The Wireless World

THE PRACTICAL RADIO JOURNAL

28th Year of Publication

No. 991. THURSDAY, AUGUST 25TH, 1938. VOL. XLIII. No. 8.

Proprietors : ILIFFE & SONS LTD.

Editor :
HUGH S. POCOCK.

Editorial,
Advertising and Publishing Offices :
DORSET HOUSE, STAMFORD STREET,
LONDON, S.E.1.

Telephone : Waterloo 3333 (50 lines).
Telegrams : "Ethaworld, Sedist, London."

COVENTRY : 8-10, Corporation Street.
Telegrams : "Autocar, Coventry." Telephone : 5210 Coventry.

BIRMINGHAM :
Guildhall Buildings, Navigation Street, 2.
Telegrams : "Autopress, Birmingham." Telephone : 2971 Midland (4 lines).

MANCHESTER : 260, Deansgate, 3.
Telegrams : "Iliffe, Manchester." Telephone : Blackfriars 4412 (4 lines).

GLASGOW : 26B, Renfield Street, C.2.
Telegrams : "Iliffe, Glasgow." Telephone : Central 4857.

PUBLISHED WEEKLY. ENTERED AS SECOND CLASS MATTER AT NEW YORK, N.Y.

Subscription Rates :
Home, £1 1s. 8d. ; Canada, £1 1s. 8d. ; other countries, £1 3s. 10d. per annum.

CONTENTS

Editorial Comment

The Show

Catering for a New Market

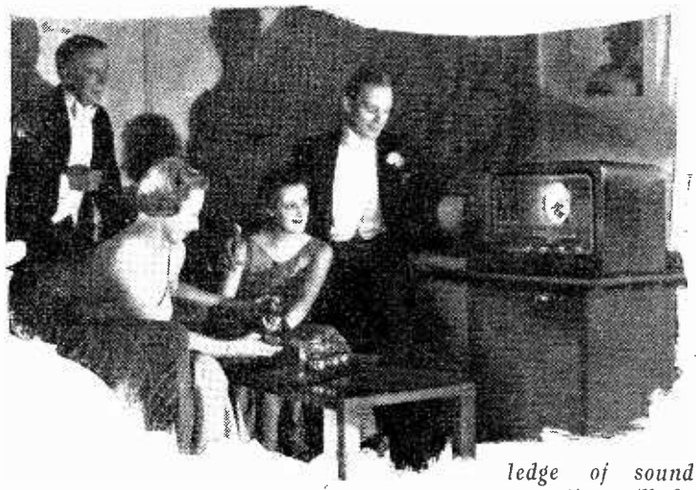
IT has been obvious for some time that wireless licences cannot possibly continue to increase in number at the rate to which we have grown accustomed during the last dozen years or so. Consequently the broadcast receiver industry has now to devote much of its energy to catering for the replacement market, and this tendency is particularly noticeable at the present Olympia Exhibition.

Push-button tuning offers an attraction to the man in the street which it is thought will be so obvious as to constitute in itself in many cases a sufficient reason for buying a new set. Perhaps an even better reason for doing so is to be found in the fact (to which a relatively negligible amount of publicity has been given) that technical features that began to be introduced into receivers some five years ago in a more or less imperfect and experimental state have now been thoroughly tested, and have only survived in their best and most dependable form. If we are to accept the view that the average domestic receiver is five years old, it would seem that the time is certainly opportune for it to be replaced.

There is hardly any exaggeration in saying that in the sphere of broadcast receivers the centre of interest has been allowed to drift from the electrical to the mechanical aspect of design. Though willing to admit the usefulness of push-button tuning, we feel that many of our readers will join with us in regretting that this feature has been allowed for the moment rather to overshadow more basically important matters of electrical interest. After all, "circuital" finality has not yet been reached. All praise is due, however, to the designers of many of the push-button sets for the ingenuity they have displayed.

The pains that have been taken to devise a scheme for distributing radio-frequency signals for demonstration purposes to the stands at Olympia are to be commended, though at the time of writing it is not possible to comment on the success of the venture, which offers for the first time in the history of the Show at least some possibility of making reasonable comparisons between one set and another. It has been suggested that the selectivity test made possible by the "Radiolympia Distant" signal, with its accompaniment of weaker jamming signals spaced 9 kc/s each side of the carrier, is one that the cheaper and simpler type of set can hardly be expected to survive. However, a test so unexacting that every set could pass it with flying colours would be no test at all, and would do nothing in educating the uninformed visitor to the Show in the attractions and advantages of the more refined type of receiver.

There has been much loose talk on the cheapening of television receivers, and insufficient emphasis has been laid on the fact that, generally speaking, the now low-priced sets are small-screen models. Actually there has been comparatively little real reduction in price, and any such reduction can hardly be anticipated unless some radical and quite unexpected new technique is developed. Television to-day offers remarkably good value for money, especially when the amount of free installation and other service that goes with many of the sets is taken into account.



The A.B.C

A SIMPLE EXPLANATION OF HOW IT WORKS

MOST readers with an elementary knowledge of sound transmission and reception will find in this article the supplementary information necessary to an understanding of the functioning of television. The subjects dealt with include the necessity for scanning, the method of synchronising pictures and the functioning of the "Emitron" camera.

THE present high standard of television is not, as some people seem to think, the result of some new fundamental scientific discovery. The cause for wonder lies rather in the ingenuity with which so many known physical phenomena have been brought together into a workable scheme, remarkable alike for its reliability and refinement of performance.

Between the aerials of the television transmitter and receiver the electrical impulses equivalent to vision do not differ essentially from those which carry sound. They manifest themselves as variations in the strength (modulation) of a wireless wave of fixed wavelength, and can be detected and reduced to a form capable of producing fluctuating light by receivers similar to those which produce the currents in the loud speaker of a broadcast set.

In the studio, light from the subject is allowed to fall on a substance such as potassium or caesium, which has the property of liberating electrons under the influence of light in the same way that the filament of a valve gives off electrons when heated. Collected together, these electrons form a current which, when amplified, may be used to modulate the transmitter.

Electricity into Light

At the receiving end the equivalent change of current could be reconverted into light by the filament of a lamp or a neon tube, but for television a more sensitive method is employed. It is the converse of that manifested in the photo-electric cell The substance used for coating the end of the television tube is one which gives off light when bombarded by electrons. The stream of electrons (cathode rays) for this purpose is produced by a valve filament. The electrons can be increased or decreased in strength, crowded into a narrow pencil and deflected from side to side by the attraction or repulsion of suitably placed electrodes or magnets. The intensity of light on the screen is, in fact, governed by applying the modulation in the wave coming from the television station to the grid of the cathode-ray tube.

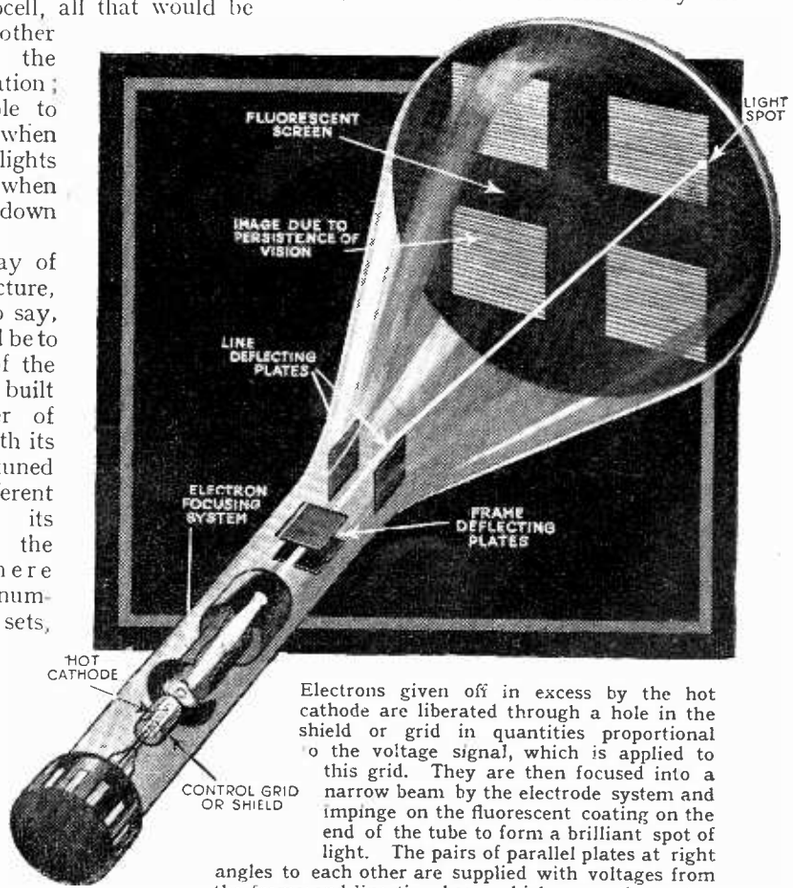
By these means we can faithfully reproduce a rise or fall in the intensity of light at the studio, but that is very far from being able to see in detail what is actually taking place there. If we were to focus a sharp image of the scene on the plate of the photocell, all that would be registered at the other end would be the *average* illumination; we should be able to tell, for instance, when some of the floodlights were turned off or when the station closed down for the night.

The simplest way of sending a picture, simplest, that is to say, in principle, would be to throw an image of the scene on a screen built up of a number of photocells, each with its own transmitter tuned to a slightly different wavelength from its neighbours. At the receiving end there would be a similar number of receiving sets, each with its lamp, neon tube or cathode-ray tube grouped in the same order as the cells at the transmitter to form a picture screen. Unfortunately, more than 200,000 transmitters would be required to send a picture of equal definition to that at present sent out.

How then does the single transmitter at Alexandra Palace manage to do the work so successfully? Simply by refusing to try to send out the whole of a picture simultaneously and by concentrating on one small spot at a time in rapid succession until the whole field of view has been covered. It does this in a systematic order, starting from the top left-hand corner and moving at constant speed in a line across to the right, then flicking back rapidly to the left and starting a fresh line immediately below, just as a reader might scan the pages of a book. The signal it sends out is a continual tale of light or dark or the shades between.

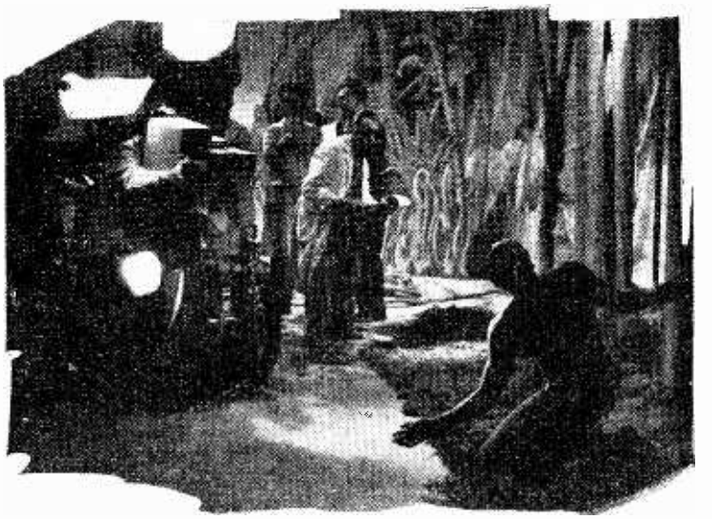
At the receiving end the spot of light generated on the fluorescent screen by the pencil of cathode rays follows a similar course, and its brightness depends upon the modulation in the transmitted wireless wave, which in turn is decided by the brightness of the particular part of the picture which the transmitter is "seeing" at that moment.

The astounding thing about television is that there never is a picture on the



Electrons given off in excess by the hot cathode are liberated through a hole in the shield or grid in quantities proportional to the voltage signal, which is applied to this grid. They are then focused into a narrow beam by the electrode system and impinge on the fluorescent coating on the end of the tube to form a brilliant spot of light. The pairs of parallel plates at right angles to each other are supplied with voltages from the frame and line time bases which cause the spot to scan the fluorescent screen from left to right in successive lines from top to bottom of the picture.

# of Television

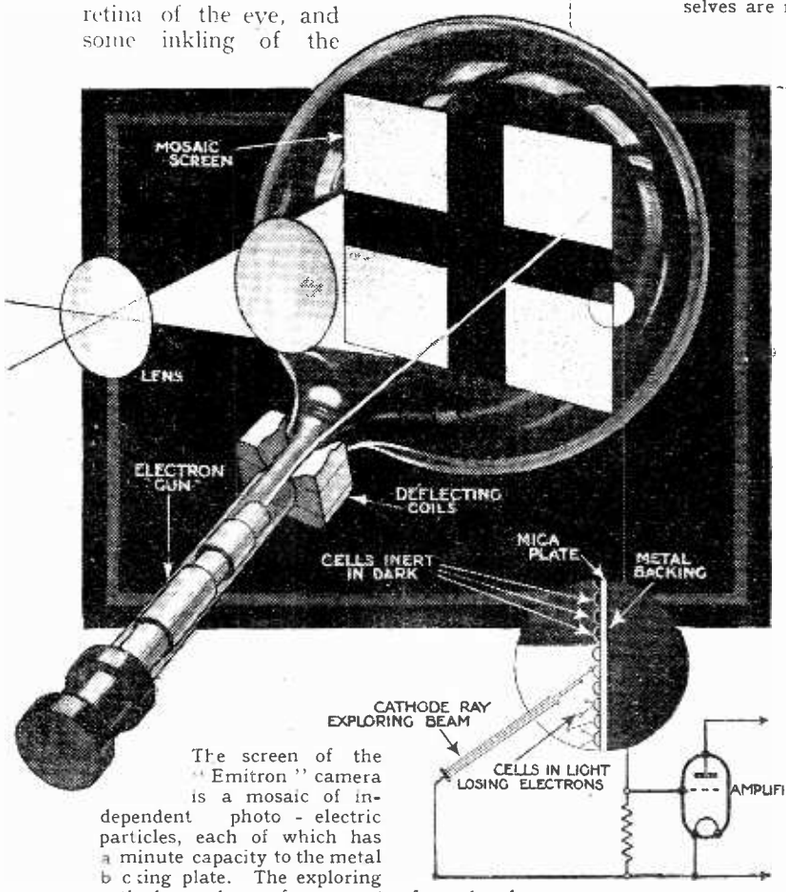


The cathode-ray beams in the "Emitron" camera (right) and the cathode-ray tube at the receiver (left) follow parallel courses in analysing and tracing out the picture. In practice the beams themselves are not visible.

screen at the receiving end. If you stop a home ciné projector you arrest the action but retain the view, and this is often done for comic effect. But if a television set could be suddenly stopped in the same way, all you would see would be a bright spot about the size of a pinhead on a perfectly black background. The spot would be intense and if allowed to remain stationary for long would "burn" the screen.

The success of television by present methods depends entirely on a defect of the eye known as persistence of vision. The retina goes on telling the brain that a light is shining for about 1/10 second after the light is cut off. An intermittent light begins to lose its flicker above 10 flashes per second, and since the television picture as a whole is changed twenty-five times a second (fifty times with interlaced scanning) the eye cannot follow the course of the spot, which makes 405 lines in every picture, and could, if put to it, make about 100,000 flashes in 1/25 second. The final picture is drawn on the retina of the eye, and some inkling of the truth of this statement may be gained by moving the head quickly from side to side or up and down, without looking directly into the screen, when a glimpse may be obtained of the composite structure of the picture.

The technique of scanning is essentially the same at transmitter and receiver, and is best understood by considering the receiving end first. Since the beam in the cathode-ray tube is composed of electron particles each carrying a negative charge, it can be deviated from its original straight path by passing it between parallel plates. If one plate is made positive and the other negative the beam will be deflected towards the positive plate and away from the negative. The deflection will be proportional to the voltage between the plates, and if the voltage can be made to increase at a constant rate the spot at the end of the beam will trace a line across the fluorescent screen. This is accomplished in the receiver by the "line time-base" valve, which charges a condenser at constant speed up to a voltage equivalent to full deflection of the spot to the right of the picture and then suddenly discharges it, causing it to fly back to the start of the next line.



The screen of the "Emitron" camera is a mosaic of independent photo-electric particles, each of which has a minute capacity to the metal backing plate. The exploring cathode-ray beam forms part of a closed circuit, and in restoring the electrons lost by those cells, under the influence of light a current pulse is generated in the grid circuit of the amplifier.

Another pair of plates is similarly supplied with voltage from the "frame time-base" running at a much lower speed. These plates are fixed at right angles to the "line" pair, and cause a downward movement of the spot so that each successive line is displaced a little farther down the picture. In the E.M.I. system, double spacing of the lines is employed and the picture is traversed twice before a frame is completed, the second scanning interlacing the lines of the first.

The electron beam in the tube can be controlled by magnet coils instead of electrostatic plates, and nowadays magnetic deflection is generally used. Essentially the two methods are the same, and we have chosen electrostatic deflection as it is easier to illustrate diagrammatically.

At the transmitting end an electron beam is also used to scan or explore the changing image of the scene thrown on the screen of the "Emitron" camera. It follows the same path as the beam at the receiving end, and by virtue of its negligible inertia is controlled with the same instantaneous response to the deflecting voltages or magnetic fields. In the case of the camera an additional property—its ability to carry a current—is made use of. Being a stream of electrons, it is, in fact, a current without a conductor.

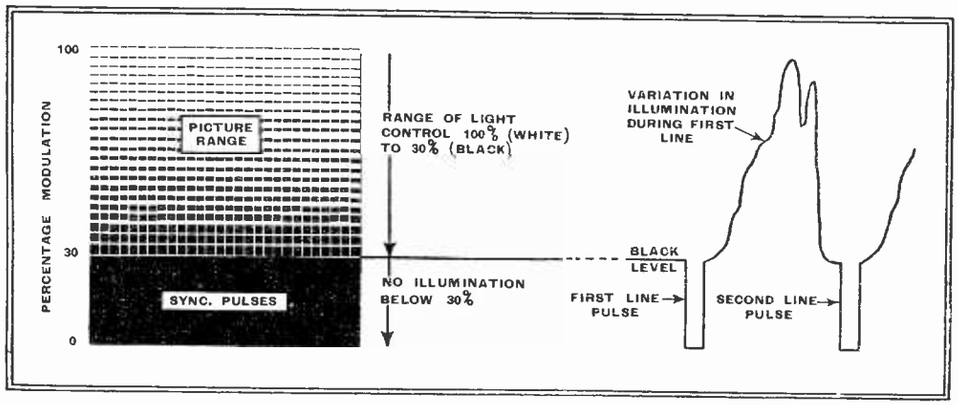
Light into Electricity

The screen upon which the image found by the camera lens falls is covered by a mosaic layer of minute particles of actively photo-electric material. The formation of this layer, which is deposited on a mica plate, is a triumph of technical skill, for each particle is insulated from its neighbours and acts as an independent photo-electric cell. The mica is backed by a metal plate, which forms a common condenser electrode to all the particles in the mosaic.

When light falls on a group of the particles in the mosaic they lose negative electricity by giving off electrons and gradually acquire a positive charge with respect to the back plate. When the electron beam passes over this particular spot in the course of its scanning travels it neutralises the charge on the cells, and in so doing causes a sudden current pulse to pass to the back plate, which is connected to the grid of an amplifying valve mounted inside the camera head. Elements of the mosaic in dark parts of the

The A.B.C. of Television—

picture do not change their charge through the loss of the electrons, and so do not cause the charging current when the beam passes over them. It will be appreciated that the passage of the beam over the screen obliterates the electrical picture at each frame, and prepares it for a rearrangement of charges if there has been any movement in the subject since the last frame was transmitted.



Graphical representation of the allocation of the available modulation of 100 per cent. between the picture and synchronising signals.

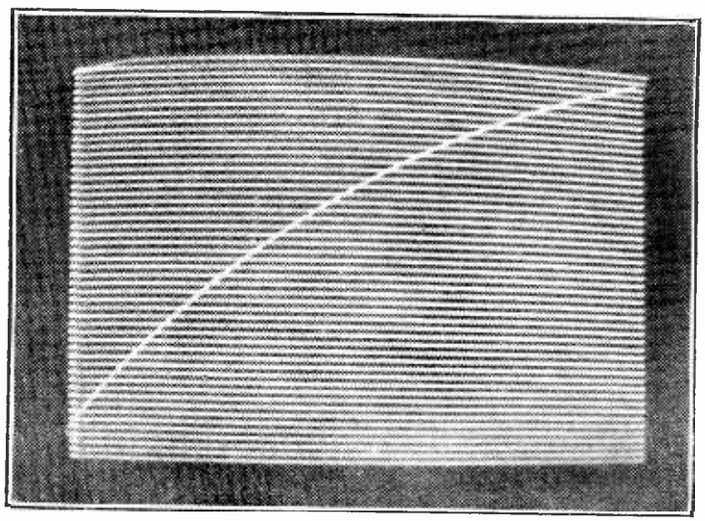
We said earlier in this article that the electron beams in the "Emitron" camera and in the cathode-ray tube at the receiving end follow the same course in tracing out the picture. They do not do this of their own accord, but must be locked together by synchronising signals. Pulses for this purpose are sent by the transmitter to the camera as well as to the receiving station at the end of each line and again at the bottom of each frame. Circuits are included in the receiving circuit to separate line and frame "sync" pulses and to prevent mutual interaction between the picture and the synchronising processes. To facilitate separation of these two functions the first 30 per cent. of the possible 100 per cent. modulation of the carrier wave can be varied without producing any effect on the television screen, and "sync" pulses are transmitted by reducing the modulation from 30 per cent. —the black level on the picture—to zero for a period equal to $\frac{1}{10}$ of the duration of a line. The frame "sync" pulse extends over about ten lines and the line pulse is kept going within this period.

Action of the Time Bases

In the time bases the growth of the charge on the condenser, if allowed to continue indefinitely, would in due course cause the anode of the gas-filled triode to which it is connected to flash over and empty the condenser, reducing its voltage to the initial value. The valve can be made to discharge before this saturation point is reached by applying a positive voltage to the grid. This is supplied by the "sync" pulse, which is thus able to trigger the time base exactly at the right moment.

No attempt is made to keep the "sync" pulses off the control grid of the cathode-ray tube, since they serve the very useful purpose of keeping the grid below the "black" level during the fly-back period. This is chiefly of advantage in the case of the frame fly-back which can be plainly seen in the "raster," or faint network of lines produced by the uncontrolled time bases, when the station has closed down.

It would require a long series of articles to do justice to the wealth of ingenuity which has gone to the perfecting of detail both in transmitters and receivers, but the foregoing covers most of the essentials of the system as a whole.



Actual photograph of the path of the light spot in a television tube. The line spacing has been increased for clarity. The frame fly-back is visible because the time base is not under the control of the transmitter. Actually it starts in the bottom right-hand corner, but a line fly-back has carried it to the left while it has travelled vertically four or five lines.

Television Programmes

Vision 45 Mc/s — Sound 41.5 Mc/s

THURSDAY, AUGUST 25th.

11 a.m., Demonstration Film. **12-1,** Come and be Televised*. **2.30,** Starlight, Leonard Henry. **2.40,** Haute Ecole, horse riding in Alexandra Park. **3,** Facets of Syncopation. **3.30,** 167th edition of Picture Page*. **4.30,** Nancy Logan, songs at the piano*. **4.40-5,** Haute Ecole. **6.30,** Queue for Song*. **7,** Forecast of Fashion*. **7.15-7.30,** Films. **8.30,** 168th edition of Picture Page*. **9,** "The Rivals," play by Richard Brinsley Sheridan. **10.15,** Interval Music. **10.25,** News.

FRIDAY, AUGUST 26th.

11 a.m., Demonstration Film. **12-1,** Come and be Televised*. **2.30,** O.B. from Regent's Park Zoo. **3,** "The End of the Beginning," a farce. **3.30-4,** Queue for Song*. **4.30-5,** Zoo O.B. **6.30,** Cabaret Cruise*. **7,** Cruising Fashions*. **7.15-7.30,** Film. **8.30,** Queue for Song*. **9,** Gillie Potter. **9.10,** Alfredo and his Gipsy Orchestra*. **9.40,** News Film. **9.50,** James Stevens—poetry. **10,** Interval Music. **10.25,** News.

SATURDAY, AUGUST 27th.

11 a.m., Demonstration Film. **12-1,** Come and be Televised*. **2.30,** Zoo O.B. **3,** Tour de Farce. **3.30,** Cabaret Cruise*. **4.30-5,** Zoo O.B. **6.30,** Queue for Song*. **7,** Forecast of Fashion*. **7.15-7.30,** Films. **8.30,** Cabaret Cruise*. **9,** Cabaret Cartoons. **10,** Interval Music. **10.25,** News.

SUNDAY, AUGUST 28th.

8.50, News. **9.5,** Starlight—Yvonne Arnaud. **9.15,** Cartoon Film. **9.20-10.35,** "Charles and Mary," a play based on the lives of the Lambs, by Joan Temple.

MONDAY, AUGUST 29th.

11 a.m., Demonstration Film. **12,** C. H. Middleton in The Garden*. **12.15-1,** Come and be Televised*. **2.30,** Zoo O.B. **3,** Jack Hylton and his Band. **3.30-4,** Queue for Song*. **4.30-5,** Zoo O.B. **6.30,** Cabaret Cruise*. **7,** Cruising Fashions*. **7.15-7.30,** Films. **8.30,** Queue for Song*. **9,** Jack Hylton and his Band. **9.30,** Starlight. **9.40,** Demonstration of Ballroom Dancing. **9.55,** Cartoon Film. **10,** Interval Music. **10.25,** News.

