really should try this circuit. All parts including valves (6KT, 6J7, 6R6G, and 6X3) and Bakelite case with back cost only 25/10/-, plus 2/6 post and insurance. Data included with the parts is also available separately price 2/-.



**TRANSFORMER 100 WATTS**

These are transformers with a wound primary tapped 200, 220, 240, but no secondary. There is ample window space, however, for the hand winding of secondary to suit your own requirements. Approximately two turns per volt are required. The amps. taken out will depend upon volts, e.g., 10 amps. at 10 volts, 50 amps. at 2 volts, etc., etc. Price 10/-, post and packing 2/-.

**DECCA CRYSTAL PICK-UP**

A snip for the connoisseur—turnover head suitable all records—limited quantity 29/6, plus 2/- post and packing.

**G.E.O. METAL CONE SPEAKER**

This fine speaker is coming to the front rapidly—price 28/15/-. Octagonal cabinet made to maker's specification, 21/10/-, walnut or oak.

**BARGAINS TO CLEAR**

**2-VOLT ACCUMULATORS**

Made for the Forces by one of the most famous firms in the world. 15 amp-hour, size approx. 6 x 1 1/2 in. square in ebonite case, pre-charged, only need filling with acid, 2/9 each, plus 1/- post and insurance.



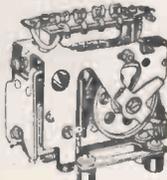
**PORTABLE CABINET**



This is ultra-modern, two-tone, bakelite with integral moulded handle. We can supply, where required, the metal chassis, dial, and all other parts necessary to make a Mains or Battery portable. Note: All of these cabinets have slight imperfections; these are hardly noticeable however, and will not impair the performance or safety of the set. Price 7/6 each, post and insurance 3/6.

**REMOTE CONTROL**

With only one pair of wires and a simple push button you can select any one of four stations. This is just one of the many applications of our impulse relay. There are many other purposes to which it can be put. Note they are somewhat soiled, due to storage, but mechanically O.K. Price 1/9, post 6d.



**5-AMP. SURFACE SWITCHES—HICRAFT**

Oblong Brown 1-way 1/4 each. Oblong White 1-way 1/4 each. Oblong Brown 2-way 1/3 each. Oblong White 2-way 1/3 each. Round Brown 1-way 10d. each. Round White 1-way 10d. each. Round Brown 2-way 1/- each. Round White 2-way 1/- each.



**WAVE-CHANGE SWITCHES**

One dozen assorted wave-change switches, ideal for experimenters. Note, these are unused and not removed from equipment. Our assortment. Price 5/-, post and packing 1/-.



**110-VOLT 2 1/2-AMP. RECTIFIER UNIT**

This is an excellent unit suitable for driving 110 v. D.C. equipment from 230 v. A.C. mains or for charging batteries for stand-by lighting, etc. Made for the Government—new and unused, with switchgear. Price 21/7/10/- each.

**NAIL INSULATORS**

Suitable for electric fences, indoor aerials, etc., 3/- per dozen, post and packing 1/-.



**WESTINGHOUSE RECTIFIER**

Full wave—suitable for up to 80 volts at 15 milliamps. Ideal for relays, meters, etc. Price 2/6, post 6d.

**SPADE TERMINALS**  
Heavy duty type made from M.G.S. Price 7/4 each, 6/- per dozen.



**HIRE PURCHASE TERMS.**—Any goods costing £5 or more may be purchased by extended payments—deposit 10% (or more)—balance spread over 12 months.

SEE OVER

**MAKE A CONVECTOR**



Almost any metal case can be converted into a useful convector type electric heater if you use our porcelain mounted element 250 watts small size. Price 2/6, post 6d.

**CAR STARTER/CHARGER KIT**

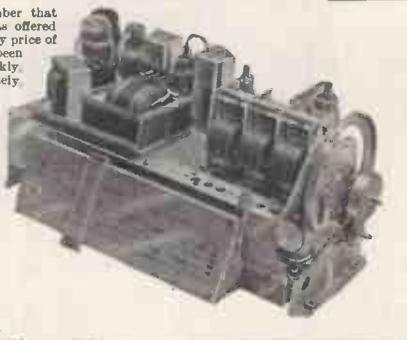
All parts to build 6- and 12-volt charger which can be connected to a 'flat' battery and will enable the car to be started instantly. Kit comprising the following—

- Mains transformer ..... 19/6
  - 6-amp. rectifier ..... 22/6
  - Regulator Stud Switch ..... 3/6
  - Resistance Wire ..... 2/-
  - Resistance Former ..... 2/6
  - Mains on/off Switch ..... 1/-
  - 0-5-amp. Moving Coil Meter ..... 3/6
  - Constructional Data ..... 1/6
- or if bought all together price is 59/6, plus 2/- extra and packing.

**LAST CHANCE TO SECURE THIS BARGAIN**

Readers will remember that this fine receiver was offered last month at the silly price of £5 and they have been going out very quickly. If you send immediately, however, you will probably be just in time to secure one.

The set, a product of one of our famous manufacturers, has H.F. stage, tuning indicator, and all modern refinements, covers 5 wavebands including short waves to 11 metres. Offered less valves and power-pack, otherwise complete and unused—price £25, carriage 7/6 (uses octal range valves).



**SOMWEAVE**



This really lovely loud speaker fabric we offer at approximately a third of to-day's cost. It is 42in. wide and our price is 12/- per yard, or panels 12in. x 12in., 1/9 each. This is also very suitable for covering plain wooden cases, for portable radio amplifiers, etc.

**CONNECTING WIRE SNIP**



P.V.C. insulated 23 s.w.g. copper wire in 100ft. coils, 2/9 each. Various colours available: 4 coils assorted colours for 10/-

**H.T. RECTIFIERS FAMOUS SELENIUM "SENTERCEL"**

All are this year's stock—for higher voltages joint two or more in series.

R.M.1	125 v.	60 mA.	3/9
R.M.2	125 v.	100 mA.	4/9
R.M.3	125 v.	120 mA.	5/9
R.M.4	250 v.	250 mA.	16/-

**FLOUORESCENT LIGHTING**



Complete kit comprises 40-watt control unit, starter lamp, lamp holders, clips and wiring diagrams. Price, less tube, 22/6 plus 1/6 post. With tube, 30/-, plus 3/6 cart.

**EVERLASTING GRAMOPHONE NEEDLES**

Jewel (Sapphire) pointed, suit any type of pick-up, precision made—improves quality, eliminates record wear, 3 types, loud, soft, trailer, 2/6 each.



**AMPLIFIER A1134a**

This is a 2-stage Intercom, and Tx pre-amplifier with transformers, etc. Easily modified as gram amplifier or dictaphone, etc. Complete with 2 2-v. valves, QFP and Triodes. Price only 9/6, plus 1/6 post and packing. Circuit diagram, free with unit, or separately, 1/6.



**BUREAU CABINET**

This is a really beautiful cabinet elegantly veneered in walnut and finely polished. The control board, revealed when the front is dropped down is ample (or the larger than average radio chassis or amplifier and alongside there is a space for a tape recorder or auto record changer mechanism. Both the radio board and the control board are left uncut to suit your own equipment. Size approximately 30in. high, 32in. wide, and 18in. deep. Price 16 guineas, carriage 12/6.

**THE TWIN 20**

This is a complete fluorescent lighting fitting. It has built-in ballast and starters—stove enamelled white and ready to work. It is an ideal unit for the kitchen, over the work-bench, and in similar locations. It uses two 20-watt lamps. Price, complete less tubes, 29/6, or with two tubes, 39/6. Post and Insurance, 2/6. Extra 20-watt tubes 7/6 each.

**THE F.M. FEEDER UNIT**



All the parts necessary to make the Denco F.M. Unit are now available. The unit gives an A.F. output suitable for feeding in at the pickup sockets of any standard broadcasting receiver and superior results can be expected. The full constructional details as prepared by the Denco technicians are available—price 1/6 post free. Alternatively, they will be given free to those ordering all the parts which come to £8/7/6, plus 2/6 post and packing. Note: Four valves and everything including a prepared metal chassis is supplied. Approximate chassis measurements are 6x6x1 1/4. Demonstrations at our branches.

**ALL MAINS THREE**



A handy mid-gate A.C./D.C. 3-valve mains receiver giving powerful reception over long and medium waves. All component parts, including valves, coils, resistors, etc., but not loudspeaker and cabinet (you may already have these) will cost you only 18/6 plus 1/6 post—data available separately 2/- post free.

**PLUGS FOR MODERN VALVE HOLDERS**

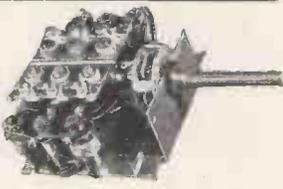


Each is fitted with a rubber shroud. For 87G button base and type 2 for 88A. Price 1/4 each, discounts for quantities.



**COMPLETE TOOL KITS—THE ELECTRICIAN'S**

This is as illustrated and contains 55 fine tools arranged on 8 trays in an automatic steel tool-box. The box opens under slight pressure of the hand and closes automatically when lifted. The tools are all that a practical electrician needs, including tenon saw, ratchet brace, hack-saw, chisels for wood, brick and steel, pliers, side cutters, hammers, spanners, socket wrenches, pad-saw, etc. Price £15/10/-, or H.P. if required.



**COIL PACK 18/6**

Manufactured by quite a famous company, this 3-wave Coil Pack incorporates a gram position and Long, Medium and Short wave band, designed for 465 kc/s. I.F. Brand new and fully guaranteed. Complete with circuit, only 18/6 plus 9d. post.



**KNOBBS**

Set of four brown knobs 1/4in. dia. Engraved tone, volume, tuning wave band. Push-on type. Post 6d. Ref. 2M46. Price per set 1/3.

**RADIO ENGINEER'S**  
This again is fitted into an automatic tool-box and contains 50 tools including pliers, side cutters, screwdrivers, side and straight snips, hammers, spanners, and socket wrenches, hand-drill, B.A. taps, drills, etc. Price £11/10/- H.P. terms if required.

**THIS MONTH'S SNIP**



**ATTACHE CASE.** Complete with leather handle and clasps—suitable for almost any portable instrument. Limited quantity—price 23/6 carriage and packing 2/6. A similar model but slightly smaller and in one colour 10/6, plus 2/6 carriage.

**THE CLEVELAND "ORGANTONE"**

The Cleveland "ORGANTONE" is a 5-valve 3-wave superhet covering long, medium and short wave. Built to a very stringent specification. Gram miniature valves are employed and low loss iron cored coils account for an excellent signal to noise ratio. Full A.V.C. is applied to both frequency changer and I.F. stages, and particular care has been taken to ensure freedom from frequency drift. The output stage utilises variable negative feedback for tone control, and, but for standard pentode correction, no cut in the ordinary sense is applied. A gram. position is provided and reproduction of records is particularly good. An amply proportioned power transformer with a primary tapped for 110-280 volts gives complete isolation from the mains. Chassis size is 12in. x 7in. x 7in.—Scale size is 10 1/2in. x 4 1/2in. This receiver has been tested in particularly difficult areas and its stability and noise rejection have produced exceptional results. Price £11/10/- or £15/0 deposit—carriage, etc., 7/6. A circuit diagram and photograph available price 2/- post free.

**ANOTHER CLEVELAND CHASSIS—THE "TREMENDO"**  
The first Cleveland chassis was good, but this one is really superb. It has a 7-valve circuit with 6 watts output, fitted with independent bass and treble controls. It is really an efficient R.F. circuit coupled to a high-fidelity amplifier. The chassis size is the same as the Organtone, namely 12x7x7 with the 10 1/2 x 4 1/2 multi-coloured scale, and it is built to the same exacting specification as the Organtone. Price £14/10/-, carriage and packing, 7/6. H.P. terms if required.

**ADDITIONAL STOCK ITEMS**

**POTTED TRANSFORMERS**

These are of really superior construction fitted in cast metal cases and compound filled. Terminals come to ebonite base-board. All are upright mounting and have 220/230 normal 50 cycle mains input and fully screened primary.

Type 5F1. 265-0-265 at 300 m.a.; 6.3 v. at 7 amp.; 4.4 v. at 2.5 amp.; Price 35/- plus 3/6 carriage.

Type 5F2. 365-0-365 at 150 m.a.; 4 v. at 2.5 a.; 6.9 v. at 4.2 a. Price 32/6, carriage and packing 3/6.

Type 5F3. 1540 v. 2 v. at 2 a.; 4 v. at 1 a.; This is an ideal transformer for televisions and scopes using V.C.R. 97, etc. Price 25/-, carriage 2/6.

**POTTED CHOKES**

These chokes are in similar type cases and therefore match the above transformers.

Type 5F4. 5 H. at 300 m.a. Price 10/-, carriage and packing 2/6.

Type 5F5. 10 H. at 150 m.a. Price 12/6, post and packing 2/6.

**HIGH POWER TRANSFORMERS**

For R.F. Heaters, transmitters, etc., etc. These are open wound type for maximum cooling and have the normal 200-250 primary fully screened.

Type 5F6. 1,000 v. at 1 amp., e.g. 15 K.V.A. Price £8/10/-, carriage and packing 5/-.

Type 5F7. 1,500 v. at 1 amp. e.g., 1.5 K.V.A. Price £15, carriage and packing 7/6.

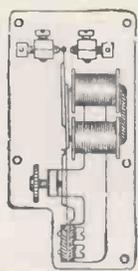
**AUTOMATIC MOTOR STARTER**

For remote control of D.C. motor between 1 and 3 h.w., adjustment for 100 v. or 230v. Unused and in first-class condition, complete with metal and wired glass cover. Price £10, carriage 5/-.



**"SNIPERSCOPE"**

Famous wartime "cats eye" used for seeing in the dark. This is an infra-red image converter cell with a silver caesium screen which lights up (like a cathode ray tube) when the electrons released by the infra-red strike it. It follows that as light from an ordinary lamp is rich in infra-red these cells will work: burglar alarms, counting circuits, smoke detectors and the hundred and one other devices as will the simpler type of photo cell. Here then is a golden opportunity for some interesting experiments, price 5/- each. Data will be supplied with cells if requested.



**RELAYS**

Extra light weight, extra sensitive for high speed or radio control work, weight only 1 1/2 oz., closes on 2 m.a., solid platinum change-over contacts, adjustable pressure. Price 12/6.

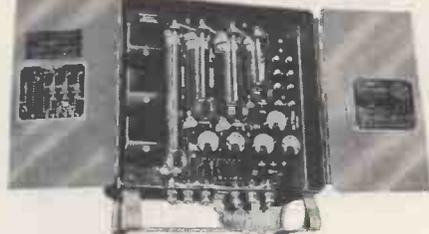
**TELEPHONE JACK PLUGS**

As illustrated 7d. each. Sockets to suit. 10d. each.

**TRANSMITTER VALVE 100 T.H.**  
Unused and fully guaranteed. £4/10/- each, post and insurance 2/6.

**HEADPHONES**

American ear insert type (HS/30), 29/8; British moving coil type, 9/6; High resistance, diaphragm type, 15/-.



**CHARGING SWITCHBOARD**

Feed this Switchboard through a Mains Transformer and Rectifier giving 24 volt D.C. up to 50 amps. and you have an excellent multi-circuit charger for simultaneously charging several batteries at different currents. This is an ex. Government switchboard rated at 550 watts 18 volts fitted into steel cases with doors. It contains three reverse current relays, one voltmeter, one main ammeter, two secondary ammeters and three variable resistors for controlling circuits. These are brand new, in original cases. Price £4/10/-, carriage 10/-.

We can supply a 12 volt, 50 amp Mains Transformer at £4/5/-, plus 5/- carriage.

**AMERICAN RADAR**

We have brand new, still in original unopened packing cases as shipped from America, three items of equipment which form the major parts of the radar system RC-184.

Item 1 known as Tower TR24a is in fact the aerial base and motor driven gear box which rotates the antenna.

Item 2 known as the Indicator I-921-A incorporates a magstrip device and appears

not only to control the Tower but also to follow it.

Item 3 is known as Control Unit BC-1268-A, incorporates a cathode ray tube as well as a control equipment.

We shall be glad to negotiate with intended purchasers of this equipment and would also like to hear from any reader able to give any more information about it.

**YOURS FOR £1 ONLY**

**COMMUNICATION RECEIVER R1155.**



This set, as most will know, is considered to be one of the finest communications receivers available to-day. The frequency range is 75 kc/s to 18 Mc/s. It is complete with 10 valves and is fitted in a black metal case. Made for the R.A.F., so obviously a robust receiver which will give years of service. Slightly used but completely overhauled and guaranteed in perfect working order. PRICE £7/19/6 or will be sent against a deposit of £1. If you cannot call to collect please include an additional 10/- to cover cost of transit and carriage. This partly returnable to you if and when you return the transit case.

**MAINS POWER PACK FOR R.1155**

With Pentode output stage. Plugs into socket on receiver so no internal modification is required. Price £5/10/- complete with 5in. speaker ready to work, carriage 3/6. If bought with receiver deposit is 30/-.



**POWER FOR TR1154/55**

We can offer brand-new, and unused, the two rectifier units for mains operating the transmitter TR1154 and its associated receiver R1155. Both rectifier units are completely enclosed in metal cases and operate directly from normal 50 cycle A.C. mains. Price £17/10/- the pair, carriage and packing 10/- extra.

**MAGNETRONS**

Precision made for RADAR type Nos. CV.186 and CV.64. Unused, guaranteed. Any not functioning correctly will be replaced. Price £2/10/-, Post and insurance 10/-.

**R1132**

We have a small quantity of these receivers less valves still available. Their condition unfortunately is not good but they appear to be repairable, and, of course, contain a multitude of spare parts. At 30/- each they represent a real bargain. If not collecting, please include 5/- for packing and carriage.

**RECEIVER TRANSMITTER 38**

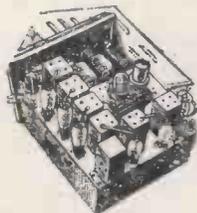
This is the British equivalent of the walkie-talkie. It operates on the frequency range 7.4-9 mc/s. It has many novelty applications in the home and can eventually be turned into a useful little portable receiver. Complete and with valves unused but not guaranteed, price 37/6, post 2/6 extra.

**STABILAVOLT**

This is a valve designed and constructed to facilitate the taking off of several voltages, each of which will be stabilized. These are brand new and unused. Price 10/6 each, post 1/- extra.

**IMPORTANT NOTE**

Owing to the bulkiness of many of the items listed on this page it may not be possible to keep stocks at all branches, therefore please telephone confirmation that the item is actually at the branch before journeying specially to see it.



**10-VALVE 1 1/2-METRE SUPERHET**

Ideal for Commercial T.V. These contain 6 valves type 6F61, and one each R17, RL16, and E450. Six IF transformers 12 Mc/s. band, and hundreds of other useful components. Price 39/6, plus carriage and packing 7/6. These receivers are unused.

**BLOCK CONDENSERS**

New and unused. .5mf. at 2,500 v., 3/6; 4 mfd. at 750 v., 3/6; 8 mfd. at 500/600 v. 5/-.



**BREAKDOWN PARCEL**

Unit for breaking down—offered at only a little over the price of the Aladdin Coil Formers it contains. Note. All parts can easily be removed as they are all bolted together. The unit contains—

- 6 Aladdin Fin. Coil Formers with dust cores.
- 6 metal cans for above coil formers.
- 1 4-position 12-pole switch.
- 6 miniature R.F. chokes.
- 2 25-mfd. 25-v. electrolytics.
- 30 paper tubular condensers. .002 to .1 mostly for 450 v.
- 56 carbon resistors, values from 1/2 watt to 2 watt.
- 2 medium-size R.F. chokes.
- 7 moulded octal valve-holders.
- 1 moulded diode valve-holder.
- 20 mica condensers (moulded, silver and ceramic).
- 7 insulated top caps for valves.
- 4 component strips (one 40-way, one 11-way, one 5-way, and one 3-way).
- 1 very useful chassis, size 18x5x3 1/4 in.
- Plus dozens of nuts, bolts, screws, washers, and other useful items such as Fin. spindle extenders, etc.

Price only 7/6, post and packing 2/6.

**GREATLY REDUCED CATHODE RAY TUBES**

VCR97. Brand new and unused, "cut off type," ideal for 'scope, etc. Full picture type forty, 39/8. Price 12/6. Carriage and insurance 5/- extra.

VCR157. 6in. guaranteed full picture. 29/6, plus 5/- carriage and insurance.

VCR139A. 2 1/2in. 32/6, plus 2/6 carriage, etc.

VCR138. 3 1/2in. electrostatic short persistence, suitable for T.V. and ideal for 'scope work, 37/6 plus 3/6 carriage, etc.

VCR112. 5in. electrostatic, persistence not known, 15/- each, plus 5/- carriage, etc.

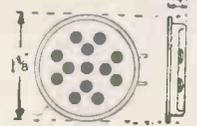
CV986. 6in. electrostatic, persistence not known, 15/- each, plus 5/- carriage, etc.

CV1140. CV1590. CV1546. All 1 1/2in. magnetic long persistence, £4/10/-, plus 10/- carriage.



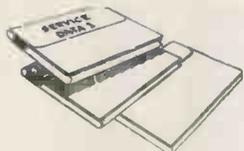
**CRYSTAL MICROPHONES**

Diaphragm driven, extremely sensitive, highly suitable for recorder work. No matching needed. 3/6 each.



**VACUUM PUMP**

Type B3 new in makers cartons—many applications in home or factory—22/6 post 1/-.



**SERVICE DATA**

100 service sheets, covering British receivers which have been sold in big quantities, and which every service engineer is ultimately bound to meet. The following makes are included: Aerodyne, Alba, Bush, Cossor, Ekco, Ever-Ready, Ferguson, Ferranti, G.E.C., H.M.V., Kolster-Brandes, Lissen, Mitchell, Marconi, Mullard, Murphy, Philco, Phillips, Pye, Ultra. Undoubtedly a mine of information invaluable to all who earn their living from radio servicing. Price £1 for the complete folder. Our Folder No. 2 consists of 100 data sheets covering most of the popular American T.R.F. and superhet receivers "all dry" etc., which have been imported into this country. Names include Sparton, Emmerson, Admiral, Crosley, R.C.A., Victor, etc. Each sheet gives circuit diagrams and component values, alignment procedure, etc., etc. Price for the folder of 100 sheets is £1. Post free.

**CABINETS FOR ALL**

We confidently believe we carry the best stock of cabinets in London. The one illustrated is The Bureau, a really beautiful cabinet elegantly veneered in walnut and finely polished. The control board is revealed when the front is dropped. Both radio board and motor board are left uncut to suit your own equipment. Price is 16 guineas, carriage 12/6. We have many other types in stock. Pay us a visit, or, send for Cabinet List



**CABINETS 19/6**

You can make an excellent bass reflex cabinet with this well made veneered and polished-walnut cabinet. Limited quantity offered at 19/6. Carriage, etc., 3/6.



**BATTERY 3-VALVER 19/6**

This employs a modern circuit which ensures good reception on both medium and long waves—all the parts including valves, resistors, tuning condensers, in fact everything except loudspeaker, cabinet, and metal chassis (you may already have something suitable, from an old receiver for instance), will cost you only 19/6. Data available separately price 1/6.

**ALL-DRY BATTERY BARGAIN**

90 volt 3-pin plug type layer built battery by famous maker—recent manufacture—approximate dimensions 2 1/2 in. x 2 in. x 3 1/2 in.—price 5/-, e.g., approximately half list—post and packing 9d.



*The INSTANTUS Greenhouse Heater*

**INSTANT HEAT CONVECTOR**

The heater with the lowest possible thermal capacity, 4ft. long, made from heavy gauge sheet steel (galvanised), 1 kw., suitable A.C. or D.C. Price only £2 or with thermostat £3/15/-. Note: The thermostat mounts separately and will control up to three heaters.



**NOW—A.C./D.C. MULTI-METER KIT**

The Multi-meter illustrated measures A.C./D.C. volts and D.C. m/amps and ohms. It has a sensitivity of 200 ohms

per volt and is equally suitable for the keen experimenter, service engineer or student. All the essential parts including 2in. moving coil meter, selected resistors, wire for shunts, 8-point range selector, calibrated scale, stick-on range indicator and full instructions for making are available as a kit, price 19/6 plus 9d. post and packing.

**THIS CABINET FREE**

This month we are giving free a very fine modern portable cabinet to all purchasers who buy both the Truvox Tape Deck and the Cleveland Wide Band Amplifier. These three items will all fit together and make an extremely good tape recorder. Prices are as follows:—Truvox Tape Deck Mark IIIU, the very latest model, price £23 2/-, Cleveland Wide Band Amplifier, designed in conjunction with Truvox engineers to get the very best results from their fine deck, price £15, or £38 the two. Hire Purchase terms, send deposit of £4 or over, balance will be spread over twelve months—carriage, packing, and insurance 12/6 on the two items.



**SENT FOR 15/- ONLY**

This cabinet is offered below cost. It is suitable for a television using tube sizes varying from 12in. to 17in., its overall dimensions being 3ft. 6in. high, 1ft 4in. deep, 1ft. 10in. wide. It is complete with plywood back and "Bowler Hat." Originally made for a very expensive television and really good quality. Unrepeatable. Offered at 27 5/-. carriage, packing, etc., 12/6. Note: These are cut for 12in. tubes, but the holes for the controls are not drilled.



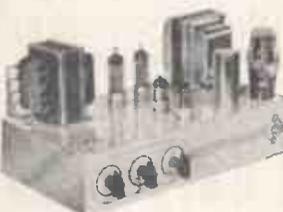
**PRICE CORRECTION**

We regret that an error occurred in our January advertisement—the Elprez Tape Recorder was incorrectly priced, it should read 39 guineas, not 35 guineas.

**NEW YEAR BARGAIN**

**MINI-MAINS FOUR**

Uses a 4-wave circuit with high-efficiency coils—covers long and medium wave bands and fits into the neat white or brown Bakelite cabinet—limited quantity only. All the parts, including cabinet, valves, in fact, everything, £3/19/6 plus 2/- post. Constructional data free with the parts, or available separately 1/6.



**MULLARD AMPLIFIER "510"**

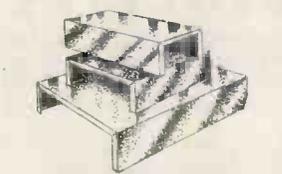
A High Quality Amplifier designed by Mullard engineers. Robust high fidelity, with a power output exceeding 10 watts and a harmonic distortion less than .4% at 10 watts. Its frequency response is extremely wide and level being almost flat from 10 to 20,000 C.P.S.—three controls are provided and the whole unit is very suitable for use with the Collaro Studio and most other good pickups. The price of the unit completely made up and ready to work is £12/10/- or 25/- deposit, plus 10/- carriage and insurance. Alternatively, if you wish to make up the unit yourself we shall be glad to supply the components separately. Send for the Mullard amplifier shopping list.

**NEW 5 AMP. THERMOSTAT (MINIATURE)**



2 1/2" x 1" x 1 1/2" high.

Useful for the control of appliances such as convector, gluepots vulcanisers, hot plates, etc. This thermostat is adjustable to operate over the temperature range 50-550 deg. F., fitted with heavy (5 amp. A.C.) silver contacts size 1 1/4in long x 1/4in. wide, price 8/6, post 6d.: 1 amp. type, 3/6, 2 amp. type, 5/6.



**BLANK CHASSIS 18 S.W.G. Aluminium**

7 x 3 1/2 x 2	3/9
9 1/2 x 4 1/2 x 2 1/2	5/-
10 x 8 x 2 1/2	5/6
12 x 9 x 2 1/2	7/-
14 x 9 x 2 1/2	7/6
14 x 10 x 3	7/9
16 x 10 x 3	8/3
16 x 12 x 3	8/8
18 1/2 x 9 x 2 1/2	8/3
20 x 10 x 3	10/-

**ELECTRONIC PRECISION EQUIPMENT LTD.**

249, Kilburn High Road, Kilburn. (Now Open.)

42-46, Windmill Hill, Ruislip, Middlesex. Phone: RUISLIP 5780 Half-day Wednesday.

152-153, Fleet Street, E.C.4. Phone: CENTRAL 2833 Half-day Saturday.

29, Stroud Green Road, Finsbury Park, N.4. Phone: ARCHWAY 1049 Half-day Thursday.

Post orders should be marked "Dept. 2" and addressed to our Ruislip dept.

Photograph kindly supplied by The Radio People Ltd., Hong Kong.

# HIGH FIDELITY IN THE FAR EAST



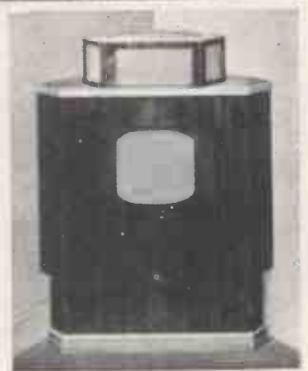
## OMNI-DIRECTIONAL 3-Speaker System W15/CS SUPER 8/CS SUPER 5 Treble Units Facing Upwards—Crossover Frequencies 800 and 5000 c/s.

This superb speaker, used here for a record recital at King's College, Hong Kong, has the W15/CS as bass speaker with fundamental resonance below 30 C/S; the Super 8/CS as middle speaker; and the Super 5 as third speaker with response well maintained to 16,000 C/S. The middle and top speakers,

fitted with a volume control, face upwards to avoid undue directional effects.

### PRICES (Tax free)

W15/CS sand-filled enclosure £47; Treble Assembly £18; HS/CR3 Crossover with V.C.s £8/10/-. Total price £73/10/-.



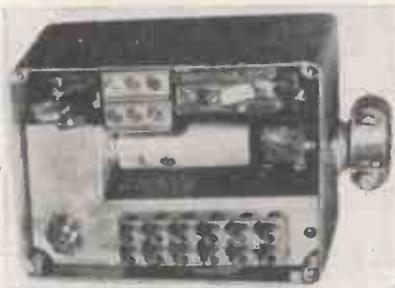
# Wharfedale

WIRELESS WORKS LTD., IDLE, BRADFORD, YORKS.

Phone : Idle 1235/6 (2 lines)

Grams : Wharfedel, Idle, Bradford

# TIME DELAY Unit



THE 'GATLEY' ELECTRONIC TIMER

An Electronic Time Delay invaluable in many fields of Electronics and electrical engineering, e.g., process control, photographic exposure timing, etc. Time intervals range from 1/5th sec. to 1 min. In die-cast case suitable for wall mounting.

Write for leaflet

## F.C.ROBINSON & PARTNERS LIMITED.

COUNCILLOR LANE · CHEADLE · CHESHIRE

MAKERS OF FINE INSTRUMENTS

# Holley's

First Again with

## SOMETHING NEW in HIGH-FIDELITY

Bearing in mind that room acoustics also are an important factor when perfection in Sound Reproduction is required, we are now in a position to demonstrate *IN YOUR OWN HOME* the latest High-fidelity equipment by the following makers.

ACOUSTICAL, LEAK, PAMPHONIC, SOUND SALES, GOODMAN'S, WHARFE-DALE, CHAPMAN, TANNOY, ROGERS, GARRARD, W.B., GRUNDIG, BARKER, LOWTHER, CONNOISSEUR, ARM-STRONG.

Phone, call or write stating type and makes of equipment you are interested in.

This offer only applies at present to the greater London area but is shortly being extended to the provinces, also we still hold *SIDE BY SIDE DEMONSTRATIONS* of the above makers' products at

## HOLLEY'S RADIO

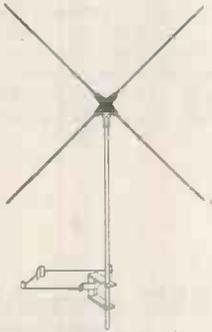
285, CAMBERWELL ROAD, LONDON, S.E.5.

Telephone : RODNEY 4988.

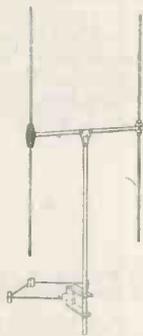
HIRE PURCHASE TERMS. AFTER SALES SERVICE.

# Aerials for everyone!

THE ANTIFERRENCE RANGE COVERS ALL TYPES OF INSTALLATION AT PRICES YOUR CUSTOMERS CAN AFFORD TO PAY



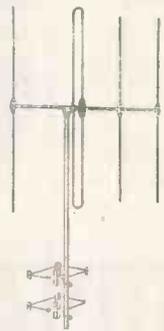
**X4L** Chimney lashing 6ft. mast for vertical mounting 75/-  
Wall mounting Model X4W 66/6.  
10ft. mast chimney lashing Model X4M 115/-  
Mast head mounting Model X4P 40/-.



**LD7R**  $\frac{1}{2}$  wave spacing; 6ft. mast 79/6.  
 $\frac{1}{2}$  wave spacing; 10ft. mast Model LP7M 124/6.  
 $\frac{1}{2}$  wave spacing; 12ft. mast double lashing Model PD7RM 168/-.



**FD73** Three element array for chimney lashing. Complete with 12ft. mast and double lashing equipment type LSG 210/-.  
As FD73 but less mast and lashing equipment Model FDH73 91/6.



**FD74** Four element array complete with 12ft. mast and double lashing equipment type LSG 231/-.  
As FD74 but less mast and lashing equipment Model FDH74 112/6.



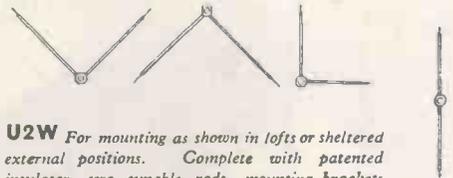
**LD7** Single Dipole with 3ft. swan neck mast and chimney lashing equipment 48/-.  
As LD7 but with wall mounting bracket Model WD7 39/6.



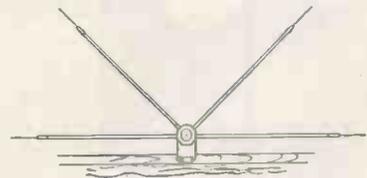
**SDU7** Single Dipole with ample stand-off Arm and Universal Bracket for surface mounting in a horizontal or vertical position 32/6.



**U2RC** A tunable "De Luxe" Room Aerial with patented insulator; cream plastic sleeved rods complete with 15ft. cream co-axial cable 21/-.  
Model U2R (as U2RC but less cable) 15/-.



**U2W** For mounting as shown in lofts or sheltered external positions. Complete with patented insulator, two tunable rods, mounting brackets and fixing screws 16/6.



**UV4** The most powerful loft aerial obtainable. Complete with patented insulator, four tunable rods, mounting brackets and fixing screws 22/6. Available for HORIZONTAL mounting as an X array 25/-.

**ANTIFERRENCE LIMITED**

Sales Division: Bicester Road, Aylesbury, Bucks. Tel. Aylesbury 1467/8

An audio  
frequency  
triumph!

### 95 GNS

(less microphone).

Wide-range Grundig  
Ribbon Microphone  
12 gns. Grundig Moving  
Coil Microphone  
6 gns. Attractive  
Hire Purchase Terms.



## GRUNDIG TK 819

### THE PORTABLE TAPE RECORDER WITH 40 c.p.s. to 14,000 c.p.s. FREQUENCY RANGE

**S**UPERBLY designed and engineered by Tape Recorder specialists. Two tape speeds ( $3\frac{1}{2}$  in./sec. and  $7\frac{1}{2}$  in./sec.) for 2 hours' speech or one hour's music recording per spool of tape. Automatic stop at end of spool. Fast forward or rewind time (2 minutes per full tape of 1,200ft.). Built-in precision place indicator, recording level meter by magic eye. Built-in pockets for 2 spare spools and microphone. Most Radio and Photographic Dealers stock Grundig. Ask for a demonstration or write for folder with full specification—Grundig (Gt. Britain) Ltd., Kidbrooke Park Road, London, S.E.3. (Electronics Division, Gas Purification & Chemical Co. Limited.)



# GRUNDIG

## THE WORLD'S FINEST portable TAPE RECORDERS

GT195

**INDUSTRIAL SUCCESS**

*Unique in the world*

**MEIRIX**

**MEIRIX**

**type 430**  
**International**  
**MULTIMETER**

- **AUTOMATIC SAFETY**  
against all overloads or faulty use
- **VERY HIGH SENSITIVITY**  
20,000 OHMS PER VOLT  
AC and DC
- **29 RANGES**  
3 to 5,000 Volts AC and DC  
50 MICROAMPERES  
to 10 AMPERES  
0 to 20 MEGOHMS
- **HIGH ACCURACY**  
according to U. T. E.  
standards  
DC: 1.5%—AC: 2.5%
- **UNRIVALLED PRICE**

COMPAGNIE GENERALE DE METROLOGIE  
ANNECY (France)

**LEADER OF THE INTERNATIONAL MEASUREMENT FIELD**

U.K. Agents: The SOLARTRON ELECTRONIC GROUP LTD.  
THAMES DITTON, Surrey.

# MEIRIX

The entire range  
of electronic and electrical  
test apparatus  
manufactured by  
the Internationally famous  
Companie Générale de Métrologie  
of Annecy, France  
can now be obtained  
from the exclusive U.K. Agents,  
The Solartron Electronic Group Ltd.,  
of Thames Ditton, Surrey.

Telephone: EMberbrook 5611

# SOLARTRON

**A NEW TECHNIQUE IN HIGH SPEED  
WAVEFORM MONITORING**

**BANDWIDTH :**

10 kc/s to 300 mc/s

**INPUT IMPEDANCE OF EACH PROBE :**

Approx. 1 pf (input element of variable capacity divider)

**MAXIMUM SENSITIVITY :**

Full Scale Deflection for 1 Volt input

**TIME SCALE :**

Variable from .05 microsecs to 5 microsecs.

**RECURRENCE RATE OF MONITORED WAVEFORM :**

100 c/s to 10 kc/s

**CALIBRATION :**

Provision is made for accurate measurement of time and voltage scales of a waveform

**PREVENTION OF JITTER :**

A circuit is incorporated for providing a stable display when a monitored waveform is jittering with respect to its driving pulse.



