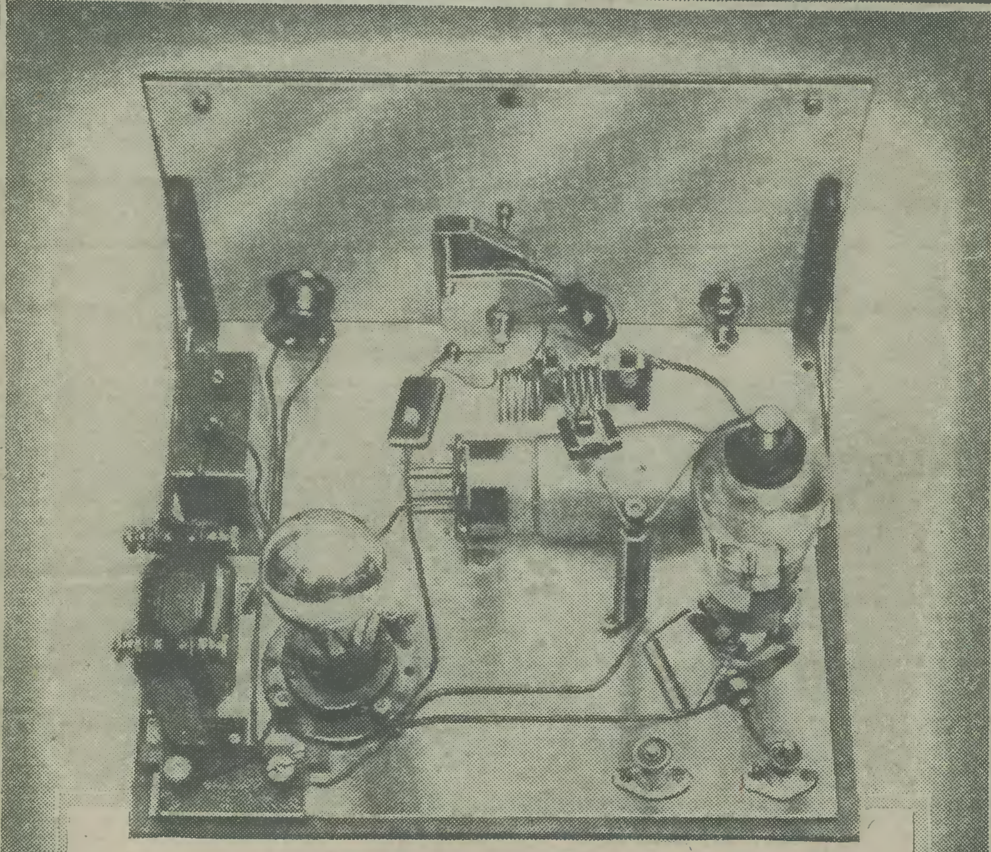
THE RADIO RANGE

Practical Wireless

9D EVERY MONTH

Editor F. J. CAMM

Vol. 22 No. 479 NEW SERIES MAY, 1946



The Ultra-short-wave Three for 10 Metres and Below. Full Details will be Found Inside

Practical Wireless
and PRACTICAL TELEVISION
14th YEAR OF ISSUE
VOL. XXII. EVERY MONTH No. 479. MAY, 1946
Editor F. J. CAMM

COMMENTS OF THE MONTH. BY THE EDITOR

Official Competition

WIRELESS dealers are greatly concerned at the decision taken by the Fulham Borough Council to sell and to service radio and televison sets from the Council's electricity showrooms. This decision followed a report from their committee which was in the following terms:

"Under the Electricity Supply Act the Council is empowered to sell inter-alia any appliance for which electricity can or may be used, and as the Council is aware, the electricity department already supplies such electrical appliances as radiators, refrigerators and vacuum cleaners. We feel that television is of such a highly technical nature that the purchaser should be able, if he so desires, to purchase his set from an organisation upon which he can rely to provide at all times a skilled staff able to give him efficient service, and for this reason we are of opinion that the sale of television and radio sets might well be undertaken by the electricity department."

This is an astonishing decision, because we do not concede that the Council's electricity undertaking has a staff skilled in the servicing of radio or television receivers. Apart from this, it is taking unfair advantage of those many dealers who have been put out of business by the war and who have not yet had a chance to rehabilitate themselves. Some are still in the Services and will not return to civilian life until the middle of this year, whilst those who have returned are desperately short of supplies. If this decision is acted upon, existing traders will suffer unfair competition, in that they are already dealing with manufacturers of electrical apparatus who also manufacture wireless and television receivers. Undoubtedly the Council would gain priority, for large manufacturers may prefer to deal with one Council rather than with a number of small traders. It is true that members of the public are not compelled to purchase receivers from the Council, but there can be no doubt that the Council would be in a special position to influence sales.

Certainly the Council would have to train television service engineers, or alternatively attract away from dealers their skilled technicians. Technical training schemes were, of course, in operation long before the war for the purpose of producing skilled service engineers, and there were radio courses in technical institutions throughout the country. A number of manufacturers, however, do not seem anxious to co-operate with the Fulham or any other Council in order to enable them to compete with their own dealers, but the trade is by no means unanimous on the matter, and the Radio Industry Council seems non-committal on the matter. The Fulham Council has been informed by one or two manufacturers that they will not deal with them; others state that they are prepared to deal with the Council's application for an agency on the same lines as they deal with all other applications from would-be dealers. Other manufacturers distribute their wares to the public through the medium of a limited number of specially appointed dealers. There should be some limit to the commercial operation of local Councils who, after all, are expected to help local traders who are heavy rate- and tax-payers; and if local Councils do decide to operate in the radio field (for undoubtedly other Councils will follow suit if the Fulham arrangements go through), what is to stop them operating in any other market? Where, therefore, would such a scheme end? Would it not put an end to local trading altogether? What is to stop a local Council, for example, from selling food, coal or cigarettes? We are not surprised that the Fulham Council has received letters of protest, and we hope that the industry will take a stronger line in opposing the scheme than they have done up to the present.

Over 10,000,000 Licences

AS announced elsewhere in this issue, there were 10,266,000 radio licences issued in this country at the end of January, and the fact was celebrated by a special B.B.C. programme which gave an interesting history of the growth of broadcasting. Of the nine post-office regions, only one showed a decline over the figures for the previous period—the Home Counties, where the licences dropped from 1,292,000 to 1,291,000. The London postal region, however, is up by 145,000, the total being 1,938,000.

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The Editor will be pleased to consider articles of a practical nature suitable for publication in "Practical Wireless." Such articles should be written on one side of the paper only, and should contain the name and address of the sender. Whilst the Editor does not hold himself responsible for manuscripts, every effort will be made to return them if a stamped and addressed envelope is enclosed. All correspondence intended for the Editor should be addressed: The Editor, "Practical Wireless," George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2.

Owing to the rapid progress in the design of wireless apparatus and to our efforts to keep our readers in touch with the latest developments, we give no warranty that apparatus described in our columns is not the subject of letters patent.

ROUND THE WORLD OF WIRELESS

Components Exhibition

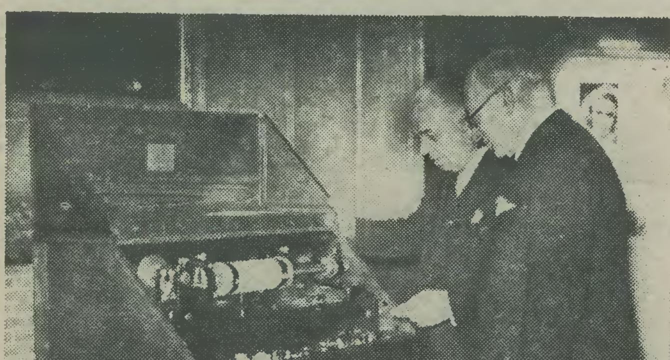
OPENING the first post-war trade exhibition of components in London in February, Sir Stafford Cripps recorded his appreciation of the trade's work during the war years and looked forward to increased activities in both home and export trade during the coming months. Many interesting items were on show, and amongst these greatest attention was centred on electronic devices of all kinds. The chairman of the RCMF stated that the industry was keen on standardisation and hoped that it would be able to keep it going.

E.M.I. Plans for Expansion

SIR ERNEST FISK, the new managing director of E.M.I., has announced plans for the redistribution of various sections of the firm into subsidiary companies, each operating under an E.M.I. name, but concentrating on their particular sphere of operation. It is anticipated by this rearrangement that the executives in each company will enjoy greater freedom of operation, and at the same time better opportunities to indulge their particular abilities to the benefit of the Group.

Government Surplus

THE Telegraph Condenser Company, Ltd., has issued a warning against the use of surplus products of theirs which may come on to the market. They state that some of these may have been designed for special Government purposes and be non-applicable to post-war equipment. Also, some of them may have been badly stored, perhaps under adverse conditions and may have deteriorated. They state that unless they have been tested by T.C.C. they cannot accept any responsibility. This, of course, also applies to a considerable amount of other wartime equipment which may come on the surplus market. Readers are accordingly warned to take special care in selecting surplus items for incorporation in any equipment they may be building.



Superintendent Cherrill, of Scotland Yard, and Sir Edward Wilshaw, K.C.M.G., Chairman of Cable and Wireless, Ltd., examining the first of a consignment of new phototelegraph equipment made for Cable and Wireless by the G.E.C.

Broadcast Wireless Licences

THE number of wireless licence holders in Great Britain and Northern Ireland now exceeds 10,000,000. The exact figure, including 47,300 licences issued free to the blind, is 10,266,300.

It is of interest to compare this figure with that of 36,000 recorded at the end of 1922—a month after broadcasting started in this country. From that time there has been a steady increase, 1,000,000 being reached in 1924, and 5,000,000 in 1932.

The current figure represents an increase of 284,000 since the beginning of this year, and it would seem that for one reason or another a good many people who have been using sets without a licence have decided to run the risk of detection and prosecution no longer. In this they are wise, because the Post Office is now becoming very active in rounding up offenders.

Amateur Transmitting Bands

THE G.P.O. have recently announced that the 28-29 mc/s amateur band has been extended to 28-30 mc/s. This is in addition, of course, to the 58.5-60 mc/s band.

The G.P.O. have authorised the following additional frequencies for use by British Isles amateurs:

1,800 kc/s to 2,000 kc/s.
29,000 kc/s to 30,000 kc/s.

The use of the 1,800-2,000 kc/s band is subject to withdrawal at short notice should there be serious interference with other services. Navigation areas are operating around 1,850 kc/s and 1,950 kc/s. Input power is limited to 10 watts on this band.

B.E.M. for Machine Shop Superintendent

FOR his work at the Philco radio factory at Perivale, Mr. Reginald M. Fiske has been awarded the British Empire Medal.

Mr. Fiske, who is 37, joined the Philco Radio and Television Company, Ltd., as a superintendent at the beginning of the war. He was given the job of organising and building up a machine shop to produce vital radar apparatus and Browning gun parts. During the peak period of 1941 to 1943, when the country desperately needed this equipment, Mr. Fiske was in charge of some 500 people.

B.I.R.E. Meetings

DURING February the following papers were read at the London, North-western and Midlands sections of the British Institution of Radio Engineers: F/Lt. C. Bovill on "Aircraft Radio," at London, on February 20th; R. Spears on "Gold Film Electrodes for High Frequency Quartz Plates," at Manchester, on February 26th; and S. W. Amos, B.Sc., on "Receiver Aerial Coupling Circuits for Medium Waves," at Birmingham, on February 20th. Meetings of the North-western Section will be held at the College of Technology (Reynolds Hall), Sackville Street, Manchester, on April 30th, and of the Midlands Section at the Birmingham Chamber of Commerce, 95, New Street, Birmingham, on April 26th.

The Institution of Electrical Engineers

AT a meeting of the Transmission Section at the Institution on Wednesday, April 10th, 1946, a paper on "Rural Electrification. The Use of the Single Phase System of Supply," was read by J. S. Pickles, B.Sc., and W. H. Wills.

President-elect of British I.R.E.

THE British Institution of Radio Engineers announce that Lord Louis Mountbatten has been nominated as President-elect for the year 1946-7. He will be the tenth president of the Institution and will succeed Mr. Leslie McMichael of McMichael Radio. Admiral Mountbatten will be formally inducted as president on the twenty-first anniversary of the Institution in October next.

Philco Change of Name

RADIO AND TELEVISION TRUST, LTD., was unanimously approved as the new name for the Philco Radio and Television Corporation of Great Britain, Ltd., by shareholders at an extraordinary general meeting of that company in London in February.

Under its old agreement with the Philco Corporation of Philadelphia the British Company were registered users of the trade mark Philco for the British Isles only. Exports under this agreement were prohibited under the name Philco or any other name. The new name enables the British Company to export radio and television receivers under the trade mark Airmec or any other name except Philco. Philco will, however, be retained as the trade mark for the British Isles.

Wireless Receiving Licences

THE following statement shows the approximate numbers of licences issued during the year ended January 31st, 1946.

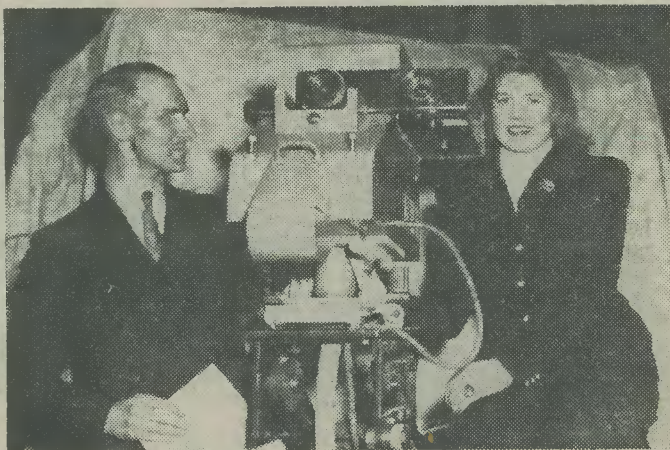
Region	Number
London Postal	1,938,000
Home Counties	1,291,000
Midland	1,451,000
North Eastern	1,585,000
North Western	1,384,000
South Western	858,000
Welsh and Border	603,000
Total England and Wales	9,110,000
Scotland	1,004,000
Northern Ireland	152,000
Grand Total	10,266,000

R.I. Council Director

THE announcement that the Radio Industry Council has appointed Vice-admiral James W. S. Dorling, C.B., M.I.E.E. (retired) as director is a fitting reminder that the Radio Industry now has substantial traditions and is keyed up to meet the requirements of a keen post-war world. Admiral Dorling's connection with radio dates back to 1912, when he was interested in the practical development of C. W. apparatus. Whilst Captain of H.M. Signal School, Portsmouth, he was concerned with the first Radar installation in H.M. ships in 1936—a date which will surprise many readers.

"Music While You Work"

TERMS of licences regarding the use of gramophone records (reproduced music) in factories have recently been made public by the Performing Right Society, Ltd., and Phonographic Performance, Ltd. These followed close on the Government's termination of the wartime arrangement with the licensors on behalf of industry in general which had in view the stimulation of work output by providing facilities for "Music While You Work." Application forms and other details may be obtained from the companies in question.



The chief announcer, Miss Jasmine Bligh; Mr. Cecil Madden, programme director, and one of the special television cameras at the B.B.C. Television Centre, Alexandra Palace.

E.M.I. Suppliers, Ltd.

A NEW company with the above name has been formed as a wholly owned subsidiary of the Gramophone Company, and has been appointed to operate as sole buying agents on behalf of the E.M.I. group of companies. The new company commenced operations in March. The personnel of the buying department of the Gramophone Company, Ltd., have all joined the staff of the new company.

British Cable Engineers in Manila

TWO Cable and Wireless engineers have arrived in Manila to re-establish the company's cable station in the Filipino capital. They will survey the damage done by the Japanese and make arrangements for the installation of new equipment, which is already on its way.

Mr. Alan Heath, the senior engineer, whose home is at Ivybridge, Devon, was the company's assistant manager-engineer in Manila before the war and when the Japanese attacked Pearl Harbour he had just embarked for New Zealand.

Preliminary reports indicate that the company's office and cable station at Manila have been burnt out. The Japanese cut the cable, removed everything of value, and mined and booby-trapped the area.

Mr. Heath has with him as assistant engineer, Mr. D. G. Smith, of Horsham, Sussex, who helped to reopen the company's Paris branch in January, 1945. His father, Mr. F. G. L. Smith, is also a Cable and Wireless engineer and is a member of the engineer-in-chief's staff at the company's head office in London.

The Ultra-short-wave Three

A Useful Battery-operated Receiver for 10 Metres and Below

By F. G. RAYER

ALTHOUGH a well-designed short-wave receiver will function upon frequencies above 30 mc/s quite efficiently, the reviving interest in U.S.W. reception makes it worth while to construct a set specially for use on these bands. The main advantages obtained will be an increase in efficiency and greatly facilitated operation, as many S.W. receivers tend to become tricky on wavelengths below 10 metres.

The Circuit Used

Although super-regenerative and other circuits have certain advantages it was decided to use a standard regenerative detector, making such alterations as the U.S.W. layout required. As Fig. 1 shows, reaction is controlled by a variable resistor. This gives a smooth control with no chance of tuning being upset by reaction adjustment and also enables a better layout in the detector-tuned circuit to be obtained, as a pre-set component can be used for the reaction condenser.

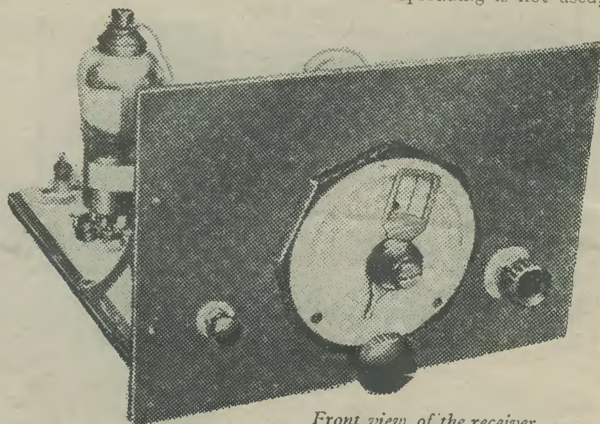
As good results can be obtained with a normal *short* aerial it was decided to use an untuned R.F. stage. This is much more simple than coupling a di-pole to a tuned stage and it avoids the necessity of ganging two tuned circuits.

A triode output stage completes the circuit, but if additional gain is required it is quite in order to use a tetrode or pentode instead, and no wiring alterations will be required.

Both the R.F. and detector valves are normal types, although if those with the grid taken to the top cap can be obtained the constructor should not overlook that some slight improvement in reception will result from using them. In this case the anode and grid connections must be changed to permit the new types being used.

Constructional Details

The panel layout is shown in Fig. 2. A wooden panel, 10in. by 6½in., is used, backed with foil. Because of losses which would be introduced bandspreading is not used,



Front view of the receiver.

and a .00005 mfd. condenser operated through a large drive is employed. The on-off switch and 50,000 ohm variable resistor completes the panel. Care must be taken to see that the resistor has a "dead" spindle, or the H.T. supply will be shorted. If the spindle contacts the element of the control washers should be used to insulate the fixing bush from the foil.

Fig. 3 shows the layout and majority of the wiring. A wooden baseboard, 10in. by 8½in., with the top lined with foil is used, and stout panel-supporting brackets

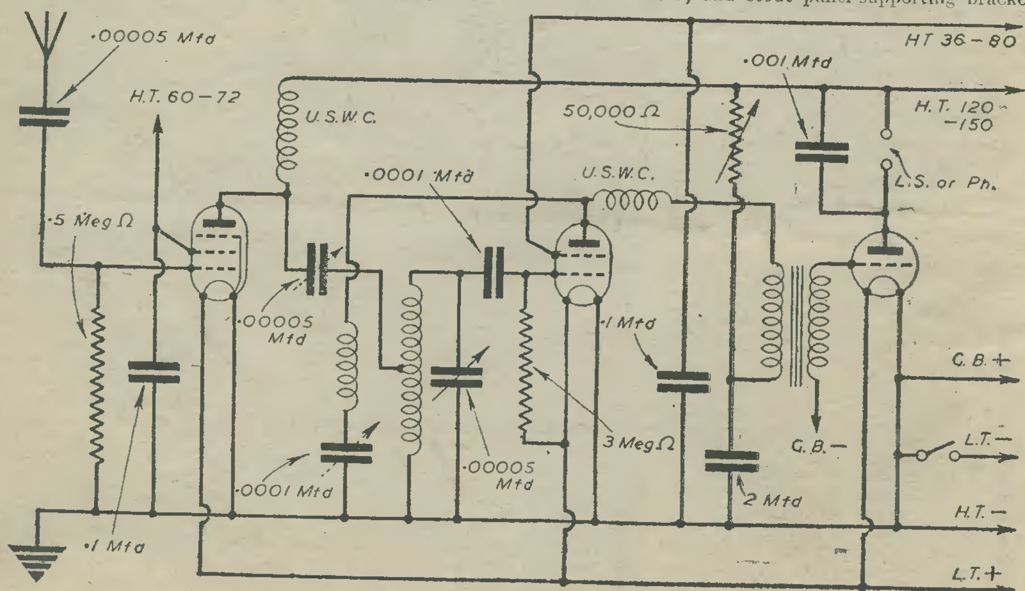


Fig. 1.—Theoretical circuit of the receiver.

must be used to prevent tuning drift from panel movement. The baseboard is 1in. above the lower edge of the panel, so that the battery leads and decoupling components can be located beneath. The detector U.S.W. choke is also below the baseboard as this gives a better layout.

Low-loss materials are not required in the output stage, but the R.F. stage has a low-loss skeleton holder and the detector a low-loss chassis type holder. The detector valve is mounted on its side, as shown, to secure short wiring, this being done by screwing the holder to brackets. Two stand-off insulators form aerial and earth connection points, and the R.F. coupling U.S.W. choke is mounted upright at the side of the R.F. valve.

Earth return leads are taken to the foil covering at the points marked "M.C." The terminals of the .001 mfd. by-pass condenser form speaker terminals. All connections should be sound, and the foil on panel and baseboard should be bonded together.

Connecting the few sub-baseboard components should present no difficulty. The two .1 mfd. condensers are mounted directly below the S.G. sockets of the valves to which they are connected, earth returns being made to securing-bolts contacting the foil. All the battery leads are taken below the base. The L.T. minus lead is taken to the switch, the second switch contact being taken to the foil.

Eighteen S.W.G. wire is used in the R.F. circuits, and the anode leads are of tinned flex. The latter are not screened, and upon no account should screening be added to them. Care should also be taken to have all connections short, and the pre-sets held in the wiring should be taut to prevent troubles being caused by vibration. The grid condenser leads will need to be only ¼in. long, and should be cut to that length. The connections should be direct and kept clear of the foil and also the metallised sides of the valves.

The Coils

Those shown are home-wound from 14 S.W.G. tinned-

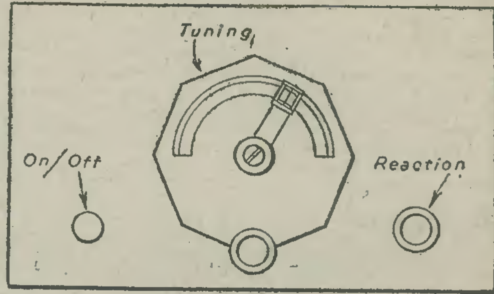


Fig. 2.—Panel layout.

copper wire. The grid coil consists of six turns wound upon a ½in. diameter former. When removed from the former the coil will spring out slightly in diameter and should be pulled out lengthwise until the turns are nearly ⅛in. apart. The grid end of this coil is soldered to the fixed tag of the tuning condenser, about ¼in. of wire being left for this. The earth end is taken to the tag of the

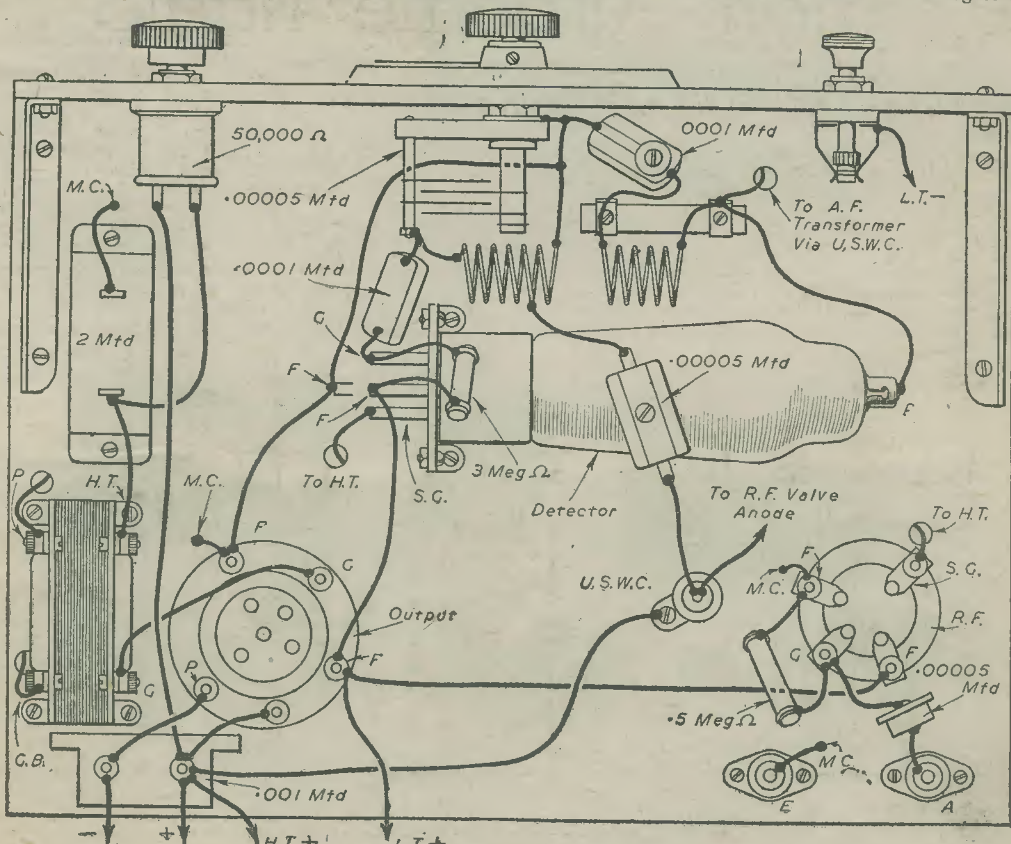


Fig. 3.—This shows the layout and wiring of the principal components of the U.S.W. Three.

moving plates, and about 1¼in. of wire will be wanted for this connection. The coil is located about 1in. above the foil, and should not be too close to the detector valve.