TUESDAY, AUGUST 30th.

11 a.m., Demonstration Film. **12,** C. H. Middleton*. **12.15-1,** Come and Be Televised*. **2.30,** Cookery Demonstration. **2.40,** Zoo O.B. **3.10,** Coffee Stall. **3.30-4,** Cabaret Cruise*. **4.30-5,** Zoo O.B. **6.30,** Queue for Song*. **7,** Forecast of Fashion*. **7.15-7.30,** Films. **8.30,** Cabaret Cruise*. **9,** News Film. **9.10,** Alfredo and his Gipsy Orchestra*. **9.40,** "Brigade-Exchange," play. **10.15,** Interval Music. **10.25,** News.

WEDNESDAY, AUGUST 31st.

11 a.m., Demonstration Film. **12,** C. H. Middleton*. **12.15-1,** Come and be Televised*. **2.30,** Zoo O.B. **3,** Cabaret Cartoons. **3.30-4,** Queue for Song*. **4.30-5,** Zoo O.B. **6.30,** Cabaret Cruise*. **7,** Cruising Fashions*. **7.15-7.30,** Film. **8.30,** Queue for Song*. **9,** Catch-as-Catch-can wrestling. **9.15,** Jane Carr*. **9.25,** News Film. **9.35,** Tour de Farce. **10,** Interval Music. **10.25,** News.

* Items from the studio at Radiolympia.

Frequency Control with Quartz Crystals

WE have been asked by Radiomart, G5NI (Birmingham), Ltd., of 44, Holloway Head, Birmingham, to state that the booklet describing the application of quartz crystals for frequency control referred to on page 131 of our August 11th issue can only be supplied on the receipt of 7½d.

Theory into Practice

I.—SELECTION AND ARRANGEMENT OF COMPONENTS

By R. H. WALLACE

IN translating a theoretical design into a practical set many points arise in regard to the particular type of component to be used, and its disposition on the chassis. The consideration of these in relation to heat dissipation and to mechanical stability have already been dealt with in earlier articles and in this one and its sequel some of the electrical details will be treated.

FROM the circuit diagram we obtain the values of the components required and, generally, the particular valves round which the set has probably been designed; the value of a resistance or choke is, however, rarely enough fully to specify it, and the interrelation of the components is also important. With a resistance one has to consider whether to use a composition or a wire-wound type; the watts to be dissipated, if not given on the circuit diagram, are readily calculated from the valve currents and should be first determined. Then the position in the set must be considered. If the resistance is for voltage-dropping only then it need not be non-inductive, and any type is suitable; economy will probably decide in favour of the composition variety if the resistance is 50,000 ohms or over, unless the rating is over 5 watts. If under 20,000 ohms and with a low rating the wire-wound type of resistance might be chosen, as its value is more stable and the rating can be slightly exceeded without risk if good cooling is provided. Resistances of small dissipation and high value require such fine wire that they are readily damaged, unless of the protected kind. One advantage of the wire-wound resistance is that failure is sudden, whereas the composition type may, if overloaded, rise permanently in value to several times its nominal resistance. Such a fault is in many cases difficult to diagnose; on this account the rating of this type should not be exceeded.

Composition or Wire-wound Resistances?

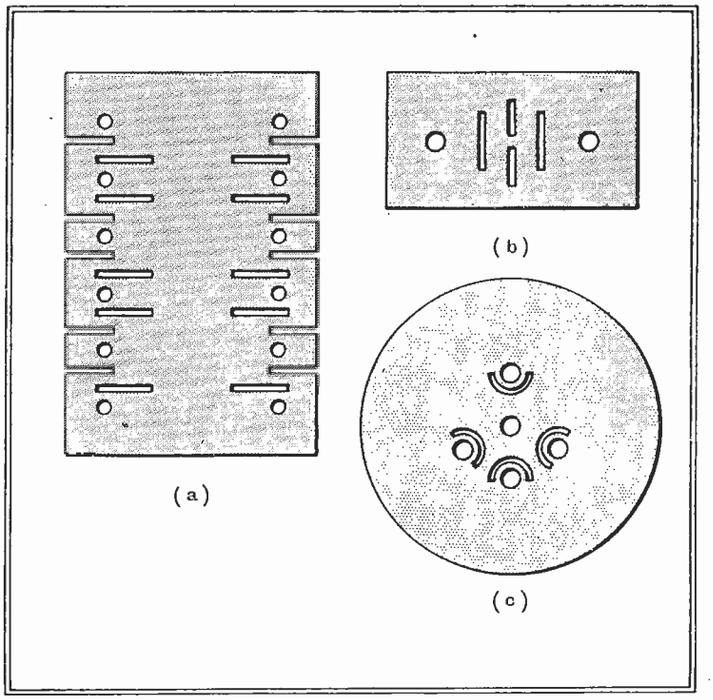
Where the resistance must be non-inductive, as is the case with grid leaks in all stages, RF stopping resistances and the potential dividers of the RF amplifier, then it is wise to adhere to the carbon or metallised kinds, as even supposedly non-inductive wire-wound ones do not retain this property at the higher frequencies. There are certain occasions when a tubular wire-wound component can be used also as an RF choke, as its inductance is enough for some short-wave circuits. The strip type of resistor is appreciably less inductive than the tubular sort.

The components associated with a diode or grid detector should be considered as forming part of both the RF and AF sections of the receiver, and should therefore be non-inductive.

In the AF amplifier such details as the resistances for preventing parasitic oscillation must be connected directly to the anode or grid terminal of the valve-holder concerned, and the same applies to those in the RF side of the set; non-inductive components are valueless if several inches of lead intervene between the part to be protected and the resistance concerned, and the higher the frequency the more necessary these precautions. A point that should not escape notice is that the temperature coefficients of the two types are opposite; that of wire is positive while composition has a negative coefficient; it follows therefore that a potential divider where the two are used will have a tapping ratio that varies with the current and the ambient temperature. Except in very special cases where this can be turned to account, potentiometers should be wholly of one or the other material.

Variable resistances, whether wire-wound or carbon, constitute one of the minor plagues of the designer's life. If the contact pressure is heavy, rapid attrition of the element takes place, while if this pressure is light the component tends to become noisy. By using a multiple stud switch and separate resistances for each step, one can avoid these troubles, but the result is not a compact assembly, and the cost puts this kind rather out of reach, except for large amplifiers and talkie apparatus.

Turning now to condensers, there is nowadays such a wide choice that the decision is sometimes an embarrassing one. In the RF amplifier fixed condensers below 0.01 mfd. should have mica or ceramic dielectric; the latter is preferable for the smaller ones, especially for short-wave work, as its temperature coefficient is very small. Mica, being a natural product, varies considerably in its properties, and the best makes are worth the extra cost. All the decoupling condensers throughout the RF amplifier must be non-inductive, but paper types are quite suitable for the larger capacities as long as this is guaranteed. As in the case of resistances, the leads to condensers should be very short or the good done by fitting a non-inductive component will be nullified; not more than one or two inches of wire ought to be used. Condensers of the early stages of a receiver are prone to capacity pick-up from other parts of the wiring, none of which should be led near them. To avoid excessive stray capacity, no grid or coupling condenser should be nearer than half an inch from a metal chassis.



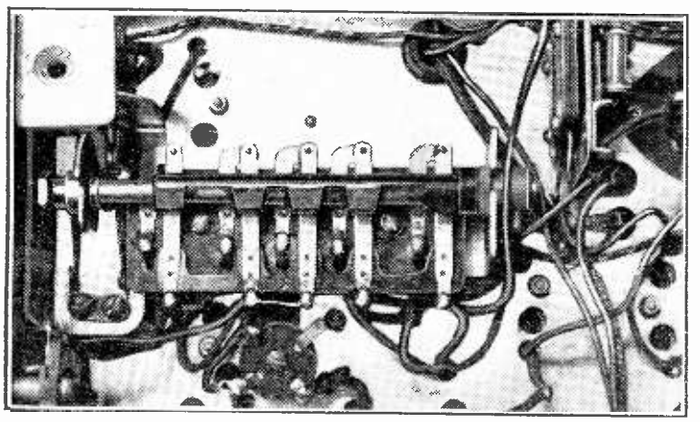
Reducing surface leakage by means of slots: (a) increasing the length of the surface path between rivets on an assembly board; (b) terminal mount for high voltages; (c) valve holder with high insulation between pins.

Electrolitic condensers used in the detector cathode circuit, or any other place where they may have to by-pass RF currents, will probably need a small non-in-

Theory into Practice—

ductive type connected in parallel. The writer has known several cases where detector stages were not stable until this was done, the residual inductance of the electrolitic type being evidently not small enough.

The losses in an air-spaced condenser, being confined to the supporting insulators, are smaller than with any other type, but the condenser is bulkier for the same capacity, and its stray capacity to earth and the other wiring is greater, so that it is not always possible to use this kind in compact sets. The higher the frequency the better does it show up and the more necessary it becomes to have as many air-spaced condensers as possible. Tuning condensers will naturally be of this type in all but the smallest sets, and the performance of the intermediate-frequency circuits is nearly always improved, both in efficiency and constancy, by their use.



The use of two separate assembly strips for the switch contacts considerably increases the length of the surface path in the "open" position; observe also the use of rubber grommets where high potential leads pass through the chassis.

The stability of the tuning condensers is of great importance, as the detuning of one of the circuits by a very small amount will lower the overall amplification of the amplifier by more than the amount due to ordinary incidental losses. In buying tuning condensers this point should be borne in mind and care taken that rigidity has not been sacrificed by undue reduction in the strength of the supporting insulators.

Low Leakage Essential

In the AF amplifier the coupling condensers of resistance-capacity stages must have very high leakage resistance, or the bias on the grid may be altered. If paper types are used they should have a high insulation value, and this is helped by using no larger a value than is necessary for the response required.

Tuning coils vary with the wavelength, from honeycomb and section wound for the longer, via the single-layer solenoid for medium wavelengths to the air-supported coils of a few turns used on the ultra-short-wave band. The kind of insulating material used for coil formers affects the self-capacity of the coil, and it is generally considered better not to impregnate the coil after winding, as any varnish used can hardly fail to raise the dielectric constant of the covering, and hence the self-capacity. In the case of coils for the very highest frequencies silver plating is a neat and efficient finish. It is preferable not to use insulating lacquers as they raise the losses.

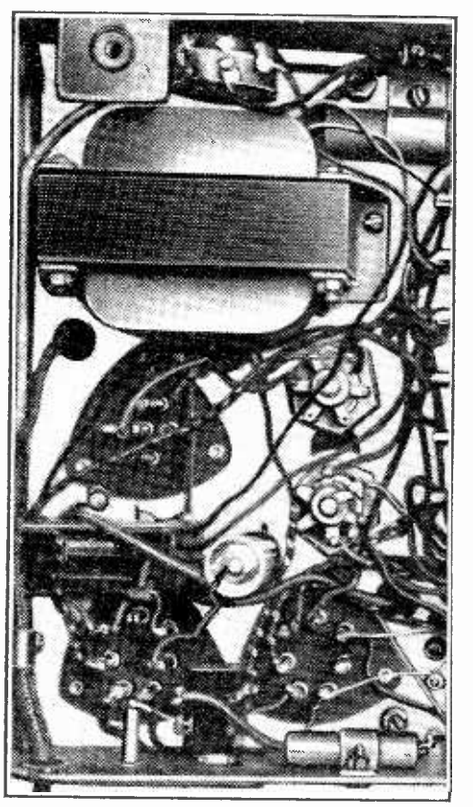
In the case of RF chokes there is again a wide divergency, according to the waveband involved. Coils of the highest inductance should be selected for use in the IF stages of superheterodynes, and at least 0.25 henry should be used. Lower values (around 0.1 henry) will be suitable for the anode circuits of triode grid detectors, but in both these positions the choke ought to be screened, and to keep the self-capacity at a low value it is much better if the windings are sectionalised. For use at the higher frequencies miniature section-wound types, unscreened, but on low-loss formers, are preferable, while for the really short wavelengths, single-layer chokes of small dimensions on ceramic formers are almost a necessity. At the ultra-short end of the spectrum a few unsupported turns formed in the lead provides all the inductance that is needed.

Each component of the set has fields, either magnetic or electric, associated with it, and these will link with those of other components and cause interaction; whether this is harmful or not will depend on the gain between the two points concerned. Naturally feed-back across two or more stages is especially serious, hence the arrangement of the chassis should be such that the output and input sections are well spaced, as less screening will then be needed.

Generally speaking there is the choice between the individual screening of the various components or the inclusion of the separate parts of the circuit in different sections of the chassis; in almost all cases the latter is the better method, as there is less modification of the characteristics of the components and better cooling, while at the same time a great deal of screening of the wiring is avoided. In the design of screening boxes a very close electrical contact along the seams, where these are unavoidable, is necessary, and it is better to solder or spot weld at a number of points where the material will permit this; when holes are needed to permit the passage of wires through the screen then it is better to make a few small ones than one larger one and especially to avoid the use of long slots. Where it is desirable to give ventilation but preserve screening then the use of wire gauze is recommended; so far as electrostatic pick-up is concerned gauze is, in nearly all cases, fully as efficient as a solid sheet, provided that the wires are all bonded together at the edges—a run of solder will ensure this. Ventilation is especially needed for the oscillator stages of superheterodynes, to prevent excessive drift of tuning, and gauze windows will help considerably in this. As regards the material of which the screens are made, the best, save for silver, is copper, and the next in order of efficiency is aluminium, but it is often cheaper to use steel of a greater thickness, and this has a much higher inductive screening effect. The only precaution that is necessary is to make really good electrical connections at all points of contact with the chassis, and this is much easier if the latter is plated with some conductor than if it is cellulosed.

Low-frequency Screening

The provision of satisfactory screening against magnetic interaction at audio-frequencies, and especially at the low hum frequencies, is more costly, and it is cheaper and better to position the parts so that the linkage is at a minimum in the absence of screening. For instance, RF chokes and those associated with tone-control devices are particularly liable to this trouble, and orientation of them in respect to the mains transformer and smoothing choke will generally be of advantage. Astatic windings help a lot to preserve a low hum level, and with the higher amplification of microphone circuits it is necessary not only to screen the whole of the leads, but also, in most cases, to



Leakage path to earth of valveholders is increased by the spacing of the fixing rivets well away from the valve pins, made possible by the special shape of the holder plate.

Theory into Practice—

enclose the microphone transformer in a cast-iron case at least ¼in. thick, or a correspondingly thinner Mumetal screen.

Feed-back at audio-frequencies is more often due to inductive than to capacitative interaction, and the amplification at AF being less than at radio frequencies, it is more easily avoided by careful positioning and the use of short leads. The author would put in a special plea for the thorough filtering of the IF or RF signals after the detector, since instability is often traced to leakage back of these from the audio stages of the set.

The better the low-note response of the set the more likely is AF feed-back to take place, and the more will the hum frequencies be passed on to the speaker. Even if this is not audible the presence of

The use of several separate small assembly boards and disposition of the larger components at the most suitable points reduces wiring and helps to prevent interaction by increasing the distances between various parts of the circuit.

these notes will tend to cause overloading of the output stage and so is undesirable.

The advantages of the double-deck construction, possible with console models, in separating the power equipment and speaker field from the earlier stages of the amplifier are considerable, and almost a necessity for luxury sets with good low-note response combined with very low hum levels. The use of this form of cabinet makes possible the provision of comprehensive tone control and the associated high-inductance chokes without noticeable pick-up of hum, a very difficult matter in a compact set. The axes of the transformers on the lower deck should be horizontal so as to reduce the vertical fields to the smallest value possible.

Insulating Material

Having dealt with leakage by induction and capacity interaction, there is yet another form of leakage to be considered, namely, that through or along the insulators of the set. With the majority of receivers, and except for the high voltages used in television, the insulation should be such that there will be negligible leakage through the various insulators, but this will not be so in the case of surface currents along the material when the receiver is dusty and the atmosphere is humid. Good design must allow for the worst of such conditions likely to occur, and this is why, at least in part, construction to tropical specifications is so much more expensive.

The surface leakage varies somewhat with the material and to a greater extent with the nature of the surface, since a polished one will afford much less opportunity for dust to settle, naturally the insulation cannot exceed that of the same length of air, but will rarely approach this unless dust is completely excluded, so that an improvement in the design of the component can afford a considerable increase in the insulation resistance. Often this can be done at little or no increased cost, as illustrated in the diagram.

It is the writer's opinion that a minimum surface path of ¼in. for each 250 volts is necessary with the best insulators, and under normal conditions; there are points in the set where this is rather on the low side. A place where special care is needed is the spacing of the grid and anode connections of resistance-capacity-coupled valves; here quite a small leak can have serious results. With transformer coupling the grid is almost short-circuited to earth, so far as DC voltages are concerned, and a small leakage will not vary the potential of the grid with respect to the cathode by an appreciable amount. In the RC coupled stage this is not so because of the grid leak, and such a leak as might occur between an anode and grid resistance on the same assembly strip may not only cause distortion, but, in the case of power valves, may decrease the valve life. A leakage path of 100 megohms with an anode voltage of 200 will raise the potential of a grid with a leak of one megohm by two volts; that is to say, the grid bias will be lessened by that amount, so the seriousness of the matter will be apparent. Similar remarks apply to valveholders, where again care in design can give long leakage paths with little or no increase in cost.

In the case of switches distinction must be made between those which deal with power applications in the set and the more numerous ones which are concerned with RF and AF currents. Both these kinds need just as good insulation as the valveholders and condensers, and, in addition, the losses will be decreased in proportion as the stray capacity in the switch is reduced, so that this should be as low as possible. The modern disc or wafer type of switch is eminently suitable for tuned-circuit use, and if the higher frequencies are to be dealt with it should have ceramic insulation; the contacts should be silvered. Similar considerations apply to radio-gramophone switches, and these should always be mounted near the valve to whose grid they are connected, the motion being transmitted, if necessary, by some mechanical device. These methods were dealt with in an earlier article and enable the switches to be placed so that short leads are ensured, while, at the same time, permitting a convenient arrangement of controls. In the case of controls of high-voltage apparatus, such as television sets, the spindles should have insulating couplings inserted between the control knob and the component to avoid risk of shock.

With power switches the problem is somewhat different, and arcing is one of the chief troubles. It is not, perhaps, always realised that the synthetic resin products are liable to a defect called "tracking," which is the formation of a low-resistance, almost conducting, path after an arc has been struck across the surface. If these materials are used, then the design should be such that any arc produced is not along the surface of the material, and rather more than the usual allowance for surface leakage should be made. The provision of ample contact surfaces is essential to reduce local heating, and to assist the insulation to retain its efficiency. Porcelain, where it can be used, or Steatite products, are especially suitable for switches of this type.

It is not possible, within the limits of an article, to deal more fully with the various components, each of which might well form the subject of an article itself, but it is the hope of the writer that some of the more important points have been dealt with and the first principles indicated.

BAIRD TELEVISION

AT a recent demonstration of Baird Television receivers the performance of their models reached a high standard. Receivers with 9in. and 12in. tubes gave bright pictures with extremely good detail and good synchronising.

The projection model, however, was outstanding in giving a good black-and-white picture with a tinge of sepia. The brightness, although lower than that of the small-tube models, was excellent, and even with a 24in. by 19in. picture it was found unnecessary to view in complete darkness. Even with quite a large amount of room lighting, the performance was exceedingly good.

A 5in. cathode-ray tube is used and the picture is projected on to the screen by means of an f/2 lens. Controls have been reduced to the minimum of a contrast control and sound volume control, and the broadcast receiver included is of the press-button type. The receiver is priced at 150 gns.

Voigt Loud Speaker Demonstration

DURING the period of the exhibition at Olympia demonstrations of the Voigt loud speaker will be given at 2, Beaconsfield Terrace Road, London, W.14, between the hours of 11 a.m. and 1 p.m., and again from 3 p.m. to 10.30 p.m. A high-grade gramophone reproducer will be available, and anyone interested may take his own test record during the morning periods and hear it played through the equipment.

Among new loud speaker units which will be shown is one giving fully distributed radiation without serious loss up to 10,000 cycles, and suitable amplifiers and a 7-metre quality receiver will also be available.

The Wireless World

How a Receiver is Designed.—XXIII.

Communication Receiver

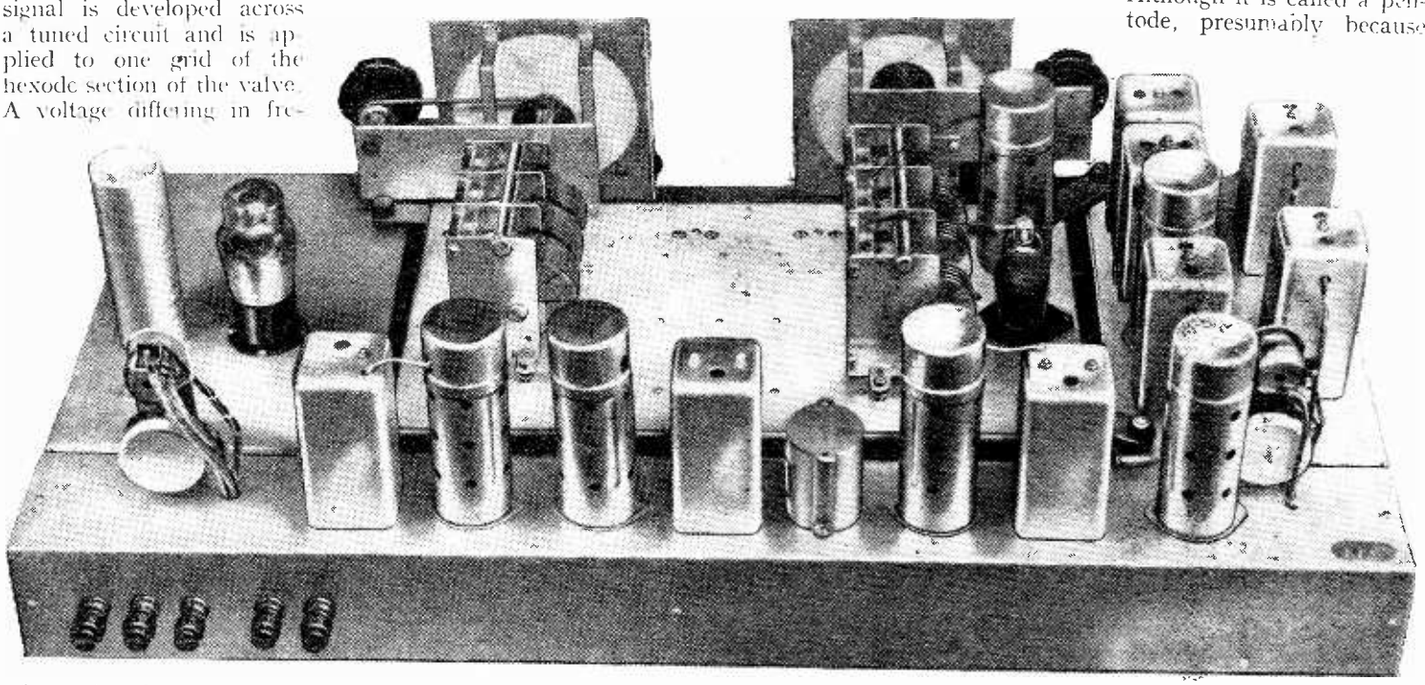
IN this article appears the first part of the constructional details of "The Wireless World" Communication Receiver, the design of which has been dealt with in earlier issues. The receiver covers 5.2-2,000 metres in eight bands and has three degrees of selectivity, manual RF and IF gain controls are fitted, AVC and the beat-frequency oscillator can be switched in and out at will, there are independent bass and treble tone controls, and push-pull resistance coupled AF amplification is used. The output is 7 watts.

ALL-WAVE TUNING SYSTEM

WHATEVER the wavelength of the incoming signal, the IF and AF amplifiers described last week function in the same way and remain unmodified. They constitute, in fact, a receiver built to receive signals on 465 kc/s only, and for general reception the tuning system must pick out the desired signal and convert it to this frequency.

The frequency-changer is of the triode-hexode type; the incoming signal is developed across a tuned circuit and is applied to one grid of the hexode section of the valve. A voltage differing in frequency by 465 kc/s is applied to another grid, and as a result of the mixing action in the valve a signal of 465 kc/s appears in its anode circuit. The triode section of the valve is used as an oscillator to generate the voltage required for frequency-changing.

If the frequency-changer were ideal, nothing more would be needed and we should have two tuned circuits only—one tuned to the incoming signal, and the other, for the oscillator, to a frequency 465 kc/s higher. A frequency-changer, however, introduces more valve hiss than an amplifier, and it is capable of producing output at the intermediate frequency in many different ways in addition to the correct one. Such spurious responses cause stations to be tunable at more than one dial setting, and if there are many stations they cause "superheterodyne" whistles.



A rear view of the complete receiver showing the tuner floating in the cut-out in the main chassis. The IF amplifier is in the foreground of the picture.

These unwanted responses must be avoided by the use of adequate pre-selection; in other words, sufficient selectivity must be provided at signal frequency. For this the circuits must be reasonably good and the ganging must be accurate. On the broadcast bands a single tuned circuit is often sufficient, but two are better, and two are almost essential on short waves. On ultra-short-waves more than two tuned circuits are desirable, but it is rarely possible to use more, largely for economic reasons. Fortunately, signals in general are so weak that the lower effective pre-selection causes little trouble; only on very strong signals indeed are repeat points noticeable.