**HIGH SPEED RECURRENT WAVEFORM MONITOR TYPE 500**

The wide bandwidth and high sensitivity of the instrument as well as the very high input impedance result from the use of a sampling technique. During each recurrence a measurement is made of the instantaneous amplitude of one point in the waveform. This measurement is amplified and applied to the cathode ray tube as one co-ordinate of a graph of the waveform. During subsequent recurrences, instantaneous measurements are made of different points, resulting, after about 100 recurrences, in a complete graph.

*Please write for further information.*

**METROPOLITAN-VICKERS**

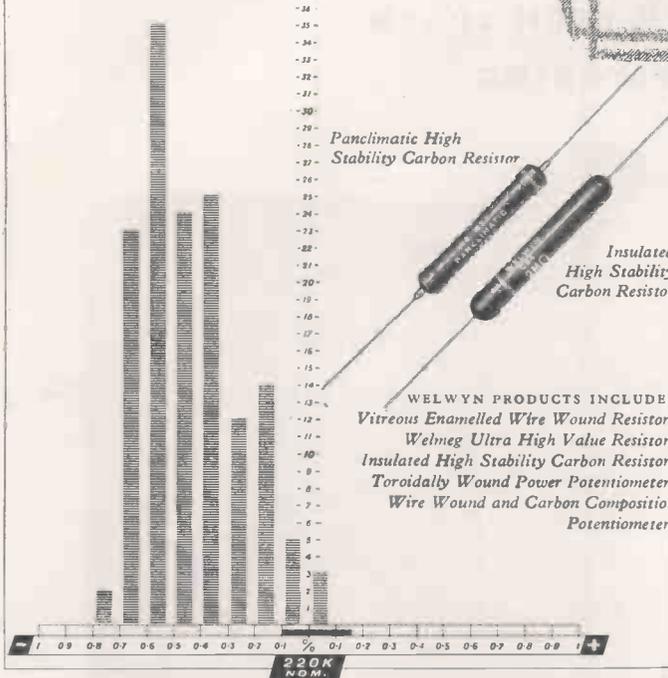
ELECTRICAL CO LTD · TRAFFORD PARK · MANCHESTER, 17

*Member of the AEI group of companies*

*Leading Electrical Progress*

**C23/220K±1%**

Distribution of more than 100 Resistors



**Consistency of Performance**

Study a moment this histogram. It is conclusive proof of the very high standards that prevail at Welwyn Electrical Laboratories. In graphic form it depicts the results of a test that our High Stability Carbon Resistors regularly undergo. Taken from the production line a representative selection of over one hundred resistors type C23/220K ±1% were tested to find out how their resistance values were distributed inside the tolerance of -1% to +1% of the nominal. The results are worthy of notice for they show that the resistance values were well within only half the marked tolerance. In time all cracked carbon resistors tend to drift towards an increased value, but, as you can see, the bulk of the distribution here is grouped below the nominal and this ensures that over their long life Welwyn Resistors remain accurate and within tolerance.



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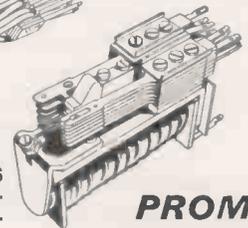
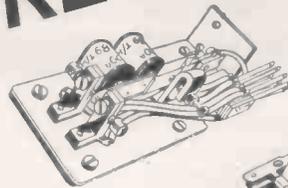
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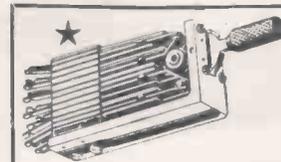
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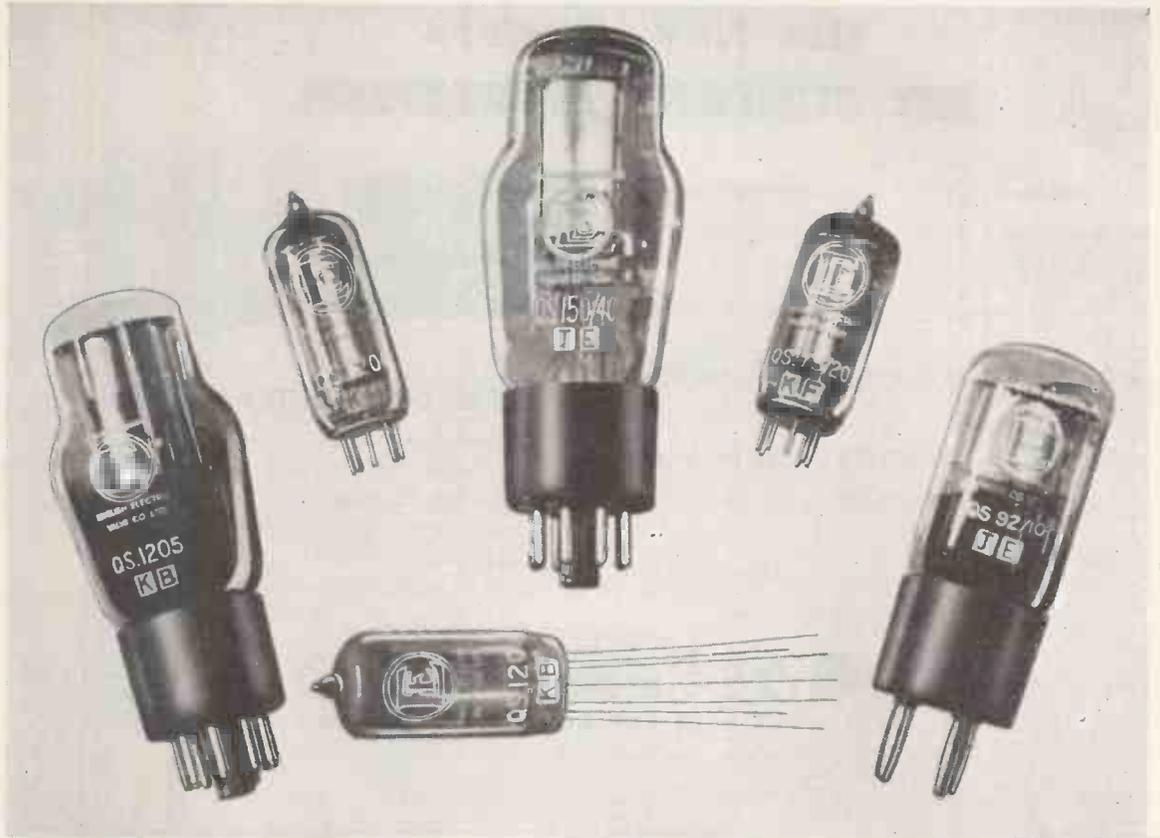
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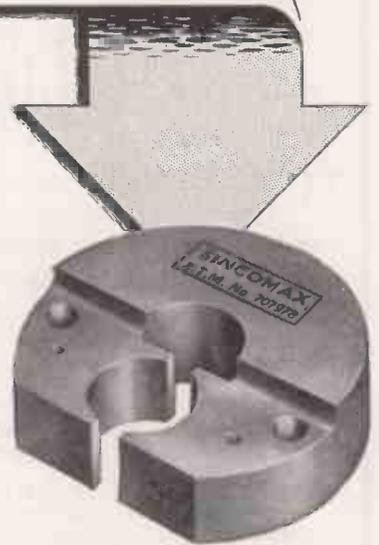
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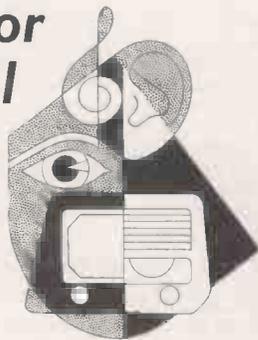
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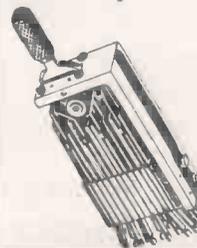
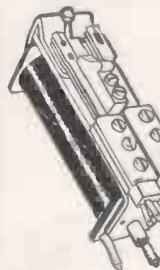
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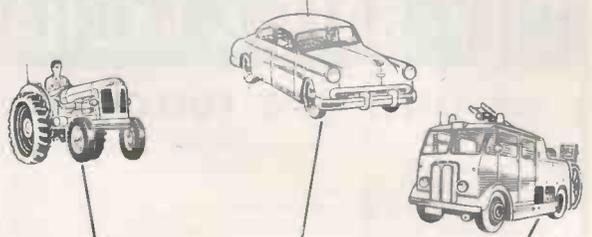
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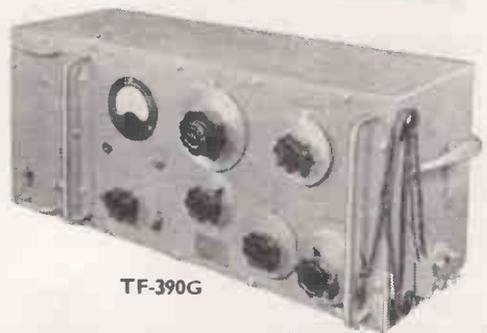
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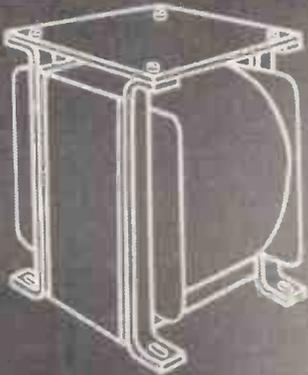
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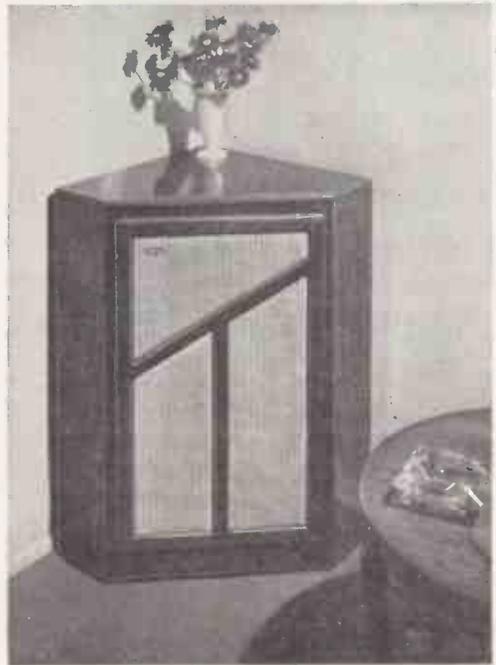
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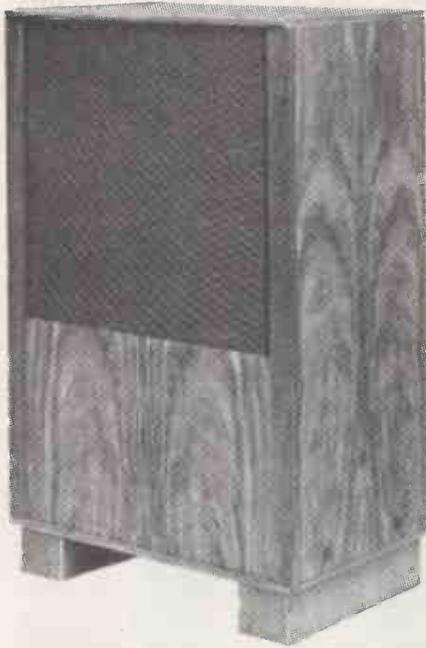
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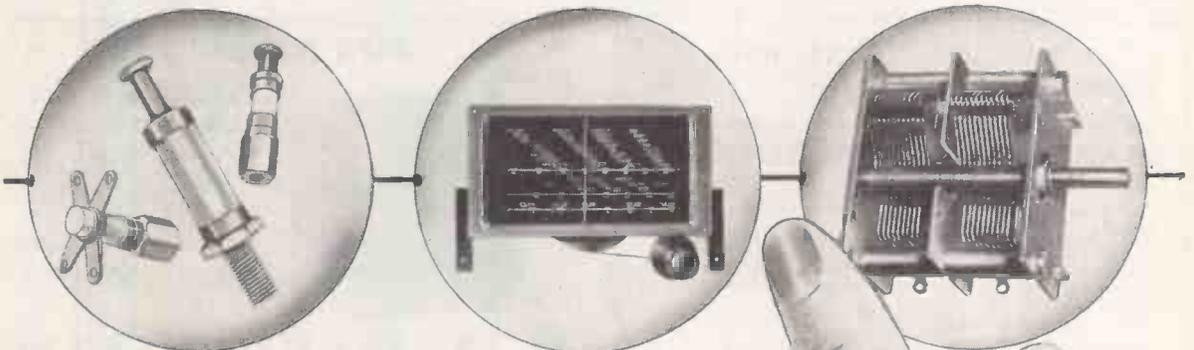
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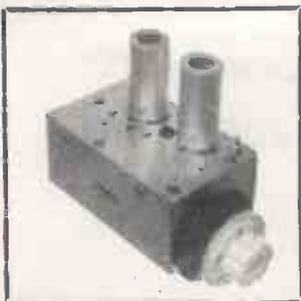
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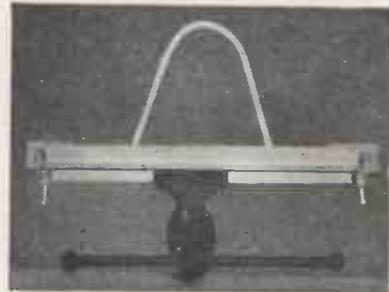
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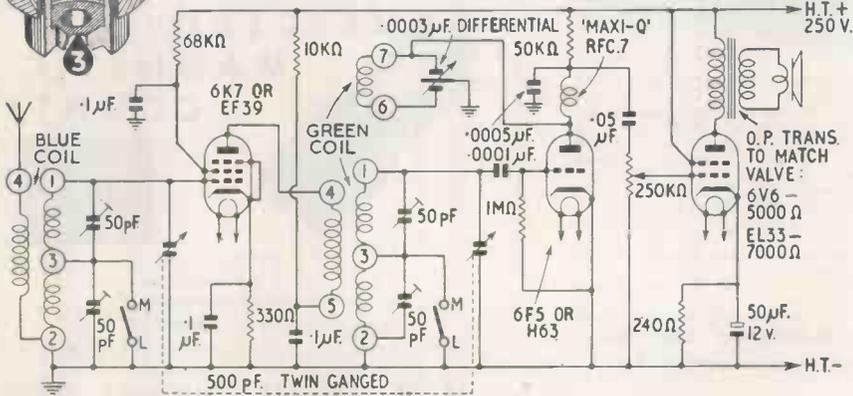
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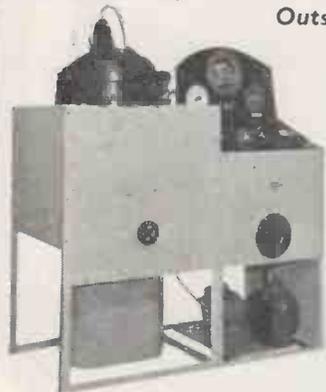
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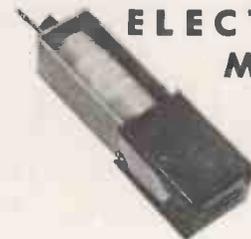
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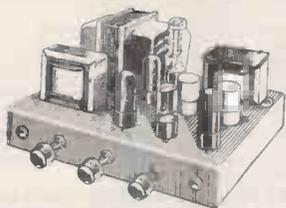
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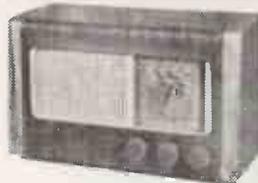
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This is a 3 valve T.R.F. plus Metal Rectifiers; with a valve line up as follows:—6K7 (HF); 6J7 (DET); 6V6 (OUTPUT). Wave band coverage is 180/550 metres on Medium wave, and 800/2000 metres on Long wave. The Walnut cabinet is the latest design and is outstanding in appearance.

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A simple and effective method of cutting out all mains noises. The Kit consists of 2 specially designed chokes together with 3 condensers. The unit can be assembled in existing receivers or separately if so desired.

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#### WALNUT POLISHED SPEAKER BAFFLETES

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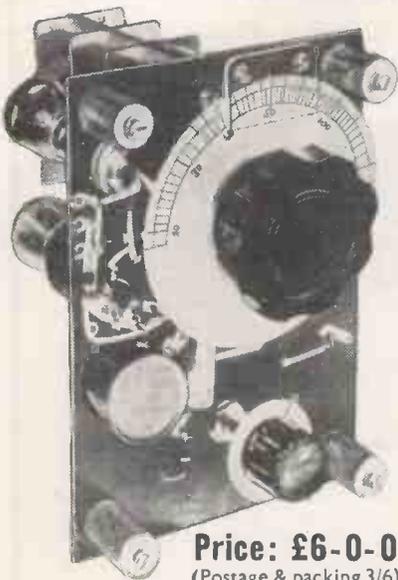
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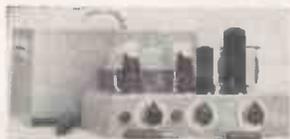
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MODEL AC10E £10/7/6.

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We are pleased to inform our customers both old and new that our Mail Order Dept. has been transferred to more spacious premises at 44, Tottenham St., London, W.1 (first turning left from George Street Underground). This move was made necessary by the ever-increasing demand for our goods. Due to the improved facilities at our new premises we can once again assure customers of immediate despatch.

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## BUILD YOUR OWN RADIO!



We can supply all the parts (including valves, 5in. moving coil speaker, cabinet, chassis and everything down to the last nut and bolt) to enable YOU to build a professional-looking radio. The chassis is punched and drilled ready to mount the components. There is a choice of any of three attractive cabinets: 12in. long, 5in. wide by 6in. high, as follows: either ivory or brown bakelite, or wooden, finished in walnut. Complete and easy-to-follow point-to-point circuit wiring diagrams supplied.

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This is a 3-valve plus metal rectifier T.R.F. receiver with a valve line-up as follows: 6K7 (HF), 6J7 (Det.) and 6V8 (Output). The dial is illuminated. Coverage is for the Medium and Long Wave Bands. Model 1—300/250 volts A.C. Mains operation. Model 3—200/250 volts A.C./D.C. mains operation.

Plus 2/6 Packing Carriage, Insur.

**£5 . 10 . 0**

### MODEL 2 SUPERHET RECEIVER

This is a powerful midset 4-valve plus metal rectifier Superhet Receiver with a valve line-up as follows: 6K8, 6K7, 6Q7, 6V6. The dial is illuminated and coverage is for the Short Wave bands between 10-50 metres, the Medium Wave bands between 190-450 metres, and the Long Wave bands between 1,000-2,000 metres. Operates on 200/250 volts A.C. mains.

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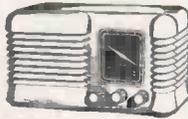
Instruction Booklet, and priced Parts List available separately at 1/-. This money will be refunded if circuit diagram is returned as NEW within 7 days.

### THE MODELS 1 & 3 T.R.F. RECEIVERS

can be supplied ready built at £8/15/6 plus 3/6 P. & C

## THE NEW T.R.F. . . .

## MODEL 1 PLUS. . . . THE RECEIVER WITH THE SENSATIONAL PERFORMANCE !!



This is a completely new design 4-VALVE, 2-Waveband T.R.F. Receiver, incorporating the latest type MINIATURE HIGH GAIN VALVES, and the most modern design HIGH "Q" IRON CORED COILS, ensuring greatly increased sensitivity and selectivity over the whole of the Medium Waveband, and providing outstanding performance on the Long Waveband. 4 Valves—6B16 R.F. Amplifier. 6BH6 Anode Bend Det. 6AQ5 Output. 6X4 Rectifier. For operation on 200/250 volt A.C. Mains. The Completed Receiver is housed in the attractive cabinet illustrated. Choice of either the Ivory or Brown Bakelite, or Wood, (Walnut Finished).

All the parts to build this Receiver can be supplied at

**£6 . 19 . 6**

Plus 2/6 Packing Carriage and Insur.

Can also be supplied ready built at £8/5/-, plus 3/6 p. & c.

INSTRUCTION BOOKLET and PRICED PARTS LIST available separately at 1/-. This money will be refunded if circuit diagram is returned as new within 7 days.

ALL COMPONENTS SUPPLIED ARE GUARANTEED FOR 12 MONTHS

### MAINS NOISE SUPPRESSOR KIT

Consisting of 2 specially designed chokes and 3 condensers. Extremely effective, cuts out all mains noise. Can be assembled in existing receiver or separately as desired. Complete with circuit diagram. 4/11 plus 1/- p.c.

### BATTERY CHARGER KIT

Incorporates metal rectifier. Transformer is suitable for A.C. mains 200/250 volts. Charges either 12, 6 or 2 volt accumulator at 1 amp. Complete with circuit diagram. Price 19/11 plus 1/6 post and packing.

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The specially selected and carefully matched components used in Barton's Radio Designs are obtainable only from Barton's (Radio) at their new address at 44, Tottenham Street, London, W.1.

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This is a 3-valve 3-stage Amplifier for use with Gramophone, Microphone or Radio. Valve line-up is as follows: 6SL7, 6V6, 5Z4. Negative feed-back. Tone control. Voltage adjustment panel incorporated. 4 watts output. For operation on A.C. Mains 200/250 volts.

The complete Kit, which includes every item down to the last nut and bolt, drilled and punched chassis, and comprehensive point-to-point wiring circuit diagram.

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PRICE

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Plus 2/6 PACKING CARRIAGE & INSUR.

The Output Transformer supplied is for use with a loud-speaker of 3 ohms impedance, and we would suggest that the output of the completed amplifier justifies the use of one of the latest W.B. H.F. Speakers which can be supplied as follows: 8in., 60/6; 9in., 67/-; 10in., 73/6. All plus 3/6 pkg., carr., ins.

Circuit Diagram and parts list available separately at 1/-. To those who require this Amplifier ready built we can supply it at £5/1/-, plus 3/6 pkg., carr., ins.

## RADIO TUNER UNIT

A new T.R.F. Tuner Unit designed for High Quality Local Station Reception, at Low Cost. Incorporates 2 Valves—6K7 and 6J7. Volume, Tuning and Wavechange Controls, Medium and Long Wave coverage. Dimensions: L. 6in. H. 5 1/2in. D. 4 1/2in.



Power Requirements: 6.3 volts at 0.6 amps. 250-300 volts 15 m.A. (This supply is already available in the above illustrated Amplifier). All the parts to build this Tuner Unit can be supplied at

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plus 2/6 Packing & Carr.

Complete with easy-to-follow Circuit diagram and Parts List.

Circuit diagram and Parts List available separately at 1/-. This Unit can also be supplied ready built at £3/15/-, plus 2/6 Packing and Carr.

WAX TUBULAR CONDENSERS WITH WIRE ENDS

Table listing various wax tubular condenser models and their prices, such as .001 mfd. 350 v. 5d. each or 4/6 doz.

VARIABLE CONDENSERS

Table listing variable condenser models and prices, including 3 gang .0005 mfd. and 2 gang .00035 mfd.

TINNED COPPER WIRE

Table listing tinned copper wire specifications and prices, such as 16 S.W.G. and 18 S.W.G.

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Table listing enameled copper wire specifications and prices, including 16 S.W.G. and 18 S.W.G.

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Aluminium Un drilled with Reinforced Corners. Available in the following sizes.

Table listing chassis sizes and prices, such as 6in. x 4in. x 2 1/2in. and 8in. x 6in. x 2 1/2in.

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Incorporating escutcheon and filter. 12in. type 11/6 ea. 16in. type 14/6 ea.

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Ex. Govt. volt meter, two ranges 0-15 v.; 0-250 v. D.C. complete in case 17/6 each.

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25 yd. reels Nylon drive cord on wooden reel 2/9 each.

WE INVITE YOU TO BUILD THIS PORTABLE FOR ONLY 61 gs.

Full details, circuit diagram, point to point wiring instructions, and complete list of components. Available 2/- ea. Case can be supplied separately.



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Vibrator unit for 6 v. operation 14/6 ea. Post 1/8. 6 v. and 12 v. Vibrators, 4 pin UX types, 6/6 each.

TERMS: Cash with order or C.O.D. Postage to be added to orders as follows: 9d. up to 10/-; 1/- up to 20/-; 1/6 up to 40/-; 2/- up to £5. MAIL ORDER ONLY. Send 6d. in stamps for illustrated Catalogue.

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Table listing various Alpha Special Purpose valves and their prices, such as 2X2, 1A5GT, 1LD5, 5Z3, 6B4, 6CG6, 6ST7, VR19, VT52, VU111, 77, 836, 807, 9001, 9002, 9003, 9004, 9006, 954, VR136, TT11, VU120A, 955, 866A, 956, CV173, CV286, E1148, VR53, VR54, VR55, VR56, VR137, VU39, VR40, VR65, VR66, VR91, VR91 (SYL), VR92, VR105/30, VR116, VR150/30, VU64, Full List Available.

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EX-GOVERNMENT HEADPHONES BY S. G. BROWN, etc.

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Throat microphones, American surplus, Complete with strap, lead and plug

"Regent" Hand Microphone. Crystal insert, nickel chrome plated head, complete with lead and jack plug, listed at 2 Gns. Our price

Throat Microphones, type Za.21095, 2 units per box

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50 KΩ; 1/2 megΩ; 1 megΩ; 2 megΩ; 1/9 each.

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Table listing Hunts condenser models and prices, such as Type W99, 200 pf. 350 V., Type W99, .005 mfd. 150 V., etc.

RESISTORS 2 WATT

2.2 KΩ; 470 Ω; 7.5 KΩ; 22 Ω; 150 Ω; 5.6 KΩ; 390 Ω; 150 KΩ; 1/2 megΩ; 39 Ω; 1.5 megΩ; 56 KΩ; all 4d. each.

BAKELITE CASED CONDENSERS

.1 mfd. 1000 V.; .03 mfd. 4 kV.; .01 mfd. 4 kV.; .03 mfd. 500 V.; .001 mfd. 4 kV. All 1/6 each.

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OSMOR COIL PACKS

Type H.O. 48/- each. Type LM 40/- each. Type T.B. 50/- each. Type TRF 40/- each.

SPRAGUE CONDENSERS

.05 mfd. 500 V.; .01 mfd. 1000 V.; .1 mfd. 350 V.; .02 mfd. 750 V. All 9/- doz.

RESISTORS—Brand new. A good selection from 10Ω to 15 meg. All popular sizes. 20/- per 100.

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Input 200/250 volts. Output 325-0-325 v. 20 mA 6.3 v. 3a. 12/- ea. 20 amp 2 pole Diamond switch, 4/6.

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Table listing loudspeaker unit models and prices, such as Rola 5in. speaker with trans., Plessey 6in. lightweight unit, Rola 6in. standard type, etc.

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CONDENSERS

Waxed cartons with flying leads, 4 mfd. 500 V. 1/6 ea. 4 x 4 mfd. 500 V. 3/4 each.

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Standard adaptable type 230 V. 450 V. 1/8 ea. Morphy Richards replacement type 3/9 ea. H.M.V. replacement type 3/- ea.

PLIERS

With side cutters 4/3 pr.

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250/250 pf.; 100/100; 100/50. All 6d. ea.

YAXLEY SWITCHES

1 pole 9 way 1/6 ea. 4 pole 2 way 1/3 ea. 4 pole 3 way 2/6 ea. 3 pole 3 way 3 bank 1/6 ea.

OCTAL PLUG AND SOCKET

(Screened) 1/- ea.

HIGH VOLTAGE E.H.T. CONDENSERS

.002 mfd. 15 kV. 7/8 ea. .001 mfd. 15 kV. 5/- ea. 900 pf. 10 kV. 5/- ea.

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Standard model, magnetic type, complete with matching transformer. Listed at 44/10s. Our Price 29/6.

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1,200 feet tape on Cydon reel. (Brown plastic type.) 18/8 reel.

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Paxolin 4d. each. Amphenol 6d. each. Ceramic 1/- each.

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Available in the following values:—25Ω, 50Ω, 100Ω, 150Ω, 200Ω, 250Ω, 330Ω, 500Ω, 1,000Ω, 1,500Ω, 2,000Ω, 2,500Ω, 3,500Ω, 5,000Ω, 6,800Ω, 10,000Ω. Tolerance plus or minus 10 per cent. Ratings 5 watt, 1/- ea.; 10 watt, 1/3 ea.; 15 watt, 1/9 ea.

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Primary 200/250 v. Secondary 6.3 v. 1.5 amps, tapped at 4 v. and 2 v. 7/6 ea. Mallory .1 mfd. 600 v. condensers, 1/- ea. Pentode Output Transformer, 2/9 ea.

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Reel case covered. (Ready for carrying 15in. x 9 1/2in. x 1 1/2in.) Internal dimensions, 14in. long, 11 1/2in. deep, 5 1/2in. front height, 8 1/2in. rear height. Weight 8 1/2lb. Price 13/6 each. Postage and Packing 2/.

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Dubbler type HY1225, 1,350 Ω with 5 taps, 2/6 ea. 945 Ω Dropper with 5 taps, 2/6 ea. Vibrator clip, 4d. ea.

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TELEVISION PRE-AMPLIFIER, by Plessey, complete with valve (EF42), a small compact modern unit for London frequency. Price 13/6.

"COMPACT" TELEVISION AERIAL for indoor use London frequency, supplied complete with universal mounting bracket in neutral brown finish. Complete with full instructions. Cat. No. CD4. Original price, 60/-. Our price 12/6 ea.

METAL RECTIFIERS FOR CHARGERS 12 v. 1 a., 1/6; 12 v. 1 a., 4/9; 2 v. 1 a., 3/-; 12 v. 2 a., 10/6; 12 v. 3 a., 13/-; 12 v. 5 a., 18/6.

MOULDED MICA CONDENSERS All wire ends. .0001, .0003, .0004, .0005, .01, .001, .005, .0027, .0008, .00005, .003, 4/6 doz.

BULGIN PORCELAIN STAND-OFF INSULATOR

3-hole fixing, wingnut type, 1/- each.

METAL CASE—AMPLIFIER OR BATTERY CHARGER CABINET. Finished brown, crackle. Removable base or chassis. Vent holes. Supplied with bakelite side panel. Size 9 1/2in. x 6 1/2in. x 7 1/2in. Price 8/6 ea.

CONDENSERS

The following is a selection of our stocks of manufacturers' surplus condensers, all by well known makers.

ALUMINIUM CAN TYPES, CLIP

Table listing aluminium can condenser models and prices, such as FXK 5 mfd. 450 v., 8 x 16 mfd. 450 v., etc.

B.R. RANGE

Table listing B.R. Range condenser models and prices, such as B.R. 850, 8 mfd. 500 v., B.R. 1050, 10 mfd. 500 v., etc.

MIDGET METAL TYPES

Table listing Midget Metal Type condenser models and prices, such as 2 mfd. 350 v., 8 mfd. 350 v., etc.

WIRE ENDED TYPES

Table listing wire ended condenser models and prices, such as 8 mfd. 450 v. cardboard covered, 30 mfd. 450 v., etc.

BIAS CONDENSERS

Table listing bias condenser models and prices, such as Tag ended metal types, 12 mfd. 50 v., etc.

WIRE ENDED TYPES CARDBOARD COVERED

Table listing wire ended cardboard covered condenser models and prices, such as 25 mfd. 25 v., 50 mfd. 12 v., etc.

WHEN ORDERING PLEASE QUOTE "DEPT. W.W."

ALPHA RADIO SUPPLY CO. 5/6 VINCES CHAMBERS, VICTORIA SQUARE, LEEDS 1.

# Introducing The Stern's "Fidelity" Tape Recorder

!! A NEW DESIGN OF OUTSTANDING QUALITY !!

● WILL PLAY THE NEW PRE-RECORDED TAPES.

● WILL TAKE ALL STANDARD TAPES UP TO 1,200ft.

● WILL PROVIDE 2 HOURS PLAYING AT 3 $\frac{1}{2}$ in. or 1 hour at 7 $\frac{1}{2}$ in. per second.

● INCORPORATES AN ELLIPTICAL P.M. SPEAKER 8in. x 5in., with EXTENDED FREQUENCY RANGE.

● We will supply it COMPLETE & READY FOR USE or YOU CAN ASSEMBLE IT AT HOME.

We have long delayed producing a Tape Recorder until we were completely satisfied that not only could we supply it at a genuinely low price, but also it had to be completely dependable and in addition it had to provide absolute fidelity recordings. !! THIS WE HAVE DONE !! and we offer our "Fidelity" model with the utmost confidence and with the knowledge that its performance equals Recorders marketed at a far higher price. It incorporates the Tape Deck and Amplifier described below both of which are so arranged that the "home assembly" of the Recorder is quickly and easily achieved.

SEND S.A.E. FOR DESCRIPTIVE LEAFLET.

## YOU CAN ASSEMBLE IT YOURSELF FOR £40

H.P. Terms are shown below. THE DECK AND AMPLIFIER ARE ASSEMBLED AND TESTED WHEN SUPPLIED.

The actual assembly of the Recorder is extremely simple and only involves a few connections. The Truvox Tape Deck and the Amplifier are supplied tested and ready for use, all that is required is to connect the two together (a connection chart is supplied) and secure them in the Attache Case.

### BRIEFLY:

#### MODEL TRIF QUALITY AMPLIFIER.

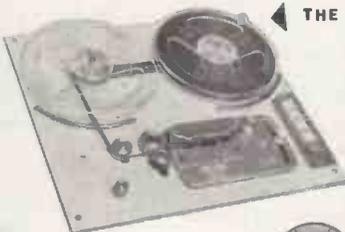
Expressly designed to correctly operate with the above Truvox Deck for recording and playback. Supplied complete with Elliptical Speaker and has level response from 60-10,000 c.p.s. Hum level 50 db down at 4 watts. Incorporates efficient tone control arrangement and MAGIC EYE LEVEL INDICATOR. Valve line-up: EF86, ECC83, EL84, 5Y3, EM34, provides 4 watts undistorted.



MODEL TRIF AMPLIFIER

### THE NEW TRUVOX MODEL TR7U TAPE DECK

THE NEW TRUVOX MODEL TR7U TAPE DECK. 3 Shaded-Pole motors. Drop-In Tape Loading. Push Button Control. Separate Push Button Brake. Fast-forward and fast-reverse. Silent drive eliminating Wow and Flutter. Half Track working and 2 speeds, 3 $\frac{1}{2}$ in. and 7 $\frac{1}{2}$ in. per sec. Positive Azimuth Adjustment. Overall size only 14 $\frac{1}{2}$ in. x 12 $\frac{1}{2}$ in.



ACOS CRYSTAL MICROPHONE MODEL MIC-33-1. A highly sensitive mike which accurately matches the input arrangement of the amplifier



SCOTCH BOY MAGNETIC RECORDING TAPE. Supplied with a 1,200ft. reel of Scotch Boy plastic tape famous for its true brilliant quality. The Recorder will take all standard makes of tape

THE ATTACHE CASE illustrated is attractively finished and covered with Rexine and is only 18in. x 14in. x 8 $\frac{1}{2}$ in. It has a concealed pocket to accommodate the Mike and Mains lead and also a pocket to carry a spare reel of tape.

GUARANTEED FOR 12 MONTHS (B.V.A. VALVES 90 DAYS)

## PRICE SUMMARY

EACH UNIT IS AVAILABLE SEPARATELY AS FOLLOWS:

	CASH PRICE	DEPOSIT	12 monthly payments of
(a) TRUVOX Mk. TR7U TAPE DECK	£23 2 0	£5 17 0	£1 12 4
(b) AMPLIFIER MODEL TRIF WITH SPEAKER	£14 14 0	£4 16	£1 0 5
(c) PORTABLE ATTACHE CASE	£5 0 0	—	—
(d) ACOS CRYSTAL MIKE "33"	£2 10 0	—	—
(e) REEL OF TAPE 1,200FT.	£1 15 0	—	—

Please include £1 when ordering (a), (b) or (c) for packing charge this whole amount will be refunded if case is returned to us intact.

WE WILL SUPPLY ALL FIVE UNITS LISTED ABOVE, i.e. THE COMPLETE BUT UNASSEMBLED RECORDER FOR £40/-.. H.P. Terms: Deposit £10 and 12 monthly payments of £2/15/10 or in two parts as follows:—

	CASH PRICE	DEPOSIT	12 monthly payments of
(a) TRUVOX Mk. TR7U TAPE DECK MODEL TRIF AMPLIFIER WITH SPEAKER. 1 200FT. REEL OF TAPE	£33 10 0	£8 10 0	£2 6 8

(b) ATTACHE CASE AS ILLUSTRATED LACOS CRYSTAL MICROPHONE } £6 10 0  
NOTE: Please send 30/- to cover cost of packing, carriage and insurance. We will refund £1 if the packing case is returned to us intact.



SUPPLIED COMPLETE AND READY FOR USE £50

FOR USE ON A.C. MAINS  
H.P. Terms: Deposit £12 10 0 and 12 monthly payments of £3 10 0  
Including mike and 1,200ft. reel of tape.

# STERN RADIO LTD.

109 and 115 FLEET STREET, LONDON, E.C.4

Phone: CENTRAL 5812-3-4

# YOU'RE SURE TO GET IT AT STERN'S



**BY FAR THE BEST FOR HOME CONSTRUCTORS!**

## The "TELE-VIEWER"

**5 CHANNEL TELEVISOR  
DESIGN OF A COMPLETE 12" SUPERHET T.V. RECEIVER**



**PERFECT PICTURE QUALITY**  
SIMPLE DIAGRAMS MAKE CONSTRUCTION EASY



**PERFECT FRINGE AREA RECEPTION**  
BETTER RECEPTION AT HALF COMMERCIAL COST



This complete TELEVISOR, including all Valves, can be built for only **£28/16/4** (Plus cost of C.R.T.)

Here are some of the features which combine to make this such a fine receiver.

- The Superhet circuit easily tuned to any of the five channels, i.e., LONDON, SUTTON COLDFIELD, HOLME MOSS, WENVOE and KIRK-O-SHOTT. (The extreme ease of tuning is accomplished by the provision of pre-aligned I.F.T.s.)
- A lifelike, almost stereoscopic, picture quality made possible by the following factors:
  - a. Excellent band width of I.F. circuits.
  - b. A really efficient video amplifier.
  - c. C.R.T. Grid modulated from low impedance source.
  - d. High E.H.T. voltage (approx. 10 kV.).
- The picture brilliance is also much above the average and enables comfortable viewing with normal room lighting or daylight.
- FIRM picture "HOLD" circuits (Frame-Line) ensure a steady picture free from bounce or flicker even under the most adverse conditions met with in "fringe" areas and excellent "interlace" ensures the absence of "liney" effect.
- Negative feedback is used in the audio frequency circuits which provide 2/3 watts of High Quality Sound.
- Entire receiver built on two chassis units each measuring 14 1/2 in. x 6 1/2 in. x 3 1/2 in.
- Rigid C.R.T. mounting enables entire receiver to be safely handled with tube in position.

