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VOLUME 16 NUMBER 8

NOVEMBER 1 1961

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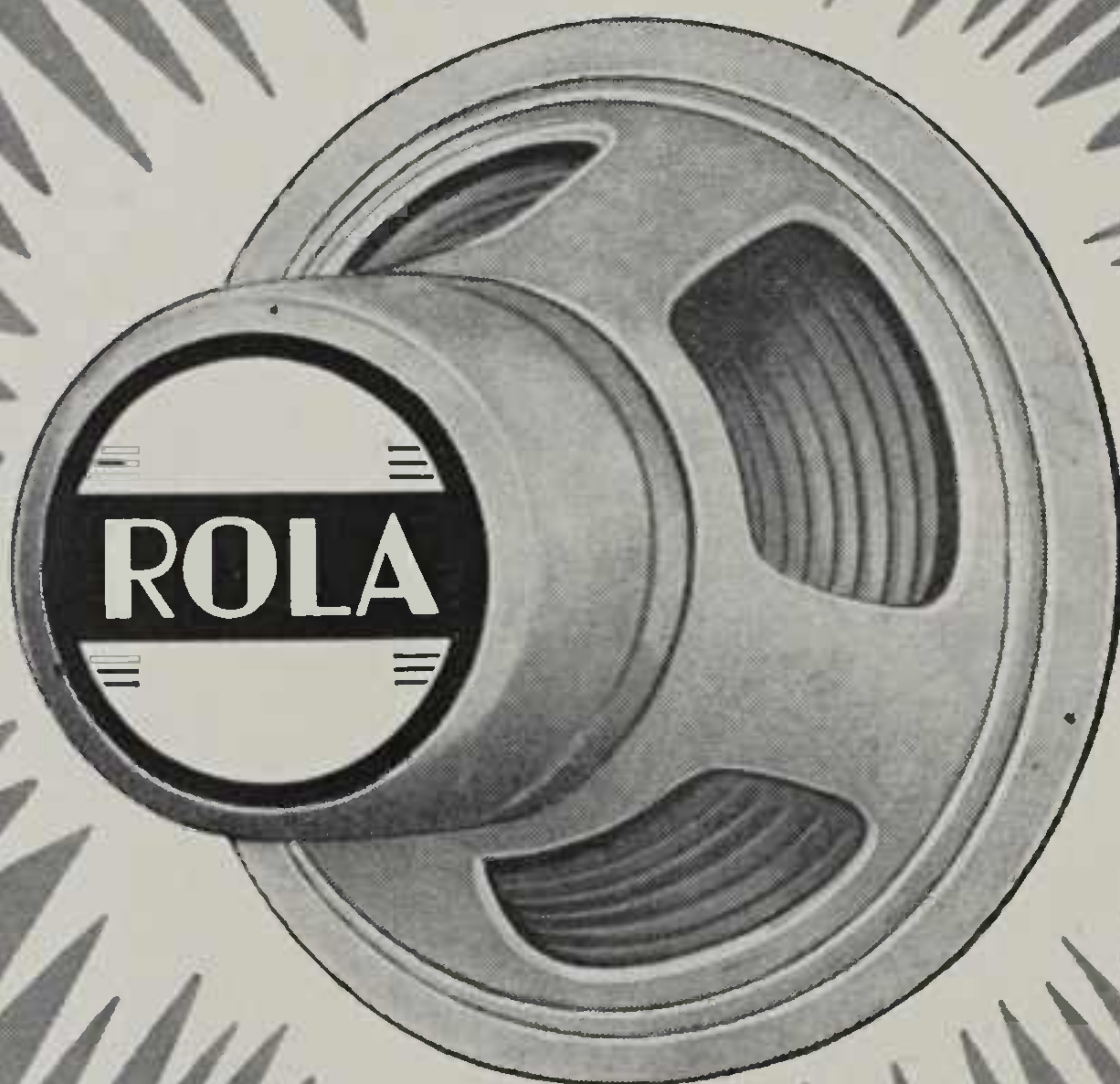
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VR14

Letters from Readers

Dear O.M.,

I have been very interested in your 20W mobile of R. & E. Review July 1961, and I have just received the August issue today, 14th Nov. I have built up and used a Marine/BC Receiver using the 114AW unit and quite a good little job it is. Now I would like to build and incorporate your transmitter on account of its low-drain which is a major item on Marine or Mobile Units. I wonder if you would mind answering a few questions for me personally and in a hurry; it is not the usual procedure but would you mind as time is short before Xmas. I don't know why the R. & E. Review is so late in reaching our local Booksellers!

I have a motor-gen on hand 6v/250v at 150M/A which is rather heavy drain from the battery, also a 6 or 12v Vibrator unit. I did write to Beacon Radio Ltd. to find out about their Transistor DC Converters but have had no reply in about six weeks. I thought perhaps they might solve my HT+ problems, could you express a brief opinion.

In one case one of my friends wanted to mod. an 807 for about 25w on a marine job but to get the necessary HT for the mod. meant M-G requiring a heavy drain on the battery, so he finally settled for S/G Mod. using the M-G from a Type 19 Set to supply the HT— 12v input to 500v at 50 M/A, and 275v at 110 M/A output; even so a very heavy drain. Many thanks for your co-operation and I am looking forward to hearing from you.

73 SEF

P.S.—Is the 12BY7 valve as an OSC a MUST, haven't made its acquaintance yet, or can any other valve do, e.g. EL91.

QUERIES:

1. GET.572 PNP Power Transistors, can you give me their source of supply or Philips equivalent, and are they OK on 12v system. Perhaps change T2 for 12v/250v ratio.

2. Could you give me a rough sketch of the shape and size of your metal box (housing) used as their heat sink or, could they conveniently be mounted on the main-chassis if it was large enough?

3. Would like to use the unit as a marine transmitter on a launch, using a Wafer Type switch 3 position 2 pole to select one of 3 Xtals 2182, 2162, 2045 kc/s and the necessary extra loading for the whip Aerial.

4. Value of Cathode Res. for au7. R.17 not given in the diagram.

5. The purpose of your switches, S2 ON/OFF filaments and transistors, S.1 a P&T.4PDT lever sw? S.1 aerial change over, S.1a HT+300v, ON/OFF, but I can't quite see S.1b and S.1c? Guess I'm too dumb.

Dear SEF, O.M.,

Our technical editor has replied at length to your queries—should be in the mail shortly—Ed.

* *

THANKS FROM A
WELLINGTON READER
Sir.

I was delighted to find a design for a transistorised BFO in the August/September issue, per my earlier request. (June 61, R. & E.)

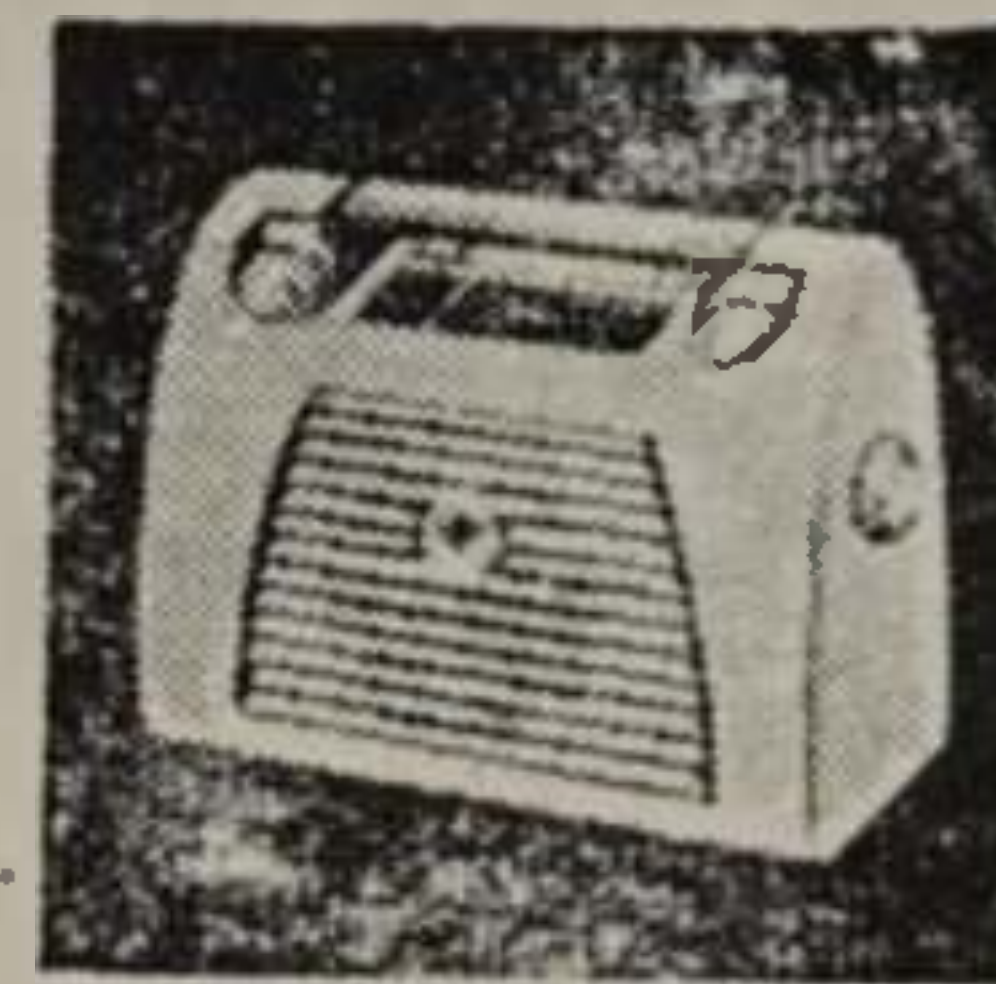
I am most impressed with the neat and compact design and most of all with the promptitude of your response to my request.

C. G. COSTELLO.

Wellington.

Glad you were pleased with the unit which Mr. Hall designed and built. As far as possible, we hope in the future to maintain and extend such service to readers.—Ed.

ON LAND



IN THE AIR



ON THE SEA



UNDER THE SEA



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SX11	60	100	80	-35 to +160	0.2	1.07
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SEMICONDUCTORS

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PT 9	310/310 V	80 Ma.	6.3 V	3 Amp.	5 V 2 Amp.	
PT 10	350/350 V	80 Ma.	6.3 V	3 Amp.	5 V 2 Amp.	
PT 11	310/310 V	100 Ma.	6.3 V	4 Amp.	5 V 2 Amp.	
PT 12	350/350 V	100 Ma.	6.3 V	4 Amp.	5 V 2 Amp.	
PT 13	310/310 V	125 Ma.	6.3 V	4 Amp.	5 V 3 Amp.	
PT 14	310/310 V	150 Ma.	6.3 V	5 Amp.	5 V 3 Amp.	
PT 15	400/400 V	150 Ma.	6.3 VCT	5 Amp.	5 V 3 Amp.	
PT 16	400/400 V	150 Ma.	6.3 VCT	2 Amp.	5 V 3 Amp.	6.3 V 4 Amp.
PT 17	450/450 V	150 Ma.	6.3 VCT	2 Amp.	5 V 3 Amp.	6.3 V 4 Amp.
PT 18	450/450 V	200 Ma.	6.3 VCT	2 Amp.	5 V 3 Amp.	6.3 V 4 Amp.
PT 19	500/500 V	200 Ma.	6.3 VCT	2 Amp.	5 V 3 Amp.	6.3 V 4 Amp.
PT 20	595/595 V	350 Ma.				
	(500 V DC)	Choke Input				
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PT 22	295/295 V	360 Ma.	6.3 V	10 Amp.	5 V 3 Amp.	Sec. Tapped 240/240 V
	Suitable for use with either RCA or Philips TV Kits Primary 0.210, 220, 230, 240 V.					
PT 23	Deleted					
PT 24	Pri. 0-230-270 V		6.3 V	5 Amp.	6.3 V 5 Amp.	5 V 2 Amp.
	Used in TV Receiver with Mains Rectification.					
PT 25	115 V	360 Ma.	12.6 V	5 Amp.	CT used with Silicon Diodes in Voltage Doubler Circuit.	
PT 26	280/280 V	80 Ma.	6.3 V	4 Amp.	6.3 V 1 A.	
PT 27	280/280 V	125 Ma.	6.3 V	5 Amp.	CT 6.3 V 1 A.	
PT 28	280/280 V	175 Ma.	6.3 V	4 Amp.	CT 6.3 V 4 A.	CT 5 V 3 A.

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Commission Control of Broadcasting . . .

One of the most prominent Bills passed during the current Session of Parliament was the Act for setting up the necessary machinery to form a Board of Control or Commission to control the activities of the New Zealand Broadcasting Service and its associated Television section.

A lot of very intense debate was directed to this Bill with certain political policies coming to the fore. Whilst this magazine has not and does not intend to discuss politics in general, this particular Bill does have some bearing on many of our readers.

The Broadcasting Service under its present frame of construction and control has undoubtedly given great service to the public whilst maintaining the highest technical and moral standards. In fact they have been accused on more than one occasion of being too puritan in outlook. This certainly is a tradition which some similar services overseas could do well to emulate.

Within the bounds of the Commission Control these qualities must be continued. However, as an independent body the Commission will now have the opportunity to develop some facets of the Broadcasting and Television service which to date have not been practical under the direct control of a Government Minister and his Department.

It is a fact that commission control of radio and television is quite common. Many of the Commonwealth countries and other large nations have commissions or similar bodies controlling their broadcasting and television services. Apparently such services are generally well run, with high standards, and the listening and viewing public seem satisfied.

In our case there is provision for extending the coverage of the country with more transmitting stations possible for both sound and vision broadcasting. In many places in New Zealand there are areas which due to topography are cut off from the major city areas, yet, in a number of cases they are also cities. These places to date have been reasonably served in the world of sound broadcasting, but with the advent of television will be without coverage for some time, and deserve all the assistance they can get in the way of stations set up to serve them; and it will be left to the commis-

sion to decide in what manner they can be served.

In other countries it is often the policy to let private enterprise install and operate such stations, and providing that these are disciplined with the same control as the balance of the service, surely it cannot do the country any harm. The remaining stations must of course be financed either directly from the commission or from receipts from advertising. In any case, providing that the basic principles which have been observed up to now are adhered to, there should be no reason for such a system to become unmanageable.

Another point which deserves consideration is the fact that a Broadcasting Service in its own right must have certain elements of originality, art and devotion to their job which under normal conditions would not pertain in ordinary business or in any Government Department. Long hours are spent by staff in preparation of programme material and a great deal of forethought is required in many cases. The service contains within one component unit musicians, artists of many kinds, people with technical ability in production and also men with a great deal of electronic engineering experience, and all these are woven together in the production of a feature or featurette to play or be screened for just a few minutes. There is really little reward in terms of productivity for the many hours which have been spent, therefore in compensation there must be some provision made to encourage and give credit, where it is due, for such work, and not have it hidden under the incognito of a Director or Minister of such a service. Such a policy surely will be in the interest of good public relations as well as providing the cultural background for an improved service.

The commissions real and main job then should be an earnest endeavour to lend new stimulus and incentive in an attempt to provide, where possible better and more varied quality of programme, longer hours and greater coverage for sound and vision broadcasting. If any or all of these are attained whilst maintaining the good name of the existing service, then surely this country must benefit.

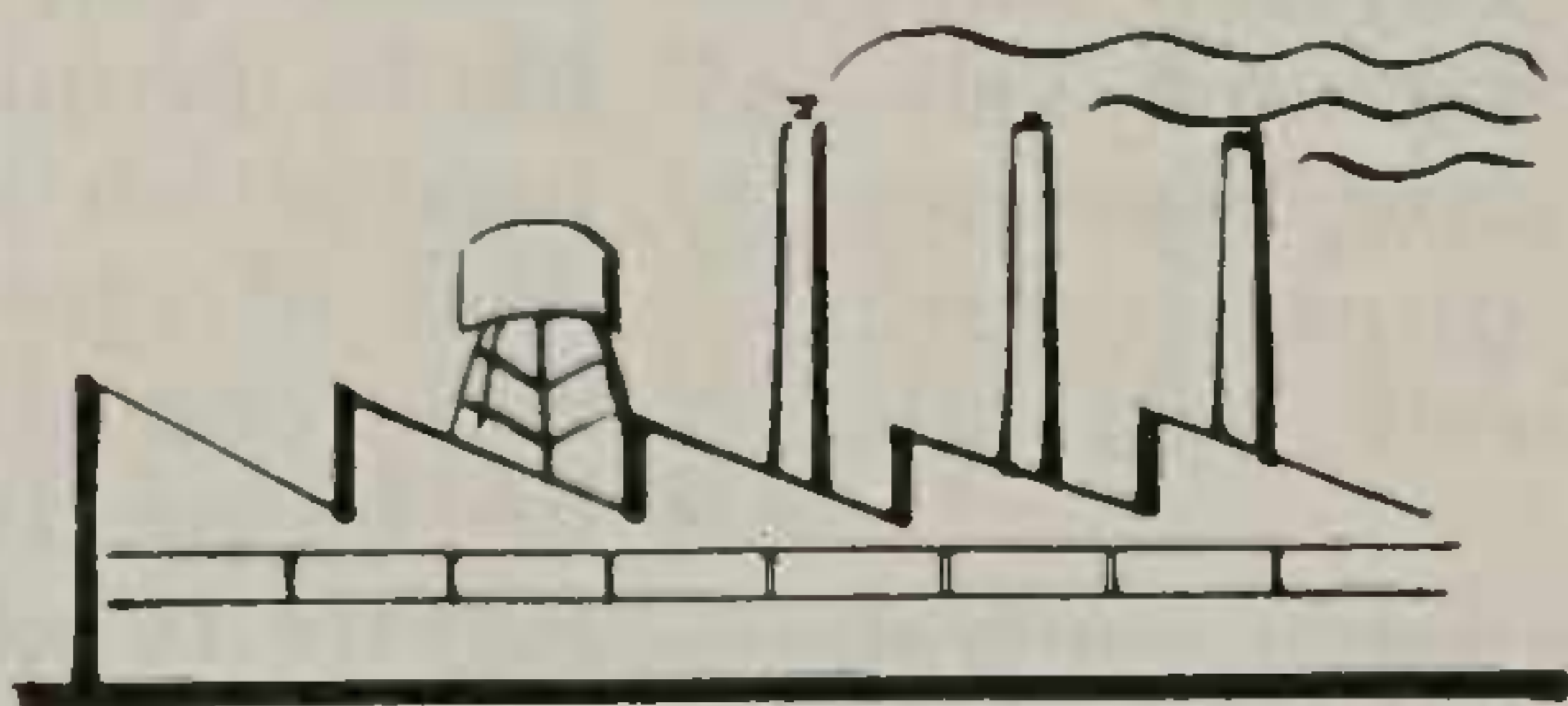
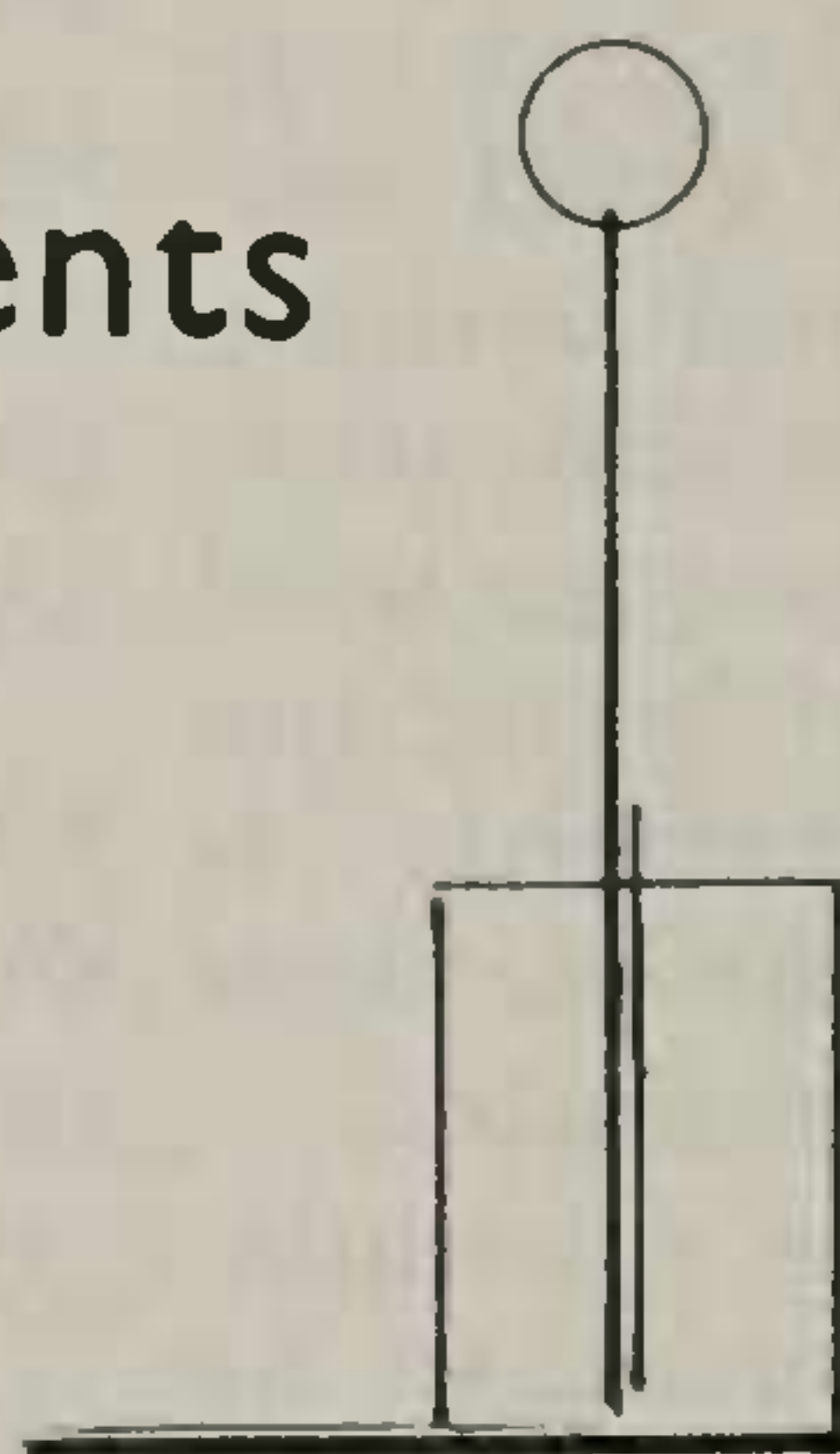
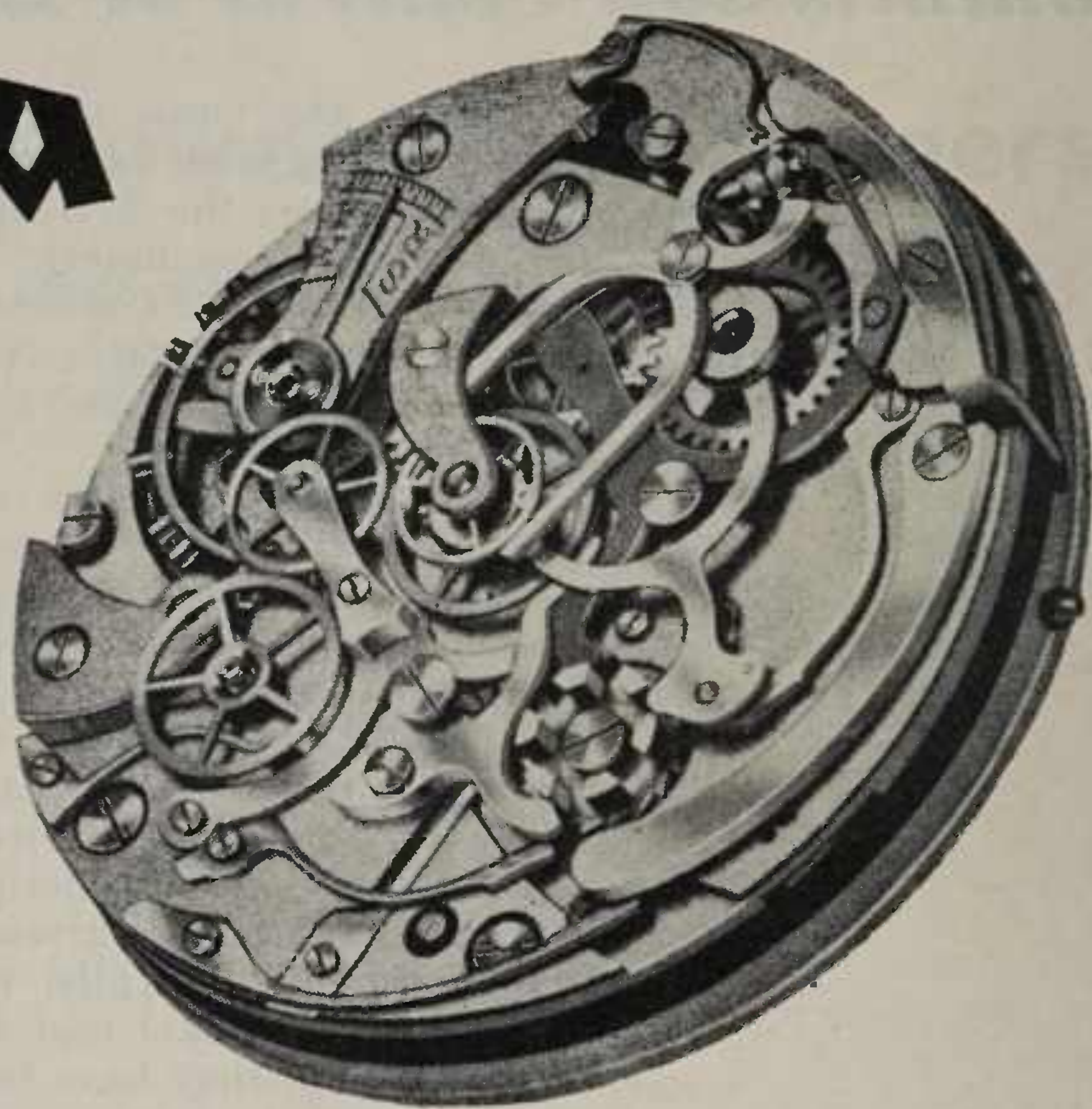
—I.H.S.