We decide, therefore, to use two signal-frequency tuned circuits, and this fits in well with the measures which we must take to keep valve hiss at a minimum. As the frequency-changer introduces more hiss than an amplifier, it must be preceded by an amplifier giving sufficient gain to make the frequency-changer noise negligible in comparison with its own noise. Furthermore, the valve used in the amplifier must be chosen for minimum hiss.

Fortunately, a single stage will provide all the gain needed, and our two tuned circuits are consequently employed in the input to this valve and for the coupling between it and the frequency-changer. The valve we choose is one of the new low-noise RF pentodes—the EF8. Although it is called a pentode, presumably because it fulfils the usual function of an RF pentode, it is really a hexode.

The essential details of the switching and method of tuning have already been described, and we can turn right away to Fig. 26, which shows the complete circuit diagram of the tuner. Eight wavebands are provided with two gang condensers and two waveband switches. For ultra-short-wave reception, which in this case is taken to cover 5.2-16 metres, switches

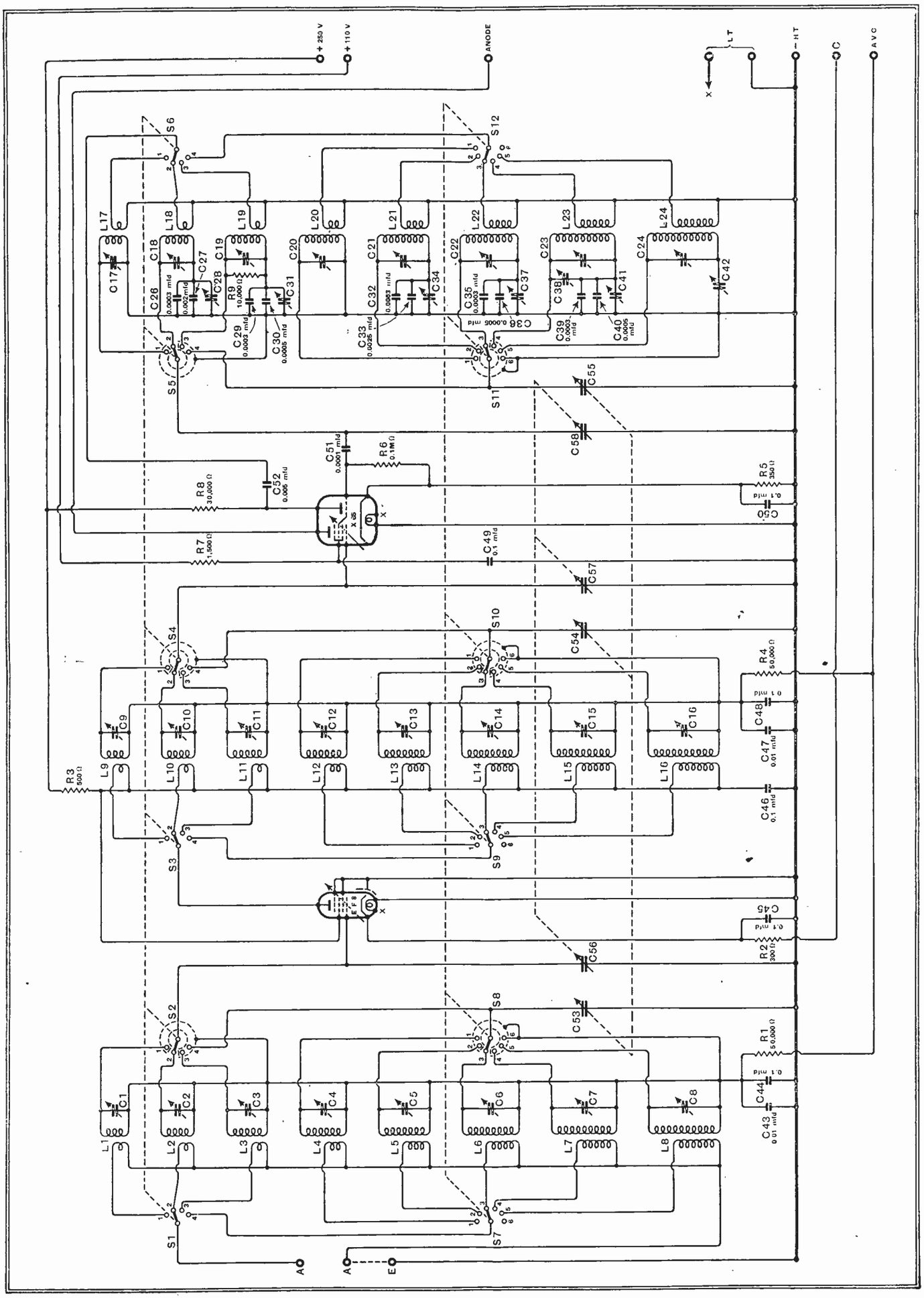
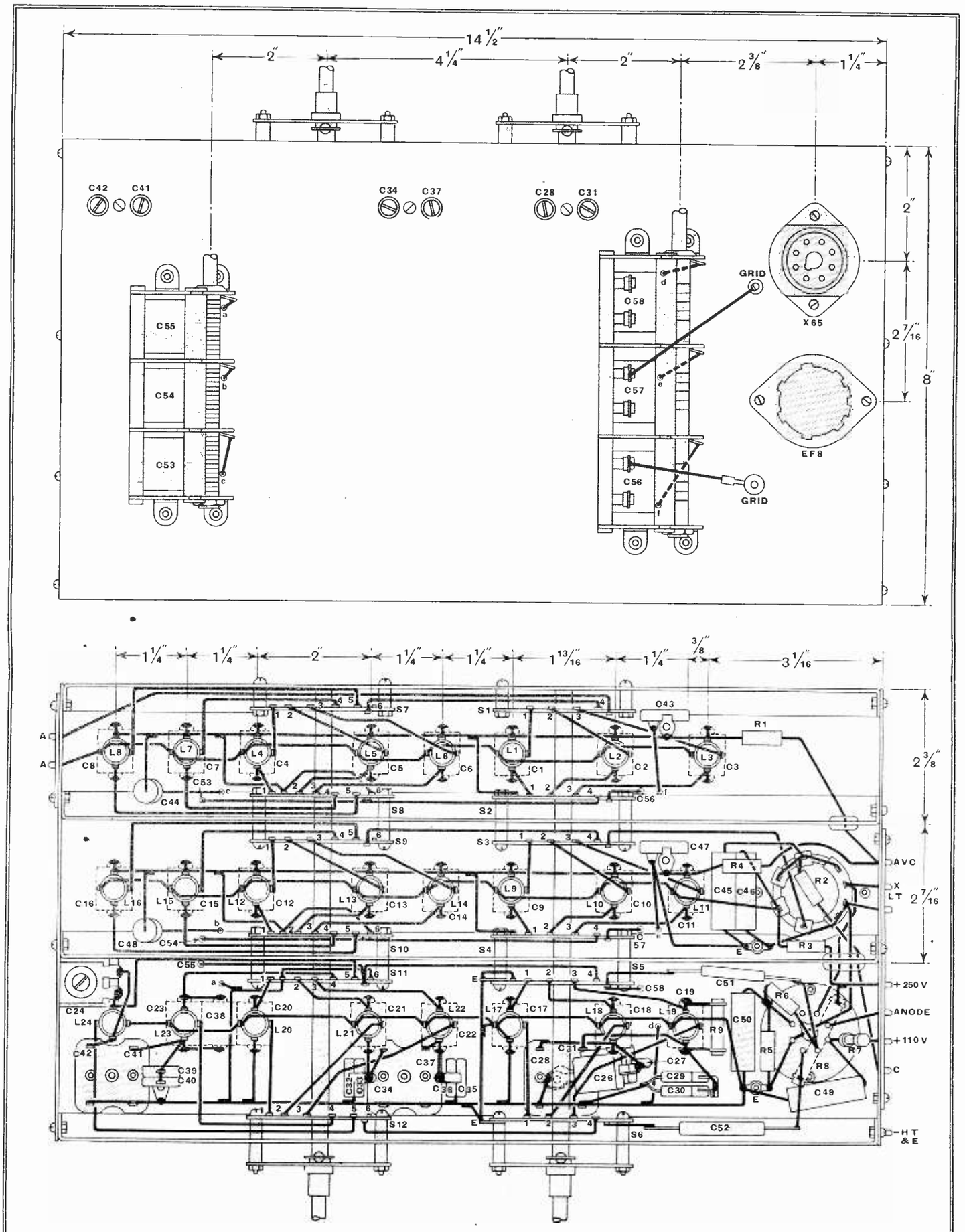


Fig. 26.—The complete circuit diagram of the tuner appears here. The switches S1, S2, S3, S4, S5, and S6 control the three ultra-short wavebands which are tuned by the gang condenser C56, C57 and C58. The remaining switches control the other five bands which are tuned by the larger gang condenser C53, C54 and C55. The other condenser is then available for band-spread.

THE TUNING UNIT



The layout and practical wiring diagram of the tuner chassis.

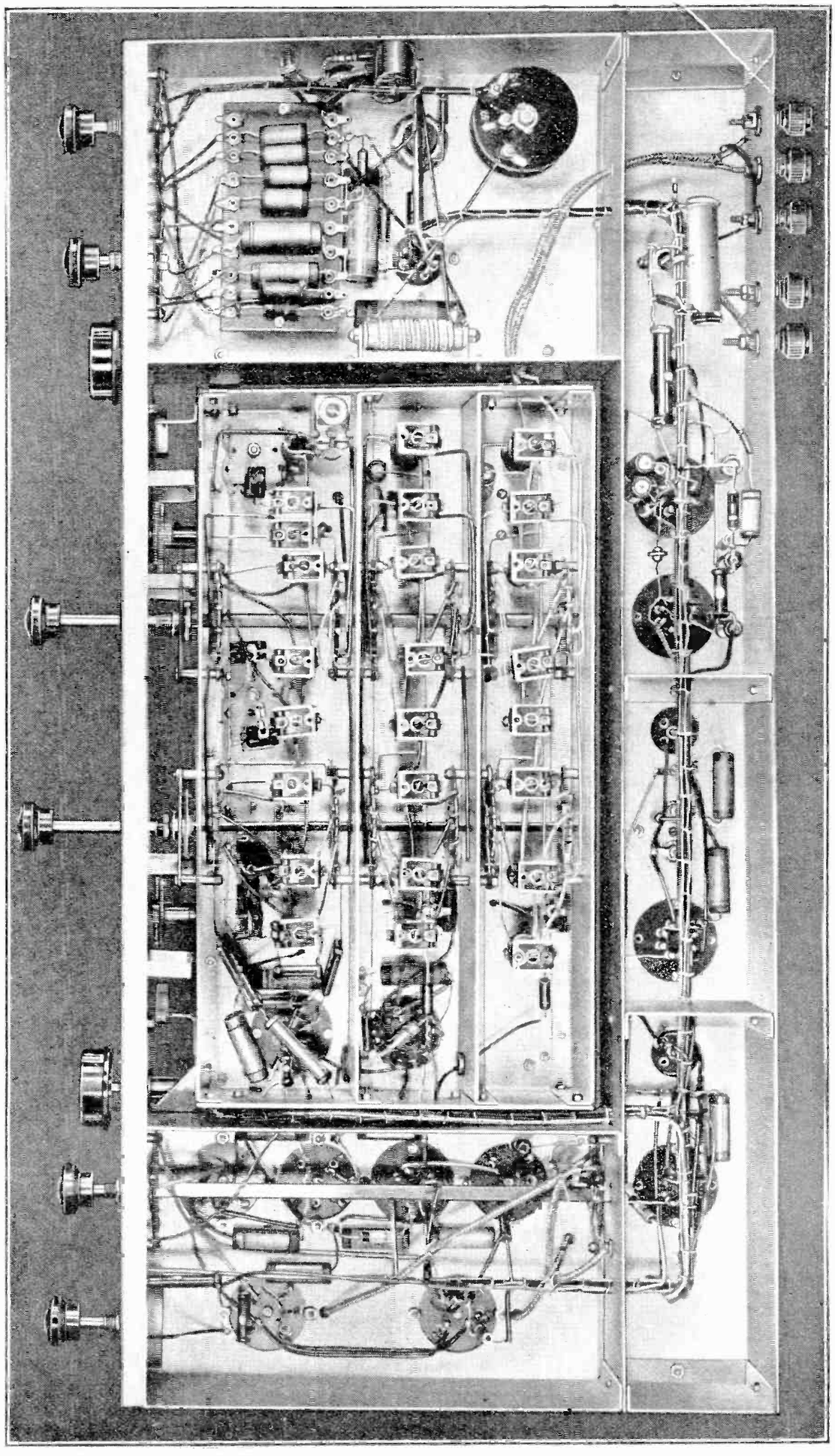
The Wireless World **Communication Receiver**—

S7, S8, S9, S10, S11, and S12 are all in position 6, and the other switch bank is set to position 1, 2 or 3, according to the particular band required. Tuning is then carried out on the dial controlling the small 60-$\mu\mu$F. condensers C56, C57 and C58. The other tuning control has no effect.

For all higher wavelengths S1, S2, S3, S4, S5 and S6 are set to position 4, and the other switch bank set to the required one of the five bands. These bands extend upwards from about 15 metres, and three of them are conveniently termed short-wave bands, although one of them extends up some distance into the medium waveband. This is because the medium waveband proper does not tune down as far as usual, but stops at about 220 metres, because it extends up to 600 metres at the other end instead of the usual 550 metres.

On all of these five bands tuning is carried out on C53, C54 and C55, the other condenser being set at zero. This is important. If it is not set at zero the tuning ranges will be abnormal, since on these bands the two condensers are in parallel. The small condenser is not without its uses, however, for on short waves it can be used as a bandspread condenser, and this makes tuning considerably less critical.

Examination of Fig. 26 will show that the circuit is quite straightforward, and, apart from the duplication of variable condensers and switches, follows normal practice. AVC is applied to both RF and FC valves through the 50,000-ohm resistances R1 and R4 the decoupling condensers

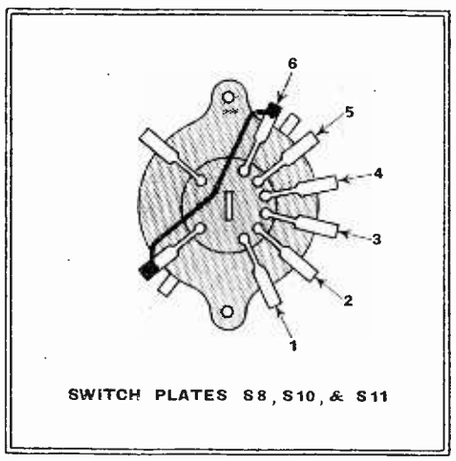


In this photograph of the underside of the receiver it will clearly be seen how the different units which form the whole chassis are grouped around the tuning system.

The Wireless World Communication Receiver—

are duplicated, since they form part of the tuned circuits. In the first circuit, for instance, a 0.1 μF. condenser, C44, is used, and is intended chiefly for the long, medium, and longer short waves. It is shunted by the 0.01-μF. mica-type condenser C43, since this is more effective on ultra-short waves. Similarly, in the intervalve circuit two condensers, C46 and C47, are used.

Each signal-frequency coil assembly has two windings—the tuned secondary and a primary. On short and ultra-short waves all windings are solenoids, and on most bands the primary and secondary are interwound; on the higher wavelengths, however, the primaries are overwound on the earthy ends of the secondaries. On the medium waveband the tuned windings are of the machine-wound two-bank type, and the primaries are similarly wound and suitably spaced. The so-called large primaries are not used because of the risk of break-through of signals operating at the intermediate frequency, for on the medium waveband large primaries usually resonate around 465 kc/s. On the long waveband, however, the possibility of this trouble arises with small primaries, and large primaries are accordingly used here. Each of the



SWITCH PLATES S8, S10, & S11

Face-view of the switch plates, showing the cross-connection.

sixteen signal-frequency coils has its own parallel trimmer mounted on the coil itself.

Turning now to the oscillator, the arrangement is very similar, but the reaction coils are in most cases wound with resistance wire to reduce any chance of parasitic oscillation. The inductances are smaller than those of the signal-frequency circuits, and, in addition to the parallel trimmers, padding condensers are included on six of the eight bands. On bands 1 and 4 the capacity required is so large that it has a negligible effect and it can be omitted.

The parallel capacity on band 7 (medium waves) is larger than can be obtained in one of the small trimmers used in the other circuits; two are accordingly connected in parallel, and it is intended that one be screwed up fully and the other only used for adjustment. On long waves still more capacity is needed, and here a different type of trimmer proves suitable.

The padding capacities in most cases consist of two fixed and one adjustable condenser is parallel. Two fixed condensers are used merely because the required value is non-standard.

In the drawings which accompany this

THE LIST OF PARTS REQUIRED FOR BUILDING "THE WIRELESS WORLD" COMMUNICATION RECEIVER

TUNER

1 **Set of 24 coils** — **Sound Sales SCR1-24**
1 **Variable condenser**, 3-gang, 0.0005 mfd. — **Polar C1703**
1 **Variable condenser**, 3-gang, 60 mmfds. — **Polar C1705**
2 **Dials**, geared slow motion — **Peto-Scott**
1 **Valve holder**, 8-pin, octal type — **Clix V4**
1 **Valve holder**, 8 contact — **Bulgin VH24**
24 **Trimmers**, 30 mmfds. — **Eddystone 1023**
1 **Trimmer**, 160 mmfds. — **Bulgin CP2**
1 **Double trimmer**, 150-550 mmfds. — **Polar 55**
2 **Double trimmers**, 250-650 mmfds. — **Polar 66**
1 **Valve screen**, small octal type — **B.T.S.**
1 **Grid clip**, octal type — **Bulgin P96**
1 **Plug top valve connector** — **Belling-Lee 1175**

Fixed condensers:

3 0.0005 mfd., mica	T.C.C. "M"
5 0.0003 mfd., mica	T.C.C. "M"
1 0.0001 mfd., mica	T.C.C. "M"
1 0.0025 mfd., mica	T.C.C. "M"
1 0.002 mfd., mica	T.C.C. "M"
1 0.005 mfd., mica	T.C.C. "M"
2 0.01 mfd., mica	T.C.C. "M"
6 0.1 mfd., tubular	T.C.C. 341

Resistances:

1 300 ohms, ½ watt	Erie
1 350 ohms, ½ watt	Erie
1 500 ohms, ½ watt	Erie
1 1,500 ohms, ½ watt	Erie
1 10,000 ohms, ½ watt	Erie
2 50,000 ohms, ½ watt	Erie
1 100,000 ohms, ½ watt	Erie
1 30,000 ohms, 1 watt	Erie

Chassis, fitted with switches and knobs, complete with screws, etc. — **B.T.S.**

Miscellaneous: — **Peto-Scott**
2 Lengths systoflex, 1 oz. each Nos. 18 and 22 tinned copper wire, etc.

Valves:
1 **X65** — **Osram**
1 **EF8** — **Mullard**

RECEIVER

5 **IF transformers**, 465 kc/s — **Varley BP124**
1 **Inter-IF coupler**, 465 kc/s — **B.T.S. WW/IFA**
1 **IF-Det. coupler**, 465 kc/s — **B.T.S. WW/IFB**
1 **Coil assembly** — **B.T.S. WW/BFO**
2 **DP switches**, 5-way, with knobs and locators — **B.T.S. C125**
1 **3-way locator plate with 9¼in. drive bar, 2 switch banks, 2-pole 3-way and knob** — **B.T.S. B123**
2 **Potentiometers**, wire wound, 10,000 ohms — **Reliance TW**
1 **Potentiometer**, tapered, 2 megohms — **Reliance SG**
1 **Switch**, rotary type, DPDT — **Bulgin S114**
1 **Switch**, rotary type, DPST — **Bulgin S115**
4 **Shaft couplers** — **Bulgin 2005**
2 **10½in. lengths and 2 11in. lengths ¼in. rod** — **Bulgin**
1 **Resistance group board**, 10-way — **Bulgin C32**
6 **Valve holders**, 8-pin, octal type — **Clix V4**
5 **Valve screens**, small octal type — **B.T.S.**
4 **Grid clips**, octal type — **Bulgin P96**
1 **Correction choke**, 1.3 H. — **B.T.S. WW3**
1 **Connector**, 5-way — **Bryce 5C4**
1 **Plug**, 7-pin — **Bulgin P37**
5 **Knobs** (black), ¼in. — **B.T.S.**

Fixed condensers:

1 0.0003 mfd., tubular	T.C.C. 451
1 0.0005 mfd., tubular	T.C.C. 451
2 0.005 mfd., tubular	T.C.C. 451
1 0.002 mfd., tubular	T.C.C. 451
1 0.01 mfd., tubular	T.C.C. 451
1 0.015 mfd., tubular	T.C.C. 451
2 0.05 mfd., tubular	T.C.C. 341
14 0.1 mfd., tubular	T.C.C. 341
1 0.2 mfd., tubular	T.C.C. 341
1 0.5 mfd., tubular	T.C.C. 341
1 50 mfds., 12 volts, electrolytic	Dubilier 3016
1 8 mfds., 500 volts, electrolytic	Dubilier 0281
1 1 mmfd., ceramic	T.C.C.

4 **Panel bushes**, ¼in. bore — **Bulgin 1048**

Resistances:

2 300 ohms, ½ watt	Erie
7 500 ohms, ½ watt	Erie
1 1,500 ohms, ½ watt	Erie
1 4,000 ohms, ½ watt	Erie
1 7,500 ohms, ½ watt	Erie
1 10,000 ohms, ½ watt	Erie
1 20,000 ohms, ½ watt	Erie
6 50,000 ohms, ½ watt	Erie
2 100,000 ohms, ½ watt	Erie
1 250,000 ohms, ½ watt	Erie
1 500,000 ohms, ½ watt	Erie
1 100,000 ohms, 1 watt	Erie
1 10,000 ohms, 2 watts	Erie
1 9,000 ohms, 3 watts	Erie
1 1,500 ohms, 20 watts	Bulgin PR6

5 **Terminals**, ebonite shrouded, A(2), E(1), PU(2) — **Belling-Lee "B"**
1 **RF Choke** — **Bulgin HF10**
3 **Lengths screened sleeving** — **Goltone**
Chassis and Panel, complete with screws, etc. — **B.T.S.**

Miscellaneous: — **Peto-Scott**
6 lengths systoflex; 2 ozs. each Nos. 18 and 22 tinned copper wire, etc.

Valves:
1 **KTZ63, 3 KTW63, 1 D63** — **Osram**
1 **6N7** — **Premier Supply Stores**

POWER UNIT

1 **Mains transformer**, Primary 200-250 volts, 50 c/s., screened. Secondaries: 4 volts, 2 amps., C.T.: 6.3 volts, 4 amps; 5 volts, 3 amps; 350-0-350 volts, 150-160mA. — **Savage WW51**
1 **Choke**, 10H., 150 mA., 100 ohms — **Sound Sales 10/250/H**
1 **Choke**, 20H., 50 mA., 400 ohms — **Bulgin LF14S**
2 **Valve holders**, 4-pin (without terminals) — **Clix Chassis Mounting Standard Type V1**
1 **Valve holder**, 7-pin (without terminals) — **Clix Chassis Mounting Standard Type V2**
3 **Valve holders**, 8-pin, International octal type — **Clix V4**

Fixed condensers:

1 0.01 mfd., tubular	T.C.C. 451
4 0.1 mfd., tubular	T.C.C. 341
3 8 mfds., 500 volts, electrolytic	Dubilier 0281
1 4 mfds., 500 volts, electrolytic	Dubilier 0283
1 50 mfds., 50 volts, electrolytic	Dubilier 3004

Resistances:

2 50 ohms, ½ watt	Erie
1 1,000 ohms, ½ watt	Erie
1 1,200 ohms, ½ watt	Erie
1 9,000 ohms, ½ watt	Erie
3 10,000 ohms, ½ watt	Erie
2 100,000 ohms, ½ watt	Erie
4 250,000 ohms, ½ watt	Erie
1 2 megohms, ½ watt	Erie
1 40,000 ohms, 1 watt	Erie
1 500 ohms, 20 watts	Bulgin PR2

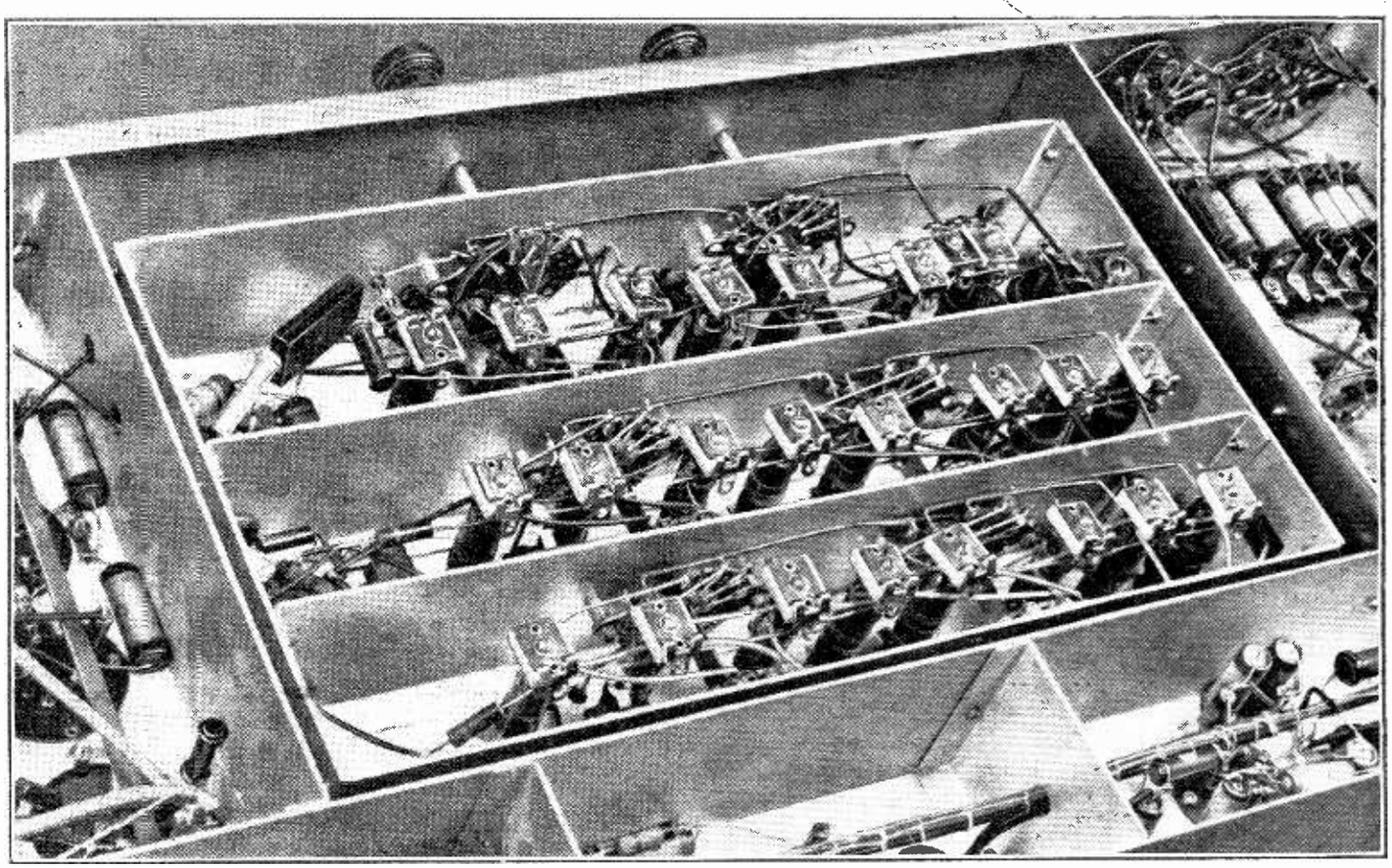
1 **Fused mains input connector** with 2 amp. fuses — **Belling-Lee 1114**
1 **Plug and socket**, 3-pin — **Belling-Lee 1119**
1 **Grid clip**, octal type — **Bulgin P96**
Chassis, complete with screws, etc. — **B.T.S.**

Miscellaneous: — **Peto-Scott**
3 lengths systoflex, 1 oz. No. 20 tinned copper wire, etc.