● All pre-set-controls are mounted on side of chassis, enabling all adjustments to be carried out whilst facing the C.R. Tube.

As no hire purchase terms are available the receiver can be bought in five separate stages (practical diagrams and circuits are provided for each stage) thus enabling hire purchase interest rates to be avoided. The complete set of ASSEMBLY INSTRUCTIONS is available, price 5/-. The instructions include really detailed PRACTICAL LAYOUTS, WIRING DATA AND COMPONENT PRICE LIST. ALL COMPONENTS ARE AVAILABLE FOR INDIVIDUAL PURCHASE.

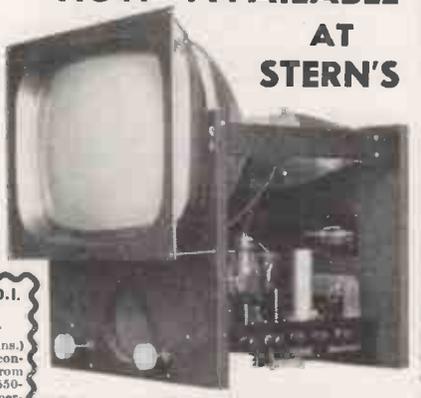
## The "WIDE ANGLE" TELE-VIEWER

- A design that retains all the distinctive features of the 12in. Televisor but with increased Time Base efficiency, producing 15 to 16 kV. E.H.T., with ample scanning power for C.B. Tubes up to 17in.

● It can be completely built including supply of all valves for **£33** (plus cost of C.R.T.) and is as simple to construct as the 12in. model.

- This is the most efficient "WIDE ANGLE" large screen design yet offered to constructors, and yet it can be built for almost half the cost of similar designs.
- Complete assembly instructions, diagram, etc., available for 5/-.

## NOW AVAILABLE AT STERN'S



### BRAND NEW C.R.T. MASKS

Latest aspect ratio for 12in. "Round" tubes, finished Ivory (plus 1/- postage)

**12/6**

### SPEAKER BARGAINS

PLESSEY, 10in. 3 ohm V/coil	£1/5/0
GOODMANS, 10in. 3 ohm V/coil	£1/13/6
TRUVOX, 12in. 3 ohm V/coil	£2/7/6
ROLA, 12in. 3 ohm V/coil	£3/19/6
BAKERS, 12in. 15 ohm V/coil	£4/19/6
GOODMANS, 12in. 15 ohm V/coil	£5/19/6

(Carriage and Ins. 1/6 extra.)

### THE NEW W.B. "STENTORIAN"

HI FI SPEAKERS ARE IN STOCK

Model H.F. 6-inch	£2/10/6
Model H.F. 8-inch	£3/7/0
Model H.F. 8-inch	£3/0/6
Model H.F. 10-inch	£3/13/6

These speakers are of the very latest design and provide quality reproduction for the lower-price range, 3 or 15 ohm models are available.

### WE CAN SUPPLY EX-STOCK

(a) The Editor Tape Recorder complete	£47/5/0
(b) The Truvox Tape Deck	£23/2/0
(c) The Grundig Model TK9 Tape Recorder, complete	£88/5/0
(d) The Grundig Model 700L Tape Recorder, complete	£84/0/0

Each is available on Hire Purchase and descriptive leaflets are available—send S.A.B.

### WE CAN SUPPLY... COMPLETE KIT or ASSEMBLED CHASSIS FOR THE OSRAM 912 AMPLIFIER.



Designed by General Electric Co. A modern high quality 12 watt Amplifier for the HOME CONSTRUCTOR, having a Valve line-up of U709, B309, Z729 and two N709's in Push Pull.

The Assembly Instructions include five "easy stage-by-stage" diagrams and is available for 3/6.

Price of COM-**£23/10/-** (Plus 7/6 Carr. and Ins.)

WE WILL SUPPLY THE COMPLETELY ASSEMBLED (Plus 7/6 Carr. & Ins.)

AMPLIFIER for **£25/-** (Carr. & Ins.)

H.P. Terms: £3/5/- Deposit and 12 months at £1/15/2.

### The DENCO M.T.O.I. Modulated Test Oscillator

**£3/15/-**

(Plus 2/- carr. and Ins.) Has Frequency range continuously variable from 170-475 Kc/s. and 550-1,600 Kc/s. Battery operated and thereby self-contained.

### SELENIUM RECTIFIERS

6 or 12 volt 1 amp. rating	7/6
6 or 12 volt 2 1/2 amp. rating	12/8
6 or 12 volt 4 amp. rating	17/6
6 or 12 volt 6 amp. rating	£1/2/6

### WE HAVE IN STOCK... THE DENCO F.M. FEEDER UNIT

Consisting of a 5 valve Superhet design incorporating R.F. (6AM6) and F/C (12AH9) Stages followed by Two I.P.s. (6BA6's) and Ratio Discriminator 6AL5, the coverage provided being 88-100 Mc a.

**THE COMPLETE KIT including VALVES and DRILLED CHASSIS is available for £6/13/6**

It is suitable for use with any type of High Fidelity Amplifier. (plus 4/- carriage and insurance)

The descriptive manual, including circuit and Component, Layout etc., is available for 1/6.

**THE COMPLETELY ASSEMBLED CHASSIS, ready for use, aligned and tuned £8/17/6**

(plus 6/- carriage and insurance).

### WE CAN SUPPLY... COMPLETE KIT or ASSEMBLED CHASSIS THE MULLARD HIGH QUALITY AMPLIFIER

A design by Mullard Ltd. of a quality 5 valve 10 watt Amplifier incorporating the latest Mullard valve line-up with two EL84's in push-pull.

PRICE COMPLETELY ASSEMBLED TO **£18/10/-**

SPECIFICATION (Plus 7/6 Carr. and Ins.)

H.P. Terms Deposit **£4/12/-**, 12 months of **£1/6/1**.

Price of complete kit **£17/10/-**. (Plus 7/6 carr. and Ins.)

The Mullard Assembly Manual is available for 2/6.

### BATTERY CHARGER KITS

All kits are for A.C. Mains 200-250 volts. They comprise a Metal Rectifier and Transformer, tapped for 6 or 12 volt charging, and a tapped Resistor, with Selector Switch, to enable the charging rate to be varied. A M/coil meter 5 amp. max., 13/6 extra.

For 6 or 12 volt batteries at max. 1 amp. **£11/7/6**

For 6 or 12 volt batteries at max. 2 1/2 amp. **£2/5/3**

For 6 or 12 volt batteries at max. 4 amp. **£3/2/6**

An easily followed Wiring Diagram is included with each kit.

### FILAMENT TRANSFORMER

6.3 v. 1 1/2 a. **5/9**

4 v. 1 a. **5/9**

# STERN RADIO LTD.

# RECEIVER CHASSIS

## Modernise your old Radiogram

# RECORD PLAYERS

COMPLETE RADIOGRAM EQUIPMENT—QUALITY AT LOW COST

STERN'S DESIGN FOR HOME CONSTRUCTORS

### The "SUPER-SIX"

A compact and highly efficient superhet Radio-Radiogram chassis of outstanding quality.

**YOU CAN BUILD IT FOR £10/7/6**

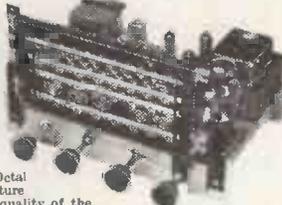
Including the OCTAL VALVE LINE-UP

(£12/7/6 with the miniature valves)

Incorporating the new B.V.A. Miniature Valve Line up. This receiver is designed to the very latest specification and provision is made to incorporate either the standard Octal Valve Line-up or the new B.V.A. range of miniature valves. Great attention has been paid to the quality of the reproduction of both Radio reception and Record playings, and excellent clarity of speech and music is obtained. A few brief details.

- Covers 3 wavebands 18-50 metres, 190-550 and 800-2,000 metres.
- Employs 6 valves having PUSH-PULL for 5-6 watts output.
- Incorporates delayed A.V.C. on all wavebands and pre-selective feedback.
- A 4 position Tone Control operation on both Radio and Gram.
- Has independent mains supply socket for a Record Player.
- Size of Assembled Chassis 12in. x 8in. x 8in. Dial aperture 8 1/2in. x 4 1/2in.
- For operation on A.C. mains 200-250 volts 50 cycles.

THE INSTRUCTION AND ASSEMBLY MANUAL is available for 2/- . It contains very detailed practical drawings and circuit diagrams and a complete Component Price List.



### !!!THE LATEST!!!

## RADIO-RADIOGRAM CHASSIS

Model F3PP. A 7-valve 3-waveband Superhet Chassis with Push-Pull Stage. This Chassis has been designed with particular regard to the quality of reproduction. It incorporates SEPARATE BASS and TREBLE CONTROLS thereby ensuring the utmost flexibility of Tone on both Radio and Gram.

Briefly:

- Waveband coverage 16-50, 190-550 and 900-2,000 metres.
- Valve line-up X79, 6BA6, 6AT6, ECC83, GX30 and two 6X4's in push-pull for approx. 6 watts output.
- Negative Feedback and delayed A.V.C.
- Has independent mains supply socket for gram connection.
- Overall size of Chassis 12in. x 8in. high x 7in. with dial size 11 1/2in. long x 4 1/2in.

For use on A.C. Mains 100/110 volts and 200/250 volts.

Cash Price, tested and ready for use **£17/17/0** (plus 7/6 carr. and ins.)

H.P. Terms: Deposit **£4/7/0** and 12 monthly payments of **£1/5/4**.

## THREE COMPLETELY ASSEMBLED ALL-WAVE SUPERHET CHASSIS

- Model B.3. A 5-valve 3-waveband receiver.
- Model B.3.P.P. A 6-valve 3-waveband Receiver with PUSH-PULL OUTPUT.
- Model B.3.P.P./R.F. A 7-valve 3-waveband Receiver incorporating an R.F. stage with PUSH-PULL OUTPUT.

The three Receivers are for operation on A.C. mains 100/110 volts and 200/250 volts, and employ the very latest miniature valves. They were designed to the most modern specification great attention having been given to the quality of reproduction which gives excellent clarity of speech and music on both gram. and radio, making them the ideal replacement chassis for that "old Radiogram," etc.

Brief specifications: Model B.3.—Valve line-up, 6BE6, 6BA6, 6AT6, 6BW6, 6X4—waveband coverage short 16-50, medium 187-550, long 900-2,000 metres. Controls: (1) volume with on/off; (2) tuning (flywheel type); (3) wavechange and gram; (4) Tone Control (operative on gram. and radio). Negative feedback is employed over the entire audio stages. Chassis size: 11 x 7 1/2 x 8 1/2in. high. Dial size 8 1/2 x 4 1/2in. Price complete and "READY FOR USE, excluding speaker" **£12/12/-** (carr. and ins. 7/6 extra). H.P. Terms **£3/4/-** deposit, 12 months at 17/8.

Model B.3.P.P. This model is the B.3 Receiver but incorporates two 6BW6 VALVES in PUSH-PULL, resulting in really excellent quality reproduction up to approximately 6 watts. Price **£15/15/-** (plus 7/6 carr. and ins.) or **£3/19/-** deposit, 12 months at **£1/2/2**. Model B.3.P.P./R.F. This model is similar in appearance and has same waveband coverage as the Model B.3, but in addition it incorporates at R.F. STAGE together with PUSH-PULL OUTPUT, employing a total of 7 valves with two type 6BW6 in Push-Pull. This makes for a really sensitive receiver with genuine quality reproduction. Price **£18/18/-** (plus 7/6 carr. and ins.) or **£4/13/-** deposit, 12 months at **£1/6/9**.

**109 and 115 FLEET ST., London, E.C.4.** Phone: CENTral 5812/3/4

This 3-SPEED AUTOCHANGER is by a Famous Manufacturer and is offered for

**£11/10/0** (Plus 7/6 carr. & ins.) Normal Price **£16/10/0**

Hire Purchase Terms **£2/17/6**

Dep. and 12 months at **16/4**.

- These units will autochange on all three speeds, 7in., 10in. and 12in.
- They play MIXED 7in., 10in. and 12in. records.
- They have separate sapphire for L.F. and 78 r.p.m., which are moved into position by a simple switch.
- Minimum baseboard size required 14in. x 12 1/2in., with height above 5 1/2in. and height below baseboard 2 1/2in. A bulk purchase enables us to offer these BRAND NEW UNITS at this exceptional price.



## THE NEW ARMSTRONG F.C. 48

A high quality replacement Radio or Radiogram Chassis having provision for an F.M. Feeder Unit.

PRICE ASSEMBLED and READY FOR USE **£23/18/0**

(Plus 7/6 Carr. and Ins.)

H.P. Terms **£5/18/-** Deposit and 12 months at **£1/13/9**.

OUTSTANDING FEATURES INCLUDE:—

- 8 Valves including 2 double Triodes.
- 8 Watts output from push-pull tetrodes. Heavy negative feedback is used, resulting in negligible distortion and high damping factor.
- Provision for using F.M. adaptor to receive the present high quality transmissions from Wrotham and the new B.B.C. V.H.F. stations.
- An accessible socket at rear provides the power supply for this unit.
- Independent controls give BASS and TREBLE lift and cut with unique Thermometer visual indicator.
- Gram position on wavechange switch.
- 4 Wavebands Coverage 16-51, 50-120, 190-550, 1,000-2,000 metres.
- Large four-colour illuminated dial.

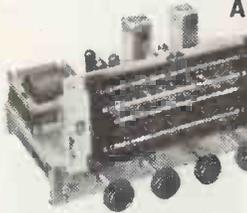
## AN OUTSTANDING OFFER

A BULK PURCHASE ENABLES US TO OFFER THIS "PUSH-PULL" 7 VALVE SUPERHET RECEIVER

For only **£12/19/6** (Carr. & ins. 7/6 extra.)

H.P. — **£3/4/6** Dep. 12 mths. at 18/4.

These receivers Model A WS-7 are made by a well known set of manufacturers and incorporate the latest Osram Valve Line-up of X79—W77—DHT7—H77—U78 and two N7's in Push-Pull for approx. 7 watts output. They cover 3 wavebands 18-50 metres, 190-550 and 800-2,000 metres, and are for operation on A.C. mains 200-250 volts. A Gram. position is on the Wavechange Switch. They make an excellent replacement Radiogram Chassis having a P.U. connection on the chassis. Extension speaker connection is also provided. Overall size of chassis: 12in. long x 7 1/2in. x 6 1/2in. high, dial aperture 8 1/2in. x 4 1/2in. (Dial Escutcheon available for 4/9).



THESE RECEIVERS ARE BRAND NEW AND FULLY GUARANTEED.

## THE NEW COLLARO 3-SPEED UNIT MODEL 3/554.

**£8/18/4** (Plus 6/- carr. and ins.)

- A Non-Autochange 3-speed unit having the new lightweight STUDIO "O" CRYSTAL PICK-UP.
- Will play 7 and 10in. and 12in. records.
- THE VERY LATEST MODEL.



## SPECIAL REDUCTIONS FOR COMPLETE EQUIPMENT

SUMMARY—Select a RECEIVER CHASSIS and we will supply it TOGETHER WITH THE ABOVE 3-SPEED CHANGER AND AN 8-inch or 10-inch P.M. SPEAKER as follows:—

THE £11/10/- AUTOCHANGER WITH A SPEAKER AND:—

	Cash Price	Deposit	Monthly
(a) With Model B3 chassis	£24 15 0	£6 4 0	12 of £1 14 10
(b) " " B3PP	£25 0 0	£7 0 0	12 of £1 19 5
(c) " " B3PP/R.F.	£31 2 0	£7 15 0	12 of £2 3 9
(d) " " Armstrong F.C.48	£36 4 0	£9 1 0	12 of £2 10 11
(e) " " AW3-7	£25 5 0	£6 7 0	12 of £1 15 5
(f) " " F3PP	£30 2 0	£7 10 0	12 of £1 17 8

An additional charge of 10/- is made in each case to cover Carriage and Insurance.

# "Hi-Fi" EQUIPMENT and KITS TO SUIT ANY BUDGET

## TWO COMPLETE "Hi-Fi" AMPLIFIER KITS

### "STERNS" HIGH QUALITY 8-10 WATT AMPLIFIER



Having a front panel which is very attractively finished in deep gold, and on which the controls are clearly identified. The ideal amplifier for general home use and for small halls, etc.

Price of COMPLETE KIT including Valves and Drilled Chassis, etc. **£7/10/-** (Plus 2/6 Carr. & Ins.)

We will supply it Completely Built for **£9/10/-** (Plus 5/- Carr. & Ins.)

Designed for high quality reproduction up to an output level of 10 watts, having 6V6s in Push-Pull and incorporating negative feedback. It is suitable for use with all types of Pick-ups and most types of microphones and the output transformer provides for use of 3 and 15 ohms speakers.

#### BRIEF FEATURES

- Valve line up 6Z5, 6SN7, 5Z4, with 6V6s in push pull.
  - The undistorted output level of up to 10 watts is produced from an input of 25 volts.
  - First class reproduction of Radio (where a Tuning Unit is used) and Record Playing.
  - Separate Bass Boost and Treble Controls provide an excellent range of frequency control.
  - Very satisfactory results are obtained with an average type of high impedance Moving Coil or Crystal Microphone, a clear speech level of approx. 5 watts output being obtained.
  - Power supplies (H.T. and L.T.) are available for a Tuning Unit.
  - For operation on A.C. Mains 200-250 volts 50 cycles.
- THE ASSEMBLY MANUAL is available for 1/- and includes detailed layouts and component Price List.

### "STERNS" 12 Watt "HIGH FIDELITY" Push-Pull AMPLIFIER



A very high quality Unit attractively finished in deep gold with each control clearly identified on the front panel. Comprising a Main Amplifier Chassis and a Remote Control Pre-Amplifier-Tone Control Unit. The remote control unit measures only 9in. x 4in. x 2 1/2in. and contains four controls, being: Bass-Treble-Volume and a Radio, Gram, Microphone Switch control. It incorporates its own feedback circuit on the Bass Channel. Loop negative feedback is employed on the Main Amplifier which has a valve line up of 6J5-6N7-5U4 with two PX25's in push-pull and 6J5 and 6SN7 are used in the remote control unit.

THE COMPLETE KIT IS AVAILABLE FOR **£14/-** (Carr. & Ins. 6/- extra.)  
THE COMPLETE UNIT ASSEMBLED AND READY FOR USE **£17/-** (H.P. Terms £4/5/- Deposit, 12 Months at £1/3/11. (Carr. & Ins. 7/6 extra.)

The measured frequency range of the amplifier with this unit shows an excellent response from 14,000 cycles down to 20 cycles, the bass and treble controls allowing independent control of gain at both ends of the frequency range from zero to a gain of 50. It can be seen, therefore, that ample correction is provided to suit any type of pick-up with any type of recording. Input voltage for maximum output is 70 mV and 6.3 volts at 2 amps, and 30 mA. H.T. is provided for tuning unit, etc. This Amplifier compares well with the Williamson and similar designs at a fraction of their cost. The complete set of assembly instructions is available for 2/-.

## SPECIAL PRICE REDUCTIONS FOR COMPLETE EQUIPMENT

SELECT A TUNING UNIT and AMPLIFIER  
or TUNING UNIT, AMPLIFIER and RECORD PLAYER  
(and a SPEAKER if required) and we will supply at a  
REDUCED PRICE. H.P. TERMS ALSO QUOTED.

### "STERNS" MODEL C.P.3. COMBINED AM/FM TUNING UNIT

A UNIT DESIGNED TO RECEIVE BOTH THE A.M. and F.M. BANDS WITH THE VERY HIGHEST DEGREE OF QUALITY.

**A.M. TUNER SECTION.** This employs a 4 valve 3 waveband circuit incorporating 2 stages of I.F. Amplification switched to provide bandwidths of 7.10 and 14 kc/s. Valve line-up: X79 (Mixer) W77 (I.F. Amplifier) W77 (2nd I.F. Amplifier) DH77 (Detector & V.C. and 1st A.F. Amplifier).

**F.M. TUNER SECTION.** This is a design incorporating a wide band R.F. stage followed by a frequency changer which has a variably tuned oscillator enabling the band 88-100 mc/s to be covered. Two stages of I.F. Amplification provide excellent sensitivity and a ratio type discriminator stage gives high output with good A.M. rejection.

**SWITCHING.** A three position switch incorporated into the chassis enables the F.M. Tuner or the A.M. Tuner, or gramophone pick-up to be selected. This switch also switches the H.T. supply to the tuner selected. The Triode section of the DH77 in the A.M. circuit is also controlled by this switch and becomes the first A.F. amplifier not only for the A.M. Tuner but for the F.M. tuner and gramophone pick-up also. A volume control is provided for all three.



**POWER SUPPLIES.** Adequate H.T. and L.T. supply is obtained from the built-in mains power pack for 200-250 v. A.C. mains input. Full wave rectification with a 5Z4 rectifier valve is used.

**TUNING.** A common tuning control covers both the A.M. and F.M. bands. The dial is calibrated with station names and wave lengths for the A.M. channels and has a logging scale for the short wave and F.M. bands.

**CHASSIS DIMENSIONS.** 14in. x 9in. x 9in. overall including a three coloured full vision dial. Size 8 1/2in. x 4 1/2in.

PRICE, ASSEMBLED AND READY FOR USE **£25/10/-**. (Plus 10/- carriage and insurance.)  
H.P. Terms. Deposit **£6/7/6** and 12 months at **£1/15/10**.

### "STERNS" MODEL CP3G 3 WAVEBAND SUPERHET TUNING UNIT

A highly sensitive tuning unit providing for excellent reception of stations on the short wavebands (16-50 metres) medium waveband (200-550 metres) and the long waveband (800-2,000 metres).

- Valve line-up — 6K8G (Frequency Changer), 68K7g (I.F. Amplifier), 6Q7g (Detector, AVC and 1st A.F. Amplifier), and 5Z4g (rectifier).
  - A gramophone position is incorporated with the wavechange switch and the 6Q7g valve becomes the 1st A.F. Amplifier for the gramophone pick-up.
  - Volume control and tone control operative in both radio and gramophone positions of the wavechange switch.
  - This unit is precisely similar in appearance to the AM/FM unit illustrated, but the overall chassis dimensions are 12in. x 8 1/2in. x 8in. including the full vision dial, Size 8 1/2in. x 4 1/2in.
  - For A.C. Mains only, power supply required—H.T. 250 volts 30 mA, L.T. 6.3 volts 1 1/2 amp.
- Price completely assembled and including built-in power supply **£10/10/-**. H.P. Terms. Deposit **£2/12/6**, 12 months of 15/-.  
Price completely assembled excluding power supply **£9/-**. Carriage and insurance 7/6 extra.

### The NEW "LEAK" TL/10 AMPLIFIER and "Point One" PRE-AMPLIFIER



This Amplifier has a maximum output of 10 watts and maintains in every respect the world renowned LEAK reputation for precision engineering; fine appearance and fastidious wiring. The Pre-Amplifier will operate from any make or type of pick-up. A continuously variable input attenuator at the rear of the Pre-amp. permits the instantaneous use of crystal, moving iron and moving coil pickups. H.T. and L.T. supplies are available for a Radio Tuning Unit. An input attenuator is fitted. S.A.E. for descriptive leaflet.

#### PRICES :

- (a) THE COMPLETE AMPLIFIER WITH PRE-AMPLIFIER, **£28/7/-**, or **£7/2/-** Deposit and 12 months at **£2**.
- (b) THE TL/10 MAIN AMPLIFIER ONLY: **£17/17/-**, or **£4/7/-** Deposit and 12 months at **£1/5/4**.
- (c) THE "POINT ONE" PRE-AMPLIFIER ONLY: **£10/10/-**, or **£2/12/6** Deposit and 12 months at **15/-**.

### WILLIAMSON AMPLIFIERS BY GOODSSELL

These Amplifiers hardly need enlarging upon, it being sufficient to say that they have now become the accepted standard for quality reproduction by which all others are judged. Two Models are available:

- MODEL G.W.18.** Built completely to specification and giving 15 watts output. Price **£33/15/-** (plus 7/6 carriage and insurance.) H.P. Terms. Deposit **£8/9/-** and 12 months at **£2/7/5**.
- MODEL G.W.12.** Uses slightly lower H.T. voltage to produce 10-12 watt output but otherwise is built completely to specification. Price **£27/10/-** (plus 7/6 carriage and insurance.) H.P. Terms. Deposit **£3/17/6** and 12 months at **£1/18/8**.

### THE MODEL P.F.A. TONE CONTROL UNIT

This Control Unit has established a reputation for its excellent quality of reproduction, and ability to give adequate gain for any type of pick-up.

Price **£20/-** (plus 7/6 carriage and insurance.) H.P. Terms. Deposit **£5/-** and 12 months at **£1/8/2**.

WE HAVE THEM IN STOCK AND WILL BE PLEASED TO DEMONSTRATE or send S.A.E. for illustrated and descriptive leaflet.

▲ THE GOODSSELL "ULTRA LINEAR" M.A.S. AMPLIFIER

A "High Fidelity" Amplifier using a Triode connected push-pull output stage providing 10-12 watts output.  
Price **£14/17/6** (plus 7/6 carriage and insurance.)  
H.P. Terms. Deposit **£3/12/6** and 12 months of **£1/1/1**.

THE TONE CONTROL—PREAMP. UNIT  
Recommended for this Amplifier is the model UL/P.T.C. Its main features are adequate equalising for gramophone reproduction, separate control of bass and treble and low pass filter. Feedback is used over each of four stages.  
Price **£12/12/-** (plus 6/- carriage and insurance.)  
H.P. Terms. Deposit **£3/4/-** and 12 months at 17/8.

When submitting orders, please include postage and packing.

# STERN RADIO LTD.



**CONSTRUCTORS SAY**  
**"IT'S STILL THE BEST MAINS OR BATTERY PORTABLE SET"**

A Midget 4-valve Superhet Portable covering medium and long wavebands. Designed to operate on A.C. mains 200/240 volts or by an "Aldry" battery. The set is designed so that the main section can be supplied as a separate unit, and can be added at any time. The set supplied as an "Aldry" battery Superhet can be accommodated in the attaché case illustrated (size 9 1/2 in. x 4 1/2 in. x 7 1/2 in.). This is attractively finished in lizard, maroon, dark green or blue rexine. As a combined Mains/Battery Superhet Portable a polished cabinet is available to accommodate both Mains Unit and Batteries. Circuit incorporates delayed

A.V.C. and pre-selective Audio Feedback. The Set is complete in every detail and includes ready-wound frame aerials, fully aligned I.F. transf. and drilled chassis, etc. Overall size of assembled chassis 8 in. x 4 in. x 2 1/2 in. This receiver, as illustrated, can be completely built for £8/16/3 (plus Mains Unit if required). Send 1/3 for the fully descriptive Assembly Book which includes Practical Layouts and complete Price List of Components. Attaché case available separately. 37/6.

**"PERSONAL SET" BATTERY ELIMINATOR**

A complete Kit of parts to build a Midget "Aldry" Battery Eliminator, giving approx. 69 volts and 1.4 volts. This eliminator is for use on A.C. mains and is suitable for any 4-valve Superhet Receiver requiring H.T. and L.T. voltage as above, or approx. to 69 volts. The Kit is quite easily and quickly assembled and is housed in a light-aluminium case size 4 1/2 in. x 1 1/2 in. x 3 1/2 in. Price of complete Kit with easy-to-follow assembly instructions, 42/6.



In addition we can offer a similar COMPLETE KIT to provide approx. 90 volts and 1.4 volts. Size of assembled unit 7 in. x 2 1/2 in. x 1 1/2 in. Price 47/6.

**A COMPLETE "CAR RADIO" FOR THE HOME CONSTRUCTOR**  
 11 in. x 4 1/2 in. x 3 1/2 in.

A design of a complete 5-VALE SUPERHET RECEIVER employing an R.F. Stage, and incorporating a separate VIBRATOR PACK size 4 1/2 x 2 1/2 x 6 1/2 in. for use on 6 or 12 volt D.C. supplies. We can supply all components to build this complete Receiver and Vibrator Pack including a Metal Case, Valves, Drilled Chassis and 5 in. P.M. Speaker for £13/9/6 (Carr. and Ins. 5/6 extra). Or the Receiver Components for £9/19/6 and the Vibrator Components for £3/10/-. This is NOT an EX-GOVT. Receiver, it is a new design employing new Components. Send 2/8 for the complete set of ASSEMBLY INSTRUCTIONS, CIRCUITS and PRACTICAL LAYOUTS, including a complete individual Component Price List.



**A BULK PURCHASE ENABLES THIS SPECIAL PRICE REDUCTION**

**OF THE FAMOUS SHAFTESBURY PORTABLE AMPLIFIER**

Suitable for home use and small Halls. Has matched inputs for both Record Players and Microphone. Also provides for the "mixing" and "fading" of both Gram. and speech as requested.



**COMPRISING**

- (a) A 4-Valve High Gain Amplifier for use on A.C. or D.C. mains 200-250 volts with 5 watts output. Incorporating independent Volume Controls for Mike and Gram, either of which can be faded at will, a variable Tone Control and independent input sockets for Mike and Gram.
- (b) A Transverse Carbon microphone which obtains its polarizing current from the amplifier—no batteries are necessary.
- (c) An 8 in. Goodmans P.M. Speaker with the "Ticoonal" magnet for first-class reproduction.

**THE COMPLETE EQUIPMENT is all contained in the PORTABLE CARRYING CASE £18'0'0**

Having been reduced from £30/9/- **HIKE PURCHASE TERMS. DEPOSIT £4/10/-** and 12 monthly payments of £1/5/4 • Light in weight • Easy to CARRY • GENUINELY PORTABLE. An illustrated leaflet containing free data is available on receipt of 8 A.E.



**THE "MINI TWO-THREE"**

An "Aldry" Battery Portable of midget size, 6 1/2 in. x 4 1/2 in. x 3 1/2 in. designed to cover medium waveband 190-559 metres, with use of short trailer aerial.

The simple design of this Receiver is so arranged that either a 3-valve set or a 2-valve (afterwards easily converted to the 3-valve) can be made.

Consists of a T.R.F. circuit using a regenerative detector with H.F. stage and a high gain output pentode. Valve line up IT4—IT—DL94.

The 2-valve set can be completely built for £4/3/6 (less case) and the 3-valve for £5/3/- (less case). Each price includes valves, speaker, and drilled chassis.

Send 2/- for the assembly instructions; they include simple and complete practical component layouts and diagrams which enable the most inexperienced constructor to successfully build either set.

**!! CONSTRUCTORS !! A NEW SUPERHET TRANSPORTABLE THE "SUPER THREE"**

Designed for local station reception without the use of an external aerial. This design provides for a 3-valve (plus Metal Rectifier) Superhet Receiver incorporating a Frame Aerial for "room to room" use, provision is also made for a short external aerial, if required, for the reception of Continental Stations.



Briefly the features are as follows:—

- For use on A.C. Mains 200-250 volts.
- This set includes a Mains Transformer and Chassis is NOT live to mains (as many other sets of this type are) and consequently the Receiver can safely be used in the Kitchen, etc.
- Valve line up 6K8—6J7—KT61, plus Metal Rectifier.
- The I.F. Transformer is supplied "pre-aligned" and thereby ensures extreme simplicity of Tuning—in fact, more simple than most T.R.F. Receivers.
- Compact and easy to build simple "point to point" practical diagrams are supplied with a completely drilled chassis.

The complete Receiver Chassis can be built to cover the Medium Waveband only for

£6 . 6 . 6  
 £6 . 16 . 3  
 £1 . 1 . 0

Or to cover both Long and Medium Waves for

The attractive Polished Wood Cabinet 11 1/2 inches wide, 5 1/2 inches high and 6 inches deep illustrated above is THE CONSTRUCTOR'S MANUAL is available for 1/-, this shows the component prices, which are all available for separate purchase.

**A DUAL-CHANNEL PRE-AMPLIFIER and TONE CONTROL UNIT**

Attractively finished in "Old Gold" and providing full control of BASS and TREBLE in conjunction with a main volume control.

It can be used with any amplifier and with any pick-up, the range of frequency control provided by the unit affording ample compensation for all types of pick-ups and all natures of recordings, i.e., English, American and long-playing. without recourse to pick-up correction. The extreme flexibility of the bass and treble control is such that the level of bass and treble can be set to suit any conditions irrespective of the volume output of the amplifier. Response characteristics are given in 12-watt amplifier advt. The unit measures only 9 in. x 4 in. x 2 1/2 in. including self-contained power supply and can be accommodated either on or away from the main amplifier, i.e., on the front panel of a cabinet or any other position. Price including drilled chassis, valves (68N7 and 6J5), £3/16/9. Complete assembly data are available separately for 1/-. Completely assembled and ready for use, £5/5/-.

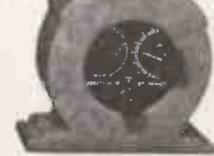


**"MINI-TWIN" 1-VALVE BATTERY SET**

A design of a simple 1-valve 2-stage Battery Receiver, giving excellent results on medium and long wavebands and having exceptionally low battery consumption. Drilled chassis and practical diagrams make it the ideal set for the beginner to build.

The complete chassis, including valve, can be built for 37/6, plus 8/11 P/Tax, the attractive plastic case is 9/6, and suitable headphones, 14/9.

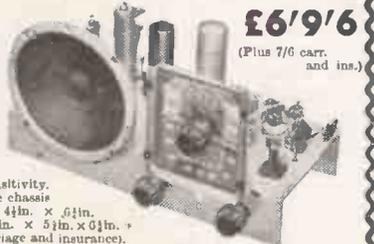
The complete assembly instructions, layout and a component price list are available for 1/6.



**A COMPLETELY ASSEMBLED 4 VALVE T.R.F. CHASSIS**

Including a 5 in. P.M. SPEAKER and VALVES

This receiver is of the very latest design and is for use on A.C. or D.C. Mains. It covers both Long and Medium Wavebands, and includes the modern BVA miniature valves The line up being 12BA6 — 12A7B—12A6—35W4. It incorporates Permeability Tuned Coils, thus ensuring excellent selectivity and sensitivity. The overall size of the complete chassis including speaker L 10 1/2 in. x 4 1/2 in. x 6 1/2 in. An attractive Cabinet size 11 in. x 5 1/2 in. x 6 1/2 in. available for 16/6 (plus 2/6 carriage and insurance).



£6'9'6  
 (Plus 7/6 carr. and ins.)

**109 and 115 FLEET ST.**  
**LONDON, E.C.4. Phone: CENTRAL 5812-3-4**

**Volume Controls**

Midget type. Long spindle. Guaranteed 1 year. All values 10,000 ohms to 2 Meg-ohms.  
No Sw. S.P.S.w. D.P.S.w.  
3/- 4/- 4/9

**COAXIAL PLUGS** 1/2  
**LINE CONNECTOR** 1/2  
**OUTLET BOXES** 4/6

**80 ohm COAXIAL CABLE**

STANDARD  $\frac{1}{16}$  in. diam. Polythene insulated. GRADE "A" ONLY

**8d. yd.**  
SPECIAL—Semi-air spaced Polythene. 80 ohm Coaxial  $\frac{1}{16}$  in. diam. Stranded core. Losses cut 50% (just released) **9d. yd.**

**BALANCED TWIN FEEDER** per yd. 6d.  
**TWIN SCREENED COAXIAL FEEDER** per yd. 1/-

80 ohms

**50 OHM COAXIAL CABLE**, 8d. per yd.  $\frac{1}{16}$  in. dia.  
**TRIMMERS**, Ceramic, 30, 70 pf., 9d. 100 pf., 150 pf., 1/3; 250 pf., 1/6; 600 pf., 1/9.

**RESISTORS**—All values: 10 ohms to 10 meg.  $\frac{1}{2}$  w., 4d.;  $\frac{1}{4}$  w., 6d.; 1 w., 8d.; 2 w., 1/-; High Stability,  $\frac{1}{2}$  w. 1/6, 2/-; Preferred values 100 ohms to 10 Meg.

**WIRE-WOUND RESISTORS**—Best Makes Miniature Ceramic Type—5 w., 15 ohm to 4 K., 1/9; 10 w., 20 ohm to 6 K., 2/3; 15 w., 30 ohm to 10 K., 2/9; 5 w. Vitreous, 12 K. to 25 K., 3/-.

**WIRE-WOUND POTS. 3 WATT FAMOUS MAKE.**  
Pre-Set Min. T.V. Type Size Pots, 2  $\frac{1}{16}$  in. Spindle Knurled Slotted Knob. High Grade. All Values. All values 25 ohms to 50 K. 3/- ea. 50 K., 4/-  
Ditto Carbon Track 50 K. W/W EXT. SPEAKER CONTROL 10  $\frac{1}{16}$  in. Standard

**O/P TRANSFORMERS**—Heavy Duty 70 ma., 4/6. Ditto tapped primary, 4/9. Tapped small pentode, 3/9.

**L.F. CHOKES**, 10 h. 65 ma., 5/-; 20/25 h. 100/150 ma., 12/6; 5 h. 250 ma., 15/-; 15 h., 100 ma., 10/6. LYNX, 3 h. 250 ma., 13/6. SIMPLEX, 10 h. 150 ma., 10/6.

**MAINS TRANS.**—Made in our own workshops with high grade specification. Fully inter-leaved and impregnated. Tapped prim. 200 v./250 v., Heater Trans., 6.3 v., 1 amp., 7/6; ditto 6.3 v., 3 amp., 10/6; ditto, 12 v., 75 amp., 7/6; 350-0-350 80 ma., 6.3 v., 4 a., 5 v., 2 a., ditto 300-0-300 ditto 250-0-250, 21/-  
**AMPLIFIER TRANS.** 250 v. 50 ma.  $\frac{1}{2}$  wave, 6.3 v. 2 a. Fully Shrouded, 17/6. Television Auto Type, 35/-; Simplex, 35/-.