The reaction coil is five turns, similarly wound, and is mounted upon a support about ¼in. from the grid coil. The turns on each coil must be in the same direction. The pre-set for reaction is wired directly between the reaction and grid coils as shown. Subsequently, the exact distance between the coils may be adjusted to obtain smooth and adequate reaction.

The lead from the coupling pre-set condenser from the R.F. valve is soldered to a tapping upon the grid coil. It may be taken to either the second, third or fourth turn according to results desired. Moving the tapping towards the grid end of the coil will increase volume, but selectivity will be sacrificed slightly and the damping may introduce difficulty in obtaining reaction.

Operational Notes

The .00005 mfd. pre-set should be set about half open, and can afterwards be adjusted for best results. The .0001 mfd. pre-set must be adjusted so that smooth oscillation commences when the variable resistor feeding H.T. to the detector is rotated towards maximum.

The H.T. voltage applied to the S.G. of the detector will also influence results, as will the coupling between the grid and reaction coils. The coupling pre-set of the R.F. stage will also influence the damping imposed upon the grid circuit of the detector and, in consequence, the ease with which reaction is obtained.

These points should be carefully adjusted, therefore, until best results are obtained. The aim should be to obtain smooth and adequate reaction over the whole of the tuning range. When the pre-sets have been set they do not require further alteration, of course, unless a different detector valve is used in the receiver.

If low-loss plug-in coils for U.S.W. operation can be obtained they may be used. Alternatively, it is possible to wind these, and the coils specified for various wavelengths by the manufacturers of the plug-in coils are as follows: 4-6 metres, four-turn grid coil and three-turn reaction coil; 6-8 metres, six-turn grid coil with four- or five-turn coil for reaction; 8-10 metres, eight-turn grid coil with six-turn coil for reaction. These coils are approximately of the dimensions given on page 225.

LIST OF COMPONENTS

Three valveholders.
.00005 mfd. tuning condenser and reduction dial.
.0001 mfd. and .00005 mfd. low-loss pre-set condensers.
.00005, 0001, .001, two .1 and one 2-mfd. condensers.
On-off switch.
50,000 ohm variable resistor.
.5 megohm and 3 megohm leaks.
A.F. transformer.
Two U.S.W. chokes.
Two panel brackets. Foil for panel and baseboard.
U.S.W. coil mount.

German Airborne Radio—2

Details of Medium Frequency Equipment

WITH the exception of single-seat fighter aircraft, such as the well-known Me 109, German aircraft were equipped from the beginning of the war with a very practical, highly standardised, M.F. communication set (FuG 10) which compared favourably with the later British counterpart.

In the case of single-seat fighters, however, a surprising backwardness was observed until the introduction of FuG 16Z during 1943. The equipment used prior to this conversion was the FuG 7a, using a simple T.R.F. receiver with no provision for frequency stablising and no means of adjusting the tuning in flight. The various M.F. types will now be discussed.

Funkgeraet 3

This equipment, although now obsolete, is of interest in that, as the forerunner of the FuG 10, it was the type in which the Germans began to use the two frequency bands 3-6 mc/s and 300-600 kc/s for general communication purposes. Only the long-range aircraft had extra frequency coverage. It was with this equipment, also, that the motor generator was introduced. Originally (as in this country) to supplement the air-driven generator for emergency use of the transmitter on the ground or water, it became the normal method of supply for both the transmitter and receiver in the air.

The original FuG 3 was later modified to FuG 3a

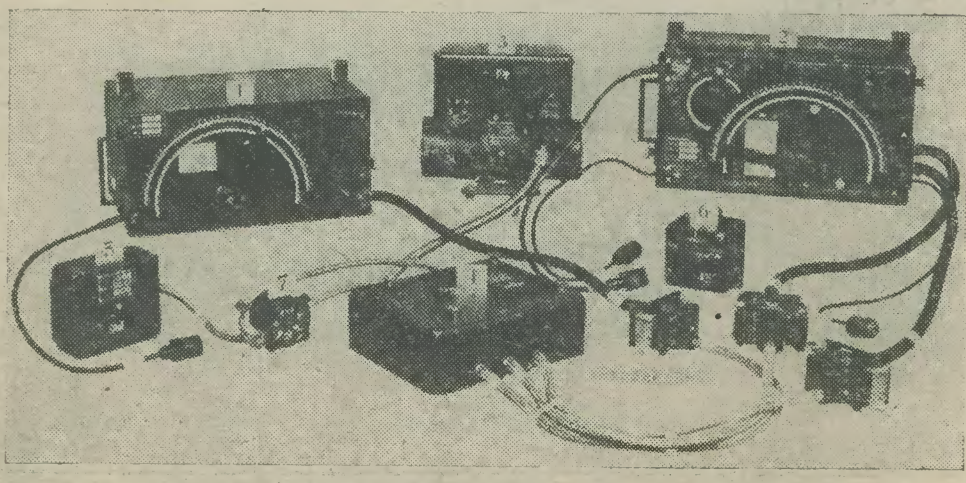


Fig. 5.—Funkgeraet 7a, complete installation. Legend: 1. Receiver. 2. Transmitter. 3. Motor generator and smoothing unit. 4. Junction box. 5. Resistance box. 6. Switch. 7. Aerial current meter.

which, later, became the FuG 3aU when the motor generator (Umformer) was included. Both 3a and 3aU were used on transport aircraft, flying boats, and second-line obsolescent aircraft generally.

The modifications included in the FuG 3a were:

(a) Addition of an aerial unit (AZG 1) with a send-receive relay, allowing the receiver to operate on a different frequency from the transmitter, plus "listening through" facilities.

(b) Addition of an "Impulse" unit (JZG 1) for modulating the transmitter. (A now obsolete long-wave D.F. system.)

(c) Provision for "back-tuning" the transmitter to the receiver, with the transmitter on low power and the receiver on low gain.

(d) Separate coarse and fine tuning provided for both long and short waves.

(e) Three-position selector switch added for operating on normal transmission modes (b) or (c) above.

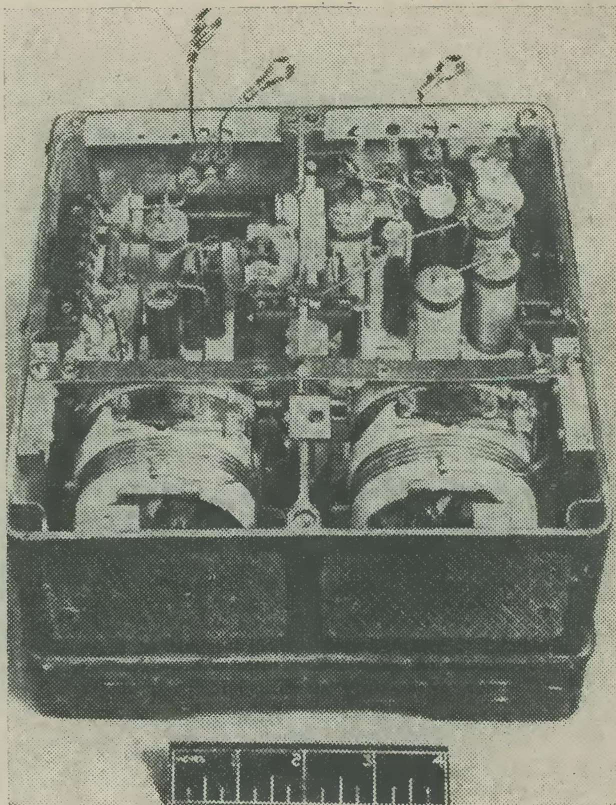


Fig. 6.—R.F. section of latest L.W. transmitter FuG. 10.

Funkgeraet 7

The final version of this apparatus, FuG 7a (illustrated in Fig. 5), was the standard equipment on German single-seat fighters at the beginning of the war, and, although already out of date at that time, was used for this purpose until 1943. On these aircraft it provided R/T only and the main consideration in its design appears to have been simplicity of operation, the pilot having only "send-receive" and volume control to operate.

The transmitter and receiver were pre-set before flight and, in the absence of crystal control, the lack of

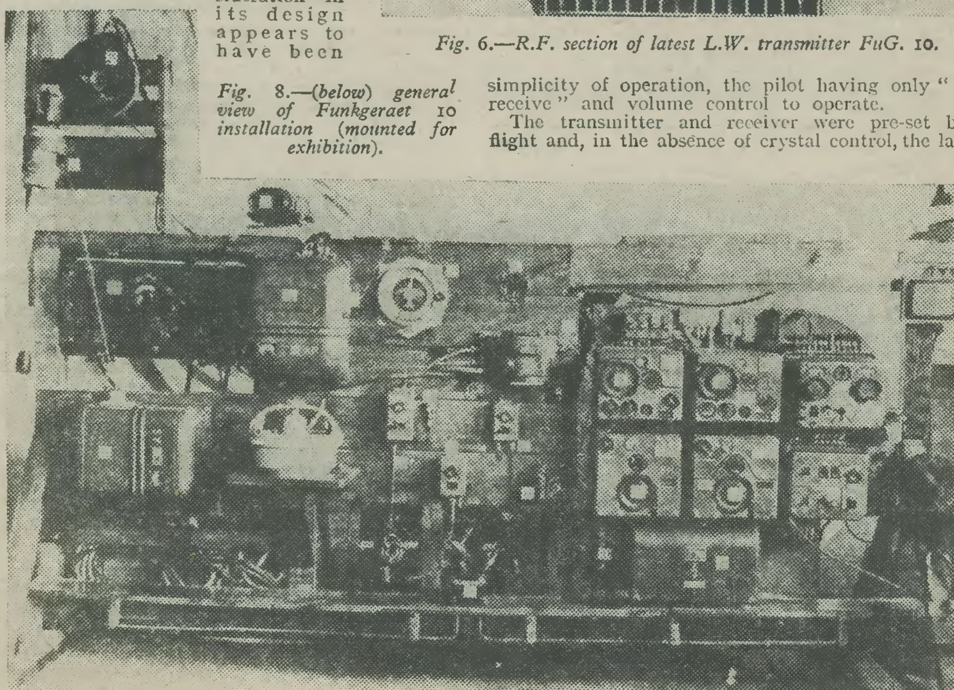


Fig. 8.—(below) general view of Funkgeraet 10 installation (mounted for exhibition).

receiver fine-tuning prevented the pilots from getting the best out of this apparatus, whilst its replacement by the FuG 16 was much overdue. The continued use of the FuG 7a for fighter R/T was thought to indicate the Germans' reluctance for re-equipment during the war as well as their preoccupation with bomber radio devices, to the detriment of defensive aircraft.

Funkgeraet 10

This was the present standard general purpose set and used on all multi-engined operational aircraft, including light and medium bombers (such as the Me 110 and Me 410) and most seaplanes.

The FuG 10 appeared at the beginning of the war and represents a remarkably high standard of production and planning. Short- and long-wave coverage is by separate receivers and transmitters, all of high performance and great tuning accuracy. The equipment includes two remote controlled aerial matching units (tuned by synchronous, Selsyn, motors), an electrically-wound automatic aerial winch, and an intercommunication amplifier by means of which signals from the FuG 10 receivers, or additional navigational equipment, may be distributed to the pilot and navigator.

The frequency coverage is rather inadequate by our standards, and it is not surprising that long-range aircraft carried one or more extra short-wave units, resembling the formal FuG 10 in all points, except frequency range, mounted with an additional aerial, aerial matching unit and power unit.

In spite of the care manifested in its design, some modifications to the FuG 10 have appeared. The first one seen provided two-way R/T for the pilot on the S.W. units, grid modulation on the S.W. transmitter being applied from the intercommunication amplifier. This largely disappeared with the introduction of FuG 16 for the same purpose.

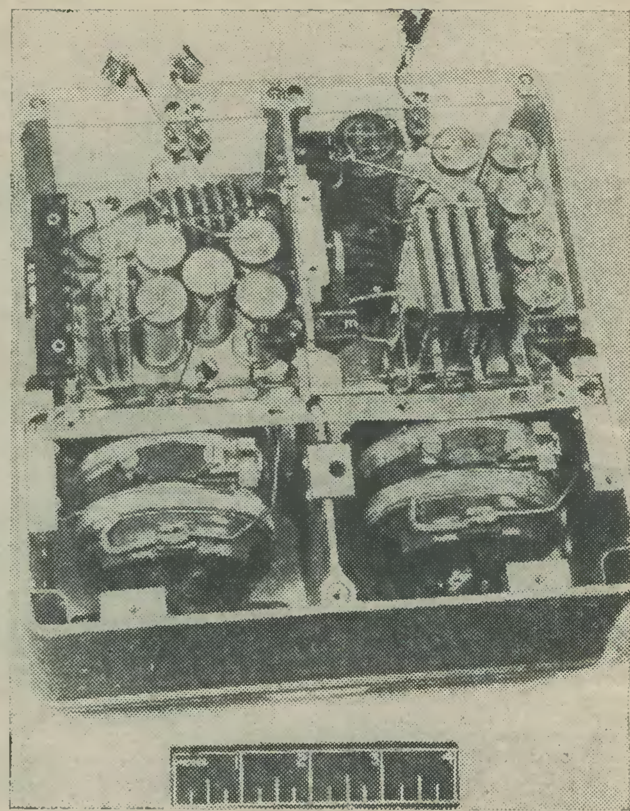


Fig. 7.—R.F. section of latest S.W. transmitter FuG. 10. Note the use of "straw" type condensers.

Secondly, the "Impulse" transmission arrangement on the L.W. transmitter was abandoned; that is, the four valves generating the controlling frequency of 300 cycles have been removed from the intercommunication amplifier. The fact that it was abandoned presumably indicated that there was no further need for precautions of this nature due to advances in ground D.F. design.

A more detailed modification was in the production of improved transmitter and receiver units, sub-type "a." It includes three extra valves which have been fitted into the existing receiver chassis providing A.V.C. and an extra I.F. stage, whilst the output valve is now in parallel with a second similar valve. In addition, the magnifying window is enlarged and is now illuminated. The sub-chassis carrying the tuned circuits of the later pattern transmitters are illustrated in Figs. 6 and 7, showing some of the constructional features and the components used.

In Fig. 8 a complete general view of the FuG 10 installation, mounted for exhibition, may be seen.

The latest modified version is known as the FuG 10P. In this sub-type, the long-wave receiver E10L or E10aL, and its mounting, is replaced on the FuG 10 panel by the mounting and receiver of the Peilgeraet 6 D.F. outfit. This receiver, known as type EZ 6, performs a dual function of D.F. and communication. Three ranges are provided, but only one (300-600 kc/s) is used for communication, the trailing aerial being connected to the receiver on this range only. Thus the frequency coverage of the FuG 10 remains unaltered.

NEWS FROM THE CLUBS

International Short-wave Club

THIS club is renewing its activities again and welcomes those interested in short-waves and amateur radio. Full details may be obtained by those interested from A. E. Bear, 100, Adams Gardens Estate, London, S.E.16.

Whitefield and District Radio Society

THE above society was recently formed to foster a practical interest in all branches of amateur radio. All local radio transmitters and constructors and anyone interested may attend the meetings which are held at the Stand Grammar School, Higher Lane, Whitefield, or write for details to the Hon. Sec. Mr. R. Purcell, 28, Stanley Street, Prestwich.

British Short-wave League

THE Signal Survey Section has arranged for a dedicatory programme to be broadcast over Radio Ankara, TAP, in honour of the League. This will be the first BSWL programme to be given since 1939. The frequency of the transmission is 9,465 kc/s (31.7 metres).

F.M. Calibration Method for Disc Cutting-heads

A New American Technique. Reviewed by DONALD W. ALDOUS, M.Inst.E.

FOR many years the conventional methods of obtaining or checking the frequency characteristic of cutting-heads used for wax or direct disc recording have been:

(1) To record a range of frequencies and reproduce them with a calibrated pick-up, amplifier and valve-voltmeter and, after taking into account the pick-up and amplifier responses, the true frequency characteristic can be determined.

(2) The cutting-head with stylus is mounted under a microscope, and a beam of light is then focussed on the stylus and, with different frequencies applied, the amplitude of the stylus motion in air is measured with the calibrated microscope, thus enabling a frequency characteristic to be plotted.

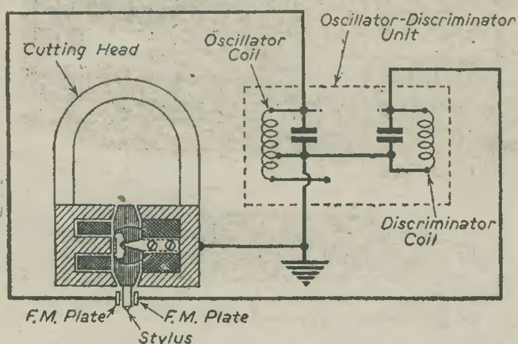


Fig. 1.—Arrangement of plates adjacent to stylus shank in F.M. calibrator for disc cutting-heads.

(3) To record the different frequencies and then measure their groove amplitude with a calibrated microscope.

(4) An improvement of the microscope method (2) in which a photo-electric cell is substituted for the human eye and having the stylus vibration modulate a beam of light being transmitted to the cell.

(5) The "light diffraction" or "Christmas tree" pattern (the Buchmann-Meyer effect) on a recorded disc cut by the particular head for making an overall calibration.

The degree of simplicity and accuracy of the aforementioned procedures varies; for instance (2) depends upon the assumption, generally correct, that the load imposed on the stylus by the recording material, which is not included, is small compared with the mechanical impedance of the cutting-head, and so will not introduce any appreciable error, but it is inaccurate at the higher frequencies where, because of constant velocity recording, the amplitude of movement is small and the light spot is no longer small in comparison with the amplitude of motion; and (5) is of considerable value in checking the flatness of the constant velocity portion of a frequency-run on a record and in making a final test of a cutting-head, etc., provided certain precautions are taken, i.e., a point source of light (if sunlight cannot be used) located at such a distance that the light rays are parallel, and having these rays impinge on the disc nearly parallel to its surface, and observing, with only one eye, the reflected pattern at right-angles to the plane of the disc, about 3 to 6ft. away.

These techniques have served their purpose, and still have useful applications, but they do not permit a calibration during actual cutting of the disc. This problem of calibrating a recording-head under cutting conditions has recently been solved by Alexis Badmaieff and H. E. Roys, of the R.C.A. Victor Division of the Radio Corporation of America, and the system has been described in the *Journal of the Society of Motion Picture Engineers.*

Utilising Frequency Modulation

This device, which utilises what can be considered a push-pull frequency-modulation system, can be attached to a cutting-head without requiring much space, or adding mass to the moving parts, or be coupled electrically to the field coils, and can be fitted without interfering with the vibration of the cutting stylus.

The set-up, in schematic form, is shown in Fig. 1. Two tiny plates, one on each side of the stylus shank or bar, insulated from each other and from the cutting-head, are spaced a few thousandths of an inch from the stylus. As neither mass nor stiffness is added to the moving parts there is no change in its mechanical action. Flexible leads from the plates are connected to the oscillator-discriminator unit mounted on the traversing mechanism close to the cutting-head. Variation of capacitance between the plates and the stylus owing to

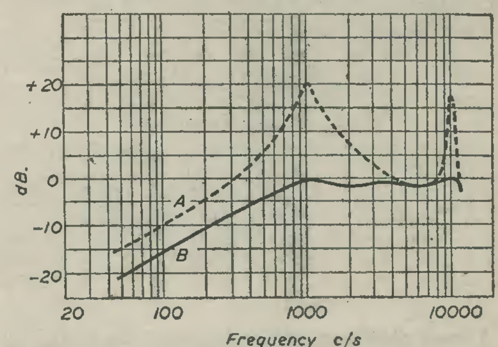


Fig. 2.—Frequency response of damped and undamped cutting-head. A is without viscoloid damping block, and B is with damping block inserted.

its vibration, changes the oscillator frequency and tuning of the discriminator. The audio-frequency output from the rectifier of the oscillator-discriminator unit is transferred to adjacent stationary equipment, containing amplifier and power supply, and the amplifier output can then be measured by means of a valve-voltmeter or additionally amplified for listening or other purposes.

One of the first practical tests was a comparison of results obtained with the F.M. and optical calibrators using the R.C.A. MI-11850 cutting-head. The small size of the F.M. plates permitted them to be kept in position while the cutting-head was mounted in the optical calibrator so that a direct comparison was simply made. The results of frequency response measurements made in this manner reveal a close agreement between the two methods, except at the low-frequency end, where the amplifier characteristic used in the optical calibrator caused a slight increase in the bass response.

Advantages of the System

As measurements can be made under actual cutting conditions, the chief advantage of this F.M. calibrator is achieved when investigating the change in frequency response due to cutting load. A number of factors must be considered when making these measurements, e.g., type of record material, the stylus with its burnishing edge, turntable speed and recording diameter, and the test frequency. The tests confirmed theoretical predictions that the greatest effect of the cutting load would be at the resonant frequencies of the mechanical system. Fig. 2 shows the response curve, in air, of an undamped cutting-head and also the response after the viscoloid damping block has been inserted. It will be seen that there are two resonant frequencies, one about 1,000 c/s and the other around 10,000 c/s, and that the damping block has little effect on the frequency response between 5,000 and 8,000 c/s.

The cutting load loss as a function of groove velocity at several different frequencies—the groove being cut in a lacquer coated disc with a sapphire stylus of tip radius approximately 2 mils, a 90-degree included angle, and the usual burnishing edge—is shown in Fig. 3. For this particular cutting-head, having the high-frequency peak at 12,000 c/s instead of 10,000 c/s, the maximum loss owing to the cutting load was at 1,000 c/s, the fundamental resonant frequency of the mechanical system. The minimum loss occurred at the lower frequencies and in the region from 5,000 to 8,000 c/s, which was to be expected from the damped and undamped responses. The curves of Fig. 3 indicate that over the diameters and turntable speeds normally covered in 78 and $33\frac{1}{3}$ r.p.m. recordings the loss is small. For a $33\frac{1}{3}$ r.p.m. recording, at the innermost diameter, the 1,000 c/s loss compared with that of the greatest diameter is only about 1.2 db. Styli with larger burnishing edges may increase this loss and tests with 10 new styli showed an average loss of about 1.7 db., or 0.5 db. more than the previous test. At 78 r.p.m. the loss at 1,000 c/s between the inside and the outside of the disc is approximately 1 db.

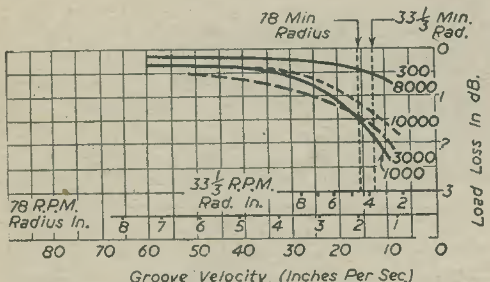


Fig. 3.—Shows cutting load loss, with R.C.A.MI-11850 head, and lacquer-coated disc.