Valves:
2 **PX4, 1 KTZ63, 1 U52** — **Osram**
1 **6N7** — **Premier Supply Stores**

The Wireless World **Communication Receiver**—article the construction and wiring of the tuner are clearly shown, and the importance of following them in detail must be emphasised. It is too often the habit to think that as long as the correct points are joined, nothing else matters, but in actual fact the length and position of leads become increasingly important as the oper-

A receiver built to the design described in this series of articles is to be seen on "The Wireless World" Stand (No. 6) at the Olympia Show.



In this underview of the tuner the arrangement of the coils and switching can clearly be seen. The RF section is in the middle with the oscillator compartment at the back (front of tuner).

ating frequency increases. Remember that the inductance of the wiring is appreciable—on band 1 it probably exceeds the inductance of the coil! To use long leads here would be equivalent to winding the coil with too many turns.

There are other things, too. The precise points for earth connections must be retained. A common earthy bus-bar is used in each compartment; it is quite satisfactory to return each circuit to convenient points along it, but do not return different earthy leads from one circuit to different points. All earthy leads from any one short-wave circuit *must* be returned to the same point on the bus-bar.

The temptation to err will occur in the oscillator circuit where a bus-bar connects all the variable padding condensers, while the fixed padding condensers are mounted between the coils and the bus-bar. The neatest wiring job is obtained by taking these condensers to points on the bus-bar immediately opposite the appropriate coils. Experience shows that the padding capacity is almost completely ineffective if this is done. It is most important that all the padding condensers in one circuit be returned to the bus-bar at one and the same point.

The construction of the tuner is by no means difficult, but care must be taken. Awkward leads, such as the earthing wires to some of the switch plates, should be connected before the coils are mounted, and the fitting of the gang condensers should be left until the end is neared. All connections within the tuned circuits should be made with No. 18 wire, but the more conveniently handled No. 22 is suitable for the other circuits, including the connections to the primaries.

(Further details on the construction of this receiver will follow in next week's issue.)

News from the Clubs

Romford and District Amateur Radio Society

Headquarters: Red Triangle Club, North Street, Romford.
Meetings: Tuesdays at 8 p.m.
Hon. Sec.: Mr. R. C. E. Beardow, 3, Geneva Gardens, Chadwell Heath.

Recent activities have included participation in the DF competition organised by the Brentwood Society and a technical "bee" in which questions were asked and were answered by members called upon to do so. The Club ran a stall at a recent fête at which the funds were augmented by a competition in which participants had to guess the length of wire upon a conical former.

Newcastle and District Short-wave Club

Hon. Sec.: Mr. K. Scott, 1, Farquhar Street, Newcastle-on-Tyne, 2.

The Club has now decided to devote all its attention to short-wave work, and a full programme is being arranged for next winter. A meeting will be held at the Hon. Secretary's address at 6 p.m. on September 4th, at which anybody interested will be welcomed.

Radio, Physical and Television Society

Headquarters: 72a, North End Road, London, W.14.
Meetings: Fridays at 8.15 p.m.
Hon. Sec.: Mr. C. W. Edmans, 72a, North End Road, London, W.14.

Visits have been arranged to Beckton Gas Works, The Royal College of Surgeons, the Main London Telegraph Office of Cables and Wireless, Ltd., and the Battersea Power Station.

It may be possible to find room in the parties for one or two non-members. Readers who would care to join any of them should apply to the Hon. Secretary stating in which visit they are interested. Applications will be dealt with in strict rotation.

Weymouth and District Short-wave Club

Headquarters: 15a, Hope Street, Weymouth.
Meetings: Wednesdays at 8 p.m.
Hon. Sec.: Mr. E. Kestin, 55, St. Mary Street, Weymouth.

Club news is radiated from G2XQ on 160 metres at 10 a.m. and from G8WQ (the club's HQ) on 20 metres at 10.30 a.m. every Sunday. Reports will be welcomed.

On August 10th, a visit was paid to the G.P.O. CSW station at East Chaldon, where communication is carried on with Guernsey. It is interesting to note that signals from the Alexandra Palace, 120 miles away, have been received at this station.

A field day is to be arranged shortly.

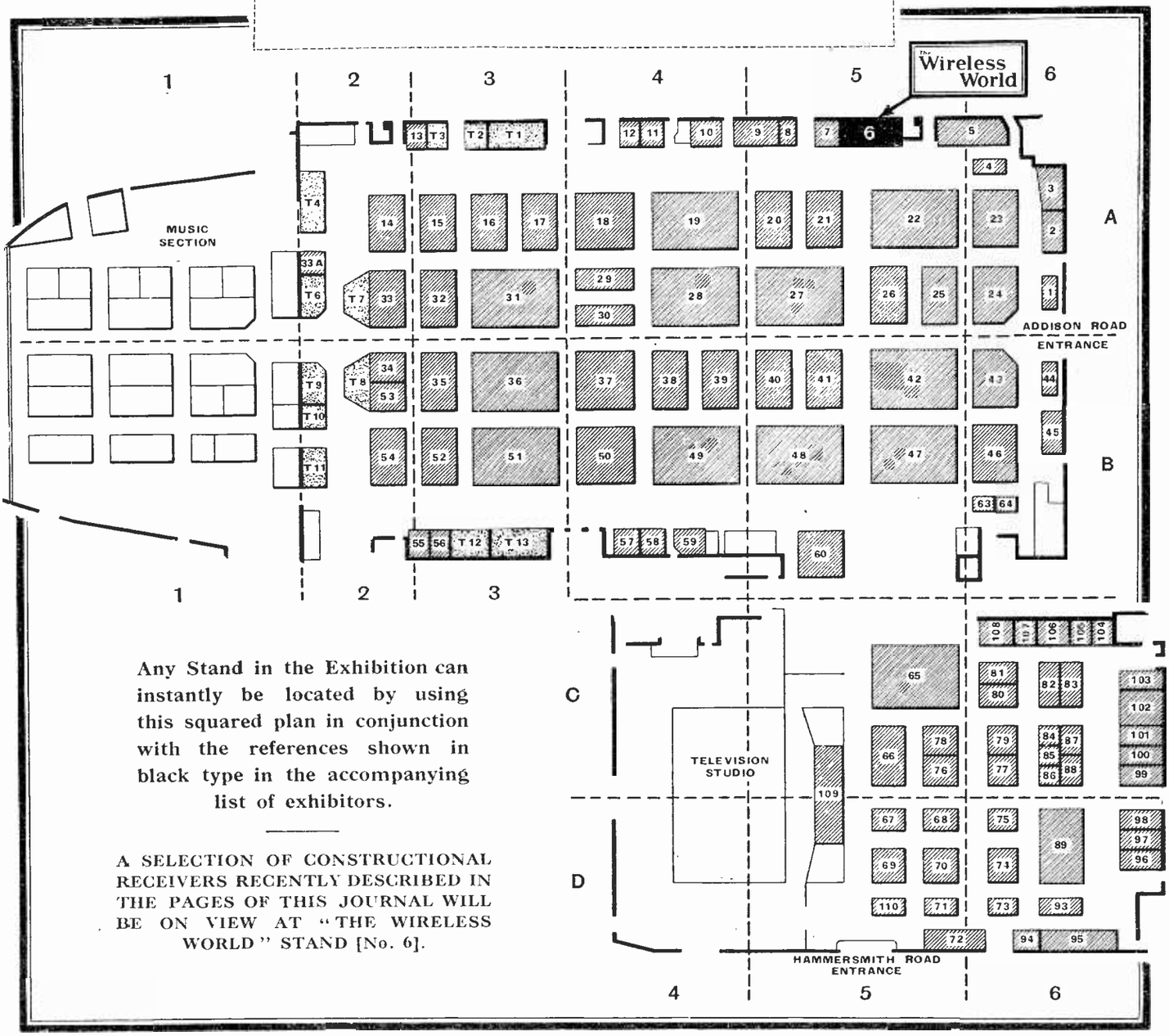
Exhibitors at Olympia

ALPHABETICAL LIST WITH STAND NUMBERS AND REFERENCES TO THE PLAN ON THE OPPOSITE PAGE

Name.	Stand.	Reference.
Armstrong Manufacturing Co. 100, King's Road, Camden Town, N.W.1.	88	C 6
Automatic Coil Winder & Elec. Equip. Co., Ltd. Winder House, Douglas Street, S.W.1.	21	A 5
Autotrope, Ltd. 4, Bruton Street, Berkeley Square, W.1.	79	C 6
Baird Television, Ltd. Worsley Bridge Rd., Lower Sydenham, S.E.26.	19	A 4
Balcombe, A. J., Ltd. 52–58, Tabernacle Street, E.C.2.	40	B 5
Beethoven Electric Equipment, Ltd. Chase Road, North Acton, N.W.10.	38	B 4
Belling & Lee, Ltd. Cambridge Arterial Road, Enfield, Middlesex.	4 & 5	A 6
Bird, Sydney S., & Sons, Ltd. Cambridge Arterial Road, Enfield, Middlesex.	102	C 6
Britannia Batteries, Ltd. Union Street, Redditch, Worcs.	52	B 3
British Belmont Radio, Ltd. 1–5, Ridgemount Street, W.C.1.	23	A 6
British Mechanical Productions, Ltd. 79A, Rochester Row, S.W.1.	107	C 6
British Pix Co., Ltd. Pix Works, Lillieshall Road, S.W.4.	82	C 6
British Rola Co., Ltd. Minerva Road, Park Royal, N.W.10.	108	C 6
British Tungsram Radio Works, Ltd. West Road, Tottenham, N.17.	20	A 5
Brown Bros., Ltd. Great Eastern Street, E.C.2.	T. 13	B 3
Bulgin, A. F., & Co., Ltd. Abbey Road, Barking, Essex.	72	D 5
Burndept, Ltd. Light Gun Factory, Erith, Kent.	43	B 6
Bush Radio, Ltd. Power Road, Chiswick, W.4.	28	A 4
Carr Fastener Co., Ltd. Finsbury Court, Finsbury Pavement, E.C.2.	98	D 6
Celestion, Ltd. London Road, Kingston-on-Thames, Surrey.	95	D 6
Chloride Electrical Storage Co., Ltd. Clifton Junction, Nr. Manchester.	15	A 3
Cole, E. K., Ltd. Ekco Works, Southend-on-Sea, Essex.	48	B 5
Cosmocord, Ltd. Cambridge Arterial Road, Enfield, Middlesex.	67	B 4
Cossor, A. C., Ltd. Cossor House, Highbury Grove, N.5.	42	B 5
Davies, D. M. (Slough), Ltd. Trading Estate, Slough, Bucks.	13	A 3
Davis & Timmins, Ltd. Brook Road, Wood Green, N.22.	96	D 6
De la Rue, Thos., & Co., Ltd. 90, Shernhall Street, E.17.	11	D 4
Dew, A. J., & Co., Ltd. 32–34, Rathbone Place, W.1.	T. 6	A 2
Dibben, Horace, Ltd. 34, Carlton Crescent, Southampton.	T. 3	A 3
Dubilier Condenser Co. (1925), Ltd. Ducon Works, Victoria Rd., North Acton, W.3.	69	D 5
Dynatron Radio, Ltd. Perfecta Works, Ray Lea Road, Maidenhead, Berks.	1 & 44	A 6 & B 6
E.M.I. Service, Ltd. Sheraton Works, Hayes, Middlesex.	60	B 5
Eastick, J. J., & Sons Eelex House, 118, Bunhill Row, E.C.1.	T. 8	B 2
East London Rubber Co., Ltd. 29–33, Great Eastern Street, E.C.2.	T. 9	B 2
Edison Swan Electric Co., Ltd. 155, Charing Cross Road, W.C.2.	18	A 4
Everett, Edgecumbe & Co., Ltd. Colindale Works, Hendon, N.W.9.	55	B 3
Ferguson Radio Corporation, Ltd. 105–109, Judd Street, W.C.1.	32	A 3
Ferranti, Ltd. Radio Works, Moston, Manchester, 10.	14	A 2
Fuller Accumulator Co. (1926), Ltd. Woodland Works, Chadwell Heath, Essex.	57	B 4
Garrard Engineering & Manufacturing Co., Ltd. Newcastle Street, Swindon, Wilts.	25	A 5
General Electric Co., Ltd., The Magnet House, Kingsway, W.C.2.	39 & 49	B 4
Goodmans Industries, Ltd. Lancelot Road, Wembley, Middlesex.	3	A 6
Gramophone Co., Ltd. 98–108, Clerkenwell Road, E.C.1.	47 & M. 1	B 5 & A 1
Heayberd, F. C., & Co. 10, Finsbury Street, E.C.2.	2	A 6
Higgs, Charlton (Radio), Ltd. Edward Street, Dudley Hill, Bradford.	85	C 6
High Vacuum Valve Co., Ltd. 111–117, Farringdon Road, E.C.1.	103	C 6
Hobday Bros., Ltd. 21–27, Great Eastern Street, E.C.2.	T. 12	B 3
Hunt, A. H., Ltd. Bendon Valley, Garratt Lane, Wandsworth, S.W.18.	12	A 4
Invicta Radio, Ltd. St. Andrew's Road, Cambridge.	17	A 3
Kolster-Brandes, Ltd. Cray Works, Sidcup, Kent.	41	B 5
Linkafone, Ltd. 118, Hill Road, Pinner, Middlesex.	84	C 6
Lugton & Co., Ltd. 203, Old Street, E.C.1.	T. 7	A 2
McMichael Radio, Ltd. Wexham Road, Slough, Bucks.	24	A 6
Manufacturers' Accessories Co. (1928), Ltd. 85, Great Eastern Street, E.C.2.	T. 10	B 2
Marconi-Ekco Instruments, Ltd. Electra House, Victoria Embankment, W.C.2.	33	A 2
Marconiphone Co., Ltd. 210-212, Tottenham Court Road, W. 1.	54 & 65	B 2 & C 5
Masteradio, Ltd. 1, Newton Street, High Holborn, W.C.2.	86	C 6
Morris & Co. (Radio), Ltd. 167, Lower Clapton Road, E.5.	74	D 6
Mullard Wireless Service Co., Ltd. 225, Tottenham Court Road, W.1.	29, 30 & 99	A 4 & C 6
Murphy Radio, Ltd. Broadwater Rd., Welwyn Garden City, Herts.	27	A 5
National Band Gramophone Co. 22-23, Clerkenwell Close, E.C.1.	T. 2	A 3
New London Electron Works, Ltd. East Ham, E.6.	34	B 2
Philips Lamps, Ltd. 145, Charing Cross Road, W.C.2.	51	B 3
Pilot Radio, Ltd. 87, Park Royal Road, N.W.10.	37	B 4
Plessey Co., Ltd. Vicarage Lane, Ilford, Essex.	71	D 5
Pye, Ltd. Radio Works, Cambridge.	31	A 3
Radio-Aid, Ltd. 45, Duke Street, W.1.	94	D 6
Radio Gramophone Development Co., Ltd. Globe Works, Newtown Row, Birmingham, 6.	36	B 3
Radio Society of Great Britain 53, Victoria Street, S.W.1.	10	A 4
Regentone Products, Ltd. Worton Road, Isleworth, Middlesex.	45	B 6

Name.	Stand.	Reference.
Rose, Norman (Electrical), Ltd. .. .. .. 43, Lamb's Conduit Street, W.C.1.	87	C 6
Rothermel, R. A., Ltd. .. .. Rothermel House, Canterbury Road, N.W.6.	80	C 6
Scophony, Ltd. .. .. Thornwood Lodge, Campden Hill, W.8.	22	A 5
Scott Insulated Wire Co., Ltd. .. .. .. Queensland Works, Westmoreland Rd., N.W.9.	8	A 5
Selecta Gramophones, Ltd. .. .. .. 81, Southwark Street, S.E.1.	T. 11	B 2
Siemens Electric Lamps & Supplies, Ltd. .. 38 39, Upper Thames Street, E.C.4.	16	A 3
Steatite & Porcelain Products, Ltd. .. .. Stourport-on-Severn, Worcs.	76	C 5
Sterling Batteries, Ltd. .. .. Sterling Works, Dagenham, Essex.	59	B 4
Stratton & Co., Ltd. .. .. Eddystone Wks., Bromsgrove St., Birmingham.	77	C 6
Tannoy Products .. .. Canterbury Grove, West Norwood, S.E.27.	79	D 5
Telegraph Condenser Co., Ltd. .. .. .. Wales Farm Road, North Acton, W.3.	81	C 6
Telegraph Construction & Maintenance Co., Ltd. Telcon Works, Greenwich, S.E.10.	78	C 5
Thompson, Diamond & Butcher .. .. 34, Farringdon Road, E.C.1.	T. 1 & T. 2	A 3
Tucker, George, Eyelet Co., Ltd. .. .. Cuckoo Road, Birmingham, 7.	58	B 4
Ultra Electric, Ltd. .. .. Western Avenue, Acton, W.3.	50	B 4
Vacuum Science Products, Ltd. .. .. 166, Weir Road, Balham, S.W.12.	105	C 6
Vidor, Ltd. .. .. West Street, Erith, Kent.	46	B 6
Westinghouse Brake & Signal Co., Ltd. .. 82, York Road, King's Cross, N.1.	35	B 3
Weston Electrical Instrument Co., Ltd. .. Cambridge Road, Enfield, Middlesex.	83	C 6
Whiteley Electrical Radio Co., Ltd. .. .. Victoria Street, Mansfield, Notts.	26	A 5
Wingrove & Rogers, Ltd. .. .. .. Arundel Chambers, 188-189, Strand, W.C.2.	106	C 6

Guide to the Stands



Any Stand in the Exhibition can instantly be located by using this squared plan in conjunction with the references shown in black type in the accompanying list of exhibitors.

A SELECTION OF CONSTRUCTIONAL RECEIVERS RECENTLY DESCRIBED IN THE PAGES OF THIS JOURNAL WILL BE ON VIEW AT "THE WIRELESS WORLD" STAND [No. 6].

Olympia Show Report

IN the following pages we give a classified description of the newer productions of the British broadcast industry as shown at Olympia. Readers will find that, so far as "sound" receivers are concerned, developments are largely directed towards greater ease of control, and also that those technical features that were introduced in more or less experimental form a few years ago have been improved, generally in the direction of greater simplicity and consequently improved reliability. In the field of television, one of the highlights of the show is the introduction of small-screen televisors. Components and accessories are dealt with under appropriate headings in this Report, where the latest productions of these branches of the industry are described.

The New Receivers

FOR the convenience of readers, the new receivers chosen for inclusion in this report have been classified into price categories. It should be realised that in many cases where table models are described there are also consoles and radio-gramophones with a similar chassis, sometimes modified by the fitting of an output stage of higher power and a larger speaker. Occasionally the number of valves as given will not agree with that of the manufacturers' specification, as we do not include power rectifiers, tuning indicators, etc., in the total. Universal AC/DC versions of many of the AC mains sets are available.

Mains-driven Sets

UNDER 8 GUINEAS

One of the lowest-priced sets in the Show is the Belmont Midget, Model 550, a universal AC/DC straight set at £4 4s. Another midget by the same firm costs £6 19s. 6d.

The Beethoven Baby Push-button Superhet at 7½ gns. is an example of the modern tendency to dispense entirely with the tuning dial, push-button control being used entirely for the selection of the six stations for which adjustments are provided. This is a self-contained AC mains set operating on a frame aerial and the circuit comprises seven stages with three valves plus a power rectifier.

Another example of the "all push-button" receiver is the Invicta Model 520, which has no tuning knob. A choice of two long-wave and four medium-wave stations is provided by manipulation of the buttons, the other controls being for tone and volume-on/off. The set costs £7 19s. 6d.

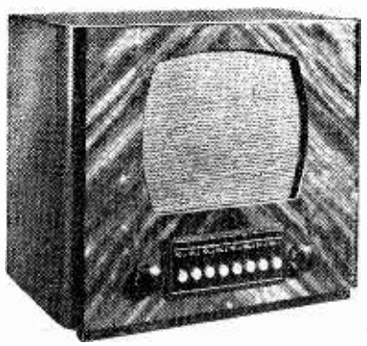
Cossor straight TRF receivers for AC and AC/DC are sold at 6 gns., and the same firm has produced an all-wave superheterodyne model with triode output at the extremely low price of 7 gns.

A straightforward but sound specification without "frills" is the basis of the G.E.C. AC5, a two-band AC superheterodyne, fitted with international-type valves, which costs only £7 19s. 6d.

8-12 GUINEAS

Mechanical push-button tuning with easy access to the adjustments from outside the cabinet is employed in the Alba "Prestotune" superhet, a three-band set which costs 10 gns. for AC and 11 gns. for AC/DC; it is also available as a radio-gramophone. A basically similar system of tuning is employed in the Burndept Model 299, which gives continuous wavelength coverage from 13.5 to 2,000 metres (except 580-750) in four steps.

Choice of fully automatic or combined automatic-manual control is given in two new Bush models. The push-button set, which is a compact four-valve superhet operating with a frame aerial, employs



Push-button tuning only: Bush Model PB50.

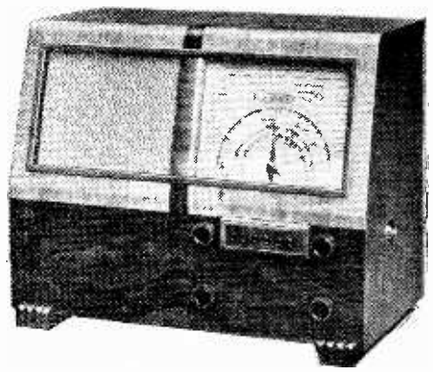
variable permeability for pretuning the required stations. Wave-changing is automatic and the range of frequencies covered by each button circuit, though naturally limited, is amply wide. This set costs 9½ gns.; the companion model, with a similar system of pre-set tuning and the addition of manual tuning, costs 10½ gns.

A system of automatic tuning that is similar, at any rate externally, to the dialling mechanism of the familiar automatic telephone is employed in one of the new Cossor sets which was recently reviewed in these pages. Permeability variation is the principle on which the automatic tuning system of the lower-priced Ekco press-button sets work. These superhetero-

NEW PRODUCTIONS IN ALL BRANCHES OF THE INDUSTRY

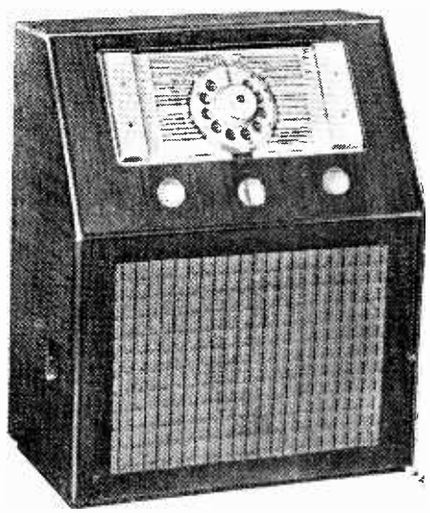
dynes, which cover three bands, cost 10½ gns. for AC and 11 gns. for AC/DC.