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The criticism of portable transistor radios on this page, in conjunction with the angry outbursts this summer from offended holiday makers, have prompted some basic re-thinking on the subject. The TransistEar 1 (as yet still in the plasticine model stage) can be operated only when clamped firmly to the ear by sound proof suckers, writes the Art Editor of "Design Magazine." He continues: For those who want to hear both programmes at once, a two-ear model is also being considered.

DESIGN

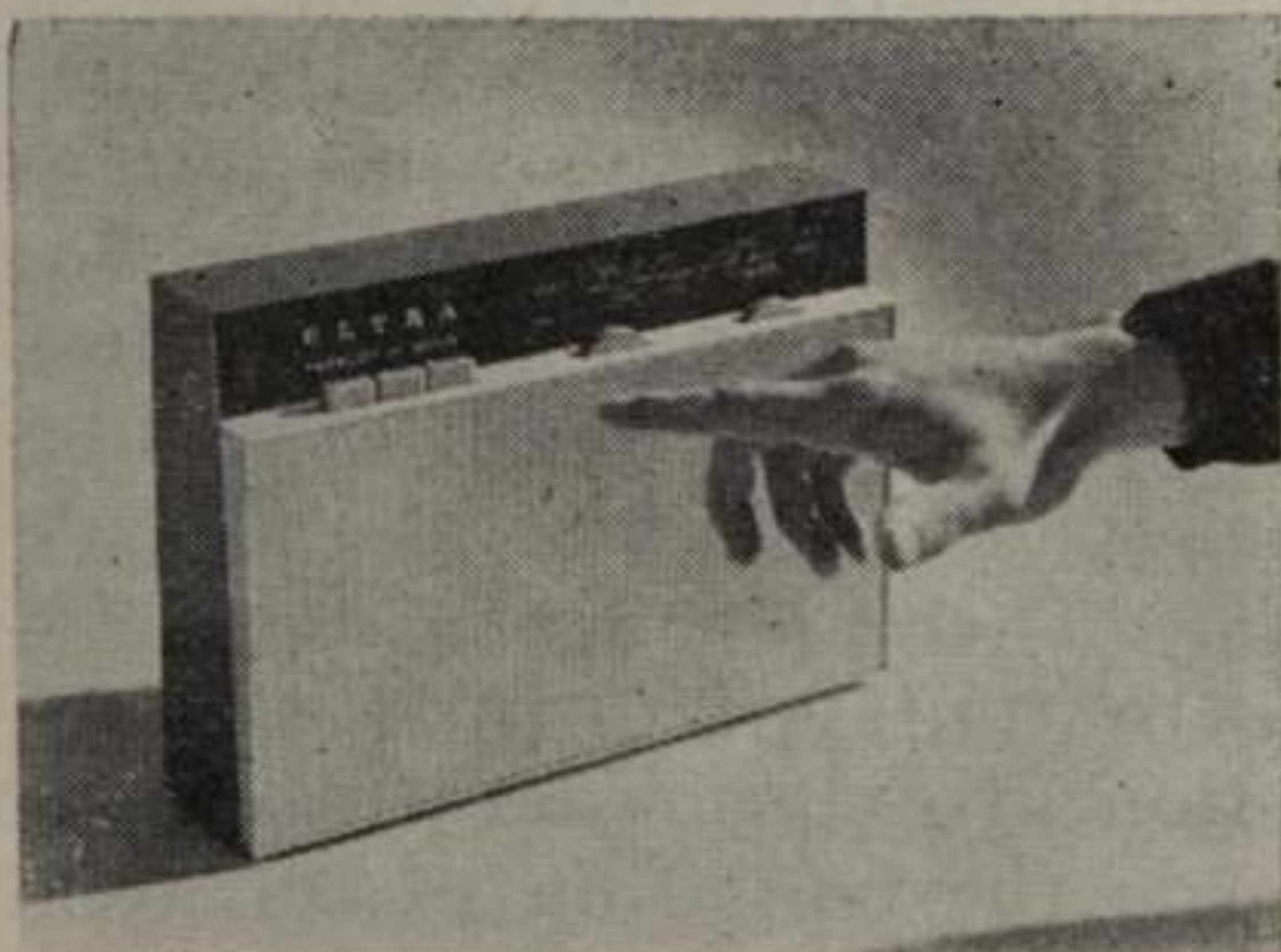
at the National Radio Show

On the following pages J. Stubbs Walker reviews technical aspects of the National Radio Show. It is valuable also to consider the design aspect. The world-ranking authority, "Design Magazine," in its November issue says, under the heading "Radio Contraction":

The National Radio Show this year presented a rather more encouraging picture of the industry in its attitude towards design than has been apparent for some time. While there was enough brash vulgarity to delight the cynics, improvements were sufficiently plentiful to be noticeable without microscopic search. Greater attention to detail, for example, has resulted in better lettering, neater controls and less blatant trade marks. The faces of cathode ray tubes have apparently grown larger (as the masks become more square), and with the increasing use of integrally moulded implosion shields, the sets seem to be more compact and better proportioned. There has been a tidying up of side and rear views and almost all backs of television sets are now formed from resin bonded fibre or glass fibre.

One tendency this year was to exploit every possible geometric variation on leg structures—crossed, sloping, tapered, parallel, three-legged versions; cross-braced or fitted with trays, racks, shelves, *et al.* The upsurge in transistor portables was evident among radios, though why the sharp, square cornered look should apply to something presumably intended to be carried in one's pocket must remain a mystery.

But perhaps the most dominant impression of the show was created by the large open spaces—indicative of the integration and contraction that have taken place in the industry. The mergers into big groups are beginning to have their effect on the design of cabinets, and designers are now faced with the problem of creating an individual style for each of the firms within any one group, and at the same time of making the groups as a whole distinguishable from the others.



(Left) The Ultra Portable Transistor Radio, subject at this year's award at the Duke of Edinburgh's Prize for Elegant Design (see "Radio & Electrical Review"—July 1961.

LONDON RADIO SHOW REVEALS NEW TECHNIQUES

BY J. STUBBS WALKER

AT the recent National Radio Show, at Earls Court, London, British manufacturers showed some of the most advanced receiver techniques. Some of these were technical refinements designed to give the viewer an improved picture with a complete absence of "fiddling" with the controls; others were aimed at more economic production and easier servicing; all the improvements, however, were aimed at higher reliability, lower cost and a breadth of application which makes the receivers generally suitable for the export markets.

British Television Trends

In Britain, viewers are at present bemused by the possibilities of a change in the foreseeable future in the television line standards and the likely emergence, eventually, of a colour service. At present there are two national television networks, but under consideration is the provision of a third which will mean widening the scope of receivers to operate on the Ultra High Frequency bands as well as the present Very High Frequency bands. These future possibilities have presented manufacturers with a lively production problem in which some kind of provision will have to be made to cope with the still undecided potential requirements of the home market.

This, though, is a purely domestic matter and it has not been

The new twin panel teletubes introduced at the recent National Radio Show in London by Brimar Ltd., Rochester, Kent, England, offer a major improvement in picture quality and presentation while ensuring a greater degree of protection without the use of a separate safety shield. The illustration shows the glass or Diakon shield with fitting lugs which is bonded to the face of the television tube.

allowed to divert the industry's objective of increasing its export of television sets. In the past this has not been a particularly large contribution to Britain's overseas electronic business. This year, however, most of the British manufacturing organisations have begun to make a much more serious attack on export markets. Thus the fact that British television standards differ from those of most other countries, not only in line standards but in the form of picture and sound modulation, is of little consequence.

Although some of the modules in British television receivers are common to both export and home models, manufacturers are finding it an economic proposition to lay down a specific production line for export instruments which is quite separate from the section dealing with sets for the home market. Even the cabinet styling is being tailored by some firms to fit overseas requirements.

Though Britain is unlikely to have a U.H.F. television service for at least a couple of years, the wide experience gained by British manufacturers of U.H.F. communications equipment has enabled them to produce receivers and waveband converters which stand comparison with equipment produced anywhere.

Overseas Engineers "View" Advances

Overseas electronics engineers



at Earls Court were able to see some valuable engineering contributions which have been incorporated into new sets and which are now available for overseas markets. Most manufacturers have produced improvements in circuitry which take full advantage of new valves, particularly those of the frame-grid high mutual conductance type whose introduction has, in many cases, enabled the performance of a receiver to be increased while reducing the number of amplifying stages. Several manufacturers showed models which are making greater use of solid state components, such as silicon and germanium diodes and transistors. (Fully transistorised portable television receivers were also available, but from the technical point of view the introduction of transistors into certain circuits of standard mains-operated sets is even more interesting).

Clever Turret Tuners

On the engineering side some of the cleverest new ideas were to be found in the design of turret tuners and such things as the combined television tube and implosion screen shown by Brimar (1). In this, the thick protective plastic screen is built in with the tube face, which has several advantages. There are fewer surfaces, light output is improved and reflection of exterior lighting is reduced; the mounting of the tube

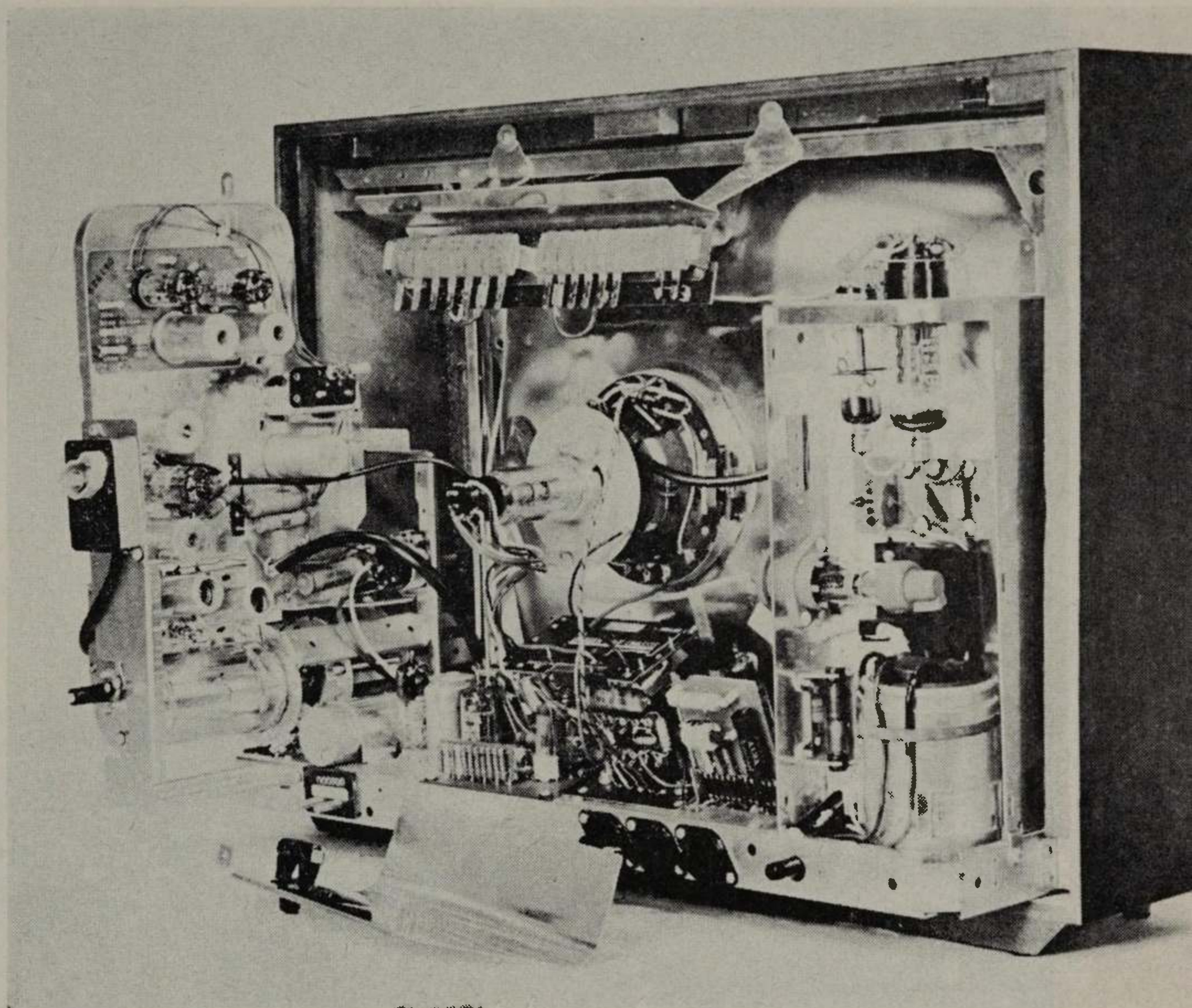
in the receiver is simplified, as the implosion guard can be bolted directly to the chassis, forming its own support for the tube; the problem of sealing the tube face to keep it free of dust is no longer necessary.

So many firms displayed receivers incorporating new techniques that it is difficult to select any one make of receiver as outstanding. Possibly an example of more than usual interest was to be found in the new Murphy (2) sets, and certainly the engineering approach to their tuner unit is interesting. This has seven push-buttons mounted radially, which include tuning for V.H.F. sound transmitters as well as television channel selection. As the button is pressed, a lever moves a thrust roller forward to engage with a swash plate which revolves the turret head to the required position. When a button is pressed to receive sound-only transmissions, the video circuits are automatically switched off.

The tuner is said to require only a comparatively light touch on the push-buttons, yet to give a high degree of precision in the movement, which, coupled with tuning inductances wound on low-loss formers and adequately temperature-compensated circuits, enables station-switching to be achieved without the necessity of using a fine tuning control. Before production started, this tuner was tested to the equivalent of seven years use. Particularly interesting in the receiver is the fact that selection of the V.H.F. sound channels can never produce off-frequency tuning as the Frequency Modulation circuit provides the necessary voltage from the discriminator to operate automatic frequency control.

Oil-Filled Transformer

Again, on the question of reliability, one of the parts of a television set that is invariably over-worked and which provides a big percentage of technical failures is the line time-base transformer. This has now been produced by Murphy as an oil-filled "package" built as a miniature edition of transformers used in power distribution networks.



The V659 television receiver by Murphy Radio Ltd., of Welwyn Garden City, Hertfordshire, England, which was exhibited at the recent National Radio Show in London, has many design features, such as pluggable resistors and capacitors which are simply pushed into holes on a printed circuit board; an oil-filled line time-base transformer which is cooled by mounting the relevant valves above it; and the compass tuner, an ingenious push-button mechanism for station control. All that is needed to expose the receiver chassis is to undo two screws and pull.

Many of the television receiver refinements are, on the face of it, simple things. For example, it is important that the time-base transformer should not overheat, though it is necessary to associate it closely (physically) with the line valves which generate quite a lot of heat. By placing the valves above the transformer, Murphy states that the high temperature they produce is used to draw a draught of cold air over the transformer, reducing its operating temperature by 14 degrees Fahrenheit. Simple, but highly efficient!

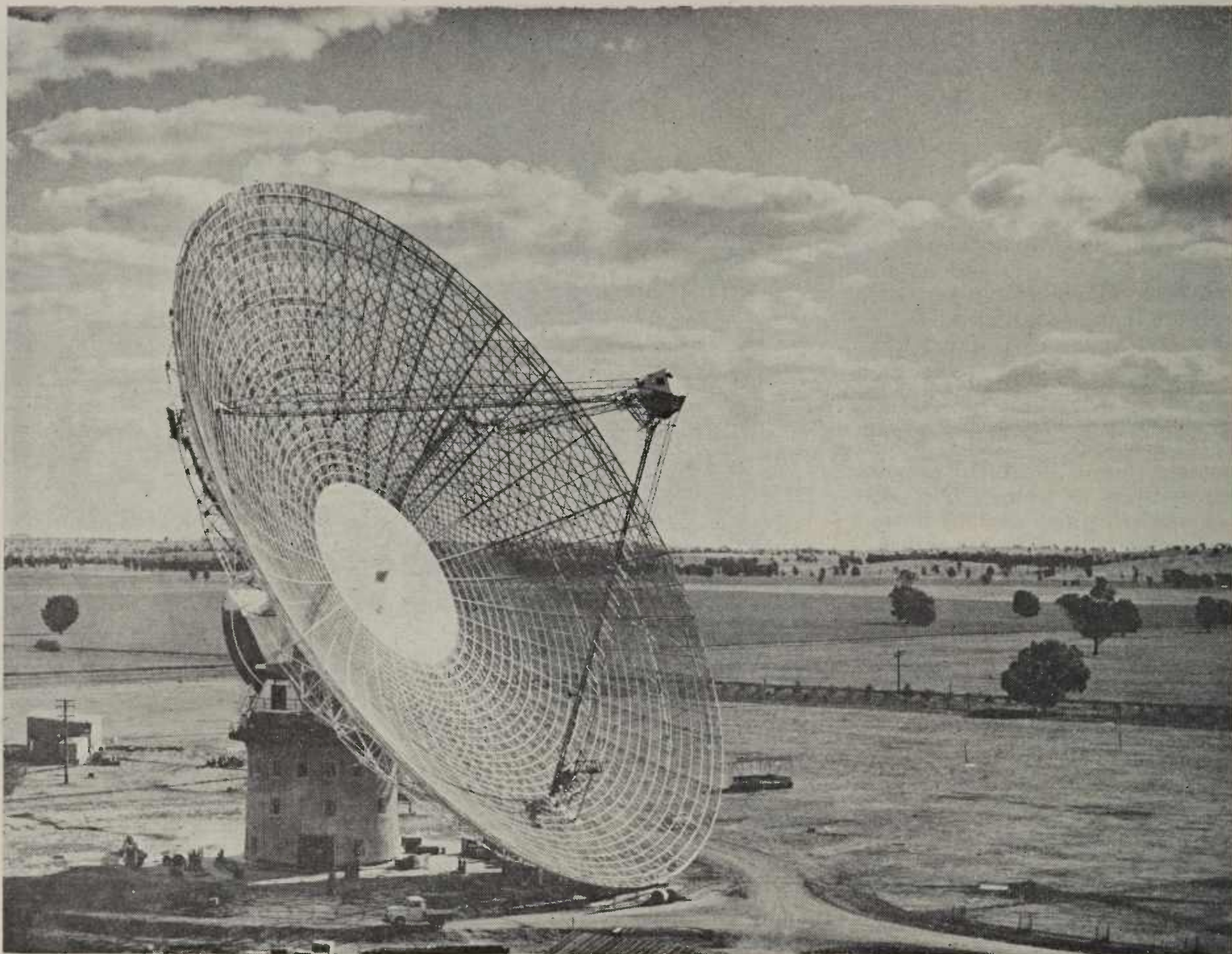
Remote Control Units

The Earls Court show produced a fairly wide variety of methods for the remote control of receivers. Some of these were purely electrical, with a lead from the set to a tidy little control box on the arm of the viewer's chair as

shown by Pye (3), but there has been an extensive introduction of "cordless" controls. One of these by Murphy produces two ultrasonic notes, one to control the switching of programmes, the other the sound volume. The controlling sound is produced by the depression of a finger plate, releasing a small hammer to strike a tuned metal bar which vibrates at a frequency well above that audible to a human being. A half-inch microphone on the receiver picks up the "silent sound," amplifies it and converts it to an electrical signal which moves the controls.