The previously quoted tests have revealed that the maximum loss from loading occurs at the resonant frequencies of the mechanical system. The 1,000 c/s resonance having a broader peak (Fig. 2), there is less chance of errors from frequency shift of either the applied signal or the mechanical system, and therefore the change in recording level with depth of cut was examined at 1,000 c/s. Ten styli were measured for level loss at 1,000 c/s and an average one selected. Of these 10 the average load loss for a groove 5 mils in width was 2.9 db., the maximum loss was 3.2 db. and the minimum loss 2.7 db. The sapphire had a tip radius of about 2 mils and a 90-deg. included angle. Fig. 4 plots the results of changing the depth of cut, which is expressed in terms of groove width, as this is easy to measure with a microscope. Curve A shows the loss at the inside of a $33\frac{1}{3}$ r.p.m. recording. Curve B shows the loss at the outside of a 12in. disc at 78 r.p.m. The results of similar tests, but using a steel stylus instead of a sapphire, are shown in curves C and D. The steel stylus had no burnishing edge or tip radius and had an included angle of 90 deg. The change in level is not marked except at the lower groove velocities, such as the speed at the inside diameter ($7\frac{1}{2}$in.) of a $33\frac{1}{3}$ r.p.m. recording. At this diameter a groove variation from 4 to 5 mils caused an amplitude reduction of about 0.6 db. Cutting-head bounce or flutter, which fortunately is usually less at $33\frac{1}{3}$ r.p.m. than at 78 r.p.m., or an irregular disc surface, could be responsible for this variation in groove depth.

Effects of Distortion

An important requirement of a good calibrator is freedom from distortion so that accurate measurements of the cutting-head distortion may be made. An overall distortion measurement that includes the disc and pick-up is not satisfactory as it does not permit isolation of the amounts introduced by the recording and reproducing heads. As the F.M. calibrator is an amplitude device, by limiting the range over which the F.M. system operates so as to keep the distortion low, accurate measurements may be undertaken.

To find what spacing between the F.M. plates and the stylus was necessary to meet this requirement, tests

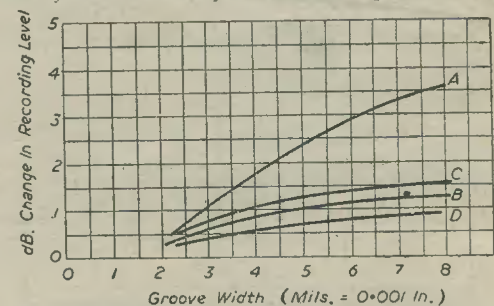


Fig. 4.—Change in recording level at 1,000 c/s, with groove width representing groove depth. A is inside of $33\frac{1}{3}$ r.p.m. disc, sapphire stylus; B is outside of 78 r.p.m. 12in. disc, sapphire stylus; C is inside of $33\frac{1}{3}$ r.p.m. disc, steel stylus; D is outside of 78 r.p.m. 12in. disc, steel stylus.

were made using the cutting-head with the viscoloid damping block removed, so that at the fundamental resonant frequency (around 1,000 c/s) very little electromagnetic energy was needed to give normal amplitudes of vibration and therefore the distortion introduced by the cutting-head under these conditions would be low.

Numerous distortion measurements at 1,000 c/s were made at various amplitudes of vibration and plate separation. Input-output or linearity measurements were also made leading to a recommendation of an 0.015in. plate separation for distortion measurements at the lower frequencies, where the stylus amplitude is plus or minus 3 mils. For higher frequencies, where the amplitude of motion is less, the spacing may be decreased, which also increases the sensitivity. With an 0.015in. plate separation the distortion at 1,000 c/s was less than 1 per cent. for the entire system, which included the recording amplifier and the amplifier used to increase the output of the F.M. calibrator. These amplifiers measured less than one-half of 1 per cent. each, so that the distortion of the F.M. system was of this order for the highest amplitudes of vibration that might be encountered. With the viscoloid damping block inserted the overall measured distortion at 1,000 c/s was about 1.5 per cent. at normal recording level. These distortion measurements were made using the R.C.A. distortion meter, in which a signal is fed directly from the oscillator to balance out the fundamental of the signal being measured, the residue representing the total harmonic distortion.

Although this F.M. calibrator was designed primarily for obtaining cutting-head frequency characteristics, it can also be employed successfully for monitoring.

Checking Shorting Coils Visually

Details of a New Instrument for Testing Coils.

By L. G. W. KNOTT

As coil winding is done by machinery, it is quite possible to have coils delivered to a production bench either partially or wholly short-circuited, this due to the insulation mediums being chafed or rubbed on bobbins or guides during the winding process. A shorting coil may not altogether unbalance a tuning circuit with but one variable condenser shunting it, but if it were in a network incorporating two other coils and a three-gang condenser, instability of operation would be in evidence. Various forms of test equipment have been devised to check against good or bad coils, ranging from low-valve ohmmeters to electron-ray rigs designed to show variations in amplitude, the application of which made quite obvious that what was wanted was an instrument which was absolute and instantaneous in action, extremely sensitive, compact, robust, and not costing too much to produce; the requirements of which, it is believed, are met in the test equipment to be now described.

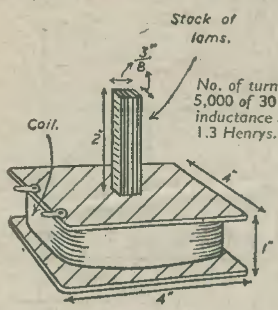


Fig. 1

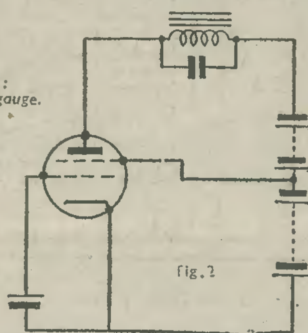


Fig. 1 shows the most interesting component of this new device, the coil to be tested having to be placed over the stack of laminations. The wire is wound on a bobbin with presspahn flanges to keep it snug. Insulated wedges assure rigidity. Fig. 2 shows the basic circuit of the dynatron oscillator.

A New Method

For instantaneously and *visually* checking coils for shorting turns has been resolved around an oscillatory circuit so designed that it will *stop* oscillating when a defective coil is coupled to it magnetically. The set-up comprises a *negative resistance* oscillator of the dynatron type, the inductance of which is representative of the positive resistance in the circuit and to which is incorporated an *explorer testing stack or pillar* of iron stampings over which the coil to be checked is placed. Doing so changes the circuit constants of the network and not only stops it from oscillating but causes a small *flashlight bulb to be extinguished* as an indication of a coil with partial or wholly shorting turns. If the coil under test is without this fault, the lamp remains alight. Fig. 1 depicts the exploring coil and stack, together with dimensions and winding data for construction.

The coil ends are brought out to soldering lugs for ease of connection and replacement.

Circuit Considerations

An ordinary transition circuit of oscillation could have been used, though without advantage, as no consideration had to be given to either waveform or frequency stability; the dynatron circuit was, however, the more simple of the two for general design and was thus decided on. Nevertheless, some consideration was necessary relative to the tuned circuit, it controlling the frequency at which oscillation had to take place. Requirements were:

(*a*) That the highest workable frequency be of a sufficiency to permit the tuned circuit capacity across the coil to be always the predominant tuning capacity "component": that is, the action of the coil under test, when over the stack, must be such that any mutual capacity present should have little or no effect on frequency.

(*b*) That the lowest workable frequency be of a sufficiency to permit the single tuned circuit —made up as an iron-cored inductance with capacitance—to have a reasonably high Q or sensitivity factor.

Operational Frequencies

These can approximately range from 1,000 to 5,000 c.p.s., the final design, shown in Fig. 2, having an operating frequency of 2,000 c/s, dynatron controlled. Fig. 3, on which values can be noted, illustrates that the signal frequency is fed through a condenser to a single valve amplifier, one designed to serve *two* purposes: (1) To amplify the signal to such power that it is sufficient to light the flashlight bulb. (2) To supply automatic bias of such sufficiency in limiting action that it will prevent the lamp from burning out; additionally, this also acts as a sensitivity factor to prevent excessive oscillation and prevent the circuit becoming insensitive to minute changes in induction or positive resistance.

Design Sensitivity

That of the circuit shown (Fig. 3) is such that it will indicate two shorting turns on a coil wound from No. 44 SWG wire, or similarly, one wound with No. 38 SWG having but one shorting turn. This, converted to values of parallel resistance across an inductance, is

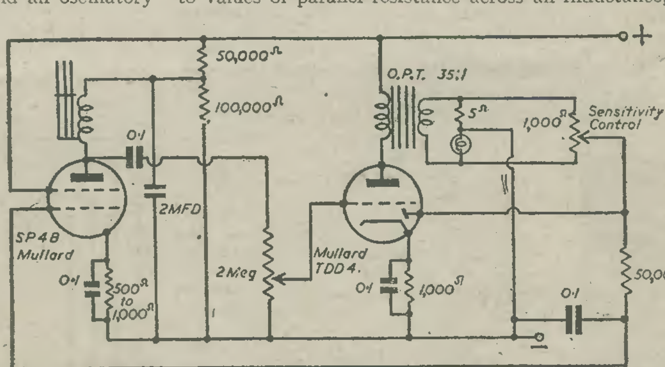


Fig. 3.—The complete circuit, including the amplifier. The exploring stack of laminations is shown in the anode circuit of the SP4B Mullard valve. Circuit constants should be adhered to. If other valves are used, cathode bias resistors must be correspondingly changed in values. Operating potentials are dependent upon the types of valves employed.

in the neighbourhood of 3 megohms in shunt with an impedance of 25,000 ohms. As an example, a coil placed over the stack had an inductance value of 2 henrys; then a 3-meg. resistor was shunted across the turns—the indicating lamp went out, this stressing the fact that the instrument can be made less sensitive by shunting resistance across the circuit inductance.

Approximating Turn Numbers

By modifying the circuit to Fig. 4, it is possible to approximate the number of turns in a coil under test with windings ranging from 400 to 50,000 in number. Although it is not possible to definitely indicate the number of turns on a faulty coil, there is, in most instances, a similar coil used as a standard in a receiver from which a ratio of good to bad may be found, comparison more or less indicating the number or location of the shorting turns. The method of switching from a range of coils, 500 to 5,000 turns, and 5,000 to 50,000 turns, is clearly shown on the drawing, the 2-megohm potentiometer having to be calibrated from coils of known turn numbers and the switch thrown for the second set of readings which are multiples of 10 of the first or calibrated set of readings.

To Operate

Warm up the tester for 15 minutes previous to use, making sure that all coils are well away from the vicinity; then adjust the sensitivity control until the lamp lights and place the coils to be tested one at a time over the stack of laminations, watching at the same time to see if the lamp extinguishes itself as indication of a partial or entirely short-circuiting set of turns. To check the rig before testing, place over the stack a 2in. diameter ring made from No. 20 SWG tinned copper wire; if in working order the lamp will automatically shut itself off.

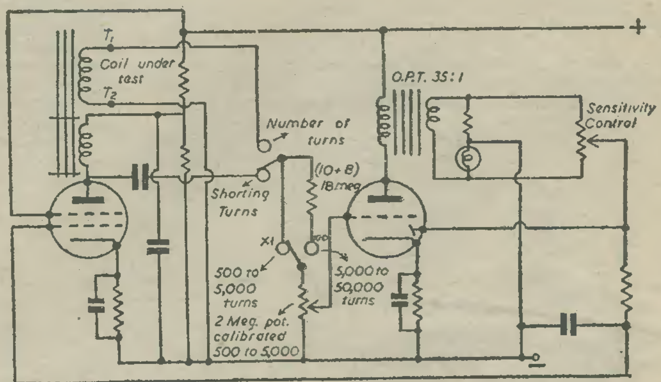


Fig. 4 depicts the simple circuit modifications necessary for approximating the position of the shorting turns. Constant values, not shown, are as for Fig. 3.

Servicing Application

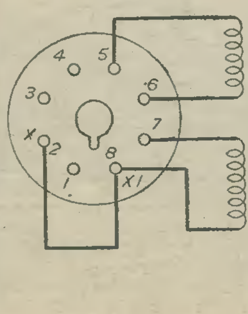
This instrument will prove extremely useful to service engineers as an aid to checking against intermittents suspected as being due to short-circuiting coils expanding and contracting under operating conditions—especially oscillator coils in superheterodynes.—*Paper read before the Institute of Practical Radio Engineers.*

Wave-change Indicator for Plug-in Coils

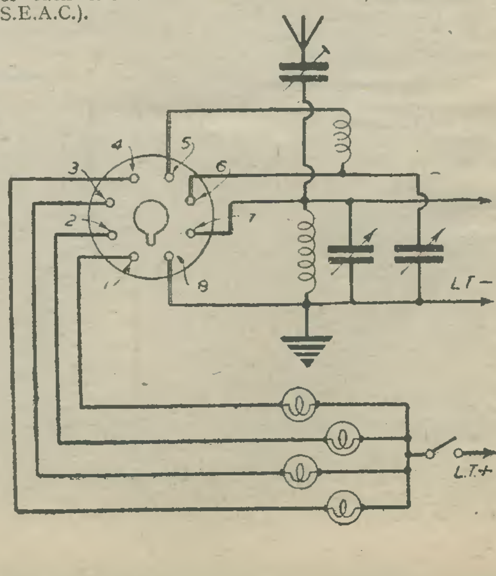
HAVING built a small set with plug-in coils I found it difficult to find the coil I required when operating the set in the dark. So I hit on this idea. Fig. 1 is an octal based coil. This coil was made with the base of a valve. To cover all the short-wave bands I made four coils like this. The connections to the valve base from the coils are shown in Fig. 3. Note: These connections are quite normal except for the connections X, X1. In each coil the connection X1 remained on the earth pin No. 3, but the connection X was taken to a different one of the blank pins, 1, 2, 3 and 4 in the case of each of the four coils.

Fig. 2 is the connection of the valve-holder in the set. It will be seen that each of the blank pins 1, 2, 3 and 4 have a pea lamp connected between them and L.T.+. These four-pin lamps are of different colours, and they are so arranged before the dial of the receiver as to give an equal light over the dial.

It can now be seen that X, X1 connections on any of the coils will complete the circuit and light the pea lamp. The position of X on the coil is different in the case of each coil so that a different bulb is lit for each coil. This means that the colour of the dial changes for each one of the four coils.—A.C./1 MARTIN, R (S.E.A.C.).



Figs. 1 and 2 (left). — The coil and details of connections to the coil pins. Fig. 3 (right). — Circuit showing how the lamp switching is effected.



Constructing a Communications Superhet

A Novel Idea for Simplifying the Construction of this Type of Receiver

THIS article puts forward, in brief, suggestions for those amateurs who have a certain amount of technical and practical knowledge, but who hesitate at the rather formidable task of constructing a communications superhet, and for those who have to consider seriously the cost involved.

The basic principle of the scheme in mind is not a new one, but dressed up in many refinements it can be adapted very efficiently for our purpose.

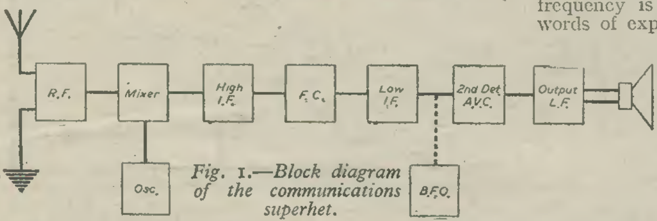


Fig. 1.—Block diagram of the communications superhet.

Nearly all will be familiar with the conventional converter/broadcast receiver type of short-wave set. No really serious communications work can be done with this type of apparatus in its usual form, but with certain modifications and a few additions the amateur can use this principle, and make for himself a highly efficient communications superheterodyne, with a great saving in both expense and time, over more conventional methods of construction.

It will be appreciated that when a converter is used ahead of a broadcast superhet receiver, the apparatus as a whole functions as a double superheterodyne. Fig. 1 depicts in block diagram form a suggested stage-by-stage lay-out for a communications receiver built on the aforementioned principle.

Circuit Layout

It will be seen that the last four stages of Fig. 1 are simply a broadcast superhet of average specification, with the addition of a beat-frequency oscillator. Previous to this there is an amplifier marked "high I.F.," and in front of that an efficient short-wave frequency-changing circuit, preceded by a radio-frequency amplifier.

The advantages of this type of circuit are as follows: A well-designed R.F. stage does much to reduce noise—an important factor when receiving weak transmissions. If the right type of valve is chosen, considerable gain is also available, even upon the highest frequency range of the set.

The type of frequency-changer depicted uses two valves, one as a mixer, and the other as a separate oscillator. This arrangement tends towards freedom from frequency drift, and complete isolation of the oscillator tuning, so that there is no pulling between the oscillator and other tuning controls.

The high I.F. amplifier is simply a fixed-tuned radio-frequency amplifier, which is tuned to the same frequency as the broadcast receiver which follows it. Since this frequency is extremely important, it requires a few words of explanation. In order to obtain good image suppression at high frequencies it is advisable to use a high intermediate frequency. This is done by tuning the above-mentioned amplifier and broadcast receiver to a wavelength of about 200 metres.

Construction Details—The Broadcast Receiver

This portion requires very little actual work, but if the complete receiver is to function correctly there are various details which will require care. It is not suggested that the B/C. receiver be left in its cabinet. It should be mounted, together with the other units, on a shallow chassis, which will be considered later. It is impossible to take any particular receiver into consideration, since each individual will probably find access to a different type. However, whatever the receiver, keeping in mind that it must be a superhet and preferably mains operated, the following tests and alterations should be performed.

Firstly, remove the receiver from its cabinet. Thoroughly clean, using a soft brush, and carbon-

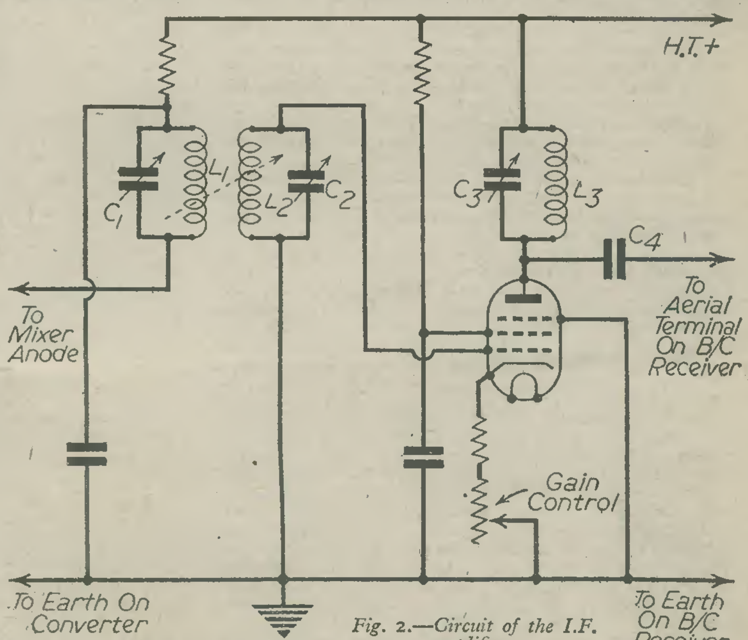


Fig. 2.—Circuit of the I.F. amplifier.

tetrachloride where necessary. Air test the set, and if there is the slightest suspicion of mains hum this should be completely removed, the probable cause being the smoothing condensers in the power supply, especially since in most cases the receiver will either be second-hand or one which has seen much use in the past.

All controls should be smooth and noiseless in action. Clean the wave-change switch contacts thoroughly. If possible, make a component test throughout, paying

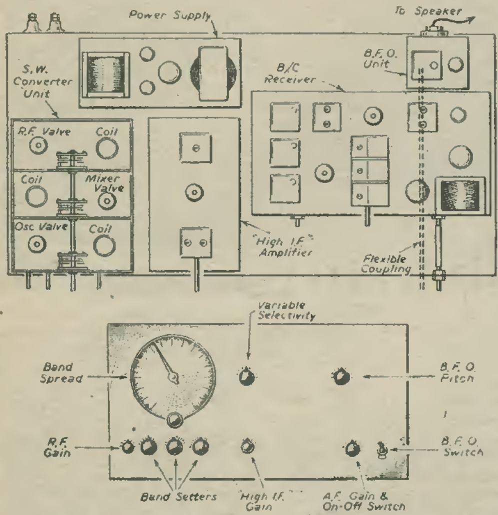


Fig. 3.—Suggested layout of the complete superhet.

special attention to condensers. Check the wiring for bad connections and poor insulation. Be sure that the I.F. transformers are correctly aligned. Have all valves tested. Any spurious noises or crackles in operation must be eliminated.

Finally, the input and oscillator tuned circuits must be ganged for optimum efficiency on the lower part of the medium-wave band.

If the amateur has insufficient facilities and experience to carry out the above, particularly the ganging and I.F. alignment, he should approach a reliable service engineer.

The High I.F. Amplifier

The construction of this unit should present no real difficulty, since it follows quite normal R.F. practice, and requires few components. One stage of amplification is quite sufficient, and Fig. 2 suggests the type of circuit which can be used, although the experimenter will undoubtedly discover many modifications which will work equally well.

The I.F. transformer L_1, L_2 may be easily constructed by using two small lengths of tubing, and winding on each a single layer coil which will tune over the lower part of the medium wave band in conjunction with C_1 and C_2, which should be small .0001 mfd. preset condensers. One coil should be made variable with respect to the other to obtain variable selectivity, and the control brought out to the front panel.

C_1, C_2 and the coils L_1, L_2 must be mounted together inside a screening can.

The tuned circuit C_3, L_3 is identical with either primary or secondary of the transformer just described. However, with loss of gain, it may be omitted, and an efficient high-frequency choke put in its place, although this procedure is hardly advised. Of course, this tuned circuit must be completely screened.

The coupling condenser C_4 is a small capacity preset type, and the shortest possible connections must be used in coupling it to the B/C receiver. Here again, screening may be necessary.

The gain control is essential and must not be omitted, otherwise strong signals will completely overload the B/C receiver. To obtain the best signal-to-noise ratio, this control should always be kept as low as possible during operation. The valve used may be any suitable R.F. pentode of the variable-mu type.

The lead to the mixer anode must be as short as possible, and this can be arranged when laying out the components.

The Converter

This is the most important part of the entire apparatus, but it is not intended in the scope of this article to give exact constructional details of any particular piece of apparatus, but rather to put forward suggestions which will guide the constructor and experimenter in his efforts.

Difficulties of ganging may be overcome by using separate bandset condensers of about .00015 mfd. capacity and ganged bandspread condensers of 15-20 mmfds., in conjunction with plug-in coils, which in their turn will obviate difficult wave-change switching and its associated losses. All coils should be screened, however. If it is desired to work the receiver down into the 56 megacycle amateur band regions, then it will be found necessary to reduce the value of the bandsetters to not greater than .0001 mfd. for various reasons.

If operation over the amateur bands only is required, further simplification is possible, by eliminating the bandsetters and fitting specially wound coils with small air trimmers. To cover the lower frequency bands, it may be then found necessary to increase the value of the bandspreaders a little. The type of frequency changer suggested has been dealt with in previous numbers of PRACTICAL WIRELESS and lends itself to simple and efficient layout, also stable high-frequency operation.

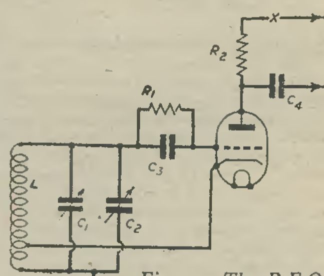


Fig. 4.—The B.F.O circuit.

C_1—.0005 mfd. preset.
C_2—25 mmfd. variable.
C_3—.0003 mfd.
C_4—Approximately 5 mmfd.
R_1—50,000 ohms.
R_2—20,000 ohms.

The RF stage should make use of a low-noise pentode, such as the Mullard EF8, or one of the special high-frequency types shortly to become available.

Fig. 3 gives a suggested layout for the receiver, and all units are mounted on a shallow chassis, either of metal, or of wood with foil covering.

The B.F.O.

This can be built up as a small unit and mounted behind the B/C receiver. Fig. 4 shows an extremely simple form of B.F.O. circuit.

The circuit L, C_1, C_2 should tune over a range covering the intermediate frequency of the B/C set. For 465 kc/s I.F., L should be wound on a 1in. diameter former, and consists of approximately 180 turns of 36 gauge insulated wire, tapped about one third up from the earthy end, the winding being in the form of a single layer coil. The trimmer, C_1, should be mounted together with the coil and the pitch control, C_2, in a screening can. C_2 can be operated from the front panel by means of a flexible coupling. If the I.F. of the receiver is around 110 kc/s, then it is best to obtain an old I.F. transformer of that frequency which has its windings slot wound, remove one coil completely, and tap the other one third from its earthy end. C_1 will then be replaced by one of the trimmers in the transformer.

The other end of C_4 goes to the second detector diode anode in the B/C receiver, or if the second detector is a triode, to its grid.

H.T. must be adjusted until stable operation is obtained.

The unit may be switched at the point marked X in Fig. 4.

Power Supply

This will depend upon whether A.C. or D.C. mains are available. The B/C receiver has its own, and it is not advisable to run the other units from it. However, a separate unit should be built up, and many suitable circuits for such have appeared in PRACTICAL WIRELESS during the past.

In conclusion, a few final suggestions might be put forward to guide the experimenter.