Higgs Radio are showing a four-valve, two-band superheterodyne for AC at £9, and an all-wave model with a pre-set tuning system, compensated against frequency drift, at £11 19s.



Alba Presto-tune Model 90.

Automatic waveband selection is combined with press-button tuning in the new Ferguson sets. Model 771 gives a choice of two long-wave and five medium-wave pre-set stations, and is a three-band AC superheterodyne providing an output of 4½ watts from a beam power valve; the price is 11½ gns.

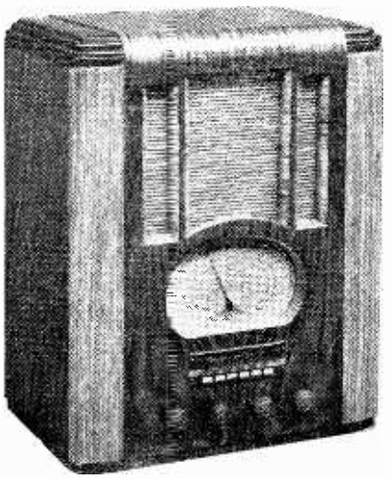


Cossor Model 397 with "Teledial" station selector.

In the "46" group, which comprises the lower priced Murphy mains sets, the table model costs £9 10s. for AC and £9 15s. for AC/DC. This is the three-band superheterodyne; console and radio-gramophone models are also produced in this series.

Olympia Show Report—

Mechanical operation of the push-button tuning system through a cam is employed in the Pilot Model BT530, a three-band superhet on which the station



Pilot Model BT530.

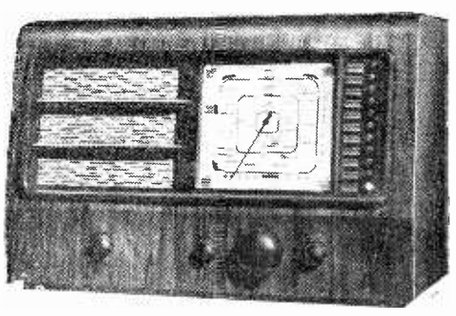
selection adjustments can easily be made from the front of the cabinet. The price is 12 gns., an extra half-guinea being charged for the AC/DC version. "Piano tuning" included in other Pilot models operates by pressure of a key.

In the Pye Model 830 push-button tuning only is employed, without any manual control. This set gives a choice of seven stations and has a four-position speech-music tone control. The price is 9 gns.

A purely mechanical tuning system of the telephone dial type, which allows the selection of adjacent-channel stations if desired, is employed in the Belmont Model 570 at 10½ gns. Three wavebands are covered and in the interests of stability all fixed condensers in the RF unit are of the silvered mica type. An alternative system of automatic tuning effected by means of permeability variation is employed in another Belmont model at 11½ gns.

OVER 12 GUINEAS TO 16 GUINEAS

An output of 8 watts, fed to twin tone-compensated loud speakers, is provided in the new three-band Beethoven model, which costs 15½ gns. This is a table model; the Cossor Type 538, also a three-band superhet, is a radio-gramophone, fitted with 10in. speaker, induction motor, turntable and pick-up. Complete in a big upright cabinet, this model costs 16 gns.

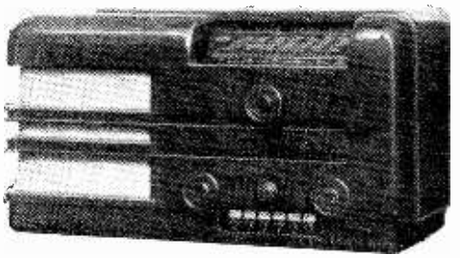


Ekco motor-tuned 8-stage superhet.

The system of motor tuning employed in the Ekco 12½-guinea model is similar to that found in the more expensive Ekco sets, but it does not provide automatic waveband selection or "motor cruising." Refinements include AFC as an adjunct to the operation of the tuning system, negative feedback over two stages, three-band wavelength coverage, and the generous number, for its type, of eight tuned circuits.

A useful feature of the G.E.C. "Touch-tune" press-button tuning system is that a button cannot be fully depressed unless the wave-change switch is in the appropriate position for the corresponding station required. This system is employed in a three-band superhet at 12½ gns.

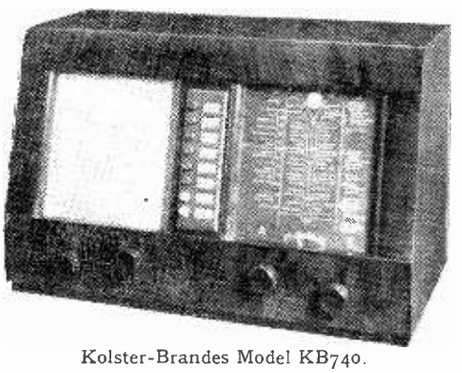
In the lower-priced H.M.V. press-button sets a system of pre-tuned circuits is employed; Model 658, a 3-band superhet at 13½ gns., offers the choice of six stations and includes automatic wave-changing—a valuable feature for the unskilled (or thoughtless) user.



Ferranti "Prestune" receiver.

The "Prestune" system included in the Ferranti Model 514 PB at 14½ gns. gives a choice of six stations. This is a three-band set with the relatively high output of 4 watts, which is also available without press-button tuning at 13 gns.

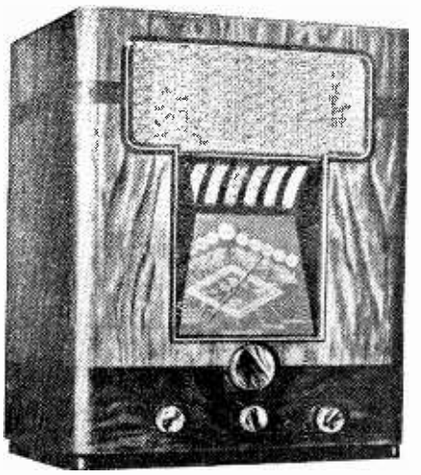
Automatic waverange changing is one of the features of the Kolster-Brandes



Kolster-Brandes Model KB740.

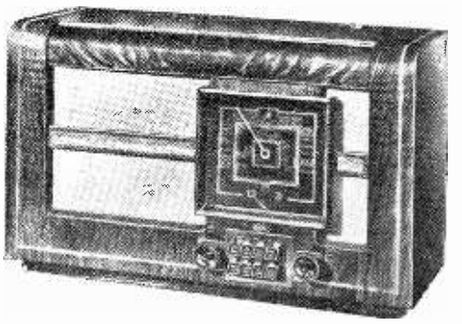
KB740, a three-band superhet with four valves, plus a rectifier. A choice of six medium-wave and two long-wave stations are given by the automatic tuning system. Another Kolster-Brandes model in this price category is the seven-valve KB750, without automatic tuning, but with four wavebands (starting at the unusually low wavelength of 11.5 metres) 8 watts output and a signal-frequency RF stage.

Selection of stations by means of a switch (as opposed to the more conventional push buttons) is employed in the Invicta Model 500; three medium-wave and two long-wave stations can be selected by this means; four wavebands are covered and the set costs £13 19s. 6d.



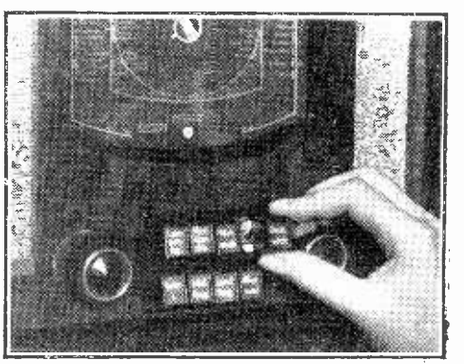
Invicta Model 500.

One of the most ingenious of mechanical push-button systems is that employed in the Mullard MAS24. The buttons actuate a sliding sleeve-action ganged condenser, of which each unit comprises a pair of meshing brass-strip spirals. The eight stations provided by the automatic system can be easily pre-tuned from the front of the cabinet. Negative feedback is another feature of this set, which for AC costs 13½ gns., or 14½ gns. with a built-in converter for DC.



Mullard push-button superhet. Type MAS24.

Choice of six stations is given by the pre-set push-button tuning system of the Marconiphone Model 855, which is a three-band superheterodyne costing 13½ gns. Motor-tuning models are also shown at rather higher prices.



Philips push-button system: removable cover on button gives access to pre-set tuning adjustment.

Olympia Show Report—

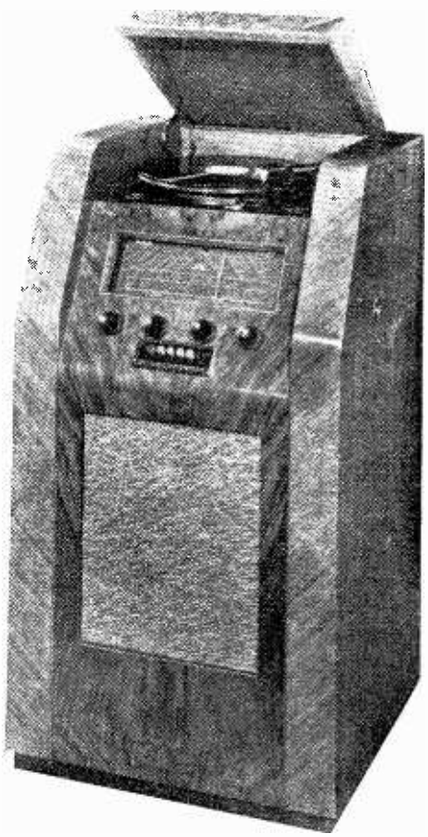
In the majority of mechanical push-button systems it is necessary to translate the to-and-fro movement of the button into a rotary movement of the condenser spindle. No such link mechanism is called for in the Philips direct-action system, which is designed around a radically new non-rotary condenser. The mechanism, whereby the amount of interleaving of the condenser electrodes is made to correspond with the capacity setting needed for the desired station, is simple but highly ingenious. This feature is included in a three-band superhet with 4 watts output (negative feedback), costing 13½ gns.

A large console model sold at a low price is the Ultra 205, a 7-stage 3-band superhet with push-button tuning and a rated output of 8 watts, which is priced at 13½ gns. A DC model costs 1 gn. extra, while a radio-gramophone on similar lines is priced at 20 gns. Provision for easy adjustment by the user of the pre-set tuning system is a feature of Ultra sets.

In the Vidor nine-valve four band superheterodyne at 13 gns. the exceptionally high output of 18 watts is provided by a pair of beam power valves.

OVER 16 GNS. TO £30

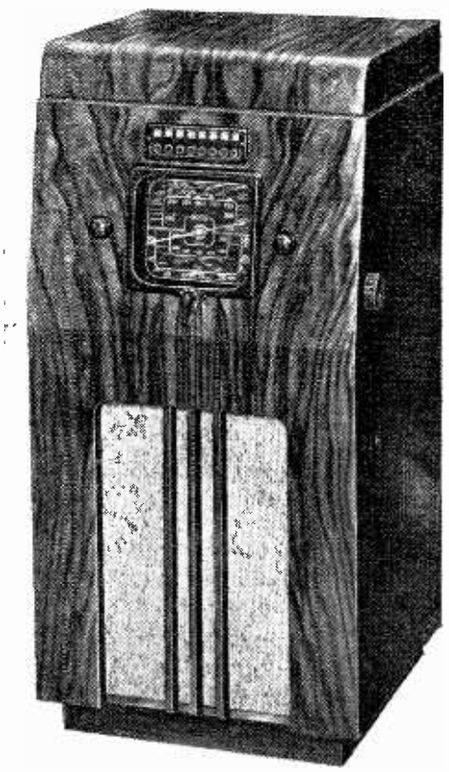
An 8-valve straight TRF circuit is used in the Dynatron "Ether Duke" model, a 2-band set with variable selectivity available in various forms as a radio-gramophone, a radio console and a table model, the last-mentioned costing 23 gns.



G.E.C. "Touchtune 5" radio-gramophone.

The most elaborate of the Ekco table models is the motor-tuned PB199, which covers three wavebands. The press-button tuning system provides automatic waveband switching, and is assisted by automatic frequency control. The set, which costs 18½ gns., has a signal-frequency stage; negative feedback is included, and an output of 6 watts is obtainable from a beam power valve.

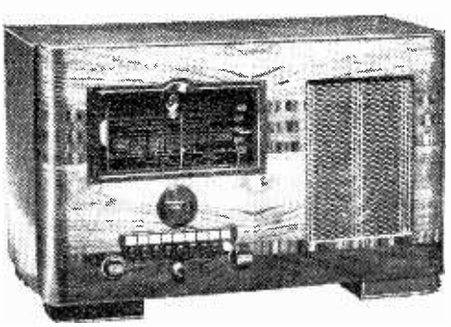
An alternative to push-button station selection is to be found in the 6-way switch which makes the appropriate circuit alterations for the desired stations in the G.E.C. "Selectalite 6." The circuit is a 5-valve superheterodyne arrangement with an RF stage and a beam power valve giving 6 watts output. Four medium-wave and one long-wave stations can be tuned in on the switch; the sixth position gives manual operation. The price of this receiver is 16½ gns.



Ultra push-button radiogram, Model 206.

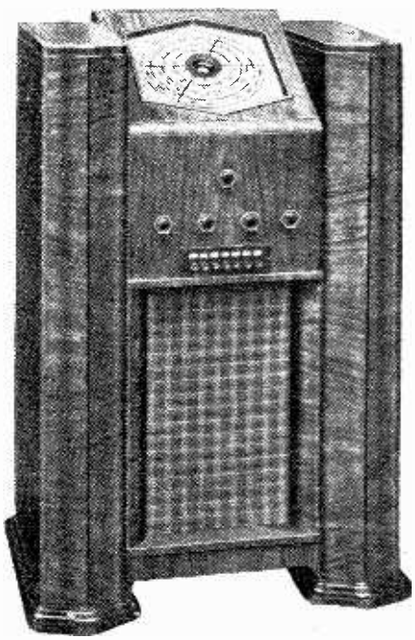
A waverange of from 13-2,000 metres is covered by the new H.M.V. Model 657, which includes a motor tuning system giving eight stations; another button actuates the change-over from manual to automatic operation. Frequency stability is assured by the use of air-dielectric trimmers in the oscillator circuit. This set costs 17½ gns.

Automatic frequency control and a 10-station motor-tuning system are included in the Ferguson 773 AC Console at 20 gns. This is a 5-band 12-valve receiver covering three short-wave bands, including television sound. Beam power valves in push-pull are used in the output stage.



Marconiphone motor-tuned superhet, Model 853.

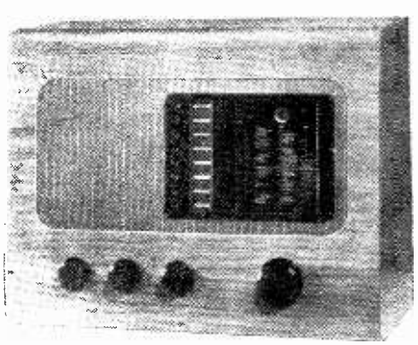
The Higgs Radio Console model, a four-valve AC set covering wavelengths from



Higgs Radio Console receiver.

13 metres upwards, has a signal-frequency stage, push-pull output, and a pre-set drift-compensated push-button system; it costs £26.

Model 52, the first Murphy push-button set, has many unusual features, and may be considered in many ways as a successor to the A36, as it has a similar band-spreading and double frequency-changing arrangement on short waves. As compared with the earlier receiver, gain is stated to be improved, as is signal/noise ratio and image suppression. There is no

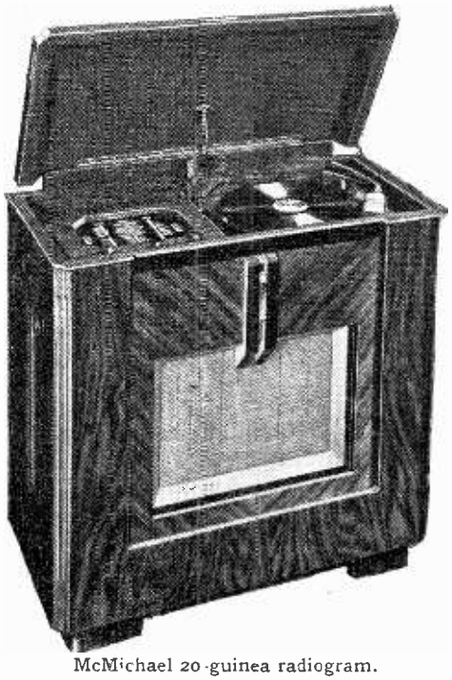


Murphy Model 52, with short-wave band-spreading and push-button selection.

risk that an unskilled user will forget the wave-change switch, as the buttons appropriate to any setting of the latter are the only ones to become visible. Any of the official short-wave bands can also be selected by buttons; output is 5 watts, and the price is £18 10s.

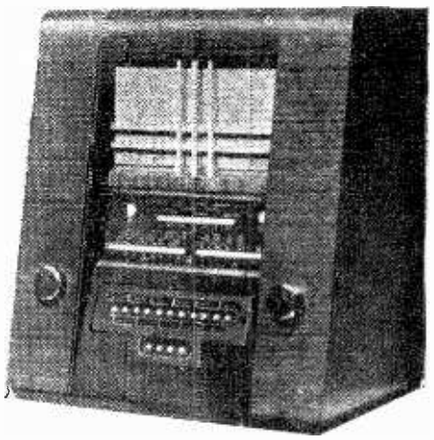
A choice of eleven stations is given by the motor-operated push-button system fitted in the McMichael Model 382, an 11-stage AC superhet at 18½ gns., which in-

Olympia Show Report—



McMichael 20-guinea radiogram.

cludes such features as AFC, 4-position tone control, 5-watt output, and an 11-stage circuit. There is also a new low-priced AC radio-gramophone at 20 gns.; this is an 8-stage, 3-band set giving 5 watts output and fitted with a 4-position tone-control switch and a tone-compensated volume control.



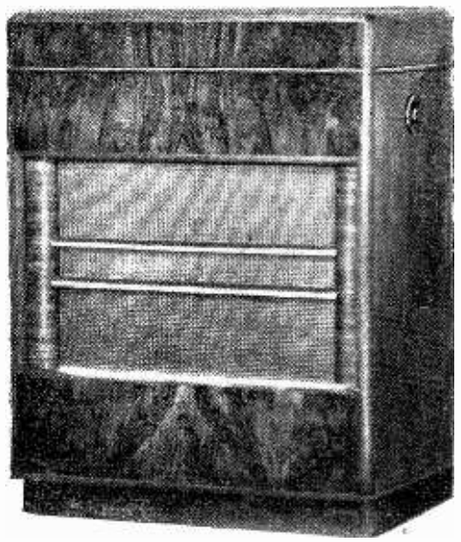
Pye Model 806.

Automatic switching of the mains supply is a feature of the push-button tuning system in the Pye Model 806. The action of pressing the appropriate button switches on the set and tunes in the desired station. This 3-band AC set costs 16½ gns.

OVER £30

Provision for the automatic changing of no fewer than 33 records, 10in. or 12in., or both mixed, and for playing on one side or on both sides, is provided in the fully automatic Autotrope radio-gramophone. On the radio side there is an elaborate superheterodyne chassis with signal-frequency RF amplification, 2-stage IF amplifier and push-pull output. Wavelengths from 12.25 metres upwards are covered in five stages.

The most ambitious of the Dynatron sets is the "Ether Empress" radio-gramophone, of which the circuit is switched from "straight" for local-station reception to superheterodyne for long-distance work. This 18-valve chassis has independent bass and treble tone control, variable selectivity, tunable whistle filter (controlled from front panel), multiple loud speakers and an automatic record changer. This model, with a rated output of 15 watts, costs 115 gns.; with Voigt loud speaker as a separate unit the price is 155 gns. A rather less ambitious Dynatron set, which, however, contains many of the features of the "Empress," is the 65-guinea "Prince" radio-gramophone.



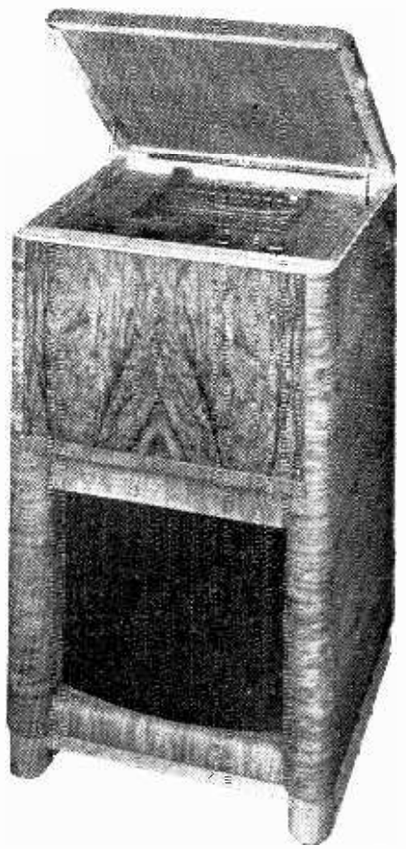
Dynatron "Ether Empress" radio-gramophone.

An automatic record changer is included in the Burndept all-wave radio-gramophone, which covers a waverange of 13.5-2,000 metres in four bands. The set is fitted with a 12in. speaker.

Three valves are employed in the automatic frequency control device of the H.M.V. Model 659 Console, a highly developed 10-valve set at 31 gns. One of these AFC valves acts as a discriminator amplifier, another as a rectifier, and the third as the frequency-control proper. The motor-operated auto-tuning system gives a choice of ten stations, and the waverange covered is from 13.5 to 2,000 metres. Variable selectivity and an output of 8 watts are among the features of the set. Similar arrangements are found in the auto-radiogram Model 664 at 54 gns.

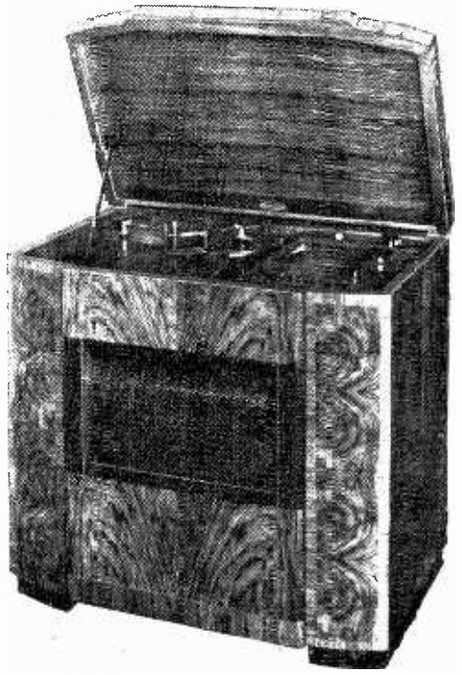
The Marconiphone Model 866 high-fidelity automatic radio-gramophone has a combined variable selectivity and brilliance control, with ASC as part of the automatic tuning system, which is motor-operated. Four wavebands are covered.

Though primarily designed for quality reproduction, the Murphy "40" series includes provision for short-wave reception with electrical band spreading. Variable selectivity allows the useful audio range to be carried up to 8,500 c/s and the output is rated at 12 watts. The console model in which these features are included costs £35, and a somewhat similar set in the form of an automatic radio-gramophone costs £85.



HMV 10-valve console.

This year Model 1295 is the most ambitious of the many highly developed sets shown by R.G.D. This model is an auto-changing radio-gramophone with a resistance-coupled push-pull amplifier giving an output of 12 watts. Four wavebands are covered, and among the refinements to be found are contrast expansion, an acoustic labyrinth for improving bass reproduction and motor-driven push-button tuning in conjunction with AFC. The 14-button system controls both station and waveband selection and the feature has been



R.G.D. 75-guinea radio-gramophone.

Olympia Show Report—

carried to its logical conclusion by making provision for remote control. The price of this model is 95 gns.; the automatic and remote tuning features are included in other sets at lower prices.

BATTERY RECEIVERS, PORTABLE AND FIXED

Iron-cored coils are used throughout in the Alba 4-valve 4-band superheterodyne, which has a pentode output valve. The price is 8½ gns., without batteries.

One of the comparatively few superheterodyne portables is the new model Burndept at 8 gns. complete. It employs a more or less standard circuit arrangement with an octode frequency changer and a pentode output valve. Weight is 20 lb., and the controls are conveniently disposed on the top of the cabinet, where they are protected by a lift-up flap. There is also a 4-band open aerial superheterodyne at the low price of £8 5s. complete, which covers wavelengths between 13.5 and 2,000 metres.

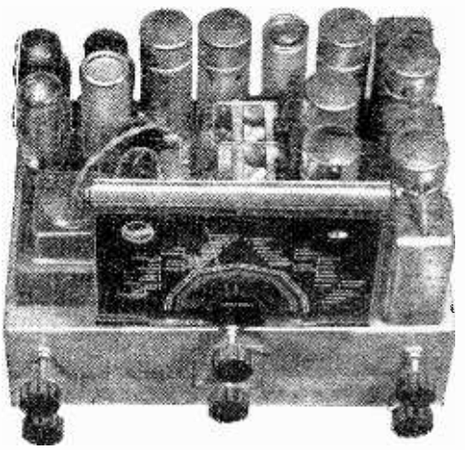
Permeability pre-set tuning is employed for the automatic tuning system of the 3-band Ekco battery superheterodyne. Although the frequency range covered by permeability tuning on any one circuit is necessarily somewhat limited, matters are so arranged that the choice of pre-tuned stations is virtually unrestricted, there being ample overlap. Wave-changing is automatic, so far as press-button tuning is concerned.