**SOUNDMASTER SPECIALS**—Mains Trans., 35/-; L.F. Choke, 10/6; O/P Trans., 5/6; Envelope, 6/6. Specified Wafer Switches, 22/6 per set of 3.

**TAPE RECORDING BARGAIN**

**LIGHTWEIGHT XTAL HAND MIKES.** Chrome finish—Quality and sensitivity for only 25/-  
**ELECTRODYNAMIC MIKE INSERT.**—U.S.A. make, precision engineered. Size only  $\frac{1}{16}$  in. diam. by  $\frac{1}{16}$  in. Bargain Price 3/9. Matching Trans. 3/9.

**COPPER PLATED AERIAL RODS.**  $\frac{1}{16}$  in. x 12 in. push fitting, 2/6 doz., P. & P. 9d.

**TYANA.**—Midget Soldering Iron. 200/250 v. or 230/250 v., 14/11. TYANA TRIPLE THREE.—Complete with detachable bench stand, 19/6.

**NEW SOLON MIDGET IRON.**—25 w., 19/6. IDEAL FOR RADIO CONSTRUCTORS.

**C.R.T. HEATER ISOLATION TRANSFORMER.**—Low leakage winding with 25% sec. boost. Ratio 1:1.25, 2 v., 10/6; 4 v., 10/6; 6.3 v., 10/6; 12 v., 10/6.

**MIKE TRANS.**—Ratio 50:1, 3/9 ea., new and boxed.  
**VHOLDERS.**—Fax: Int. Oct. 4d.; EF50, EA50, 6d.; B12A CRT, 1/3. Moulded: Int. Oct. 6d.; B7G, 9d.; with screening can, 1/6; B8A, B8G, B9A, 1/-; VC897, 2/6. Ceramic: EF50, B7G, 1/-; ENG. and AMER. 5-, 7- and 9-pin, etc., 1/-.

**TAG STRIPS.**—2- or 3-way, 2d.; 4- or 5-way, 3d.; 6-way, 4d.; 9- or 10-way, 6d., etc.

**T/V PRE-AMP.**—Channel 1. Easily modified for other Channels or Converter use. Midget Chassis, 4 1/2 x 2 1/2 x 1 1/2 Complete with EF42 valve, coaxial lead and plug. Ready for use. Brand New Mfrs. Surplus. Listed £3/15/-. Special Clearance Price, 27/6; p. & p. 1/6.

**TOGGLE SWITCHES EX-GOV'T.**—"On-Off" 9d. Ercin M core solder 60/40, 16 g. or 18 g. 5/6  $\frac{1}{16}$  in., 4d. yd. T.C. wire, 18 to 22 s.w.g., 2/-  $\frac{1}{16}$  lb. P.V.C. Connecting wire, 10 colours. Single or Stranded. 2d. yd. 2 K. 5 w. H.D. w/w Pots. 4/6. 10 K., 25 K., Colvern w/w Pot.  $\frac{1}{16}$  in. spindle, 3/6.

**SCREENED GRID CAPS:** I. Oct. or Mazda 6d. ea. BULGIN HIGH VOLTAGE VALVE CAPS. I. Oct., 1/-.

**FUSES.**— $\frac{1}{16}$  in. all values 60 ma. to 10 a., 6d.

**ALADDIN FORMERS** and cores,  $\frac{1}{16}$  in., 8d.;  $\frac{1}{8}$  in. 10d.

**LOW MOTION DRIVES.**—Epicyclic ratio 4:1, 2/3  
**INT. OCTAL CABLE PLUG** (8-pin), with cover, 1/3.  
**200-250 Volt SELECTOR SOCKET** (2in. x 1in.) with Plug 1/-. **PILOT LAMPS.**—6.3 v. 3 a., 8d.

**EXT. L.S.**—Switched Socket, on-off and parallel switching, complete with plug, 2/-.

**MAINS DROPPERS.** 3in. x 1 1/2 in. Ad. 1 holders. 3 amp. 1750 ohms, 4/9. 2 amp., 1,000 ohms, 4/3.

**LINE CORD.**—3 amp., 60 ohms per foot, 2 amp. 100 ohms per foot, 2 way, 1/6 a yard; 3-way, 1/6 a yard.

**Plessey Multi Speed Changer**



PRICE Carriage Paid (TAX PAID) **£9. 19. 6**

GREAT REDUCTION

Brand New Plessey 3-speed Autochanger Mixer Unit for 7, 10 and 12in. Records. Twin Hi-Fi Xtal Head with Duopoint sapphire stylus. Plays 4-1000 records sprung mounting. Superb Quality. Bargain.

**\* MIXER TYPE MECHANISM**  
**\* DUAL POINT TURNOVER HEAD**

**BARGAIN OFFERS**

Nuts, Bolts and Washers, 12 of ea. 1/- sockets, 2, 4 and 6 BA.

**BATTERY CHARGERS. FULLY GUARANTEED.** 200/250 v. Output 6 v. and 12 v. 1  $\frac{1}{2}$  amps., in steel case complete with fuse and leads, ready for use. OUR OWN MAKE 35/-. Post 1/-.



**WOODEN WALNUT CABINET.**—12in. x 7in. x 5in. TRF or superb, punched chassis, dial, back-plate, drive, pointer, etc., 28/6.

**SUB MINIATURE VALVES WIRE ENDS**

\* R.F. Pent. 625 v. Fil.  
\* L.F. Pent. 1.25 v. Fil.  
Brand New. Ex Deaf Aid Apparatus, by Mullard, Hivac and American. Types—  
\* XFW 10 \* XFY32  
\* XFW 20 \* XFY32  
\* 505 AX \* DL66  
\* DF66 \* DL72  
\* DF70 \* 503AX  
\* 507 AX  
all at **7/6** each post free

**VCR97 £2 TESTED FULL PICTURE**

P. & P. 2/-.

**CRYSTAL DIODE.**—Very sensitive. G.E.O., 3/6. H. R. PHONES.—(Hi-grade Amer.), 15/6 pr. S. G. BROWN 5, 4,000 ohms, 15/6 pr.

**RADIO COMPONENT SPECIALISTS**

THO 1665. Buses 133 or 68 pass door.  
307 WHITEHORSE RD., WEST CROYDON  
OPEN ALL DAY SATURDAY.

P. & P., 6d. £1 orders post free. Lists 3d.  
ALL MAINS TRANS.—1/- extra postage.

**PYE Aerial Plug and Socket, 1/6 pr.**  
5in. RADIO SCREWDRIVERS.—Sheffield made blade 2  $\frac{1}{16}$  in. Ins. handle 5,000 v. 4  $\frac{1}{2}$  d. each.

**CONDENSERS.**—New stock .001 mfd. 6 kv. T.C.C. 5/6  
Ditto 12.5 kv. 9/6; 2 pf. to 500 pf. Mica 6d.; .001 500 v. .01 Sprague 500 v. .02 500 v. 1 mfd. 350 v. Micramom 9d.; .05 mfd. and .1 mfd. 1/-; .25 mfd. 1/6; .1 mfd HUNTS MOLDBEAL—500 v. .005. .01 mfd. 9d. 600 v. 1/3; Tubular 5 mfd. 350 v. 1/9.

**SILVER MICA CONDENSERS.**—10%  
5 pf. to 500 pf., 1/- 600 pf. to 3,000 pf., 1/3.

**DITTO 1% (ex stock).**  
1.5 pf. to 500 pf., 1/8. 515 pf. to 1,000 pf., 2/-.

**ELECTROLYTICS ALL TYPES NEW STOCK.**

Tubular Wire ends	50/25 v.	1/9
8+16/500 v.	5/6	50/80
16+16/500 v.	6/-	Can Types, Clips, 3d. ea.
1/275 v.	2/3	32+32/350 v.
2/450 v.	2/6	32+32/275 v.
4/350 v.	1/6	16/450 v.
4/500 v.	2/-	32/350 v.
8/450 v.	2/8	60/350 v.
8/500 v.	2/9	250/350 v.
10/500 v.	2/8	8+16/450 v.
16/500 v.	4/-	8+16/500 v.
8+8/500 v.	4/6	16+16/450 v.
32/350 v.	4/-	16+16/500 v.
32/500 v.	5/-	16+32/350 v.
32+32/350 v.	5/6	32+32/450 v.
32+32/500 v.	7/6	60+100/350 v.
25/25 v.	1/8	100+200/275 v.

**SPECIALS.** Can Types. 500 mfd. 12 v., 3/-; 1,000 mfd. +1,000 mfd., 6 v., 6/6; 1,500 mfd. 6 v., 4/6; 1 mfd. 1.5 kv. T.C.C., 3/6.

**GENETEC RECTIFIERS. E.H.T. TYPE FLY-BACK VOLTAGES.** K3/25 2 kv., 4/3; K3/40 3.2 kv., 6/-; K3/45, 3.6 kv., 6/6; K3/50 4 kv., 7/3; K3/100 8 kv., 12/6; K3/160 14 kv., 18/-  
**MAINS TYPE.**—R.M1, 125 v., 60 ma., 4/-; R.M2, 100 ma., 4/9; R.M3, 120 ma., 5/9; R.M4 250 v. 275 ma., 16/-.

**KNOS, GOLD ENGRAVED.**—Walnut or Ivory  $\frac{1}{16}$  in. diam., 1/6 each. "Focus", "Contrast", "Brilliant", "Brilliance—On-Off", "On-Off", "Volume", "Vol. On-Off", "Tone", "Tuning", "Trebble", "Bass", "Wavechange", "Radio-Drum", "S.M., L. Gram.", "Record-Play", "Brightness." Ditto not engraved, 1/- each.

**POINTER KNOBS.**—Brown with white marking line, small 9d., large 1/-.

**COILS.**—"P" type, 2/6 each. Midget "Q" Type adj. dust core, 3/6 each. All ranges.

**REACTION COND.**—0001, .0003, .0005 mfd., 3/6 ea.

**BANKRUPT STOCK**

**PEN TORCHES.**—Drydex, chromium plated with vest pocket clip. Complete. New battery and bulb. Listed 3/4. Our Price 2/6.  
**HANDLELITE.**—Drydex, pocket or handbag flashlight. Complete. Battery and lens bulb. Listed 3/5. Our Price 2/6.

**ALUMINIUM CHASSIS.**—18 s.w.g. Plain, undrilled, folded 4 sides and riveted corners lattice fixing holes. Strong and soundly constructed with 2  $\frac{1}{16}$  in. dia. 7in. x 4in., 4/6; 11in. x 7in., 6/9; 13in. x 9in., 8/6; 14in. x 11in., 10/6; and 18in. x 16in. x 3in., 15/6.

**CHARGER TRANS. PRIM.**—0/200/250 v. Sec., 0-9 v.-15 v. (for charging 6 v. and 12 v.) 1.5 a., 13/6; 2 a., 16/-; 3 a. 18/6; 4 a., 21/-; 6 a., 26/-.

**FULL WAVE BRIDGE SELENIUM RECTIFIERS.**—6 or 12 v. 1  $\frac{1}{2}$  amp., 8/9; 2 a., 11/3; 6 a., 23/6. Ditto F.W. only 6 v. 1 a. (9 v.-9 v. A.C.), 5/6.

**ACID HYDROMETER.**—New ex-Govt. Unbreakable. Packed in metal case, 7in. x 1  $\frac{1}{16}$  in. dia., 4/6.

**H.F. MIDGET CHOKES.**—14 M.H., 2/6 each.

**BRIMISTORS.**—CZ1 for 3 a. heater chains, 3/6. CZ2 for 1.5 a., or 2 a., 2/6. CZ3, 1/6.

**COPPER ENAMEL WIRE.**—1 lb. 14 to 20 s.w.g., 2/-; 22 to 28 s.w.g., 2/6; 30 to 40 s.w.g., 3/6.

**SWITCH CLEANER** Fluid, squirt spout, 3/9 un.

**TWIN GANG TUNING CONDENSERS.**—0005 mfd. midget with trimmers, 8/6; 375 pf. midget less trimmers, 6/6; .0005 Standard size with trimmers and feet, 9/-; less trimmers, 8/-; ditto, soltd, 2/6.

**SLEEVING.**—Various colours, 1, 2 mm., 2d.; 3, 4 mm., 3d.; 6 mm., 5d. yd.

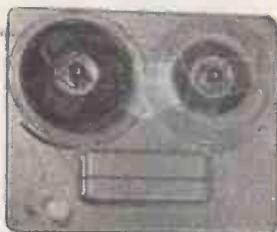
**LOUDSPEAKERS P.M. 3 OHM.** 3in. Plessey, 12/6. Good mains 4in. square, 15/6. 5in. 14/6. 6in. 16/- 7in. Elliptical 18/6. 8in. R. & A. 17/6. 10in. R. & A., 25/- 6in. Plessey with trans., 7,000 ohms to 3, 19/6.

**I. F. TRANSFORMERS**

465 Kc/s Stag tuning Miniature Circular Can, 2  $\frac{1}{16}$  in. by  $\frac{1}{16}$  in. diam. Fits octal V-holder cut out. High Q and good bandwidth. By Pye Radio. Two mounting feet.

**BRAND NEW, 6/9 PAIR**

RADIO · TELEVISION · HI-FI · ELECTRONICS · RECORDERS



"SENTERCEL" SELENIUM RECTIFIERS

K3/10, 250 v.	2/6
K8/40, 3.2 kV	6/-
K3/45, 3.6 kV	8/2
K3/50, 4.0 kV	8/8
K3/100, 8.0 kV	14/8
K3/160, 12.8 kV	21/6
K3/200, 16 kV	26/-

"SENTERCEL" METAL RECTIFIERS

RM1, 125 v., 60 mA	3/10
RM2, 125 v., 100 mA	4/6
RM3, 125 v., 125 mA	5/-
RM4, 250 v., 250 mA	16/-

**MAINS TRANSFORMERS**  
Special for MT1155, etc. Drop-through chassis mounting, half shrouded. 275-0-275 v., 110 mA. 6.3 v. 4 amps., 5 v. 3 amps. **LASKY'S PRICE**, each 29/6

SPECIAL OFFER OF CONDENSERS

8 Mfd., 500 v.w., standard lin. can. Limited quantity only. Each 1/2

**BATTERY CHARGER KITS**  
200-250 v., A.C. mains transformer and metal rectifier.  
No. 1, 6 v. at 1 amp. 19/6  
No. 2, 2, 6 and 12 v. at 1 amp. 21/-  
Post extra.

**RECORDING TAPE**  
Every make and type stocked. Scotch Boy, E.M.I., Ferrovoice, Grundig, Ferrograph, Puretone, Gavert and Agfa etc.

★ **THE MULLARD 10/12 AMPLIFIER KIT**  
All components, chassis and valves in stock. Available separately. **THE BOOK**, 2/6 post free.

★ **THE OSRAM 912 AMPLIFIER KIT**  
All components in stock. Chassis, Partridge trans., chokes, W/B., etc. Available separately. **THE BOOK**, 3/6, post free.

**INTERCOM. UNITS**  
4-station operation. For use on A.C./D.C. mains 200-250 volts. Complete, with 3 valves. Fitted in attractive plastic cabinet.

**MASTER UNIT £5/19/6**  
Carriage 5/- extra.  
Extension Units, price 21/- each complete. Carriage 2/- each extra.

**PLESSEY AUTOMATIC RECORD CHANGERS**  
3-speed Mixer, crystal turn-over head. Brand new and unused in makers' original cartons. Limited quantity only. **LASKY'S PRICE** £9/19/6. Carriage 3/6 extra.

NOW IN STOCK! — THE NEW "LANE" TAPE TABLE MK.VI

Two speed, 7 1/2 in. and 3 1/2 in./sec. Three high-grade motors. Record, playback, fast forward and fast rewind (under 1 minute). Takes standard reels up to 1,200 ft. capacity. Separate record and erase heads. **PRICE £18.10**

Carriage 3/6 extra. Available on H.P. terms.

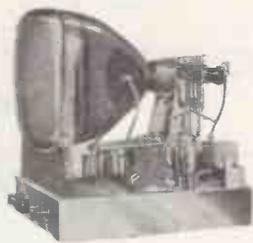
CONVERT YOUR "VIEW MASTER" TO 14, 16 or 18 inch SCREEN

Wide Angle Conversion Kit using only W/B components as specified.

The Kit consisting of line trans., frame trans., scanning coils, width and linearity controls, focus magnet, ion trap, tube base, 1-K3/100, 1-K3/40, metal rectifiers, 1-6CD6, 1-6U4GT, 3 resistors, 9 condensers. **THE COMPLETE PARCEL** including valves and data book, Post and packing 3/6 extra. **£9.3.8**

"View Master" Wide Angle Conversion booklet and full details, 3/6 post free.

**LASKY'S RADIO**



**LASKY'S T.V. CONSTRUCTORS' PARCELS**

**No. 1 WIDE ANGLE PARCEL.**

Containing ferrocube line E.H.T. transformer, ferrocube scanning coils, frame output transformer, p.m. focus unit, frame blocking osc. transformer, 14-, 15- or 17-inch mask and glass, width and linearity controls. Also the following valves: 6U4GT, 6CD6, 6AL5, 2-6AM5 (N78), 3-12AU7. Full circuit. **LASKY'S PRICE COMPLETE £8/15/11** Carriage 3/6 extra

**No. 2 WIDE ANGLE PARCEL**

As No. 1 parcel but less valves **LASKY'S PRICE 94/11** Carriage 2/6 extra

**No. 3**

All brand new components by Igranite. Comprises E.H.T. flyback line transformer, 7-10 Kv. with ferrocube core and rectifier heater winding; scanning coils; frame output transformer; Elac focus unit with vernier adjuster, U.25 E.H.T. rectifier, 1 1/2 in. mask and glass. **LASKY'S PRICE FOR THE COMPLETE PARCEL 79/6** Carriage and packing 3/6 extra

**No. 4 COMPLETE SET OF METALWORK**

Unassembled Comprising main chassis tube supports and valve holders. (Less sound-vision chassis.) **PRICE 25/-** Carriage 3/6 extra



**INEXPENSIVE RADIO YOU CAN BUILD**

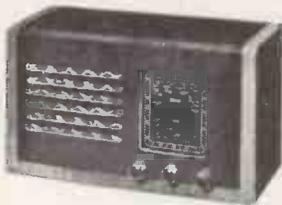
EVERY COMPONENT AND CABINET AVAILABLE SEPARATELY  
**THIS TRF 3-VALVE RECEIVER CAN BE BUILT FOR £5.10.0** (Carr. & Pkg. 2/6 extra)



Latest type circuit for 200/250 A.C. Mains, medium and long wave. Uses 6K7G, 6J7, 6V6. and Metal Rectifiers. Handsome Plastic Cabinet, 12 x 6 1/2 x 5 1/2 in. deep, Walnut or Ivory finish. If preferred a Wood Cabinet is available (see illus. below). **FULL DATA**, wiring and circuit diagrams and price list of components, 1/- post free. **CABINET** only, plastic or wood, 17/6. Carr. & Pkg. 2/6 extra.

**THIS 4-VALVE, 3-WAVE SUPERHET CAN BE BUILT FOR £7.19.6** (Carr. & Pkg. 2/6 extra)

Very efficient Superhet Circuit for 200/250 A.C. Mains, long, medium and short wavebands. Uses 6K8 freq. changer, 6K7 I.F. amp., 6Q7 det., A.V.C., AF-amp., and 6V6 output valves. Wood Cabinet, Walnut veneer, size 12 x 6 1/2 x 5 1/2 in. deep, or Plastic Cabinet as illus. above **FULL DATA**, wiring and circuit diagrams and price list of components, 1/- post free. **CABINET** only, plastic or wood, 17/6. Carr. & Pkg. 2/6 extra.



**THE "HARROW" BAFFLE RADIO CAN BE BUILT FOR LESS THAN £5.10.0** (Carr. & Pkg. 2/6 extra)



200/250 A.C. Mains, medium and long wave, using 2-6K7, 6V6 and 5Z4 valves. Note the attractive Baffle design Cabinet outside dim. 17 1/2 x 11 1/2 x 5 in. deep, finished satin mahogany veneer. Easy to build and gives fine performance. **CIRCUIT DIAGRAM** and price list of components, 1/- post free. **CABINET** only, 32/6. Carr. & Pkg. 2/- extra.

**HIRE PURCHASE TERMS AVAILABLE**

on certain items. Please give details of your requirements.

**FAMOUS MAKER'S SURPLUS OF RECORD PLAYER CASES**

Well made and covered lizard pattern rexine. Size 18 1/2 x 13 1/2 x 8 1/2 in. Will take Collaro auto-changer. An opportunity you should not miss. **LASKY'S PRICE 50/-** Carriage 3/6 extra.

**MORE MONEY-SAVING LASKY BARGAINS ON NEXT PAGE**

# LASKY'S RADIO

## ★ ANOTHER BIG BARGAIN RADIOGRAM CHASSIS

5-valve superhet, 3 wavebands—long, medium, short. Latest type miniature valves, gram. switch, ext. speaker socket. Large full vision dial. Size 12 x 7 x 8in.

**LASKY'S PRICE £10.50**

Packing and Insurance 10/- extra.

SAVE POUNDS! ORDER BY POST IF YOU CANNOT CALL

## BUILD THE "TELE-KING"

### 5 Channel 16 or 17 inch SUPERHET RECEIVER

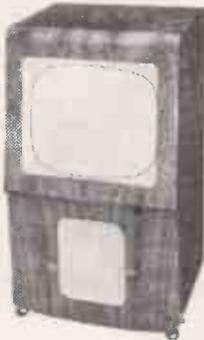
This famous and well tried home constructor set can now be built for £29/10/-. Tube and cabinet extra.

EVERY COMPONENT CAN BE SUPPLIED SEPARATELY.

Full constructional data, wiring diagrams and circuits.

**PRICE 6/- POST FREE**

WRITE NOW FOR OUR NEW "TELE KING" PRICE LIST. WE CAN SAVE YOU MONEY.



**MAINS TRANSFORMERS**  
All 200-250 v. 50 c.p.s. primary. Finest quality, fully guaranteed.

**MBA/3.** 350-0-350 v. 80 mA. 6.3 v. 4 a., 5 v. 2 a. Both filaments tapped at 4 volts. An ideal replacement trans. 18/-.

**MBA/6.** 325-0-325 v. 100 mA. 6.3 v. 3 a., 5 v. 2 a. With mains tapping board. Price 22/6.

**MBA/7.** 250-0-250 v. 80 mA. 6.3 v. 3 a., 5 v. 2 a. Both filaments tapped at 4 volts. 18/-.

**MBA/8. SPECIAL OFFER.** Drop through type. 235-0-235 v. 60 mA. 6.3 v. 3 a. 12/6.

**MBA/9.** 400-0-400 v. 60 mA. 6.3 v. 1 a., 4 v. 2.5 a. Price 12/6.

**AT/3.** Auto transformer. 0-10-120, 200-230-240 volts 100 watts. Price 17/6.

## HOUSE YOUR TV MAGNIFICENTLY IN ONE OF THESE SUPERB CABINETS!

### THE DE-LUXE

Complete with mask, glass, castors, shelf, bearers, C.R.T. neck end protector, back, speaker fret and baffle board. Finished in beautiful figured medium, light or dark walnut veneer, with high polish. Suitable for most home constructor T.V. receivers, including the "Viewmaster," "Practical Television," "Tele-King," "Magniview," "Wireless World," etc. Can be supplied with cut-out for 14in., 16in. and 17in. C.R. tubes at no extra cost.

An allowance of 4/6 will be made if the mask is not required.  
Inside Dimensions: Depth 16in.; width 17in.; height 28in. Overall height 32in. and width 18in.

**WHY NOT CONVERT YOUR TABLE RECEIVER TO A CONSOLE MODEL?**  
Adaptor frames for fitting 9in. or 10in. C.R. tubes available if required.

**LASKY'S PRICE £8/10/-**  
Carriage 12/6 extra.



**H.P. Terms.** Deposit £2/17/- plus carriage. Balance plus charges spread over 12 mths.

### THE ROTHESAY

The last word in outstanding contemporary design. Absolutely rigid construction throughout with the finest laminated woods, veneered in walnut, polished light, medium or dark shade. Fitted with gold anodised speaker grille. The C.R.T. aperture frame is detachable, supplied to suit any size tube to order. Full length doors if required can be supplied with the cabinet. Veneered both sides, polished to match the cabinet, and mounted with full length piano hinges.

**NOTE THESE GENEROUS SIZES.**  
Outside dim. 34in. high, 21in. wide, 21in. deep. Inside dim. 18in. wide, 19in. deep. Size of top 22in. x 21in. Thickness 1in.

**LASKY'S PRICE £9/19/6**  
Carriage 15/- extra.

**H.P. TERMS.** Deposit £3/10/- plus carriage charge. Balance plus charges The Rothersay cabinet with doors. Price £14/9/6.



## MANUFACTURERS' SURPLUS

- WIDE ANGLE 38 mm.**
- Line E.H.T. trans., ferro-cube core. 9-16 kv. . . . 25/-
- Scanning Coils, low imp. line and frame . . . . . 25/-
- Frame Output Transformer . . . . . 10/6
- Scanning Coils low imp. line and frame . . . . . 17/6
- Frame blocking osc. transformer . . . . . 4/6
- Line Blocking osc. transformer, caslam cored . . . . . 4/6
- Focus Magnets Ferroxdure P.M. Focus Magnets. Iron Cored . . . . . 19/6
- Duomag Focalisers . . . . . 29/6
- 300 mA. Smoothing chokes . . . . . 15/-
- Electromagnetic focus coil, with combined scan coils . . . . . 25/-

## ION TRAPS. All types, 3/-.

- ENERGISED SPEAKERS**
- 8in. with O/T 600 ohm field, 15/6.
- 8in. less O/T 600 ohm field, 12/6.
- 8in. less O/T 1,200 ohm field, 12/6.
- 6in. with O/T 600 ohm field, 14/-.

## TV COMPONENT BARGAINS

- STANDARD 35 mm.**
- Line Output Transformers No. E.H.T. 12/6 Line Output Transformers 6-9 kv. E.H.T. and 6.3 v. winding. Ferro-cube . . . . . 19/6
- Scanning coils. Low imp. line and frame . . . . . 12/6
- Scanning Coils. Low imp. line and frame, by Igranac . . . . . 14/6
- Line blocking oscillator transformer . . . . . 4/6
- Frame blocking oscillator transformer . . . . . 4/6
- Frame output transformer . . . . . 7/6
- Focus Magnets: Without Vernier . . . . . 12/6 With Vernier . . . . . 17/6
- Focus Coils. Electromagnetic 12/6 200 mA. Smoothing chokes 10/6

## CLOSED FIELD SPEAKERS

- 6in. . . . . 18/6
- 8in. round and 6in. Elliptical . . . . . 19/11.

## P.M. LOUDSPEAKERS

- 2in., 16/-, 5in., 18/6, 6in., 16/6, 8in., 12/6, 10in., 18/6, 10in., 19/11.

Special Purchase! Super Bargain in

## SPEAKER CABINETS

Attractive design finished in figured walnut veneer. Size 12 1/2 x 8 x 4 1/2 in. Will take 6in. speaker.

**LASKY'S PRICE 17/11**

Post and packing 2/6 extra.



## MOVING COIL MICROPHONES LESS THAN HALF USUAL PRICE!



By well-known manufacturer. Moving coil. Switch incorporated. Low impedance. Listed at £6/6/-.

**LASKY'S PRICE 59/6**

**MIKE TRANSFORMERS, 100-1**  
Each 1/11.

## ELECTROLYTIC CONDENSERS ALL BRAND NEW

- 8 mfd. 450 v.w. . . . . 1/9
- 16 mfd. 350 v.w. . . . . 2/6
- 16 mfd. 500 v.w. . . . . 3/6
- 20 mfd. 500 v.w. . . . . 3/6
- 30 mfd. 450 v.w. . . . . 3/3
- 60 mfd. 350 v.w. . . . . 3/11
- 64 mfd. 450 v.w. . . . . 3/11
- 150 mfd. 350 v.w. . . . . 3/6
- 400 mfd. 150 v.w. . . . . 2/6
- 8 + 8 mfd. 450 v.w. . . . . 3/6
- 8 + 16 mfd. 450 v.w. . . . . 4/3
- 12 + 12 mfd. 350 v.w. . . . . 2/6
- 16 + 16 mfd. 350 v.w. . . . . 3/6
- 16 + 16 mfd. 450 v.w. . . . . 4/6
- 20 + 20 mfd. 275 v.w. . . . . 2/-
- 60 + 100 mfd. 350 v.w. . . . . 7/6
- 32 + 32 mfd. 450 v.w. . . . . 5/11

## MANY OTHER SINGLE AND MULTIPLE CONDENSERS

## HIGH VOLTAGE E.H.T. CONDENSERS

- .1 + .1 mfd. 3.5 Kv. . . . . 5/11
- .1 mfd. 7 Kv. . . . . 15/-
- .001 mfd. 12.5 Kv. . . . . 7/6
- .001 mfd. 15 Kv. . . . . 10/-
- .0005 mfd. 10 Kv. . . . . 3/6
- .0005 mfd. 15 Kv. . . . . 6/6
- .04 mfd. 12.5 Kv. . . . . 5/-

## C.R.T. Neck Protectors 2/6.

## SPECIAL T.V. CONDENSERS

- 64 mfd. 450 v.w. . . . . 3/11
- 100 mfd. 450 v.w. . . . . 4/11
- 32 + 100 mfd. 450 v.w. . . . . 7/6
- 100 + 200 mfd. 350 v.w. 5/11

## DENCO F.M. FEEDER UNIT

All components and valves in stock Uses 6AM6, 12AH8, EB01, and two 6AB6. **THE COMPLETE PARCEL** £6/7/6. Post extra. All components available separately.

**VALVES & C.R. TUBES.** Over 25,000 in stock. Mullard, Brimar, Osram, G.E.C., Ferranti, etc.

## METROSILS. 10 Kv. 5/-

## BRIMISTORS.

CZ.1 1/6 each. CZ.3 6d. each.

## OUTPUT TRANSFORMERS

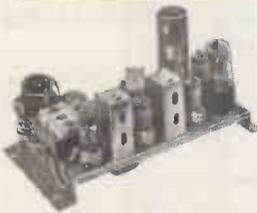
- Midget Pentode . . . . . 3/6
- Miniature Personal, 3S4, etc. 3/6
- Standard pentode . . . . . 3/11
- Push-Pull, 6V6 . . . . . 9/6
- Multi Ratio, P.P. . . . . 12/6
- Heavy Duty, P.P. . . . . 14/11

MORE MONEY-SAVING LASKY BARGAINS ON NEXT PAGE

EVERYTHING FOR HOME CONSTRUCTOR & SERVICEMAN

**LASKY'S  
RADIO**

**COMPLETE 5-VALVE RADIO CHASSIS**



Completely wired and ready for use with the addition of a speaker and output transformer. Two controls: Volume and Station switch. Valves used: 10C1, 10F9 or UF41, 10LD11 or UBC41, 10P14, UO40 or UY41.  
**LASKY'S PRICE, less 69/6**  
valves, Post 3/6.  
Complete with valves, £5/19/6.

- ★ I.F. 465 kc/s.
- ★ A.V.C.
- ★ 4 watts output.
- ★ 3 Station Pre Set.
- ★ Frame aerial.
- ★ Fully aligned.
- ★ Chassis size only 10in. x 5½in. Max. height 5½in.

**ANOTHER LASKY SUPER SCOOP!**  
THE SCOPHONY-BAIRD CINE "SOUNDMASTER" NEW & UNUSED  
A COMPLETE TAPE RECORDER—CAN ALSO  
BE USED AS A STRAIGHT AMPLIFIER

**LIST PRICE 72 GNS.**

Originally designed for connecting to a cine projector for synchronising sound to silent films, this superb equipment with the addition of a motor becomes a Complete Tape Recorder of 5 watts undistorted output, and it can also be used as a straight Amplifier. Two Inputs for use with Crystal Mike and radio or gram. Permanent magnet Erase. Amplifier uses five valves:—2-6SN7, 2-6V6, 1-5Z4. For 200/240 A.C. mains.



LIMITED NUMBER ONLY. Full operating instructions and circuit diagram supplied with each Recorder. Write for further details.

**LASKY'S PRICE**  
**£17.13.0**

(Carriage 12/6 extra)

Comprising the "SOUNDMASTER" complete with 5 valves, cover incorporating Bin. Loud Speaker with 24ft. of cable, Spare Input Plug, one empty Tape Spool, Mains Lead. Dimensions: 13½ x 16 x 11in. Nett weight 32lbs.

ROTHERMEL CRYSTAL MIKE complete with lead and plug. 25/- extra (Listed at 5 gns.)

**ARMOUR PLATE GLASS FILTERS**

16in. Actual size 17½in. x 15½in. x ¼in. ....	7/11
15in. Actual size 16½in. x 13in. x ¼in. ....	6/11
12in. Actual size 13in. x 10½in. x ¼in. ....	4/-
9in. Actual size 9in. x 8in. x ¼in. ....	3/-

**TRIPLEX DARK SCREEN FILTERS**

14 x 12½ x ¼in. ....	7/6
15½ x 13½ x ¼in. ....	9/6
Postage and packing 5/- per piece extra. (This charge is necessary owing to extra packing required.)	

**PERSPEX IMPROSION GUARDS, incorporating escutcheon and filter plate.**

12in. ....	7/6
12in. de Luxe ....	15/-
16in. de Luxe ....	17/6

**C.R.T. MASKS. Brand New LATEST ASPECT RATIO**

9in. ....	7/-
10in. ....	7/6
12in. Rubber ....	15/-
12in. Old Ratio ....	9/6
12in. Escutcheon mask, with Perspex filter ....	12/6
14in. Rectangular ....	12/6
15in. Cream rubber ....	17/6
16in. Plastic, white ....	12/6
17in. Rectangular ....	15/-

**TELESCOPIC AERIAL MASTS**  
As previously advertised Complete. **LASKY'S PRICE 25/-**. Carriage 2/6 extra.

**AERIAL ROD SECTIONS**  
Steel, heavily copper plated. 12in. long, ¼in. diameter. Any number may be fitted together. 2/6 per doz. Post free.

**SPECIAL TRANSFORMER**  
Secondary tapped as follows: 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 20, 24 and 30 volts at 2 amps. **PRICE 17/6.**

**CRYSTAL DIODES**

Glass type, wire ends. Each 1/6 Higher grades, 12 assorted for 30/-, post free.

**CYLDON 5-CHANNEL SWITCHED TELETUNERS**

Brand new. Instant and positive selection of any one of the 5 B.B.C. television channels, by a single control knob.  
**LASKY'S PRICE 12/6**  
Post Free.  
With valves 37/6.

**2-WATT MIDGET AC DC AMPLIFIERS PUSH PULL, VERY HIGH GAIN.**

4 valves: 2 UL41 in push pull, 1 UCH42 and 1 UAF42. Input voltage 100/110 AC/DC. Very easily converted to 230 volts. Supplied with circuit diagram and full de. table. Size:—9 x 4 x 4 inches. Uses 2 metal rectifiers, 1 each RM2 and RM3. Ideal for ships record players, tape recorders, home record players, baby alarms, etc., etc. Supplied complete fully assembled and wired, with 4 valves.  
**LASKY'S PRICE. 65/-**, carriage free.

**CO-AXIAL CABLE**

75-80 ohms impedance.	
Single Core, per yard, 8d.	
Twin Core .....	1/-
Twin Balanced Feeder .....	6d.

**CHOKES**

40 m/a. 3/3	120 m/a. 7/3
60 m/a. 3/11	200 m/a. 12/6
80 m/a. 4/11	250 m/a. 14/-

**DULCI RADIO CHASSIS**

Full range stocked. 6 types to choose from.

**ALUMINIUM CHASSIS. 18 S.W.G., undrilled, with 4 sides, reinforced corners. Depth 2½in.**

6 x 4in., 4/-	12 x 8in., 7/-	16 x 10in., 8/3
8 x 6in., 5/-	14 x 9in., 7/6	12 x 3in., 4/9
10 x 7in., 6/-	16 x 9in., 8/-	12 x 6in., 6/6
Post 1/- per chassis extra.		

**METAL RECTIFIERS**

6 or 12 v.  
F.W. Bridge.

2 amp. ....	11/3
4 amp. ....	15/-
6 amp. ....	23/6
1 amp. ....	6/6
10 amp. ....	32/6
½ amp., 6 v. ....	2/6
½ amp., 12 v. ....	3/11
3 amp., 12 v. ....	12/6

**R.1155 RECEIVERS**

Now available on H.P. terms

5 Frequency ranges: 18.5-7.0 Mc/s; 7.5-3.0 Mc/s; 1,500-600 kc/s; 500-200 kc/s; 200-75 kc/s. Supplied in maker's original wood transit case.  
**LASKY'S PRICE, brand new £11/19/6**  
Secondhand, Grade 1, ..... £9/19/6  
Secondhand, Grade 2, ..... £7/19/6



Carriage 17/6 extra, including 10/- returnable on packing case.

**ASSEMBLED POWER PACK/OUTPUT STAGE FOR R.1155 RECEIVER.** For use on 200-250 v. A.C. Complete with 2 valves. In metal case, size 12 x 7 x 5½in., 79/6. Carriage 5/- extra.

**POWER PACK** as above, fitted with 6½in. P.M. Speaker, £5/5/- . Carriage 5/- extra.

**POSTAGE & PKG. CHARGES**  
(unless otherwise stated)  
Orders value £1, 1/- extra.  
Orders value £5, 2/- extra.  
Orders value £10, 3/6 extra.  
Over £10 carriage free.  
All goods fully insured in transit.

**LASKY'S  
RADIO**

LASKY'S (HARROW RD.), LTD.

TWO ADDRESSES FOR PERSONAL CALLERS  
Open all day Saturday. Early closing: Thursday.