To improve appearance, the dial of the B/C set should be removed. The speaker should be housed in a separate case, the leads from the receiver being brought out to a valve socket on the back of the main chassis. The leads from the speaker may then be attached to a valve base, which may be plugged into the socket.

If a tone control is not already fitted to the B/C receiver, this can be done quite easily. Again, headphones may be added, also the A.V.C. line in the B/C receiver can be switched, so that A.V.C. can be made optional. The existing on-off switch should be made to operate the power supply as well as the B/C set. A send/receive switch could be added, in fact, the unit system of construction makes it possible for the keen experimenter to make many alterations and modifications with ease, and without disturbing the entire receiver.

The I.F. amplifier unit could, if desired, be modified to include a crystal gate and the tuning gang on the broadcast receiver replaced by small trimmers.

U.S.W. Listening

The Importance of Choosing a Suitable Receiver, and Some Hints for 10 Metres and Below.

By W. J. DELANEY (G2FMY)

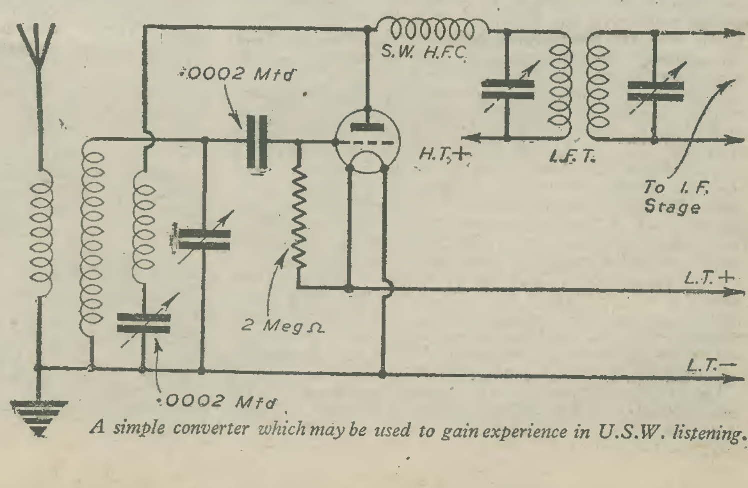
MANY readers are at present finding a great interest in listening to the amateur bands, some merely from an entertainment point of view, but others in order to gain experience in the procedure which is adopted in both W/T and R/T communication. The latter readers are in all probability hoping at some future date to join the ranks of the transmitters and find the W/T signals very useful for their morse practice. One thing which will strike many of those who are already listening to these bands is the importance of the receiver efficiency. Almost every time one tunes in to the amateur band one can hear a local amateur giving a C.Q. call, and whilst he is searching the band you can on your own receiver perhaps run over the band and hear a really long-distance reply, only to find on going back to the local amateur's frequency that he has failed to get it on his receiver. It is not, however, always due to inefficiency in the receiver, but on the 10 and 5 metre bands the aerial plays a very important part. Therefore, let us see just what we must do if we are to get the best out of the present amateur frequencies.

Aerial Design

Firstly, it is important to remember that the only frequencies at present licenced are the 10 and 5 metre bands (actually 28 to 30 mc/s and 58 to 60 mc/s). These frequencies are quite different in their performance from those used for B.B.C. programmes, for instance. At the time of writing it is possible on quite a small and very simple receiver to hear American amateurs up till about 5 o'clock, and then they fade out and cannot be heard at all. Therefore it is difficult at some times to tell whether one is using an inefficient aerial or receiver or whether conditions are bad. Experience will enable one to ascertain what is wrong, as well-known commercial stations may be found on other nearby frequencies and their performance used as a check. For the aerial, the ordinary straight wire as used for the B.B.C. normal programme is not the best. It will give good results, as also will the various forms of elevated capacity aerials. But for 5 metres especially, the special beams, folded arrays and other unusual types will be found much more satisfactory. The only drawback is that they must be designed for one of the bands only, and an aerial built, for instance, for 10 metres will not be so efficient on 5 metres as one specially designed for the latter wavelength. However, by erecting a harmonic aerial—say, half-wave on 5 metres—this will act as quarter-wave on 10, and with some of the special aerials this may be found a very effective arrangement. The main drawback to these special arrays is the room that they take up, but provided that space is available they are definitely well worth while, and will make all the difference to long-distance reception.

Receiver Design

So far as the type of receiver is concerned, there is considerable scope for experiment. Undoubtedly the best type of receiver is a properly built and designed multi-valve superhet, with good band-spread tuning. But many amateurs still prefer the super-regenerative two- or three-valver, and get remarkable results on



A simple converter which may be used to gain experience in U.S.W. listening.

them. My advice, if you are eventually going to join the ranks of the transmitters, is to spend the time building a really good multi-valve superhet (or obtaining a good make of commercial receiver), and in this connection the type known as a "communications receiver" should be the aim, not a standard broadcast receiver which might include 10 metres in its range. Normally, the standard broadcast set which has a short-wave section does not go below about 15 metres; there are a few which may still be in use with tuning down to 9 metres, but in the majority of instances the tuning is far too crowded on the 10-metre band. The ideal arrangement, of course, would be to have a receiver with a tuning scale covering 300 degrees (such as the Eddystone), and the coils so chosen that the complete amateur band *and no more* is covered by a complete rotation of the dial. The only drawback to this arrangement is the time it takes to tune round the scale, but if it is being used only for entertainment this will not matter too much. Some of the better class of commercial communications receivers have double-geared dials, or fly-wheel tuning or something similar, whereby one can get round the dial a bit quicker, but again this is open to question, as, if you are searching for a reply to a call, for instance, tuning too quickly round the band may result in passing a station just as there is a slight pause in the transmission, or missing a very faint signal, whereas, on the other hand, if tuning is too slow, by the time you have reached the other end of the band the station replying may have finished and gone over to reception.

A C ompromise Needed

It is therefore necessary to compromise in some way, either by concerning yourself with only one half of the band or by careful choice of the tuning band. It will be seen from the above that the question of receiver and aerial design for these frequencies is not a simple matter, but the keen amateur will find the utmost pleasure in experimenting with all the different schemes which are available. Circuits are published from time to time in these pages for receivers, and the question of aerials will also be covered in due course. In the meantime, if you can obtain the co-operation of a local transmitting amateur and listen to the wave-bands in question on his aerial and receiver you will get some idea of what to expect in your particular locality, remembering also that conditions vary according to particular local geographical conditions, as well as time of day and year.

Comparison of Electrostatic and Magnetic Deflection in C.-R. Tubes

Précis of a Discussion at a Meeting of the Radio Section of the I.E.E., held on Tuesday, February 26th, 1946

THE method of deflection used in a cathode-ray tube is of particular importance in television because it has considerable influence on picture quality, brightness and cabinet depth. The relative advantages of the various methods were argued at a discussion meeting held by The Institution of Electrical Engineers on February 26th, 1946.

The openers stated in their introductory remarks that a knowledge of the properties of magnetic and electrostatic deflection cathode-ray tubes and of their associated circuit problems is necessary before one can decide on the most suitable type to use in any given instance. When the choice is not dictated by technical factors it may be an involved technical and economic problem.

The Properties of the Cathode-ray Tube

The designer produces a cathode-ray tube which is the result of compromise. It must have an adequate life and a good focus and be as bright as possible. The focus must be satisfactory over the whole screen area. This is an important condition, because in all tubes the focus size increases as the beam is deflected. This property is called "deflection defocusing." The defocusing is a more serious problem in electrostatic tubes, because the different cross-sections of the beam undergo different energy changes in the deflecting field. The defocusing can be mitigated by increasing the sensitivity and by reducing the beam diameter. In a typical case with a half scan angle of 12 deg. the beam has to be trimmed to about half the diameter which can be focused without aberration by the electron lens in the centre of the screen. In the equivalent magnetic tube the beam diameter can be increased to the limit determined by the aberration of the lens. Since the lens diameter of a magnetic tube is greater than that of the equivalent electrostatic tube, more than twice the beam diameter can be used, compared with the electrostatic case. This corresponds to at least a fourfold increase in brightness. In practice this superiority of the magnetic tube can be used in other ways, e.g., by increasing the scan angle the length of the tube can be reduced with some sacrifice of brightness.

The electrostatic tube suffers from trapezium distortion, while the magnetic tube may have pincushion or barrel distortion if the scanning coils are badly designed.

All tubes contain gaseous ions when the tube is operating. Electrostatic deflection spreads the charged ions uniformly over the screen, but a magnetic tube develops a black spot or patch in the centre because the heavy ions are not appreciably deflected. For some applications this may be a serious fault.

Circuit Properties

At all normal accelerating potentials the energy required to scan an electrostatic tube is considerably less than that required to scan a similar electromagnetic tube.

With electrostatic deflection, the load into which the deflecting circuit operates is a fairly pure capacitance, so that, theoretically, very little power is required. In practice, the energy supplied is destroyed after every deflection cycle, unless only a narrow band of frequencies is to be reproduced. The power supply to the deflecting circuit will be proportional to the frequency, so that the inherent efficiency of the electrostatic tube enables it to be deflected over a wide band of frequencies.

The load in the magnetic case is mainly inductive, but will possess various resistive and capacitive components. The maintenance of a constant field shape and intensity over a wide band of frequencies, while feeding into such a complex load, presents considerable difficulty.

Combination of Tube and Circuit Properties

The final choice of type of deflection must be governed by a careful balance of both tube and circuit considerations. In some instances the choice is well defined, but certain border-line cases provide scope for discussion. Where a considerable area of the cathode-ray tube screen has to be illuminated the increased brightness of the magnetically deflected tube usually outweighs other factors.

Old Circuits Reviewed—2

In this Article the Cockaday and Various Reflex Circuits are Dealt With

I HAVE evolved a modification of the Cockaday circuit, which is shown in Fig. 10. In this the aerial is centre-tapped on to the coil A, which consists of 65 turns of No. 22 wire on a 2½in. former. The bottom end of this is connected to a small inductance coil B, the bottom end of which is earthed. The coil A is screened from the rest of the circuit. The coils C and D are identical, and consist of 65 turns of No. 22 wire on a 2½in. dia. former. The coil B, which is one or two turns only of No. 18 wire, is wound over the coil C, about halfway along its length.

The action of tuning is as follows: Rotate the condenser C_2 until the desired station is heard, however faintly. Then rotate C_1, which should bring it up in strength. The set will probably oscillate, so C_3 (the stabiliser) is manipulated until oscillation ceases and the desired station is received free from interference. A little practice is required before the set can be handled properly, but once skill has been acquired in the handling you need not fear a powerful local station.

As mentioned previously, this circuit not only separated the Home Service on 285.7 metres from the Light Programme on 261.1 metres, but received a French station in between and got a whiff of several more—the equal of a superhet or of a straight set with several H.F. stages for selectivity.

I now propose to describe a few dual-amplification circuits which have the merit of having been tried by the writer with modern valves, etc. So far, I have dealt solely with circuits in which the valve did only one job at a time; the following circuits furnish us with the pleasant idea of one valve doing several jobs at once—hence the term, dual-amplification.

Reflex circuits have suffered a heavy decline in recent years, and may be new to many. Their chief attraction is, of course, their economy, since one valve and a crystal rectifier can be made to give (nominally) three-valve results. On the score of filament current and H.T. juice, therefore, they are well worth while to those who are prepared to give them the necessary attention to enable them to operate satisfactorily.

From the very earliest days of broadcasting the idea has been adopted of using a valve over and over again to increase the amount of amplification, and correctly used, this idea is a very powerful one. The reader will be aware, of course, how reaction or regeneration is used in this way, by feeding back a certain quantity of energy. This is a widely used method of increasing the amplification. Other methods are by reflexing, and by super-regeneration. It is with reflexing that I propose to deal now.

The Simple Reflex

Firstly, let us see how a simple reflex receiver can be constructed with the aid of a crystal set. This circuit is shown in Fig. 11. A modern output type tetrode valve is used, such as the Cossor K.T.2. The crystal set is included at the position shown. The phone terminals of the crystal set are connected to the primary of an L.F. transformer, the secondary of which is connected between the bottom of the coil and L.T. negative, with a G.B. battery inserted to bias the valve.

The valve first amplifies at high-frequency, the magnified H.F. impulses being passed from the anode to the tuned coil of the crystal set. They are then

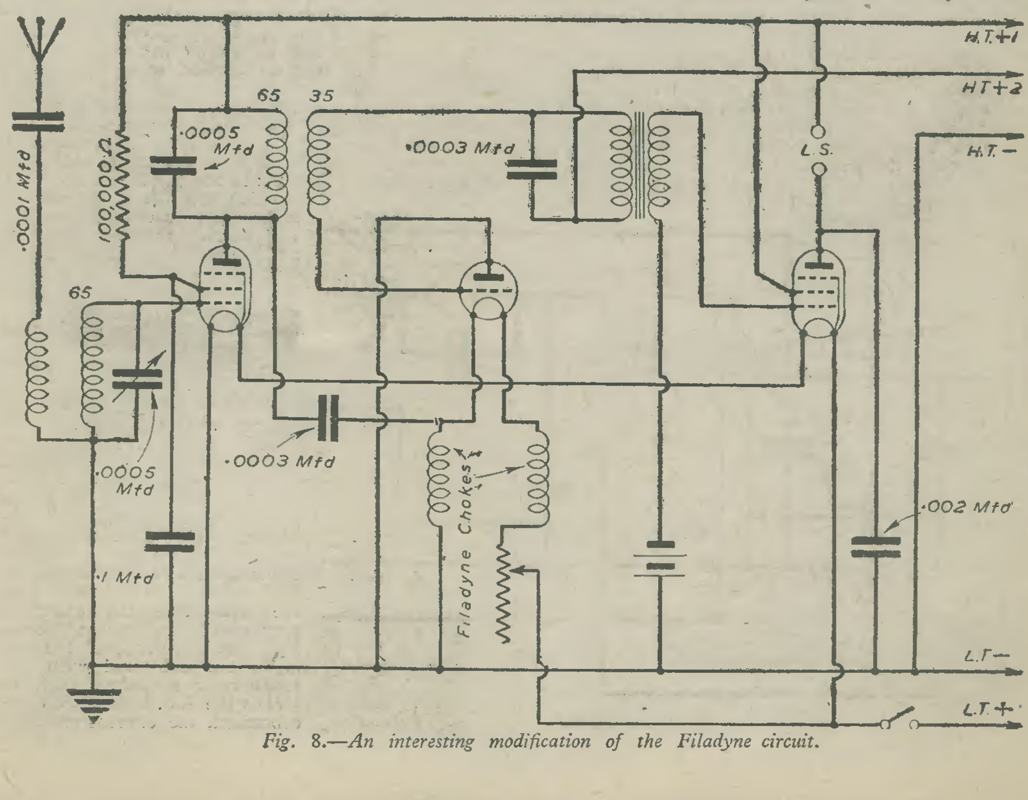


Fig. 8.—An interesting modification of the Filadyne circuit.

rectified by the crystal and passed to the grid of the valve again by the transformer, where the customary amplification at low frequency takes place. The phones are connected as shown, but in most cases a loudspeaker will be used. The tetrode valve is not nearly so prone to self-oscillation as the triode, and no neutralising is necessary. If desired, an H.F. pentode can be used in place of the L.F. tetrode, but this will

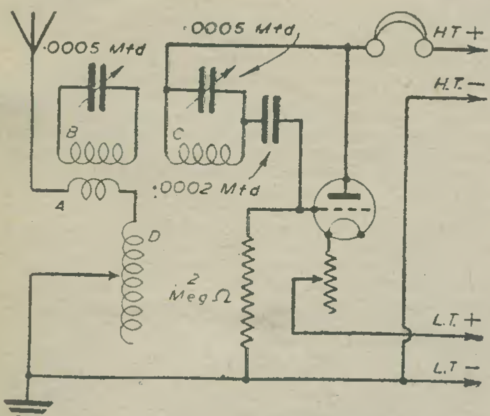


Fig. 9.—The Cockaday 4-circuit set

not be as satisfactory as its impedance is too high to work into such a load as a loudspeaker or phones. Note the .0003 mfd. condenser across the secondary of the transformer and G.B. battery, and the .002 mfd. condenser across the phones and H.T. battery; these are for the purpose of by-passing H.F. currents.

This circuit illustrates the principle of all reflex circuits, i.e., the valve first amplifies at high frequency, afterwards at low frequency. In the ordinary way you cannot use reaction twice in one receiver, unless each volume of reaction is less than the limit possible with one form only. But when the frequencies are widely enough separated we can use two forms of reactions without trouble. That is, when one form of regeneration is at high frequency we can employ another form of regeneration at low frequency, and still keep the circuit stable.

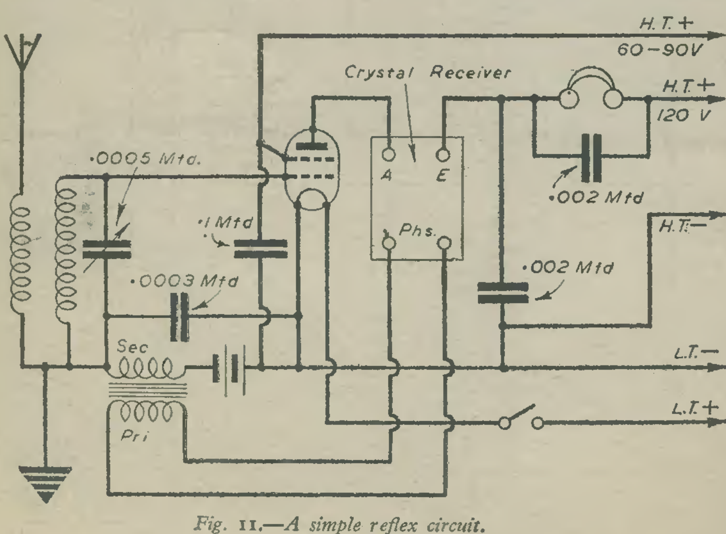


Fig. 11.—A simple reflex circuit.

The Hale Circuit

This is the principle of operation of Fig. 12. This will be seen to differ from the foregoing circuit, and indeed from most reflex circuits. The arrangement of the transformer and crystal rectifier is somewhat unusual, but surprisingly effective. It is known as the Hale circuit.

Simply explained, the function may be said to be as

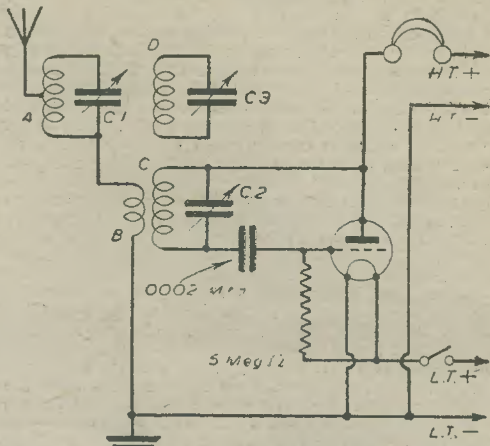


Fig. 10.—Modified Cockaday circuit.

follows. The incoming signals are tuned by the coil and condenser in the usual way, but they are applied to the grid and filament of the valve in a rather unusual way. It will be seen that a lead is taken from the top of the coil to the lower end of the secondary of the L.F. transformer. Now, every winding has a certain capacity, and while in modern transformers the self-capacity is reduced to negligible proportions, so far as the low-frequency (audio) currents are concerned, the capacity still present is quite sufficient in this case to convey the high-frequency (radio) currents from the lower end of the winding to the upper end, which is connected to the grid. This capacity is shown by a dotted condenser in Fig. 12. The H.F. currents therefore reach the grid and are amplified. The amplified energy is fed back to the grid by means of the reaction coil. It is possible to make the set oscillate by variation of the reaction coil, and by keeping the set below oscillation point we can get all the advantages of reaction amplification.

So far we have been considering the high-frequency current without detection. Let us now see what happens in the rectification of the signal.

You will notice that the primary of an L.F. transformer is connected in series with a crystal detector, and that these two components are connected across the main coil and condenser. The L.F. pulsations thus obtained induce current in the secondary of the transformer, one end of which is connected to the grid and the other is connected to the filament through L_1. The inductance of the coil is so low compared with the transformer secondary that, as far as the L.F. fluctuations are concerned, the effect is precisely the same as if the lower end of the transformer secondary were connected directly to the filament.

Grid-bias is obtained through the coil and transformer

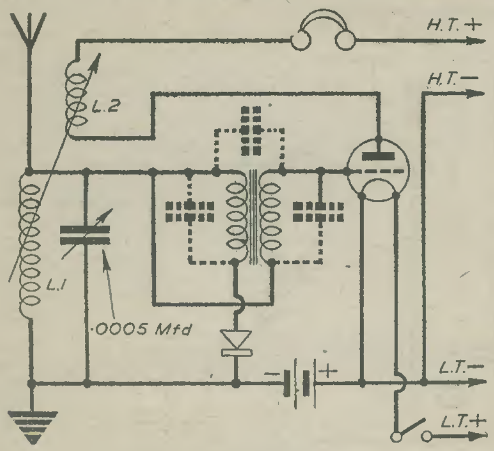


Fig. 12.—The Hale circuit.

secondary, and by adjusting this we can cause the valve to work on a suitable portion of its characteristic curve for amplification purposes. The valve thus not only works as a high-frequency amplifier, but also as a low-frequency amplifier. We thus obtain the advantages of three stages in one, and the circuit is so efficient that it will work a loudspeaker without pushing the reaction too much.

Modernising the Hale Circuit

Thus far the old circuit of the Hale receiver. The modernising of the Hale is simply carried out, and is indicated in Fig. 13, which it will be seen employs a pentode valve.

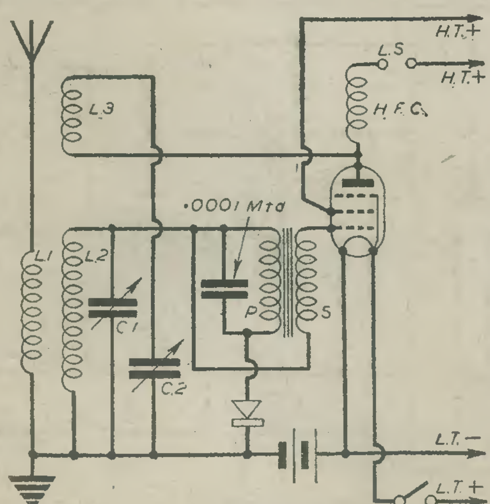


Fig. 13.—A modified Hale circuit.

Aperiodic coupling has been here added to the aerial, to increase selectivity and do away with the old moving-coil reaction in favour of a coil and condenser, L_3 and C_2. This necessitates an H.F. choke, which is included in the usual position. The pentode can be a Mullard P.M.22A, or similar valve of other makes, or a beam tetrode may be employed.

The rectifier can be a semi-permanent type of crystal detector, but some makes are only sensitive to strong signals such as the local station, and with these you will miss the weaker stations. With a suitable rectifier distant stations can be picked up, whilst the local comes in at great strength on the loudspeaker. It is also worth mentioning that with some transformers grunting or popping noises may be heard at oscillation point (threshold howl). A condenser (.0001 mfd. or .0002 mfd.) across the primary, and/or a resistance of ¼-meg. across the secondary, will in most cases cure this.

Strange as it may seem, there are "straight" and "queer" reflex circuits. Figs. 12 and 13 are examples of the latter class, while Fig. 11 is an example of the former. Nearly all reflex circuits are modifications of Fig. 11.

Thus, by employing an H.F. transformer, with the crystal in series with the secondary, and by feeding the output of the crystal to the primary of an L.F. trans-

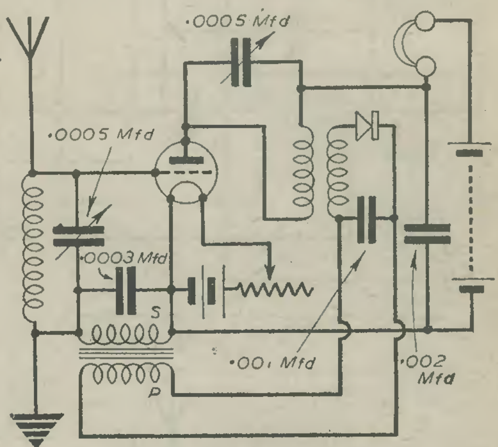


Fig. 14.—Another reflex circuit.

former, the secondary of which is included in the grid circuit of the valve, we have a modification of Fig. 11. Such a circuit is Fig. 14. I give it as it appeared. The modern version is given in Fig. 15, which, it will be observed, uses a tetrode valve (L.F. beam tetrode such as Cossor K.T.2).

This valve, as previously mentioned, is much less prone to self-oscillation than the triode, due to the action of the screening grid, which it will be observed is used to provide some regeneration. This auxiliary or screening-grid is given a potential of 45-90 volts, depending upon the anode voltage and grid-bias. For loudspeaker operation, both the anode and auxiliary grid may be given a potential of 120 volts, with appropriate grid-bias. I have also taken the opportunity to introduce reaction, from the screen grid. This can be recommended as reasonably trouble-free, providing care is taken in the spacing of the wiring, etc.