Other systems use light-sensitive cells on the receiver which are actuated when the viewer directs a beam from a torch on them. These were shown by E. K. Cole (4) and Philco (5).

(Continued on Page 39)



AUSTRALIA'S NEW 210 FT. RADIO TELESCOPE

The Commonwealth Scientific and Industrial Research Organisation's 210-ft. radio telescope, 12 miles north of Parkes, New South Wales, will become available for full-time research in radio astronomy by the end of 1961, after a series of test and acceptance trials which began in September.

Some of the more important of the investigations for which the telescope will first be used include:—

- A study of the detailed structure of the galaxy containing the Earth.
- Exploration of the external galaxies nearest to Earth—the large and small Clouds of Magellan.

- A survey of sources in the outer regions of the Universe, and a search for clues to its origin.

This turret rotates as a whole to provide motion in azimuth, moving on four tapered rollers which run on a hardened steel track, finished to a high degree of flatness, which is set into the top of the reinforced concrete tower.

The telescope can be tilted to a minimum altitude of 30 deg. above the horizon; motion in azimuth of 450 deg. is provided.

The drive and control system is a unique feature. A miniature precision-built equatorial unit is placed at the intersection of the

altitude-azimuth axes of the radio telescope. This unit may be pointed and made to follow any required course and the radio telescope is made to follow it precisely by means of a master-slave system.

An error detector, mounted in the hub of the telescope and operated by a beam of light, senses whenever the telescope is not aligned with the master unit and the signals it then generates operate the altitude-azimuth motors to bring the telescope into position.

A control desk on the top floor of the tower is the point from which the radio telescope is completely operated by a skilled controller in charge at all times. This

controller ensures the carrying out of the programme requested by the radio astronomers on duty.

Details

The reflector is 210 feet in diameter; its 54-ft. inner section is covered with steel plates and the remainder with panels of 5/16th inch mesh of high-tensile steel wire.

The surface is formed to that of a paraboloid of revolution of focal length 86 feet, the maximum permitted departures being plus or minus 9 mm. Adjustments provided at intervals on the purlins allow the surface to be brought to the correct shape.

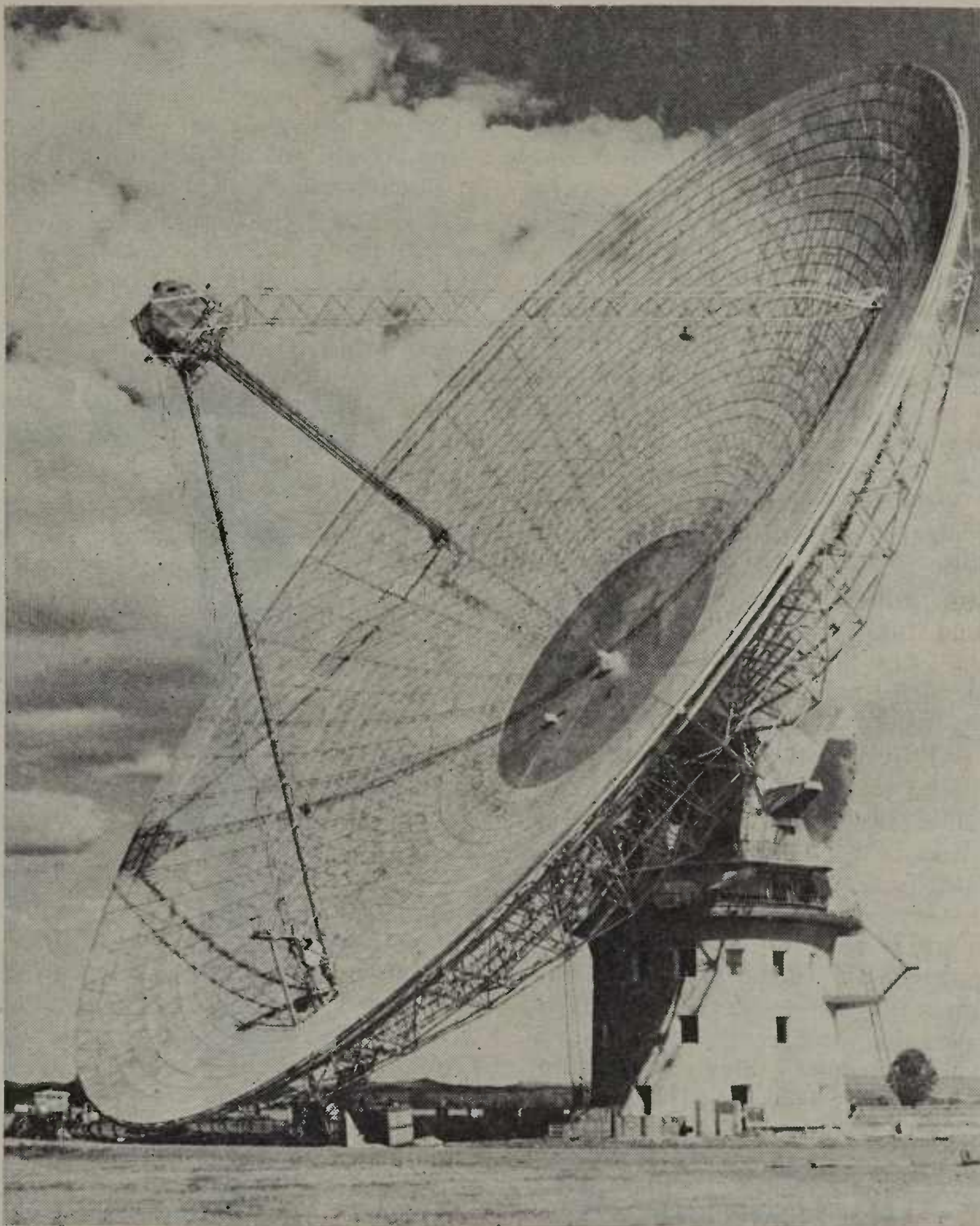
An aerial cabin, mounted on a tripod above the reflector provides means for supporting aerial feeds which collect the radio waves focussed by the dish; it also houses the initial stages of the radio receivers.

The mount is of the altitude-azimuth type. The reflector moves in altitude, that is, it tilts about two short axes which project one each side from the heavy steel hub and are supported in bearings mounted at the apices of the A-shaped turret.

After tenders had been called on a world-wide basis, the contract was awarded to the West German firm of Maschinenfabrik Augsburg-Nurnberg A.G., known as M.A.N., which acted as prime contractors. Metropolitan-Vickers, of Manchester, sub-contracted for the drive and servo-control system; Askania-Werke, of West Berlin, provided the master equatorial unit, error detector and control desk; Concrete Constructions Ltd., of Sydney, built the foundations and concrete supporting tower.

In September, 1959, construction of the concrete tower was begun. It was finished in February, 1960, ready for the hub and turret structure which had been made and assembled at the M.A.N. plant, then assembled and shipped to Sydney.

The dish surface of the instrument is supported on radial purlins carried on two series of interesting radial purlins which are attached to 30 radial ribs. These ribs were cut and assembled in



jigs on the site and welded at night so that all parts were at constant temperature. A 240-ft. high derrick lifted the ribs into place during assembly on the site.

The science of radio astronomy was considerably helped by discoveries made in Australia in 1946 after observation by a small radio telescope at Dover Heights, near the entrance to Sydney Harbour.

These discoveries were:—

- The sun's atmosphere, or corona, has a temperature reaching a million degrees.
- Enormously powerful radio waves are sometimes emitted from the vicinity of sunspots.
- There are point sources of radio waves, known as "radio stars," which are not associated with prominent visible objects.

The C.S.I.R.O. says that the new radio telescope will be used partly for "the exacting task of tracking the space vehicles man is on the brink of sending forth to explore the more accessible parts of our solar system. Its primary purpose, however, will be the probing of depths of space and time that lie beyond the infinitesimal part of it that is within reach of man-made vehicles."

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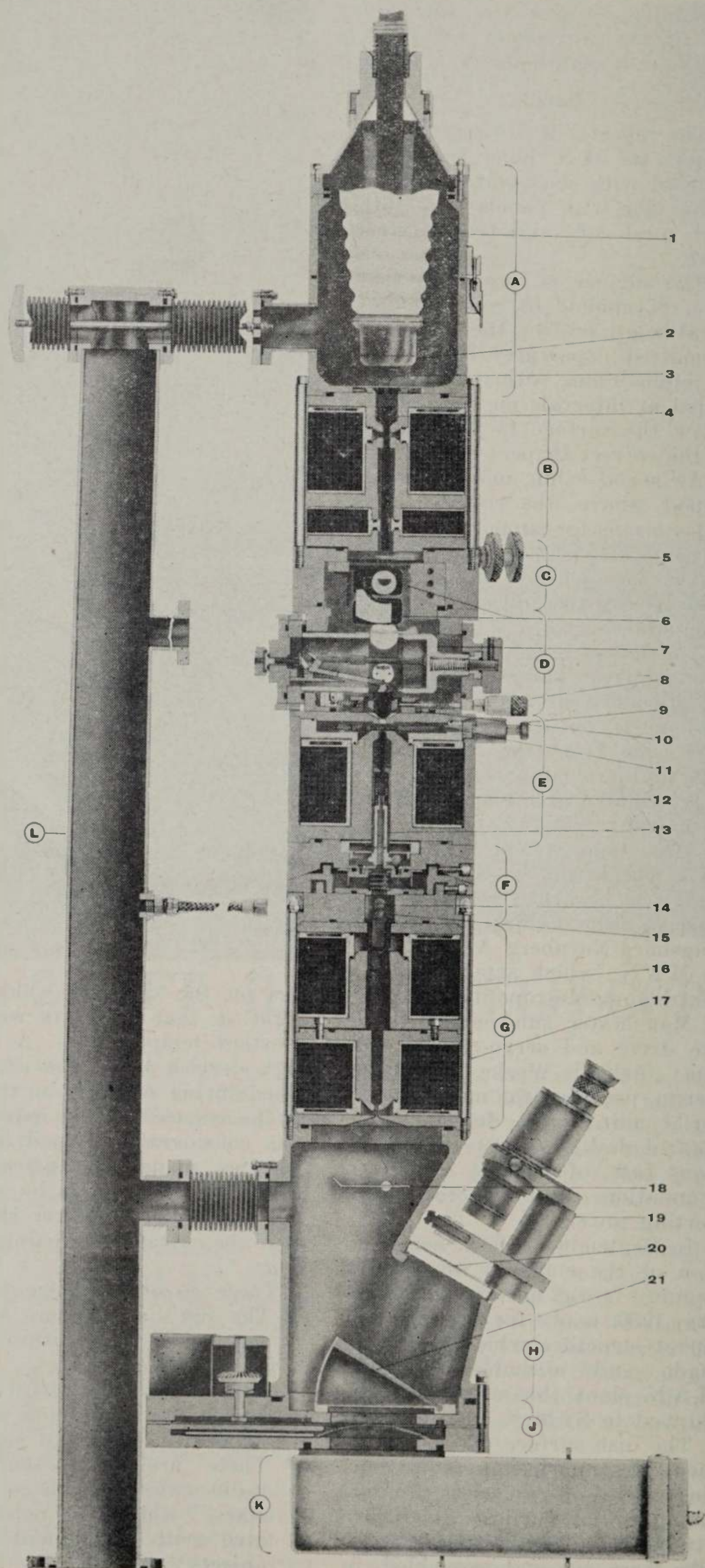
AEI AUCKLAND HOLDS FILM EVENING

The Auckland Office of Associated Electrical Industries (N.Z.) Ltd. recently held a film evening to celebrate the second anniversary of the establishment of their Company in New Zealand.

Already prominent in the fields of electrical and electronic engineering, the company entertained their guests with three excellent films followed by a delightful supper. The films, as is evident from the titles, showed the diversity and range of products manufactured by A.E.I. and their subsidiary companies.

The first film dealt with the A.E.I. new "1010" Digital and Data processing computer. This masterpiece of electronic engineering is capable of handling up to thirty or more ancillary machines for the storage, calculation, processing and recording of data of any kind. The film showed how such a computer could take over the whole office procedure of a

- A Electron Gun
- B Double condenser lenses
- C Illumination alignment stage
- D Specimen chamber
- E Objective lens
- F Intermediate stage
- G Projector lenses
- H Viewing chamber
- J Camera airlock valve
- K Camera
- L Pumping manifold
- 1 Insulator
- 2 Cathode assembly
- 3 Anode aperture
- 4 Screening tube
- 5 Adjustable triple condenser apertures
- 6 Electrostatic magnetic beam deflectors
- 7 Airlock mechanism
- 8 Stereo control
- 9 Objective aperture mechanism
- 10 Specimen stage
- 11 Objective lens lid
- 12 Objective lens body
- 13 E.S.A.C. lens
- 14 Preset diffraction aperture
- 15 Variable area diffraction apertures
- 16 Intermediate projector
- 17 Final projector
- 18 Shadow mask
- 19 Binocular telescope
- 20 Window
- 21 Fluorescent screen



very large manufacturing company with ease.

The second film showed the latest technical advances in Marine Radar. The "Escort" marine radar manufactured by the B.T.H. subsidiary of A.E.I. utilises an analogue computer to present a vastly improved plot of surrounding objects. Particularly useful in crowded coastal waters, this type of radar gave considerably more assistance to the navigating pilot than other conventional systems.

The third film unfolded all the mystery and background of the Electron Microscope. Displaying the A.E.I. E.M.6 high resolution electron microscope at work this first film made by the A.E.I. Film Unit was one of the only two British Films to gain a Certificate of Merit at the 15th International Scientific Film Association Congress. Of particular interest was the use of television scanning and intensifying of the image produced by the microscope. We are indebted to Mr. T. McGeachie, of A.E.I., Auckland, for the following notes of elucidation regarding this Electron Microscope.

Television Electron Microscope Images

The conventional electron microscope provides a highly magnified image which is viewed by means of a fluorescent screen mounted within the vacuum system of the microscope. The method of recording is generally by means of photographic plates or films, which are also inserted into the vacuum and which register the electron beams which fall directly on them. Direct viewing is necessarily restricted to a few observers who can look through the window of the microscope.

The image has to be focused and the field of view adjusted by direct viewing of the fluorescent screen and consequently sufficient beam intensity must be used to make the image easily visible. At the same time, in order to preserve specimens against radiation damage from the electron beam a very low beam intensity must

be used. A compromise between these conflicting conditions is usually made by operating the microscope in the dark and the operator's eyes have to become dark adapted. Quite clearly, conditions would be easier both for the operator and any observers if the necessity for viewing in the dark could be eliminated.

One method to eliminate viewing in the dark is to transfer the image electronically to display cathode ray tubes remote from the microscope and if possible to intensify the image, and the problems involved in doing this have been discussed for many years. The basic technique for achieving the desired result lies in the use of the television image tube, but such tubes cannot work in the dynamic vacuum system of the electron microscope because the sensitive elements would be damaged by the residual vapour present.

In 1955 Dr. M. E. Haine, of AEI Research Laboratories, put forward a system using amorphous selenium as the sensitive material. This amorphous selenium can be exposed to air without deleterious effects. Later Haine and Einstein built an experimental apparatus and showed that not only could an image converter tube be made to work within an electron microscope but in addition a substantial degree of intensification could be obtained.

The operation of the intensifier relies on the increase in the conductivity of selenium which occurs when it is bombarded by high energy electrons. The primary electron beam in the microscope falls on a layer of selenium supported on a thin plastic membrane, backed by a layer of evaporated aluminium held at positive potential. When the free surface of the selenium is scanned in a standard television raster from a low voltage electron gun, a signal appears on the backing layer which is proportional to the primary beam intensity at the position of the scanning spot. This signal is amplified and applied to a cathode ray tube scan-

ning in synchronism. By this means the electron intensity image in the microscope is converted into a voltage signal which can be transmitted through a television system. The intensification of the image results from the fact that several thousand electrons are released inside the selenium film for every single high energy incident electron. Efficient collection of these electrons produces a signal of reasonable amplitude for further amplification.

The system neither detracts from nor adds to the quality of the electron microscope image since, for a given exposure time, this is limited by the quantum noise of the electron beam.

The intensifier is still in the development stage but its development is sufficiently well advanced for it to be of use in relaying the image and also for use as a focusing aid when only a weak primary intensity can be used in the microscope.



For the purpose of illustration in the B.B.C. "Science International" programme and in one of the "Eye on Research" programmes, the latter recently shown on Auckland T.V. Channel 2, two AEI high resolution type EM6 electron microscopes were fitted with special image converters of the sort described.

(Continued on Page 33)

Demonstration of Modern Electronic Equipment

by George H. Sample & Son (N.Z.) Ltd.

George H. Sample and Son (N.Z.) Ltd., recently held a demonstration of modern electronic equipment at the Seddon Memorial Technical College in Auckland.

The equipment was ably demonstrated by Mr. Tom E. Cottle, Chief Sales Engineer for Sample Electronics (Vic.) Pty. Ltd.

A considerable number of the latest Hewlett Packard instruments were shown in operation in addition to a number of other specialised instruments produced by other firms.



Of particular interest was the H.P. Clip on D.C. milliammeter type 428A. This meter had the new current probe which enabled current measurements to be made without breaking into the circuit for currents from 3 ma to 1 amp full scale.

One of the more specialised instruments which caught the writer's attention was a digital voltmeter manufactured by "Non Linear Systems" Ltd. This digital voltmeter provided 4 digit readout of either polarity. Fully transistorised, this down to earth and useful piece of equipment was demonstrated by feeding it with D.C. from a stabilised selectable power supply. Another D.C. Voltmeter which showed no effects of drift even when switching polarity or from the lowest to the highest ranges was an H.P. D.C. Voltmeter type 412A. This instrument is based on the A.C. voltmeter principle and utilises a Photoconductive chopper to convert the D.C. to A.C. before amplification.

Another more specialised instrument—the R.F.L. Gaussmeter was demonstrated. This instrument was capable of measuring Flux from 1 to 20,000 gauss. With a built in 1,000 gauss reference for calibration, and using the Hall effect principle in the probe this transistorised unit was suitable for field use as it was operable from either batteries or A.C. It could also be used with oscilloscope, recorder or remote meter indicators.

A thoroughly interesting two hours was spent and we appreciated the courtesy of the Invitation to view this equipment.

THE AMERICAN IDEA

A HEARING AID TRANSISTOR THE SIZE OF A GRAIN OF RICE will enable hearing aid manufacturers to obtain up to four times the battery life of present units, or make a smaller hearing aid with longer life and less supporting circuitry. The transistor, developed by Raytheon Co., is only 1/27th the size of standard transistors and can amplify sound by 10,000 times its volume.

AUTOMATED SHOPPING IS MOVING INTO WEST GERMANY, reports the German American Chamber of Commerce. Subscribers to the new technique in 20 West German cities are furnished with a telephone attachment plus 180 punched cards. After dialing the store, subscriber inserts cards selected to order food, housewares, tobacco, etc. Entire Purchase-accounting transaction is completed automatically without use of the spoken word.

THE WORLD'S FIRST "FULLY AUTOMATED" TRAIN has successfully passed its test on the New York City Subway System. Electronic impulses from a large wayside signal cabinet are transmitted to the train via the rails. Receiver coils on the train pick up the signals and feed them to a decoder inside the cab which carries out operating instructions. Tracks are broken down into six insulated joints which let through a different rate of impulses to control starting, stopping, speed, acceleration or slowing down. System was developed co-operatively by General Railway Signal Co., Union Switch and Signal Co., and Westinghouse Air Brake Co.

A WRIST WATCH LIKE NO OTHER CLOCK SINCE TIME BEGAN is called the Accutron by its manufacturer, Bulova Watch Co. The name was coined from the words "accuracy" and "electron." Instead of springs and gears, it has a tiny tuning fork that hums faintly at a rate of 360 cycles a second on eight-millionth of a watt from a dime-size battery.

ELECTRONIC DEVICES ARE MAKING LIFE EASIER FOR INDUSTRIAL GUARDS. W. Sherman Burns, president of William J. Burns International Detective Agency, says photo-electric cells that detect metal on a person no matter how well hidden, closed circuit television, radar and other electronic devices are cutting employee theft considerably.

A NEW SYSTEM THAT USES SIMPLE ENGLISH WORDS TO INSTRUCT COMPUTERS will reduce programming time and costs for electronic data processing users substantially, predicts Donald H. Kunsman, RCA vice president. The system, which replaces the complicated numerical jargon understood only by computer specialists, is called COBOL (Common Business Oriented Language). It was created by a committee of computer producers to provide a standardised language that would be interchangeable among different systems.

STANDARD FREQUENCY TRANSMISSIONS

L. S. Spackman (ZL1AC)

Mr. Len Spackman, who is father of I. Spackman, one of our Consultant Editors, has had a lifetime with Radio and Electronics, being one of the first Radio Amateurs licensed in New Zealand with the call sign of 1AC which he still holds.

For many years Mr. Spackman has been actively interested in precision frequency measurement and maintains probably the only privately owned primary frequency standard in Australasia, corresponding regularly with the National Physical Laboratory in England and the National Bureau of Standards in the U.S.A. Although a Public Analyst by profession Mr. Spackman has also been associated with Public Address and Recording Companies in a technical and administrative capacity.

MOST readers are aware of the WWV standard frequency transmissions and there are few who have not had, at some time or another, occasion to make use of these transmissions.

The purpose of this article is to explain how the signals are generated; how they may be used and their limitations.

Before proceeding further it is necessary to point out that frequency and time are inter-related. Frequency is the number of events per unit time; in our case, usually cycles per second. Likewise time is the period of a cyclic phenomenon. In other words, time is the reciprocal of frequency.

Standard time is derived from astronomical observations, the solar day being the period of one revolution of the earth around its axis. This could also be called a frequency of one cycle per day. As the day is an inconveniently long period it has to be divided down into smaller increments; hours, minutes and seconds. For this purpose quartz crystal clocks are invariably used. These consist of a quartz piezoelectric crystal, basically similar to those used to control a radio transmitter but using cuts having a substantially better order of stability and the

temperature of the crystal being controlled within very narrow limits so as to provide an oscillator having a very high order of stability. The fundamental frequency of the crystal is usually 100 K/C per second but other frequencies are also used. This fundamental frequency is electronically divided down to a lower frequency suitable for driving a synchronous clock and also further to one cycle per second to provide the one second time pips familiar to all radio listeners.