"Touchtune" tuning, as described in the section of this report devoted to mains sets, is employed in the G.E.C. battery superheterodyne at 13 gns. This is a 5-valve 3-waveband set with two Osram KT2 valves in push-pull in the output stage.

Beethoven portable Model P109.

An economy switch is a useful feature of the new H.M.V. "Economy 4," an 11-guinea superhet in which the operation of the switch reduces the normal HT consumption of about 8 mA. to 4.5 mA. for low-volume listening. The modern tendency to use automatic bias in battery sets is exemplified in this receiver, as it is in the Kolster-Brandes KB720, a 4-valve superhet with 7 tuned circuits and pentode output.

The latest McMichael frame aerial portable, the "Bijou" model, employs an RF-Det.-2 AF circuit and embodies an unusual tuning system, in which the usual knob is replaced by a knurled cylinder carried on a transverse spindle. The cylinder is rotated with the finger tip, the drive being transmitted to the variable condenser through appropriate gearing. This set, which is of compact dimensions, weighs 22 lb. and costs 8 gns. Turning to open-aerial sets there is the McMichael Model 388, an all-wave superhet with push-button tuning selling at 14½ gns. A 4-position tone control giving the appropriate frequency characteristics for various conditions of reception is included. The switch positions are marked "normal," "high-fidelity," "foreign," and "bass." In the last-mentioned position the lower register is accentuated.



Armstrong all-wave chassis with 10-watt push-pull output stage.

A speech output of 400 mW. for an HT consumption of 8 mA. is given by the new Marconiphone battery superheterodyne, which covers three wavebands and embodies a change-over switch whereby HT consumption may be approximately halved when full volume is not required.

A cylindrical alphabetical tuning scale, certainly one of the most practical aids to station finding, is included in the Murphy Model 47 battery superhet, which has QPP output and costs, without batteries, £11 10s. A 4-band model including the waverange 70-200 metres (yachts, long amateur band, etc.) costs £11 15s.

Reflexing of the IF stage is employed in the Mullard MBS6 battery superheterodyne at 8 gns., without batteries. The IF valve also serves as an AF amplifier.

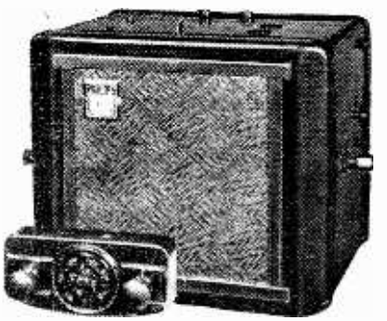
A successor to the well-known "Baby Q" is to be found in the new Pye portable at 8 gns., complete with batteries and waterproof carrying case. This set is of the modern lightweight type weighing 17½ lb., and employs a straight circuit with QPP output. The control panel is safeguarded from harm by a locking cover working on the roll-top desk principle.

Vidor Portable No. 2 is a low-priced straight set of the compact suitcase type, selling at £5 19s. 6d., complete with batteries. The circuit is a straight RF-Det-AF arrangement of 3 valves. A superheterodyne model costs 8 gns.

SPECIAL-PURPOSE RECEIVERS

Armstrong chassis suitable for building into the purchaser's own cabinet, etc., are available in various forms. The smallest is a 7-stage all-wave chassis with iron-cored coils and push-button tuning. This set costs £7 19s. 6d., with valves and speaker. The largest Armstrong chassis is a 10-valve model, covering 5 wavebands with 2 IF amplifiers, variable selectivity, and RCC push-pull output; the price is 17 gns., with valves.

Ferranti car radio is designed for easy installation in the typical British car; it employs a 6-valve circuit and gives an output of 2½ watts; consumption from the car battery is about 36 watts; both 6- and 12-volt models are available. A Ferranti roof aerial has been introduced.



Philips Motoradio (built-in speaker model) showing control head.

Philips "Motoradio" sets have recently been improved by the provision of larger pick-up and the reduction of background noise. Consumption of battery current has also been reduced. Models with self-contained or separate speakers are available.

Television Receivers

ON the introduction of television, most receivers included a 12in. cathode-ray tube giving a picture of some 10in. by 8in. Last year also such receivers were in the majority, but there was evidence of a trend towards smaller pictures, since quite a number of sets included 9in. tubes. There were also, it is true, a few examples of projection apparatus giving pictures of some 20in. by 16in., but the general tendency was clearly shown to lie in the direction of smaller pictures.

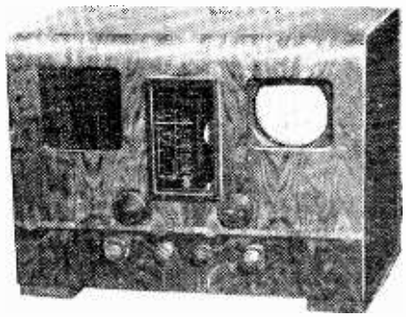
This year sees an acceleration of the progress in this direction. Nearly all the new sets have tubes smaller than 9in. In general, firms have retained their existing models with 9in. or 12in. tubes unaltered, but have introduced new models to extend their range, and these new models have 7in., 6in., or 5in. tubes.

To those who criticise the "standard" 10in. by 8in. picture as being too small, this will seem a retrograde step, but it is done to reduce the price of the apparatus.

Olympia Show Report—

A reduction in picture size means quite a big saving in cost; the tube is cheaper and is smaller physically so that it can be accommodated in a smaller cabinet, again saving cost. With a small picture equivalent brightness can be obtained at a lower voltage, and not only is this advantageous in itself, but also indirectly through reducing the deflecting power needed from the time-bases. Furthermore, if advantage is taken of the smaller tube size to reduce the deflecting angle, the time-base power can be still further reduced.

The saving effected by all these points has enabled the price of television equipment with a 5-in. tube to be brought down to about one-half of that with a 12-in.



The Marconiphone Model 706 television and all-wave sound receiver. A 5-in. tube is used.

A good example of one of these small sets is the Marconiphone Model 706, which is essentially the same as the H.M.V. Model 904; both sets are priced at 29 gns., and have a 5-in. tube giving a picture of 4¾in. by 4in. The picture is black and white. In addition to television, sound reception on short, medium and long wavebands is provided.

The receiver is a superheterodyne with one RF stage, triode-hexode frequency-changer, and one IF stage. For general sound reception this IF valve feeds a duo-diode-triode detector, AVC, and AF valve, which in its turn is followed by an output tetrode.

For television the first three valves are still used, but the coils, including the IF couplings, are changed by switching, and the output of the IF valve is taken to a separate IF amplifier used only for television. A total of three IF stages is used on vision, and the first two stages, as well as the RF and FC valves, are common to sound and vision. The television sound signal is picked out after the second IF stage, and feeds the duo-diode-triode of the standard sound receiver.

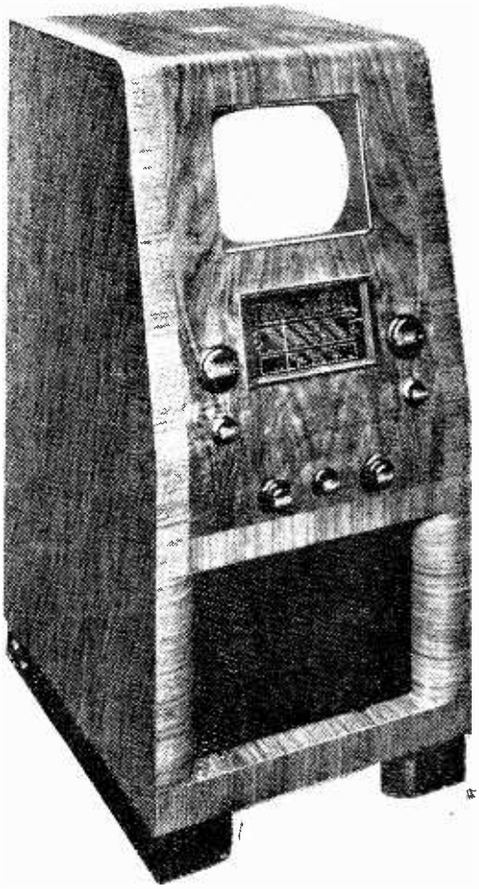
The vision output of the third IF stage is taken to an anode-bend detector which feeds the CR tube directly and also the amplitude filter for sync separation. This contains two valves, a diode and an RF pentode.

Magnetic deflection is used, and the time-bases consequently generate a saw-tooth current output. Hard valves are used throughout, the oscillators being of the squegging type. Four valves are used in the time-bases, the line and frame output stages being a tetrode and a triode respectively. There are two rectifiers, one for the general HT supply and the other for the tube. When sound reception only is required, the purely television equipment is switched off.

The television tuning is entirely pre-set, no controls being provided. The television controls include brilliance and contrast, frame and line hold, and focus on the panel, and rear adjustments for picture height and width.

Larger receivers marketed by these firms are very similar in general design but differ somewhat in detail. The H.M.V. Model 905 and Marconiphone Model 707 differ only in having a 7-in. tube; they are priced at 35 gns. and the picture size is 6¼in. by 5in. In the Marconiphone Model 709, however, the receiver is somewhat different. This equipment, which in common with the H.M.V. Model 907 is priced at 45 gns., has a 9-in. tube with a picture size of 7½in. by 6in.

For vision there is one RF stage, followed by a triode-hexode frequency-changer, three IF stages, detector, and one VF stage. The sound signal is picked out after the second IF stage and taken to the detector of the broadcast set. For general broadcast reception, the 1st vision IF valve is switched over to act as IF amplifier, and is preceded by a triode-hexode frequency-changer. Two

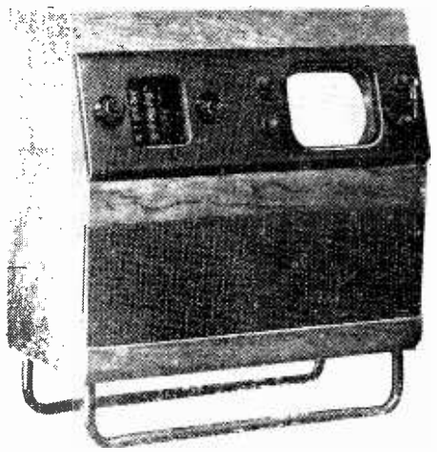


The H.M.V. Model 907 vision and all-wave sound equipment with a 9-in. tube.

valves are used for sync separation, and there are four valves in the time-bases.

The well-known 12-in. tube models are retained, and there is a projection type giving a picture of 22in. by 18in., which is priced at 200 gns.

The lowest priced of the Murphy receivers is the Model A56V at £30, and



The Murphy Model A58V television receiver. A 9-in. tube is used and there is an all-wave broadcast set.

it is unusual in that it has a 9-in. tube giving a picture 7½in. by 6in. It is, however, for television only and no broadcast set is included. One RF stage is used, and this valve, together with the frequency-changer, handles both sound and vision signals. In the sound channel there is one IF stage, a duo-diode-triode, and an output pentode, while for vision there are three IF stages, diode detector, and one VF stage. A duo-diode is used for sync separation, and in the time-bases gas-triode oscillators are used with pentode amplifiers.

The tube is magnetically focused and deflection is also arranged magnetically. There are three rectifiers for HT supply, the tube being operated at 4,500 volts. The tube is viewed directly. The model A58V at £45 consists of essentially the same vision equipment with the addition of an all-wave broadcast receiver. The model A42V, with a 12-in. electrostatic tube, is retained.

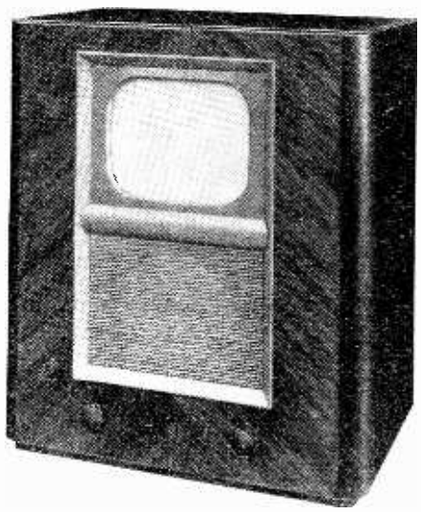
The Pye model 815 is unusual in that a straight receiver is used. For vision, band-pass couplings are used with a band-width of 3 Mc/s. Gain control is effected by varying the suppressor grid voltage of the RF valves in order to reduce the effects of the control on the tuned circuits and to maintain the total drain on the HT supply at a more constant level. A full-wave diode detector is used with direct coupling to the CR tube. The sound channel is also a straight set with two RF stages and a diode detector directly coupled to the first AF stage. This valve is arranged to have a sharp cut-off, and with the direct coupling adopted ignition interference is reduced.

Two RF pentodes—one for line, the other for frame—are used as sync separators with direct coupling from the detector. Magnetic deflection is used, and the line time-base consists of a blocking oscillator followed by an output valve transformer-coupled to the deflecting coils. A similar arrangement is used for

Olympia Show Report—

frame scanning, but using a triode-hexode. The triode functions as a blocking oscillator and the hexode as the output valve. The picture size is $7\frac{1}{8}$in. by $5\frac{3}{4}$in.

Another receiver produced by this firm



The Baird table model T20 receiver for television and its accompanying sound.

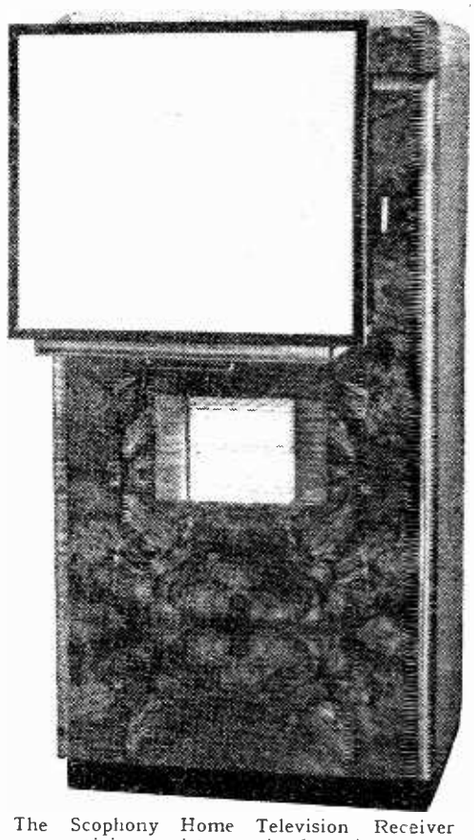
is the model 817 with a picture measuring 4in. by $3\frac{3}{8}$in. It is very similar to the model 815, but the band-width is $2\frac{1}{2}$ Mc/s. and the sound receiver consists only of RF and detector stages, its output being arranged for connection to the pick-up terminals of any broadcast set. For the line-scan a triode-tetrode is used, the tetrode functioning as an output valve, and for frame-scan a triode-hexode. Other models include these vision receivers as well as a broadcast receiver.

Baird equipment has magnetic deflection, and the smallest type is the T20 at 35 gns. for the table model. The picture size is $7\frac{3}{4}$in. by $6\frac{1}{4}$in. and it is for television only. A larger set with a 12in. tube is the T18 at 44 gns.; this includes an all-wave broadcast set. There is also a projection model, the T19, with a picture 18in. by 15in., which can be increased to 24in. by 19in. with a separate screen. This is priced at 150 gns.

Although general, the cathode-ray tube is not universal, for Scophony show mechanical receivers. The Home Receiver gives a picture 24in. by 20in. The light source is a mercury lamp, and the control is by the supersonic light relay reproducing 200 picture elements simultaneously. Scanning is carried out by special forms of mirror drum. This firm also has the "Junior Public Viewing Projector," giving a picture 6ft. by 5ft.

A similar receiver is shown by E. K. Cole, and is known as the Ekco-Scophony Home Model ES104. A mercury-lamp light source is used, consuming 300 watts, and its output is focused on to the light control cell for modulation. After this it passes to the high-speed scanner and thence to the low-speed scanner, and so to the screen. The receiver is a straight set with four RF stages; diodes are used for detection and sync separation. A total of 30 valves, including the mercury-lamp, is used, and the consumption is 1 kilowatt.

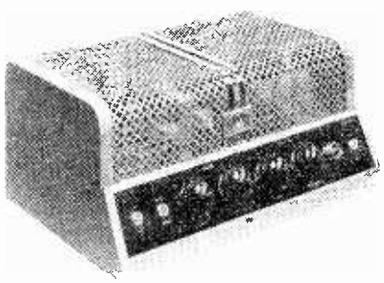
Philips have a large-screen model of the projection CR tube type. A 4in. tube is used, and the picture is projected on to a screen 18in. by $14\frac{1}{8}$in. by an f/1.9 lens. The tube is operated at 25,000 volts, and the equipment costs 120 gns.



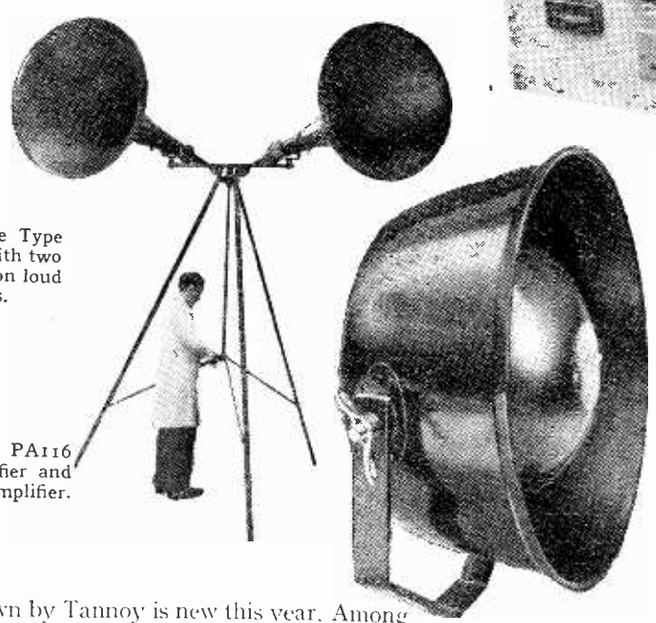
The Scophony Home Television Receiver giving a picture 24in. by 20ins.

Loud Speaker and PA Equipment

APPARATUS for sound reinforcement forms a substantial part of the exhibit of E.M.I. Service, Ltd., and ranges from complete portable band-amplifying equipment to high-powered horn loud speaker assemblies for outdoor work. A comprehensive range of microphones includes the Marconi-Reisz and a moving-coil type with a response of 60-8,000



E.M.I. Service PA116 10-watt amplifier and microphone amplifier.

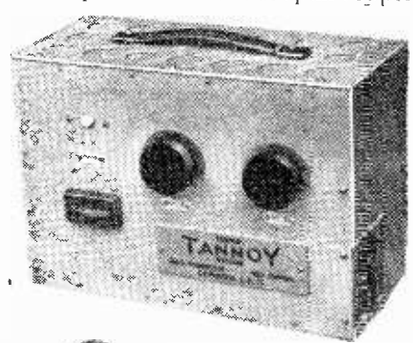


E.M.I. Service Type PS71 tripod with two PS51 projection loud speakers.

cycles, costing £7 9s. Several new amplifiers are shown and one of the most interesting is the PA 115, which has an output of 10 watts and costs £7 9s. A suitable microphone amplifier for use with this chassis costs £7 19s., or the two may be purchased as a combined unit with controls.

A large proportion of the equipment shown by Tannoy is new this year. Among amplifiers the Type 230 12-watt mobile unit is designed for operation from a 12-volt car battery and the metal case measures $19 \times 9\frac{1}{2} \times 9$ inches. The Types 220 and 210 for universal mains operation are housed in cases of the same robust type and deliver 20 and 10 watts respectively.

The Tannoy "Co-ax" loud speaker is a bowl-shaped folded horn of spun copper,



Tannoy Type 230 12-watt amplifier.

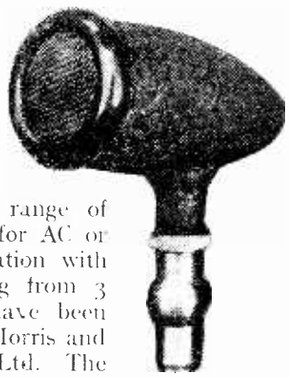
Tannoy Type 313 "Co-Ax" loud speaker.

which is suitable for a variety of PA applications, including attachment to the front of patrol cars. It may be actuated without intermediate amplifiers by the new "Power-Microphone," which is capable of modulating directly currents of up to 4 or 5 amps.

Microphones operating on the piezo-electric principle have for many years been a speciality of R. A. Rothermel, Ltd., and this year the range has been extended by

Olympia Show Report—

the addition of new Junior, Lapel and Bullet types.

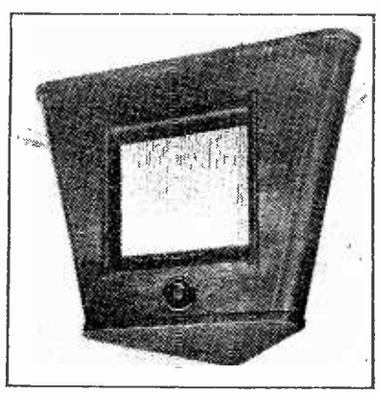


Rothermel-Brush bullet-type crystal microphone.

A complete range of PA amplifiers for AC or universal operation with outputs ranging from 3 to 60 watts have been developed by Morris and Co. (Radio), Ltd. The prices range from £2 15s. to 15 guineas and with the exception of the 3-watt models, all are fitted with universal output transformers. The gain in all cases is sufficient for operation from low-level crystal and velocity microphones. Most of the models have two- and three-channel input circuits and tone controls are also provided.

Loud speakers produced by the recently combined resources of the Celestion and Magnavox concerns are shown on the stand of Celestion, Ltd., and certain models will be distributed to the wholesale and retail trades by Cyril French. These will include the "Sixty-Six" and "Duode 33," and the range of chassis and cabinet models, which includes the Junior and Standard 8, Junior and Standard Auditorium PM chassis. A new design, the "55," with a large field magnet and 12-inch curvilinear cone is shown for the first time. A high flux is maintained in a much larger gap than usual, and particular attention has been given to the maintenance of a uniform bass response.

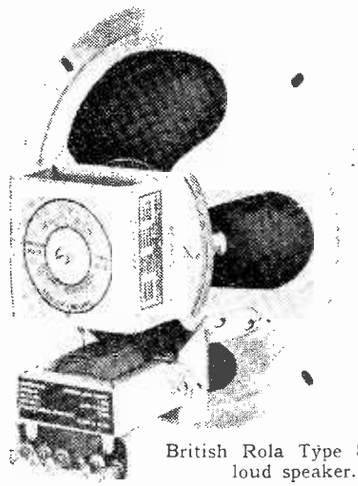
The Stentorian range of loud speaker chassis, shown by the Whiteley Electrical Radio Co., Ltd., is continued with minor modifications. In the new range of cabinet extension loud speakers incorporating these chassis some very interesting designs are to be found. In one case the unit is concealed in the upright supporting member of an occasional table, and in another the loud speaker is



W.B. Stentorian pendant loud speaker.

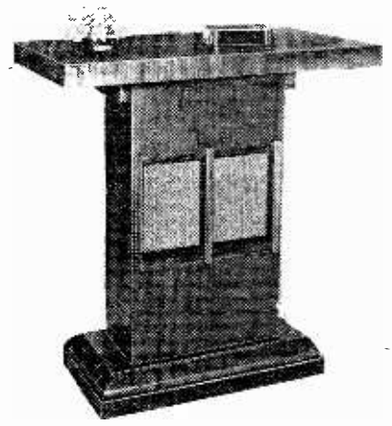
mounted below the table surface in a satin-finished walnut coffee table. When fitted with the "Long Arm" remote control, these novel extension loud speakers cost 4 gns. and 5 gns., respectively. In the W.B. pendant model, at 49s. 6d., the chassis is mounted in a triangular cabinet which may be suspended from the picture rails at the corner of the room. Extension loud speakers in well-proportioned cabinets of the more conventional type are shown with switching arrangements indicating the correct setting for every well-known make of receiving set.

No fewer than eighteen different designs are included in the programme of the British Rola Co., Ltd., and the majority are made completely dustproof by a form of construction which entirely excludes foreign matter from the air gap. Energised and PM models of each type are shown and the magnet systems of the types 8Z and 10Z are of interest for the fact that the active material is concentrated in the centre pole. The well-known G12 and F742 units are continued, and the "Roma" and "Rex" cabinet extension speakers incorporating the 8Z unit are provided with universal matching connections.



British Rola Type 8Z PM loud speaker.

The B.T.H.-R.K. Senior loud speakers (Ediswan), which are available in permanent magnet or energised form, are fitted with curved-sided cones designed to produce sub-harmonics, and a specially designed coil former which does not change its shape under the influence of heat or humidity.



W.B. extension loud speaker incorporated in an occasional table.

On the Goodman's stand, apart from the 10-inch and 12-inch speakers with dual exponential cones, the interest is chiefly in PA reproducers. The "Duplex Horn" and "Concentric Diffuser" types are shown and a new 12-inch permanent magnet model capable of handling 20 watts.

Under the heading of public address equipment may be included the intercommunication systems for use in large factories and departmental offices. In the Ediswan "Loud-speakerphone" a master unit costing £9 14s. 6d. is capable of working from one to six extension units, the price of which is £1 19s. 6d. each. The master unit is AC mains operated and consumes about 40 watts.