Without a Crystal Set

There are, however, those who do not like the crystal set. They prefer the steady qualities of a valve, and in their case the extra expenditure is worth while. The old circuit of a set employing a separate valve for detection is given in Fig. 16. Little comment will be necessary, except to say that the circuit is extremely difficult to handle, due to the triodes breaking into oscillation when not wanted.

Fig. 17 (to be given next month) shows what can be done to modernise such a circuit as Fig. 16. A modern twin coil is used, tuned by a 2-gang condenser of the usua .0005-mfd. each section. The coils have the usua primary, secondary and reaction windings. The aerial, A1, goes to the primary of the aerial coil through a .0001-mfd. fixed condenser when the set is reflexed; when "straight" the aerial goes to the A2 connection.

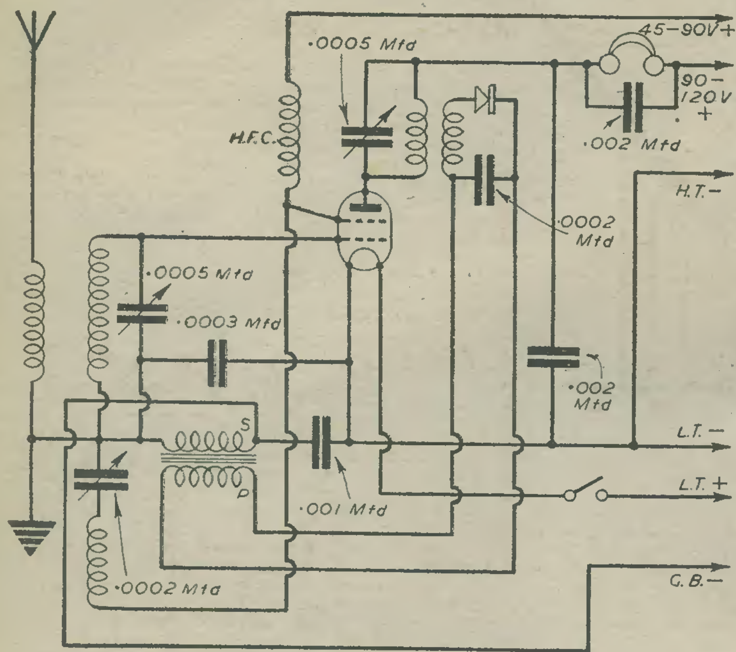


Fig. 15.—A modified form of Fig. 14.

The secondary winding of the aerial coil goes to the grid of the reflex valve in the usual way, without the inclusion of a condenser.

Let us now briefly trace the signal through the receiver. Emerging from the anode of the reflex valve, it passes (H.F. only) through the primary of the intervalve coil and thence to earth via the .001-mfd. condenser. In so doing it generates a corresponding signal in the secondary winding, which is fed through the .0002 mfd. condenser to the grid of the detector valve, where it is rectified. Thereafter, we deal with an L.F. component of the applied signal, which passes through the H.F.C. to the L.F. transformer. Here, instead of being led to a third valve it is fed back to the first valve again.

The loudspeaker connection is taken from the anode circuit of this valve through an H.F. choke which, together with the .001 mfd. condenser at the bottom end of the primary winding of the intervalve coil, forms a sort of "parting of the ways"; the L.F. component takes the easier path through the loudspeaker, while the H.F. part takes the easy path to earth through the condenser just mentioned.

By means of a switch the circuit can, however, be converted into an ordinary detector-L.F. affair. This is done by connecting the aerial to the A2 terminal, and opening the switch in series with the .001 mfd. condenser which provides a return to earth for the H.F. currents circulating in the secondary of the aerial coil. This is especially useful when listening to the local station for which no H.F. amplification is required. There is also an added brilliance, due to the removal of the condenser, in the reproduction.

Adequate decoupling of the detector stage ensures stability under all conditions, while volume can be controlled by means of the 50,000 ohms potentiometer across the primary of the L.F. transformer. Reaction is smooth and under perfect control by means of the .00015 mfd. differential reaction condenser.

No extravagant claims are made for the performance of this set. The sensitivity in the reflexed condition is not quite so high as that of the usual three-valver. It is capable, however, of bringing in numerous stations at good loudspeaker strength, and one has the satisfaction of knowing that one is getting "something for nothing"—a gain in H.F. amplification amounting to about 20/1 with no increase in either high-tension or low-tension consumption.

(*To be continued*)

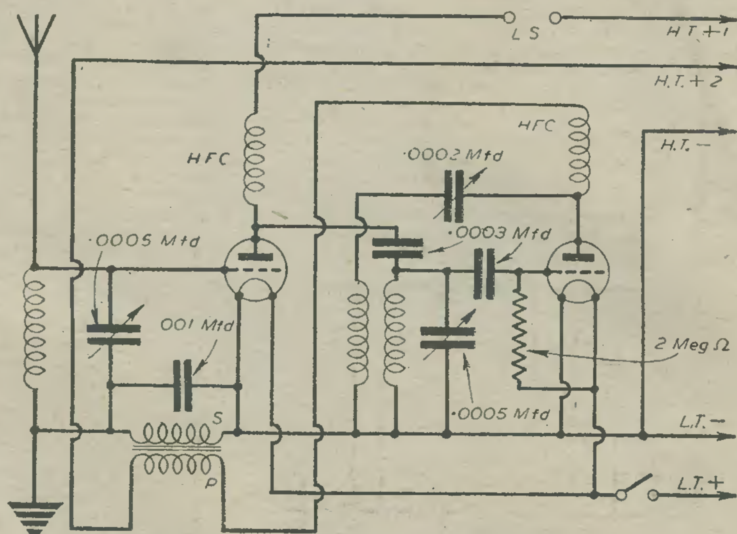


Fig. 16.—A reflex circuit employing a valve for detection.

Police V.-H.-F. Equipment

Details of Some of the Radio Equipment Now in Use

MOBILE radio telephony apparatus developed by The General Electric Co., Ltd., has been adopted by police and fire services in all the principal towns and cities of England. Forty important centres now have police schemes using G.E.C. equipment. More than 500 police cars are involved.

The National Fire Service have 27 similar schemes, the largest of which, in London, includes a river service.

Among the principal areas to adopt the G.E.C. system recently for police purposes are Cardiff, Hull, Leeds, Liverpool, Manchester, Newport (Mon.), Newcastle-on-Tyne, Plymouth, Portsmouth, Sheffield, Southampton, Southend, S. Staffordshire, Swansea and the Metropolitan Police.

Technical Details

The equipment is designed for continuous operation on any fixed frequency within a range of 30-131 mc/s (10-2.29 metres) and will work under varying degrees of temperature and humidity.

The 100-watt transmitter at the control station comprises six units—radio-frequency output unit, radio-frequency driver unit, A.G.C. modulator, control panel, modulator power supply unit and radio-frequency power supply unit. These are mounted in a steel cabinet, the heavier units being arranged on slide rails to facilitate removal for servicing. The cabinet has a protective finish and is adequately ventilated. The radio-frequency driver unit comprises a crystal oscillator, two doubler stages and a buffer amplifier. The valve used in this is a double triode, the output of which is at four times the crystal frequency. This unit is coupled to the radio-frequency output unit which comprises a class "C" power amplifier with two valves in push-pull. Meters are fitted to the front panels of both units and switches allow grid and cathode currents of all the H.F. stages to be measured. The frequency range of 30-131 mc/s is divided into wavebands. A change to a frequency in another band entails the changing of one or more coils, the fitting of another crystal and the resetting of all tuning controls. The modulator unit consists of a six-stage high-gain amplifier, two stages of which have automatic gain control. The output will fully modulate the H.F. final stage at high level. A level control is included and is operative on microphone and line jacks, sockets are provided on this unit for a plug-in self-contained audio tone oscillator which can be provided if required for modulated continuous-wave telegraphy. A meter fitted to the front panel of the modulator unit indicates the cathode currents of the valves in all stages. The modulator power supply unit provides three separate supplies—modulator filaments, H.T. (250 volts) for the first stages and H.T. (1,000 volts) for the class B modulator valves. These supplies are controlled from the control panel. The radio-frequency power supply unit provides two separate supplies—radio-frequency filaments and H.T. A special choke is incorporated for reducing the H.T. supply to a safe value when tuning up the transmitter. These supplies are also controlled from the control panel. A thermal delay switching unit is incorporated giving a time delay of 30-60 seconds to allow a sufficient delay period before applying the H.T. to the indirectly-heated valves.

The control panel consists of a group of electrically interlocked switches, which control individually each of the various power supplies for setting up, routine tests, etc. Pilot lamps are fitted above these switches. Master switches are also provided for normal control of the transmitter. Terminals are provided at the rear of this panel for remotely controlling the filaments and H.T. supplies from a nearby operating point, and by means of the G.E.C. special remote control equipment it is possible to control the transmitter from a distance of several miles.

The power circuits are fully fused, the fuses being grouped at the rear of the control panel.

A safety gate switch is incorporated which automatically disconnects the mains supply from the transmitter when the rear door of the cabinet is opened.

Remote Control

The transmitter/receiver remote control equipment is usually employed when the geographical situation of Police H.Q. is not ideal for direct use as a control station. It will operate at any distance up to 12 miles over a single pair of telephone lines.

The equipment comprises a control panel, a terminal panel and a microphone amplifier panel mounted on a 6ft. rack situated at the control station, and a relay panel and terminal panel on another 6ft. rack at the same site as the transmitter and receiver. It operates on a power supply of 195-250 volts 50/60 cycles single phase. The power input of the control panel is 30 watts, of the relay panel, 5 watts, and microphone amplifier, 25 watts.

The equipment for the control station can be supplied with a control desk suitable for mounting on the rack,

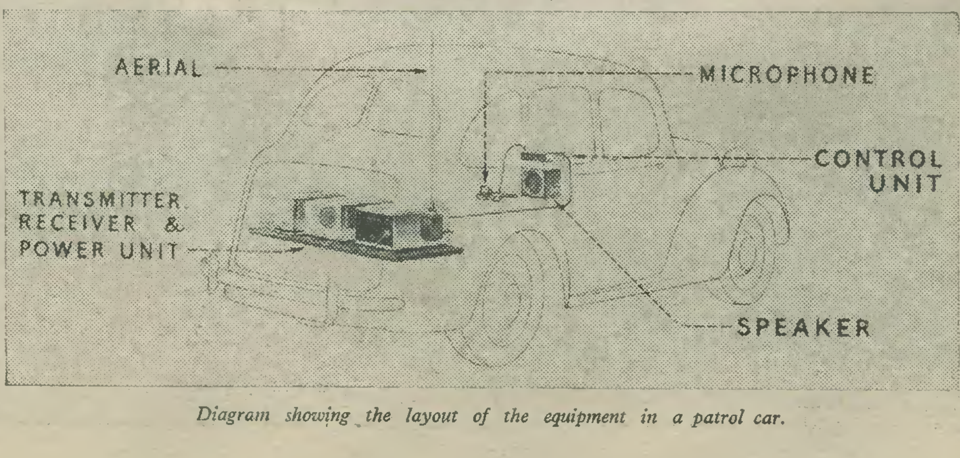


Diagram showing the layout of the equipment in a patrol car.

thus providing facilities for controlling the equipment simultaneously with the recording of messages. The following ancillary items are required for operation with the remote control equipment—a high-power aerial changeover relay, a moving coil microphone and a loudspeaker unit.

Extended Control Unit

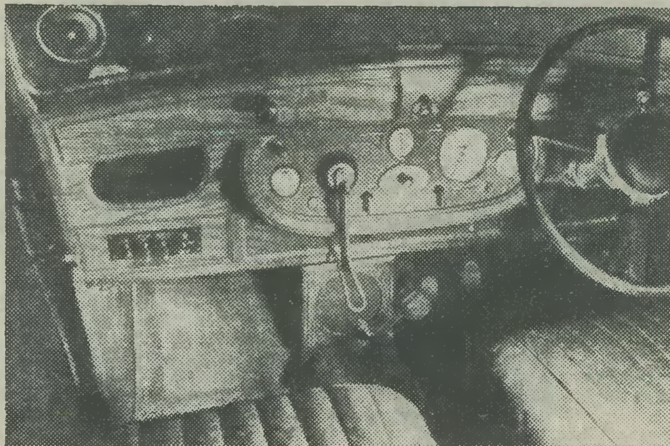
An extended control unit has been designed to provide a control of fixed station equipment up to a distance of 200ft. from the transmitter and receiver. It is intended for use with equipment arranged for "Simplex" operation, and comprises a small control unit and a separate line transformer. The unit is fitted with a mains "on/off" switch, a "transmit/receive" changeover switch and jacks for plugging in a microphone or a hand combination telephone. A volume control is incorporated to adjust the signals in the telephone receiver circuit to the desired level and two pilot lamps are provided for indicating the transmit and receive condition. All connections are made from the rear of the control box by means of a 10-way plug and socket connection.

Receivers

Both the station and mobile receivers embody a superheterodyne circuit with a stage of signal frequency amplification employing a pentode valve. This is followed by the first detector stage employing a similar valve. The oscillator stage, which is crystal controlled, consists of a triode connected tetrode in which the crystal frequency is tripled in the anode circuit. This is followed by a pentode as a further multiplier, giving an injection signal of 12 to 18 times the crystal frequency (12th or 18th harmonic). The 12th harmonic of the crystal frequency is utilised when operating in the signal frequency band of 63.5 to 83.09 mc/s and the 18th harmonic when operating in the signal frequency band of 83.09 to 131 mc/s. Following the first detector there are three stages of I.F. amplification employing a tetrode valve in each stage. These are followed by a double-diode valve functioning as second detector and noise limiter. The second detector is followed by a double-diode-triode, the diodes providing A.V.C. and the triode functioning as first L.F. amplifier. The audio signals are further amplified by a final stage employing a power tetrode.

The tuning controls are air dielectric condensers with screwdriver type of adjustment with integral locking. The frequency range of 30-131 mc/s is divided into wavebands. A change to a frequency in another band entails the changing of one or more of the coils, the fitting of another crystal and the realignment of all tuned circuits.

To limit the number of different crystal frequencies required to cover the complete range, the output of the oscillator multiplier (providing a local signal of a frequency 12 or 18 times that of the crystal) is arranged to operate either above or below the frequency of the incoming signal. A further reduction is effected by taking advantage of the frequency coverage of the I.F. stages, i.e., without altering the tuning of the oscillator multiplier, a signal of a frequency differing slightly from that to which the receiver has been previously set up can be received by retuning the I.F. and S.F. tuned circuits. This adjustment can be made to receive a signal of any frequency within the bands for which the receiver has previously been set up. The band-width of the I.F. amplifier is sufficiently wide to ensure that the frequency drift of the crystal does not detune the receiver.

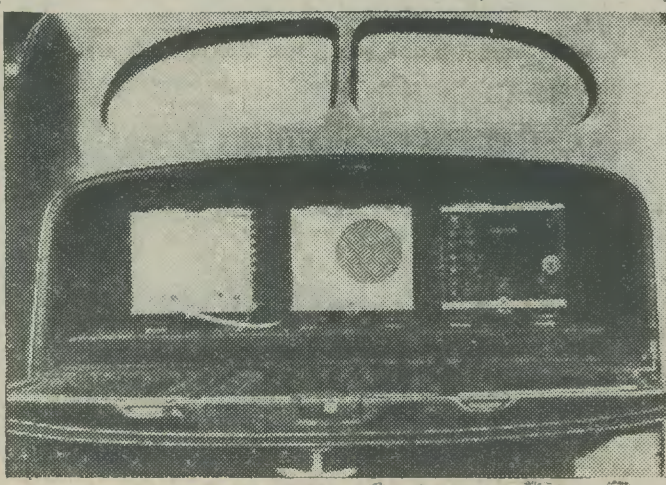


Interior of a police patrol car showing the mike on the dashboard and the loudspeaker below. The control panel is under the glove box.

Delayed A.V.C. is applied to the signal frequency and intermediate-frequency amplifier valves and the carrier operated noise limiter is permanently in circuit.

The mobile receiver consists of a single chassis housed in a suitable ventilated steel cabinet secured to a resiliently mounted base by means of a "quick release" device. It is normally operated from a 12-volt battery supply with either positive or negative pole earthed, H.T. being supplied by a separately mounted rotary transformer unit. Multi-way plug and socket connections are used for the receiver and power supply unit. A loudspeaker is supplied as a separate unit.

The station receiver consists of a mobile receiver chassis, with associated mains-power supply unit mounted with a loudspeaker in a ventilated steel cabinet arranged for rack mounting. It operates from power supply of 200-250 volts A.C., 50/60 cycles single phase.



The complete equipment in the boot of a patrol car. Left to right—receiver, power unit and transmitter.

Mobile Transmitters

The mobile transmitters consist of a single chassis housed in a ventilated steel cabinet and secured to a resiliently mounted base by means of a " quick release " device.

A similar type of transmitter is also supplied for low-powered fixed outstations, except that this has an associated mains power supply unit and is mounted in a ventilated steel cabinet arranged for rack mounting. This operates from a power supply of 200-250 volts, 50/60 cycles, single phase.

There are two types of mobile transmitter, the only distinction being that in one of them the modulator can also be utilised as a power amplifier giving approximately 8 watts output for " public address " purposes. Both models are normally operated from a 12-volt battery supply with either positive or negative pole earthed H.T. being supplied by a separately mounted rotary transformer unit. Multi-way plug and socket connections are used for the transmitter and power supply unit. Meter jacks allow for routine testing and tuning adjustments.

For operation on a frequency within the 64 to 131 mc/s range, the transmitter circuit includes a twin triode valve, the first triode functioning as an oscillator, which is crystal controlled, and a frequency doubler, and the second triode functioning as a second doubler; this is followed by two twin triodes as further doublers. The biasing system is arranged to protect the valves in the event of failure of excitation. Circuit arrangements for operation on a frequency within the 30-64 mc/s range differ from those for 64-131 mc/s operation by the omission of the first doubler coil which is short-circuited. The removal from the circuit of one of the doubler coils results in the frequency of the signal at the aerial being eight times the crystal frequency in the 30-64 mc/s range as against 16 times the crystal frequency in the 64-131 mc/s range. The output stage is modulated at high level by using a tetrode valve as modulator.

The frequency range of 30-131 mc/s is divided into wavebands. A change to a frequency in another band entails the changing of coils, the fitting of another crystal and the realignment of all tuned circuits. The tuning controls are pre-set. The mobile transmitters can be adjusted from the front, the fixed outstation transmitter from the rear with the transmitter in the normal operating position.

A " low power " switch is provided to prevent the possible over-running of valves while tuning adjustments are being made. Meter jacks allow for routine testing and for use when tuning.

Power output is 7 watts telephony, and power input to output stage 16 watts.

Radar—2

Extracts from a Speech to the Physical Society on January 2nd, 1946, by Sir Edward Appleton, G.B.E., K.C.B., Secretary of the Department of Scientific and Industrial Research

AN altimeter was developed by Espenschied and Newhouse of the Bell Telephone Company. In this apparatus the operating frequency is 450 mc/s with a frequency swing of 25 mc/s. The height values recorded are displayed on meters reading directly in feet. This meter has two scales, the upper extending from 0 to 5,000 feet and the lower 0 to 1,000 feet. An indication of the character of the surface over which the aeroplane is flying is given by the variations of the meter reading. A city, for example, usually causes rapid fluctuations of the order of 50ft., depending, of course, on the height and spacing of the buildings.

But both the Kennelly-Heaviside Layer and the ground are extensive surfaces from which we might expect to get substantial reflection and to which we can assign definite reflection coefficients. How is our problem altered if we are dealing with a reflecting object of smaller dimensions, for example, an aircraft or a balloon or a very large bird ? And can we speak of a reflection coefficient in any such case ?

To answer this question it is necessary to invoke certain theoretical considerations and derive a certain basic formula. I do not apologise for doing this since I regard it as a fundamental matter and one which it is necessary should be fully understood.

Evolving a Formula.

Let us suppose that a sender S illuminates a target T with radio waves and let us suppose that the power and directive gain of S is such that the electric field strength produced at T is given by E_i (incident field strength) in volts per metre. Now, due to the influence of the electric forces in the incident beam, electric currents will be produced in T if it is a conductor. If it is a dielectric, displacement currents will be similarly induced. Such currents will be of the same fequency as that of the incident radiation and their strength will be proportional to E_i. Now these currents in the target itself act as a source of re-radiation, the scattered or reflected radiation, and the field strength of this radiation will be proportional to the strength of the currents and inversely proportional to the distance. If, therefore, E_s is the field strength of the re-radiation at a distance r from T (e.g., back at S) we see that E_s is directly proportional to E_i, the incident field at the target and inversely proportional to the distance (r) from the source of re-radiation.

We can therefore write

$$\frac{E_s}{E_i}=\frac{L}{r}$$

where L s a quantity which I have defined as the scattering coefficient of the target. We see from the equation that its dimensions are those of a length. When the value of L (say, in metres) is known for any target it is possible calculate the strength of the received echo since the value of E_1 can be calculated.

We can also express the strength of the returned echo in another way, namely, in terms of the effective reflection coefficient of an imaginary infinite surface situated at the distance of the scattering object and oriented at right angles to the direction of that object relative to the station. The relation between the effective reflection coefficient of such a surface and the scattering factor L is given by

$$\text{(eff. reflection coeff.)}=\frac{2L}{r}$$

From this equation we can see how a small target differs from a large surface. For a large surface the effective reflection coefficient is the same at all distances whereas, for a small target, the effective reflection coefficient gets smaller as the distance is increased, which illustrates the great difficulty of detecting small targets at great distances.

This can easily be illustrated by an example. Let us take as our target a spherical balloon with a metallized surface and let the diameter of the balloon be, say, 4 metres. Now it is easy to show that the L factor for a balloon of this size for, say, decimetre waves is equal to 1 metre. Substituting for L in our equation we therefore see that, at a distance of 1 km. (i.e., 1,000 metres), the effective reflection coefficient is $\frac{2}{1,000}$; whereas at 100 km. it is reduced to $\frac{2}{100,000}$, a very much smaller quantity. This indicates the need for high sender power in order that detection at large ranges can be achieved.

We can put this fundamental point in another way. The received power at a certain distance from a wireless sender in free space varies inversely as the square of the distance. That is an example of the ordinary law of inverse squares. But for a target such as a balloon, or an aeroplane, the energy reflection coefficient also varies inversely as the square of the distance. We thus see that the received power, after reflection, varies inversely as the fourth power of the distance. In other words if we wish to double the range of a particular radiolocation system of this simple type we must increase the power 16 times. This again emphasizes the difficulty of achieving enormous ranges.

Radiolocation of Artificial Objects

After these general theoretical considerations I now turn to what has been, I think, the most striking application of radar, namely, the position finding of aircraft. Of course, if an aircraft were more regular in shape one might have calculated its effective reflection coefficient. But it was left to the experimental people to detect the reflection of radio waves by aircraft and to give us some idea of the magnitude of the scattering coefficient.

The Post Office Engineers have the honour of being the first to recognize that aircraft reflections were detectable. They found they got fluctuating signals on their short-wave receivers when aircraft were around. They referred to this effect in their report on the subject as "interference"!

Two years later, in 1935, the extension of observations of this kind, including the employment of the pulse-method of distance measurement, was undertaken by a small group of three British scientists, Messrs. Bainbridge-Bell, Bowen and Wilkins, led by Sir Robert Watson Watt at an Air Ministry Station on the East Coast of England. This effort, begun by this small nucleus, rapidly expanded in volume, and, as a result, this country was already provided with radiolocation sentinels for the detection of aircraft when war broke out in 1939. This is a simple statement of a very important fact.

Let us now look at the changes we must make to an ionospheric radio pulse sender in order to make it suitable for the detection of aircraft.

We have got to do three things:

(a) We have got to illuminate the lower layers of the atmosphere by raising our aerial or by using shorter waves.

(b) We have got to have a short pulse to enable us to follow the aircraft into shorter range.

(c) We have got to have exceedingly high power—all the power we can get.

We can see that the use of short wavelengths has two marked advantages. First, with such wavelengths, it is easy to design directive aerials systems for both sender and receiver of manageable size; while, second, we are able to illuminate the lowest layers of the atmosphere and so detect low targets.

For wavelengths of less than about a metre metallic mirrors of parabolic shapes are very suitable for producing directed beams. Many of you will remember the pioneer experiments on radio communication across the English Channel carried out by the Standard Telephones & Cables Company in 1931. Here a wavelength of 17 cms. was used and parabolic reflectors used at both sending and receiving ends.

But I hasten to explain that when parabolic reflectors are used to concentrate a radio flux of energy one must not assume that the beam travels out into space localized like an optical searchlight. There is, in fact, far more spread in the radio case than in the optical case.

Let us examine this matter a little more closely for it is both interesting and important. I want you to picture a dipole radiating from the focus of a parabolic mirror.