In England the National Standard of Time is defined by the Royal Greenwich Observatory and in the U.S.A. a similar service is performed by the U.S. Naval Observatory. These two observatories work in very close collaboration and within the last few years by making use of the special properties of the very low frequency radio transmissions the two national standards of time have been brought into virtual agreement, both as regards the period of the standard time interval and also the commencing time of each standard interval. Other nations operate observatories and their standard time is made to agree with either Greenwich or U.S. Naval Observatory time, which are now, for all practical purposes, the same.

The British National Standard of Frequency consists of a bank of highly stabilised crystal oscillators similar to those used at the abovementioned observatories and is maintained at the National Physical Laboratory, Teddington, England. Through close collaboration with the Royal Greenwich Observatory the National Standard of Frequency is maintained in agreement with the crystal clocks operating at the observatory. In addition the frequency of the National Standard of Frequency is compared regularly against several atomic standards of frequency comprising

types of Caesium beam resonators. The stability and accuracy of the National Standard of Frequency is thus as high as is possible according to the present state of the art. Similarly, in the United States of America the National Standard of Frequency is maintained by the National Bureau of Standards at its Radio Standards Laboratory, Boulder, Colorado, U.S.A. The U.S. Standard of Frequency is similar in most respects to the British Standard, is maintained in collaboration with the U.S. Naval Observatory and is also compared against a group of Caesium beam resonators. By agreement between the two laboratories a frequency of 9,192,631,770 cycles per Ephemeris second has been adopted as the resonant frequency of the Caesium beam resonator. The national standards of frequency of the two countries are thus identical. So far as is known, all other countries base their standards of frequency on either the British or U.S. standards.

When the quartz crystal clocks first displaced the pendulum clocks previously used as time standards at the observatories it was discovered that the rate of revolution of the earth was not uniform as was at first believed. It is now known that the length of the solar day is subject to variations of unpredictable magnitude and for this reason it is necessary from time to time to adjust the standard clocks so as to bring them into agreement with mean solar time. The second of solar time is therefore, not a uniform quantity. This meant that the solar second was no longer suitable for use with high precision frequency standards and the frequency of these is now based on the Ephemeris second.

Ephemeris time is based on the annual rotation of the earth around the sun and as far as present observations can determine, is a constant quantity. Mean solar time, which is the same as Universal Time (UT) or Greenwich Mean Time (GNT) has to be used for daily living and for navigational purposes. There is

thus a difference between the solar second and the ephemeris second and this means that the time kept by frequency standards differs from that kept by observatory clocks. This difference is decided by agreement between the British and American authorities and for convenience, is usually kept constant for a full year, changes being made at 0000 hours Universal Time on January 1st of each year. The difference for 1961 is 1.5000 parts in 10^8 , the ephemeris second being this much slower than the solar second.

In order to make the national standards of frequency available to the greatest number of users it has been the practice, for many years to transmit standard frequency transmissions. By international agreement the spot frequencies of 2.5, 5, 10, 15, 20 and 25 megacycles per second are reserved for the exclusive use of standard frequency stations. These frequencies are convenient and require a minimum of ancillary equipment on the part of the ultimate user.

The frequency of the control oscillator is obtained by multiplication of a selected crystal oscillator, one of several comprising a high precision frequency standard. Adjustments are made to this oscillator from time to time to keep it within the prescribed limits of accuracy as advertised for the particular transmitting station.

The first standard frequency station to be brought into operation was WWV, operated by the U.S. National Bureau of Standards and it was located at Beltsville, near Washington city. The first transmissions, on a limited basis, were made 25 years ago. In addition to radiating continuously on all the internationally assigned standard frequencies, WWV now also transmits a number of other services. These include one second time pips, standard audio frequencies of 440 and 600 cycles per second and a binary time code which permits time to be determined with an accuracy of one microsecond. The

440 cycle signal is useful as it is the standard philharmonic pitch of A above middle C and the 600 cycle tone bears a definite relationship to the 60 cycle power line frequency used in the U.S.A. In England an equivalent service is provided by MSF which is operated by the British Post Office from pulses and a modulation frequency of 1,000 cycles per second. The transmissions from both of these stations are continuously monitored against the National standards of frequency and are maintained at their nominal frequency within one or two parts in 10^{10} .

It is interesting to note that when WWV first commenced transmission the guaranteed accuracy was one part in 5 million, which was considered a very high order of accuracy in those days.

It will be remembered that the frequency of the frequency standard used at the standard frequency station and hence, the frequency of the radiated carrier wave is tied to the ephemeris second. On the other hand, the seconds pulses mark mean solar time.

Now, the ephemeris second and the solar second are different, as previously explained. Not only the carrier, but all the modulation frequencies and the one second pulses are obtained by multiplication and division of the same crystal oscillator. It follows therefore, that the frequency of the carrier and the one second time pulses cannot both be correct. As the time signals are more frequently used than the radio frequency signals it is the custom to make the time signals agree with mean solar time. Because of this the carrier frequencies and the audio tones have to be offset by an amount depending on the difference between solar time and ephemeris time. The carrier frequencies and modulation frequencies are transmitted by all the main standard frequency stations are therefore low in frequency, and for 1961 this deviation amounts to 1.500 parts in 10^8 . For many purposes this

can be ignored but for all precision work it has to be taken into consideration.

Most nations now operate standard frequency stations on the assigned frequencies and as some of these stations have considerable aerial power (notably Moscow with 20 K/W) there is considerable mutual interference. This has now assumed such proportions that it has largely destroyed the value of the transmissions and has led to the suggestion that the number of transmitting stations be reduced or that time be shared between them. It is not surprising to find, human nature being what it is, that most nationals are in favour of this suggestion, providing, of course, that it is not their own transmissions which are to be curtailed. Although most of the transmitters operate on the same nominal frequency there are actually small but finite differences between them and in any case, the varying distances between the transmitter and the receiving point will cause phase differences between the received signals. In addition, the signals are affected by another and more potent source of error. All HF signals, when reflected from the ionosphere undergo a change of frequency due to Doppler effect. Where several hops are involved these frequency changes can tend to cancel or they can be additive. The net result is to produce relatively large unpredictable errors in the signals as received. In addition, the reflected signals suffer a diurnal change in frequency, the frequency being high in the morning and low in the evening. For this reason, the transmissions should not be used when the ionosphere is disturbed corresponding to the periods when dawn or dusk is between the transmitting station and the receiving point. For best results readings should be made at times when midnight occurs midway between the two points. The above errors may not be important when one uses the transmissions for calibrating relatively inaccurate devices such as a receiver, VFO or signal generator,

but they largely destroy the value of the transmissions for work of medium precision and where high precision is required they are of no use.

The standard frequency stations audible in New Zealand are briefly as follows:—

WWV, located at Beltsville, Maryland, U.S.A. transmits continuously (except for 4 minutes immediately following minute 45 in each hour) on all the standard frequencies from 2.5 M/C to 25 M/C with a power of 8 K/W. The 5, 10, 15 and 20 M/C transmissions are received strongly in New Zealand and can be easily identified by the voice announcements. Modulation frequencies are 1 second, 440 C/S and 600 C/S.

WWVH, Hawaii, transmits almost continuously on 5, 10, and 15 M/C except for silent periods of approximately 3 minutes every quarter hour and from 1900 hours to 1934 hours U.T. Power is 2 K/W and modulation frequencies are the same as WWV.

JJY, Tokyo, Japan, transmits with a power of 2 K/W on 2.5 M/C (from 0659 hours to 2259 hours U.T.) and continuously on 5, 10 and 15 M/C except for a silent period from minute 29 to minute 39 of each hour. Modulation frequencies are one second and 1,000 C/S except on the 15 M/C transmission which carries the one second pulses only. Those who like to collect QSL cards will be interested to know that JJY acknowledges receipt of reports with a very attractive card. Their address is "The Radio Research Laboratories, Kokubunji P.O., Koganei-Shi, Toyko, Japan."

JG2AE, an experimental station controlled by JJY from the same location is at present transmitting on 8 M/C from 20.59 hours to 10.59 hours U.T. with 1 second and 1,000 C/S modulation with a power of 500 watts.

BPV, Pekin, China, as far as can be ascertained, transmits on 5, 10 and 15 M/C. At the last report no schedules of this sta-

tion had been lodged with the International Telecommunications Union, Geneva, and enquiries by the writer have not been answered. The power used would appear to be about the same as JJY as the signals have about the same strength as received. The transmissions appear to be unmodulated except that the station call is sent in morse for the last minute in each five.

LOL, Buenos Aires, transmits on all frequencies from 2.5 to 25 M/C with a power of 2 K/W. Modulation frequencies used are 1 second, 440 C/S and 1,000 C/S. Transmissions are made on week days for one hour every three hours from 1100 hours to 2400 hours U.T.

ZLFS, operated by the Dominion Physical Laboratory, Lower Hutt, transmits an unmodulated carrier on a frequency of 2.5 M/C with a power of 250 watts every Tuesday afternoon from 1 p.m. to 4 p.m. NZT. For those who are close enough to Wellington to receive the ground wave, this offers the highest precision standard frequency transmission available on the normal frequencies in New Zealand.

It seems that there are a large number of amateurs and servicemen who do not know the correct way of matching their local oscillator to the standard frequency signals. In many cases it is considered sufficient to just "zero beat" to the signal. As most people cannot hear frequencies below 40 or 50 cycles this means that there is a zone of silence from 80 to 100 cycles wide and the true "zero" is somewhere in this zone. Full information on how to "zero" accurately is to be found in textbooks, but the methods advocated may not work in New Zealand where the signals are very much weaker and where there are several signals all competing on the one frequency.

To zero accurately is it first essential that the local signal should have about the same strength as the one being re-

ceived. This usually means reducing the strength of the local oscillator by some means or other. The next procedure should be to try and adjust the local oscillator so that it is centred as near as possible in the centre of the silent zone. Concentrate now on the background noise and tune slowly back and forth when a distinct flutter should be heard. It may require a little patience at first but after a while the flutter becomes quite distinct and is immediately recognised. The flutter, is, of course, the beat between the two signals. If a communications receiver is being used it is sometimes a help to turn on the receiver BFO.

In this case listen for the cyclic variation in the volume of the beat note. Varying the BFO control will vary the frequency of the heterodyne whistle but the speed of the flutter will not change. Now adjust the local oscillator until the flutter or pulsation is as slow as possible. Under optimum conditions and with a good signal it is easily possible to match a local oscillator to a received signal within a very small fraction of a cycle. Adjustments of this order of accuracy are seldom possible with overseas standard frequency transmissions as the slow beat becomes confused with fading and also because of beats between the several signals audible due to the inevitable differences in frequency between them. However, one can generally get within two or three cycles of the correct frequency. A directional aerial can be of some assistance.

A more accurate method is that used by the author. However, it requires possession of a local oscillator with a high order of stability—such as an oven controlled crystal—and this oscillator must be fitted with a good vernier dial capable of discriminating accurately to a small fraction of a cycle. This oscillator will normally be running continuously; will normally be within zero beat of the standard frequency station and its approximate zero reading will be known

within a few degrees. The dial of this oscillator should now be offset from the standard frequency signal by a matter of several cycles so as to produce a beat that is slow enough to count but which is fast enough to be definitely distinguished. After a little practice beats as fast as four to five per second can be counted quite easily. Using a stop watch time a definite number of beats—say 200. Now retune the local oscillator to about the same amount on the other side of the zero position and again time the beats. Repeat the procedure, back and forth, several times. The readings should not be expected to agree exactly and sometimes the differences will be quite considerable. This will be due mainly to changes in the frequency of the standard frequency signal. Take the average of each set of readings—those above separately from those below. Now plot these readings on graph paper and draw a straight line through the two readings. The point where this line intersects the zero axis will be the correct reading. Determine the frequency increment in cycles per dial division and make the necessary adjustment for the offset used by the standard frequency station.

If possible it is desirable to repeat the above determination with each of the transmissions of usable strength. This is usually the 5, 10 and 15 M/C signals. It will generally be found that the results obtained from the different frequencies are not the same. Any reading which differs by a substantial amount is best rejected. If all results obtained are then averaged the final figure will probably be the best approximation of the correct frequency obtainable. Observations have been made by the author of transmissions from both WWVH and JJY over a number of years and comparisons made against a local frequency standard of very high stability and the results obtained indicate that none of the three transmissions from either station show a constant deviation. The errors appear to be quite random

so that over a period the mean of all readings should be approximately correct. The accuracy obtainable by this method can be better than one part in a million. Observations should not be attempted within a couple of hours either side of sunrise or sunset as at this time the signals are very confused. For best results, when using WWVH, observations should be made about midnight and when using JJY about 2 a.m. in the morning. JJY is the best station to use normally as readings can be obtained free from interference from WWVH during the quarter hourly silent periods of the latter station.

It is because of the faults of the high frequency transmissions which have been described that attempts have been made to use the very low frequency transmissions for frequency comparison. As very low frequency signals are not reflected from the ionosphere they are not affected to anything like the same extent by propagation conditions. For several years past the giant British station, GBR, operating from Rugby, England, has had its carrier controlled from the same oscillator that controls MSF, the British standard frequency station. GBR transmits on a frequency of 16 kilocycles (equivalent to a wavelength of about 19,000 metres or 9 miles). GBR handles routine morse code traffic but by using suitable reception methods it is possible to obtain a comparison between its frequency and that of a local frequency standard. Recently the United States naval station NBA, Panama Canal Zone, operating on 18 kilocycles has also had its carrier controlled by a standard frequency source of similar very high precision and also referred to atomic standards. Both of these signals can be received in Auckland although much of the time they are well below the noise level which is always very pronounced at these very low frequencies.

These transmissions are of no use to the average person as quite special technics have to be used

to receive them. Primarily it is necessary to have a local standard of frequency with a very high order of stability. A special fixed tune receiver having high selectivity is also required, fitted with a phase detector and some recording system to measure the phase difference between the received signal and a locally generated carrier, even when the received signal is some 20 DB or more below the noise level. The bandwidth of the receiving system has to be very narrow, of the order of 0.01 cycle, but it is possible to use these narrow bandwidths because of the extreme stability of the signals being received. Satisfactory reception of both GBR and NBA is possible in Auckland most of the time except for a period early in the morning when interference from electric razors creates absolute pandemonium. The use of these stations has made it possible for the author to define the frequency of his primary standards of frequency with a precision of about 2 parts in 10^9 which is at least two orders better than obtainable when relying on high frequency standard frequency transmissions.

For many readers of this magazine the above remarks are of academic interest only as they are not concerned with the calibration of high precision instruments. However, there are now quite a number of digital frequency meters in use and they can be expected to become increasingly popular. These instruments are capable of an accuracy of plus or minus one count, on the basis of a sampling period of one second is equivalent to plus or minus one cycle per second. Assuming a frequency of measurement of 10 M/C this is equivalent to an accuracy in the order of one part in 10 million—a very high order of accuracy indeed.

However, the accuracy depends on the frequency standard built into the instrument and for absolute frequency measurement it is essential that this frequency standard be precisely correct. It can be expected that the frequency standard will be adjusted to the correct frequency when the instrument leaves the works, but in common with all crystal oscillators the crystal will drift and the frequency will change with use. Assuming the drift rate of 1 part in 10^7 per day, which would be quite normal, this means a change of frequency at the rate of one cycle per day at 10 M/C, so that in a month readings obtained from the frequency meter could be expected to be in error to the extent of some 30 cycles. There are digital frequency meters in use in which the frequency standard has not been touched since the instrument was unpacked. Under these circumstances the inherent high order of accuracy of the instrument can be quite misleading as all results obtained could be in error to the extent of several hundred cycles. If full advantage is to be taken of the potential of digital frequency meters it is important that the frequency standard be corrected at frequent intervals. It is in cases such as this that the maximum accuracy has to be extracted from the available standard frequency transmissions and indeed, for the more precise and accurate grade of digital frequency meter the high frequency transmissions are not adequate. For proper adjustment of the frequency standard in these instruments some other method has to be found.

LOOKING AT

AUDIO

Frequency Intermodulation Distortion

What it is and how it is Measured

There are two types of distortion encountered in audio work. Simple Harmonic distortion and Intermodulation distortion. Both of these have their origin in essentially the same source; curvature of amplification characteristics.

Although both audio transformers and transistors have similar non-linear characteristics which contribute to intermodulation distortion, this discussion will be confined mainly to Valve characteristics, the effects of improper operating conditions, and the deterioration of performance caused by using valves beyond their normal useful life.

How Is Intermodulation Produced?

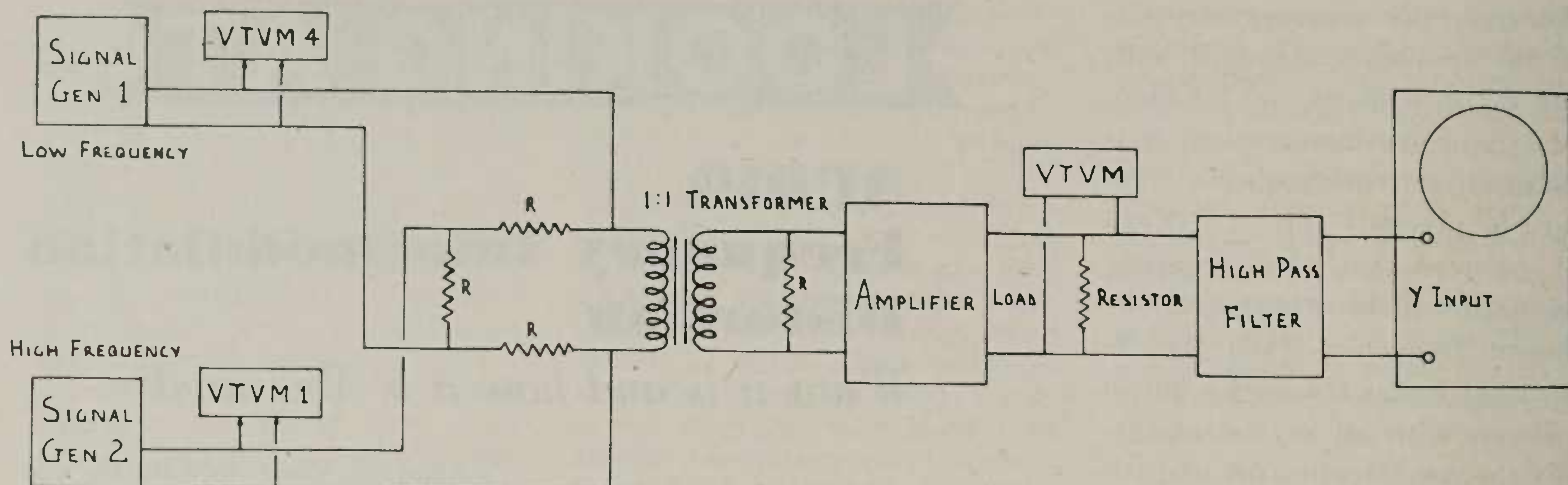
When two different frequencies are applied to a perfectly linear device, that is, one whose output varies directly in relation to the input, then the output of the device contains only those two frequencies. If on the other hand there is any non-linearity in the device, then one of the signals is modulated or changed by the other. When this takes place, additional frequencies are generated and these are not necessarily harmonically related to either of the original frequencies. For example—if two different test tones such as 400 and 5000 cycles are fed into an amplifier which has a non-linear transfer characteristic then we get additional frequencies of 4,600, 5,400, 4,200, 5,800 and 800 cycles as well as the original tones and many other combinations of the two original tones.

None of these additional signals was present originally so we now have introduced distortion. The amount of this distortion is the R.M.S. sum of all these added signals expressed as a percentage of the signal which was modulated. In the example just given, if the square root of the sum of the squares of all the resultant frequencies is 0.1 volt and the amplitude of the 5,000 c/s signal alone is 5 volts, then the intermodulation distortion is 2 per cent.

Effects Noticeable by the Listener

There are two audible effects of intermodulation distortion; one of these is the result of the amplitude variation that occurs, and the other is the result of the unharmonically related added frequencies. Assume you are listening to a Bach Chorale with the sopranos being accompanied by a loud bass passage on the organ. If the equipment has high IM distortion the voices may get an unpleasant fluttery and confused sound because these high frequency notes are being modulated by the low frequency tones of the organ.

In addition to this effect, any time that you listen to any combination of tones or even a single tone that is anything but a simple sine wave, the added frequencies due to the IM distortion introduce a roughness or harshness that seems to cloud over the original tones. Any added frequencies whether harmonically related or not constitute distortion. But when these frequencies are not harmonically related, then the audible effects can be quite unpleasant.



Outline of simple equipment to determine intermodulation distortion. The filter in the output should remove any low frequency signal other than that modulating the high frequency signal.

Intermodulation Distortion and Amplifier Design

Single ended amplifiers produce relatively high Intermodulation distortion while push-pull amplifiers are capable of very low intermodulation distortion if the overall amplification characteristics are relatively linear.

This is because the single ended amplifier must be accepted with its curved transfer characteristics while push-pull tubes tend to aid each other in producing an overall straight characteristic.

In high quality audio equipment, where the balance in the output tubes is adjustable, then the use of any instruments set up for measuring intermodulation distortion is perhaps the best method of balancing the output. If the balance is set for the minimum amount of intermodulation, then the amplifier characteristics could be considered to be as straight as possibly can be obtained.

In general when an amplifier has low intermodulation distortion, it also has low total harmonic distortion. When the intermodulation distortion is high, so, generally speaking is the total harmonic distortion.