**370 HARROW ROAD, PADDINGTON, W.9.**  
(Opposite Paddington Hospital)  
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**SELENIUM RECTIFIERS**

L.T. Types	H.T. Type H.W.	
2/6 v. 1 a.h.w. ....	1/9	120 v. 40 mA. .... 3/11
6/12 v. 1 a.h.w. ....	2/9	250 v. 50 mA. .... 5/9
F.W. Bridge Types		
6/12 v. 1 a. ....	4/11	250 v. 80 mA. .... 7/9
6/12 v. 1.5 a. ....	7/9	250 v. 150 mA. .... 9/9
6/12 v. 2 a. ....	9/9	RM4 250 v. 250 mA. .... 11/9
6/12 v. 3 a. ....	12/3	300 v. 275 mA. .... 12/11
6/12 v. 4 a. ....	14/9	F.W. (Bridge Type)
6/12 v. 6 a. ....	19/9	250 v. 80 mA. .... 11/9
6/12 v. 10 a. ....	29/9	
24 v. 10 a. ....	57/6	

**CO-AXIAL CABLE.** 75 ohms  $\lambda$ in., 7d yard. Twin screened feeder, 9d yd.

**SILVER MICA CONDENSERS.** 5, 10, 15, 20, 25, 30, 35, 50, 100, 120, 150, 180, 200, 230, 300, 330, 400, 470, 500, 1,000 pfd. (.001 $\mu$ F), .002 mfd. (2,000 pfd.). All at 5d. each. 3/9 dozen one type.

**DIAL BULBS, M.E.S.,** 8 v. 0.15 a., 6/9 doz.; 6.5 v. 0.15 a., 6/9 doz.; 4.5 v. 0.3 a., 6/9 doz.

**ELECTROLYTICS** (Current production) NOT ex Govt.

Tubular Types	Can Types		
8nF 450 v. ....	1/11	18 mfd. 350 v. ....	1/11
8 mfd. 500 v. ....	2/6	16 $\mu$ F 450 v. ....	2/9
16 $\mu$ F 350 v. ....	2/3	24 $\mu$ F 350 v. ....	2/11
16 $\mu$ F 450 v. ....	2/9	32 $\mu$ F 350 v. ....	2/11
24 $\mu$ F 350 v. ....	3/3	32 mfd. 450 v. ....	4/9
32 $\mu$ F 250 v. ....	3/9	64 mfd. 450 v. ....	4/9
32 mfd. 500 v. ....	5/9	100 mfd. 450 v. ....	4/9
8-16 $\mu$ F 600 v. ....	4/11	8-8 $\mu$ F 450 v. ....	3/11
25 $\mu$ F 25 v. ....	1/3	8-8 mfd. 500 v. ....	4/9
50 $\mu$ F 12 v. ....	1/3	8-16 $\mu$ F 450 v. ....	2/11
50 $\mu$ F 50 v. ....	2/3	16-16 $\mu$ F 450 v. ....	4/11
Can Types			
8 mfd. 250 v. ....	1/3	16-32 $\mu$ F 350 v. ....	4/9
8 mfd. 450 v. ....	2/3	32-32 $\mu$ F 350 v. ....	4/9
8 mfd. 500 v. ....	2/9	32-32 $\mu$ F 450 v. ....	5/11

**AMPLIFIER OR CHARGER CASES.** Size 14 $\frac{1}{2}$  x 5 $\frac{1}{2}$  x 7 $\frac{1}{2}$  in. high. Strongly made in perforated steel. Grey enamel finish. Only 9/6.

**VOLUME CONTROLS** with long spindles, all values, less switch, 2/9; with S.P. switch, 3/9.

**WIRE WOUND POTS:** 20 ohms, 500 ohms, 5K, 20K, 50K, 100K (medium length spindles), 2/9. 220 ohms, 2K, 10K, 20K, Preset type, 1/9 each.

**AMMETERS.** Moving coil. G.E.C. 0-5 amps., 2in. scale, 11/9.

**EX-GOVT. E.H.T. SMOOTHING CONDENSERS**  
 .25 mfd., 4,000 v. Blocks. .... 4/9  
 .5 mfd., 2,500 v. Blocks. .... 3/9  
 .5 mfd., 3,500 v. Cans. .... 3/3  
 .1 mfd. plus 1 mfd. 8,000 v., large blocks (common negative isolated). .... 9/6  
 1.5 mfd., 4,000 v. Blocks. .... 5/9

**EX-GOVT. ACCUMULATORS** with non-spill vents. Unused and guaranteed. 2 v. 16 A.H., 5/9 each.

**EX-GOVT. BLOCK PAPER CONDENSERS**  
 2 mfd. 800 v. .... 1/9  
 4 mfd. 500 v. .... 2/9  
 4 mfd. 750 v. .... 3/9  
 4 mfd. 1,000 v. .... 4/3  
 4 mfd. 1,500 v. .... 4/9  
 4 mfd. 400 v. plus 2 mfd. 250 v., 1/11.

**EX-GOVT. BLOCK ELECTROLYTICS.** Small size 2,000 mfd. 12 v. for L.T. smoothing, 1/11 ea.

**M.E. SPEAKERS.** All 2-3 ohms, 8in. R.A. field, 600 ohms, 11/9. 10in. R.A. field, 1,500 ohms, 23/9. 10in. R.A. field, 1,000 ohms, 23/9. **SPECIAL OFFER.** Mains Trans. 200-250 v. 50 c/s. Primary. Secs. 300-0-300 v. 150 mA. 6.3 v. 4 a. 5 v. 3 a., half shrouded drop through, 21/9.

**HEAVY DUTY BATTERY CHARGER**  
 For normal 200/250 v. A.C. mains input. To charge 12 v. battery. Variable charge rate of up to 10 amps. Fitted Meter and Fuses. Guaranteed 12 months. Carr. 7/6 £6/19/6.

**HEAVY DUTY BATTERY CHARGER KIT**  
 For normal 200/250 v. A.C. mains. Comprises mains transformer, 2 F.W. Metal Rectifiers, 2 variable resistors, 4 insulated terminals, 2 meters, 4 fuses and circuit. Total output 18 amps. Separate outputs for 6 v. and 12 v. Will make ideal Charger for Garages. Carriage 15/-. £9/19/6.

**DRYDEX HANDLAMPS,** suitable for garage lights, etc. (Normal price 29/6). Limited number. Brand new boxed, fitted with bulb, 19/6.

**R.S.C. TRANSFORMERS**

**FULLY GUARANTEED, INTERLEAVED AND IMPREGNATED**

**MAINS TRANSFORMERS**

Primaries 200-230-250 v. 50 c/s.

**FULLY SHROUDED UPRIGHT MOUNTING**

250-0-250 v. 60 mA., 6.3 v. 2 a., 5 v. 2 a., Midget type, 2 $\frac{1}{2}$ -3.3in. ....	16/9
350-0-350 v. 70 mA., 6.3 v. 2 a., 5 v. 2 a., 0-4-5 v. 3 a. ....	18/9
250-0-250 v. 100 mA., 6.3 v. 4 a., c.t., 0-4-5 v. 3 a. ....	23/9
250-0-250 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a., 250-0-250 v. 100 mA., 6.3 v. 6 a., 5 v. 3 a., for R1355 conversion. ....	22/8
300-0-300 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a., 300-0-300 v. 100 mA., 6.3 v. 4 v. 4 a. c.t., 0-4-5 v. 3 a. ....	29/6
350-0-350 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a., 350-0-350 v. 100 mA., 6.3 v. 4 a., c.t., 6.3 v. 4 a., c.t., 5 v. 3 a., suitable Williamson Amplifier, etc. ....	22/9
450-0-450 v. 250 mA., 6.3 v. 6 a., 6.3 v. 6 a., 5 v. 3 a. ....	23/9

**TOP SHROUDED DROP THROUGH TYPE**

250-0-250 v. 70 mA., 6.3 v. 2.5 a. ....	12/11
200-0-200 v. 70 mA., 6.3 v. 2 a., 5 v. 2 a. ....	15/9
350-0-350 v. 80 mA., 6.3 v. 2 a., 5 v. 2 a. ....	17/6
275-0-275 v. 80 mA., 6.3 v. 3 a., 4 v. 2.5 a. ....	14/11
250-0-250 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a. ....	21/9
300-0-300 v. 100 mA., 6.3 v. 4 v. 4 a., c.t., 0-4-5 v. 3 a. ....	21/9
350-0-350 v. 100 mA., 6.3 v. 4 a., c.t., 5 v. 3 a. ....	21/9
350-0-350 v. 150 mA., 6.3 v. 2 a., 6.3 v. 2 a., 5 v. 3 a. ....	29/11
500-0-500 v. 150 mA., 6.3 v. 4 a., 5 v. 3 a. ....	26/9

**E.H.T. TRANSFORMERS.** 2,500 v. 5 mA., 2-0-2 v. 1.1 a., 2-0-2 v. 1.1 a., for VCR97, VCR517 .... 36/6

**FILAMENT TRANSFORMERS**

Primaries 200-250 v. 50 c/s.	
6.3 v. 1.5 a. ....	5/9
6.3 v. 3 a. ....	8/11
12 v. 1 a. ....	7/9
0-2-4-5-6.3 v. 4 a. ....	16/9
6.3 v. 2 a. ....	7/6
0-4-6.3 v. 2 a. ....	7/9
6.3 v. 6 a. ....	17/6
12 v. 3 a. or 24 v. ....	17/6
1.5 a. ....	17/6

**CHARGER TRANSFORMERS**

All with 200-230-250 v. 50 c/s Primaries: 0-0-15 v. 1 $\frac{1}{2}$  a., 11/9; 0-9-15 v. 3 a., 18/9; 0-9-15 v. 4 a., 18/9; 0-9-15 v. 6 a., 22/9; 0-9-15 v. 15 a., 45/-.

**ELIMINATOR TRANSFORMERS**

Primaries 200-250 v. 50 c/s. 120 v. 40 mA. 120 v. 40 mA., 5-0-5 v. 1 a. .... 14/9

**OUTPUT TRANSFORMERS**

Midget Battery Pentode 66:1 for 3S4, etc. ....	3/6
Small Pentode, 5,000 $\Omega$ to 3 $\Omega$ . ....	3/9
Standard Pentode, 5,000 $\Omega$ to 3 $\Omega$ . ....	4/9
Standard Pentode, 8,000 $\Omega$ to 3 $\Omega$ . ....	4/9
Multi-ratio 40 mA. 30:1, 45:1, 60:1, 90:1, Class B Push-Pull. ....	5/6
Push-Pull 8 Watts 6V6 to 3 ohms. ....	8/9
Push-Pull 10-12 Watts 6V6 to 3 $\Omega$ or 15 $\Omega$ . ....	15/9
Push-Pull 10-12 Watts to match 6V6 to 3-5-8 or 15 $\Omega$ . ....	16/9
Push-Pull 20 Watts high-quality sectionally wound 6L6, KT66, etc., to 3 or 15 $\Omega$ . ....	47/9

**SMOOTHING CHOKES**

250 mA., 3 H., 50 ohms. ....	11/9
150 mA., 7-10 H. 250 ohms. ....	11/9
100 mA., 10 H. 200 ohms. ....	8/9
80 mA., 10 H. 350 ohms. ....	5/6
60 mA., 10 H. 400 ohms. ....	4/11
50 mA., 40 H. 1,000 ohms. Potted. ....	10/9
20 mA., 30 H., 1,000 ohms. ....	4/9

**EX-GOVT. MAINS TRANSFORMERS**

All 230 v. 50 c/s. input	
8.8 v. 4 a. ....	9/9
48 v. 1 a. ....	9/9
0-11-22 v. 15 a. ....	35/9
0-11-22 v. 30 a. ....	72/6
16-18-20 v. 35 a. ....	79/6
7.7 v. C.T. 7 amps 4 times. ....	25/9
480 v. 200 mA., 6.3 v. 5 a. ....	27/9
365-0-365 v. 150 mA. ....	8/9
300-0-300 v. 80 mA. 5 v. 3 a. ....	8/11
278-0-278 v. 100 mA. ....	8/9
300-0-300 v. 150 mA., 610-0-610 v. 150 mA., 1,220 v. 350 mA. ....	29/9
40 v. C.T. 150 mA. 4 v. 6 a., 6.3 v. 6 a., 6.3 v. 0-6 a., 4 v. 6 a., 4 v. 3 a., 4 v. 3 a., 4 v. 3 a., 5 v. 2 a. ....	22/9

**EX-GOVT. AUTO. TRANSFORMERS**

15-10-5-0-195-215-235 v. 500 watts. ....	27/9
Double wound 10-0-200-220-240 v. to 10-0-275-295-315 v. 1,000 watts. ....	69/6
Double wound 0-230 v. to 0-230 v. in steps of 11 volts from 57.5 KVA (21 amps). £6/15/-	
Double wound 0-110-240 v. to 0-130-140-150-160-170 v. 1,500 watts. ....	69/6
Carriage on any of above 5/- extra.	

**EX-GOVT. SMOOTHING CHOKES**

250 mA., 10 H. 50 ohms. ....	14/9
250 mA., 10 H. 100 ohms. ....	14/9
250 mA., 3 H. 50 ohms. ....	8/9
150 mA., 10 H. 50 ohms. ....	10/11
100 mA., 10 H. 100 ohms, Tropicalised. ....	6/9
100 mA., 5 H. 100 ohms, Tropicalised. ....	3/11
100 mA., 50 H. 1,000 ohms. Potted. ....	8/11
90/100 mA., 10 H. 100 ohms. Potted. ....	8/9
50 mA., 5-10 H. ....	2/9
L.T. type 1 amp. ....	2/9

**CHASSIS**

18 s.w.g. undrilled aluminium amplifier type (4-sided). ....	
12in. x 9in. x 2 $\frac{1}{2}$ in. ....	6/11
14in. x 9in. x 2 $\frac{1}{2}$ in. ....	6/11
14in. x 10in. x 3in. ....	7/11
18in. x 10in. x 3in. ....	8/3
18 s.w.g. aluminium receiver type. ....	
6in. x 9in. x 1 $\frac{1}{2}$ in. ....	1/11
7 $\frac{1}{2}$ in. x 4 $\frac{1}{2}$ in. x 2in. ....	2/9
10in. x 5 $\frac{1}{2}$ in. x 2in. ....	3/3
11in. x 6in. x 2 $\frac{1}{2}$ in. ....	3/11
10 s.w.g. aluminium receiver type. ....	
12in. x 8in. x 2 $\frac{1}{2}$ in. ....	5/3
16in. x 8in. x 2 $\frac{1}{2}$ in. ....	7/6
20in. x 8in. x 2 $\frac{1}{2}$ in. ....	8/11
16 s.w.g. aluminium amplifier type. ....	
12in. x 8in. x 2in. ....	7/11
10in. x 8in. x 2in. ....	10/11
20in. x 8in. x 2in. ....	13/6
14in. x 10in. x 3in. ....	13/6

**THE SKY CHIEF T.R.F. RECEIVER**



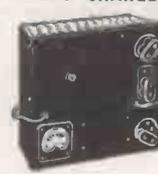
A design of a 4-stage, 3-valve 200-250 v. A.C. Mains receiver with selenium rectifier. For inclusion in either of cabinets illustrated above. It consists of a variable Mu high gain H.F. stage followed by a low distortion grid detector triode. The next stage is a further triode amplifier with tone correction by negative feedback. Finally comes the output stage consisting of a parallel connected double triode giving ample output at an extraordinary low level of distortion. Point-to-point-wiring diagrams, instructions, and parts list, 2/6. This receiver can be built for a maximum of £4/19/6 including cabinet.

**P.M. SPEAKERS.** All 2-3 ohms. 6 $\frac{1}{2}$ in. Plessey, 16/9. 8in. Plessey, 15/9. 10in. R.A., 26/9. 10in. Plessey, 18/6. 10in. Rola with Trans., 29/6.

**R.S.C. BATTERY CHARGER KITS.** For mains input 200-250 v. 50 c/s. To charge 6 v. accumulator at 2 amps., 25/9. To charge 6 v. or 12 v. battery at 2 a., 31/6. To charge 6 v. or 12 v. battery at 4 a., 49/9.

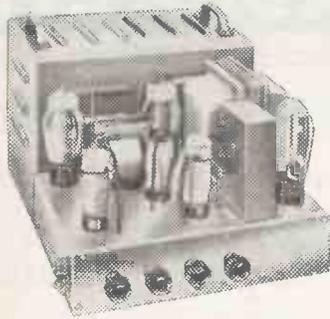
**ABOVE KITS CONSIST OF BLACK CRACKLE LOUVRED STEEL CASE, MAINS TRANSFORMER, FULL WAVE METAL RECTIFIER, FUSES, FUSE-HOLDERS AND CIRCUIT.** Any type assembled and tested for 6/9 extra.

**R.S.C. 6 v. or 12 v. BATTERY CHARGER**  
 For normal A.C. mains input 200-230-250 v., 50 c/s. Selector panel for 6 v. or 12 v. charging. Variable charge rate of up to 4 AMPS. Fused, and with 5 amp meter. Well ventilated metal case with attractive crackle finish. Guaranteed for 12 months, 69/6. Carr. 2/6.



# R.S.C. HIGH FIDELITY 25 watt AMPLIFIER A 4

**A NEW DESIGN FOR 1955**  
**HIGH GAIN "PUSH PULL OUTPUT."** BUILT-IN PRE-AMP TONE CONTROL STAGES. INCLUDES 7 valves, sectionally wound output transformer, block paper reservoir condenser, and reliable small components. AN INPUT OF ONLY 20 millivolts IS REQUIRED FOR FULL OUTPUT. THIS MEANS THAT ANY TYPE OF MICROPHONE OR PICK-UP IS SUITABLE. Two separate inputs controlled by separate volume controls allow simultaneous use of "Mike" and Gram., or Tape and Radio, etc., etc. Individual controls for Bass and Treble "lift" and "cut." Six negative feedback loops giving total of 24 D.B. Frequency response  $\pm 3$  D.B. 30-20,000 c/s. H.P. Terms now available on request. Cover as illustrated if required, price 17/6 extra.



Hum level 66 D.B. down. Certified total harmonic distortion of only 0.35% measured at 10 watts. Comparable with the very best designs. SUITABLE FOR SMALL HOMES OR LARGE HALLS, CLUBS, GARDEN PARTIES, DANCE HALLS, etc., etc. For ELECTRONIC ORGAN OR GUITAR. For STANDARD OR LONG PLAYING RECORDS. Size approx. 12in. x 10in. x 9in. Weight 20 lb. Power consumption 175 watts. Outputs for 3 and 15 ohms speakers. The kit is complete in every detail. Chassis is fully punched. Easy to follow point-to-point wiring diagrams, are supplied. EXTRA HIGH SENSITIVITY, HIGHEST QUALITY for Or assembled ready for use 50/- extra. **9 Gns.** plus carr. 7/6.

**W.B. "STENTORIAN"** High fidelity P.M. Speaker. HF1012, 10 watts, 15 ohm (or 3 ohm) speech coil. Where a really good quality speaker at a low price is required we highly recommend this unit with an amazing performance. £3/13/6.

**MICROPHONES.** Crystal, hand or Desk type, good quality Aeos, 50/- Stand type with base and adjustable stand, £6/19/6. Both suitable for use with our amplifiers.

**PLESSEY 3-SPEED MIXER AUTOCHANGERS** with high impedance magnetic pick-up with duo point alloy stylus for long playing or standard records. (Will play 2,000 records before replacement stylus required.) Brand new, cartoned, guaranteed. Limited stocks at only 10 gns, plus 5/- carr.

**H.M.V. LONG PLAYING RECORD TURNTABLE COMPLETE WITH CRYSTAL PICK-UP (SAPHIRE STYLUS).** Speed 33 $\frac{1}{3}$  r.p.m. BRAND NEW, CARTONED. Only £3/19/6 (approx. half price). Carr. 5/-. (For 200-250 v. A.C. Mains).

## R.S.C. 4-5 WATT HIGH GAIN AMPLIFIER TYPE A5



A highly sensitive 4-valve quality amplifier for the home, small club, etc. Only 50 millivolts input is required for full output so that it is suitable for use with the latest high-fidelity pick-up heads, in addition to all other types of pick-ups and practically all mikes. Separate Bass and Treble controls are provided. These give full long playing record equalisation. Hum level is negligible being 71 D.B. down. 15 D.B. of negative feedback is used. H.T. of 300 v. 25 mA. and L.T. of 6.3 v. 1.5 a. is available for the supply of a Radio Feeder Unit, or Tape Deck pre-amplifier. For A.C. mains input of 200-230-250 v. 50 c/s. Chassis is not alive. Kit is complete in every detail and includes fully punched chassis (with baseplate), with green crackle finish, and point-to-point wiring diagrams and instructions. Exceptional value at only 24/15/-, or assembled ready for use 25/- extra, plus 3/6 carr.

## A PUSH PULL 3-4 WATT HIGH-GAIN AMPLIFIER FOR £2/19/6

For mains input 200-250 v. 50 c/s. Complete kit of parts including point-to-point wiring diagrams and instructions. Amplifier can be used with any type of feeder unit or pick up. This is not A.C./D.C. with "live" chassis but A.C. only with 400-0-400 v. Trans. Output is for 8-3 ohm speaker. (We can supply a very suitable 10in. unit by Roia at 27/9). The amplifier can be supplied ready for use for 25/- extra. Full descriptive leaflet, 6d.



**R.S.C. MASTER INTERCOMM. UNIT**, with provision for up to 4 "Listen-Talk Back Units" individually switched. A high gain amplifier enables speech and other sounds emanating from the rooms containing remote control units to be heard at the master control. The unit is in kit form and point-to-point wiring diagrams are supplied. A walnut veneered wood or Brown Bakelite cabinet is included. Mains input is 200-250 v. 50 c/s. H.T. line 300 v. CHASSIS IS NOT "ALIVE." Ideal for use as "Baby Alarm" Sound amplification 4 watts. Price only 25/19/6. "Listen-Talk Back Unit" in bakelite or walnut veneered cabinet can be supplied at 35/- each. Full descriptive leaflet 9d. The Master Unit can be supplied assembled and tested for 30/- extra.

## PERSONAL SET BATTERY SUPERSADER KIT.

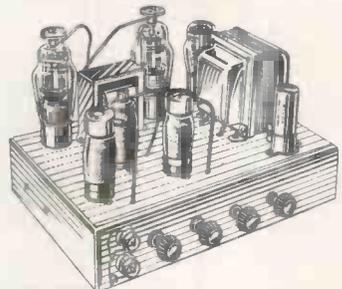
All parts for an "All Dry" Battery Eliminator. Complete with case. For 4 valve receivers requiring 90 v. 10 mA. and 1.4 v. 250 mA. Fully smoothed. Outputs from normal. 200-250 v. 50 c/s mains. Price with circuit, 35/6. Or ready for use, 42/6. Size of units 5 $\frac{1}{2}$ -4 $\frac{1}{2}$  in.

**BATTERY SET CONVERTER KIT.** All parts for converting any type of battery receiver to all mains. A.C. 200-250 v. 50 c/s. Kit will supply fully smoothed H.T. of 120 v. 90 v. or 60 v. at up to 40 mA., and fully smoothed L.T. of 2 v. at 0.4 a. to 1 a. Price complete with circuit and instructions only 48/9. Supplied ready for use for 8/8 extra.

**H.T. ELIMINATOR AND TRICKLE CHARGER KIT** with case, Mains input 200-250 v. Output 120 v. 40 mA. and 2 v. 1 a. Price with circuit, 29/6. Or in working order, 37/6.

## R.S.C. A3 10 WATT "PUSH PULL" HIGH FIDELITY AMPLIFIER.

With Self Contained Pre-amplifier and Tone Control.



This amplifier, whilst having sufficient output to fill a small hall, is the ideal amplifier for the quality enthusiast who knows that though the average listening level is less than one watt it is necessary, for the very highest quality, to have an output of at least ten times this figure in order to obtain completely distortionless reproduction of sudden loud sounds.

The layout of the components has been planned to give the very maximum of performance with the minimum of constructional effort. Large safety factors in every component, A.C. and H.T. fuses, punched chassis with baseplate, screened and plug valves, and with easy-to-follow point-to-point wiring diagrams. The only things necessary to build this superb instrument are a soldering iron, screw-driver and pliers, everything else is supplied down to the last nut and bolt.

Two independent inputs are provided with two associated independent volume controls so that programmes can be mixed together if desired, such as microphone announcements superimposed on a musical programme, or two independently controlled microphones, or even just gramophone/radio, fading over from one to the other. Variable base lift and cut with variable treble lift and cut tone controls are fitted, giving full long playing record equalisation for uncorrected pick-ups. They are also provided so that the user can alter the tonal values to suit his personal taste and surroundings. Because of the large negative feedback employed the output transformer can be so designed that it provides all the specified power even with large variations of loudspeaker impedance. Terminals are provided for 3 ohm and 15 ohm loudspeakers.

H.T. and L.T. available for the supply of a Radio Feeder Unit.

Six Negative Feedback Loops. Max. min input for full output 130 millivolts. Frequency response  $\pm 3$  DB 50-20,000 cycles. Negligible hum and distortion. For A.C. mains input 200/230/250 v. 50 c/s.

## COMPLETE Kit of Parts, £7/19/6 (carriage 5/-).

Supplied assembled and tested for 45/- extra.

H.P. TERMS AVAILABLE ON ASSEMBLED UNITS.

## FOUR STAGE RADIO FEEDER UNIT.

Design of a HIGH FIDELITY, L. and M. wave T.R.F. Unit with self-contained heater supply and through H.T. decoupling. Only 250-400 v. 15-20 mA. H.T. required from main amplifier. Three valves and Low Distortion Germanium Diode Detector. Flat topped response characteristic. Loaded H.F. coils. Two variable Mu controlled H.F. stages, 3 gang condenser tuning. Cathode follower output stage. Switch position for Gram. and Gram. input and output sockets. Performance comparable with the best in Feeder Units. For A.C. mains 200-230-250 v. operation. Size 11-6-7 $\frac{1}{2}$  in. Illustration, full set of easy-to-follow wiring diagrams and instructions and individually priced parts list 2/6. This unit can be built for only 23/15/-, including Dial and Drive Knobs and every item required.

# Radio Supply Co. (LEEDS) LTD.

32 THE CALLS. — LEEDS, 2.

Terms C.W.O. or C.O.D. No C.O.D. under £1. Postage 1/- extra under 10/-. 1/6 extra under £2, 1/11 extra under £3. Full Price List 6d. Trade List 5d. Open to Callers: 9 a.m. to 5-30 p.m. Saturdays until 1 p.m.

# CLYNE RADIO LTD.

## 18, TOTTENHAM COURT ROAD, LONDON, W.1

MUSEum 5929/0095.

All goods specially selected for quality and value. Prompt Service—Money-back guarantee—It will pay you to visit our new rebuilt shop premises. Situated 50 yds. only from Tottenham Court Road Tube! (Genuine).

**TAPE RECORDING EQUIPMENT.** We can offer a well constructed cabinet hand-somely finished in grey or brown rexine made specifically to take Truvox and Wearite Tape Decks. Measures 22in. x 14in. x 9in. deep. Completely portable, also has attractive speaker grille at one end, to take 8in. speaker. This cabinet is especially made to take in addition to the above decks, the very latest EL21C tape amplifier (Mk. V) £18/16/- Price of cabinet 7/6, plus P. & P.

**N.E.—**We can supply from stock the latest Truvox and Wearite Tape Decks at 22 guineas and 235 respectively. Reduction of 20/- on cabinet if purchased at the same time as either of these tape decks!

**N.B.—**We can also supply from stock. Overall length 4in. x 2in. x 2in. Just plug into your tape recorder or any suitable amplifier to receive direct reception from any two local stations, or to make recordings (in the case of tape recorder) of any of the latest programmes radiated by the selected stations. Price only 23/8/4 tax paid, or send stamp for illustrated leaflet.

We also have in stock Elpico new tape deck at £19/19/-. Truvox Tape Amplifier type "C" at £16/16/- especially for use with Truvox Deck. Truvox Telephone adaptor at £2/2/-; also Dictation Attachment at £4/4/-.

**SPECIAL PURCHASE.** We can offer strictly limited supply of "Limpet" telephone tape recorder attachments. Simply stick rubber suction pad to base of telephone and plug into input-jack on your tape recorder. This automatically records incoming telephone conversation. Our price absolutely complete with lead and jack plug. 17/8 only, post free!

Manufacturer's surplus high-quality crystal microphone for hand or stand use. A few only at 50/-, post free. We also have a limited number of Ronette Type 2A crystal microphone inserts at 23/6.

**ROTHERMEL DA1 Crystal Microphone Inserts.** Brand new, 7/6 each, plus 9d. P. & P.

**METER SPECIAL.** We have a limited quantity of aircraft electrical thermometers Brand new, by Weston. 2in. moving coil meter, flush with dial. These meters have a luminous scale graduated 40-140 degrees centigrade, but the full scale deflection is approximately 150 microamps! Price 12/6 each only, plus 1/- P. & P.

**VIBRATOR PACK.** Brand new, by Mallory. 12 volt input, 150 v. 40 mA. one transformer with synchronous vibrator 27/6.

**R1155A RECEIVERS** guaranteed serviceable in original packing cases. 27/19/6. Fully assembled Power Pack and output stage, to plug straight into R1155 for A.C. 200/250 volts at 79/6. We have a few brand new R1155A at £11/19/6, also in original packing cases—Deduct 10/- if purchasing either receiver together with power pack. Plus 10/- packing and carriage.

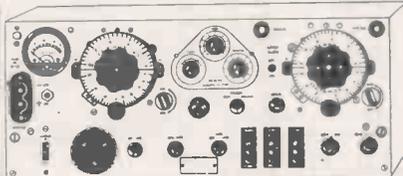
**R1124 RECEIVER UNIT.** Coverage 30-40 Mc/s. Including 6 valves—3 type 90Z, 1 each, 8D2, 15D2 and 4D1—Six valve-screening case, 24 ceramic trimmers, ceramic valve holders, resistors, condensers, I.F.T.'s coils, etc. In very good condition, a bargain at 16/6 each only, plus 3/6 packing and postage.

**RECEIVER TYPE 25/73.** (The receiver section of TR119). Supplied complete with full data for conversion to a very superhet receiver. Unit is complete with 6 valves 2-EP39, 2-EP36, FK32 and EBC33. Also standard I.F.T.'s 465 Kc/s. Price 27/6 plus 2/6 P. & P.

**TR1198 TRANSMITTER PORTION.** We can also supply the transmitter portion of the above receiver incorporating valves, EL22, EF50, CV501. Type 600 relay transformer, coils, switches, etc. Limited quantity at 12/6 only, plus 2/6 P. & P.

**24 VOLT ROTARY CONVERTER.** Input 24 v. D.C. Output 200/250 v. A.C. 100 watts. Complete in black steel box 19in. x 11in. x 8in. Weight approx. 30 lb. Completely smoothed, incorporates Sodium Lamp transformer. Brand new, 92/6.

### SPECIAL PURCHASE OF EX-NEW ZEALAND ARMY TRANSMITTER/RECEIVERS.



**TYPE ZC1 MK. II.—**Built into substantial steel cabinet mounted on easily removable resilient mountings. The instrument is fully tropicalised. Two wave-bands. 2-4 Mc/s (75-150 metres) 4-8 Mc/s. (67.5-175 metres) switching by means of band switches. Transmitter output up to 2 watts depending on type of aerial used, gives greater ranges may be obtained by the use of horizontal aerials. H.T. is supplied by a built-in vibrator pack, requiring 12 volt input. Valve line-up, 2-6V6GT, 7-8U7, 6K9 and 6Q7GT. 465 Kc/s. I.F.T.'s. Set weighs 58 lb. Measurements 22in. x 10in. x 10in. These units are brand new, and price is 26/19/6 only, plus 10/- packing and carriage. This price includes fully illustrated 68 page instruction booklet including full circuit diagrams, suggested aerials, fault-finding, etc. An unrepeatable bargain!

### REMOTE CONTROL UNITS

These units originally intended for use with the above transmitter/receiver, when inter-connected can be used as ordinary telephones or for practice Morse-working one-to-one. Complete in handsome steel case, can be operated by ordinary torch battery. Has built-in Morse key and buzzer unit. Price for each is 15/-. Suitable headphones can be supplied at 7/6 plus 5/- for carbon hand microphone. The whole plus 2/6 P. & P. Each unit includes full operating instructions—and is brand new.

N.B. Certain other spares are available and your specific enquiries will receive our very prompt attention.



F.S.D.	Size	Type	METERS Fitting	Price
50 microamp	D.C. 2in.	M.C.	R.P.	45/-
100 microamp	D.C. 2 1/2in.	M.C.	F.R.	50/-
500 microamp	D.C. 2in.	M.C.	R.P.	13/6
500 microamp	D.C. 2in.	M.C.	F.R.	18/6
1 mA.	D.C. 2in.	M.C.	F. Sq.	17/6
1 mA.	D.C. 2 1/2in.	M.C.	F. Sq. (scale calib. 1.5 kv.)	15/-
1 mA.	D.C. 2 1/2in.	M.C.	Desk Type	27/6
5 mA.	D.C. 2in.	M.C.	F. Sq.	7/6
10 mA.	D.C. 2 1/2in.	M.C.	R.P.	8/6
10 mA.	D.C. 2 1/2in.	M.C.	F.R.	10/6
15 mA.	D.C. 2in.	M.C.	F.R.	7/6
20 mA.	D.C. 2in.	M.C.	F.R.	8/6
50 mA.	D.C. 2in.	M.C.	F. Sq.	7/6
150 mA.	D.C. 2in.	M.C.	F. Sq.	7/6
1 amp.	R.F. 2 1/2in.	Thermo	R.P.	10/6
3 amp.	R.F. 2in.	Thermo	F. Sq.	6/6
6 amp.	R.F. 2 1/2in.	Thermo	F. Sq.	7/6
20 amp.	D.C. 2in.	M.I.	H.P. (with shunt)	10/6
25 amp.	D.C. 2 1/2in.	M.I.	F.R.	6/6
30 amp.	D.C. 2 1/2in.	M.I.	F.R.	12/6
15 volt.	A.C. 2 1/2in.	M.O.	F.R.	10/6
20 volt amp.	D.C. 2in.	M.C.	F. Sq.	7/6
15-15 volt.	D.C. 2 1/2in.	M.C.	F.R.	17/6
150 volt.	D.C. 2in.	M.C.	F.R.	15/-

R.F. = Round projection, M.C. = Moving Coil, Thermo = Thermo-couple, F. Sq. = Flush Square, F.R. = Flush Bound, M.I. = Moving Iron.

**METER RECTIFIERS.** 1 mA. by G.E.C., at 8/6, also 5 mA. by Westinghouse at 8/6.

**EX-W.D. CATHODE RAY TUBES.** Guaranteed full picture. VCR97 at 40/-. VCR517C at 35/-. Also VCR13A—ideal for oscilloscope 2 1/2in. screen at 35/-. We also have VCR97 with night cut-off, very suitable for oscilloscope, testing purposes, etc., at 15/- only. All these tubes are brand new, in original packing, and tested before despatch. Please add 2/6 packing and carriage for any of the above tubes.

**AMERICAN TRIPLET MULTI-RANGE TESTMETER.** Housed in strong wooden case with carrying handle. Case size 10in. x 8in. x 6in. deep. Meter 4in. rectangular type, with 50 microamp basic movement. Knife-edge needle. Incorporating the following ranges, 0-8000 volt D.C. 7 ranges, 20,000 ohms per volt, 0-8000 volt D.C. 7 ranges 1000 ohms per volt 0-8000 volts A.C. 7 ranges, 1000 ohms per volt, 0-12 amps D.C. 7 ranges, 0-80 megohm resistance, 3 ranges, -12 to +7 decibels, 7 ranges, 0-8000 v. output meter, 7 ranges, 1000 ohms per volt. Each instrument is in nearly new condition, has been thoroughly overhauled, and is supplied ready working, complete with battery and test prods. Price £11/19/6 plus 3/6 p. & p. H.P. Terms available.

**TRIPLET RECTANGULAR METER.** 4in. scale. Knife-edge needle. Basic movement 0-100 micro-amps. At present graduated for multi-range meter. Brand new in sealed cartons, 90/- plus 2/- p. & p.

### STOP PRESS !!

**2 1/2" ROUND FLUSH MOUNTING METER** by WESTON, blank scale ready for re-engraving, 50/6 micro-amps, brand new 27/6 only.

**HIRE PURCHASE**  
We are pleased to announce advantageous hire purchase facilities on all single items over £25. For details, mentioning what you are interested in.

**22 SET POWER UNIT No. 4MK1 ZA10478—** Complete with 4 metal rectifiers each 250 v., 60 A. 12 v. 4 pin Mallory Vibrators, transformers, condensers, resistors, signal 1 amp. indicator, etc., etc., in good condition. Complete in metal box size 10in. x 6in. x 8in. Weight 19lb. 27/6, plus 5/- P. & P.

**VALVES.** We have a very comprehensive stock of special purpose surplus valves at competitive prices. A stamp will bring Valve Price List.

**L.T. RECTIFIERS TYPE R.K.** A newly manufactured range guaranteed 12 months. 6 or 12 v. 1 a. F.W. bridge type .... 7/6  
6 or 12 v. 1.5 a. F.W. bridge type .... 9/6  
6 or 12 v. 2 a. F.W. bridge type .... 11/3  
6 or 12 v. 4 a. F.W. bridge type .... 15/-  
6 or 12 v. 8 a. F.W. bridge type .... 23/6  
**CHARGER TRANSFORMERS.** Input 230 v.  
6/12 v. 1 a. .... 9/9  
6/12 v. 2 a. .... 11/9  
6/12 v. 4 a. .... 17/6  
6/12 v. 6 a. .... 25/-

**STEEL INSTRUMENT BOXES !!!**  
Crackle finished in Brown or Black. Complete with chassis and insulated front panel. Measures 6 1/2in. x 7 1/2in. x 6 1/2in. at 7/6, plus 2/6 P. & P.

**BRAND NEW C.R. TUBES.—**By leading manufacturer, L4KF4A. Latest type 14in. rectangular 6.5 v. heater. 12-14 Kv. in original sealed cartons. Limited quantity only at £13/19/6. **SORRY!! PERSONAL CALLERS ONLY!!!**

**AMERICAN INDICATOR UNIT TYPE BC929A.** Brand new incorporating 3in. tube 6X4, with mu-metal shield, 2-68M7GT, 2-68EGT, 6X4, 2-62, 6G6G, 6 potential meters 24 v. aerial switch motor, transformer, and a host of small components. The whole unit which measures only 8 1/2in. x 8 1/2in. x 13 1/2in. is brand new, enclosed in black crackle box, and can be supplied at 65/- plus 5/- p. & p. New condition.