In the Model PA, produced by Linkafone, Ltd., flexibility has been given first consideration and the unit can be used for radio diffusion as well as for "paging" in hotels. It costs £55, and the price of the extension units is 3 guineas each, but installations can be hired for 7s. 3d. per week and 5d. per extension unit. Less comprehensive models are also available at prices down to 14 guineas.

Test and Service Apparatus

THE apparatus that is shown at Olympia and which is broadly classified as test equipment can actually be divided into two main classes. In the one we have testing sets developed primarily for the use of service engineers, while in the other can be included the precision type of equipment which, for want of a better description, can be termed laboratory apparatus.

The former does not require to have such a high standard of accuracy as the latter, its main features being portability, reliability and ease of operation, as well as reasonable cost. The latter is essentially high-grade precision measuring apparatus and, consequently, the price is inclined to be somewhat high.

Means for carrying out a rapid but comprehensive test on every valve in general use is of vital importance to the service man and, in a lesser degree, to the radio dealer also. Apparatus of this kind is well represented in the Show. A fine example of compactness coupled with versatility is the Avo valve tester, for which a new universal-type valve panel has just been introduced. Hitherto there were two valveholder panels which would probably have to be further augmented as new valves made their appearance.

The new panel replaces the older ones, and it only requires to be fitted with one of each type of valveholder, as the connections to the sockets can be rearranged to suit any valve for which a holder is fitted on the panel by means of an ingenious system of selector switches. This

Olympia Show Report—

panel costs £3 3s., and the data book supplied gives the selector switch combinations for over 1,000 valves. The complete valve tester including the new Universal panel costs £12 12s. The feature of this test set is that it gives the condition of the valve in terms of mutual conductance with the optimum operating voltages on all electrodes.

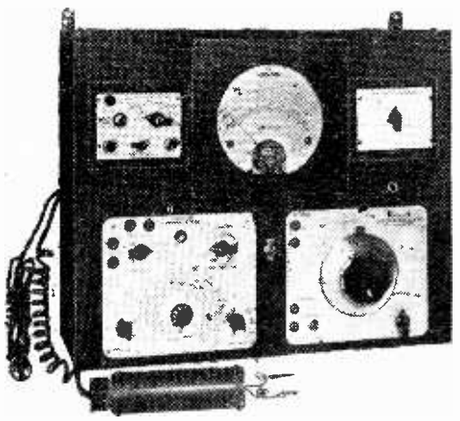
The Avo all-wave oscillator, though quite reasonable in price, for it costs £9 9s. as a portable battery model and £10 10s. mains operated, is claimed to have an accuracy better than one per cent. throughout. It is directly calibrated in kilocycles and covers a range of 95 kc/s to 80 Mc/s. Calibrated attenuators are fitted and the RF output can be modulated by a 400 c/s audio oscillator. The output from this oscillator may also be used independently for testing audio equipment.

A new instrument has been added to the Avo range of test sets. This is developed from the DC Avo Minor, being of the same size and appearance, but it has an internal resistance of 20,000 ohms per volt. This means that only 50 microamps are required for a full-scale deflection. This is one of the current ranges, the other being 250 microamps full scale, so that for current measurement it is a super-sensitive microammeter. Six voltage ranges are provided, the lowest being 0-2.5 volts and the highest 0-1,000 volts D.C. Resistance up to 50 megohms can also be measured by using an external battery. It costs £3 10s.

Avo valve tester with the new Universal panel.

A super-sensitive multi-range measuring instrument that can be used either separately or arranged to form the nucleus of a more comprehensive test set for servicing wireless receivers is shown by Weston. It is known as the Model E.772 Analyzer and has AC and DC ranges for voltage and current as well as providing facilities for the measurement of resistances. The most sensitive current range is 0-100 microamps DC. On the DC voltage ranges the resistance is 20,000 ohms per volt, and the price is £16 16s. There are also a host of accessories for use with this meter to extend its scope to the testing of valves, etc.

Everett Edgcumbe are showing the full range of Radiolab servicing apparatus to which has been added a receiver test panel, which consists of their All-Purpose



Radiolab receiver test panel.

Tester fitted with a large 6in. scale on the meter, the All-Wave Oscillator and the Workshop Test Set. This combination of instruments is assembled on a strong steel panel fitted with brackets for mounting on the test bench. It is intended for AC mains operation and includes all the necessary equipment for complete overhaul of a wireless set.

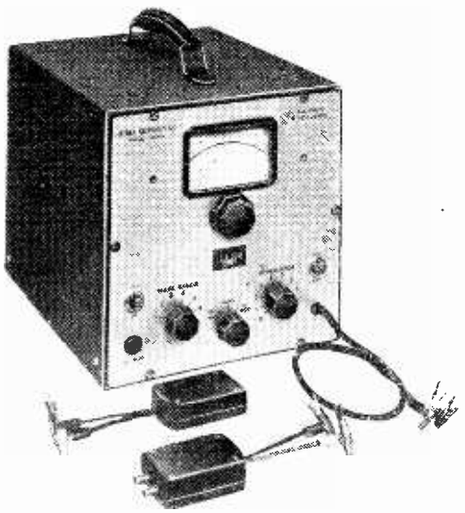
A capacity and resistance bridge and two signal generators designed for receiver testing are shown by A. H. Hunt. Norman Rose are also catering for the service engineer, and their equipment, though very reasonable in price, has a very good specification. For example, the Lilliput valve tester, a very compact instrument, enables every type of valve in general use to be tested for emission, inter-electrode insulation, etc., while it can be used also as a circuit continuity tester. It costs only £4 17s. 6d. This firm is also showing another test set described as the Tech Valve Tester, which gives an indication of the state of a valve based on mutual conductance measurements. There is a combination test set comprising several of their standard instruments arranged for the complete overhaul of a receiver.

Some exceptionally well made and workmanlike instruments are to be seen on the E.M.I. Service stand. There is a new all-wave oscillator which covers a range of 60 Mc/s to 86 kc/s (5 to 3,500 metres). It has six waveranges and charts calibrated for the individual ranges of each instrument in metres and kilocycles are supplied. An audio output at 400 c/s is available for testing AF equipment, or the audio oscillator can be employed to modulate the RF output. Special precautions have been taken to prevent RF leakage, especially at the higher frequencies, so that the attenuator shall function satisfactorily over the full frequency range. Mains-operated and battery models are available, their prices being £15 12s. 6d. and £12 12s. respectively.

There is a bridge-type capacity measuring set designed for operation from the 50 c/s mains. Mica, paper and electrolytic condensers from 10 m-mfds. to 80 mfds. capacity can be measured with a high degree of accuracy and at the same time the power factor is given, as one of the adjustments for balance is a phase angle corrector. Provision is made for insulation testing up to 500 volts DC as well as for the measurement of the leakage current in electrolytic condensers.

A set of four specially prepared gramophone records that demonstrates almost every type of electrical interference that may be heard in an average receiver and then gives advice regarding its probable cause and how to cure it has been made especially for servicing work. These cost 15s. the set.

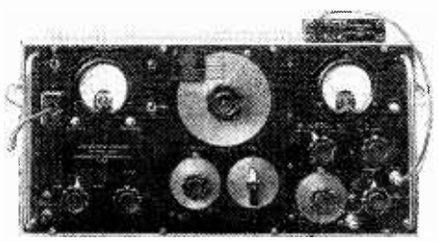
Included in the E.M.I. Service equipment is a CR oscillograph which is fitted with a 3in. "hard" tube. It embodies two time-base oscillators with a range of



E.M.I. Service all-wave oscillator.

20 to 15,000 c/s, "X" and "Y" plate amplifiers, and it can be used for the investigation of the wave-form of time-base oscillators in television receivers.

Some fine examples of precision laboratory test apparatus are to be found on the stand of Marconi-Ekco Instruments. All the apparatus is of outstanding quality and finish. There are three standard signal generators, one the Type TF.144, which has a range of 25 Mc/s to 20 kc/s, the Type TF.430 with a range of 50 Mc/s to 55 kc/s, and one for the ultra-high frequencies. The frequency range is not the primary difference between the two first-mentioned models, as they differ in many other and far more important respects. The Type TF.430 has an RF amplifier after the oscillator, which completely iso-



Type TF430 Standard-signal generator made by Marconi-Ekco Instruments.

Olympia Show Report—

lates it from the output attenuator network. No such refinement is included in the Type TF.144, nevertheless no appreciable change in oscillator load should occur owing to the careful design of the attenuator.

Both models are fitted with separate 400 c/s modulating oscillators, though external modulation can be employed if desired. A special feature of these signal generators is the precaution that has been taken to prevent RF leakage. The coils are assembled in a separate metal case which forms part of the oscillator unit, and the whole oscillator unit is screened. Then the whole set is enclosed in a perfectly screened metal carrying case; thus triple screening is employed.

Both these models are arranged for optional battery or mains operation.

The ultra-short wave signal generator follows the same general form of construction as the other two models, but its range is 150 Mc/s to 20 Mc/s, i.e. 2 metres to 15 metres. In view of the very high frequencies involved the RF oscillator uses an acorn valve. Internal modulation is provided.

The universal Impedance Bridge is a self-contained instrument for the measurement of capacity, resistance and inductance. Actually three different bridge circuits are employed, the internal changes being made automatically by a single switch. Measurements are made at 1,000 c/s, the internal generator being a microphone hummer. The range is 0-100 henrys; 0-100 mfds. and 0-1 megohm. In each case five steps cover the full range, so that the scale lends itself to quite accurate interpretation.

In addition, coil magnification, "Q," from 0-100 as well as condenser loss, can be measured. Normally, high-resistance headphones will be used with this bridge, but an external visual indicator can be supplied.

Other Marconi-Ekco test instruments that will interest the radio engineer are an output power meter, a beat frequency oscillator, valve voltmeters and a noise meter, the last-mentioned by virtue of its utilisation of radio technique. These represent only a few of the many measuring instruments made by this firm.

Shown by Morris and Co. (Radio), Ltd., is a new 10-guinea Premier 3-inch cathode-ray oscillograph. The time-base covers 15 to 30,000 cycles and vertical and horizontal amplifiers are included. There are the usual controls of focusing, intensity and displacement, and either internal or external synchronisation.

Electronic Devices

THE year's development in valves has, as usual, resulted in an increase in the number of types and also rather unexpectedly an increase in the valve bases.

Mullard have introduced the "E" series of valves. These have 6.3-volt 0.2 amp. heaters in most cases and side-contact bases of the Continental type. The range is a complete one, including all the normal types, such as RF pentodes, triodes, diodes, output pentodes, rectifiers, heptodes, and so on. It does, however, include one valve of a type not to be found in other ranges. This is the EF8.

Mullard low-noise RF pentode, EF8

Officially described as a low-noise RF pentode, the valve is actually a hexode, since it includes an extra grid between the control and screen grids. The purpose of this grid is to introduce a beam formation into the electron stream so that the electrons can pass between the wires of the screen grid without striking them. The result is a great reduction in screen current and improvement in the signal-noise ratio.

This firm has also introduced some midget valves for use in deaf aids. The DAS1 is a tetrode with top anode connection and a mutual conductance of 0.58 mA/V, while the DAS3 is a triode of AC resistance 7,600 ohms and mutual conductance 0.62 mA/V. The valves have a special 4-pin base, a diameter of 16 mm., and an overall length of 69 mm.

Osram also have introduced midget valves, the S12, H12 and L12. Of these the first is a tetrode and the others are triodes. Their filaments are rated at 2 volts 0.05 amp. A new battery duo-diode-triode is to be found in the range of ordinary battery valves—this is the HD23—and there is also the X23 battery triode-hexode for superheterodyne frequency-changing.

Osram KTZ41 television RF pentode with mutual conductance of 12 mA/V.

The range of 6.3-volt valves has been extended by the addition of a low-resistance triode, the L63, and there is a new AC/DC output tetrode entitled KT33.

Of especial interest to designers of PA equipment is the DA250. This is a triode for 250 watts anode dissipation, and a pair in Class AB1 push-pull will give an output of 400 watts. In Class AB2 push-pull—that is, with some positive drive—a pair will deliver no less than 800 watts output.

Another new valve of rather especial interest is the KT8. This is similar to the KT66, but has a 7-pin base and a top-anode connection; moreover, it is rated for 600 volts anode potential with 300 volts on the screen grid. The mutual conductance is 4.5 mA/V. Used as a transmitting RF amplifier, an output of 25 watts can be obtained at 60 Mc/s and 43 watts at 20 Mc/s. Because of its top-anode connection, the valve should also prove useful for the output of the line time-base in television equipment. It is priced at 22s. 6d. Another transmitting valve is the DET14, which is rated for 55 watts dissipation. It is a triode and is suitable for operation up to 120 Mc/s.

Mazda now have ranges of 4-volt mains valves and 2-volt battery valves with an octal base. This is not the same octal base as that adopted by other firms. Among the more interesting types are the SP41 and SP42. The SP41 has a mutual conductance of 8.5 mA/V with grid-earth and anode-earth capacities of 11 $\mu\mu$F. and 4.75 $\mu\mu$F. respectively. At 45 Mc/s the input resistance is 2,200 ohms. The SP42 is a similar valve, but rated for 100 volts on the screen and intended for use in a VF stage. This firm also has an indirectly heated voltage-doubler rectifier. This is the UD41, and it consists of two rectifiers in one envelope with the anode of one internally connected to the cathode of the other. With 500 volts RMS input an output of 1,240 volts DC at 20 mA. can be obtained.

The Osram television valve is the KTZ41—a tetrode rated for 250 volts anode and screen potentials. With a bias of −1.5 volt the mutual conductance is no less than 12 mA/V. A new diode, the E922, has also been produced for the detector of television receivers.

Mullard have a valve of the secondary-emission multiplier type with a mutual conductance of about 20 mA/V. This is the EE50 and is of special construction, the usual base being absent.

In addition to their well-known ranges with the standard British bases and with the American Octal-base, Tungsram now have a series of valves with the Continental side-contact base. The range is the "E" series, and the EF6 is recommended for short-wave work by virtue of its low capacity and high impedance. The input capacity is given as 5.4 $\mu\mu$F., and the output as 6.0 $\mu\mu$F., while at 60 Mc/s the input resistance is as high as 9,000 ohms. The mutual conductance is 2 mA/V.

Of particular interest to transmitters is a valve which can operate up to 270 Mc/s. It is the OQQ 50/1500—a triode with grid and anode brought out directly through the glass to reduce capacities to a minimum. It is rated at 50 watts with 1,500 volts anode potential.

Cossor have extended their range of 0.2 amp. AC/DC valves by the 202SPB and 202VPB RF pentodes. The former is the "straight" valve and the latter the variable-mu. Both these valves have top-grid connectors, but the 202VPB has a counterpart with a top anode—the 202VP. A directly heated output triode with a filament taking 2 amps. at 2 volts is now

Olympia Show Report—

available. This is the 2XP, and it takes an anode current of 50 mA with 300 volts HT supply.

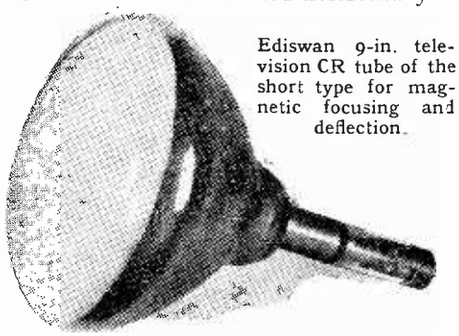
Hivac have introduced a high-voltage half-wave rectifier for use with cathode-ray apparatus. It is the HVU1 and is priced at 15s. 6d.; it is rated for 3mA at 6,000 volts. Gas-triodes for saw-tooth oscillators are now produced by this firm. There is the GR1 for television purposes—it is argon filled and priced at 20s.—and the GR2 mercury-filled valve for oscilloscope use.

Cathode-ray tubes are now a product of this firm, and two types are listed. The CR3 has a 3-in. screen and a 7-pin base. The screen is green, and two of the deflector plates are internally connected to the third anode. It is priced at 42s. A similar tube—the CR3A—has a blue screen, and all deflector plates are brought out to the 9-pin base; it costs 47s. 6d.

Cathode-ray tubes of various types are shown by Vacuum Science Products, and of especial interest is a 10-in. tube which is priced at 7 guineas. It is obtainable for either electrostatic or magnetic focusing.

In general the new cathode-ray tubes for television are magnetic types, and they are usually much shorter than their predecessors. The Mazda tubes have only grid, cathode with its heater, and anode for an electrode assembly, focusing and deflection being accomplished by means of externally mounted coils. Mullard tubes, however, have two anodes, the first of which operates at about 100-250 volts, while the second is rated for 4,000-8,000 volts, according to the type of tube. These tubes are available with screen diameters of about 9in., 12in., and 15in.

The advantage of the new short tube is that it can be mounted horizontally for

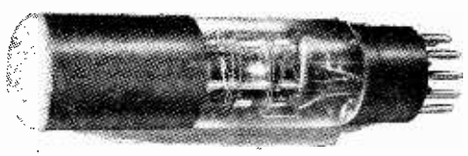


Ediswan 9-in. television CR tube of the short type for magnetic focusing and deflection.

direct viewing in a cabinet of only moderate depth. Its disadvantage is that as the deflection angle is greater, the output of the time-bases must be greater.

Because of this, Cossor have adhered to the normal tube length in their new magnetic types, and the tubes of Vacuum Science Products, referred to above, are actually longer than many of the so-called normal types, the increase in length being made to reduce the scanning power needed.

Apart from television tubes, Cossor, Ediswan, and Mullard have a wide range of small types for oscilloscopes. G.E.C. have also a 1½-in. screen tube, the 4051,



Osram 4051 CR tube for oscilloscope use.

and a 2½-in. model, the 4052. These are for quite low-voltage operation, the 4051 functioning successfully off only 350 volts.

Components and Accessories

WIRELESS components being comparatively small items physically do not usually attract the same attention as a complete set, and a quick survey of the Show might lead to the erroneous conclusion that the home constructor is not very well catered for. Actually, the amateur set builders' interests are particularly well looked after for it only needs a visit to Bulgin's stand, for example, to find ample evidence of this fact.

It is impossible to describe even briefly in the space available here all the latest additions, for there are no fewer than 260 new components awaiting the visitor's examination. If one is mainly interested in the short waves there is the new Bulgin

Bulgin 12-way miniature rotary switch and "octal" cable plug.

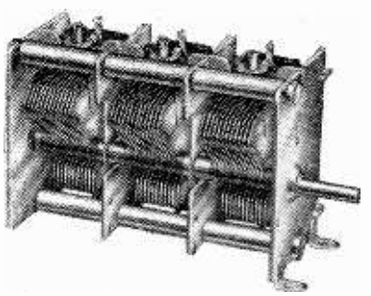
range of low-loss variable condensers in capacities of from 15 m-mfds to 160 m-mfds and assembled on ceramic plates. Prices are quite reasonable, varying from 3s. 6d. to 5s. each.

Then their range of condenser drives includes some new models, one such being a dual epicyclic drive having a ratio of 6 to 1 and embodying a vernier motion of 36 to 1 when it is rotated for a certain distance in the opposite direction.

Push-button switches in six- and eight-way types for pre-set tuning systems or motorised tuning are again new items, and their prices range from 8s. 6d. to 10s. 6d. per unit. If one is interested in the more ordinary systems of wave change, some new pattern rotary switches, capable of accommodating 16 contacts on a single switch, are included in the Bulgin range.

Many amateurs have been turning their attention to the derivation of HT for operating either a home broadcast set, a portable or portable transmitting equipment from an LT battery. A vibrator can be used for this purpose and arranged to convert the low-voltage DC into a high-voltage AC supply by means of a transformer, the AC then being rectified by contacts on the vibrator. Some new models of this style of unit are to be seen on Bulgin's stand for operation on 4, 6, 12 or 32 volts as well as the special transformers required. Prices range from 17s. 6d. to 20s.

Ordinary variable condensers of the two- and three-gang pattern have not undergone any marked change this year. There are a few new models admittedly, but on the whole the products of the well-known firms such as Wingrove and Rogers (Polar), for example, remain substantially the same. Minor improvements have, of course, been introduced where experience has shown them to be worth while. Changes merely to say "this is a new model" have not been made.

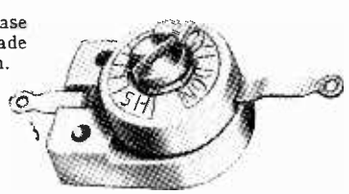


Latest pattern Polar three-gang condenser.

Specialised-type condensers, such as those used by amateurs in short-wave transmitting apparatus, are being shown this year by Sydney S. Bird (Cyldon). These have wide spacing between vanes, and there are models for 2,000, 3,000 and 5,000 volts working. Capacities range from about 0.0001 to 0.001 mfd. Some fine examples of this class of condenser are also to be found on the Eddystone stand.

The development of the push-button tuning system using pre-set condensers has necessitated some very careful attention to the design of the condensers as they obviously must be perfectly stable in use. Some mica-dielectric models mounted on ceramic will be seen on the Cyldon stand. They take the form of single as well as banks of condensers suitably assembled for push-button control. The maximum capacity of a single unit ranges from 30 m-mfds to 1,000 m-mfds. These condensers can also be used for trimming in ordinary circuits.

Ceramic-base trimmer made by Cyldon.



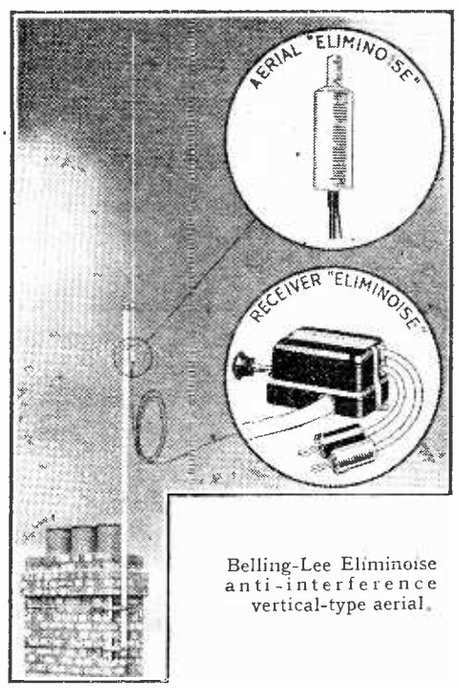
Dubilier mica trimmer condenser assembled on ceramic base.

Dubilier has an interesting selection of both mica- and air-dielectric trimmers. Again the question of stability once adjusted has entered into the design. Their metallised mica trimmers are shown in two sizes, viz. 5-20 m-mfds and 5-40 m-mfds. Another interesting Dubilier product is a stable air-dielectric trimmer with a cera-

Olympia Show Report—

mic body. It is made in sizes of 1-0 m-mfds, 1-12 m-mfds and 1-20 m-mfds, the prices being 2s. 6d., 3s. and 3s. 6d. respectively. This firm also show some new mica-dielectric trimmers in dual pattern on a ceramic base. Condensers of this kind are shown also by Bulgin, Cyldon, Hunt and Polar.

As usual, Dubilier has a most extensive range of new and improved condensers, all of which fully justify a description if only space would allow. Mention must be made, however, of their new surge-proof dry electrolytics. Rated for 500 volts DC peak working, they will withstand momentary surges of much higher potential yet the prices are quite reasonable, viz., 4s. and 4s. 6d. for a 4-mfd and 8-mfd respectively in cylindrical case. Waxed carton models are 1s. cheaper. There are also some new Dubilier dry electrolytics of 4 and 8 mfds. in the cylindrical cases, but of much smaller physical size (height) than was customary for this pattern a year ago.



Belling-Lee Eliminoise anti-interference vertical-type aerial.

Surge-proof wet electrolytic condensers obtainable from the T.C.C. for some time past are now being shown in dual capacity styles of 8-8 and 8-16 mfds, and, in addition, this feature has been extended to their dry variety. In this style condenser there are some new models styled "Midget" and "Minor"; these being 8 mfds in capacity, but of much more compact construction than the equivalent rated condenser made hitherto. Tubular-case and wax-carton styles are shown for working voltages of 500 DC, but which are capable of withstanding short-period surges at 600 volts DC.

T.C.C. ceramic precision condensers in disc and cup styles and in capacities of from 2 to 100 m-mfds will henceforth be available to the amateur set maker at reasonable prices.

Dry batteries of all kinds are well in evidence this year, the variety of sizes in what all battery makers describe as their "replacement" series is a good indication if one is needed that this form of power for a wireless set is still very popular. Likewise, there is an equally large selection of LT batteries. Among the firms catering for the battery-set user may be mentioned Britannia Batteries (Pertrix), Drydex and Exide, G.E.C., Fuller, Siemens, Sterling Batteries and Vidor.

Those who from choice use batteries but have electric supply available will find a long range of battery chargers on Heayberd's stand. Models for both HT and LT, including large capacity car starter batteries, are being shown as well as models for the battery service station.

Whilst on the subject of HT supply, attention might be drawn to the extensive range of metal rectifiers shown by Westinghouse. There are models for high- and low-voltage rectification as well as units for incorporating in rectifier-type measuring instruments. This firm's exhibit will hold much interest also for the battery service station engineer in view of the large selection of chargers they have on the stand.

A firm whose products will be familiar is Morris and Co. as they are showing a representative selection of Premier components and accessories. The transmitting amateur in search of a modulation transformer or a high-voltage mains transformer will find a visit to this stand quite profitable. Short-wave equipment is also a speciality of this firm.

Another exhibit that will interest the short-wave experimenter is that of the Telegraph Construction and Maintenance Co., where some new low-impedance aerial-feeder cables in concentric and parallel-wire pattern are being shown.