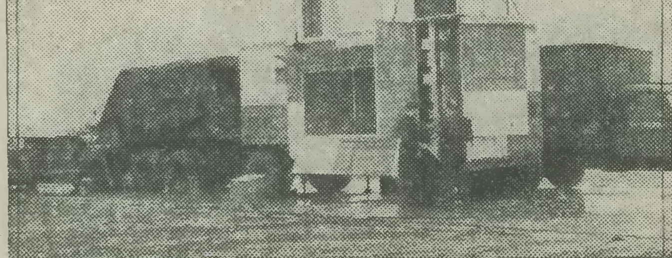
The radiation travelling out to the right from the dipole spreads out in the ordinary way and so does not materially assist us. On the other hand the waves setting out to the left from the dipole are reflected by the mirror and arrive at its opening as a plane wave of area equal to that of the mirror.

So far it is fairly easy to see what must happen, for the wave energy is confined. But what happens when the localised radio wave front leaves the reflector and travels into space? Will it keep fairly localised or will it spread?

Fortunately this problem was solved many years ago by Fresnel and Fraunhofer for the case of optical waves. The problem is, in fact, very similar to that of light travelling through a circular hole in the screen. Well, what does happen? First of all the wave front travels a very short distance localised and then, a little farther from the aperture, interference maxima and minima appear round the perimeter of the wave front while the centre is uniform. But at greater distances the whole becomes a diffraction pattern with a central maximum of illumination surrounded by weaker rings of illumination separated by rings of minimum energy.

Describing things in terms of a polar diagram, such as is familiar to radio engineers, we have a central maximum lobe surrounded by minor lobes. Clearly the strength and width of the centre lobe are matters of prime importance, and calculations show that the gain in energy flux in the main direction, resulting from the use of the reflector, is directly proportional to the area of the opening and indirectly proportional to the square of the wavelength. Similarly the sharpness of the main lobe is directly proportional to the radius of the opening and inverseley proportional to the wavelength. Therefore to get an intense sharp beam we want a large mirror and a short wavelength.

Thus, I think, we can sum up the situation by saying that the wartime development of radar will most handsomely repay the original debt of pure science, from which radar itself came.



A new "radar on wheels" unit for aerodrome control purposes. It obviates large permanent installations and has a range of about 30 miles. It is being employed at principal Transport Command airfields at home and on the Continent.

ON YOUR WAVELENGTH

By THERMION

Inebriated Cacophony

LORD SOULBURY, a former president of the Board of Education, recently said: "It would be a boon if the B.B.C. would allot a larger percentage of time to the works of great composers and rather less to the sensational and sentimental twaddle with which the air is too often polluted. It is a great mistake to think that the English are not a music and an art-loving people. Cannot we be spared the inebriated cacophony of what is, I believe, called hot music, suitable only for savages of very low mentality?" This, of course, is what I have been saying for many years. Whether known as swing, jive, jitterbugging, hot rhythm, or any other name, this form of music, which I suppose appeals to some, ought to be given a minimum amount of programme time.

I am glad to know that my campaign against it has registered in high places and also with the B.B.C., for I observe that they are devoting much less time to it now than hitherto. Even so, it is still far too much. The younger generation should be encouraged to work and equip themselves as citizens, not to spend their time jiving. There will, I suppose, always be people who can appreciate nothing but the lowest. They can, however, become the noisiest of minorities.

Radar or Radiolocation

ONE of my readers, L.A.C. Heafley, writes: "Your views expressed on the use of the word radar will receive whole-hearted approval among most of us in England who are tired of the importation of foreign names for things which can be described perfectly well in pure English. You say, however, that the use of the word radar is likely to give the impression in a few years' time that the Americans invented radiolocation. I have always been under the impression that radiolocation was a British invention. In an article in a Sunday newspaper a contributor quotes passages from a book to the effect that radar was an American invention developed by England. I wrote to the newspaper challenging this statement and received a reply to the effect that the first successful test of radar in Britain was at Daventry in March, 1935. The U.S. Navy Department announced on May 23rd, 1943, that members of the British mission stated that the development had resulted from articles reporting the preliminary work between 1926 and 1930 of Dr. Hoyt Taylor and Mr. Leo Young, of the U.S. Naval Research Laboratory, and Dr. Gregory Broit and Dr. Merle Tuve, of the Carnegie Institute, studying the height of the Heaviside layer."

It is true that Dr. Taylor and Mr. Young, working in the U.S. Naval Aircraft Radio Laboratory, observed that certain radio signals were reflected from steel buildings and metal objects. They also observed that ships passing by a transmitter and receiver at such frequencies gave a definite interference pattern. These observations gave rise to the suggestion that possibly an arrangement could be worked out whereby destroyers located on a line a number of miles apart could be made immediately aware of the passage of an enemy vessel between any two destroyers in the line, irrespective of fog, darkness or smoke-screen. I do not agree, however, that the Americans can rightly claim to have been at least two years ahead of Britain in the invention of radar. However, there cannot be any doubt that England was first in the field with the practical application of radar. The fact that someone suggested something nebulous does not make him the inventor of it. Otherwise, H. G. Wells might claim to be the inventor of the aeroplane because he wrote a book called "The War in the Air" before the aeroplane had been invented, or that Jules Verne invented the balloon because he wrote a book about balloons.

But if one listens to the propaganda pushed out over the air by Moscow, Tokyo, New York, France and Spain, the listener might be excused for wondering who invented what and when. Japan, the dishonest country which steals patents, claims to have invented the Ford car before Henry Ford. Russia of all countries claims to have invented the aeroplane, but cannot produce a tittle of evidence in support of this claim. Everyone knows that Russia was ten years behind England, America and France in the development of the aeroplane. Other countries claim to have invented the steam engine! The fact is that radiolocation was invented, developed and produced in England. Invention is not the bald statement of a vacuous idea.

Television

MY inquiries round the Trade show that manufacturers of television receivers are well advanced in production, and that they will be in the public's hands in plenty of time for the receivers to be installed before the programmes commence from the Alexandra Palace. Someone, however, has yet to discover, as pointed out in a previous issue, a reliable method of recording television programmes. The need is even greater with television than with sound-programmes, as they are far more expensive to produce, require costumes and scenery and lengthy rehearsals. Here is an opportunity for the Sound Recording Association to direct the energies of its members into a particular channel. It is realised, of course, that experiments in this direction cannot commence until the television programmes are radiated. Why does not the B.B.C. offer a prize to scientists and inventors to encourage a solution to this problem—the missing link in visible radio? I well remember the Plew television disc for thirty-line transmissions which was sold in connection with the low-definition Baird system.

The March of Science: Where To?

PRESS Items.—Radar contact was made with the moon for the first time in January last by U.S. Army Signal Corps. Impulses were sent out at intervals of 5 seconds and reflected back from the moon at intervals of about 2½ seconds.

We can now send out impulses,
Endorsed R.S.V.P.
Will replies be understandable?
We'll have to wait and see.
But it doesn't seem quite likely
We'll have invitations soon
To start week-end excursions
To the mountains of the moon!

If modern scientists are right,
There's no one there at all,
There's no one there to answer us,
However loud our call;
But this a blessing in disguise
For over-cocksure men
Who, if they ever reached the moon,
Might not get back again!

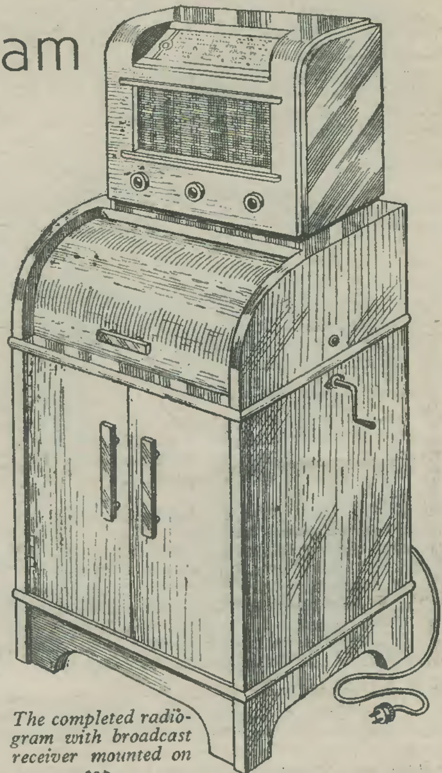
TORCH.

A Special Radiogram

Another Home-made Radiogram Cabinet
Described by EXPERIMENTALIST

THE idea behind the "Unique Radiogram" cabinet published in last month's issue of PRACTICAL WIRELESS was to make use of an old, existing radio receiver without altering it in any way. The cabinet housed the complete receiver and served to "hide" it, and by adopting the suggestion, it saved the necessity for making and having a built-in unit.

It has occurred to the writer that many readers will possess new, ultra-modern radio receivers of attractive design and finish. It would be a shame to enclose such sets in a special, home-made cabinet. Indeed, few owners would have any desire to do so. As it is the aim of this publication to try to satisfy all readers, the writer has planned another design of cabinet which is not only original, attractive and easy to construct, but serves as a pedestal for the new radio receivers, as shown in the illustration.



The completed radiogram with broadcast receiver mounted on top.

Like a Roll-top Desk

Now, in the ordinary, normal way, it is impossible to have a receiver sitting on top of a gramophone cabinet. Such cabinets usually have hinged top lids which lift up and are supported by a metal stay. In order to keep the radio receiver exposed and conveniently near, a special table needs to be provided, but this means using up valuable space in a room.

Therefore, in order to overcome the difficulty, the writer hit on a simple plan. Why not design a cabinet which could be fitted with a special, quadrant-shaped, pivoted lid? So, this was done and, needless to say, it was the action of a roll-top desk which suggested the idea. Incidentally, it is quite safe to predict that "roll-top" lids on gramophone cabinets will become the fashion soon, and if you make the cabinet—which is purposely simplified—to be described, you will be the "first with the latest!"

The cabinet is made from ⅞in. and ½in. deal shelving boards. This wood is cheap, easily wrought and more plentiful than the more expensive hardwoods. But, although deal is soft, white and contains a lot of knots, it possesses grain, and if the finished cabinet is merely coated several times with a light walnut polish, it assumes a beautiful, striking finish which, in conjunction with the "silvered" half-round moulding surrounding the upper and lower parts of the cabinet, produces a piece of work anyone would be proud to own.

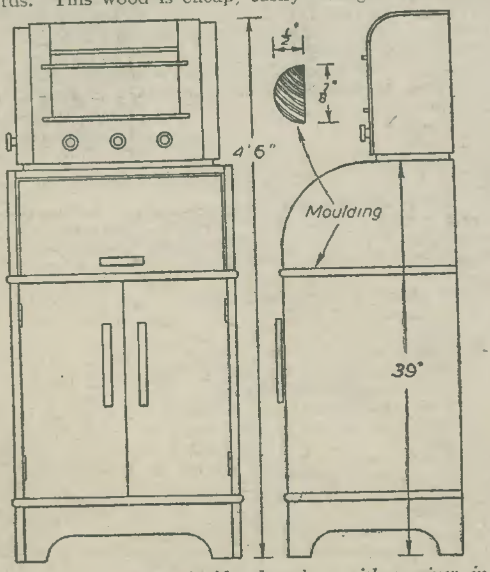


Fig. 1.—A front and side elevation, with receiver in position.

Preparing the Sides

The sides of the cabinet are prepared first. As the width is 17in., and as the widest board is only 10½in.—the finished, planed width—it is necessary to join two pieces together, such as one 10½in. board and a piece cut 6½in. wide. The waste left over helps to make panelled doors, if desired.

The two boards may be each 8½in. wide, as shown at Fig. 2. They are best joined together by gluing and dowelling, but as you may not possess a brace and a suitable dowel bit, the only alternative is to make a rub-joint. To do so, the joining edges must be quite flat and true along the length. Trimming is done with a try-plane, this producing straight edges. One can, with care and frequent testing, make good joining edges with a finely set jack plane, or even a block plane.

Clamp one board, with the joining edge uppermost, in a vice. Place the other joining edge close to it and apply a thin, hot glue to both. Bring the edges together and slide them backwards and forwards to remove the excess glue, meantime pressing them together. When movement becomes impeded by the adhesion, force the ends and sides even with the fingers and set the jointed boards aside to set.

The length of the joined boards is, of course, 39in., the thickness being ⅞in. You need two sides, and having joined up the wood and allowed the glue to set, proceed by selecting a front edge and, with the aid of a large set-square, mark out—on the interior side—the top, motor-board, shelf and bottom positions, including the shape of the feet and the top end, using pencil compasses in this connection.

Now, the pointed leg of the compasses gives the exact pivot hole position for the special lid. So, have both boards set out similar in size and shape. It is imperative

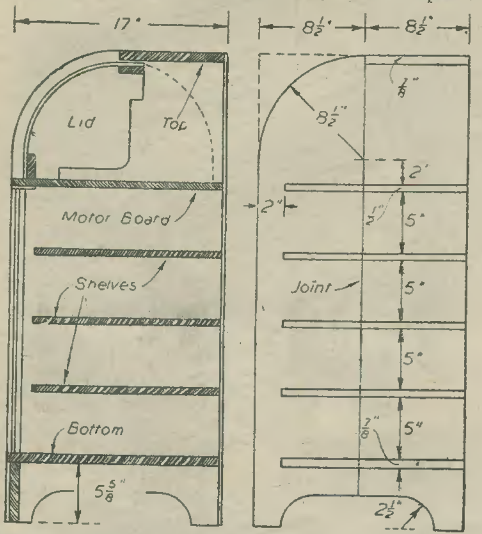


Fig. 2.—Sectional side view, with shape and size of one side, showing the position of the grooves or trenching for shelves, etc.

that there are no inaccuracies—a 1/16in. out of true will give serious trouble, particularly in respect to the movement of the lid.

The Trenching

The top, bottom and shelf trenching is cut to a depth of ¼in. The pencil lines are deeply scribed with the tip of a sharp penknife. V-grooves are made (between the scores) with the corner of a wood chisel, and these grooves provide a guiding path for the teeth of a small tenon saw.

Having cut the wood ¼in. deep, the waste wood is removed by means of a ½in. chisel or a router, the cutter of the latter being set to cut to a depth of ¼in. When the grooves have been made, prepare the top and bottom pieces of the carcase.

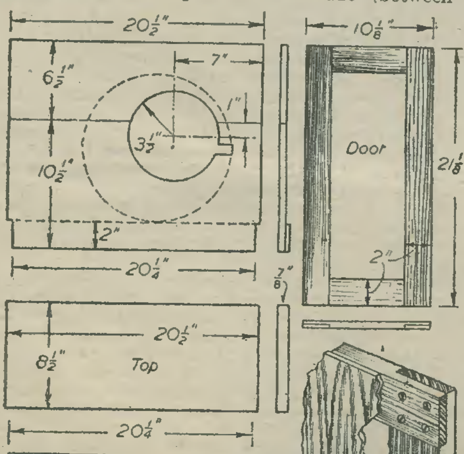


Fig. 3.—Size and shape of motor-board, top, foot and door-frame, with details of the door construction.

Top, Bottom and Shelves

The top, as shown at Fig. 3, measures 20½in. by 8½in. by ⅞in. The bottom is cut to the size and shape of the motor-board (from ⅞in. stuff), but is minus the motor aperture, of course.

Glue and nail the bottom between the sides (it is being assumed that the sides have been cut to shape, planed with a smoothing plane and glasspapered), using 2in. oval nails, then add the top, using 1½in. oval nails.

Square the work, turn it on its face, then make and fit the motor-board and the three shelves. The motor-board, like the shelves, is made from ½in. boards joined together. The gramophone motor aperture position and size is suitable for a "Garrard" (double-spring) motor bolted to a 12in. face plate only. The board needs to be built up to be ⅞in. thick at the front edge, this being done by gluing a 2in. wide by ⅜in. thick strip to its underside (see end view).

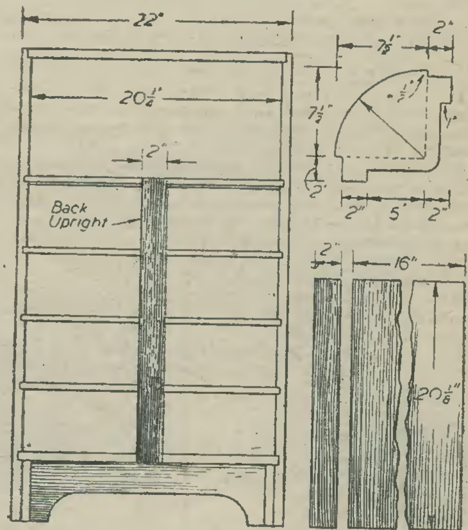


Fig. 4.—A back view of the carcase, with details of the lid.

The board is made a neat push-in fit in the grooves and is flush at the front and back. The shelves fit in similarly, but are 2in. inwards from the front. A few nails may be driven into the ends of the motor-board. There is no need to punch the heads of these nails, nor those showing at the bottom, since these will be covered by a half-round beading (moulding).

The Back

Having tested the carcase for squareness, cut out the back and attach it. The back, Fig. 6, should be ¼in. plywood, but one could use smooth roofing felt or lino material as a substitute. If you possess small pieces of plywood, the back could be pieced up. To do so a 2in. by ½in. back upright will have to be fitted (see Fig. 4). This upright is let into the edges of the bottom, shelves and motor-board to be flush. The dotted lines on the back shape show three possible joins.

The backing helps to keep the work square and rigid. This is helped by the front foot piece which can now be cut out and fitted. To give further strength, add glued blocks of wood to the inside, bottom corners. The foot piece is kept in to show an ⅛in. break at the front.

Beading and Doors

The half-round beading mentioned can be made from strips of wood measuring ⅜in. wide by ⅛in. thick. One flat side is rounded with a smoothing plane, then glass-papered, following which the strips are cut to form neat mitres at the corners. The moulding is attached with glue and fine panel nails, the heads of the latter being sunk and plugged with plastic wood, then glass-papered to have the joints, etc. quite smooth.

The doors are made as light frames half-lapped and glued and screwed together, then covered on the screwed side (where the heads show) with panels of ¼in. wood, as indicated by the detail at Fig. 3. A single piece of ⅝in. shelving 2ft. long by 10½in. circular-sawed in half and planed on the sawn side, produces two suitable door panels. This will be done at any local woodworking machine shop for a few pence. The panels, of course, cover the face side of the door framing and are glued and pinned on.

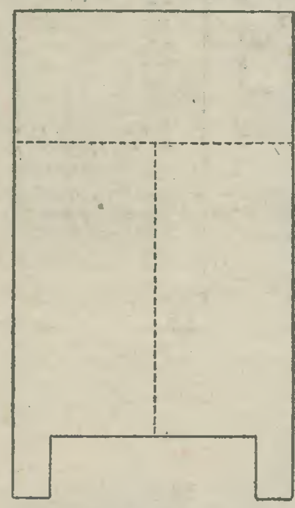
When fitted, the door edges are recessed for 2in. brass butt hinges and the hinges screwed on. The doors are then hinged in their aperture to be sitting in ⅛in. It is essential, of course, that the frames are quite square and not in twist; any twist in the framework puts a twist in the panelling, and such twists show up badly when the doors are hinged in position. Damp, unseasoned wood will, by the way, cause a framework to go in twist, for as the wood dries, it shrinks and, if hearty, invariably warps. Avoid damp wood. It is noticeably heavier in weight, although seemingly dry.

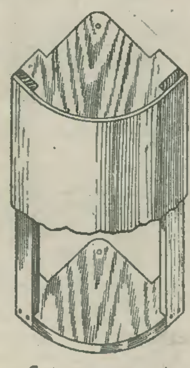
The Special Lid

The special, quadrant-shaped (quarter-round) lid consists of two shaped end pieces cut to the dimensions detailed at Fig. 4. These ends are identical and must be carefully set out and cut out.

Use ½in. wood, or ⅝in. stuff, although the latter is just rather thick. You also need two cross-rails, 20½in. long by 2in. wide by ½in. thick. These are glued and screwed to the end pieces, in the recesses provided.

A piece of ⅛in. plywood 20½in. by 16in. is wanted





Cut away view of Special Lid showing construction

Fig. 6.—Shape of the back with constructional view of the lid.

This is first glued and panel nailed to one of the cross-rails and bent (unglued) over to the second cross-rail. This will be easy, owing to the shortness of the grain. It only remains to brush on glue, bend the wood over and add a panel nail here and there to hold it down.

Make sure the lid is square and true. When the glue sets trim all necessary edges and fit the lid in position. The pivot holes are made with a bradawl, the compass point giving the dead centre position.

To pivot the lid in position, get it positioned in its aperture, drive in a 1¼in. by 6 roundhead screw through each side. The screw heads should be based with a small suitable metal washer. The screws should be a tight fit in the lid ends and be free to turn in the holes in the sides.

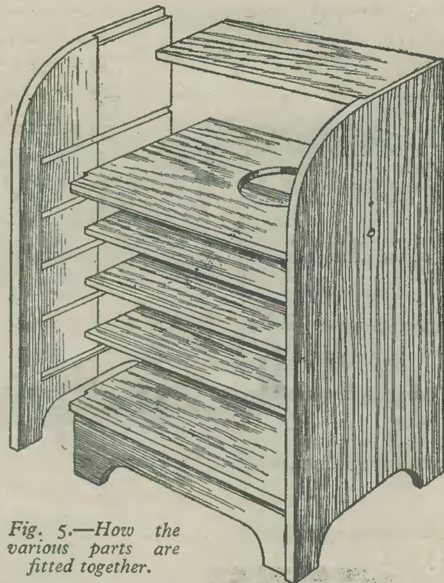


Fig. 5.—How the various parts are fitted together.

The Handles

Handles are secured to the lid front and doors, as shown. These could be made at home from wood, but the finished work will look more workmanlike if bought handles are obtained and fitted. Fancy erinoid handles look better than wooden types, or brass types.

It will be essential to have the doors fitted with a ball catch and a hook and eye. The interior of the work should be merely coated with a light walnut stain. The remainder of the work is french polished light walnut. No stain need be applied.

Use thin polish. Apply it with a mop or a flat, soft-haired paint brush. As soon as one application dries apply a second application. When this dries rub over the polish lightly with fine No. 1½ glasspaper. This removes some of the inevitable roughness. Give a third coat and, when this dries, rub down with No. 0 glass-paper. Apply the final coat of polish. This should be very thin and, if a mop is not at hand, an old shaving brush could be used.

No polish should be applied to the moulding. Instead, this is coated with silver paint, giving two separate applications. When dry, apply a single coat of clear polish, this preserving the brightness of the silvering.

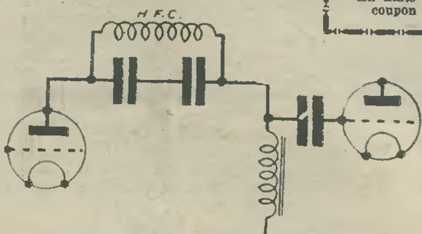
The gramophone motor face-plate is screwed to the motor-board, including the pick-up, the leads from the latter being brought out at the back for plugging into the receiver.

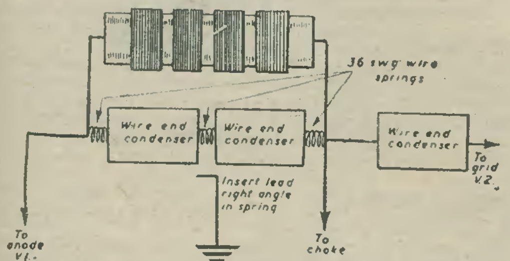
The uppermost shelf is only for odds and ends, such as tin boxes of needles of various kinds, booklets or leaflets about new records, etc. The other shelves are for various sizes of records or may be used to hold records according to their classification, such as Light Music, Opera Music, and Dance Music, etc. They are roomy shelves and the records should be kept in their cardboard covers.

Practical Hints

Connecting Wire-end Components

WHILST recently constructing a two-valve receiver (part of the circuit is shown below) I found that twisting the wire ends of the condensers, etc., together, before soldering, made a very untidy-looking job, and also there was a great risk of the wire breaking off, so I hit on the following idea. First of all, I obtained a No. 42 drill, and on to the shank I wound two or three springs, each about ¼in. long, with a 36 s.w.g. wire. When completed, I cut wire ends of condensers down





F. G. Sadler's suggestion for connecting wire-end components.

to just over ¼in., inserted ends (as shown) and soldered. When this is done the job will look quite neat, and all joints will be sound. Do not forget to insert a little flux inside of spring before soldering.—F. G. SADLER (N.16).

THAT DODGE OF YOURS!

Every Reader of "PRACTICAL WIRELESS" must have originated some little dodge which would interest other readers. Why not pass it on to us? We pay half-a-guinea for every hint published on this page. Turn that idea of yours to account by sending it in to us addressed to the Editor, "PRACTICAL WIRELESS," George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2. Put your name and address on every item. Please note that every notion sent in must be original. Mark envelopes "Practical Hints."