**6-VOLT VIBRATOR PACK.** Ex-W.D. 6-volt input, output 140 v. 30 mA. Fully smoothed and rectified, incorporating Wearite 6 volt 4 pin vibrator type N886. Unit size only 6 1/2in. x 5in. x 2 1/2in. Price 15/- plus 1/- P. & P. New condition.

**POWER PACK TYPE 301.** For 200/250 v. A.C. 50 cycle. Black case size 8 1/2in. x 6 1/2in. x 4 1/2in. Outputs 250 v. at 80 mA., 6.3 v. at 2.8 amps., 6.3 v. at .6 amp. (for 6X5), 31 v. at 3 amps. Could be adapted for R1155, etc. Price, complete, 27/6 only plus 2/6 P. & P. A bargain.

**R.F. UNITS.** All new condition and complete Case size 9 1/2in. x 5in.  
Type 24—20-30 Mc/s. 15/- Switched Tuning.  
Type 25—40-50 Mc/s. 19/6. Switched Tuning.  
Type 27—65-86 Mc/s. 45/- Variable Tuning.  
Type 28—50-65 Mc/s. Variable Tuning, 35/- We have a limited supply of R.F. units in new condition and complete, but tuning dial damaged. Price only 30/- each. ALL these units Post Free!

**TEST METER—EX ARMY.** Direct readings 15 v. and 3 v. D.C., 6 mA. and 60 mA. D.C. current, 500 ohms and 5,000 ohms resistance ranges. Complete in bakelite case with web carrying strap. 19/6 plus 1/6 P. & P.

**T1154 TRANSMITTER UNIT.** Medium/high-powered for C.W.-M.C.W. E.T 3 range. 10-5.5 Mc/s, 5-3.3 Mc/s, 500-200 Kc/s. Absolutely complete; 4 valves, 2 meters, hundreds of resistors, condensers, etc., in wooden transit case. Price 39/6, plus 7/6 carriage and packing.

**BATTERY CHARGER 6/12 v. 4 A.** Attractive grey and red metal case. Fused in and out. Full charge or half charge. Complete with heavy duty crocodile clips. **Not Ex-Govt.** Fully guaranteed. £4/19/6.

**HEADPHONES.** Brand new, ex-Govt., by S. G. Brown. Type CLR. Low resistance, 7/6 per pair. Type CHB high resistance, 12/6 per pair. We can also supply very special brand new American ex-Govt. lightweight high resistance phones by Trimm at 15/- per pair.

**CO-AXIAL CABLE.** Standard 80 ohms. brown, stranded conductor, 6d. per yard only! **Not Govt.** surplus. Min. 12 yds.  
\*\* VOLTAGE TESTER \*\* 9 volt 80 amp. ACCUMULATOR SURPLUS TYPE in a celluloid containers. Size 3in. x 3in. x 4 1/2in. high at 9/6 each plus 2/- P. & P. Or 3 for 25/6, post free.

**BRANDENBURG E.H.T. UNITS.** 6-9 kv., 6 gas, 13-16 kv., 9 gas.; 6-9 kv. coil, 39/-; 10-15 kv. coil, 55/- Wiring diagram supplied.

**No. 98 TRANSMITTER/RECEIVER.** WALKIE-TALKIE. Range approx. 5 miles. Coverage 7.4-9 mcs. The set only, complete with valves at 30/-, in very good condition.

Please add postage under £1. C.O.D. or Cash with order. C.O.D. charge extra—open 9 a.m.—6 p.m. Monday to Friday. Sorry but we close at 1.0 p.m. on Saturday.

**UNITELEX GENERAL PURPOSE AMPLIFIER MG4 AND MG4A.**

For Gramophone and Microphone.

Also very suitable for electric guitars and all types of electronic musical instruments. Maximum output 5 watts. Negative feedback employed, low signal-to-noise ratio. Matching to 3 or 15 ohm speakers. Separate treble and bass controls. Valve line-up EC83, EL84 and E-80. Overall dimensions: 1 1/2 in. x 4 1/2 in. x 5 1/2 in. high. Wgt.: 8lb. Chassis finish is a hard and durable polychromatic stove-enamel. For A.C. mains 200/250 v. Price £8/18/6. Type MG4A is the same Amplifier but with cover and plastic baseplate, at £9/19/6. Both plus 3/- p. & p. (Illustrated leaflet available. We have in stock the very latest "Elipico" Feeder Unit type RF720. Superhet for L., M., Short and Traver Bands. Very attractive illuminated black and gold dial for immediate use with any amplifier. 15 gns. tax paid.

**HIRE PURCHASE**

We are pleased to announce advantageous hire purchase facilities on any single item over £5. Ask for details, mentioning what you are interested in.

**LATEST 3-SPEED AUTO-CHANGER**, long arm model complete with C. and D. high fidelity heads. Limited quantity at £17/10/- plus 5/- P. & P. H.P. terms available.

**ANOTHER GRAM UNIT BARGAIN!** Collaro RC/531—8 record auto-changer for 78 r.p.m. Brand new complete with separate plug-in magnetic head. Our price £8/18/- only, plus 5/- p. & p. Collaro AC/514—Single record playing unit for 78 r.p.m. Brand new in sealed cartons, with separate plug-in magnetic head. Our price £4/12/6 plus 3/- p. & p.



**"CONTEMPORARY."** A well-made Cabinet in light wood, made especially to blend with this type of picture. The motor board is uncut, and will accommodate most Radio Chassis and Auto-change units. Size: 30in. x 15in. x 29in. high. Price £28/15/-, plus 10/- post and packing.

**DECCA LIGHTWEIGHT PICKUPS.** Complete with either standard or L.P. Crystal Cartridge inserts. Compl. with Rest and Tracking instructions, £2/8 plus 1/6 P. & P. Also their very latest type, as above, but with turn-over head £7/6 only! Plus 1/6 P. & P.



Carrying cases in black leatherette finish. An extremely well-made case with chrome locks and corner pieces for extra strength. This cabinet will house any 12in. Hi-Fi speaker, but can be put to a number of uses. Front panel and lid are removable, and the cabinet is packed in a strong cardboard container for carrying purposes. Size: 18in. x 10 1/2 in. x 10 1/2 in. high, 55/-, plus 5/- post and packing.

**F.M.!! (Frequency Modulation)**

We are pleased to announce our complete Kit for the "Decco" F.M. Feeder Unit. This unit provides an A.F. output suitable for feeding into the audio section of a standard broadcast receiver where triode/pentode output are available. Within an average of 30 miles from a V.H.F. transmitter one I.F. stage should be adequate, but our complete Kit supplied includes all components and valves for an extra I.F. stage if necessary, or if the unit is used at greater distances. Full Constructional details, theoretical circuit and point-to-point wiring diagram can be supplied for 1/6 post free, or the complete Kit right down to the last nut and bolt, at only £8/7/6, plus 2/6 packing and postage. This unit can be supplied if desired, ready assembled, aligned and tested, at £8/10/-, plus 2/6 packing and postage. If required we shall be pleased to align this unit for constructors not possessing the necessary equipment, for a charge of 7/6. N.B.—Valve line-up is 6AM6, 12AH5, 2-6BA6 and 6AL5. Chassis measures only 6 1/2 x 5 1/2 x 1 1/2. Demonstrations at 18, Tottenham Court Road !!



**THE "SUPERIOR" FOUR KIT.** Our new four-valve receiver. A.C. mains. 200/250 v. M. and Long Waves. As with our very successful "Economy Four" all required components are supplied. Valve line-up: 2-6XGT, 6XGGT and 6V6GT. Chassis rigidly drilled. Cabinet size, 10 1/2 in. x 10 1/2 in. wide. Maximum depth at base, 5 1/2 in., tapering to 3 1/2 in. at top. Sloping front. Very attractively finished in light walnut and peach. Each component brand new and tested prior to packing. Complete instruction booklet with practical and theoretical diagrams is provided. Booklet available at 1/6, post free. Our price for complete kit, £6/9/6 !!! Please add 2/6 packing and carriage. If preferred, we can supply Cabinet Assembly only, comprising Cabinet and bracket wavechange switch, dial, pointer, drum pulleys, drive spindle, drive spring and knobs, at 45/-, plus 2/6 packing and carriage. N.B.—Our Kits are even supplied with sufficient solder for the job.

**THE R.C. GRAM REPLACEMENT CHASSIS KIT**  
To meet the very great demand for this type of receiver, we have produced this unit. For Long, Medium, and Short Waves. Valve line-up: 6K8 Frequency changer, 6K7 I.F. Amplifier, 6G7 1st Audio, Detector and A.V.C., 6V6 Output, 6X5 Full-wave rectifier. For A.C. mains 200/250 volts, 4 watts output. Excellent quality. High sensitivity. Provision for gram. Attractive illuminated black, red, green and gold dial for horizontal tuning. Four controls are: Tuning, L/M/S/Gram. Vol./on/off, Tone (variable). Chassis size: 13 1/2 in. x 5 1/2 in. x 2 1/2 in. Dial size: 10in. x 4 1/2 in. Assembly is simplified by the use of a 3-waveband coil pack, and pre-aligned 465 Kc/s. I.F. transformers—high-grade drop-through half-shrouded Mains Transformer, with voltage adjuster panel. This chassis can easily be assembled in one evening. Illustrated pamphlet with full assembly instructions, practical and theoretical wiring diagrams and itemised price list, 1/6, post free. The main items for this receiver can be supplied separately, as under. Drilled chassis, complete with valve-holders, A/E panel, P/U panel, tuning condenser and ready-assembled dial and drive at 39/6. 3 waveband coil pack with gram position, 39/6, tax paid. Pair of 465 Kc/s. I.F. Transformers, 9/6 pair. Half shrouded drop through Mains Transformer, 22/6. The total cost of ALL items purchased separately is nearly £10, but we shall be pleased to supply all the required components right down to the last nut and bolt, at a special inclusive price of £8/8/-, plus 2/6 packing and postage. A set of four small brown and cream engraved knobs to suit is available at 1/2 each knob. This chassis is a professional job in every respect and can be seen and heard at our premises. This chassis can also be supplied, ready assembled, in very limited quantities at £9/19/6, plus 5/- carriage and packing.

**THE "ECONOMY FOUR" T.R.F. KIT**  
A three valve plus metal rectifier receiver. A.C. mains 200/250 v. Medium and Long waves. We can supply all required components right down to the last nut and bolt. Valve line-up, 6K7, 6J7, and 6V6. Chassis rigidly drilled—Cabinet size 12in. long by 6in. high by 5in. deep—Choice of Ivory or brown bakelite, or wooden, walnut finish cabinet. Complete instruction booklet with practical and theoretical diagram. Each component brand new and tested prior to packing. Our price £5/10/- complete—Remember this set is being demonstrated at our shop premises! We proudly claim that our fully illustrated instruction booklet is the most comprehensive available for this type of receiver—Booklet available at 1/6 post free. This is allowed if kit is purchased later—Please, 2/6 packing and carriage for complete kit.

**DULCI RADIO/RADIOGRAM CHASSIS**  
This very popular range of superior chassis can be supplied from stock. We will gladly demonstrate any to personal callers. All incorporate latest type valves 6BE6, 6BA6, etc. Flywheel tuning, negative feedback over entire audio section. Engraved knobs—high. All A.C. 100/110 and 200/250 v.—Dial size 8 1/2 in. x 4 1/2 in. for horizontal tuning. Attractive appearance.  
Model B.3. Long, Medium, Short Waves (5 valves). Cash Price £12/12/- . H.P. Terms, £3/4/- deposit, 12 months at 17/8.  
Model B.3 Plus Push Full Stage. (6 valves). Cash Price £15/15/- . H.P. Terms, £3/19/- deposit, 12 months at £12/2.  
Model B.3 Double Feature Push Full and R.F. Stage (7 valves). Cash Price £4/13/- deposit, 12 months at £18/9.  
Model B.6. (Medium, Long and Four Short Wavebands, bandspread.) Cash Price £15/15/- . H.P. Terms, £3/19/- deposit, 12 months at £12/2.  
Model B.6, plus Push Full Stage (6 valves). Cash Price £18/18/- . H.P. Terms £4/13/- deposit, 12 months at £18/9.  
Model B.6. Double Feature Push Pull Plus R.F. Stage (7 valves). Cash Price £22 gns. H.P. Terms £5/15/6 deposit, 12 months at £12/12/6.  
All chassis fully guaranteed 12 months. Please include 7/6 packing, carriage and insurance. Illustrated leaflet available. Suitable speakers available. Ask for speaker list.

**THE R.C. RAMBLER ALL-DRY PORTABLE KIT**

Full assembly details with practical and theoretical diagrams can be supplied at 1/6 post free. This is a truly professional 4-valve superhet—all dry—for medium and long waves. A cream plastic top panel, with dial engraved in red and green, adds to the very imposing appearance of this model which is housed in an attractive cream and grey leatherette covered attache-case type cabinet, measuring only 9in. x 7in. x 5 1/2 in. Weight (less batteries) 4 1/2 lb., with batteries 6 1/2 lb. This set really has everything! Built-in frame aerial, high quality, extremely sensitive, and very adequate volume from the 5in. speaker. Valve line-up: 3V4, 1R5, 185, 174. Also the required components, exactly as specified, including cabinet, can be supplied from stock at the special inclusive price of £7/7/- plus 2/6 P. & P. (less batteries). Uses Ever-Ready 90 v. H.T. type B126 at 9/3. Also L.T. 2.5 v. A.D.35 at 1/4.



**RAMBLER MAINS UNIT!**—At last we are able to offer our special mains unit kit for using our popular all-dry "Rambler" on A.C. Mains. Complete kit, which when assembled, fits snugly into battery compartment, can be supplied at £7/6, plus 1/6 packing and postage. Price includes all required components, and full assembly instructions.

**THE R.E.P. ONE-VALVE BATTERY RECEIVER KIT.** Simple one-valve all-dry battery receiver for headphones, easily built in one evening. All required components including headphones, can be supplied at inclusive cost of £2/- plus 2/- p. & p. Operated by Ever-Ready B114 type battery available at 7/6. Full assembly details available separately 9d. plus 3d. post.  
**THE NEW R.C. HIGH-FIDELITY AMPLIFIER.** P.P. 6V6 output. Freq. 25—18,000 cps.—60db at 6 1/2 watts.—Treble boost and cut—Bass boost—L.P. correction. Provision for Feeder Unit Max. UNDISTORTED OUTPUT 8 1/2 watts. Price 14 gns. plus 7/6. NOW AVAILABLE.—Kit of Parts, complete with fully illustrated instructions £11/19/6, plus 3/- carriage. Illustrated booklet available separately at 1/6. Attractive metal cover, now available, with built-in carrying handle 19/6.

**STUPENDOUS HALF-PRICE OFFER!!** DECCA SINGLE SPEED RECORD PLAYING DESKS 32A. Easily converted to either standard or L.P. Price with one crystal cartridge of either type, £4/19/6; or with both cartridges, £5/19/6. 5 1/2 P. & P. F.C.I. 10 WATT AMPLIFIERS. Measure 13in. x 6in. x 6in. Valve line-up—6AM6, 6AM6, 6SN7, E24, 6P6s Push Pull. Separate Bass and Treble controls, multi-ratio output transformer for 3 ohm or 15-ohm speakers. Fully guaranteed!! £10/15/- plus 5/- P. & P. We also have in stock—Connaisseur 3-speed motors, pick-ups. Pick-ups add heads by Garrard, Decca, Collaro, Acos, Chancery, etc., etc., at current prices.  
**AMPLIFIER BARGAIN. "THE EMPRESS"** Super quality push-pull 4 valve 4-watt amplifier ideal for record or radio tuner reproduction. Measures only 7 1/2 in. x 7 1/2 in. x 3 1/2 in. Valve line-up EL42, EL42, E241, EC83, for use with one or two 3-ohm speakers. Price £7/7/- plus 3/6 P. & P. PORTABLE CABINETS. Manufactured surplus. Well made brown resin covered. Will take any standard single player with bottom clearance of 3in. Total size closed 15in. x 13 1/2 in. x 5 1/2 in., fitted with snap catches and carrying handle, 22/6 only, plus 2/6 P. & P.

**CLYNE RADIO LTD.**  
18, Tottenham Court Road, London, W.1.

## The Walk-around Shop

all these fine offers are on display at:

**PROOPS BROS.** 52, TOTTENHAM  
LTD. COURT ROAD, W.1

### TEST SET 87 *Made by famous Instrument maker*

Available complete including:—  
**POWER PACK.** 200/250 v. 50 cycle Power Pack. Fully smoothed, 250 v. 50 mA., with 6.3 v. 4½ A., L.T.  
**R.F. OSCILLATOR.** RL18 oscillator 150-300 Mc/s.; easily altered to TV or FM Bands with the use of 4 inches of tinned copper wire.  
**MODULATOR AMPLIFIER.** Two-valve Modulator/Amplifier for RL18.  
**PULSE AMPLIFIER.** Six-valve Pulse Amplifier using VR65s.  
**TEST SET 87** can be easily altered to **TV PATTERN GENERATOR** or to **WIDE RANGE RC AUDIO OSCILLATOR** as fully described in M. G. Scroggie's articles in "Wireless World" issues dated August and September 1949.

Circuit diagrams available at 2/6 each.

TEST SET 87 is housed in a robust steel cabinet 23in. x 8½in. x 10in. high, copper plated and stove enamelled; fitted with chrome handles. An exceptionally fine bargain.

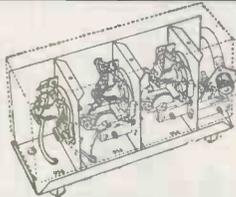
PRICE, Complete with £5:0:0  
10 valves (5Z4G, RL18 and 8 VR65s) Carriage 10/-.

**WIND FINDING ATTACHMENT** for Air Speed Indicator. Comprising two small counters. Two Desyn type follower motors. (Ideal for an antenna direction indicator. Size of motors 1½in. long, 1in. diam., 6-way terminal block. Toggle switch. Housed in metal outer case, fitted with plastic 360 degree dial. PRICE 8/6, Post paid.

**R.F. UNIT (Ex-BC800. 800.)** Can be converted for use on 2 metres or 70 cm. Contains (3) 956 valves, etc. Brand new in tropical packed cartons.

PRICE 17/6

Post Paid



**RECEIVER UNIT Ex-TR1143A.** Suitable for conversion to 2 metres and F.M. Wrotham. Circuit diagram free. Price, less valves, 9/-, post paid.

**TRANSMITTER UNIT Ex-TR1143A.** Suitable for conversion to 2 metres. Circuit diagram and coil conversion details supplied free. Price, less valves, 5/-, post paid.

**AMPLIFIER UNIT Ex-TR1143A.** A 3-stage transformer coupled amplifier. Push-pull VT52's output to modulate push-pull VT501's. Circuit diagram free, 4/6, post paid.

**INSPECTION LAMP.** 2 pole S.B.C. Holder with 6ft. spring loaded lead in case 3in. x 3in. x 4in. with on-off switch on front panel. Price 6/-, post paid.

**TOGGLE SWITCHES.** 5 amp. 1-way recessed panel type, 1/-, post paid.

**SLOW MOTION DRIVE.** Reduction 40-1. Excellent for S.W. operation, Price 3/6, post paid.

**INDICATORS.** Aircraft undercarriage type with 4 miniature E.S. holders in bakelite case. Price 1/6, post paid.

**CRYSTALS** by R.C.A. 100 kc/s. 3-pin mounting. Price 12/6, post paid.

**POINTER KNOBS.** 1in. radius, fitting ½in. spindle. Black bakelite; 3 for 2/6, post paid.

**BLOCK CONDENSERS.** 8 mfd. 600 v. W. tropical. 750 v. w., normal. Price 5/-, post 1/-.

**23-WAY SWITCH.** Make before break. Incorporating a single pole 3-way Yaxley type switch. Price 3/6, post paid.

**HEATER TRANSFORMERS.** 6.3 v., 1.5 A. output, 230 v. input. Price 7/-, post paid.

**TANNOY P.A. SPEAKERS.** 8 watt, 6in. diam. P.M. with re-entrant baffle mounted in wooden cabinet with line OP trans. Military surplus Cat. No. ZB11565. Price 20/-, post paid. Enquiries invited for quantities.

**HEADBAND TORCHES.** (Leave both hands free for awkward jobs). M.E.S. holder, bulb and reflector, headband with rubber pad, battery box with 4ft. cable; all wired ready for use. PRICE 4/-, post 1/-.

Needs 4½ v. battery Vidor VOO17 or similar standard battery.

**VALVES.** 6SN7gt 6/9. (Ex-new surplus units) 807 (American) 8/6. Disc-Sealed Triode (Lighthouse tube GL446A (19E4) Boxed, New, 25/-, All post paid.

**ALL RADIO MINDED AMATEURS** should send for full details of the "Medresco" Deaf-Aids which can be converted into many interesting devices including: 1. A Crystal Receiver incorporating a Germanium Diode. Circuit requires no alteration to present wiring. 2. An O-V-2 (detector with two stages of amplification) receiver. (Circuits for these two supplied free.) "Medresco" Units, all in perfect working order (checked by experts), complete with Crystal Microphone and incorporating three miniature valves, are a wonderful bargain at only 27/6 each. Postage 1/-, See our full-page advertisement in "Wireless World," January issue (Page 126).

We have a well organized Post Order Dept. giving prompt service. NOTE:—Orders and Enquiries to Dept. "W."

**PROOPS BROS. LTD.,** 52, Tottenham Court Road, W.1.

Shop hours: 9 a.m. to 6 p.m. Thursday: 9 a.m. to 1 p.m.

**OPEN ALL DAY SATURDAY.**

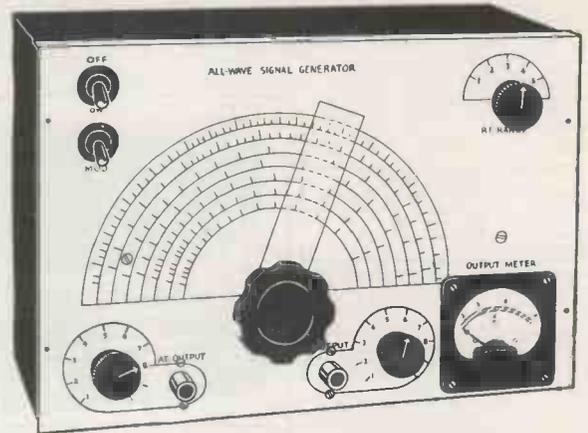
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## D. COHEN

RADIO AND TELEVISION COMPONENTS

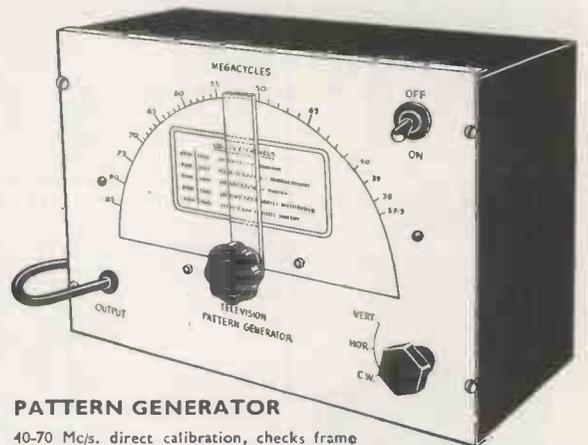
**23, HIGH STREET, ACTON, W.3**

(Opposite Granada Cinema)



### COMPLETELY BUILT SIGNAL GENERATOR

Coverage 120 Kc/s-320 Kc/s., 300 Kc/s-900 Kc/s., 900 Kc/s.-2.75 Mc/s., 2.75 Mc/s.-8.5 Mc/s., 8.5 Mc/s.-25 Mc/s., 17 Mc/s.-50 Mc/s., 25.5 Mc/s.-75 Mc/s. Metal case 10 x 6½ x 4½in. Size of scale 6½ x 3½in., 2 valves and rectifier. A.C. mains 230-250 v. Internal modulation of 400 c.p.s. to a depth of 30 per cent., modulated or unmodulated, R.F. output continuously variable 100 milli volts. C.W. and mod. switch, variable A.F. output and moving coil output meter. Black crackle finished case and white panel. Accuracy plus or minus 2%. £4/19/6, or 34/- deposit and 3 monthly payments 25/- P. & P. 4/- extra.



### PATTERN GENERATOR

40-70 Mc/s. direct calibration, checks frame and line time base, frequency and linearity, vision channel alignment, sound channel and sound rejection circuits and vision channel band width. Silver plated coils, black crackle finished case 10 x 6½ x 4½in. and white front panel. A.C. mains 200/250 volts. This instrument will align any T.V. receiver, accuracy plus or minus 1%. Cash price £3/19/6 or 29/- deposit and 3 monthly payments of £1. P. & P. 4/- extra.

### EXPORT & TRADE ENQUIRIES INVITED

(N.B. Post and packing charges stated apply to British Isles only.)

★ Both generators guaranteed for 12 months ★

**MAINS TRANSFORMER 3**  
Primary, 200-250 v. P. & P. 2/-.  
300-0-300, 100 mA., 6 v. 3 amp.,  
5 v. 2 amp., 22/6.

Drop thro' 350-0-350 v. 70 mA., 6 v.  
2.5 amp., 5 v. 2 amp., 14/6.

Drop thro' 250-0-250 v. 80 mA., 6 v.  
3 amp., 5 v. 2 amp., 14/6.

280-0-280, drop through, 80 mA.,  
6 v. 3 amp., 5 v. 2 amp., 14/6.

250-0-250 80 mA., 6 v. 4 amp., 14/-.

Drop thro' 270-0-270, 80 mA., 6 v.  
3 amp., 4 v. 1.5 amp., 13/6.

Drop thro' 270-0-270 60 mA., 6 v.  
3 amp., 11/6.

250 v. 350 mA., 6.3 v. 4 a., twice 2 v. 2 a.  
19/6.

Auto-trans. Output 200/250, H.T. 500 v.  
250 mA., 6 v. 4 a., twice 2 v. 2 a., 19/6.  
0.5-6.3 v. 1.5 a. / 10/6.

Auto Trans. Input 200/250. H.T.  
350 v. 350 mA. Separate L.T. 6.3 v.  
7 a., 6.3 v. 1 amp., 5 v. 3 amp., 25/-.  
P. & P. 3/-.

Heater Transformer. Pri. 230/250 v.  
6 v. 1 1/2 amp., 6/-; 2 v. 2 1/2 amp., 5/-.

Pri. 200/250. Secondary 9 v. 3.5 amp.,  
6.3 v. 3 amp., 12/6.

Pri 200 v. Sec. 500-0-500 and 500-0-500  
250 mA. both windings. 4 v. 3 amp.  
4 v. 3 amp., 39/6. P. & P. 5/-.

Mains Transformer, fully impregnated,  
Input 210, 220, 230 and 240. Sec.  
600-0-600, 275 mA., and 200 v. at  
30 mA., complete with separate heater  
transformer. Input 210, 220, 230, 240.  
Sec. 6.3 v. 2 amp. three times, 0, 4,  
6.3 v. at 3 amp. and 5 v. 3 amp., 45/-.  
P. & P. 5/-.

Mains Transformer, fully impregnated.  
Input 210, 220, 230, 240. Sec. 350-0-350  
100 mA., with separate heater trans-  
former. Pri. 210, 220, 230, 240. Sec.  
6.3 v. 2 amp., 6.3 v. 3 amp., 4 v. 6 amp.,  
and 5 v. 2 amp., 30/- P. & P. 5/-.

**MAINS TRANSFORMERS.** chassis  
mounting, feet and voltage panel.  
Primaries 200/250.

500-0-500 125 mA. 4 v. C.T. 4 a., 4 v.  
C.T. 4 a., 4 v. C.T. 2.5 a., 27/6.

500-0-500 250 mA. 4 v. C.T. 5 a. 4 v.  
C.T. 5 a. 4 v. C.T. 4 a., 39/6.

9in. T.V. Cabinet, front in contrasting  
walnut veneers, size 16 1/2 in. long, 11 1/2 in.  
high, by 12 1/2 in. wide. Complete with  
two pieces expanded aluminium in gold,  
12 x 9 in. and 5 in. speaker baffle and  
chassis, 20/-, post-paid.

6 1/2 in. M.E. Speaker, 1,000 ohm field,  
15/-.

R. & A. T.V. energised 6 1/2 in. speaker  
with O.P. trans., field coil 175 ohms  
9/6. P. & P. 2/6.

R. & A. 6 1/2 in. M.E. speaker with O.P.  
trans., field 440 ohms 10/6. P. & P. 2/6.

Volume Controls. Long spindle less  
switch, 50K, 600K, 1 meg., 2/6 each.  
P. & P. 3d. each.

Volume Controls. Long spindle and  
switch, 1/2, 1 and 2 meg., 4/- each:  
10K and 50K, 3/6 each. 1/2 and 1 meg.,  
long spindle double pole switch, mini-  
ature, 5/- P. & P. 3d. each.

Trimmers 5-40 pf., 5d. 10-110, 10-250,  
10-450 pf., 10d.

Twin-Gang, .0005 Tuning Condenser, 5/-.  
With trimmers, 7/6.

Twin Gang, .0005, with feet, size  
3 1/2 x 3 1/2 in., 6/6.

3-gang, .0005, with feet, size 4 1/2 x 3 1/2  
in., 7/6.

T.V. Coils, moulded former, iron-cored  
wound for re-winding purposes only.  
Ali-can 1 1/2 x 1 1/2 in., 1/- each, 2 iron-cored  
Ali-can 2 1/2 x 1 1/2 in., 1/6 each.

Used Metal Rectifier. 250 v. 150 mA.  
6/6.

Metal Rectifier. 230 v. 45 mA., 6/-.

Metal Rectifier. RM2, 125 v., 100 mA.  
3/6.

Mains Droppers. 0.3 amp., 460 ohms,  
tapped 280 and 410, 1/6; 0.2 amp.,  
717 ohms, tapped at 10 ohms vitreous,  
1/6; 0.3 amp., 350 ohms, tapped 700  
and 825, 2/8; 0.2 amp., 1,000 ohms  
vitreous, tapped, 2/6; vitreous, 0.3  
amp., 700 tapped 680, 640, 600, 3/6.  
P. & P. on each 3d.

T.V. Width Controls, 3/6.

**D. COHEN** RADIO AND TELEVISION COMPONENTS

*Terms of Business: Cash with order. Despatch of goods within 3 days from receipt of order. Where post and packing charge is not stated please add 1/6 up to 10/-, 2/- up to £1, and 2/6 up to £2. All enquiries, S.A.E., lists 5d. each.*

**SPECIAL NOTE: NO GOODS SENT WHERE CUSTOMS DECLARATION IS APPLICABLE**

**23 HIGH STREET (Uxbridge Road)**  
**ACTON, W.3. Telephone: ACOrn 5901.**

**HOURS OF BUSINESS:**  
Saturday 9—5 p.m. Wednesday 9—1 p.m. Other days 9—4.30 p.m.

**T.V. CONVERTER** for the new commercial stations complete with 2 valves. Frequency—can be set to any channel within the 186-196 Mc/s. band. I.F.—will work into any existing T.V. receiver designed to work between 42-68 Mc/s. Sensitivity—10 Mu/v with any normal T.V. set. Input—arranged for 300 ohm feeder. 80 ohm feeder can be used with slight reduction in R.F. gain. Circuit EF80 as local oscillator. ECC81 as R.F. amplifier and mixer. The gain of the first stage, grounded grid R.F. AMPLIFIER 10 db. Required power supply of 200 v. D.C. at 25 mA. 6.3 v. A.C. at 0.6 amp. Input filter ensuring complete freedom from unwanted signals. 2 simple adjustments only. £2/10/- P. & P. 2/6.

USED 12in. TUBE, aluminumized, heater cathode-short, 10KV max. 2 v. heater complete with line and E.H.T. transformer 9 KV with ferric core, line and width control, EY01 rec. winding frame O.P. scan coils and 12in. perspex escutcheon. £6/17/6. P. & P. 7/6.

As above but with 12in. non-aluminumized tube 8KV max. £5/17/6. P. & P. 7/6.

GENERAL PURPOSE 3-IN-1 MAINS TRANSFORMER. Input 200/250. Sec. 250 v. 350 mA., 6.3 v. 4 amp. twice, 2 v. 2 amp. 500 v., 350 mA., 6.3 v. 4 amp. twice, 2 v. 2 amp. Auto-trans. former, 110, 250 v., 250 watt, 19/6. P. & P. 3/6.

HIGH-IMPEDANCE PLASTIC RECORDING TAPE, by famous manufacturer. 600ft. on aluminium spool, 8/-, 1,200ft. on aluminium spool, 17/6, post paid.

PLASTIC CABINET, as illustrated, 11 1/2 x 6 1/2 x 5 1/2 in., in Walnut, Cream and Green, also in polished Walnut complete with T.R.F. chassis, 2 waveband scale, station names, new wave-band, back-plate, drum, pointer, spring, drive spindle, 3 knobs and back, 22/6. P. & P. 3/6.

AS ABOVE, with superhet chassis, 23/6. P. & P. 3/6.

Used metal rectifier, 230 v. 50 mA. 3/6, gang with trimmers, 6/6; M. & L. T.R.F. coils, 5/-; 3 obsolete ex-Govt. valves 3 v/h and circuit, 4/6; heater trans., 6/-; volume control with switch, 3/6; wave-change switch, 2/-; 32 x 32 mfd., 4/-; bias condenser, 1/-; resistor kit, 2/-; condenser kit, 4/-.

Cydon 5 channel T.V. Tuner, uses EF80 and 12AT7 less valves, 12/6, post paid.  
Radiogram Chassis, 5 valve A.C./D.C. 3 wave-band superhet 195-255 v., 19-49, 200-550 and 1,000-2,000 metres, I.F. 470 Kc. Size of chassis 13 1/2 x 8 1/2 x 2 1/2 in., size of scale 7 1/2 x 3 1/2 in. line-up 10C1, 10F9, 10L1D1, U404 and 10P14. Twin mains filter input, 2 dial lights and 8in. P.M., £8/17/6. P. & P. 5/-.

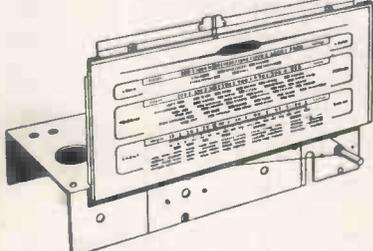
CR100 Coil packs in first-class condition less oscillator section, complete with 4-gang tuning condenser. 19/6. P. & P. 3/6.

CR100 465 Kc. I.F.s, types 3, 4 and 5 and F.B.O., new condition, 7/6 each. 465 Kc. Xtal for CR100, 12/6.

4-gang tuning condenser for CR100, 9/6.

CONSTRUCTOR'S PARCEL, medium and long wave A.C. mains 230/250 2-valve plus metal rectifier, comprising chassis 10 1/2 x 11 1/2 in., 2 wave-band scale, tuning condenser, wave-band switch, volume control, heater trans., metal rectifier, 2 valves and w/holders, smoothing and bias condensers, resistors and small condensers, and medium and long wave coil, litz wound, 22/6. P. & P. 2/6 extra. Circuit and point-to-point, 1/3.

CONSTRUCTOR'S PARCEL comprising chassis 12 1/2 x 8 x 2 1/2 in., cad. plated, 18 gauge, 7/8 in. I.F. and trans. cut-outs, back-plate, 2 supporting brackets, 3 wave-band scale, new wavelength station names, size of scale 1 1/2 x 4 1/2 in., drive sp., drum, 2 pulleys, pointer, 2 bulb holders, 5 pax. I.O. w/h., 4 knobs and pair of 465 I.F.s, twin gang, 16 x 16 mfd., 350 wkg., mains trans. 250-0-250 60 mA., 6.3 v., 2 amp., 5 v. 2 amp. and 6 1/2 in. M.E. speaker with O.P. trans. 39/6. P. & P. 3/6.



Battery charger, input 230/250 v. output 6 and 12 volt 1 amp. Black crackle finished case size 10 x 6 x 4 in. Incorporating metal rectifier, mains on-off switch, and output switch. 21/- P. & P. 3/-.

OUTPUT TRANSFORMERS. Standard type 5,000 ohms imp., 4/9; 42-1 with extra feed-back windings, 4/3. Miniature 42-1. 3/3. Multi-ratio 3,500, 7,000 and 14,000. 5/6. 10-watt push-pull, 6V6 matching, 7/- 90-1 3 ohm speech coil, 6/6.

PUSH-BACK CONNECTING WIRE. Doz. yds., 1/6. Post paid.  
STANDARD WAVE-CHANGE SWITCHES 4-pole 3-way, 1/9; 5-pole 3-way, 1/9; 3-pole 3-way 1/9; 9-pole 3-way, 3/6; Miniature type, long spindle 3-pole 4-way, 4-pole 3-way and 4-pole 2-way, 2/6 each. 2-pole 11-way twin water 5/-; 1-pole 12-way single water 5/- P. & P. 3d.

**POTATO AND VEGETABLE PEELER**

By famous manufacturer. To suit models A200 and A700, Capacity 4 1/2 lb., complete with water pump. All aluminium construction, white stove-enamelled finish. Originally intended for adaption on an electric food-mixer, can be easily converted for hand operation. 39/6. P. & P. 3/-.

PERSONAL SHOPPERS ONLY. 8in Enlarger, 17/6; 12in., 27/6.

Germanium Crystal Diode, 1/6. post paid.

Used 9in. Tube, with ion burn, 17/6. post paid.

Line O.P. Transformer in aluminium can mounted in rubber, 12/6.

Crystal Set, medium and long wave, in plastic cabinet, 16/-.

Headphones, per pair 8/-.

Speaker Matching Unit on aluminium chassis, 3-15 ohms reversible, 12/6.

Line and E.H.T. Transformer, 14 Kv., using ferrocart core, complete with line and width control, and corona shields U37 rectifier winding, 35/-.

Line and E.H.T. Transformer, 9 Kv., using ferrocart core, complete with built-in line and width control. Mounted on small 4 1/2-chassis. Overall size 4 1/2 x 1 1/2 in. EY01 rec. winding, 27/6.