Limits of Intermodulation

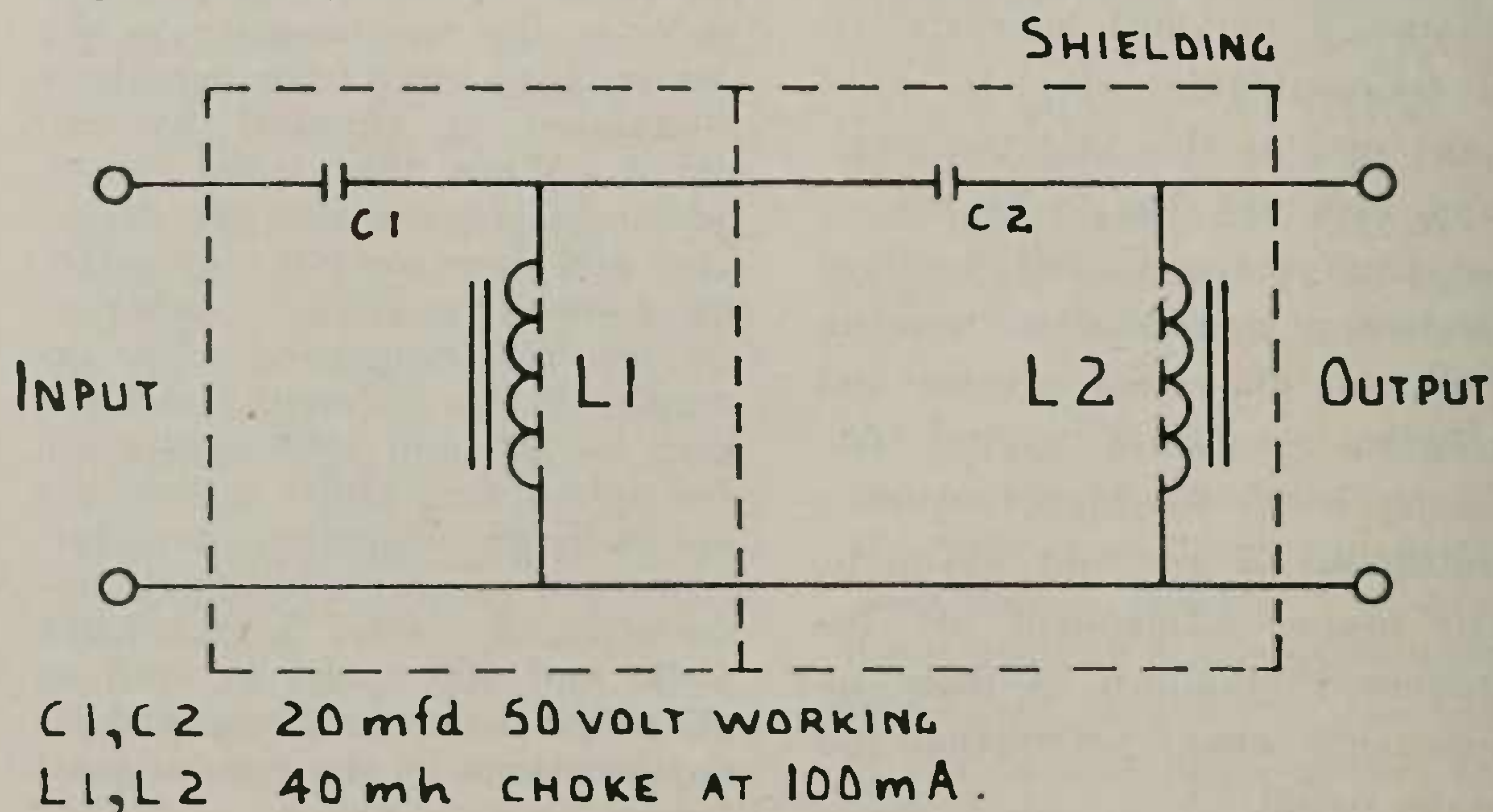
Intermodulation distortion is difficult to measure with any real degree of accuracy or consistency. There are several valid ways of measuring it, and all give slightly different results. One method which has received wide acceptance uses a test tone near the lower frequency limit and a second test tone near the upper frequency limit. The lower frequency tone is adjusted to be four times (12db) greater than the high frequency note, hence the method is often called the 4:1 method of measurement. Both tones are adjusted simultaneously to drive the amplifier to the desired test or rated output whilst

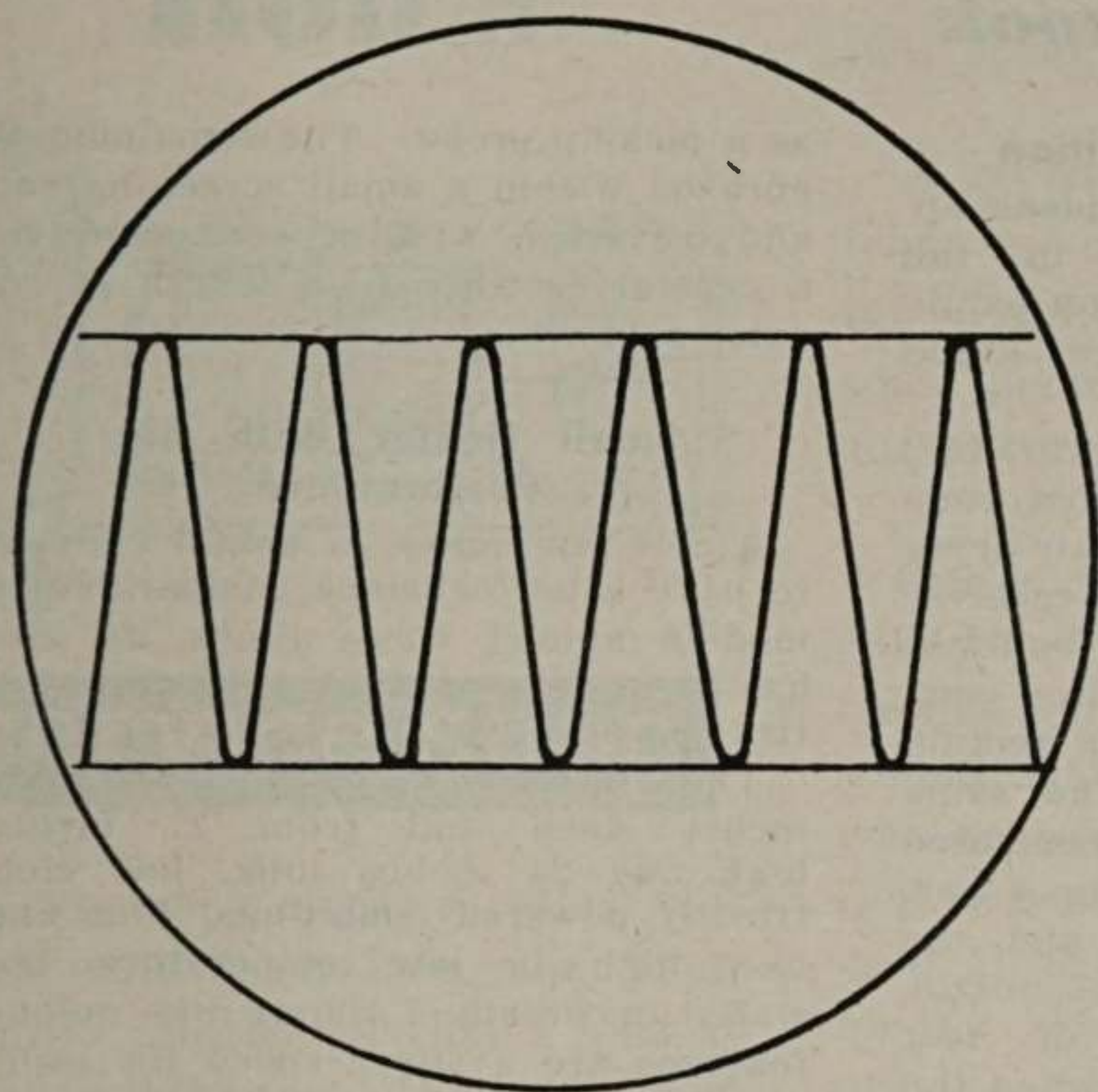
still maintaining the 4:1 ratio.

The amount of Intermodulation distortion that should be present in top quality hi-fi equipment has been the subject of lengthy debates. One arbitrary division of performance figures is as follows:

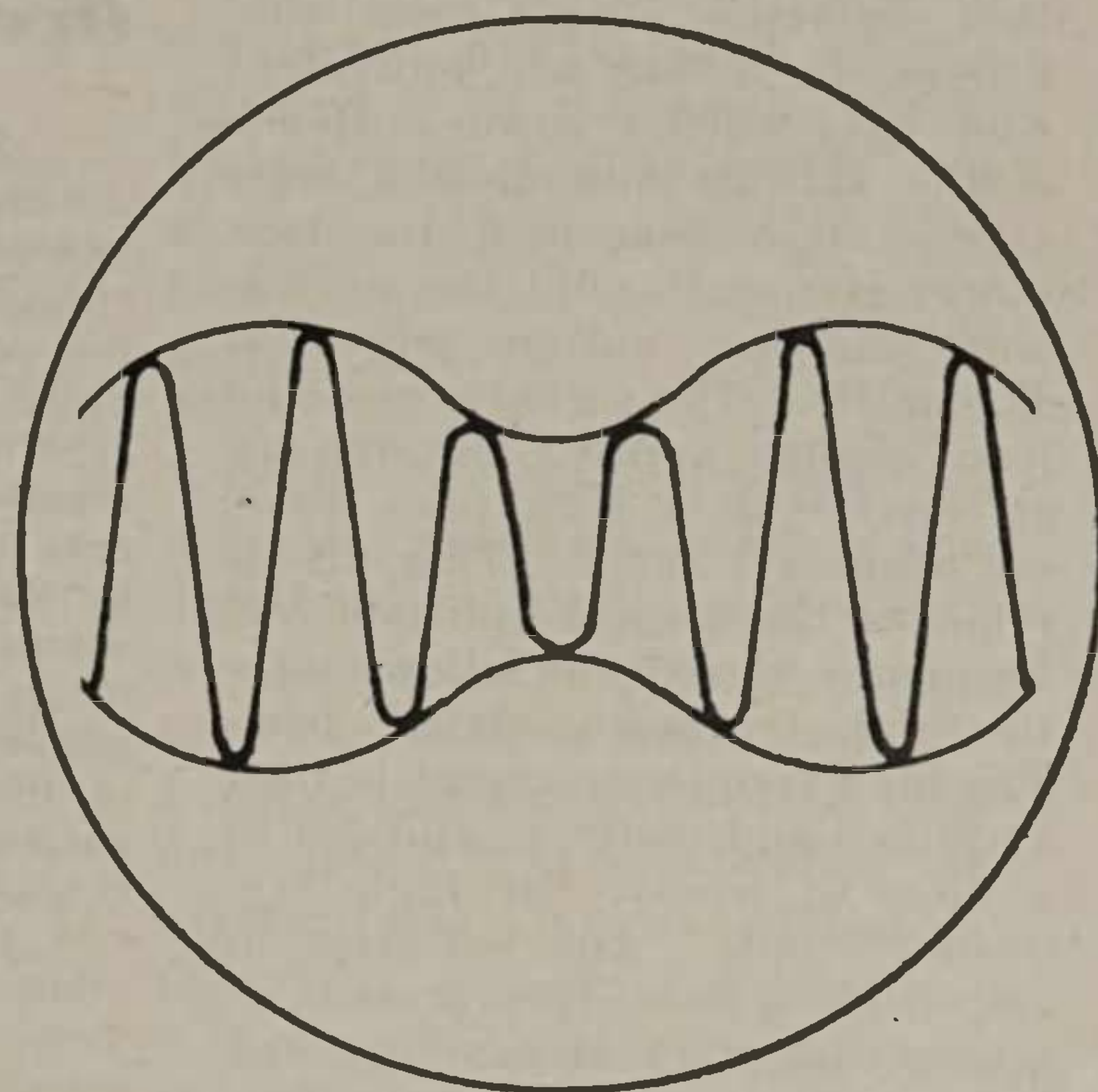
1. Very High Fidelity Amplifier
Lower Test frequency 40 c/s
2. High Fidelity
Lower Test frequency 40 c/s
3. Good Fidelity
Lower Test frequency 60 c/s
 - 1 { Less than 2 per cent
intermodulation distortion
 - 2 { Less than 4 per cent
intermodulation distortion
 - 3 { Less than 8 per cent
intermodulation distortion

FIG. 2: This is a typical High Pass Filter Circuit used to remove the low frequency signal. The slope is about 12db. per octave. The filter should be well shielded.





This is a pattern of high frequency signal on oscilloscope without intermodulation.



This is a pattern showing considerable low frequency component (intermodulation).

Recently one company manufacturing kitset audio equipment set its own standard for intermodulation distortion limits on power amplifiers. Its groupings using test frequencies of 60 and 6,000 c/s at a 4:1 ratio are:

Amplifier	Intermodulation Distortion
Professional	1 per cent or less
High Fidelity	2 per cent or less
Utility	5 per cent or less

Methods of Measurement

As mentioned previously it is common to apply to the equipment under test a low frequency signal four times the amplitude of and together with a high frequency signal.

Low frequencies in common use are 40, 60, 100 and 150 c/s, high frequencies in common use are 4,000, 6,000, 10,000 and 15,000 c/s. Depending on which frequencies are used different intermodulation figures will be obtained. Therefore it is important to state just what frequencies and amplitudes are used in a given test when specifications are quoted. It is also important to state the power level at which the measurements are taken.

To carry out intermodulation distortion measurements a certain amount of equipment is a

necessity. This is shown in Figure 1.

Two stable audio generators are used—one of these produces the low frequency and the other produces the high frequency required for the test. The two signals are fed into attenuators for isolation and adjustment of their relative amplitudes (usually 4:1). It is usually necessary to monitor the outputs of the generators with vacuum tube volt meters unless the generators are equipped with good accurately calibrated attenuators. The signals are then passed through a mixing network and applied to the input of the amplifier. This network is also shown in Figure 1. The transformer should have a 1:1 ratio and be of the highest quality. Induced by a 5 volt signal. The power that should be produced by produced by such a signal is 25 divided by the load resistance. On the other hand the true power as measured by a voltage across the load is 4 squared plus 1 squared = 17 divided by the load resistance. This means that the indicated power output must be multiplied by 25 and divided by 17 when testing for intermodulation. The resistors in the legs of the bridge should be as nearly matched as is possible to prevent

interaction between the generators.

If only one audio generator is available the A.C. mains may be used to provide the low frequency source if suitable isolation and variation in voltage can be supplied. In this case care should be exercised as it should be remembered that any hum in the amplifier will increase the apparent percentage of intermodulation since the hum will make the output have a higher low frequency component.

The amplifier should be terminated in the correct load in the form of a non-inductive resistor having adequate power rating. The voltage across this is also monitored so that the output power can be checked. It is common to operate the amplifier at full gain with the inputs adjusted to give the desired power output. In this regard it is important to use the same peak power output as would be obtained under normal single frequency conditions since it is usually at the voltage peak that the distortion is generated. If the amplifier is delivering 4 volts of low frequency and 1 volt of high frequency at the same time its total output voltage would be 5 volts. The distortion would be equivalent to that pro-

tion distortion under these conditions to obtain an equivalent sine wave output power. Hence if the voltage measured 8 volts across an 8 ohm load the true power is 8 watts, but the equivalent sinewave output power is 11.8 watts. The signal across the load is then applied through an attenuator to a high pass filter, see Figures 1 and 2. This circuit removes the large amplitude low frequency signal and allows only the high frequency signal past. The high frequency signal is then amplified and rectified, and fed to a filter to remove the high frequency ripple. Any variation in amplitude due to the intermodulation distortion shows up as a low frequency variation. This represents the distortion and is amplified and measured with an A.C. V.T.V.M. If this meter is adjusted to full scale reading with the undistorted high frequency applied it will now read the relative percentage of the distortion.

Simpler semi-quantitative measurements can be made using an oscilloscope to follow the high pass filter as in Fig. 1. This will enable comparisons to be made and the amount of distortion evaluated. Figure 3 shows a pattern with and without intermodulation distortion.

Some Causes of Intermodulation Distortion

The causes of Harmonic and Intermodulation distortion in amplifiers are directly related, for when one is present the other one usually also occurs. Whilst ageing valves should be suspected, other causes such as leaky coupling condensers putting positive bias on the following grids or grid emission will give the same symptoms. Changes in the value of plate or cathode resistors in the amplifier or low B Plus and changed screen voltages on output pentodes will also upset balance and produce distortion.

References: 1. Radiotron Designers Handbook — Langford-Smith. 2. Audio Year Book 1961. 3. Technical Notes "Sylvania Electric Products Inc." by W. J. Sember.

Overseas Notebook

Radio Show Competition

Some ingenious servicing ideas appeared among the entries in the "Ideas for Service" competition exhibited recently at the Earls Court Radio Show, London.

"Wireless and Electrical Trader" reports that probably the most common idea was to use an old hair dryer to warm up a part of the receiver where an intermittent was believed to be located. One competitor suggested using it also to cool a section of the receiver down for the same purpose. Two entrants concentrated the air stream, one by fitting a narrow tube over the orifice and the other by using a funnel-shaped nozzle. There were also a number of test alarms that gave a warning when the set to which they were connected began to work or developed a fault. These were intended to assist in the tracing of intermittent faults. You left the set switched on and waited for the alarm.

Several pieces of equipment could be used as a substitute for one or more stages in a television receiver, mainly the line oscillator or line output stage, so that it fed in a signal of known waveform and amplitude as a check on the one in the set. Valves received a lot of attention in the form of pin cleaning devices, testers and electrode voltage measuring adaptors.

Among various ingenious tools suggested the most numerous were those associated with soldering, particularly on printed circuits. A soldering iron "bit" with several points was suggested by more than one competitor, but the simplest was that of T. H. Bowling, of Hickie & Hickie, Boscombe, Hants.

His idea is to shape a length of stout tinned copper wire into a zig-zag round a circle. This results in a number of points that can be applied to a multi-tagged component, such as a transformer or a valve holder, melting the solder on all the tags simultaneously.

The wire is shaped up first in two separate semi-circular halves, and the connecting leads are then twisted together in pairs and connected to the terminals of a heavy duty solder gun. Final shaping to position the points can be done cold on the work itself.

E. Surtees, of Uptons, Middlesbrough, who was awarded a prize, actually sent in three entries, and two of them were exhibited at Earls Court. One of these was awarded the second prize. The other was a magnetic field detector, which comprises a length of ferrite rod, part of which is exposed

as a pick-up probe. The remainder is encased within a small screening can and carries a winding connected via a crystal rectifier to a length of coaxial cable.

Small Heater With Big Performance

A new fan convector heater claimed to have a performance comparable to models almost three times its size has been developed by a leading British heating firm.

The heater, which is only nine inches deep and from 27 inches high and 24 inches long, has electrically powered centrifugal fans and uses high or low temperature hot water or steam. Among its unique features are a super speed for rapid heating; clock control, thermostatic adjustment and 'all round' air diffusion.

Demand for the model from the British market has far exceeded expectations. But with the firm's 20 year record of doubling output under every four years, sales experts are confident that they will be able to meet promptly any large overseas orders.

The new range is made up of four distinct types—basic, standard, plinth and extended. Each type has either top or front outlet and is in four cabinet lengths.

The various units cover a range of emissions from 5,600 B.T.U.s per hour to 108,800 B.T.U.s per hour and are therefore being recommended for all types of buildings from churches and department stores to private houses.

The automatic time clock is a popular optional feature of the heater. It can be set to switch the motors on at "super speed" to provide quick warming-up at any chosen time. After a pre-selected period it will switch to normal speed on which the unit will run under a speed change thermostat until a further chosen time.

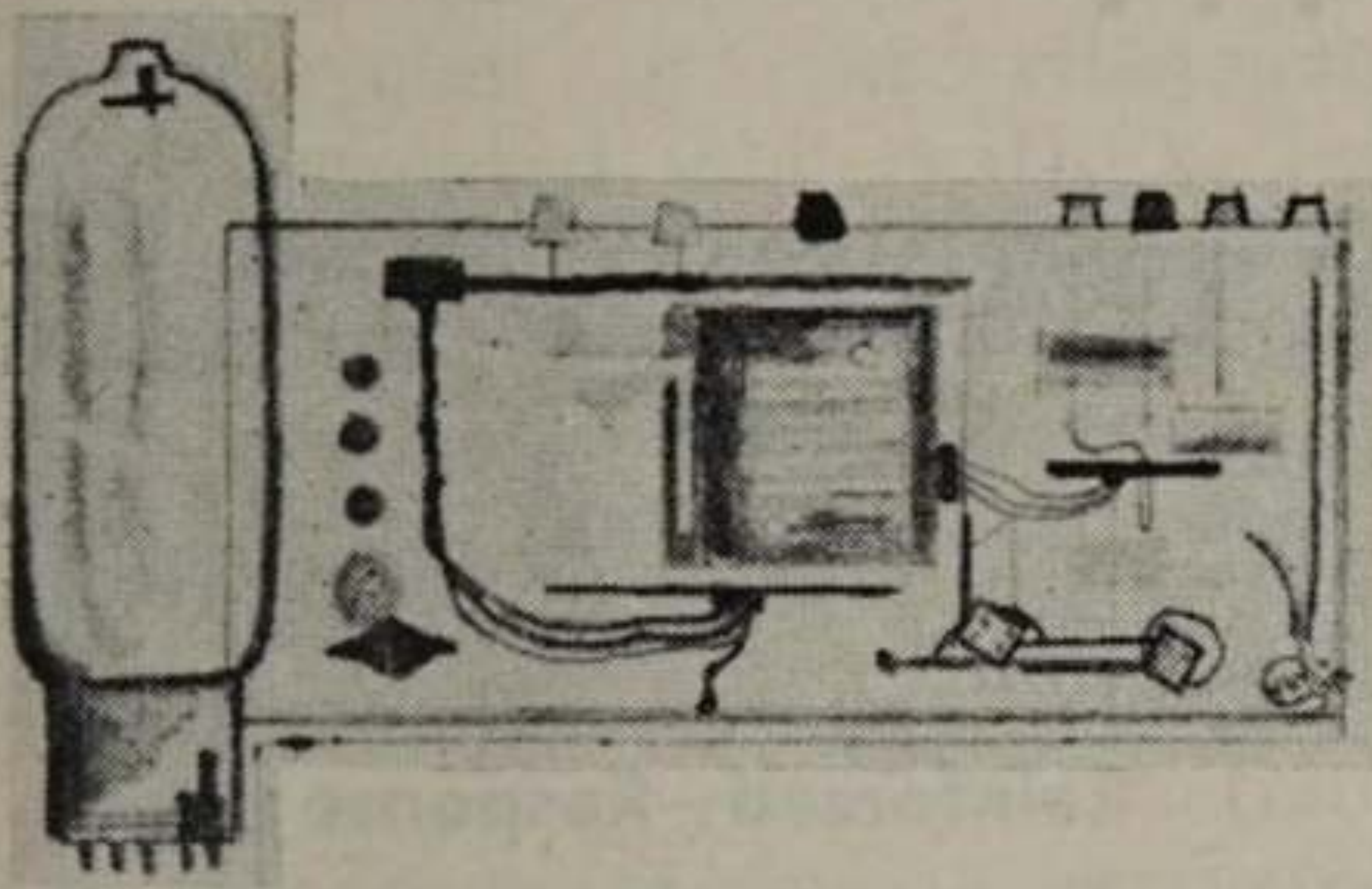
The clock also incorporates a day omitting device so that any days of the week can be omitted from the scheme. For example, the clock can be set to switch on Monday to Friday but not to function on Saturday or Sunday.