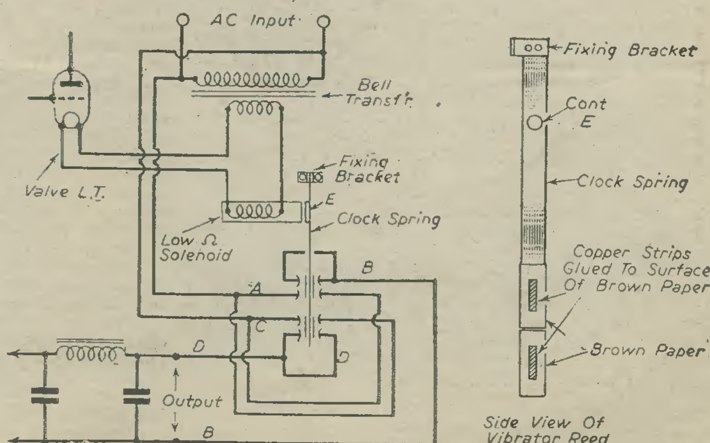
SPECIAL NOTICE

All hints must be accompanied by the coupon cut from page iii of cover.

Home-made Vibrator

THE vibrator is made of a piece of clock spring firmly fixed at one end. At the business end, it is covered with brown paper to which is glued on each side two small copper strips which act as contacts. In the diagram the shaded lines show where the copper strips lie. When the magnet E on the vibrator is attracted left the current runs A to B and C to D. When it moves right, it runs from A to D and C to B.

There should be no sparking if the clock spring is of suitable length. The best length is found by trial and error. The brushes can be made of springy steel wire and should not touch the copper strips on both sides when the vibrator is at rest or a short may result on switching on. A transformer is essential to the circuit and may also be used to supply L.T. current to valves, in which case the efficiency is high. A smoothing device may be employed as shown. —J. VERNON (Harrogate).



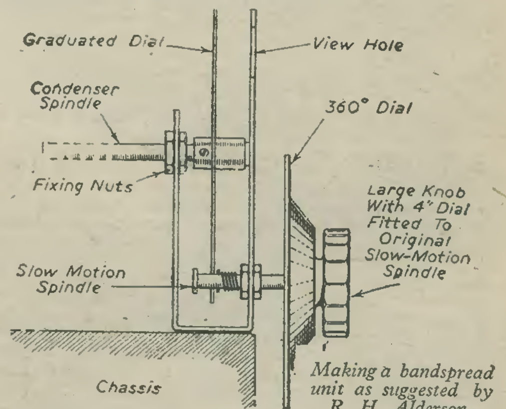
An easily-made vibrator as suggested by Mr. J. Vernon.

A Novel Bandspread Unit

ON to the slow-motion spindle of an ordinary slow-motion condenser drive, a large knob with 360 deg. dial is fitted, as in diagram.

If one revolution of the S.M. spindle covered, say, 10 deg. on the unit's dial, that 10 deg. will now be covered by 360 deg. on the large dial, an increase in accuracy of 36 times.

If desired, a new dial for the original unit could be made with every revolution of the large dial marked on it. Under this new marking the frequency coverage of that particular rotation could be marked.



Making a bandspread unit as suggested by R. H. Alderson.

If a knob with dial is not to hand, an excellent substitute can be made by bolting a 360-deg. protractor to an ordinary large knob.—R. H. ALDERSON (Pudsey, nr. Leeds).

Programme Pointers

This Month MAURICE REEVE Deals with PROGRAMME BUILDING

TWO of our leading dailies recently took a vote of their readers' radio programme likes and dislikes. In the first case 67 per cent. were agreed that programmes were not so good as they used to be, whilst the figures of a Gallup Poll in another paper showed a considerable majority in favour of commercially-sponsored broadcasting over the present monopolistic charter system.

It is the former of the two votes about which I propose to make a few remarks here. It is the question which most concerns the listener: "what is on," rather than "who is putting it on." Doubtless both systems of management have much to be said of them for and against. They certainly get some magnificent programmes—privately sponsored—in the United States. And, speaking personally, I haven't the slightest objection to being reminded that I have just listened "by the courtesy of" someone's toilet preparation, or that I shall only forget someone else's corn plasters at my own peril, always providing that that generously minded house has given me exactly the programme I most wanted to hear at exactly the moment it most suited me to switch it on.

It is this latter point on which we can offer the B.B.C. most criticism. (a) Do they give us what we want to the greatest possible extent; and (b) are the various categories or classes of items always on at the most suitable times? Let us take point (a) first.

A Good Effort

By and large, the result of the programme builders' efforts is a magnificent achievement. There can hardly be a single field of human endeavour or activity which isn't catered for at some time or other. The number of both subjects and events which find their way into the *Radio Times* is astonishing, and can only be compared to a gigantic restaurant wherein one can choose everything from larks' tongues in aspic to a boiled egg, or champagne to cocoa. It would be less than gracious, and would certainly show a complete want of toleration, if we damned them out of hand just because things are not, sometimes, exactly to our taste or convenience.

The most difficult task must be to draw up an equable balance between grave and gay, as between your tastes and mine. Sometimes one feels that improvements could be made here and there, especially when it comes to the *third* repeat of certain features. After all, when a thing is on regularly every week, one should not have to require three chances of hearing it. If we unfortunately miss it this week, we have it next week and most probably heard it last week as well. No great privation will be endured whilst there are such a host of other good things worth a place. It is the second, or sometimes third, repeat of the "once only" performance that is valuable. But there are very few, if any, of these.

It is the fact that there is an enormous common margin of agreement which proves that our wireless programmes are drawn up with skill, sympathy and understanding. It seems to me fairly obvious that, were the whole "works" exactly to my taste always, from dawn to dusk, so that there was never an item I would not regretfully miss, the opposite experience would, in inverse ratio, be your lot. You would be so fed up with the programmes constantly and everlastingly, that, not only would you never tune in at all, but you would forthwith cancel your licence.

Bad Timing ?

It is, however, with point (b) that we may find some ground for complaint with the programmes and some dissatisfaction with their compilation; the timing of various subjects and items within certain categories. The following little conversation can be overheard several times a day:

"So-and-so, or such-and-such, is on to-day."

"Splendid, I love him (her—it). At what time?"

"Six-thirty."

"Damn. Why is it they always have it just half an hour before I get in (or just as I'm getting the supper, or standing in the queue, etc., etc.)."

Yes, probably the most difficult of the programme department's many headaches. I don't refer to the standard regularly-appearing features such at Itma or The Brains Trust, with their two repetitions. But to the vast body of the programme which consists of single bookings of items and artists at irregular intervals.

Music is an especial sufferer. There is heaps of good music. Personal selfishness might prompt me to ask for yet more, but I do feel that the music lover is extremely well catered for, and, so far as hours per week of transmission is concerned, he has little to grumble at. But it is scattered and dispersed throughout the day and night that much of it is lost to the desiring listener through the inconvenient hours at which much of it comes over.

I have known innumerable instances of half-a-dozen or more items, sufficient to whet the palate of the most discriminating musician, included in a day's programme. A quartet, a symphony, piano and vocal recitals, etc., etc., a regular feast. But, alas, one is just too late to hear before we leave home in the morning, another is too early to switch on before we get back; whilst a third is being played just at that exasperating moment when one has to be hospitable to friends and neighbours, and the fourth is invariably so late that many of us would understandably begin to nod half way through it.

Background Music

A difficult problem, perhaps, but one capable of improvement. Few people, I imagine, listen to Beethoven and his confrères except with the intention to concentrate and to brook no interruption. Unlike light music, which can form the pleasantest background to many social activities except, possibly, bridge. But Beethoven, i.e., classical music, being definitely anti-social and scarcely a background, should never be broadcast at those certain times when even the most stagnant and leisured among us are unlikely to have an undisturbed half hour owing to well known and almost universal habits and customs. They frequently are.

I imagine that the section of the population to have its own special feature timed to the greatest degree of suitability and nicety are the children, and very rightly so. Their hour is an immovable feast, timed to perfection, and admirable in balance and composition. Another is the Sunday evening play, and a third the Saturday evening music hall. But straight, highbrow music is served some scurvy tricks and its devotees are asked to listen to it at the "awkwardest" hours.

The solution to such difficulties and problems? Firstly, and lastly, and all the time, a wide degree of toleration and a broad outlook. Ever bear in mind that what suits one person may not suit a second and will not suit a third. One must always try and fit one's other activities in to suit the programme. After all, that is what the *Radio Times*, etc., is for, and a glance in time will frequently enable this to be done quite easily. But if you are always going to let yourself get into the position of having to say, "Oh, dear, what a nuisance; I wish I'd known such-and-such was on sooner," then satisfaction will be difficult to obtain.

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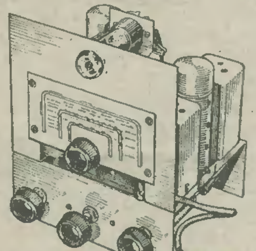

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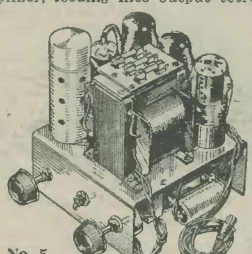

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The Radio Range–1

An Explanation of a Radio Navigational Aid which, although Used for Some Years in America Before the War, has Come into Wide Use in this Country and on the Continent only Recently

IN tuning over the long-wave band below about 1,500 metres you have no doubt heard at certain condenser settings a series of A's or N's in the Morse code, followed by a two-letter call-sign and then

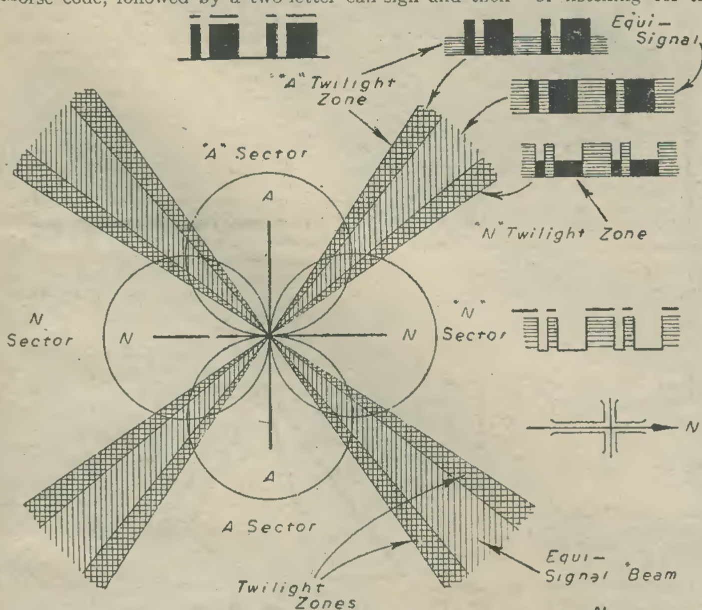

Fig. 1.—This diagram shows how the "A" and "N" sectors, and also the equi-signal "beams" of a radio range are obtained.

by more A's or N's. At one or other setting of the condenser you may have heard a steady 1,000 c/s note (interrupted at intervals by the transmission of a call sign) instead of the string of letters.

If you have heard any of these signals—and two or three can be heard at many places in the South of England—you may have wondered what they were. The signals are those from so-called radio ranges, which can be regarded as a cross between a homing beacon and a beam-approach system.

Four Beams

A fixed transmitter is used and this operates continuously in most cases, although in other instances a particular transmitter may be in use for only certain hours of the day. This transmitter provides a very simple method of navigating an aircraft along a certain "lane" or course. The output from the transmitter can be regarded as being in the form of four beams arranged to cover four different courses. In actual fact, it would be more correct to refer to the radio courses as equi-signal zones, as will be seen later. The output corresponds to that from a beam-approach transmitter, but there are three major differences between a radio range and a B.A. installation; firstly, the range operates on long waves, whereas the B.A. is on ultra-short waves; secondly, there are four beams instead of two (counting the "back beam") of a B.A. transmitter; thirdly, a marker transmitter is not normally part of the range installation.

It is evident that if a signal modulated with a steady note is beamed along a route to be flown, it is possible for the pilot to hold his course by the simple process of listening for the note, using an ordinary long-wave receiver. In practice, he uses either a midget long-wave set or the standard general-purpose aircraft receiver. The former is preferable, for the wireless operator can then keep a listening watch on the aircraft control frequency while the pilot listens to the radio-range transmission.

Crossed Loop Aerials

The aerials employed with the radio-range transmitter generally consist of two large loops set at right-angles to each other. Output from the transmitter is applied to the two loops alternately so that one loop radiates a series of A's (.— .— .—) and the other a series of N's (—. —. —.). The radiation pattern of the two loops is shown in Fig. 1, where it will be seen that there are two areas around the aerial system in which the letter A is heard, and two in which the letter N is heard. Where the two "figure-of-eight" polar diagrams overlap the dots and dashes of the A's and N's interlock, with the result that a steady note can be heard. This gives the effect of a

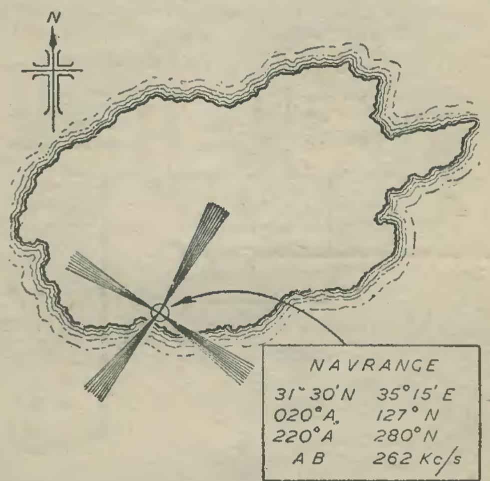

Fig. 2.—On a map showing radio navigational aids a typical radio range would be shown as illustrated here, where the radio range is a hypothetical one on an imaginary island in mid-Atlantic. The range is situated at an airfield called "Navrange," and operates on a frequency of 262 kc/s. with the identification letters AB. The "A" sectors are between 020 degrees—127 degrees and 220 degrees—280 degrees; the "N" sectors are between 127 degrees—220 degrees and 280 degrees—020 degrees.

beam of steady signal which is about three degrees wide. It will now be understood, however, that what may be regarded for practical purposes as a beam is not a beam in the true sense, but merely a very narrow sector of equi-signal.

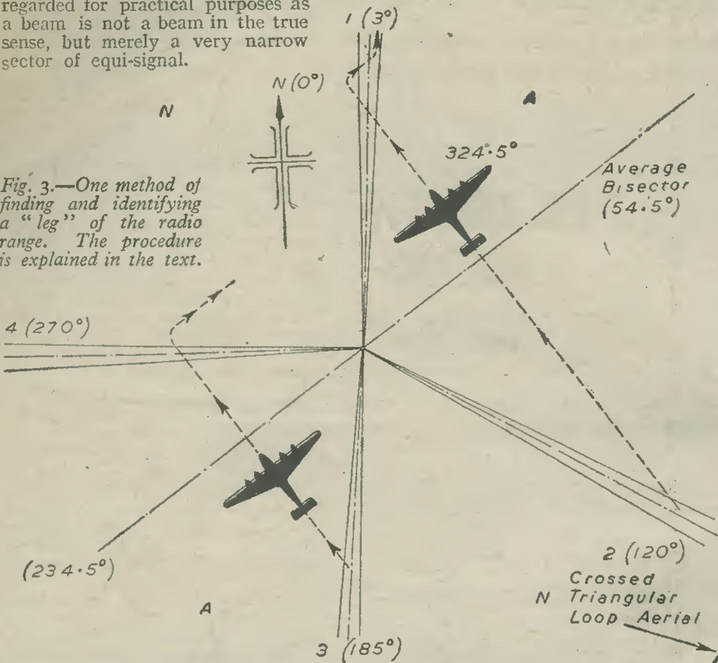

Fig. 3.—One method of finding and identifying a "leg" of the radio range. The procedure is explained in the text.

After the two letters have been sent out for about 30 seconds, a different type of keying comes into operation and this causes a two-letter call-sign to be radiated, first by the "N" aerial loop, and then by the "A" aerial loop. The call-sign is radiated for two reasons. The first is to identify the particular radio range so that the pilot can tell, by looking at his chart, precisely where the range is situated. It is generally, but not necessarily, at or adjacent to an airfield.

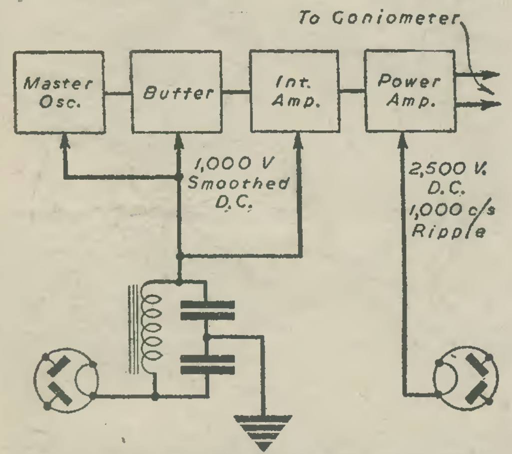

Fig. 4.—Block diagram of a representative radio range transmitter. Audio modulation is obtained from the 1,000 c/s. ripple on the H.T. supply to the power amplifier.

The reason for the call-sign being sent twice is to give the pilot a rough indication of his position within the particular A or N sector. If, for example, he is flying in an A sector, but there is little difference in signal strength between the two call-signs, he knows that he is not very far from one of the equi-signal "beams."

Alignment

Before considering more fully the method of using radio ranges it may be well to have a few more facts. One important fact is that all radio ranges are so aligned that a line running true North from the centre of the aerial array passes through an N sector, or, if a beam should lie along this line, the sector to the west of the line is an N sector. This standardisation is of assistance to the pilot in determining his approximate position in relation to the transmitter.

Details of radio ranges, carried by the pilot, include the position in terms of latitude and longitude, the frequency employed, the call-sign, and the courses or angles of the four "beams"—generally called "legs." The legs are generally at right-angles to each other, but they may be arranged to be at other angles. This may be necessary to ensure

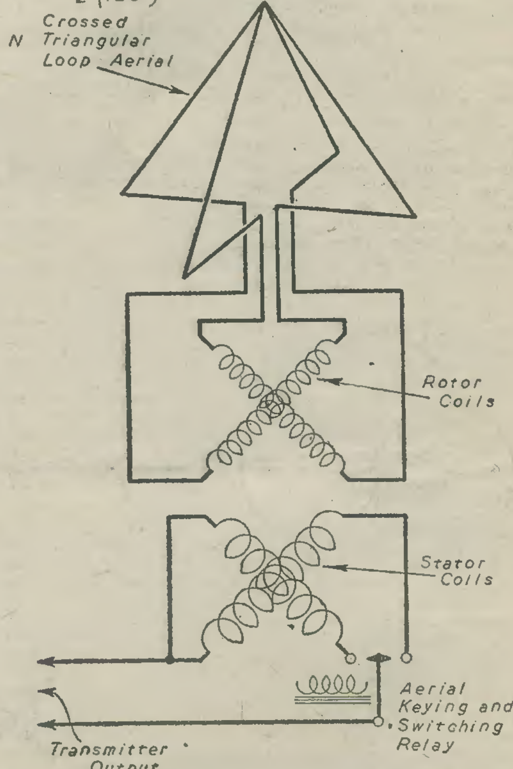

Fig. 6.—The arrangement of a Bellini-Tosi loop aerial system and associated radio-goniometer. The pair of stator and the pair of rotor coils are rigidly mounted at right-angles, while the rotor is free to rotate within the stator; a 360 degree scale is provided to indicate the position of the rotor.

that one leg from one range lines up with a corresponding leg from another range. Or it may be necessary to stagger the legs to ensure that they lie along open country or between high hills. An example of staggered legs is shown in Fig. 2, where the information concerning an imaginary range is also given in tabular form as it is usually shown on a map of radio navigational aids.

Flying the Range

And now a very brief explanation of one method of using a range for navigational purposes. This should be read while examining the diagram given in Fig. 3. First the pilot flies along a course which is at right-angles to the average bisector of two legs. In passing it should be mentioned that the reason for taking a course at right-angles to an *average* bisector is that the aircraft may may be in either of the A sectors, the pilot not knowing which.

He flies along this line until he comes into the equi-signal zone. Flying through this until he enters the N sector, he makes a 90 degree turn to the right. If that brings him back into the equi-signal zone he knows that he is in

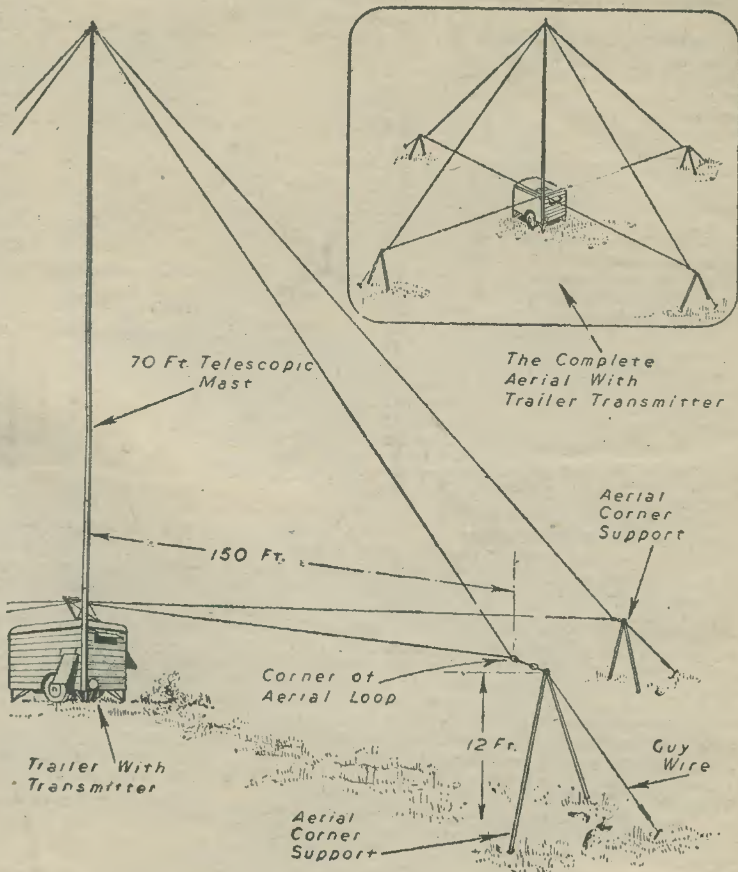

Fig. 5.—This sketch gives an impression of the appearance and set-up of a mobile radio range installation. When a mains supply is not available there is a second trailer which houses a petrol-electric set.

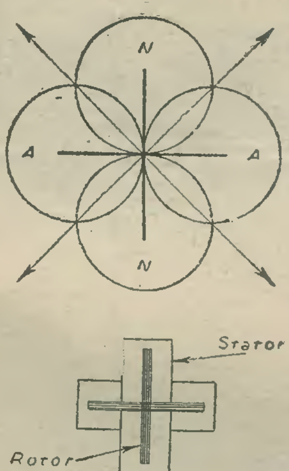

Fig. 7.—The theoretical radiation pattern from the crossed aerial loops when the stator and rotor windings of the goniometer are parallel to each other (gonio scale reading 360—0 degrees).

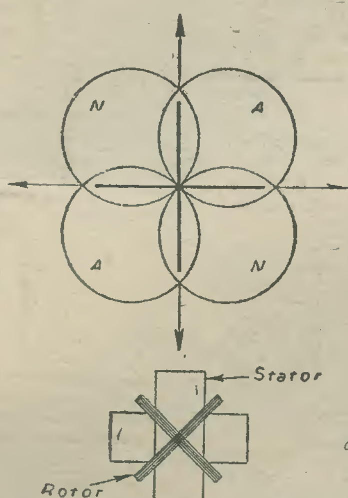

Fig. 8.—(left)—The changed polar diagram obtained by turning the gonio rotor through 45 degrees.

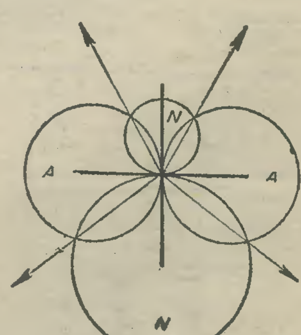

Fig. 9.—(above)—When using an Adcock aerial system the polar diagram can be distorted by the introduction and suitable phasing of a fixed aerial, as indicated here. By distorting the polar diagram it is possible to alter the angles between the equi-signal "legs."

the leg marked 1 in Fig. 3. If, on the other hand, he continues to receive N's after making the turn, he knows that he is in the leg numbered 4. In either case, he can find the centre of the equi-signal zone and fly either toward or away from the range as required. If he should fly toward the range, he will find, as with S.B.A., that there is a " cone of silence " in which no signals are received as he passes over the centre of the aerial system.

A pilot skilled in the use of the radio range will not fly down the centre of the beam, but will just skirt one edge of it. Here he is in the twilight zone, and so can hear the Morse characters of the letter A or N superimposed on a steady background. By flying his aircraft in this way the pilot can judge his line of flight more accurately than is the case when flying in the divergent equi-signal beam.