Scan Coils, low line low impedance frame, complete with frame transformer, to match above, 27/6. P. & P. 2/-.

Line and E.H.T. Transformer, 9 Kv., ferrocart core, EY01 heater winding, complete with scan coils and frame output transformer, and line and width control, £2/5/- P. & P. 3/-.

As above, but complete with line and frame blocking transformers, 5 Henry 250 mA. choke, 100 mfd. and 160 mfd. 350 wkg. 380 mA. A.C. ripple. £2/19/6 P. & P. 5/-.

Valve Holders, moulded cast Mazda and local, 7d. each. Faxola, octal Mazda and local, 4d. each. Moulded BTG, B8A and B9A, 7d. each. BTG moulded and B9A with screening can 1/6 each.

32 mfd., 350 wkg. .... 2/-  
16 x 24, 350 wkg. .... 4/-  
4 mfd., 200 wkg. .... 1/3  
40 mfd., 400 wkg. .... 3/6  
16 x 8 mfd., 500 wkg. .... 4/6  
16 x 16 mfd., 500 wkg. .... 5/9  
16 x 16 mfd., 450 wkg. .... 3/9  
32 x 32 mfd., 350 wkg. .... 4/6  
25 mfd., 25 wkg. .... 6/8  
25 mfd., 12 v. wkg. .... 11d.  
16 mfd., 500 wkg., wire ends. .... 3/3  
8 mfd., 500 v. wkg., wire ends. .... 2/6  
8 mfd., 350 v. wkg., tag ends. .... 1/6  
80 mfd., 25 v. wkg., wire ends. .... 1/9  
100 mfd., 350 wkg. .... 4/-  
100 mfd., 450 v. wkg., 280 mA., A.C. ripple. .... 3/11  
150 mfd., 350 v. wkg., 280 mA. A.C. ripple. .... 4/6  
100 x 200 mfd., 300 wkg. .... 9/6  
16 x 16 mfd., 350 wkg. .... 3/3  
50 mfd., 180 wkg. .... 1/8  
85 mfd., 220 wkg. .... 1/6  
8 mfd., 150 wkg. .... 1/6  
60 x 100 mfd., 280 wkg. .... 7/6  
50 mfd., 12 wkg. .... 11d.  
32 x 32 mfd. min. 275 wkg. .... 4/-  
50 mfd., 50 wkg. .... 1/8

Miniature wire ends moulded, 100 pf., 500 pf., and .001, ea. .... 7d.

T.V. Filter in lightly tinted Perspex size 1 1/2 x 1 1/2 x 3/16 in. 4/6.

Combined 12in. mask and escutcheon in lightly tinted Perspex. New aspect, edged in brown. Fits on front of cabinet, 12/6. As above for 15in. tube, 17/6.

Frame Oscillator Blocking Trans., 4/6.

Line Osc. Blocking Trans. 4/6.

Tube Mounting Bracket, size 9 1/2 x 4 1/2 in. 12in. tube clamps, 2/-.

CHOKES:  
2-20 Hen. 150 mA. 15/- P. & P. 3/-  
6 Hen. 275 mA. 15/- P. & P. 7/-  
100 Hen., 40 mA. 15/- P. & P. 3/-  
2 Henry 150 mA., 3/6; 250 mA. 10 Henry 10/6; 5 Henry 250 mA. 60 ohms., 8/6.

P.M. Focus Unit for any 9 or 12in. tube except Mazda 12in., with Vernier adjustment, 15/-.

P.M. Focus Unit for Mazda, 12in., with Vernier adjustment, 17/6.

Wide Angle P.M. Focus Units, Vernier adj. state tube, 25/-.

Energized Focus Coil, low resistance mounting bracket, 17/6.

Ion Traps for Mullard or English Electric tubes, 5/-, post paid.

Standard 465 Kc. Iron-cored I.F.s. 4 x 1 1/2 x 1 1/2 in., per pr. 7/6. Weirite standard, iron-cored, 405 Kc. I.F.s 3 1/2 x 1 1/2 in., per pr. 9/6.

Iron-Cored 465 Kc. Whistle Filter, 2/6.

465 Kc. MIDGE I.F. Q.130 size 1 1/2 in. long, 1 1/2 in. wide, 1 in. deep by very famous manufacturer. Pre-aligned adjustable iron-dust cores, per pair 12/6.

# GEE RADIO

**SELENIUM METAL RECTIFIERS (S.T.C. TYPE).** Built to specification from milliamps to amps, H/V., F/B., or three-phase. All-work fully guaranteed. Very good delivery. Your enquiries invited for large or small quantities.

**RECTIFIERS, PENCIL TYPES, S.T.C. K/3 SERIES.** 1 milliamp for H.T. and E.H.T. APPLICATION, EX-STOCK.

Volts	Type	Price	Volts	Type	Price	Volts	Type	Price
248	K3/10	3/10	1000	K3/40	7/6	2550	K3/100	14/8
375	K3/15	4/5	1140.	K3/45	8/2	3080	K3/120	16/8
500	K3/20	5/1	1260	K3/50	8/8	3600	K3/140	19/3
655.	K3/25	5/8	1500	K3/60	9/8	4100	K3/160	21/6
755.	K3/30	6/-	1780	K3/70	11/-	4660	K3/180	24/3
885	K3/35	6/10	2030	K3/80	12/4	5150	K3/200	26/-

**RECTIFIERS FOR L.T. APPLICATION—F/B. S.T.C. TYPE:** 12 v. D.C. at 1 amp., 6/6; 12 v. D.C. at 2 amp., 10/6, p.p. 9d. 12 v. D.C. at 3 amp., 15/-, p.p. 1/-; 21 v. D.C. at 4 amp., 17/6, p.p. 1/3; 12v. D.C. at 6 amp., 25/-, p.p. 2/-; 12 v. D.C. at 10 amp., 40/-, p.p. 2/6; 24 v. D.C. at 1 amp., 12/6; 24 v. D.C. at 2 amp., 21/-, p.p. 1/-; 24 v. D.C. at 4 amp., 30/-, p.p. 2/-; 24 v. D.C. at 6 amp., 35/-, p.p. 2/6.

**VALVE TESTER, TYPE 4.** 200/230 v. A.C. input. Ex-Govt., in good condition, with descriptive book containing circuit diagram of instrument and how to test valves from 1.4 v. to 40 v. With valve-holders for Brit., 4, 5, 7 pin and Octal, U.S., 5 and 7 pin, I/Octal, side contact, large Brit., 4 and 9 pin. Acorn and diode. Housed in substantial wooden case. Price £7/19/6, carriage 10/- extra.

**WESTON ALL-PURPOSE A.C./D.C. TEST METER, MODEL E.665.** 1,000 ohms per volt. New and unused, complete with leads and batteries. £8 each only, p.p. 3/6.

**WESTON BATTERY OSCILLATOR, MODEL E.692. TYPE 2.** Also new and unused. Coverage 100 kc/s-26 Mc/s. Audio output approx., 400 c/s. Available at the ridiculously low price of only £5/19/6, p.p. 4/6. (Oscillator complete with instruction booklet.)

**TELEPHONE L/SPEAKER No. 2 (By Vitavox).** This is H/Duty 6in. P.M. 15 ohm S/C. with 600 ohm built-in Link Transformer, housed in strong wooden case. £11/8/-, carriage 5/-.

**VITAVOX PRESSURE UNITS.** Heavy duty, P.M. 20 watts. Brand new. £4/9/6, carriage 5/-.

**TRUVOX 12in. 3 OHMS P.M. SPEAKERS.** Brand new and boxed, 39/6, post paid.

**ROTARY CONVERTERS.** 12 v. D.C. input 230 v. A.C. output, at 100 watts. Brand new. £4/17/6. Ditto, 24 v., same price, carriage 7/6.

**AN/APA-1 CATHODE RAY INDICATOR AMPLIFIER UNIT.** Complete, comprising OF. 3BP1 C.R.T., 7-6SN7GT, 1-6H6, 1-6G6, 1-2X2, 1-6X5, valves. Bargain value, £4/19/6, plus 10/- carriage.

**TUNING UNITS (EX-U.S.A.).** Types available, T.U.6B., T.U.9B. T.U.26B. Good condition, soiled cases, 19/6 each, p.p. 3/-.

**AC/DC SUPPLY UNIT. (S.T.C. SELENIUM RECTIFIER).** Complete with Mains Isolation transformer, fixed and housed in strong metal cabinet. 250 v. A.C. to 200-220 v. D.C. @ 3-4 amps. Ready to use for £6/10/- only, carriage 10/-.

**CAR RADIO TRANSFORMERS.** 12 v. ex-Philco, 300 v. H.T. at 90 mA. Brand new and unused. Only 12/6, p.p. 2/-, 12 v. Oak Vibrators, 4-pin U.X. base, new and unused, 7/6 each, p.p. 9d.

**TRANSFORMERS PUSH-PULL OUTPUT (BY PARMEKO)** 25 watts for 6L6 valves. To match, 3, 8 and 15 ohms. New and unused, 29/6, p.p. 2/6.

**R.1155 COMMUNICATION RECEIVERS.** Individually tested and despatched in good working order. Cases slightly soiled. £8/19/6, carriage 10/-.

**RECEIVER TYPE 109** in good condition. Freq. range 15-68 metres continuous, designed to operate on 6 v. battery. Limited quantity only £4/7/6, plus 10/- carriage.

**NO. 38 WALKIE-TALKIE TRANS-RECEIVER,** in good condition (less external accessories), 35/-, p.p. 2/6.

**HALF MILE OF TWIN DON "8" TELEPHONE WIRE.** Brand-new, on wooden drums, £2/12/6 per drum, carriage 10/-, England only.

**HIGH-VOLTAGE TRANSMITTING CONDENSERS.** Hank Pot Type (25 pf. 8 kV.) (40 pf. 9.6 kV.) (500 pf. 15 kV.) (600 pf. 9.6 kV.) (750 pf. 15 kV.). Any type, 3/6 each, p.p. 1/-.

**TELESCOPIC AERIALS.** Min. length 12in. Max. length 48in. Suitable for car radio aerials. 8/6 each, p.p. 9d.

**CATHODE RAY TUBES.** Type 3BP1, 3in., new and unused, with base and screen, 42/6, p.p. 2/-; Type VCR 138 (ECR35), 3 1/2in. With screen and base, in new and unused condition, 42/6, p.p. 2/-.

Type VCR97, 6in., ex-equip., in good order, 20/-, p.p. 3/6. VCRX131, 1in. C.R.T., new and in perfect condition. Miniscope replacement tube, etc., 35/-, p.p. 1/-.

Type CV 1526, 2 1/2in., 4 v. filament, 3,000 v. anode, complete with base and mu-metal screen, 20/-, p.p. 2/6.

**PHOTO-ELECTRIC MULTIPLIER CELLS. TYPE 931A.** £2/10/-, p.p. 1/- Also 931A complete on chassis with multiplier network and two 832 valve-holders, etc., £3/10/-, p.p. 2/-.

**4 CORE 3/036 "METAFLEX."** V.I.R. in flexible tubing, 1 1/2 dia. overall, 2/6 per yard., p.p. 2/6.

**SIEMENS HIGH SPEED RELAYS.** Twin 1,000 ohm coils, perfect condition, 15/-, p.p. 6d.

**2,000 OHMS H/R. EAR PIECES,** 3/6 each, p.p. 9d.

**BATTERIES H.T./L.T.** Heavy duty layer type. 150 v. tapped at 87 v. H.T. L.T. 4 1/2 v. Perfect condition. Size 9 1/2in. x 4 1/2in. x 4 1/2in. p.p. 2/6.

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## G2AK This Month's Bargains G2AK

**T.V. POWER TRANS.** By Parmeko. Pri. 200/250 v. EHT 6 kV. (RMS) 350/350 v. 250 mA., 6.3 v. 6 a., 4 v. 3 a., 4 v. for EHT Rec. Wired to Holder. Beautiful job. £4/10/-, carr. paid. FEW ONLY.

**METERS.** 2 1/2in. Flush mounting M.C. 100 mA., 0-10 mA., 0-30 mA., 12/6 ea.; 0-15 A., proj. thermo. 2 1/2in., 7/6; 0-9 A. hot-wire, 5/-.

**TEST METER.** 7 ranges as follows: 1.5 v., 3 v., 150 v. 6 mA., 60 mA., 5,000 ohms, 25,000 ohms 2 1/2in. dia. scale M.C. meter. Rotary selector switch. Black bakelite case, 6 x 4 1/2 x 4 1/2 fitted with removable lid, also provision for internal batts., ranges can be easily extended. Bargain price 30/-, plus 1/6 post.

**SPECIAL OFFER, AR88 SPARES.** Cabinets, complete with base, feet and side strips, £4/15/- each. Pkg. and Carr. 5/- Set of 14 valves for "D" or "LF" model receivers, £5/10/- Panel escutcheons, 22/6 each. "D" type I.F.S., 12/6 each. Good selection of Spare Coils available for "D" Model, 7/6 each. Output Transformers for "D" or "LF," 37/6 each.

**CRYSTAL HAND MICROPHONES.** Complete with lead and plug. High quality, very sensitive, chrome finish. List price 2 gns. Our price 24/- Few only.

**COPPER WIRE. 14G H.D. 140ft. 15/-, 70ft. 7/6,** postage and packing, 2/- Other lengths pr. rata.

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**STREAMLINED BUG KEYS.** By famous manufacturer. Lined over £4. Our price 45/- **AIR SPACED COAXIAL CABLE,** 150 ohm (normal price 3/11 per ft.), 20 yd. coils only. £1 per coil, post free.

**NEW MULLARD QUALITY AMPLIFIER chassis,** and all specified parts available from stock.

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## SAMSON'S SURPLUS STORES

**SPECIAL OFFER A.M. H.T. TRANSFORMERS.** Pri. 200-240 v. Sec. 525-0-525 v. 150 mA. 5 v. 3 a., 6.3 v. 1.5 a., 55 v. 50 mA., 32/6, P.P. 2/6.

**BRAND NEW METERS BY FAMOUS MAKERS.** 4in. Round flush M1 Ammeters, 0-40 amps. 500 c/s., 37/6, P.P. 2/-, 3 1/2in. round flush MC 0-400 mA., 30/-, P.P. 2/-, 2 1/2in. round flush MC 0-500 mA., 15/-, P.P. 1/6.

**LIGHTWEIGHT UNSPILLABLE P. & G. 2-VOLT 7 AH. AT 10 HR. RATE ACCUMULATORS.** Size 4 1/2in. x 3 1/2in. x 1 1/2in., 15/-, P.P. 1/-.

**EXIDE 10 volt 5 Ah. Glass vacuumistors,** size 7 1/2in. x 2 1/2in. x 5 1/2in. suitable for H.T. unit construction and models, etc., 7/6, P.P. 1/6. **MINIATURE ACCUMULATORS** made by Willard Co. 35 volt 0.2 Ah. Note size and weight. 3 1/2in. x 1 1/2in. x 1 1/2in. weight 5 1/2 oz., 5/-, P.P. 6d., or set of three 36 v. and one 6 v. same size but weight 4 1/2 oz. in sealed metal container, £1, P.P. 1/3. Easily filled with hypodermic syringe.

**EX-ARMY MEDICAL HYPODERMIC SYRINGES.** Brand new. 1 e.c. with needle, 4/6, P.P. 6d. 10 e.c., with needle, 7/6, P.P. 6d. Extra needles, tin of 5, 2/-, P.P. 6d.

**AMERICAN 6 VOLT 90 AH. 15 PLATE CAR BATTERIES.** Size 9in. x 9in. x 7in. Brand new in maker's cases, £2/19/6, carr. 7/6.

**PRICHTETT AND GOLD STORAGE BATTERIES.** 12 volt 75 Ah. Built in teak cases. Brand new, £4/15/-, carr. 7/6.

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**AMERICAN C.R. TUBES.** 5 CP1. Brand new, 29/6, carr. 2/6. CRT Type NC13 7 1/2in. dia. in order, 35/-, carr. 4/- R.F. UNITS, Type 24, 20-30 Mc/s., complete with valves, brand new, 15/-, P.P. 2/-.

**INSTRUMENTS, ADMIRALTY INTEGRATORS, TYPE A 891.** Incorporating very fine Galvo movement, coil 40 ohms. Centre zero to P.S.D. 1 microamp. Small mirror one metre radius. A very useful laboratory instrument, 65/-, carr. 2/6.

**METRO-VICKERS MASTER VOLTMETERS,** 0-20 volts A.C. 50 c/s. M.1 6in. mirrored scale, 25/-, P.P. 1/6. A.M. 2 1/2in. panel mounting 500-0-500 microammeters, blank scale, brand new, 25/-, P.P. 1/-.

Howard Butler 0-150 volts D.C. MC. Built in 6in. square Bakelite case, 29/6, P.P. 1/6.

**HEAVY DUTY A.M. LT. TRANSFORMERS.** Pri. 440 v. Sec. 220 v., in steps of 25 v. conservatively rated at 2.2 kW., weight approx. 50 lb. Half the above secondary can be obtained from 220 v. input, £9/10/-, plus carr. Pri. 230 v. Sec. 50 v., 20 amps., completely enclosed, £6/10/-, plus carr. Pri. 230 v. Sec. 13, 13.5, 14, 15 v., very conservatively rated at 60 amps., £8/5/-, plus carr. Pri. 115 v. Sec. 17 v. 15 amps. and 2.2 v. 18 amps., 35/-, carr. 4/- Pri. 230 v. Sec. 8.2 C.T., very conservatively rated at 10 amps., 25/-, carr. 2/6. Pri. 200-250 v. Sec. 115 v. 8.7 amps., £5/15/-, carr. 5/-.

**A.M. H.T. TRANSFORMERS.** Pri. 230 v. Sec. 1,500 v. 1.6 kVA. 65/-, carr. 7/6. 1154 T.H.T. TRANSFORMERS. Pri. 200-230 v. Sec. 1250-1300 v. 350 mA., 35/-, carr. 4/-.

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**AMERICAN "WESTON" OSCILLATOR TYPE 776.** 50 Kc/s-30 Mc/s. Modulated or unmodulated R.F. output. 400 cycle audio output. Max. output voltage 100 m/volts. 110 volt A.C. operation, £12/10/- each.

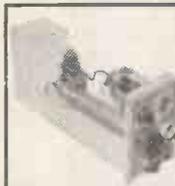
**METERS.** All brand new and boxed, 0-1 m/a., desk type, fitted with 2 1/2 in. scale. Res. 100 ohms, 25/-; 0-1 m/a., 2 1/2 in. round, F/M., M/coil, 7/6; 0-5 m/a., 2 in. square, F/M., M/coil, 7/6; 0-10 m/a., 2 1/2 in. round, F/M., M/coil, 10/-; 0-100 m/a., 2 1/2 in. round F/M., M/coil, 9/6; 0-150 m/a., 2 in. square, F/M., M/coil, 7/6; 0-200 m/a., 2 in. square, F/M., M/coil, 7/6; 0-200 m/a., 2 1/2 in. round, F/M., M/coil, 10/-; 0-20 volts, 2 in. square, F/M., M/coil, 7/6.

**AMMETERS.** 0-1 amp., 2 1/2 in., projecting, R.F., 7/6 each; 0-5 amp., 2 1/2 in. round F/M., R.F., 7/6; 20/20 amp., 2 in. round F/M., 6/6; 0-30 amp., 2 in. square, F/M., M/coil, 7/6.

**A.C. VOLTMETERS 50 CYCLE.** 0-15 volts, 2 1/2 in. round, F/M., M/I., 8/6; 0-20 volts, 2 1/2 in. round F/M., M/I., 10/-; 0-300 volts, 2 in. round, F/M., M/I., 25/-; 0-300 volts, 5 in. projection, M/I., 50/-; 0-300 volts, 3 1/2 in. M/I., housed in wooden case complete with two test leads, 39/6 each.

**MICROAMP METERS.** 0/100 2 1/2 in. flush panel mounting, scaled 0-1,500 yards. First-grade instruments, brand new and boxed, 42/6; ditto, scaled 0/50 microamp., 62/6.

**CERAMIC TRANSMITTER SWITCHES.** Extra heavy-duty silver contacts, 3 in. dia., 1 pole, 6 way, 3 bank, 9/6 each; 1 pole, 6 way, 2 bank, 6/6 each; 1 pole, 4 way, 1 bank, 5/6 each.



**TYPE 4 WAVE METERS.** Cavitated absorption wavemeter covering 200-220 megacycles, brand new and boxed, supplied with VU39, SP61, EA50 and CV51 magic eye tuner, 29/6 each.

**MAINS TRANSFORMERS.** All 230 volt 50 cycle input. 250 x 250 volt 150 m/a., 4 volt 3 amp., 9/6 each; 500 x 500 170 m/a., 4 volt C.T. 4 amp., 3,000 volt insulation, 22/6 each; 670 x 670 volt 200 m/a., 6.3 volts 4 amp., 5 volts 3 amp., 49/6 each; 1,500 volts 330 m/a., 52/6 each; 2,000 volt 5 m/a., 15/6 each; 4 volt 14 amp., 6.3 volt 1 1/2 amp., 10/6 each.

**METER RECTIFIERS.** Full bridge 2 m/a., S.T.C., brand new, 5/6 each.

**UNISELECTOR SWITCHES.** 4 bank double wiper, 25 position, 32/6. Ditto 8 bank, 45/-.

**METER SWITCHES.** Standard Yaxley type, 8 bank, single pole, 9, 11 or 12 way, 7/6 each.

**H.R.O. 6 VOLT VIBRATOR POWER SUPPLY UNITS.** Output 165 volt 80 m/a., 6.3 volts 3 amp. 6 x 5 rectifier, choke and condenser smoothed, cabinet size 7 in. x 7 in. x 6 in. Supplied with clips and leads, brand new, 29/6 each.

**P.40 POWER PACKS.** Input 200/250 volts A.C. Output 175 volts 60 m/a., 12 volts 2.5 amp. Fully smoothed, 5Z4 rectifier, 32/6 each.

**BATTERY CHARGERS.** 200/250 volts A.C. input, 24 volts 10 amps. output, perfect working condition, £12/10/- each.

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**AMERICAN POWER RHEOSTATS.** 8 ohm, 3.3 amp., 8/6 each; 8 ohm, 2.5 amp., 7/6 each; 60 ohm, 1.3 amp., 7/6 each; 90 ohm, 0.74 amp., 7/6 each; 200 ohm, 0.3 amp., 5/6 each. Ideal for train, model or charging control.

**R.1155 COMMUNICATION RECEIVERS**  
Individually aerial tested



**BRAND NEW** in original transit case £11/19/6 each  
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**USED MODELS** but in perfect working order £7/19/6 each  
A combined power pack and audio output stage for A.C. mains, can be supplied with a receiver for an extra cost of 79/6 each.

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**SOUND POWERED MICROPHONES AND RECEIVERS.** No batteries required. Just connect wires to speak or listen, 3/6 each.

**HEADPHONES.** Brand new, Canadian "Northern Electric," finest ever produced, 50 ohm coils, complete with P.I. Jack Plug, 10/6 pair.

**RELAYS.** Polarised, twin 600 ohm coils, 8/6 each. We stock all types of relays, 600 and 3,000 types, heavy and light contacts including platinum. Send us your enquiries, we are the cheapest in the trade.

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**PYE 45 MEG I.F. STRIPS.** Complete television I.F. strip with 6 EF50 valves and 1 EA50 valve. Size 1 1/4 in. x 3 1/2 in. x 3 1/2 in. Finest strip ever produced, 69/6 each. Brand new.

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**TEST SETS TYPE 109.** Brand new and boxed, fitted with 2 in. 0-5 m/a., M/C., meter, also 0-40 volt 2 in. M/C., meter, with mains plugs and leads and many other useful parts, 12/6 each.

**FREQUENCY SCRAMBLERS.** Type No. 6AC, YBO2700. For secret telephone transmissions, complete with all valves, £5 each.  
**P.O. KEY SWITCHES.** Double pole change-over. Complete with knob, brand new, 2/9.



**RECORD AMPLIFIERS.** A quality push-pull 6V6 amplifier. 8 watts output. Will match any type speaker, tone and volume controls. Housed in attractive cream desk type cabinet. Will match any type of gram input. For operation on 200/250 volts A.C. £6/10/- complete.  
This amplifier can be supplied in kit form with cabinet, complete to the last nut and bolt with easy to build point to point wiring diagram for £5/10/-. Suggested speakers for use with the above equipment, a quality 10 in. 3 ohm speaker, 22/6, or an extra special quality 12 in. 15 ohm speaker, £4/19/6.

**MIDGET REVERSIBLE MOTORS.** For operation on 4, 6, 12 or 24 volt D.C. Size 2 in. x 1 1/2 in., spindle length 1/2 in. x 1/4 in. Ideal for model makers, 10/6 each.

**MUIRHEAD PRECISION BUILT KEY SWITCHES** with heavy contacts. 8 pole, 2 way, brand new, 4/6 each.

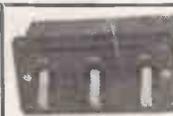
**MULTIWAY TOGGLE SWITCH BOXES.** Fitted with 16 toggle type switches. Ideal for train or model control. Brand new and boxed, 9/6 each.

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**CERAMIC SWITCHES.** 3 pole, 4 way, 4 bank, 10/6 each; 4 pole, 3 way, 3 bank, 6/6 each; 7 pole, 2 way, 3 bank, 5/6 each.

**ADMIRALTY POWER PACK TYPE FHB.** 200/250 volt A.C. input. Output 2,500 volts 10 m/a., stabilised 350 volts 200 m/a., stabilised 110 volts negative 200 m/a., 6.3 volts 10 amp., also containing a complete 6V6 audio output stage and 6 in. P.M. Loudspeaker, £5/10/- each.

**EX-W.D. POWER PACKS.** 230 volt A.C. input. Output 150 volts 60 m/a., 6.3 volts 1 1/2 amps. Fully smoothed, twin metal rectifiers, 29/6 each.



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5 way, 3/6 each.

**DESK TYPE TELEPHONES.** Standard Post Office type, complete with handset and connection block. Circuit and simple instructions available for installation. 42/6 each.

**285 POWER PACKS.** 230 volt A.C. input, output 2,500 volts 5 m/a., 350 volt 200 m/a., L.T. 6.3 volts. Double choke and paper condenser smoothed. 5U4G and VU120 rectifiers. Deal as a television power pack. Special price, 69/6 each.

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**T.R.1196 RECEIVERS.** Complete with 6 valves, 2 of EF39, 2 of EF36, 1 EK32, 1 EBC33. I.F. frequency 465 Kc/s. Simple conversion for complete superhet receiver, 27/6 each.

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**CERAMIC VARIABLE CONDENSERS**, split stator, plated vanes, spaced .035 ball bearings, butterfly 15/15 P.F. extended spindle EA. **2/6**



**VARIABLE CONDENSERS**, 100 pF. ceramic insulation. EA. **2/-**

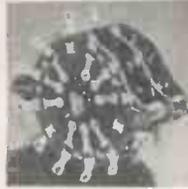


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**30-AMP. 1-WAY DOUBLE POLE** Charging Switches on 1/2 in. Ebonite Base, ex-Admiralty. EA. **9d.**



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- POTS, 3 gang each, 70K ..... EA. **1/-**
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- POTS COLVERN**, 200 ohms 5 watts. Wire wound, N.P. case. EA. **2/-**
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- 100K MINIATURE POTS** ..... EA. **1/-**

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**SLEEVING**, various colours, 1 mm. and 1.5 mm. Permaloid, Peribraid—in coils of 144 yds. Per coil **8/6**  
**COILS OF MICO FLEX SLEEVING**, 1.5 mm. in 2 gross yds. per coil **18/-**

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- STAND-OFF INSULATORS** only miniature doz. **2/-**

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Please add carriage cost of 10/6 for receiver and 5/- for Power Pack.

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Made for use with the R.1132A, this is a standard rack mounting job to match the receiver, and is for 200/250 v. 50-cycle mains with outputs of 250 v. D.C. 100 mA., and 6.3 v. 4 amps. Fitted with H.T. current meter and voltmeter, this is a first-class unit, and can be used for a variety of receivers. Used, but tested working before despatch. ONLY 90/- (carriage, etc., 5/-). Connecting Cable with Jones Plug for receiver and power unit, 10/-.

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500	thermo 2 in. Flush square	5/-
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 250 v.-0-250 v. 100 mA., 6.3 v. 6 a., 5 v. 3 a., 32/6.  
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 Please add 2/- per transformer postage.

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 EHT for VCR97 Tube 2,500 v. 5 mA. 2 v.-0-2 v. 1.1 a., 2 v.-0-2 v. 2 a., 37/6.  
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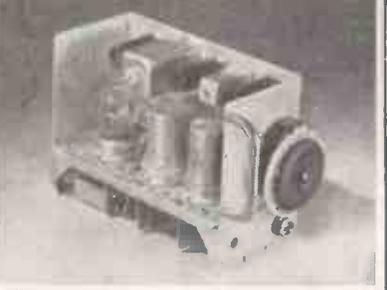
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Size 15in. x 8in. x 2in. Complete with 45 Mc/s. Pye Strip, 12 valves 10 EF50, EB34 and EA50, volume controls and hosts of Resistors and Condensers. Sound and vision can be incorporated on this chassis with minimum space. New condition. Modification data supplied. Price £5. Carriage paid.

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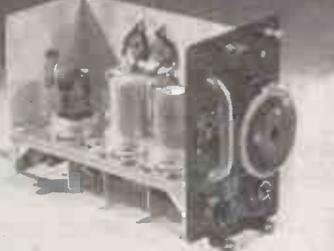
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With 3-SP61

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Variable Tuning.  
2-VR136 1-VR137

**35/- EACH**  
BRAND NEW

**Type 27**  
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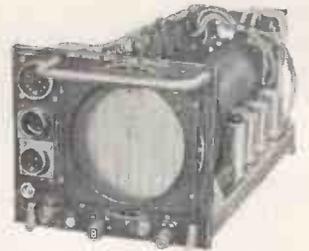
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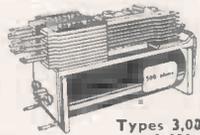
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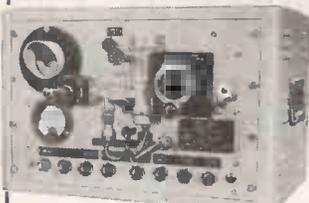
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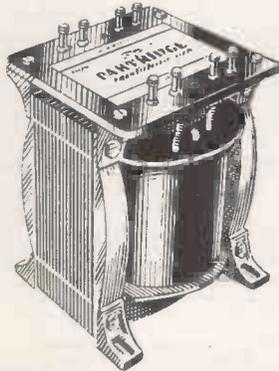


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**SIGNAL** generators, oscilloscopes, output meters, valve voltmeters, frequency meters, multi-range meters in stock; your enquiries are invited.—Requirements to R.T. & I. Service, 254, Grove Green Rd., London, E.11. Ley. 4986. [0056]

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**TURN TO PAGE NO. 165**

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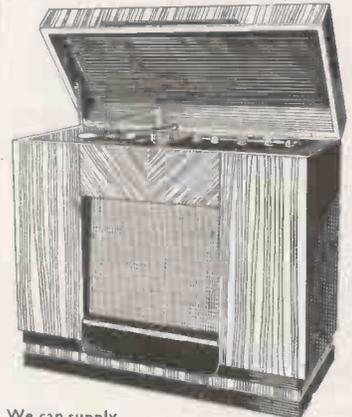
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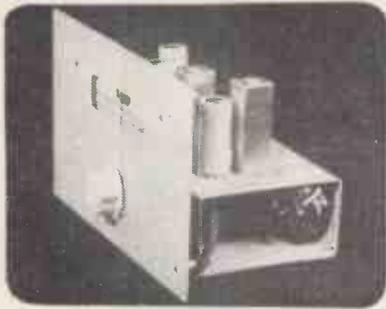
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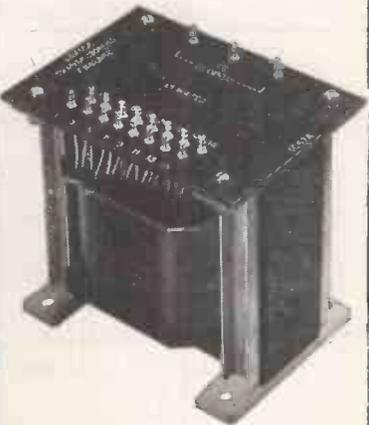
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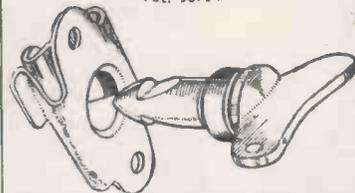
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**0.1% AT 28 WATTS**

and less than

**0.05% AT 25 WATTS**

These figures are an indication of the excellence of the circuitry and the quality of the components used.

**25 WATTS - £25**

For brief specification see "Wireless World," January, 1955, page 157.

Write for full particulars to:

**CAPE ELECTROPHONICS LTD.**  
43-45 SHIRLEY HIGH ST., SOUTHAMPTON  
Telephone: Southampton 74251

## ELECTRONICS VACANT SITUATIONS Engineers.

VACANCIES exist in the expanding electronics division of Saunders-Roe, Ltd. The range of work is unusually wide and interesting, covering design and development of analogue and digital computers, electro-mechanisms, measuring apparatus, strain gauging equipment and techniques etc. Salaries offered are commensurate with qualifications and experience. Assistance will be given with accommodation. WRITE stating age, experience, etc., or send P.C. for application form to the PERSONNEL Department (Ref. WW/17), Saunders-Roe, Ltd., East Cowes, I.O.W. [3292]

### LONDON COUNTY COUNCIL.

NORWOOD Technical College, April, 1955; Assistant Grade B to teach telecommunications subjects to C. & G. Full Tech. Cert. standard; additional television advantage; must have degree or equivalent, together with teaching in the industrial experience; salary within the scale £585×£25—£964 plus London allowance £36 or £48; commencing and maximum salary according to age, qualifications and experience.—Application forms from Secretary at College, Knights Hill, S.E.27, returnable by February 12, 1955. [4018]

### MURPHY RADIO require:—

1. SENIOR Radio Receiver Designer.
2. INDUSTRIAL Chemist with previous experience of plating and finishing processes; the applicant will be in charge of the chemistry laboratory and should be able to deal with all chemical problems arising out of radio and television design and productions.
3. VERSATILE Engineer with sound knowledge and previous experience of component design and application as well versed in quality control and life test methods; thorough knowledge of plastic materials and good theoretical background an advantage. APPLICATIONS stating which vacancy referred to and giving details of age, experience, qualifications and salary should be addressed to Personnel Department (A.L.), Murphy Radio, Ltd., Welwyn Garden City. [4003]

### DRAUGHTSMEN and designers.

E. K. COLE, Ltd., Ekco Works, Southend-on-Sea, have the following vacancies:—

MOULD designers and jig and tool draughtsmen for the plastics division  
ELECTRONIC, radio and television designers and draughtsmen for development and engineering departments.  
MECHANICAL draughtsman for plant layout in the production engineering department.

APPLICATIONS to the Personnel Manager, Southend-on-Sea 49491. [4028]

METHODS development section of Pye, Limited, has VACANCIES for senior and junior television circuitry engineers and mechanical development engineers to work on printed circuit and other new system developments; this is work in a new and expanding field and offers almost unlimited scope for engineers with drive and initiative; salaries dependent on qualifications and experience.—Apply to Chief Television Engineer, Pye, Ltd., Cambridge. [3994]

### TECHNICAL Instructors (telecoms) for work with

ROYAL SIGNALS (Civilian Establishment). Vacancies exist in 1 Training Regiment Royal Signals for unestablished Grade III Instructors (with prospect of eventual establishment). Successful applicants will be required to undertake interesting and varied instructional duties in the fields of electronics and the basic principles of radio and/or line communications. Salary scale: £510×£20—£640. Commencing salary according to age. Liberal leave.

APPLICANTS should have a sound knowledge of radio and/or VF telegraphy and carrier telephony. Academic qualifications are not essential, but O.N.C. or City and Guilds Certificates would be an advantage. Training in instructional techniques would be given to successful applicants. Apply to: THE Chief Instructor, 1 Training Regiment, Royal Signals, Catterick Camp, Yorkshire. [4032]

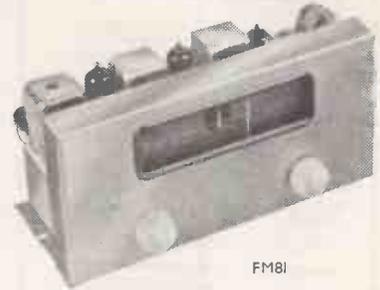
### TECHNICAL Instructor (HF and VHF radio) required for

POSTS and Telegraphs Dept., Nigerian Federal Govt., for one tour of 12 to 24 months in the first instance. Appointment either (a) on contract with salary scale (including expatriation pay) £807 rising to £1,269 a year with gratuity at rate of £100/£150 a year, or (b) with prospect of permanency with salary scale (including expatriation pay) £750 rising to £1,175 a year. Quota allowance £60. Free passages for officer and wife. Assistance towards cost of children's passages or grant up to £150 annually for maintenance in U.K. Liberal leave on full salary. Candidates must have extensive experience in G.P.O. or with firm of electrical manufacturers in installation and maintenance of HF and VHF radio telephone links.—Write to the Crown Agents, 4, Millbank, London, S.W.1. State age, name in block letters, full qualifications and experience, and quote M2C/4032/WF. Candidates at present employed by the General Post Office should submit their applications through their Establishment Division. [4033]

ELECTRONIC development engineers required for work on industrial electronic, nucleonics, X-ray and electro-medical apparatus. Good conditions and pension scheme operating. APPLY to: General Radiological, Limited, Chief Engineer, 15, Clipstone St., W.1. [4036]

# TUNERS

V.H.F./FM



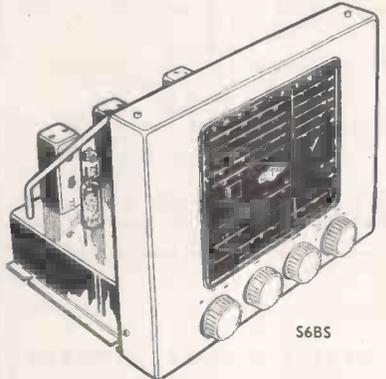
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S5 3 Wave Bands. 16m-2,000m, R.F. pre-Amplifier, variable selectivity I.F. Delayed Amplified A.V.C. very low distortion. £21/6/8. Tax paid.