"This arrangement is especially convenient for the control of convectors in schools or business premises," an official of the firm said.

The super speed—the highest of the three speeds—is particularly useful, say the manufacturers, in buildings with high occupancy periods, such as school classrooms, where rapid heating is desirable.

Copperad Ltd., Colnbrook, Slough, Buckinghamshire, England.

Bob's



service shop

A woman brought a rather old, large mantel set into the shop recently and asked that I "fix it up," explaining that it was "stone dead."

On questioning her I found out that this particular breakdown started when her "little Albert" had poked his pencil through the speaker cloth into the speaker cone making a rather large hole. When hubby came home he decided, being a handy sort of fellow, to repair it himself.

He proceeded to remove the speaker from the cabinet, then very carefully placed a patch over the hole and applied glue to it. He then left it till later to dry. When he started to put the speaker back into the cabinet he discovered to his horror that the cone was, in his wife's words, "loose and floppy." As it was quite easily moved back and forth he decided that it had "come unstuck from around that round piece of metal in the centre of the cone." He therefore stuck it back by applying glue between the cone and this metal piece.

As he screwed the speaker back into the cabinet he decided that he had done a good job and had saved himself some money. But imagine his horror when switching on the set still stubbornly refused to play.

As you can guess it required a new speaker.

A recent job concerns a somewhat out of the ordinary problem for a radio serviceman, but then some people say that I am very much "out of the ordinary!"

One of the factories where I am called in to do industrial electronics repairs asked me to repair a small 200 watt RF welder which was drawing excessive plate current when the foot control was used an 813 as a T.G.T.P. oscillator on 27 mc/s or thereabouts pressed. This particular welder with a plate input of about 200 watts.

Well, to get on with the story I arrived at the factory and switched on the welder. Placing some of the material welded by this welder between the electrodes I pressed the control. Sure enough, the plate current rose to a very high value, in fact high enough to operate the overload cut out. I suspected a lack of grid drive due to an open grid leak or shorted grid bypass. But no, the grid current was just about normal. Oh, well, I thought, it seems like just plain overload so with this in mind I proceeded to check the various insulators, etc., in the plate and output circuits and electrodes. However, there was no sign of an arc-over or breakdown.

I should mention at this stage that I was the fourth technician to have a go at this job. The other three had all given it up at the stage at which I now found myself. Also I might add that this was the moment the staff chose to tell me about the other three giving up. As the moments of strained silence slipped by I had dark thoughts about not

being told these things early in the piece. At the same time I resolved to fix this one or die in the attempt (I almost did in a moment of carelessness some hours later) being a matter of honour, etc.

After some hours fruitless testing (and cursing) darkness had descended on the factory and I was just about to give up when I gave the foot control a last jab. I just caught sight of a small flash down inside the cabinet before the overload relay cut out. Repeating the above procedure I managed to isolate the flash to a point at the side of the metal cabinet where a cross member of the frame just touched the side panel when the electrodes were together. "In a flash it came to me!" The cabinet panels were normally insulated from one another by the paint, but at this spot the paint had gradually worn off thus allowing them to touch. The effect was to form a large shorted screen around the tank coil—hence the overload. A couple of minutes' work with a piece of plastic sheet and the job was finished.

As I packed up my tool kit and departed home to bed the owner had a funny "well, I would never have thought he had it in him" look all over his face.

—R. J. Hall.



"There's your trouble, sir—no cone."



Instructor at NYIT answers student's question.

IN one of its two main forms—television or electronic teaching aids—electronic education is being used in more than a thousand American classrooms; part of the curriculum in 400-plus schools throughout the country.

Television—either the conventional kind or closed-circuit—is the leading electronic teacher today. In its simplest form it can consist of a programme to which the home viewer tunes in. A more or less conventional classroom instructor presents his lesson to the TV audience, usually with the help of a “live” classroom, which also appears in the viewer’s picture.

Most famous of these educational programmes is “Continental Classroom” on NBC.

An almost equally simple but quite different use of television brings classroom demonstrations within the vision of large numbers of students. A camera is set up at the teacher’s position and TV receivers—now called monitors—are set up around the classroom. Instead of the whole class crowding around the instructor in the hope of seeing at least a part of what is being demonstrated, four or five students gather around each monitor and are able to observe every detail.

This use of television has become very popular in surgery. Formerly a student in the balcony of the “operating theatre” had only the vaguest idea of what was happening. Today, he sees the whole procedure—often in colour—as clearly as if he were standing beside the surgeon.

A combination of the two methods is seen in some school closed-circuit systems. One instructor

ELECTRONICS...

THE MODERN SCHOOLTEACHER by ERIC LESLIE

may lecture several classes over the school closed circuit, or a programme may be picked up from an outside point and “piped” to the classrooms. If monitors are plentiful, students have the additional advantage of closeup views of any demonstrations.

Most dramatic and possibly most important of all experiments in TV instruction is broadcasting lessons and lectures from a plane flying 23,000 feet above its “school district.” Thorough experimental programmes have already been carried out, and the Mid-west Programme on Airborne Television Instruction (MPATI) is scheduling regular operation this fall. The area covered is centred on Monpelier, Ind., and extends to five states. At 23,000 feet, all antennas within a 210-mile radius are line-of-sight. During the experimental transmissions, good reports were received from points 250 miles from Montpelier. The quality of instruction is expected to be high. Excellent instructors have been engaged and generous budgets provided for the effects necessary to present each lesson.

The Teaching Machine

The language laboratory was the first type of purely electronic teaching. In its simplest form it consists of a tape recorder-player (sometimes accompanied by a disc record player) from which the student can hear samples of the language he is learning. He then repeats or answers what he has heard, and finally compares his own efforts with the original. By properly programming the recorded material, the student can be led through a complete course in the language while practising his pronunciation.

To this simplest form of electronic teaching can be added provision for making permanent records, for communicating with an instructor and for the instructor

to listen in at will or to break in if desirable.

Reinforced Response

One factor in the rapid expansion of electronic teaching is a new discovery in education theory. Known as the reinforced response, it was first developed as a way to teach animals to do tricks in a fantastically short time. Later it was found to produce remarkable results in human learning.

Briely—and crudely—the method operates on the theory that if a student can be told almost continuously if he is right or wrong while studying a subject, he will learn faster and better than if his learning is evaluated at the end of a complete lesson, or by periodic examinations. As an elementary example, a mathematics student turns in an exercise containing 10 or 20 problems for the instructor to mark. When his paper is returned, he learns how right or wrong he was, and—in some cases even more important—where! Reinforced response would have told him whether he was right or wrong after each problem, would have reinforced his correct approaches and discouraged his wrong ones. In some cases, where a problem could be broken down into portions, he might have an opportunity to get back on the right track several times during the course of a single problem.

The electronic teaching machine is ideally adapted to this method of education. It can be programmed so the student can supply it with answers at each step in the work. If the answers are correct, the machine encourages the student—if wrong, it tells him where to go for information.

Possibly the most elaborate machine of that type was developed experimentally by the New York Institute of Technology.

A computer type of device, it greeted the students with the taped voice of an instructor and presented him with a lesson in which questions were asked in multiple-choice form. The student pushed button according to the answer he selected, and—according to his answer—was complimented by the electronic teacher, given instructions on reference material, corrected and told where he was wrong, or sharply rebuked and told to study his lesson again, or to see his instructor.

The machine was originally designed for individual instruction, but its cost (approximately 1,200 dollars per student) made it impractical for immediate use. The prototype model is being used, however, to evaluate new programmes. A new lesson is tried on a group of students and their record of results is immediately made available by the computer.

If study of the record shows that some of the questions are being answered by an abnormally low number of students, or that more than half the questions are being answered correctly by everybody, the lesson should obviously be modified. The computer makes it possible to read instantly results that could be obtained formerly only by checking the answers on each student's paper and adding the totals, a much slower job.

The Electronic Classroom

The classroom on our cover has been described as "probably the ultimate in electronic teaching finesse." Each desk in the system has a (disc) record player in one of its drawers, and a number of television monitors are scattered strategically through the room. (The ultimate objective is to equip each desk with one). There is also an intercom system between each student and the instructor.

The objective of this approach to electronic education is to free the instructor from the burden of lecturing, a task that takes up at least three-quarters of the aver-

age teacher's time in the conventional classroom. Thus he has much more opportunity for individual instruction and supervision.

Lecturing is the duty of the record player, a duty it shares with a printed workbook supplied to each member of the class. If the student is baffled at any point, he picks up his 'microphone, a "hushed" type into which he can talk without disturbing those at nearby desks. The teacher can answer him verbally, flashing a book page, diagram or other aid on the student's TV screen when helpful.

Additional electronic aids include a TV camera suspended on a track that runs along one side



TV camera relays teacher's notes to students.

of the room. It can be poised above any of the desks along its route if the instructor cannot grasp the situation with the aid of the intercom alone, or if he wishes to examine a student's diagram. If neither student nor instructor has the answer to a problem, the instructor can call the library on his intercom and have information displayed on the classroom monitor.

When the student—with or without aid from the teacher—is satisfied he has the right answer (either the book or the record may pose questions), he presses a stylus against a selected lettered or numbered square on a panel on the desk. This makes an electrical contact that registers a correct answer with a green, a wrong one with a red light. At the same time a counter is advanced for

each correct answer, and a record of the answer is made at the instructor's desk.

Semi-electric Systems

Experiments are being made with a number of variations of the above system. Some are quite nonelectronic, such as one in which number circles are touched with a damp brush. If the answer is correct, the circle becomes green—if wrong, it turns red. Thus the student is reinforced if he is right, and a permanent record of the answers is made for the benefit of the student or instructor, or both.

The reinforced response technique extends even to books. Several texts have been published in which the student, reading to page 5, finds a set of numbered questions at the bottom of the page. According to the answer he chooses, he is told to turn to perhaps page 22 or 34. There he is instructed as to what he should do next, either as to what he should do next, either progress to the next subject, review, or re-read the material he has just gone over. These books have no immediate relation to electronics, but some tend to show electronic inspiration.

The New York Institute of Technology has taught courses in electronics, physics and mathematics successfully. Teaching languages electronically has become almost the standard method, and the very term "language laboratory" means an electronic installation. A whole gamut of courses has been presented by television in the "Continental Classroom" type of instruction, a method that will no doubt be extended by MPATI. The exact methods that electronic instruction will follow in the future are not clear, but the question "Will it be a factor in future education?" has been answered. Make no mistake about it—electronic education is with us, and extending fast.



A LOW COST —

LOW PASS FILTER

FOR AMATEUR TRANSMITTERS

By Irving H. Spackman,

A.M.I.R.E. (ZL1MO)

Irving H. Spackman, A.M.I.R.E.—associated with electronics in one form or another all his life, family involved in Radio and Broadcasting since inception in this country. Educated at Kings School and College and at the University of Auckland, has since been actively engaged in many facets of electronics including X-ray and electro-medical fields. Has primarily been interested in communication and industrial aspects—was for some time design engineer in the laboratory of one of N.Z.'s leading manufacturers.

Is now engaged in a consulting capacity in communication, audio and industrial electronics. Holds a First Class Certificate of Radio Technology, has been active in amateur radio, particularly V.H.F. operation, as ZL1MO for the past 13 years and is an associate of the Institute of Radio Engineers.

ADDENDA

Article—Two Metre Converter using the Nuvistor Triode—

Correction—Circuit diagram Page 11: A 50 pf of Silver Mica condenser should be inserted between anode of 12AT7 pin 6 and grid of 6J6 pin 5. The condenser connecting 12AT7 pin 3 to coaxial cable is .01 disc ceramic.

Page 28: Parts List. C4 is a .01 mfd disc ceramic whilst R5 is a 1k ½ watt resistor.

In the article "Looking at Class B Transistor Circuits"—

Corrections: Page 19. In the third column 4th line the value 63 ohms should of course be 68 ohms.

We apologise for these typographic errors.

The consideration of the major requirements for the design of a low pass filter for use in the output of the average amateur all-band 100 watt transmitter is not really difficult until the time comes to choose capacitor and inductance types and values which can be readily repeated again and again.

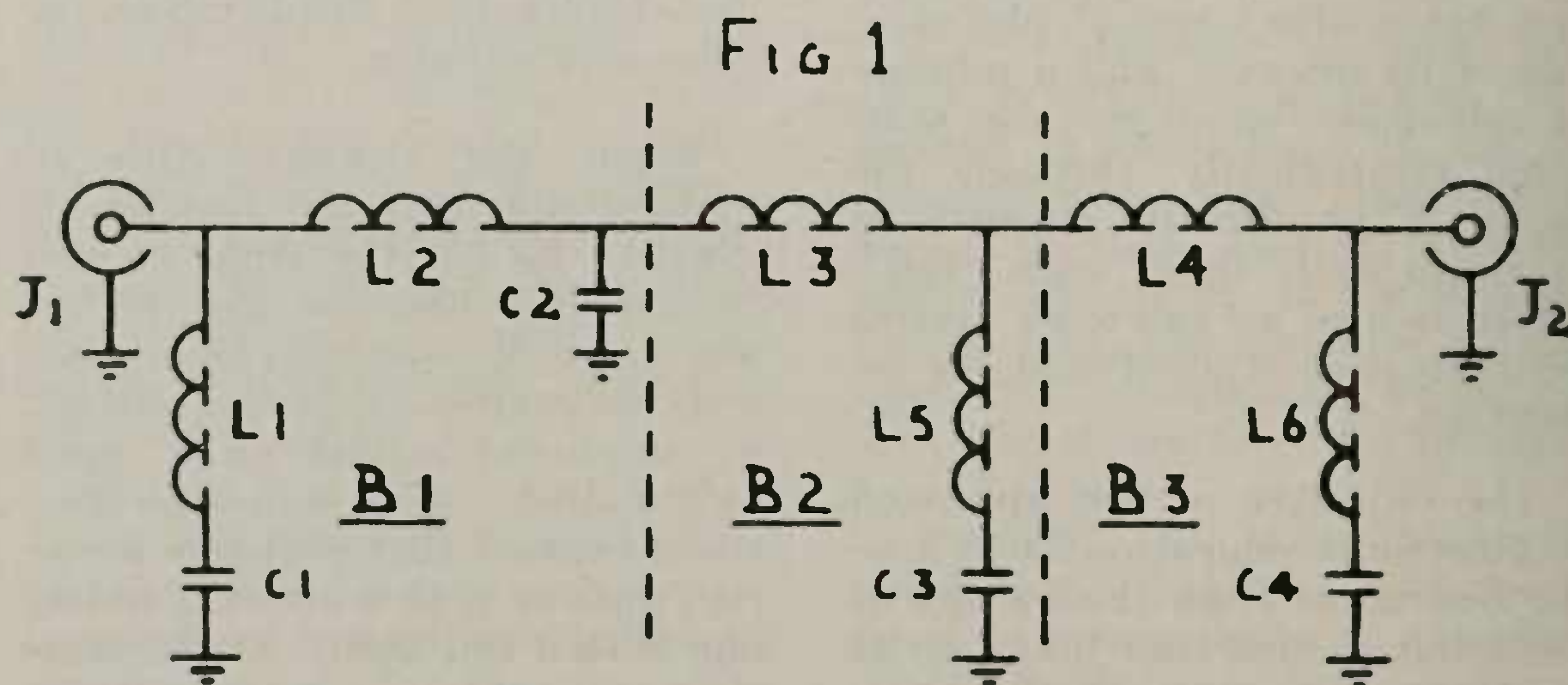
As an introduction it will be necessary to discuss a number of factors:

1. A low pass filter in the antenna lead is not worth installing unless the transmitter is effectively shielded and the power and accessory leads to and from the transmitter are absolutely R.F. free. There are articles in the various Handbooks showing how

these details may be dealt with properly.

2. Low pass filters will not work efficiently—indeed in some cases fail to work at all, if the standing wave ratio on the feed-line is high. Most low pass filters will not tolerate standing wave ratios more than about 3 to 1 and even under these SWR figures, may not be completely effective.

The filter described in this article is designed to use with 75 or 50 ohm coaxial cable and will perform satisfactorily for powers up to three times our legal input on AM or SSB. The condensers are good quality silver micas of preferably 5 per cent tolerance although greater tolerance can be



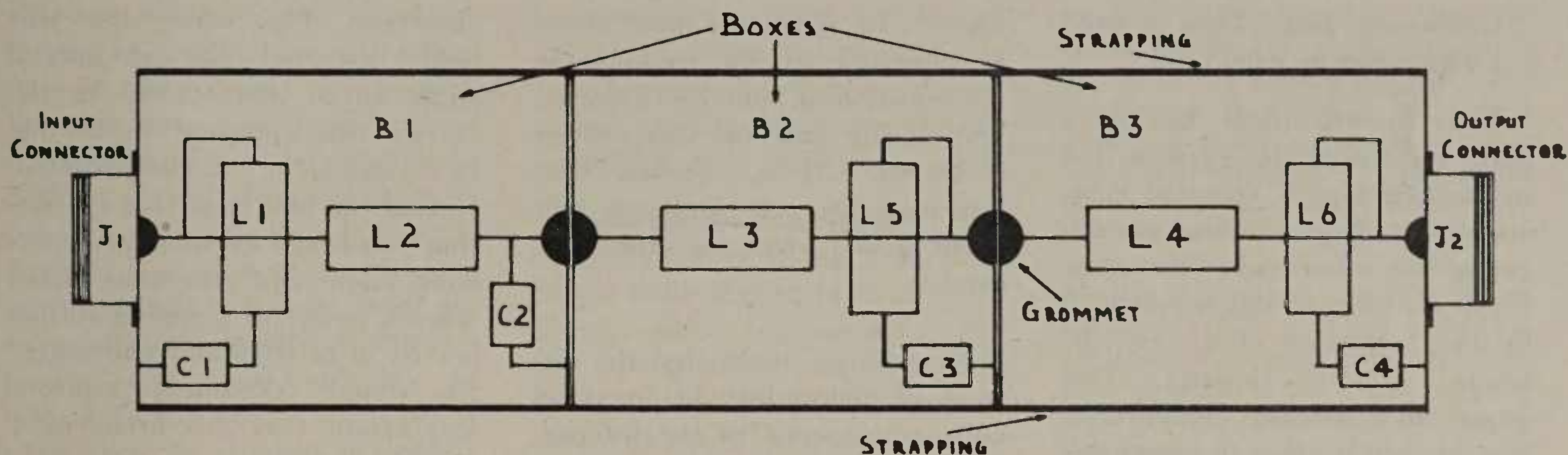


FIG 2

used if the tuning of the filter is carefully carried out. These condensers appear satisfactory for voltage rating, etc., provided the SWR is kept within bounds. Ceramic condensers also prove satisfactory provided they do not have a high temperature co-efficient and are rated for 500 volts DC working. Good quality micas are also useable for this job with the same reservations.

Details of the Circuit

The circuit is shown in Fig. 1. The filter cuts off at 43 mc/s, and the m-derived sections have maximum attenuation points at approximately 58 and 65 mc/s, these frequencies being selected for their usefulness in the T.V. Channels.

The coils are adjusted by using a Grid Dip Oscillator. Firstly, short J1 and adjust the spacing of L1 so that L1 C1 resonates at 58 mc/s. Then short J2 and resonate L6 and C4 also at 58 mc/s. Short the junction of L3 and L4 and L5 to chassis with the shortest possible low inductance lead and adjust the spacing of L5 for resonance at 65 mc/s. With no shorts on the filter one should be able to detect resonance at 43 mc/s when coupled to L2 or L4 and the turns of L2 and L4 should be adjusted to bring the resonant point correct if it is not so. Then go right through all the tuning points and re-check as there is a slight interaction between the various sec-

tions of the filter during initial adjustment.

The theoretical attenuation of this filter is over 60 db and its performance will more than repay the time spent on it.

All coils are wound self supporting, using 12, 14 or 16G wire, the diameter dimensions are measured inside the coil. It is recommended that in the interests of stability 14G wire or 12G wire, should be used if available.

A satisfactory container for this filter can be made from three wedding cake tins. These are easily procured from any stationer or general store. They are bonded together end to end by soldering a strip of tin plate or copper down each side and along the full widths of the bottoms of the tins after soldering the edge of the tins together. When the filter is completed a similar strip can be soldered along the top after all the lids are in place and soldered down.

With two of the tins, a coaxial plug or socket is fitted in one end and a $\frac{1}{2}$ in. hole is drilled in the opposite end. The third tin also has $\frac{1}{2}$ in. holes drilled in its ends coinciding with holes in the ends of the other two tins. Grommets are placed in the holes once the boxes are soldered together to prevent the leads through the holes touching the metal. The coils are soldered in as shown in the drawing whilst the condensers are soldered one end directly to the box and the other end to the respective coil with the shortest possible leads. When soldering the condensers use a pair of thin nosed pliers to grip the lead near the condensers as a lot of heat is required to solder to the tin plate and the heavy wire of the coils.

When completed this filter will give good protection against any harmonics, emanating from amateur transmitters in the 80 metre to 10 metre bands, and with an RF tight ring will go a long way in the alleviation of TVI.

Table of Design Data:

52 ohm line	L5: 3 turns $\frac{3}{8}$ in. diam. $\frac{1}{2}$ in. long.
C1, C4: 40pf (2 x 20pf in parallel)	72 ohm line
C2: 150pf (100 + 50 in parallel)	C1, C4: 25 pf
C3: 100pf	C2: 100pf
L1, L6: 4 turns $\frac{1}{2}$ in. diam. $\frac{1}{2}$ in. long	C3: 75pf (50 + 25pf in parallel)
L2: 6 turns $\frac{1}{2}$ in. diam. $\frac{3}{4}$ in. long	L1, L6: 6 turns $\frac{1}{2}$ in. diam. $\frac{3}{4}$ in. long
L3: 7 turns $\frac{1}{2}$ in. diam. $\frac{7}{8}$ in. long	L2: 8 turns $\frac{1}{2}$ in. diam. 1in. long
L4: 6 turns $\frac{1}{2}$ in. diam. $\frac{3}{4}$ in. long	L3: 8 turns $\frac{1}{2}$ in. diam. 1in. long
	L4: 8 turns $\frac{1}{2}$ in. diam. 1in. long
	L5: 4 turns $\frac{3}{8}$ in. diam. 1in. long.