It will be evident, of course, that the radio range transmitter can also be used as a fixed radio beacon from which D.F. loop bearings can be taken by the wireless operator. In some cases it is found convenient to take bearings in order to determine in which of the sectors the aircraft is flying; knowing that, the pilot can set his aircraft on such a course that he flies into an equi-signal beam. Having done that, he can fly along the beam as required, either towards or away from the transmitter.

Fixed and Mobile Installations

With a general mental picture of the radio-range system and the method of using it, we can now look at some of the practical and technical aspects of a typical installation. It should be remembered that there are variants of the type of transmitter and aerial array which will be briefly described, and that radio-range installations are of two broad types: permanent and mobile. The mobile equipments normally comprise two large trailers, one of which houses the transmitter and associated equipment, and the other houses a power-supply system which comprises a petrol engine driving an alternator and a generator.

Transmitter Circuit

A typical radio-range transmitter would have four valves arranged as master oscillator, buffer amplifier, intermediate power amplifier, and output power amplifier, as represented by the block diagram in Fig. 4. Power is normally supplied at 115 volts, 500 c/s. One reason for the use of a frequency of 500 cycles will be seen shortly. A transformer, rectifier and smoothing system is employed to apply a plate voltage up to about 1,000 volts to the first three valves, while a second transformer, rectifier and smoothing system give the necessary bias voltage. The final power amplifier is given a H.T. voltage of, say, 2,500, but although this is rectified through a full-wave rectifier, no smoothing is employed.

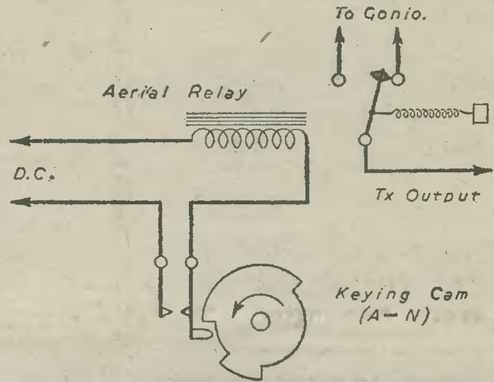

Fig. 10.—Diagrammatic representation of the action of the A N keying cam, which is used to operate a biased relay. This relay transfers the transmitter output from one aerial to the other, through the goniometer.

In consequence of this, there is a ripple at 1,000 cycles per second in the power amplifier anode supply. It is this which provides the audio-frequency modulation of 1,000 c/s; there is, therefore, no need for an audio-frequency oscillator.

Tuning circuits are provided for the master oscillator as well as for the intermediate and final power amplifiers, but the buffer stage is aperiodic. In the case of one transmitter, which is typical, tetrodes are used for the first three stages, with a neutralised triode in the final output stage.

(*To be continued*)

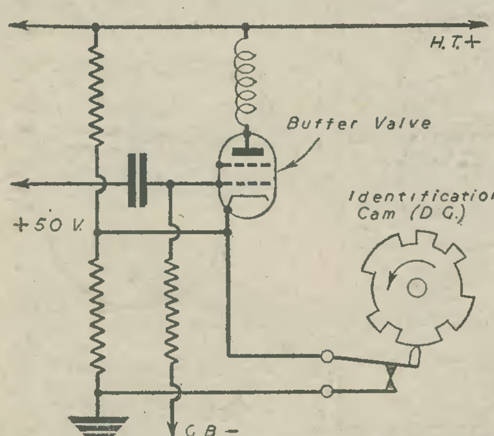

Fig. 11.—The identification cam, which automatically keys the transmitter with a two-letter call sign, operates a pair of contacts which open and close the bias circuit to the buffer valve connected between the R.F. oscillator and the intermediate amplifier stage.

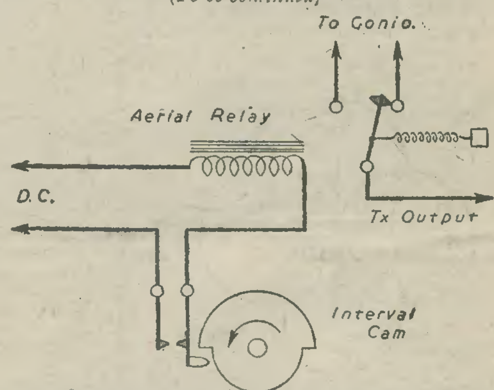

Fig. 12.—The interval cam runs at half the speed of the identification cam, connecting the transmitter output first to one aerial and then to the other while the two-letter identification is sent out. In practice, the contacts of all three cams are interconnected and the cams are operated through a somewhat complex system of gears.

Impressions on the Wax

Review of the Latest Gramophone Records

H.M.V.

"A MESSAGE to the Empire" will recall the broadcast made by H.M. King George VI on Christmas Day, 1945, from his study at Sandringham House. Once again, it has been the privilege of "His Master's Voice" to provide a lasting record of this stirring message on *RC*3481, a double-sided 12in. record. It will be remembered that His Majesty gave a special message to the young; he urged them to devote the great spirit they had shown in overthrowing the common enemy to creating a world where men and women can live and walk together in mutual trust and friendship. The profits from the sale of the record are being paid to charities nominated by H.M. The King.

Sir Thomas Beecham has always been regarded as the greatest interpreter of Mozart's works, and the latest release of H.M.V. of Mozart's "Die Entfuhrung Aus Dem Serail" Overture—performed by the London Philharmonic Orchestra, under the baton of Sir Thomas—is an example which will be welcomed and greatly appreciated by all lovers of Mozart's works. The Overture ranks as a masterpiece, and the Orchestra gives a magnificent performance. The record is *H.M.V. DB*6251, double-sided.

Many may remember the broadcast in March of last year by the noted composer-pianist Francis Poulenc and Pierre Bernac (baritone) of a recital of Faure's "La Bonne Chanson," and they will, therefore, be very interested in *H.M.V. DB*6250. This record is a fine recording by these two talented artists of "Au Rossignol" (Lamartine-Gounod), and "Serenade: Quand Tu Chantes" (Hugo-Gounod). A perfect understanding is demonstrated between singer and pianist, and Pierre Bernac is a delightful baritone, ideally suited for the songs in question which he renders in French.

The Glasgow Orpheus Choir, conducted by Sir Hugh Roberton, have added another recording to their series, the last of which was released in November. This time they perform in splendid style: (a) "Far Away" (Londonderry Air); (b) "The Old Woman," and on the other side of the record "The Turtle Dove." The recordings are on *H.M.V. C*3463.

In Sweden much is made of midsummer and great festivals are arranged as part of the celebrations, and one of the leading Swedish composers—Hugo Alfven—portrays in a most striking manner the spirit of midsummer in a land of long dark winters. The work is entitled "Midsummer Watch" (The Midsommarvacka), and it has been recorded on *H.M.V. C*3482-3 by the Members of The Stockholm Concert Society Orchestra, conducted by Nils Grevillius. The performance and the composition are truly delightful, and I strongly recommend it for your hearing. The fourth side of these two records is "Elégie" for Orchestral Suite "Gustave II Adolf," also performed by the same orchestra.

To close the selection of H.M.V. 12in. records, I suggest *H.M.V. C*3484, as this is a recording by the Hallé Orchestra under the conductorship of John Barbirolli. The work is Delius's "The Walk To The Paradise Garden"—Interlude between Scenes 5 and 6 "A Village Romeo and Juliet," (arr. Beecham). The composition creates in great beauty the feelings and moods of the frustration of two young lovers, and the great skill of John Barbirolli enables all the delicate and subtle qualities of Delius's orchestration to be revealed and enjoyed.

My first H.M.V. 10in. is *H.M.V. DA*1852, which is an exceptional recording by Elisabeth Schumann (soprano) with Gerald Moore at the piano. "Vollmond Strahlt Aus Bergeshohen" (from "Rosamunde") and "Die Forelle" (The Trout) (Op. 32), both works being by Schubert, are the two items selected for this recording, and great praise is due to Miss Schumann for her splendid performance.

On *H.M.V. BD*1120, Perry Como (baritone) has recorded with orchestra "Till The End of Time" and "That Feeling In The Moonlight," while "Hutch" (L. A. Hutchinson) offers "Nancy" and "Everybody Knew But Me," on *H.M.V. BD*1121.

Columbia

"CHACONNE in G Minor" (Purcell, arr. Whittaker) is the latest recording by the Philharmonia String Orchestra, conducted by Constant Lambert. It is a fine example of Purcell's vigorous orchestral style, and consists of a series of different upper parts upon a set or ground bass. A style or scheme which is closely allied to the *passacaglia*, which with the *chaconne* are really derived from old dance forms. The recording is on *Columbia DX*1230, double-sided.

For those who love perfect pianoforte recordings, might I stress *Columbia DX*1231 for their consideration. When I mention that the artist is Harriet Cohen, and the composer Chopin, well, I think that is sufficient in itself, as Miss Cohen's playing is superb, and the beauties of Chopin's compositions are ever attractive and inspiring.

In Old Time Dance Series, Columbia have released Nos. 24 and 25 this month. These consist of two 12in. records, recorded as usual by the ever popular Harry Davidson and his Orchestra. No. 24 consists of "The Denman Quadrilles"—3 parts—while No. 25 is that evergreen "Destiny Waltz." These two records, *Columbia* 1232-33, provide most pleasing light music.

Now here are some Columbia 10in. records for your consideration. *DB*2203, by Albert Sandler and his Palm Court Orchestra playing, in their usual delightful manner, "Chanson De Nuit" and "Chanson De Matin."

If you liked the film "Anchors Aweigh," you will, no doubt, like to hear Peter Yorke and his Concert Orchestra playing a selection from that film on *Columbia DB*2204. The vocals are shared by Bette Roberts and Sam Browne.

On *Columbia DB*2202 Frank Sinatra swoon-croons "A Friend of Yours," assisted by the Ken Lake Singers and "Nancy."

Turner Layton has two good numbers on *Columbia FB*3185. They are "Gim-Me Crack Corn" and "It Might As Well Be Spring"—the latter being featured in the film "State Fair."

Steve Conway, with Jack Byfield and his Orchestra, sings "I Can't Begin To Tell You" and "Wait and See," on *Columbia FB*3186, while Gene Kelly offers "The King Who Couldn't Dance"—two parts—on *Columbia FB*3184.

Parlophone

*PARLOPHONE F*3359 is a fine recording entitled "Scottish Country Dance," which introduces "Flowers of Edinburgh," "White Cockade," "East Neuk of Fife," "Circassian Circle," "Mason's Apron" and "Roll her on the Hill." These are played by Chalmers Wood and his Country Dance Orchestra, and very nicely too.

Another recording which will appeal to those North of the Border will be found on *Parlophone F*3358, namely, "Highland Schottische," introducing "Cameron's Got His Wife Again," "Highland Whisky," "Lady Mary Ramsay" and "Stumple"; on the other side of this record is "Lassie" (valse), all the numbers being played by William Hannah and his Band.

Roberto Inglez and his Orchestra, on *Parlophone F*2122, present "Serenade" (Beguine) and "Ya Que Te Vas" (Beguine), both being well orchestrated and performed.

No. 69 of "Tin Pan Alley Medley," introducing "I'm So All Alone," "No Can Do," "Carolina," "I'll Close My Eyes," "The Moment I Saw You," "Did You Ever Get That Feeling In The Moonlight," is on *Parlophone F*2110, and is, of course, played by Ivor Moreton and Dave Kaye.

Open to Discussion

The Editor does not necessarily agree with the opinions expressed by his correspondents. All letters must be accompanied by the name and address of the sender (not necessarily for publication).

News from Ceylon

SIR,—I received the December copy of PRACTICAL WIRELESS, a few days ago, from England. Before I was a subscriber I was able to buy four copies of PRACTICAL WIRELESS from the Services which were issued free to them, for 50 cents (9½d.). Though I am only 15 years old, I find PRACTICAL WIRELESS very interesting, and I am glad that I can understand the practical articles in them easily, although the theoretical articles with some difficulty.

Radio parts are very dear and costly in Ceylon, and for this reason I have been only able to construct a crystal set with a tuning coil which I made from the data given in your excellent book "The Wireless Constructor's Encyclopædia" and a lead sulphide crystal. I did not use a tuning condenser because (1) I live five miles away from the Colombo Broadcasting Station, and (2) tuning condensers can be purchased only from shady dealers for not less than Rs. 10 (15s.) and as I am a schoolboy I cannot afford to pay this amount. This set worked satisfactorily on my friend's headphones, but now it's kept on my table as headphones are not available even in the shops of shady dealers.

Looking through the column "Open to Discussion" in the May, 1945, PRACTICAL WIRELESS, I found the station JLG4 (Ceylon), 19.07 metres, in Mr. Leslie G. Clark's log. I think that this station is Radio SEAC, Ceylon, which has not yet shifted to its H.Q. in Singapore, which broadcasts three transmissions daily: 11.30-13.00 and 14.30-19.00 hours in the 19 metre band and on 88.3 metres; 19.30-22.30 hours in the 25 metre band and on 88.3 metres. I wonder whether any of your readers have tuned in to Colombo (call sign ZOH) which broadcasts three transmissions daily on 428.6 metres (700 kc/s) and on 61.2 metres (4,900 kc/s) simultaneously. The times of transmissions are as follows: 7.30 a.m.-8 a.m.; 9.30 a.m.-2 p.m.; and 4.25 p.m.-10.30 p.m. (Ceylon standard time is 5½ hours ahead of G.M.T.).—T. SIVAGNANASUNDERAM (Colombo, Ceylon).

Calibrating Details

SIR,—In reply to Mr. G. C. Bagley's request for frequencies of certain stations heard in order to calibrate his set, as in your January edition of PRACTICAL WIRELESS (Open to Discussion), the following are a few, and I hope they will be of some help.

GYA18, 12,270 kc/s, Whitehall; CGX2, 13,510 kc/s, Halifax; CGW8, 11,500 kc/s, Halifax; GYC5, 11,430 kc/s, Whitehall; GYE12, 16,100 kc/s, Whitehall; GYG22, 15,665 kc/s, Bermuda; GYZ69, 13,975 kc/s, Malta; MSA3, 425 kc/s, Alexandria; MSA39, 14,220 kc/s, Alexandria.

MSA3 is the L.F. component of Alexandria area broadcast for shipping.—H. E. WATTS (H.M.S. *Cormorant*).

Economy Battery Charger

SIR,—It occurred to me after studying the theoretical circuit of Experimentalist's Economy Battery Charger (PRACTICAL WIRELESS, March, 1946, page 169), that the switching arrangements might conceivably lead to trouble.

To my mind it appears as if the terminals of the accumulator on charge are in effect short circuited when both switches are in the "on" position at the same time.

I would suggest that a different method of switching be employed. For instance, a single pole 5 ampere two-way switch with "off" position could be used in place of the two existing switches, the wiring being altered to suit.

May I also point out that "Experimentalist" has not mentioned the desirability of connecting the mains lead to the charging board so that the positive lead is joined to the upper mains terminal and the negative is joined to the lower mains terminal. This will ensure that the accumulator terminals remain at a low potential. In the event of the mains lead being connected in the opposite manner the voltage at one of the accumulator terminals would be that of the mains supply, the remaining terminal being 2 volts or so less. In this latter case it would be possible for a person to receive quite an unpleasant shock if he happened to touch one of the terminals and at the same instant be in contact with an object having a good electrical path to earth, e.g., a water pipe or a damp floor.—W. HERRIDGE (Eastbourne).

[*Similar criticisms were received from two or three other readers, but the author of the article covered the point in the last paragraph of his letter. Of course, all risk of closing both switches together could be avoided by a modification of the switching arrangement.*—ED.]

Australian Stations

SIR,—Referring to the letter from Mr. H. M. Pantin, of Marlboro, asking for information regarding Australian stations, the following details may be useful.

The transmissions, beamed on this country, open at 8.20 to 8.50 G.M.T. on VLC8 on 41.21 metres. This is a recent replacement of a transmission on 25.62 metres at about 7.0 G.M.T. This is, according to information supplied in announcing the change, "beamed on the long path." This, on the last occasion on which I had the opportunity of hearing it, was a good R7.

At 15.15 G.M.T. VLA3, 30.99 metres, comes on the air with a strong and consistently good R6 to R7 signal, which is, however, often subject to strong QRM from a German station at about 30.96 metres.

An alternative to this used to be VLG5 on 25.25 metres; this has now been abandoned for VLG on 31.32 metres, which is almost, although not quite, as good as VLA3.

A transmission on VLC8 on 41.21 metres is also available at this time, also of good quality, although of the three VLA3 is easily the best.

A transmission not beamed on the British Isles is sometimes to be heard at 9.20 G.M.T., on 31.2 metres. News for Australian Forces, which is followed on its termination by a transmission in Japanese.

These transmissions from Australia for the British Isles are very clear and strong and are a great advance on pre-war days when to have heard the Kookaburra was a radio feat of tuning and reception! My RX is a five valve T.R.F.—T. C. McCOMBIE YOUNG (N.W.3).

SIR,—In reply to Mr. H. M. Pantin's letter asking for details of Australian transmissions in English, I am sending this list of English programmes that have been logged in Cambridge. All stations with call-sign VLG or VLR are located in Melbourne, and those with call-sign VLC and VLA in Shepparton, Victoria.

08.20-08.50 G.M.T., VLC8, 7,280 kc/s. Strength R6; to British Isles.

09.00-11.45, VLA6, 15,200 kc/s to Australian Forces and British Pacific Fleet. Was reliable signal last autumn at R6 with a flutter. Occasionally good signal now.

09.00-10.00, 10.30-11.00, 12.30-12.45—VLC6, 9,615 kc/s, and VLG3, 11,710 kc/s to Asia; VLC6, R7 at 12.30, unreliable at other times; VLC3 only audible at 12.30.

13.00-13.45, VLC5, 9,540 kc/s to Eastern States of North America; weak signal—R3.

13.00-13.30, VLR, 9,580 kc/s, Australian National

Programme, to Northern Australia. News, 13.00; R5+ transmits from 08.00 to 13.30.

14.00-14.30, VLC6, 9,615 kc/s; VLG, 9,580 kc/s; and VLA, 7,280 kc/s to Asia; VLC6, R8; VLG, R6; and VLA, R4.

14.35-15.00, VLC6, VLG and VLA (VLA to 14.45) to Forces in S.E. Asia. Strengths as before.

15.15-15.45, VLA3, 9,680 kc/s, and VLG, 9,580 kc/s, and VLC8, 7,280 kc/s to British Isles; VLA3, R8 or R9; VLG, R7+; VLC8, R7.

16.00-16.45, VLC6, 9,615 kc/s, and VLG4, 11,840 kc/s, to Western States of North America. Only VLC6 heard; R5+ with flutter.

20.00, VLR2, 6,140 kc/s, and VLA4, 11,880 kc/s, open n Australian National Programme to Northern Australia. Only VLR2 logged, on February 6th; R2 rapidly fading right out.

During the present period of sunspot activity, South Americans on the 60 metre band have been unusually good. I have logged at R9, YV1RX, Maracaibo, 4,800 kc/s; YV5RN, Caracas, 4,920 kc/s; YV5RU, Caracas, 4,860 kc/s—all at about midnight. After much searching I found ZQI, Kingston, Jamaica, 4,700 kc/s, at 23.30, on February 1st; strength R3 with heavy morse QRM. I have not heard it strongly enough since.

The set is an 0-v-1 (pentodes) working from A.C. mains and using an indoor aerial.—C. S. S. LYON (Trinity College, Cambridge).

Details of ZRB

SIR,—I am a very enthusiastic DX fan. My set is a commercial superhet, and I have logged various stations amongst whom are tons of Yanks; CHOL, CHTA, Canada; OQ5BJ, Belgian Congo amateur. He was using an H.R.O. receiver and 150 watt 'phone transmitter. He is operating on 20 metres. PY2AA, Brazil, calling OQ5BJ, also 'phone on 20 metres; Radio Seac, Ceylon; HCJB, Quito, Equador; VLC6, VLQ, VLG4, Australia; KRHO, Hawaii (attractive Veri received); Radio Saigon; Singapore, testing on 19 metres; Radio PCJ, Huizen; Rome on 31 metres; Radio Tananarive, Madagascar; Delhi, all over the band; TAP, Ankara; Rio de Janeiro; Buenos Aires; Brazzaville, Leopoldville, have sent various letters and reports, but no reply.

I read that Mr. Bagley wants to know about ZRB. Radio ZRB is located at Robertsheights, working on 23 metres. Officer-in-charge told me he will send a suitable letter to those sending in a report.

The station that Mr. Bagley states is an American test station is located in New York under the name of "American-Palestine and Telegraph Company." This station's frequencies vary.—H. EKSTEEN (Pretoria).

A Reader's Selectivity Aid

SIR,—I should like to bring to the notice of fellow-enthusiasts a tip that I have not seen mentioned before. It concerns selectivity.

We cannot all use powerful superhets, and the selectivity and sensitivity of "straight" sets (whether embodying H.F. stage or not) can be improved appreciably and cheaply by using the optimum size Detector-Grid-Condenser. This, I find, is very much *smaller* than is usually used. The best size seems to be 25 pf. (.000025 mfd.), and if the small ceramic type is not obtainable one of the postage-stamp trimmers of 30 pf. not quite screwed up tight will do. In these conditions a higher grid leak, say 3 or 4 megs., can be used.

This little dodge has never failed to improve the selectivity of all the sets I have tried it on.—H. STRIPE (New Malden).

Commercial Set Design

SIR,—May I reply to C. H. Hammond, of Sutton, who in a letter in your March issue questioned the necessity of a mains transformer in a radio set, preferring the universal type as being easier on electrolytic condensers due to lower voltage, and even comparing the quality to be as good as that from a comparable A.C. set.

I cannot agree with the statement of C. H. H., and will go so far as to say that there is no comparison at all between the two without even mentioning push-pull output, and on the electrolytic question—well, failures are by no means unknown on A.C.-D.C. sets.

It has, perhaps, escaped your contributor's notice that in nearly all universal sets the condensers used are of a lower voltage test than in A.C. sets, so that condenser failure should be about equal in each type of set, but this again depends on their position in the set, some being far too near to the hottest valves—rectifier and output—and in the case of a universal, the dropper and barretter.

The latter type of set is fundamentally inferior since it is impossible to raise the H.T. voltage above the mains voltage. Therefore such a receiver would not be chosen unless likely to be used on D.C. mains.

I believe that although manufacturers of electrolytic condensers clearly state the working conditions of their products, these are often exceeded in the interests of initial economy, or non-appreciation of the fact that the maximum voltage developed across the condenser is considerably greater than the normal D.C. working.

Attention to the above points would, I think, increase the life of electrolytics as a whole.

I, personally, am looking forward to the time when the mains in this country will be a standard 240-250 A.C., when, I hope, the universal set, as we know it to-day, can be safely forgotten.

This will mean the disappearance of all those midgets in the lovely cabinets (I hope) which seemed to be on sale in all kinds of shops before the outbreak of the last war, and which were such an appeal to the ladies.

There is really no case to answer between the two types from a quality point of view, but a few advantages of the A.C. set which readily come to mind are: cheaper to run, gives better quality, is safer to handle, lower hum level, no direct connection to the mains, not so liable to breakdown, and replacements, at least in the north-east, easier to procure.—R. G. HARRISON (Newcastle-on-Tyne).

Log Corrections

SIR,—Have just received my first post-war issue of PRACTICAL WIRELESS, and was very interested to read the Logs on your discussion page. Your correspondent, R. Aldridge, however, is not quite correct in his logging. FZI should read 25.05 and/or 25.45; and WCRC, 25.34; while Canada on 19.71 is CHTA, *not* CKTA. (I have received DSL cards from CKXA (25.63), CHTA and CKNC). Moscow should read RIC, 25.77, 25.24 and 25.34. OLR has been received here on 49.62 and 25.49 approx. Hoping this may be of some use to your correspondents and wishing your paper continued success—C. RICHARDS (Bedminster).

A Valve Detector Set

SIR,—*Re* the plan for a valve detector set in Vol. 22 of January, 1946.

The length of the chassis is given as 6in. This is let into channels at the sides ¼in. deep, making the length of the front panel 6½in. as in Fig. 4. In this case the bottom panel should be 5½in. and not 5in. Or, if as in Fig. 6, the length of the front is 6in., the chassis must be 5½in. I wonder how many other readers have noticed this?—R. GILL (B.A.O.R.).

[The author states: I am extremely vexed about the error which somehow has crept in the article dealing with the valve detector set, despite every care on my part.

The whole crux of the matter lies in the sizes shown at Fig. 6. The width of the back, like the front, should, obviously, have been 6½in., and not 6in. It is rather unfortunate that, when mentioning the case bottom, sizes, I glanced at Fig. 6 and said the length was 5in. when—as R. Gill points out—it was really 5½in.

The mistake concerns quite a small piece of wood which, if kept in the scrapbox, would doubtless come in handy on another occasion.—"EXPERIMENTALIST"]

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