S5E As S5 but 12.5m-550m. £21/6/8. Tax paid.

S4 The Standard high-quality Feeder Unit Specification as S5 but without R.F. amplifier. £16. Tax paid.

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**BURDEPT, Ltd.** have vacancies, due to expansion, for:  
 1. Telecommunications Development and Research Engineers. Qualified to operate as Project Leaders under direction of Chief Engineer on Government and proprietary designs. Experience must be within one or more of the following fields—  
 (a) Aeronautical Telecommunications, both airborne and ground station designs, with special emphasis on U.H.F. techniques within this field.  
 (b) F.M. single- and multi-channel equipment development in both V.H.F. and U.H.F. bands.  
 (c) Development of subminiaturisation techniques and special components.  
 2. Telecommunications Laboratory Instrument Mechanics and Wiremen.  
 MUST be fully conversant with modern miniature and subminiaturisation techniques, and be able to wire from circuit diagrams on own initiative. Those capable of converting experimentally wired models to final stage by own initiative will receive special consideration. Excellent working and model shop facilities. APPLICATIONS giving full particulars, including present salary, should be sent in confidence to Personnel Manager, Burdept, Ltd., Erith, Kent. [3980]

**SHORT BROTHERS & HARLAND, Ltd.,** Belfast, require a laboratory superintendent for their research department. THE position involves responsibility for providing equipment, supplies and services in the laboratories; also control of laboratory personnel. CANDIDATES should possess organizing ability, and be familiar with the running of a laboratory or workshop. EXPERIENCE in light electrical equipment or precision instruments essential. CONSIDERABLE tenacity and drive necessary to co-ordinate and sustain action with external official bodies. THIS appointment is suitable for a retired officer of one of the technical branches of the Services. ASSISTANCE with housing, and with removal expenses. SEND full details of age, qualifications and experience, quoting Ref. 613/SL App., Equal Opportunities Officer, Short Bros. & Harland Ltd., P.O. Box No. 241, Belfast. [3344]

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**ENGINEERS.**—B.Sc. or A.M.I.R.E., plus 5 years' practical experience in radar, preferably radar fire control. APPLICATIONS should be natural born British subjects.—Write stating age, experience, qualifications, to Box 0741. [3989]

**RADAR and Electronics.**—Senior, Intermediate and junior development engineers required. Salaries according to experience and ability.  
**ALL-POWER TRANSFORMERS, Ltd.,** Chertsey Rd., Byfleet, Surrey. [3973]

**A. V. ROE & Company Limited** have the following vacancies for electronic and mechanical engineers in their Weapons Research Division at Woodford:  
 (a) SENIOR Engineer with Honours Degree and considerable experience of development of electronic computers or simulators to take charge of a group developing guided weapon simulators.  
 (b) SENIOR Engineer with Honours Degree and considerable development experience to take charge of a group developing hydraulic and pneumatic servo and precision mechanical devices.  
 (c) A number of engineers with either Honours Degree in Physics or Engineering or appropriate research or development experience to work on guided weapon computing navigation and control systems. SALARIES will be commensurate with ability and experience. Applications, giving full particulars of age, qualifications and experience, etc., should be addressed to: The Chief Designer, Weapons Research Division, A. V. Roe & Company Limited, Woodford, Cheshire. [3792]

**RADIO/TV service engineers** for inside and outside work; attractive salaries and excellent prospects for right men; West-End and N.W. areas of London.—Apply Broadmead Wireless Co., 123, The Broadway, S.W.19. [4049]

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**PHILCO RADIO SETS.** 3-wave 5-valve. Fully reconditioned and tested. Incorporating 2 speed tuning. In walnut cabinet. A.C. or Universal Mains. Approx. size: 18 x 14 x 9 1/2, £5/10/-, Carr. paid.

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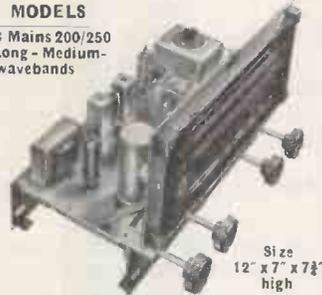
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(d) RELAYS and vibrators.  
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A good salary and a progressive future are offered to men who can design components suitable for high production rates, while maintaining standards of quality and performance. There are also vacancies for qualified engineers and draughtsmen with less experience who will be able to undertake responsible design work after a period in the laboratory. All posts are permanent and pensionable and a modern laboratory provides efficient and agreeable working conditions. Send particulars of qualifications, experience and salary required to the Personnel Manager, The Plessey Company Limited, Ilford, Essex. [4039]

**NATIONAL COLLEGE OF RUBBER TECHNOLOGY**, Northern Polytechnic, Holloway, London, N.7.  
**SENIOR** laboratory technician with knowledge of electrical circuits and some experience with electronics required for duties mainly in Physics Laboratory. Department contains X-ray diffraction equipment, radio frequency dielectric heating apparatus and electron microscope. Salary scale £401X£25—£503 with possibility of proceeding to maximum of £580. APPLY in writing giving full details of age, qualifications, experience, etc., to the Secretary. [4040]

**SERVICE** engineers; all-round experienced and improvers required.—Radio Centre, 33, Tottenham Court Rd., London, W.1. [4022]

**APPLICATIONS** are invited for trainees as studio installation and maintenance engineers for home and overseas service with well-known television company.—Apply Box 0483.

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**TESTERS** required for television and radio manufacturers; good rates for experienced men, N.W. London area.—Write for full particulars to Box 7628. [0032]

**EXPERIENCED** TV engineers reqd.; must drive; progressive posts and excellent salaries.—Apply Ernest Coyne, 120/122, Ladbrook Grove, W.10. Bay. 1947. [C4013]

**SERVICE** engineers with knowledge of tape recorders required; permanent position; excellent salary.—Radio Centre, 35, Tottenham Court Rd., London, W.1. [4021]

**AN** expanding instrument firm pioneering new developments in the field of radiation physics has vacancies on its research staff for Electronic Engineers or Physicists with an electronic background.

APPLICANTS should have a sound theoretical training and considerable practical experience. The posts would be of particular interest to those who wish to obtain experience in new fields of electronic technology. THE laboratory is pleasantly situated in Surrey and a Pension Scheme exists.—Box 0635. [3969]

**TECHNICAL** salesman required for West End showroom, specialising in HiFi and tape recorders; knowledge of domestic radio and television also required.—Radio Centre, 35, Tottenham Court Rd., London, W.1. [4020]

**ENGINEERS** required for installation and operation of television transmission equipment.—Apply in first instance by letter to Engineer-in-Charge, Pye, Ltd., 11, Hinde St., London, W.1. [3885]

**BUYER** required for radio manufacturer situated in West Midlands; experience at senior level in similar capacity essential; four figure salary.—Apply, giving full details of past experience and stating salary required, to Box 0894. [4041]

**TECHNICAL** Engineer required by radio and television component manufacturers in Reading area; £750 per annum.—Apply Gillone Electric, Ltd., Rockstone Works, Rosemary Lane, Blackwater, near Camberley, Surrey, Tel. Camberley 2360. [4053]

**McMICHAEL RADIO, Ltd.**, Slough, Bucks, have vacancies from time to time for electronic engineers to be engaged on Government projects; those wishing to be considered are invited to write fully to the Chief Engineer, Equipment Division. [0198]

**EXPERIENCED** radio testers and inspectors required for production of communication and radio apparatus, also instrument makers, wires and assemblers, for factory test apparatus.—Apply Personnel Manager, E. K. Cole, Ltd., Ekco Works, Malmesbury, Wilts. [0238]

**ELECTRONIC** Development Engineers, Senior and Junior, with a leaning towards technical writing, to undertake the preparation of instruction manuals, specifications, etc., for guided weapons and like projects. A working knowledge of pulse circuitry and microwave techniques essential. APPLY, giving full details of experience, age, etc., to the Personnel Manager, The General Electric Co., Ltd., Brown's Lane, Alksey, Coventry. [5873]

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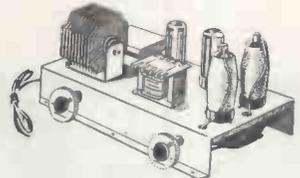
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**SPOTLIGHTS.** 8/9. Butlers, new but ex-W.D. 7 1/4 in. dia. 6 1/2 in. deep. These lights are similar to those sold for £3-£5, but finished black. This light is easily fitted to dumb irons of bumper. Bulbs now available 6 v. 36 or 48 watt. 12 v. 30 or 48 watt. 4/6 each.

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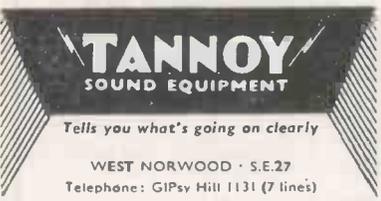


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**SITUATIONS VACANT**  
**TELEVISION Demonstrations**—Applications are invited for the following appointments:  
(a) **SENIOR Maintenance Technicians**.—Applicants must have experience of television equipments and be capable of accepting technical responsibility for the efficient maintenance of a studio.  
(b) **CAMERA Control Technician/Operators**.—Previous experience of TV cameras and associated equipment an advantage.  
(c) **TELECINE Technician/Operators**.—Previous experience of film projection an advantage but applicants must also have a good technical experience to enable them to maintain this type of equipment.  
(d) **SOUND Technician/Operators**.—Previous experience of audio amplifiers, microphones, etc., for "stage or public address" work an advantage. THESE posts are suitable for applicants possessing a good technical background and who are prepared to accept considerable responsibility. All appointments are permanent and pensionable; successful applicants will normally be based in London but may be required to travel overseas; please write, giving full details of experience and qualifications to—Box 0775. [3999]

**AN expansion of the English Electric Co.'s Guided Weapons Division at Luton has created further vacancies for all grades of Senior and Junior Staff for the Electronics Department, particularly the following:—**  
**SENIOR Engineer** with experience of production engineering of prototype electronic equipment coupled with a working knowledge of electronic circuitry.  
**SENIOR Engineer** to lead a large group of engineers and junior engineers in the development of specialized electronic test gear for factory and field use.  
**SENIOR Engineer** with sound fundamental knowledge of electronics coupled with an ability to apply it to general circuit development.  
**SENIOR Instrumentation Engineers** with either a degree or H.N.C. together with experience of the design of transducers for use with electronic or bridge measuring systems.  
**SENIOR Engineer** to lead a small group concerned with the development and field trials of ground radar equipment. Applicants should have had considerable previous experience of similar work.  
**SENIOR Engineer for Radar experiments and maintenance.** Applicants should have a wide experience of Services radar equipments.  
**SENIOR Engineer for missile telemetry installation planning.** Applicants must be familiar with existing telemetry systems and measuring techniques. Although no trials work is involved this post would suit a man with trials experience.  
**JUNIOR Engineers and Laboratory Assistants** are also required to assist in the above work. HOUSING assistance will be given in some cases.

ALL of the above posts are permanent and progressive and attractive salaries are offered to the successful candidates for each post. A STAFF Pension Scheme is in operation.—Applications to Dept. C.P.S., 336-7, Strand, W.C.2, quoting Ref. S.A.36B. [4012]

**APPLICATIONS** are invited for posts in a development laboratory located in Northamptonshire; minimum qualification required is a degree in physics or the equivalent experience in microwave work would be advantageous.—Box 0842. [4014]

**SCANNER mechanics** wanted, must be able to dismantle and repair mechanical details of radar gear, ex-service radar mechanical tradesmen with suitable experience will be considered.—Write, stating experience and wages required, to Box 0738. [3986]

**TECHNICAL Assistants.** A small number of opportunities exist to enter the factory laboratory of a leading radio and television receiver manufacturer for young men of H.N.C. and O.N.C. standards. These positions provide interesting work in the pre-production stages of large scale manufacture. COMMENCING salaries will be in accordance with age, experience and qualifications.—Please apply in writing to the Personnel Officer, Mitcham Works, Ltd., New Road, Mitcham, Junction, Surrey, quoting reference G.1. [4043]

**EXPERIENCED technical executive** required by successful public television and radio company to supervise national organization for development, manufacture and service; opportunity of directorship for right man; pension.—Full details in strict confidence to Box 0163. [3525]

**EXPERIENCED Fault-Finders** wanted by Midlands manufacturers of radio equipment; permanent post located in the Midlands are offered to men with experience of radar, radio control, V.H.F. equipment.—Write, stating fully experience and salary required, to the Personnel Manager, Box 0394. [3875]

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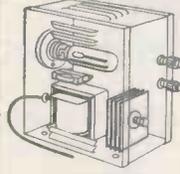
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**ELECTRONIC** Engineer required by company in East Anglia to take charge of small but expanding department wiring and testing electronic units for precision instruments; practical production experience essential; pension scheme.—Details of age, experience and salary required to Box 0684. [3576]

**JUNIOR** designers required to deal with small transformers power, audio, pulse, etc.; specialised training will be given to engineers with suitable basic training and experience. Applications to Technical Director, Gresham Transformers, Ltd., Twickenham Rd., Hanworth, Middx. [3569]

**TECHNICAL** Correspondence Clerk. A vacancy exists for a radio and television correspondence clerk at the new factory of Bush Radio, Ltd., Kew.—Applications should be forwarded with full details of past experience, etc., to the Personnel Manager, Bush Radio, Ltd., Power Rd., Chiswick, W.4. [3983]

**RADIO** and radar testers. First-class men required for work on V.H.F. communication gear and Government contracts for radio and radar equipment by Midland manufacturers; men with wide experience of fault finding in any of the fields mentioned should write, giving full details, to Box 0393. [3874]

**DECCA RADAR, Ltd.,** require testers for fault finding and alignment on radar equipment; applicants with experience in radio or television testing considered good prospects in an expanding department for suitable applicants.—Personnel Officer, Decca Radar, Ltd., 2, Tolworth Rise, Surbiton, Surrey. [4017]

**ENGINEER** with sound basic knowledge of light electrical and A.F. engineering for sound recording equipment department; pension scheme; your attention is drawn to your qualifications, age and salary required, to the Personnel Manager, B.A.F. Ltd., Woodger Rd., London, W.12. [4010]

**ELECTRONIC** Engineers.—If you are seeking a permanent position in a Company specialising in control equipment for the industrial field, your attention is drawn to the fact that Messrs. Lancashire Dynamo Electronic Products, Ltd., have, as a result of further expansion, a number of vacancies for technical and administrative staff.

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**TEST** gear design engineers and maintenance engineers required with practical experience of this class of work, based on sound knowledge of electronic principles; these vacancies are permanent and progressive; a company pension scheme in operation; London area.—Please write, in confidence, giving full details of qualifications, to Box 0811 [4006]

**RADIO** testers required, some v.h.f. experience desirable together with some servicing knowledge on domestic or service equipment.—Applications, giving full details of previous experience and qualifications, should be submitted in writing to The Personnel Manager, Eye Telecommunications, Ltd., Newmarket Rd., Cambridge. [3806]

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**SITUATIONS VACANT**  
RADIO and/or television engineer required for bench and outside repairs, driver; references, age, experience, salary expected.—Field's Radio, Ltd., 52, Hall Gate, Doncaster. [3542]

RADIO service mechanics required by Smiths (Radlmobile), Ltd., for many parts of the country.—Write details of experience and qualifications to Personnel Officer, Goodwood Works, North Circular Rd., London, N.W.2. [0342]

**PHYSICIST**—Young graduate required for research and development work on transistors and their applications, excellent opportunities and wide scope for man with initiative.—Applications, giving age, full details of qualifications, experience and salary required, should be forwarded to Personnel Dept., Murphy Radio, Ltd., Welwyn Garden City. [3990]

**ELECTRONIC** engineer required to supervise testing of prototype electronic equipment, an ability to quickly diagnose faults, and a wide experience of modern test equipment are essential qualifications; this is a staff position offering good prospects and a large salary. APPLY: The Wayne Kerr Engineering Co., Ltd., Tolworth Close, Surbiton, Surrey. [3992]

**TELEVISION** service engineer required by leading dealer holding all main agencies; good position for first-class engineer with high standard of service; semi-detached modern house with garage available if required and good rate of salary.—Write, stating details of experience, etc., to E. Hughes & Sons, 28, Clarence Place, Newport, Mon. [3581]

**ELECTRONIC** Engineer with practical experience in industrial applications and good technical knowledge is required by a large and organisation centred in London, for the development, design and construction of electronic equipment. Applicants should have initiative and be resourceful. Post will be of supervisory grade and salary according to age and experience.—Apply Box 0685. [3978]

**WANTED**, deputy chief inspector to cover both mechanical and electrical inspection and test of electronic equipment, under A.I.D. conditions; successful applicant will be required to serve a probationary period as quality inspector, 5-day week, excellent canteen facilities.—Applications, stating salary required, to Personnel Manager, E.M.F. Factories, Ltd., Penrochy, Rhondda, S. Wales. [3985]

**BRITISH ACOUSTIC FILMS, Ltd.**, Woodger Rd., W.12, have vacancies for laboratory engineers and scientists to work on sound recording and reproducing equipment and kindred projects for television, 35 and 16mm film, tape recorders, etc.; salary according to experience and qualifications; pension scheme.—Application should be made, in writing, to the Personnel Manager. [4019]

**E. K. COLE, Ltd.**, Malmesbury Division, require Draughtsmen for interesting work on radar and communications projects, minimum qualification O.N.C., knowledge of ministry design requirements to R.C.S. 1000 an advantage. Salary dependent upon ability, experience and qualification. Apply to Personnel Manager, Exco Works, Malmesbury, Wiltshire. [4042]

**RADIO** and TV engineer with laboratory experience required by leading London firm of electrical component manufacturers for work in connection with printed circuits; E.N.C. standard; superannuation scheme.—Write, giving full details of education and experience, age and salary required, to Personnel Manager, Box 3M.L9248, A.K. Adv., 212a, Shaftesbury Ave., London, W.C.2. [3849]

**TEST** department personnel required for expanding department engaged in the production of small and varied batches of electronic and nucleonic equipment; highly interesting work with opportunities of gaining experience of the latest developments in electronic applications.—Write, stating age, experience, and salary required to Personnel Manager, E. K. Cole, Ltd., Southend-on-Sea. [3967]

**ELECTRONIC** Engineers required; excellent opportunity for men of degree standard to broaden experience in a field of great interest and variety and involving latest techniques; restrictive specialization can be avoided by joining Marconi Instruments who produce light current communication measuring and test apparatus for a wide range of requirements.—Apply Marconi Instruments, Ltd., Longacres, Hatfield Rd., St. Albans. [3895]

**MECHANICAL** engineer reqd. for work on the design of small electro-mechanical equipments; applicants should have served an engineering apprenticeship, or the equivalent, together with several years' experience in the field of design; small model shop facilities available to engineer; Greenford area; pensionable and salary commensurate with ability.—Apply giving age and fullest details of experience to Box 0878. [4026]

**RADIO** technicians required by International Aeradio, Ltd. for overseas service; permanent and pensionable positions, inclusive salary from £85 per annum to £1,375 per annum, tax free, according to marital status; free accommodation; kit allowance; free air fares; generous U.K. leave.—Qualified candidates to whom replies only will be sent please write quoting RT to Personnel Officer, 40, Park St., W.1. [0282]



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**SITUATIONS VACANT**  
**E.M.I.—Domestic Electronics Division** has a vacancy for a T.V. design engineer for an interesting programme in receiver development (including colour receivers). Applicants should have good academic background with at least three years' experience in this field.—Please write with full details to Personnel Dept. (DED/2), E.M.I. Factories, Ltd., Blyth Rd., Hayes, Middx. [4057]

**SENIOR Electronic Engineers, Mechanical Designers, Draughtsmen and Detail Draughtsmen** are required by a leading Midlands manufacturing concern engaged on the design, development and production of domestic radio and television and on Government contract work, an expanding programme will provide excellent opportunities for promotion; applicants should write to—The Personnel Manager (Ref. GLB), Box 0742. [1396]

**SENIOR and junior development engineers** required for responsible work in radio and television development laboratories; applicants for senior position should be able to undertake development work with minimum supervision; excellent conditions and salary available for applicants who are accepted.—Apply in first case to Personnel Manager (Dept. R.D.), McMichael Radio, Ltd., Wexham Rd., Slough, Bucks. [3880]

**LIAISON Engineer/Writer** reqd. with sound basic knowledge of television and radar principles; he will be reqd. to work with design teams engaged on complex television and radar projects, to assimilate the technical details and subsequent prepare technical notes in good and concise English.—Applicants should write, with full details, to the Personnel Dept. (ED/182), Eng. Dev., Ltd., Hayes, Middx. [3968]

**ELECTRONIC Wiremen** required to assist in the production of Prototype High Grade Television Transmitters and similar equipment; applicants to possess fundamental knowledge of radio and television, to be capable of producing own component layouts and wiring to a high standard; pension scheme, canteen.—Write, stating age, experience, and salary required, to Cinema-Television, Ltd., Worsley Bridge Rd., Lower Sydenham, S.E.26. [4048]

**FIRST-CLASS Man** is required for the inspection and test of industrial electronic apparatus. He should preferably have served an apprenticeship in the electrical industry, being in possession of a Higher National Certificate and aged 25-35. Good prospects are open to the right man. Write giving full details of age, experience and salary required to E. J. Baham Works, Ltd., 45, Nightingale Lane, Balham, S.W.12. [4044]

**TEST engineers** are required to assist in the production of a variety of precision electronic laboratory instruments; previous test department experience is essential (preferably in connection with electronic measuring instruments); salaries in the range of £450-£575 p.a. according to qualifications and experience. Apply, stating full details to the Personnel Manager, Furzehill Laboratories, Ltd., Boreham Wood, Herts. [3920]

**MECHANIC** required for duties in the Department of physics, good knowledge of electronics essential, with experience in instrument making and repairing; duties will include maintenance and construction of electronic, laboratory and experimental apparatus; weekly rate of pay £9/5/6 (44 hrs).—Written application should be addressed to the Head of the Department of Physics, Chelsea Polytechnic, Manresa Rd., S.W.3. [3995]

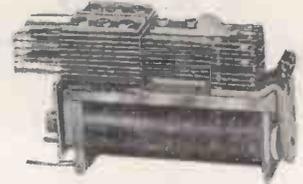
**RADIO and TV engineer** required by Mains Radio Gramophones, Ltd., to take over position of chief of test; to be responsible for test standards and for technical liaison between development and production; good prospects in expanding organization for right applicant; superannuated staff position.—Please send details of experience and salary expected to the Personnel Manager, 359, Manchester Rd., Bradford. [4005]

**JUNIOR apparatus technician** required to assist in the building of scientific apparatus. Applicants should be working for City and Guilds certificates of the Ordinary National Certificate in electrical or radio engineering. Salary scale £150 (age 16) to £395 a year. Application forms, to be returned within 7 days, from Secretary, Institute of Psychiatry, Maudsley Hospital, Denmark Hill, London, S.E.5. (MRC) [4038]

**E.M.I.—Domestic Electronics Division** has a vacancy for a development engineer in their component laboratory for work which includes design of high fidelity equipment, loud speakers and pick-ups; applicants should have a good academic training and preferably experience in the design of electro-mechanical components.—Please write with full details to Personnel Dept. (DED/3), E.M.I. Factories, Ltd., Blyth Rd., Hayes, Middx. [4058]

**ELECTRICAL foreman** with wide production experience in radio industry of small and medium electrical control gear manufacture test and installation required, by manufacturers of materials handling vehicles in pleasant country district, 1 hour London; good prospects of advancement; housing assistance; canteen and social facilities.—Please write, giving details of age, past experience, present salary, salary required, married/single, to Box 0803 [4004]

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**TELEVISION** engineers required by old-established company holding every one of the well-known agencies; applicants must be fully experienced and preferably able to drive; top rates and permanent progressive positions to the right man—Apply to A. S. White & Sons, Ltd., 130/2, High Rd., S. Tottenham, London, N 15 Sta. 7861-2. [3178]

**SENIOR** colwinding planning engineer required, experienced in the planning of radio and television coils; the selected candidate will have the drive and initiative necessary to deal rapidly with the day-to-day electrical and mechanical problems on the shop floor, East London area; this vacancy, for which a good salary will be paid, presents ample scope and opportunity to a man of first-class ability.—Please reply, giving full details of experience, to Box 0/59. [3897]

**A VACANCY** occurs for a Works Costing Engineer for radio and television production; applicants should have had a good education, preferably with a degree, and should be members of the Institute of Cost and Works Accounting; experience of Budgetary Control, Standard Costing and Estimating is essential; the situation is permanent, and offers good prospects to suitable applicant.—Apply in writing to Personnel Department, Murphy Radio, Ltd., We-wyn Garden City. [4051]

**MARCONI** Instruments, Ltd., have an immediate vacancy at St. Albans in their Technical Literature (Telecommunications) Section; the applicants should have electrical engineering qualification and/or experience in the design or development of electronic equipment; the duties are varied and interesting and the post provides a permanent and pensionable position in a well-established company.—Apply Marconi Instruments, Ltd., Longacres, Hatfield Rd., St. Albans. [3894]

**DECCA RADAR, Ltd.**, require technicians and engineers for radar installation at home and abroad; previous industrial and/or service experience essential; ex-technical officers and senior N.C.O.s from H.M. Forces are particularly invited to apply.—Applications should be made in writing in the first instance giving full details of qualifications, past experience, and salary required to the Manager, Heavy Installations Division, Decca Radar, Ltd., Malden Way, New Malden, Surrey [3896]

**SENIOR** and Junior Design Draughtsmen required for interesting work in connection with electronic equipment, commercial radio and television and/or light electro-mechanical engineering; London area; the positions vacant offer ample scope and opportunity for future advancement to men of good ability; a fine salary will be paid to the selected candidates; all recognised staff privileges available.—Please reply, giving full details of experience, to Box 0843. [4015]

**ELECTRONICS** installation and service engineers required for work in field and laboratory; interesting and responsible posts in new expanding department; duties embrace V.H.F., electronic and nucleonic activities in commercial sphere; applicants must have practical technical knowledge and servicing experience, preferably with electronic instruments.—Write, stating age, qualifications, any experience, to Personnel Manager, E. K. Cole, Ltd., Southend-on-Sea. [4011]

**RADIO** Repairing Instructor (unestablished) required at Slough Government Training Centre. Applicants must be skilled craftsmen who have completed articles of apprenticeship or a period of training acceptable to the appropriate craft union and have not less than five years' recent practical experience at their trade. Commencing salary £550 per annum plus pay supplement of £25, on a scale of £550-£25 to £640, plus pay supplement. Lower rate if under 28.—Apply to any Employment Exchange. [3981]

**THE GENERAL ELECTRIC Co., Ltd.**, Brown's Lane, Allesley, Coventry, requires mechanical development engineers, designer draughtsmen and draughtsmen, preferably with experience of radar-type equipments for work on guided weapons and like projects; also required, senior and junior electronic development engineers, particularly in the field of microwave and pulse applications; salary according to age, qualifications and experience.—Apply by letter, stating age and experience, to the Personnel Manager, Ref. R.G. [0259]

**DEVELOPMENT** engineers are urgently required for work in advanced television and radio receiver circuitry by a progressive company with laboratories situated in Central London, some experience in this field essential. Candidates with H.N.C. or equivalent will get preference and experience of magnetic tape recorders will be welcomed; attractive salaries are offered in accordance with experience and qualifications.—Reply in confidence to Chief Engineer, Hartley Baird, Ltd., 37-39, Thurloe St., S.W.7. Tel. Knightsbridge 2511. [4047]

**THE GENERAL POST OFFICE** has vacancies for radio operators at its coast radio stations and applications are invited from men between 21 and 35 years of age who hold the Postmaster-General's first-class certificate of proficiency in radiotelegraphy. Selected candidates will be considered later for permanent pensionable posts.—Application should be made to The Inspector of Wireless Telegraphy, Radio and Accommodation Department, Wireless Telegraph Section, Union House, St. Martins le Grand, London, E.C.1. [3808]

Electronic computing techniques are now being successfully applied to many accounting and statistical problems. There are excellent prospects with the expanding Production Development and Research Departments of the **British Tabulating Machine Co. Ltd.**, Letchworth, Herts., for University Graduates and men of H.N.C. standard or higher with an interest in electronics and their application to computing machines. The Company will be pleased to hear from men seeking an opening in this field. Assistance with housing may be given to suitable applicants. Pension and Sick Pay Schemes are in operation. Enquiries should be addressed to Personnel Officer in the first instance.

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Ferranti Ltd. invite applications for vacancies in their ELECTRONIC COMPUTER DEPARTMENT. The vacancies described below are in their LONDON COMPUTER AND INFORMATION-HANDLING LABORATORY but vacancies of types (i) and (iii) exist also in the COMPUTER LABORATORIES in MANCHESTER.

- (i) **Electrical Engineers and Physicists** for Computer Design Groups concerned with the design of analogue and digital computing circuits, visual displays, conversion equipment, storage systems, etc., and for basic research on interesting new techniques. Reference WSE(i).
- (ii) **Electrical or Mechanical Engineer** for the Engineering Design Group. To work in close touch with Electronic Circuit Designers on principles and details of construction. Keen interest in advanced methods of construction is essential and experience of printed circuits or dip soldering and related techniques would be an asset. Reference WSE(ii).
- (iii) **Electrical or Mechanical Engineer** for Engineering Design Group. For work on the design of precision instruments and components. Design experience in some branch of instrument technology is essential. Knowledge of optics and high-speed photography is an advantage. Reference WSE(iii).
- (iv) **Electrical Engineer, Physicist or Mathematician** for compiling Technical Manuals primarily intended for use by maintenance personnel and covering both the logic and detailed electronics of machines designed by the Laboratory. This work is an excellent introduction to digital systems in general. The successful applicant may be required to assist in the training of maintenance personnel. Reference WSE(iv).
- (v) **Mathematicians** for work on the logical design of computers and other digital systems. Some background in electronics would be an advantage, but is not essential. Reference WSE(v).

There are also vacancies for Project Leaders to take responsibility for projects through all stages. The positions offer scope for the exercise of initiative and for advancement in an expanding organisation. The Company operates a Staff Pension Scheme.

Application forms from Mr. T. J. Lunt, Staff Manager, Ferranti Ltd., Hollinwood, Lancs.

Please quote appropriate reference and indicate whether MANCHESTER or LONDON post is desired.

### SITUATIONS VACANT

**LEADING** manufacturers of electronic equipment in the Provinces require a foreman for large coil-winding section. Applicants should be fully experienced on Westminster and other automatic interleaving machines; good salary and prospects to suitable man; write stating age and experience. to—The Personnel Manager, Box 0932. [4029]

**DEVELOPMENT** engineers, qualified men with experience, interested in the design and development of domestic radio and television equipment are offered interesting and progressive work in this field; situated in Midlands; applicants should write stating qualifications and experience. to—The Personnel Manager (Ref. GLB), Box 0831. [4029]

**ELECTRICAL/Electronic Engineer**—Vickers-Armstrongs, Ltd., Supermarine Works, require for employment at their experimental airfield graduate with research and development experience in electronic and electromechanical devices and/or recording equipment for interesting work on ground and airborne measuring apparatus; the right man for this post will be keen to suggest, assess, new techniques and to design and engineer suitable and workmanlike equipment; permanent pensionable post with good prospects for suitable engineer.—Apply, Personnel Department, Hursley Park, Nr. Winchester. [4000]

**JUNIOR** development engineers are urgently required to assist in the development of precision electronic laboratory instruments; successful applicants will be engaged in interesting long-term projects concerned with the development of a wide range of equipment; the appointments are permanent and carry considerable technical responsibility; applicants should have had previous development experience preferably in the instrument field; academic qualifications ranging from H.N.C. to degree standard are preferable; salaries are dependent upon age, qualifications and experience.—Apply, stating full details to the Personnel Manager, Furzehill Laboratories Ltd., Boreham Wood, Herts. [3921]

**AIR MINISTRY** requires Scientific Officer (male) at R.A.E. Station near High Wycombe, Bucks, for operational research duties, theoretical studies and development work in field of communications and general electronics. Qualifications: First or Second Class Honours degree in physics or electrical engineering, or equivalent. Salary: Within range £467/10—£845. Post unestablished with possibilities of establishment through Civil Service Commission whilst remaining under age 31. Opportunities for promotion to higher grade posts of staff of Scientific Adviser to Air Ministry.—Application forms, quoting A109/54A, from M.L.N.S., Technical and Scientific Register (K), 26, King St., London, S.W.1. Closing date February 11, 1955. [4023]

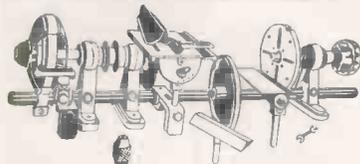
**MURPHY RADIO, Ltd.**, have vacancies in the Electronics Division Laboratories for qualified engineers to design and develop the following: (1) V.H.F. and U.H.F. communications equipment; (2) airborne and ground radar equipment; (3) computing devices and servo systems; (4) nucleonic equipment and measuring instruments; (5) transistors and associated circuitry; the salary range is £500-£1,000 per annum depending upon experience; further posts are available to engineers of H.N.C. standard or equivalent having less experience, the salary range being £450 to £650 per annum; these vacancies are at Welwyn Garden City but one or two vacancies of a similar nature are available at the Ruislip works.—Applications, giving age, full details of qualifications, experience and salary required, should be forwarded to Personnel Department, Murphy Radio, Ltd., Welwyn Garden City. [3991]

**ELECTRONIC** Engineer required at Ministry of Supply, Headquarters, London, to work in the Department of Guided Weapons Directors, responsible for planning and progressing contracts with various weapons firms. The officer will be required to visit these contractors during the course of his duties. Qualifications: Higher School Certificate (Science) or equivalent, but possession of degree or H.N.C. in Electrical Engineering may be an advantage. Knowledge of electronics required and some experience in guided weapons field would be an asset. Salary within Experimental Officer range (Min. age 26), £720—£890 p.a. (Women somewhat less) plus Pay Supplement of £30 p.a.—Application forms from Ministry of Labour and National Service, Technical and Scientific Register (K), 26, King St., London, S.W.1, quoting D.650/54A. Closing date February 11, 1955. [4025]

**ELECTRONIC** engineers with several years' research or development experience are invited to apply for posts with a well established company engaged primarily on the development of precision electronic laboratory instruments; applicants should preferably possess a degree or equivalent qualifications in physics or light electrical engineering, although this is not essential as considerable practical experience is equally acceptable; the appointments are of permanent nature for engineers able to undertake the responsibility for the development of new projects to the prototype stage, and they offer scope for the exercise of individual initiative; furthermore, the work covers a wide range of electronic instruments and similar devices; salaries are commensurate with qualifications and experience.—Applications should be made in writing, stating full details to Personnel Manager, Furzehill Laboratories Ltd., Boreham Wood Herts [3922]

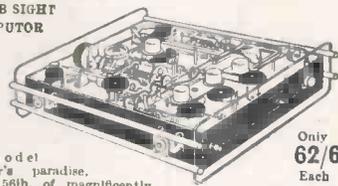
## SSC Bargains from SHERMAN'S

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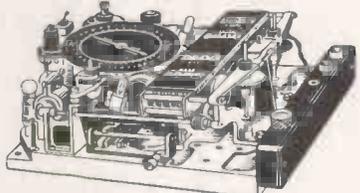
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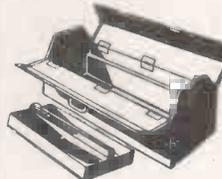


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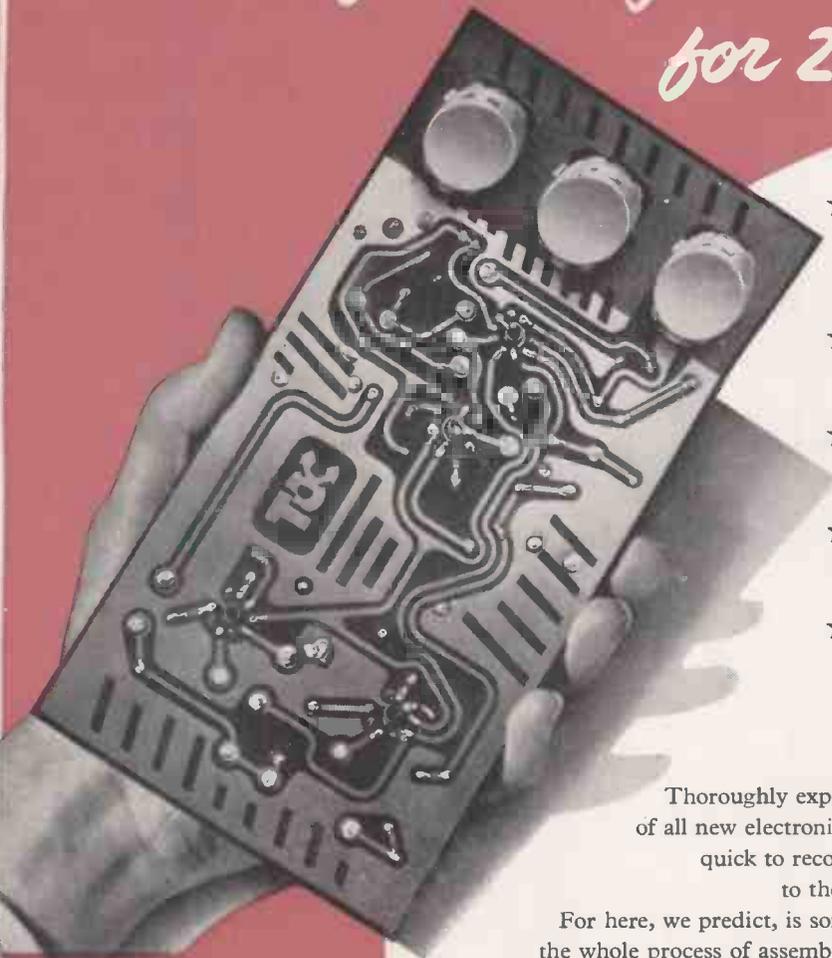
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