Greenwich Mean Time is used—Frequencies in Kilocycles.

Your correspondent has more than one theory to explain the enthusiasm that is reflected in so many ways from all those participating in shortwave listening. Fresh evidence of this is provided by the formation of a new listeners' club in Holland. This group has already planned a monthly publication to commence in December this year and it offers a free sample copy to mark the occasion. The Secretary is Mr. W. Roelos, and his address is Regentesseplein, No. 3, The Hague, Holland. The annual subscription is 10/-. A new voice for the Shortwave listener is always welcome and we wish the club Good Luck!

Competitions and popularity surveys run by broadcasting

waves. In addition a short essay is requested giving reasons for the selection of your No. 1 choice. The closing date for this contest is 1/1/62. It is expected that broadcasting organisations will grant good prizes for the best entries.

There is no doubt that the element of uncertainty in reception adds much spice to the international mixture on these frequencies. One often finds stations which operate on the same frequency, taking turns with each other. One may dominate the channel one day and yet, at the same time the following day the other appears alone, loud and clear. This occurs here in New Zealand even with local signals provided by Radio N.Z. and Radio Australia. It is, alas, more usual to find both transmissions arriv-

observed. The music too was badly distorted and as only a slight surge was evident in the carrier this appeared to be due to equipment maladjustment. During the half hour that the station was heard no announcements were made and reception ended when a powerful jamming station moved in at 0315 and obliterated the signal. Obviously someone was afraid that this broadcaster would talk!

* * *

Following the adoption of a new Summer schedule SWITZERLAND is no longer heard as formerly from 0730 to 0830. The frequency of 21605 has been dropped and the session best received here is between 0900 and 1000 using 11865, 15315 and 21520. This also means that their DX programme on Fridays is not

Shortwave Survey

by MIKE BUTLER

A Listeners' Guide to Broadcasts in English

organisations and DX clubs undoubtedly give added interest to our activities. A recent example is the Transistor Radio Ballot sponsored by The Voice of America. The closing date for entries was November 18th. These must include a code number announced over the air. In this ballot it is possible to win an all-wave all-transistor radio valued at over U.S. \$200. The writer has sent his entry, of course.

Another competition which has a worthy aim to provide broadcasting stations with a measure of their popularity is being held by the International Shortwave Club, 100 Avons Gardens Estate, London, S.E.16. You are asked to send them a list setting out, in order of preference, the five stations you like best on the Short-

ing together with results well known to all of us. This same propagational quirk may be used to advantage as with regular and planned listening a station rarely heard in the listener's area may sometimes be logged when conditions are unfavourable for the station normally occupying the channel concerned.

* * *

A mystery interests most of us and so here are details of such a signal recently received, the identity of which may be solved by one of our readers. It was tuned at approximately 0245 on 17900 and the strength was good. The station played short samples of "light classical" music with periods of silence lasting about a minute between. The "silence" was not quite pure however as an appreciable level of hum was

heard at 0745 but instead, at 0930.

* * *

SURVEY BY COUNTRY

AUSTRALIA. The 13 metre band outlets of Radio Australia have been providing some of the best reception from this country. 2215 - 0130 on 21540. Currently fades towards 0130.

0430 - 0545 on 21680 To Africa. Usually excellent.

0500 - 0600 on 21540 Good. Indonesian at 0600.

0700 - 0730 on 21600 Good. Closes 0730.

0730 - 0900 on 21540. Usually excellent.

The session to Gt. Britain and Europe is now transmitted on 9570 and 11710 between 0815 and 0915. The 31-metre band frequency is usually poor at this time.

15180 is not now used by either the regional station in the mornings or the overseas broadcast in the evenings, N.Z. time. These sessions have been transferred to 15220. The internal programme is heard well from 2015 but weakens and is subject to interference later, although it has been observed to 0015. Radio Australia's session commences strongly at 0600 and has been heard until 1045 when the strength is poor."

An improvement in the morning transmissions from the Regionals is noted. VLQ9 on 9660 is clearly heard from 2130 to 0100 while VLR9, 9680, has been heard at 0030 although a faint signal appears earlier. VHL11 using 11880 was heard at 2230. This last mentioned transmitter with call sign VLH15 is also heard between 0245 and 0330.

CANADA. The CBC to Europe is heard at fairly good strength on 11720 and 15325 between 1830 and 1915. The 25 metre signal was stronger although the other was freer from interference. A similarly beamed transmission has been received from 2045 to 2115 on 17820.

CHINA. Radio Peking has been using 6210 when heard at fair strength about 1930.

CUBA. Further frequencies observed for Radio Havana are: 15280 between 1830 and 1900. The station has French at 1900. Also 11775 from 0500 to 0545. Both outlets were received at fairly good strength with only light interference.

CZECHOSLOVAKIA has been heard during three sessions in English. The first from 0300 to 0355 is found on 7355, 9670, 11990 and 15290. The best signal is at present on the 41 metre band although 15290 has also been excellent on occasions. The second session is timed 0515 to 0555 and

is received on 9795, 11990 and 15290. Perhaps the clearest signal received here from Prague occurs during the third broadcast, from 0800 to 0855 on 21450.

FORMOSA (TAIWAN). The "Voice of Free China" has been tuned while testing to Europe for half an hour commencing 0110. The frequencies employed are 15345, 17785, 17890. Your correspondent's own reception was obtained on a Sunday. This station's regular transmissions are heard between 1015 and 1055 and the following frequencies are used: 7130, 11735, 11755, 11825.

FRENCH CONGO. Radio Brazzaville which is owned and operated by Radiodiffusion-Télévision Française is being heard at good strength at 0515 on 11725. At 0530 the station changes to a foreign language.

GERMANY. "The Voice of Germany" emanating from the German Federal Republic has been received on several frequencies not previously reported in our survey. They are: 11715, heard through some interference at 1915; 6145. A really good signal is recorded for this frequency between 0615 and 0645; 15275 opens at 0645 with a short announcement in English, 21735 is used at 0815 for a brief 15 minutes which is well received here. At 0830 the station proceeds in a foreign language; 15275 and 21650 are the frequencies used at 0845 for one of the shortest English language sessions on the shortwaves—a mere five minutes of news. After this a broadcast in French is usually aired.

A recent check was made on three frequencies previously reported: 9640, 9740, 11945. These were no longer audible here at the times given.

GREAT BRITAIN. Since the publication of our BBC schedule in the July article, the Corporation has made a number of

changes and additions. One of these worthy of special mention concerns the Pacific Service. The frequency of 11955 is no longer used for this session and 11750 has been substituted. No doubt this change was made because of interference from a jamming station, centred on an adjacent frequency which nevertheless sprayed 11955 making reception on that frequency difficult. The new channel is itself not entirely free from interference which is due to the AFRTS Far East Network at Tokyo. It is surprising to me that an outlet of the Pacific Service has not been placed on 41 metres as reception of the General Overseas Service on this band just before 0800 has been excellent. In fact this band has many free channels available for reception here during the N.Z. evening hours and appears good for short distance transmission as well. Radio Australia's signal on 7190 from 0745 provides ample evidence of this. Other additions for the BBC are:

1900 - 2030 on 11860*
 1900 - 2030 on 11820
 2115 - 2130 on 9820
 2130 - 2230 on 9765*
 2200 - 0215 on 11750
 At 2230 on 11820, 15140
 (15140: "London calling Caribbean")
 2245 - 0030 on 11860
 0230 - 0300 on 9580
 0415 - 0800 on 6110, 9580*
 0430 - 0500 on 9510
 0515 - 0730 on 7185
 0600 - 0730 on 7120
 0600 - 0645 on 3975*
 At 0615 on 7260
 European Service
 0630 - 0715 on 15390
 0630 - 0700 on 9765*
 European Service
 0700 - 0730 on 3955
 At 0715 on 7230, 21640*
 21710
 0745 - 0800 on 17790
 0900 - 1030 on 17790*
 0900 - 1000 on 17710
 0910 - 1000 on 9690*
 (Singapore)
 0915 - 1100 on 15435
 0915 - 1000 on 21470
 0915 - 0945 on 21710

(Continued on Page 40)



A Merry  Christmas

and a Happy  New Year

to all our clients and prospective clients for 1962

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Overseas Notebook . . .

Powerful Radiotelephones For Ambulance Service

Manufactured and installed by Amalgamated Wireless (Australasia) Ltd. Sydneys Central District Ambulance Service now has the most modern radio-telephone system in Australia.

The radio control base station equipment is housed in the Central Railway clock tower immediately above the clock itself, with the aerial at the top of the tower flagpole 250 feet above the footpath.

The initial installation, made by Amalgamated Wireless (Australasia) Ltd., about 26 years ago, which operated until after the war, is credited by the service with having saved many lives.

By present-day standards, the apparatus was bulky and of restricted efficiency. Its large transmitter, in the base of Ambulance headquarters at Central Station, had a heavy grill in front, and was known to the staff as "the beast in the cage." Using an aerial which hung from the clock tower to the station balustrade, it was used in conjunction with a number of receivers in various ambulance stations.

The first "mobiles" to be used were also heavy comprising three separate units, a variation of the original car radios.

In the post-war period, the service re-equipped its fleet, and A.W.A. installed what was then the most modern V.H.F./FM system, able to discriminate against noise, but this system, although far more efficient than the earlier one, was still bulky.

The latest A.W.A. installation is comparatively small, streamlined, and capable of satisfactory operation over a wide area at all times. The service controls the main and the emergency base station from the new Quay Street headquarters, where it is integrated with the despatch and recording system to give maximum efficiency in operation of the base station unit.

* * *

Electronics Aid X-Ray Micro-analysis

Cambridge Instrument Company Ltd., of London, England, have been very successful with their new "Microscan" commercial X-ray micro-analyser. Sixteen have been installed within the past 18 months in British, American, Dutch and German research and development organisations.

X-ray micro-analysis is a comparatively new technique for the detailed examination of the microscopic composition of substances by probing

with a finely focussed beam of electrons and analysing the resulting emission of X-rays.

The new technique has been successfully applied to the study of the micro-structure of metals and minerals. Of these studies metallurgy is the one in which most work has been done. The "Microscan" instrument has been specifically designed for studying metals although it could also be used to study other substances. The types of metallurgical phenomena it can investigate include precipitates, solution segregations, diffusion gradients, phase diagram determinations, denuded and enriched zones at grain boundaries, oxide scales, fracture surfaces, inclusions, and corrosion effects.

* * *

New Electronics Company For Nigeria

It is announced today by the L. M. Ericsson Company of Sweden and Marconi's Wireless Telegraph Company of England that they have together formed a new company in Nigeria, to be known as the Nigerian Telecommunications Corporation.

The purpose of the new Corporation is threefold; to provide an "on-the-spot" organisation which can deal rapidly and efficiently with all aspects of telecommunication requirements; to promote the expansion of technical education in Nigeria, and to introduce local assembly of some types of telecommunication units rather than import them already assembled.

The L. M. Ericsson Company is well known all over the world for the quality of its telephone equipment, notably the crossbar telephone exchange, the transistorised carrier systems and the 'Ericofon' telephone instrument. They undertake the planning, installation and maintenance of all categories of telecommunications equipment, including nation-wide systems. Since 1960 L. M. Ericsson has been represented in Nigeria by the Industrial Products Company (West Africa) Ltd. (IPTC).

The Marconi Company is at present responsible for the maintenance of much of the Nigerian Federation telecommunications network. In 1956, under contract from the Department of Posts and Telegraphs, the Company set up a Telecommunication School at Oshodi, Lagos, in which 217 students are currently under training on four-year courses. The initial (1956) intake of trainees have now completed their course and have taken over as maintenance engineers in the Nigerian P. and T. Other

Nigerian engineers are undergoing training at the Marconi Works in England.

It is hoped that the formation of the Nigerian Telecommunications Corporation will do much towards increasing the tempo of technical training in Nigeria. Initially it will have its headquarters at the office and factory premises already established by Marconi's on the Apapa Industrial Estate, Lagos.

* * *

New Computer is Ultra-Fast

So 'complex are the problems of nuclear engineering that the U.S. Atomic Energy Commission a few years ago asked the International Business Machines Company to develop a computer that could operate much faster than the fastest then in existence. To meet the commission's needs, IBM developed the Stretch computer, believed to be the world's fastest and most powerful.

Nuclear scientists are now dealing with problems that involve thousands of millions of calculations, possibly as many as 100 thousand million. To solve such problems without long delays, they asked IBM to "stretch" the resources of technology to the limit in designing the new computer. This is how the Stretch machine got its name.

In less than 10 seconds, Stretch can make some 6,000,000 additions or 3,000,000 multiplications. It works on many parts of a problem at the same time. Because of its speed, it can solve problems for which equations are known, but for which solutions are not practical on any previous computer system.

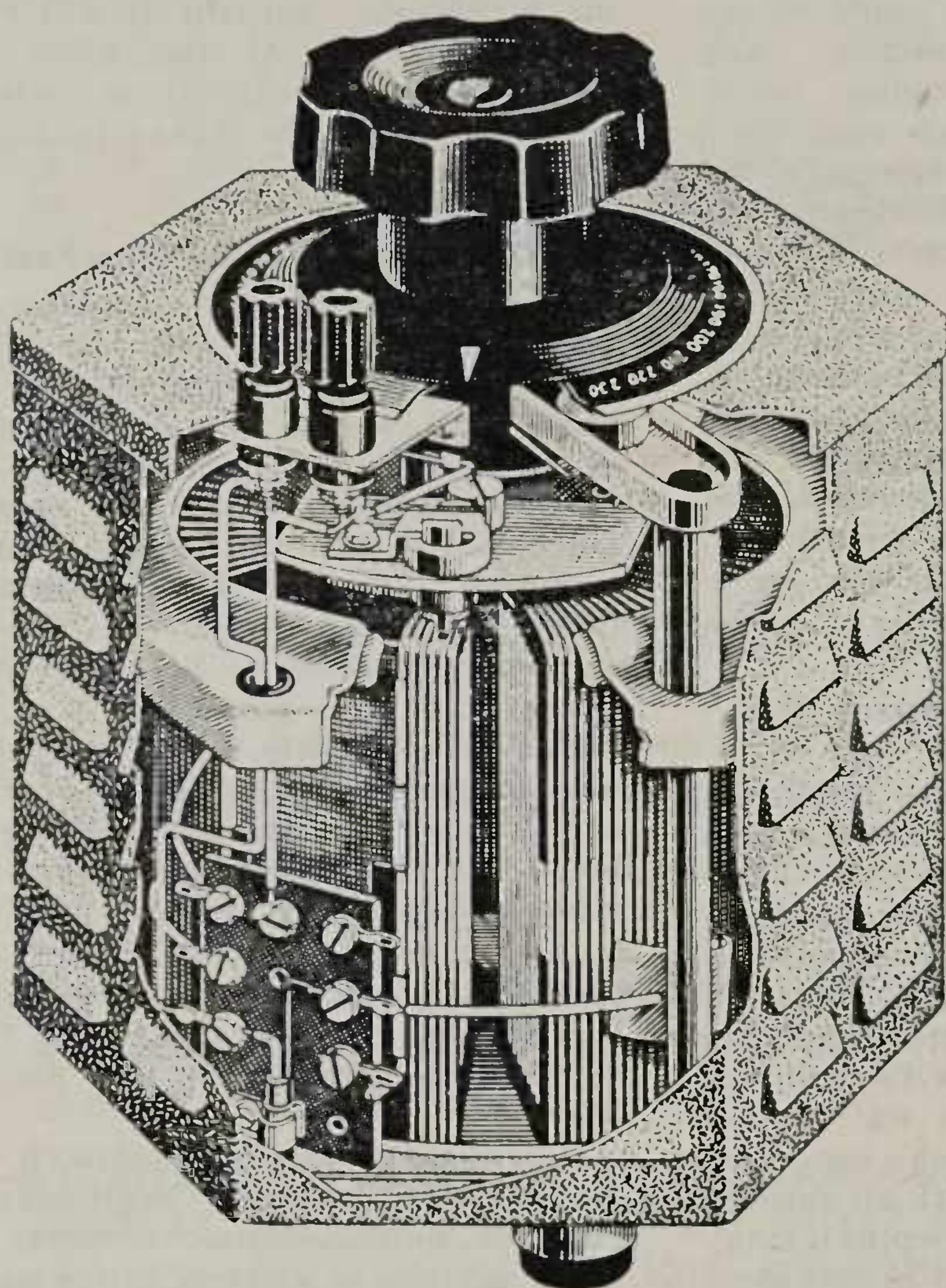
AEI AUCKLAND HOLDS FILM EVENING

(Continued from Page 15)

Hitherto a conventional TV camera had been used to view the microscope screen and to transmit a picture of the view as seen by the microscope operator looking at the internal screen of the instrument. This procedure has given only mediocre results due to the various limitations outlined earlier.

Since the new image intensifier will facilitate operation of the electron microscope and will probably extend the application of the instrument to make it even more versatile it is possible that further developments will result becoming an integral part of the in the image intensifier eventually electron microscope."

PHILIPS *Variable transformers*



IMPORTANT!

Recently released overseas and an **ESSENTIAL** for all TV service work is the new Philips double-wound **ISOLATING** variable transformer.

These transformers have a power rating of 350 watts which is more than sufficient for all TV service work. They are available for bench mounting complete with fusing and voltmeter, or for panel mounting. Further particulars on request. Limited stocks only are available.

Philips variable transformers are designed and manufactured with such care that they will give reliable service over a long period of life. They are available mounted in a durable, attractive case or without the case for panel mounting.

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record review

by Professor C. G. F. Simkin

KEY:

- Not recommended because of poor performance or recording.
- ☆ Recommended although the performance or recording has faults.
- ☆☆ Strongly recommended because both performance and recording are excellent.

☆ **GILBERT AND SULLIVAN:** Excerpts from *The Mikado*. Performed by Wm. Dickie, Ed. Darling, Elisabeth Harwood, Pauline Stevens, Barbara Elsy, Ian Humphries, David Croft, John Gower, Norma Willett, the London Singers and the Westminster Symphony Orchestra; conducted by Alexander Faris. World Record EZ1022.

★ **GILBERT AND SULLIVAN:** Excerpts from *The Gondoliers*. Performed by David Croft, Norma Willett, Wm. Dickie, Duncan Robertson, Chris. Keyte, Ursula Connors, Elisabeth Harwood, Ruth Little, Ed. Darling, the London Singers and the Westminster Symphony Orchestra; conducted by Alexander Faris. World Record EZ1023.

These two discs should give pleasure to all who appreciate Gilbert and Sullivan operas. The performances catch the spirit of two durable favourites, the soloists sing with a clarity that enables us to catch every word, they are well supported by chorus and orchestra, and the recording is usually brilliant and warm. Top gradings cannot, however, be given because the soloists seldom display musical gifts of a high order and because the recording is occasionally strident and guilty of pre-echo.

The *Mikado* appealed to me as the better disc, both for performance and recording. John Gower is a splendid *Mikado* and Norma Willett a very satisfactory *Katischa*, their duet is excellent and is well followed by the *Mikado*'s solo about the proper punishment of crime. David Croft is also good as *Koko*, although more declamatory than musical, and Barbara Elsy is pleasing as *Pitti-Sing*. Edward Darling is rather disappointing as *Nangi-Poo* because of a soft voice and too gentle utterance. I



also found Elisabeth Harwood a somewhat inadequate interpreter of *Yum Yum*. The choruses are very well done, and the orchestral accompaniment often excellent.

The Gondoliers is the better work musically but, for that reason, shows up more strongly the musical deficiencies of the soloists. Nevertheless, I particularly enjoyed William Dickie's 'I Stole the Prince,' the quartet 'In a Contemplative Fashion' by Harwood, Little, Robertson and Keyte, and Norma Willett's 'On the Day that I was Married.' David Croft is as good a Duke of Plaza-Toro as he was a *Ko-Ko*. Purists may be upset by the order of the numbers in Act II; 'Rising Early in the Morning' follows 'After Sailing to this Island,' and 'Dance a Cochucha' is substituted for the Finale. But there is artistic sense in the changes, at least in a selection from the opera, which is all this disc offers.

BEECHAM IN REHEARSAL: Rehearsals of Haydn's Symphonies Nos. 100, 101 and 104 and of Mozart's *Il Seraglio*, by Sir Thomas Beecham and the Royal Philharmonic Orchestra, with the soloists Gottlieb Frick, Gerhard Unger, Lois Marshall and Ilse Hollweg. World Record EZ1204.

This disc, of course, cannot be graded in the usual way. Although it sounds surprisingly well, it was made from tapes of experiments in placing microphones before actual recording. There are snips of fine playing and singing, but too few and brief to give the disc any musical value. It offers just what its title says—audio impressions of Sir Thomas at work with his favourite orchestra. They are such interesting impressions that all admirers of the great man will want to have the disc.

On the first side we hear him getting the orchestra to produce some of the effects he wants in the Salomon symphonies. It all sounds very good natured but definite. His methods range from clear instructions, illustrated by a hoarse crooning, to brief discussions with the musicians about tempi and phrasing. Sir Thomas apparently kept rehearsals from becoming too tense or dull by occasional pleasantries and anecdotes. His ability as a raconteur is well displayed when the rehearsal of the London Symphony halts because of the noise from rain and he fills in time by telling amusing stories. There is also an illuminating comment here about rehearsals: "The only way to get real and vital performance is not to rehearse"; players are at their best when under tension.

The second side gives a more connected view of a rehearsing under Beecham. At the start we hear him urging the piccolo to "blow for dear life" so as to make "recordable" music, and later some fine singing from Frick against a background of rhythmic shouts from Beecham to the orchestra. The general atmosphere of the rehearsal is nicely caught by the banter between Sir Thomas and the soloists as they disperse for lunch. And after lunch we have another sample of the old man cajoling his people to give him just precisely what he wants.

☆☆ **SCHUMANN, Cello Concerto in A Minor, Opus 129; and TCHAIKOVSKY, Variations on a Roccoco Theme, Opus 53; played by Pierre Fournier and the Philharmonia Orchestra, conducted by Sir Malcolm**

Sargent. World Record PZ500.

This magnificent disc combines fine playing, by both soloist and orchestra, with superb recording. It can be recommended without any qualification on these grounds. Whatever, moreover, one thinks of Schumann and Tchaikovsky as composers, these two works are important parts of the limited repertoire of cello concertis.

Schumann's compositions for the orchestra generally lack variety and have too turgid a colouring. Such faults are evident enough in the cello concerto, but are minimised because, as he himself said, it is really a concert piece for the cello with an orchestral accompaniment. It shows an extraordinary sympathetic understanding of this noble instrument, and can never have been better rendered than by Pierre Fournier. His technical skill is dazzling, but always subordinated to the complete artistry of an assured interpretation. The beautiful slow movement is, as one would expect, particularly well done, but there is never a lapse from the highest standards of taste and competence. In the last movement Fournier substitutes his own cadenza for Schumann's, and it proves a very satisfactory bit of virtuoso writing. Sir Malcolm Sargent and the orchestra provide an accompaniment that matches the distinction of Fournier's playing.

Tchaikovsky's variations are irresistibly lyrical, provide an extraordinary display piece for the cello, and have a masterly orchestration. Fournier and the Philharmonia make the most of them.

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Thermo-Electric Generator Protects Mile-Deep Gas Well

This report is of particular interest at the moment in view of the recent oil-seeking project at Taranaki.

PITTSBURGH, U.S.A.—A thermoelectric generator, developed by Westinghouse Electric Corporation, has been put into service to protect a mile-deep gas well of El Paso Natural Gas Company, El Paso, Texas, in the United States.

The generator, installed in a remote region of the San Juan Basin, north-east of Farmington, New Mexico, supplies the electric power needed to prevent self-corrosion of the well's steel casing.

The technique, known as cathodic protection, keeps the casing from being eaten away through an electrochemical reaction that occurs spontaneously in metal

objects buried in the ground.

The thermoelectric generator taps a small amount of the gas coming from the well, burns it, and converts the heat directly into the electricity that safeguards the well.

"This is an excellent application for thermoelectricity," Dr. R. A. Ramey, director of the Westinghouse new products laboratories, declared. "A thermoelectric generator has no moving parts. It is a simple, trouble-free, static system ideally suited to power production in remote areas where routine maintenance of equipment is especially difficult.

"We can expect to see thermoelectric power increasingly used for such applications, both industrial and military."

The thermoelectric generator is connected between the 5000-foot gas well casing and a ground bed consisting of silicon cast iron anodes packed vertically in a hole 200 feet deep. It reverses the normal flow of current set up by the casing as it chemically reacts with the soil. Thus, the easily

replaceable ground bed is slowly eaten away instead of the casing itself.

Protection of the well casing is accomplished with about six amperes of current at eight volts DC. This power is generated at a temperature of 800 degrees Fahrenheit on the hot side of the generator. The cool side of the unit operates at 200 degrees F., higher than the boiling point of water at the 6100 foot elevation at which the generator operates.

El Paso Natural Gas reported that the thermoelectric installation was a co-operative project with Westinghouse to evaluate the use of this new method of power generation for gas well and pipeline protection.

A great number of the wells and lines in the southwest are in isolated regions without conventional electric power service. The two firms are conducting this pilot experiment to determine the feasibility of adopting the technique for cathodic protection in other El Paso Natural Gas Company locations.

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Diodes
in 142
115 p.i.v. @
15 mA. etc.

General
Purpose
Silicon
Diodes
HS1012
50 p.i.v.
140mA
in 456
25 p.i.v.—
90mA

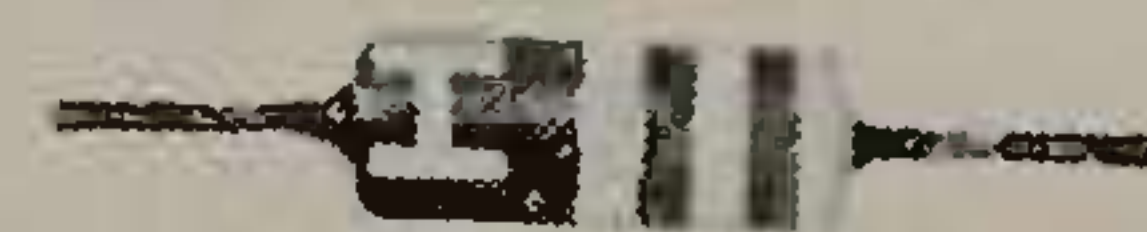
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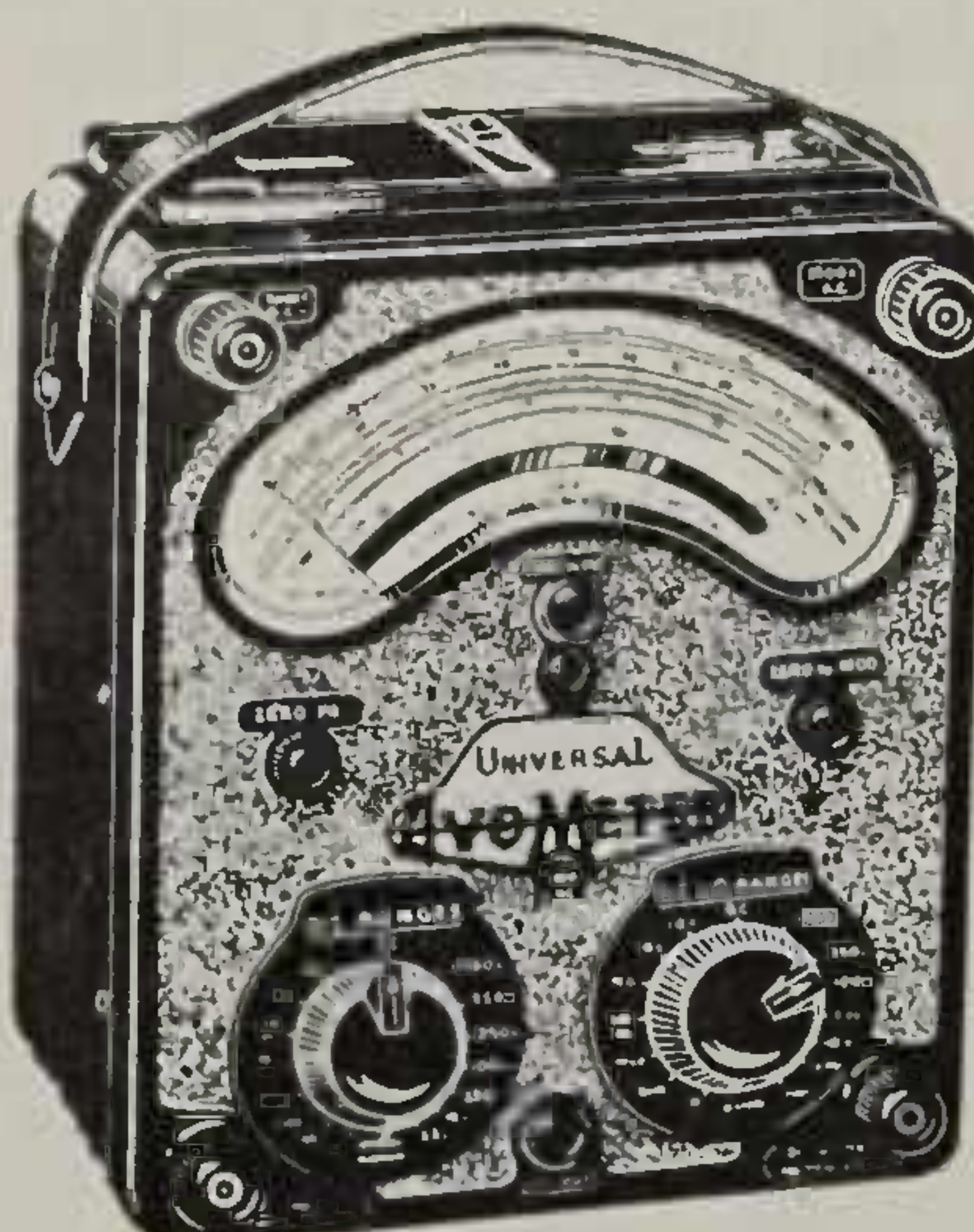
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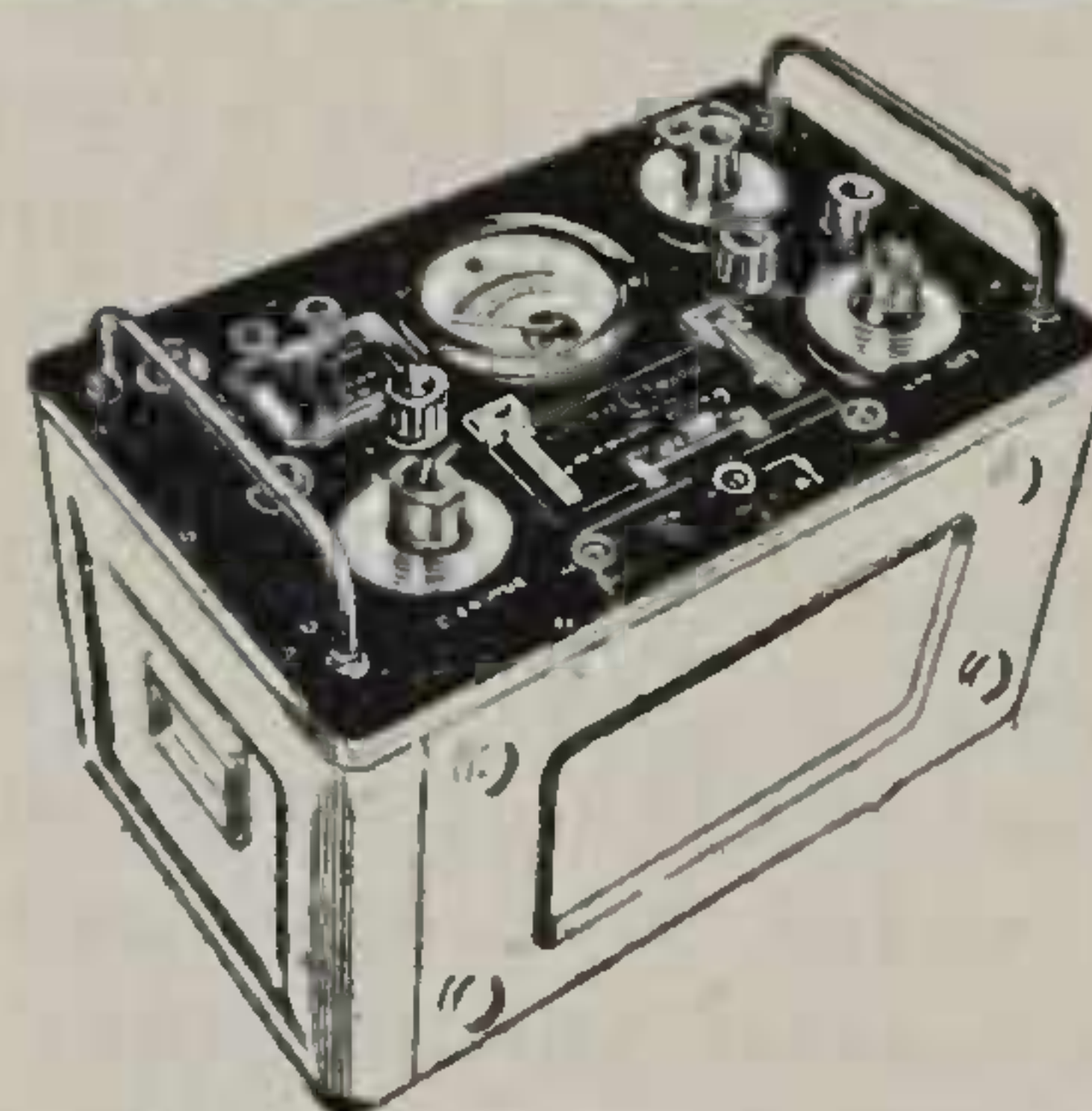
MODEL 8 UNIVERSAL AVOMETER

Has a sensitivity of 20,000 ohms per volt on all D.C. voltage ranges and 1,000 ohms per volt on A.C. voltage ranges from 100v. upwards. Retains traditional simplicity of operation and compact portability of the Model 7 Avometer.



MODEL 40 UNIVERSAL AVOMETER

A self-contained, multi-range A.C./D.C. instrument providing 40 ranges of current, voltage and resistance. Higher ranges are obtainable with the aid of accessories.



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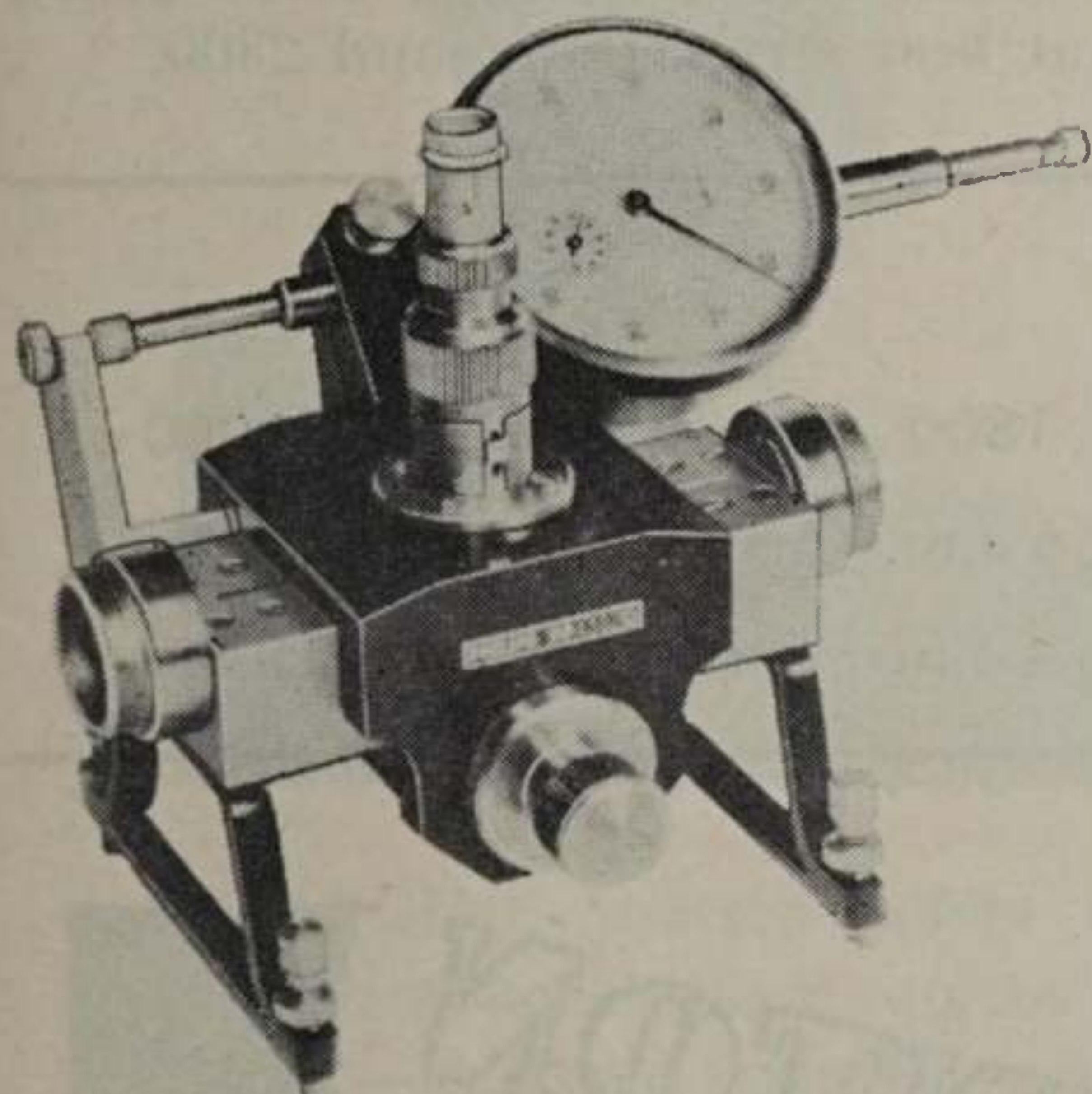
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Philips Standing Wave Detector, Type PP 4382 Q

N. V. Philips, Holland, recently announced the extension of their range of microwave components for the 8 millimetre band with the introduction of the precision Standing Wave Detector, Type PP 4382 Q. This instrument with its precise mechanical construction is intended for measurements of VSWR'S up to 300 (min. readily VSWR 1.03) and is therefore very use-



ful for a great variety of measurements such as the determination of dielectric and mechanical constants.

Other information: Frequency range 31 to 36 Gc/s.; Max. probe carrier displacement 30 mm.; Accuracy of the displacement 0.01mm.; Probe penetration adjustable up to 2 mm.

The waveguide section is provided with Franco-British standard flanges, type Z83.0019.

Full technical information is available from E.D.A.C. Ltd., P.O. Box 6415, Wellington, and P.O. Box 9338, Auckland, who would welcome all inquiries.

* * *

Miniature Push Button Switch

A U.K. firm announce the introduction of a miniature push button switch which is available with one to twelve buttons. The switch is of an extremely compact design which makes it highly suitable for inclusion in small domestic radio receivers, tape-recorders and professional equipment when chassis and cabinet space are restricted. Each button can provide up to 6-pole changeover switching per side, giving a possible total of 12

poles per button. Press-to-set and press-to-release operation is available on any combination of buttons.

The switch is available for standard chassis mounting or for printed circuit applications. In the printed circuit version, the contacts are arranged so that they 'plug-in' to their respective circuit points when the switch is mounted horizontally in relation to the printed circuit panel.

The Plessey Co. Ltd., Ilford, Essex, England.

* * *

Radiotelephones for Tough Locales

Pye has developed a 20 watt transistorised H.P. radiotelephone specially designed for use in areas where public communications and power supplies are limited. Robust construction makes it suitable for vehicle mounting.

The Pye "Mercury" is a 20 watt transistorised H.F. radiotelephone designed for use in overseas territories where public communication and power supply facilities are limited. Its robust construction makes it suitable for vehicle mounting.

The transmitter, which has a transistor modulator and power supply, can be preset to eight crystal controlled frequencies, four of which can be situated in the band 1.6 to 3.8 Mc/s and the other four in the band 3.8 to 10 Mc/s.

The receiver, which is fully transistorised, is continuously tuneable over three frequency ranges; the broadcast band 535 to 1605 Kc/s, the medium shortwave band 1.6 to 3.8 Mc/s and the shortwave band covering 3.8 to 10 Mc/s. It has facilities for C.W. reception with manual gain control. The built-in loudspeaker is automatically disconnected when headphones are plugged into the jack socket on the front panel.

Transmitter and receiver are built on separate chassis housed in a single cabinet. All interconnections between the two units are internal and completely concealed during normal operation.

A removable panel on the front of the transmitter allows access to the bank of crystals and all preset tuning controls. The transmitter can be set

LONDON RADIO SHOW REVEALS NEW TECHNIQUES

(Continued from Page 11)

Quite a surprising new trend was noted at the Earls Court show. This was the interest being shown by the public in television cameras which can be used in the home. At present it is a fairly expensive hobby, even though manufacturers have managed to produce cameras at a price in the region of £100.

Originally these cameras were intended for industrial use, but they are now finding domestic applications, one of which is fitting the camera in a nursery so that an eye can be kept on the baby. The cameras are quite small, and one transistorised piece of equipment, produced by Nottingham Electronic Valve Company (6), is no bigger than a home cine camera. The camera is connected to the aerial socket of a standard domestic television set and can be operated through an ordinary coaxial aerial cable.

The National Radio Show is organised on behalf of The British Radio Equipment Manufacturers' Association (7) by Radio Exhibitions Ltd. (8).

Key to manufacturers of products mentioned:—

- (1) Brimar Ltd., Rochester, Kent, England.
- (2) Murphy Radio Ltd., Welwyn Garden City, Hertfordshire, England.
- (3) Pye Ltd., P.O. Box 49, Cambridge, England.
- (4) Ekco Radio and Television Ltd., Southend-on-Sea, Essex, England.
- (5) Philco (Great Britain) Ltd., 21 Cavendish Place, London, W.1.
- (6) Nottingham Electronic Valve Company Ltd., Main Street, East Bridgeford, Nottinghamshire, England.
- (7) The British Radio Equipment Manufacturers' Association, 49 Russell Square, London, W.C.1.
- (8) Radio Industry Exhibitions Ltd., 59 Russell Square, London, W.C.1.

to operate on any of the preset channels by means of a channel switch and only the antenna tuning control requires to be adjusted for maximum R.F. output when a different channel is selected.

The set is normally operated in conjunction with a long wire or whip antenna but a wide range of other antennas can be used.

Pye Telecommunications Ltd., Newmarket Road, Cambridge.

SHORTWAVE SURVEY

(Continued from Page 31)

At 1015 on 7105 (Singapore) Indonesian at 1030

An asterisk against the frequency denotes poor reception either on account of weak signal strength or interference.

Frequencies previously reported and not currently heard here are: 5985, 6045, 7190, 9600, 9640, 11925, 15070, 15110, 15180, 15415, 17740, 17870.

HOLLAND. Radio Nederland was heard during the half hour commencing at 1930 using both 15425 and 17810. The latter channel provided the stronger sig-

nal. At the time of writing, the Sunday "Happy Station" programme appears to have departed from the frequencies carrying this popular feature a week or so ago. These were 9715 and 11780. There are reports that the session is now broadcast on 9590 although no sign of the station could be observed on this frequency last Sunday between 0600 and 0725.

INDIA. All India Radio has been heard with new frequencies which can be taken as replacements for those previously described. That is, with the exception of their morning transmission heard from 1945 to 2045 on 9635 which continues to be well received. In parallel with this fre-

quency are two others, 11955 and 15110. These, however, are usually inferior to the 31 metre band outlet. At 0430 a news session in English is tuned on 17855. Previous to this the station uses another language. Between 1030 and 1100 a further session in English is received on 15310 and 21620. The 19 metre band frequently is usually by far the more satisfactory one at this time.

NEW GUINEA. VLT6 is the call sign of the ABC's Port Moresby regional station heard clearly from 0730 until after 1100 on 6130. The mornings transmission from this station on 9520 is usually received here only during the winter months when it is heard at best strength around 2300.

TIME CONVERSION CHART

GMT	0200	0400	0600	0800	1000	1200	1400	1600	1800	2000	2200	0000
N.Z.	2 p.m.	4 p.m.	6 p.m.	8 p.m.	10 p.m.	Midn't	2 a.m.	4 a.m.	6 a.m.	8 a.m.	10 a.m.	Noon
AET	Noon	2 p.m.	4 p.m.	6 p.m.	8 p.m.	10 p.m.	Midn't	2 a.m.	4 a.m.	6 a.m.	8 a.m.	10 a.m.

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