Belling and Lee as usual have a big selection of connectors, terminals and a host of small but important items. A new vertical aerial embodying the Eliminoise anti-interference system is being shown. Those who are troubled with electrical interference should visit this stand as noise suppression is a subject in which they specialise, and many new methods of treatment have now been evolved.

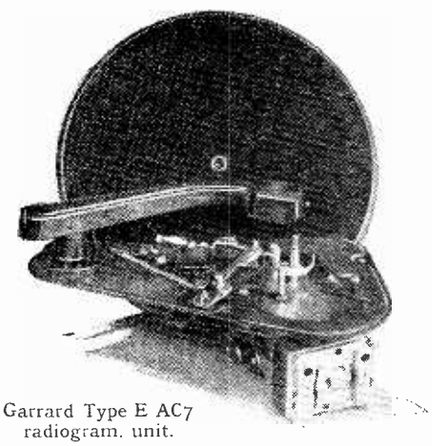
T.C.C. "Midget" and "Minor" dry electrolytic condensers.

Among the newer short-wave components that Eddystone are showing this year is a flexible cable coupling designed for operating volume controls and similar forms of variable components where a straight, stiff shaft is not possible. It will actually drive through an angle of 90 degrees. They now have a series of knobs and dials for transmitters, a very compact and ingenious air-dielectric trimmer and transmitter formers and bases.

Since all amateurs are keenly interested in the apparatus used by fellow experimenters, a visit to the stand of the Radio Society of Great Britain will not only enable them to examine some fine pieces of amateur gear, but they will find many kindred spirits gathered round this natural focal point of amateur radio.

GRAMOPHONE ACCESSORIES

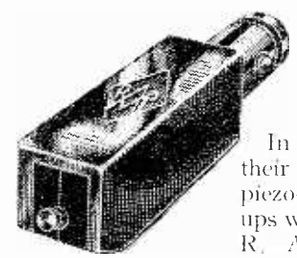
The new Type E AC7 radiogram. unit shown by The Garrard Engineering Co., Ltd., is mounted on a simple base-plate and incorporates a frictionless automatic switch and a compact pick-up with moulded bakelite tone arm. Screened output leads are fitted as standard and the price of the complete unit is 52s. 6d.



Garrard Type E AC7 radiogram. unit.

Playing desks for converting table model sets to radiogramophones are shown by Cosmocord in a wide variety of types, including pedestal models. The turntable and pick-up are housed in a concealed recess with a hinged flap which draws the mechanism forward when opened. The Model 25 magnetic pick-up has been improved and now costs 25s., and a new crystal pick-up with an output of 3.6 volts at 1,000 cycles has been introduced.

Portable gramophone conversion units and a wide variety of table and cabinet models constitute the exhibit of the National Band Gramophone Co. Prices range from £3 19s. 6d. for the portable unit, to 23½ guineas for the Model 05 cabinet with Garrard automatic record changer.



Rothermel-Brush replacement crystal pick-up head.

In addition to their usual series of piezo-electric pick-ups with tone arms, R. A. Rothermel, Ltd., are showing a group of replacement heads which includes special models for the Collaro and Garrard automatic record changers and one for general replacement purposes.

Negative Feedback

WHAT IT IS, and WHY IT IS USED

By "CATHODE RAY"

SINCE I last dealt with this subject it has attracted a much bigger audience, and many who have come in late and missed the beginning are in rather a muddle about it and are asking who this negative feedback fellow is and why he keeps coming into the picture. He is such an interesting and versatile character as to be too much to discuss in a single article, so this one will attempt no more than a general idea of what negative feedback is and why it is used, leaving till next week some practical information on how to apply it.

Although superhets have made the use of reaction in receivers almost obsolete I suppose everybody knows what it is. Part of the output from a valve is coupled or fed back to the input in such a way as to reinforce it and so add to the amplification, in the same way as compound interest keeps on increasing the value of the original capital. Reaction also adds to the selectivity, because whichever frequency is already amplified most is naturally the one that benefits most by the reaction process, so that in tuned circuits the response to the wanted frequency is increased, whereas the amplification of other frequencies is already so small that the addition of reaction has little effect. The resonance peak is therefore increased and sharpened (Fig. 1).

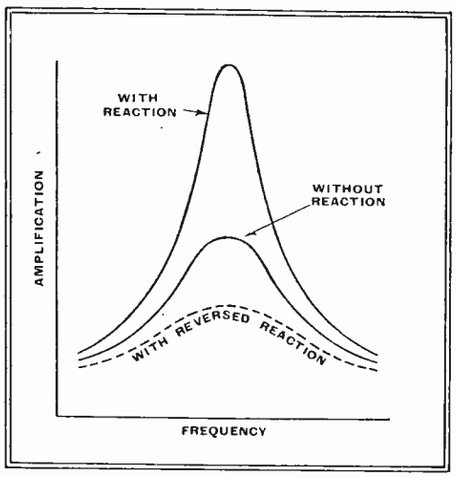


Fig. 1.—The well-known effect of reaction, or positive feedback, is to increase amplification and sharpen resonance peaks. Negative feedback, therefore, may be expected to do the opposite, giving improved frequency characteristics to audio amplifiers.

Now in audio-frequency (AF) amplifiers it *may* be desirable to boost the amplification, but with modern valves there is generally no difficulty in getting all that one wants without any such help; in fact, there is often more than one knows what to do with. On the other hand it is most important to check any tendency towards a resonant peak, as the object is to get the same amplification at all frequencies. If reaction, or *feedback*, is applied in the opposite or *negative* direction, so as to reduce amplification instead of increasing it, it is natural to expect any peaks in the amplification curve to be flattened, giving less distortion.

This is actually what happens, and if one is prepared to sacrifice some amplification the distortion can be reduced. To maintain the amount of amplification required to get full volume it must first be increased so as to stand the application of negative feedback. It may seem a silly proceeding to increase amplification in order to bring it back to the original amount by throwing the surplus away, but, as I have just implied, amplification is plentiful and cheap, whereas freedom from distortion is worth paying something for. If a very high standard of quality is aimed at it may be cheaper to use ordinary components giving a lot of amplification and to cut the surplus down by negative feedback than to exclude distortion by very careful and expensive design, which generally means sacrifice of amplification anyway.

In case any readers are not satisfied with the "anti-selectivity" explanation just given, here is something more definite. Suppose the box in Fig. 2 contains an amplifier giving a gain of 12 times. That means that for every one signal volt applied to the input twelve are given from the output, up to the limit imposed by the power the valve can handle. In Fig. 2(a) it is shown with 2 volts in and 24 out. Now suppose that a certain fraction of the output is fed back to the input by some such connection as that shown in Fig. 2(b). If the fraction is $\frac{1}{4}$ (usually described as 25 per cent. feedback) then the voltage fed back to the input is $-\frac{24}{4}$ or -6 volts, the minus indicating that it is in opposition. In order to maintain the same output the input must be increased from 2 to 8 volts, the difference of 6 being necessary to neutralise the -6 fed back. Although the amplifier itself works just as before (a fact that is often overlooked) the addition of the feedback connection may be thought of as reducing the amplification from $\frac{24}{2}$ (or 12) to $\frac{24}{8}$ (or 3).

Now suppose that owing to imperfection in the amplifier the gain at the extreme frequencies is down to a half normal, or 6. The effective gain when 25 per cent. feedback is applied can be worked out in the same way. Take any signal voltage, say 2 again; then the output is 2×6, equal to 12. A quarter of this is fed back; -3 volts. Total input therefore 5 volts; and effective gain, output divided by total input, is $\frac{12}{5}$, or 2.4 (Fig. 2(c)). Instead of being half normal, or 6 decibels loss, as in the original amplifier, this is $\frac{2.4}{3}$, 0.8 normal, or only 2 decibels loss. In the same way any peak that may exist in the amplifier is flattened down.

Reducing Amplitude Distortion

So *frequency distortion* can be substantially reduced by negative feedback. Worse forms of distortion arise when the output is not exactly proportional to the input. This is called non-linearity or amplitude distortion, and is invariably present in some degree because no real

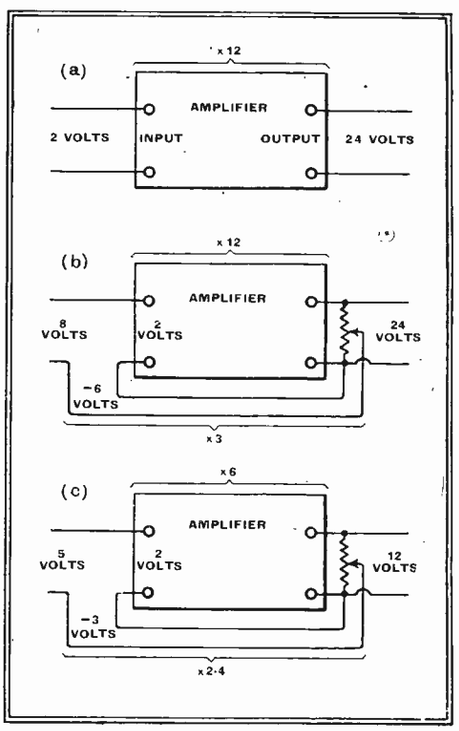


Fig. 2.—The action of negative feedback is illustrated by a simple numerical example. (a) shows an amplifier without feedback, having a voltage amplification of 12 times. (b) shows the same amplifier with feedback; the amplifier itself still magnifies by 12, but including the feedback loop the overall amplification is down to 3. If the gain of the amplifier is altered to 6 the overall gain with feedback is 2.4, a comparatively smaller loss.

Negative Feedback—

valve characteristics are perfectly straight. Transformer couplings are also liable to the same defect; especially at very low frequencies.

The baleful results of non-linearity have been freely discussed in the correspondence columns, and although there is some difference of opinion about the relative offensiveness of harmonics and intermodulation products, it is agreed by all that the distortion consists of the production by the amplifier of tones that were not present in the original signal.

Supposing that the amplifier in Fig. 2 generates what for brevity I shall call harmonics equal to 10 per cent. of the output, which you remember is 24 volts. The output of the amplifier without feedback therefore contains 2.4 volts of harmonics, which can be regarded as being introduced in series with the output of the amplifier, as indicated in Fig. 3(a); as only distortion voltages are now being shown and the input is assumed distortionless it is marked as zero volts. Now when feedback is applied the effect is a little less simple to work out than the previous examples, but readers should be able to follow it quite easily by examining Fig. 3(b). The output is unknown for the moment so we call it x. A quarter of x is fed back negatively, and is then amplified to the extent of $\times 12$, so the output from the amplifier is now the original 2.4 volts of distortion minus $3x$ volts of feedback and amplified distortion; and we already know this combined result is equal to x. Hence the very simple little equation written below the diagram which shows that the effect of feedback is to cut amplitude distortion to a quarter of its original amount, which, incidentally, is the same extent to which amplification is cut (Fig. 2(b)). The same arguments hold good for anything generated *within* the amplifier, such as valve noise or hum.

Constancy of Output

Negative feedback is really beginning to look quite interesting; are there any more things it does? Well, it follows from Fig. 2 that if anything happens that tends to alter the amplification—mains or battery voltage variations, or valve replacements—the alteration is much less in amplifiers where feedback is employed. The example of Fig. 2 shows that with the amount of feedback specified a change in amplification of 50 per cent. is reduced to a change of 20 per cent. That is not especially useful in ordinary domestic receivers, but it may be very valuable in laboratory apparatus or telephone repeaters.

There is still another result of negative feedback, which is the one it is most commonly used for in the radio and allied trades. It is the change in the apparent internal resistance of the valve from which the feedback is derived, and is almost invariably adopted for reducing the resistance of a pentode or tetrode output valve so that it tends to suppress loud-speaker resonances like a triode. Another beneficial result, not so well known, is that it compensates for changes in output load, so that extension loud speakers can be plugged in without noticeably reducing the volume from the one already connected.

In a general sort of way this is not difficult to understand, for if you imagine the amplifier of Fig. 2 to be feeding a certain load resistance, and then that load resistance to be reduced by connecting other loads in parallel with it, the output voltage will tend to drop. But if negative feedback is in use, any such reduction in output voltage causes a proportional reduction in feedback and a rise in amplification that raises the output voltage and partly neutralises the tendency to drop. Similarly if the load is reduced or removed altogether the rise in output voltage is checked by the increased feedback. A system in which the output voltage changes very little when the load resistance varies a lot is one in which the internal resistance is low. An example is the public electricity supply system. The feedback circuit shown tends to give the same sort of characteristics.

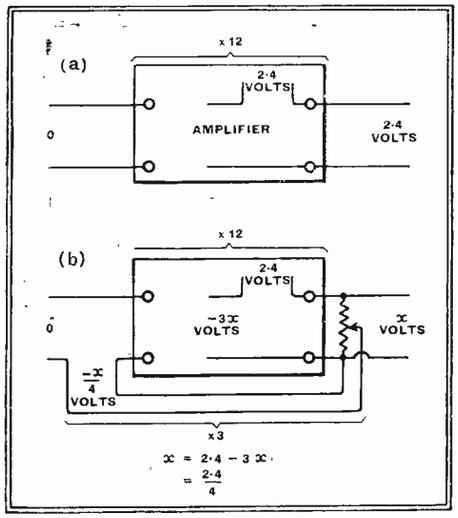


Fig. 3.—Amplitude distortion, hum, or noise occurring in the amplifier, can be represented by a voltage introduced in series with the output. Ten per cent. distortion (compare Fig. 2) is shown at (a). When feedback is used the distortion is reduced in the same proportion as the amplification (b).

There are other ways of connecting a feedback circuit, and although they all have the same sort of effect on amplification and distortion they have opposite effects on input and output resistance. In Figs. 2 and 3 the feedback is drawn off in parallel from the output and applied in series with the input. If it is taken off in series with the output (Fig. 4) it obviously does not work at all unless some load is connected to the output. If a very low load resistance is connected the feedback voltage is large, and the output voltage is reduced. So it acts in just the opposite way to the parallel connection, and tends to maintain the output *current* constant rather than output *voltage*. This is obviously equivalent to a system with a very *high* internal resistance. Whether it is a good thing or not depends on circumstances, but for loud speakers it is generally bad because a very high resistance valve fails to damp out cone resonances.

Easy Tone Control

There is still another way in which negative feedback is sometimes employed. Up to the present we have assumed that the feedback circuit itself is free from any form of distortion. As it contains no valves or transformers there is generally no question of amplitude distortion. But if condensers or inductances—things that vary in impedance according to the frequency—are included, the amount of feedback will depend on frequency too. For example, suppose a condenser is shunted across the part of the potentiometer that taps off the feedback. At low frequencies the condenser may make negligible difference, but at the high frequency end of the scale it may reduce the percentage feedback. The result is to give a lift to the treble end of the frequency characteristic. By using suitable components it is possible to employ negative feedback as a very flexible sort of *tone control*.

Of course, this is only one side of the story. There are practical difficulties in applying negative feedback, but these will be left to the next article, which will also include simple formulæ for quickly working out how to produce a desired amount of effect.

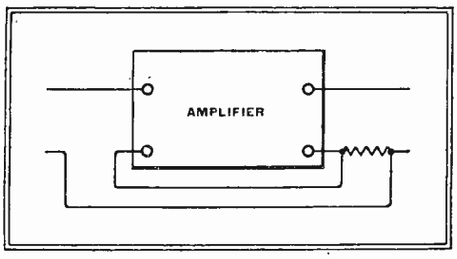


Fig. 4. An alternative method of providing feedback is from a resistance in series with the load instead of a potentiometer across it.

In the meantime the following results of negative feedback can be remembered:—

If a simple resistance feedback circuit is used—

(1) amplification is reduced,

(2) all forms of distortion are reduced

(3) internally generated noise or hum is reduced

(4) variability of amplification with change of valves or supply voltages is reduced.

If a circuit containing capacities or inductances is used—

(5) tone control can be obtained.

If the feedback is tapped off in parallel with the output load—

(6a) the apparent internal resistance of the output valve is reduced.

If it is tapped off in series with the load

(6b) the apparent resistance is increased.

Secrets of the Show

AN IMPORTANT DISCLOSURE

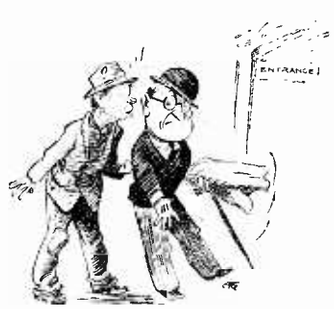
By FREE GRID

AS this issue of *The Wireless World* will appear the day after Radiolympia opens it will be obvious to all of you that I shall not have had time to make that thorough and searching examination of the exhibits and the exhibitors which I always like to do on your behalf before committing my views to paper. I quite realise, of course, that if I so desired I could have had an extensive pre-view of the Show before the public was admitted, but this did not fit in with my ideas at all. I like to visit the Exhibition as an ordinary member of the public when the red carpets have all been put away in favour of the coconut matting, as it is only in this manner that I am able to get at the real truth about things.

Consequently I am not giving you this week any details of what is to be found there, although, fortunately, by a pure stroke of luck, I find myself in a position to reveal to you the reason behind one of the mysteries which this year's visitors will find at Olympia, namely, the seemingly first-rate quality which is being put out by the sets on show there which, as you will probably have heard rumoured, are actually being demonstrated this year.

Fidelity Filters

Many of you have in all probability noticed the extremely poor quality which the B.B.C. transmitters seem to be putting out of late. I first noticed it a week or two ago and forthwith disembowelled my set, but was unable to trace the fault, and as I found the same poor quality on another set, I wondered if something were amiss with the local station on which I had been testing the set, but to my surprise none of the other B.B.C. stations was any better.



"I was just about to enter Olympia"

Naturally I at once concluded that it must be a fault in my set after all, and I was about to begin to disembowel it once more, when it occurred to me to tune in a Continental station, and to my surprise quality was perfectly normal. In brief, none but B.B.C. stations was affected, and I was just going to write a paper on this newly discovered "effect" for the purpose of reading it before a certain learned society of which I am a Fellow, when, quite by chance, I discovered the cause.

I was, as a matter of fact, just about to enter the Olympia Exhibition when I was stopped by a ragged-looking down-and-out who was at one time a well-known salesman employed by one of our great wireless manufacturers, but had lost his job through attempting to give an intelligent answer to a technical enquirer at last year's show. He asked me in a hoarse whisper whether it was worth a few coppers to learn something of interest, and upon my assenting he led me to a greasy-looking fish-and-chip restaurant somewhere in the back streets bordering on Olympia. As soon as we were safely ensconced in the low-down dive and had commenced our piscatorial repast, he commenced to unfold a truly astonishing story.

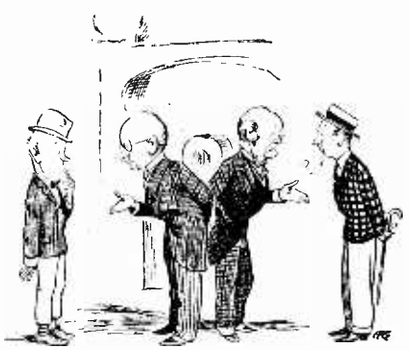
He first asked me if I had noticed the extremely poor quality of the B.B.C. transmissions lately, and as soon as I said yes, he asked me if I had any idea of the reason. I naturally commenced to give him a précis of the paper I was preparing for the learned society, but he cut me short with a somewhat contemptuous laugh. It appears from what he tells me that the poor quality is part of a back-door agreement between the B.B.C. and our wireless manufacturers. The distortion, so my informant told me, is being deliberately introduced so that listeners will become dissatisfied with the performance of their receivers, and therefore be in the right mood to be persuaded to decide upon a new one at Radiolympia.

This year, my informant said, a radio- as well as an audio-frequency signal is being supplied to the stands at Radiolympia, but it will be found that the new models do not reveal the poor quality of the B.B.C. transmissions. As it is known exactly what distortion the B.B.C. are introducing, it is obviously easy to design a filter unit to give exact correction, and this is the reason why all the new sets appear to give such vastly superior results when demonstrated to you in comparison with your old one. Of course, the new sets will not be sold with the filter unit, but by the time they are installed in your house the B.B.C. transmissions will have returned to normal.

Needless to say, I was extremely gratified to receive this very important piece of information, and have rewarded my informant accordingly, using certain influence I possess in finding him a position in the Intelligence Department of the War Office to which his espionage talents seemed to be suited. As for the information itself, it is invaluable coming as it does at the beginning of the Show like this, and I intend to make very diligent enquiries into this apparent breach of trust by the B.B.C. What they get out of it I don't know, as their Charter prevents their receiving any pecuniary *quid pro quo* from the manufacturers.

Mention of the Intelligence Department has, by what I believe psychologists call the theory of opposites, reminded me of the people on the Exhibition stands who answer enquiries. I have been told on what is quite reliable authority that this year manufacturers have made a great innovation in this respect, and have staffed their stands with people who have been specially trained to answer questions.

This information may mean anything or nothing, of course, as the question answerers may only be ex-political orators. However, I am intending to give them the benefit of the doubt, and have prepared a special list of test questions which I intend putting to them. Most of the questions are, as a matter of fact, extracted from a recent set of examination papers prepared for candidates aspiring to a science degree at one of our most ancient seats of learning, and so there will be no unfairness about them.



"Specially trained to answer questions"

Wait and See

With regard to the rumours that each stand is to be fed with a RF as well as an AF signal this year, and that sets are to be actually demonstrated, I prefer to say nothing until next week. You will, I feel sure, appreciate the fact that there are so many wild rumours flying about that it is difficult to separate fact from fiction. One rumour which has reached me, for instance, is to the effect that all sets are to be individually tested before they leave the factory, and the old system of supplying one or two "defective" models to listeners before permitting them to have the working one is to be finally abandoned. Needless to say, I can hardly credit such wild and revolutionary statements as this, and that is why I prefer to say no more until next week.

NEWS OF THE WEEK

RADIOLYMPIA

Television the Focal Point of the Show

ON entering Radiolympia, one is struck with the spacious appearance of the show as compared with previous years. Each stand is very much larger, and this is undoubtedly due to the introduction of demonstration television receivers on the stands themselves, and not in the special booths as last year. The quality of the pictures shown on the demonstration receivers is excellent, and should do much to convince the hesitant buyer that television is beyond the experimental stage.

The principal attraction of the show to the general visitor is the television studio. This is almost twice as large as those in general use at Alexandra Palace, and is fitted with four separate "sets." Visitors gain a very good view of the artistes at work, for three sides of the studio are glass.

Every endeavour is being made by the B.B.C. to render the public "television conscious," as is evidenced by the talk which was broadcast by the Deputy Director-General the day before the opening of the show.

VALVE PRICE REDUCTIONS

IMMEDIATELY prior to the Olympia Exhibition reductions in the prices of many valves were announced, the reductions being operative from August 15th, 1938. Brimar, Cossor, Ever-Ready, Ferranti, Marconi, Mazda, Mullard, Osram and Philips valves are affected.

Battery screen-grid types are in general reduced from 11s. to 9s., duo-diode-triodes from 9s. to 7s. 6d., frequency-changers from 14s. to 10s. 6d., while QPP output valves come down from 17s. 6d. to 12s. 6d.

Among mains valves there is a reduction of 2s. in the price of many RF pentodes, and of 3s. in the case of output pentodes. Frequency-changers become 11s. 6d. instead of 15s. Triodes of the 15-watt class are now 9s., and many output pentodes and tetrodes become 10s. 6d. The largest reductions are in some of the heavy-duty rectifiers, which are now 15s. instead of 25s.

TELEVISION STANDARDISATION

THE French Minister of Radio's announcement that the system of transmission employed by the television service in France will remain substantially unaltered until July 1st, 1941, should be a great stimulus to receiver sales in that country. The year 1941 will mark a vital period in the progress of television, for it may be remembered that the guarantee given by Major Tryon, Postmaster-General, concerning the stability of the present system of B.B.C. transmission, will expire in January of that year.

THE INTERFERENCE NUISANCE

Australia Takes Action

WHILE Britain still shilly-shallies with the question of interference legislation, Australia is taking active steps. It is understood that the Commonwealth P.M.G. has investigated the Government powers to deal with sources of electrical interference with radio reception, and has discovered that existing statutes provide all that is necessary to deal effectively with the situation.

Is it possible that our own P.M.G might make a similar discovery?

MUSIC PRODUCTIONS UNIT

Conveying the Opera House Atmosphere to the Listener

THE B.B.C. Music Productions Unit, which was formed last winter, includes engineers as well as musicians, and readers will probably remember the technical excellence of the performances of "Manon," "The Bartered Bride," and "Faust," for which the unit was responsible. Special attention is given to the placing of microphones in order to convey the impression that the operas really are being acted, and not merely sung in concert versions.

During the autumn quarter the unit will produce two full-length operas in English in St. George's Hall, which provides the singers with something of the atmosphere of the opera house.

SATURATION POINT IN U.S.A.

IN Milwaukee, Wisconsin, 99 per cent. of the families possess wireless receivers—that is, according to investigations made by advertising authorities, which show that 82 per cent. of America's 26,666,500 homes are radio-equipped. This follows the statement published by *Radio Retailing* to the effect that when 81.99 per cent. of the homes in U.S.A. owned receivers, saturation point would be reached.

PARLIAMENTARY BROADCASTS

Success of New Zealand Experiment

THE suggestion that debates in the House of Commons should occasionally be broadcast has frequently been made. There would be many obstacles to overcome, not the smallest of these being the opinion of the M.P.s themselves, who, apparently, still retain something of the tradition of secrecy which obtained a century or so ago.

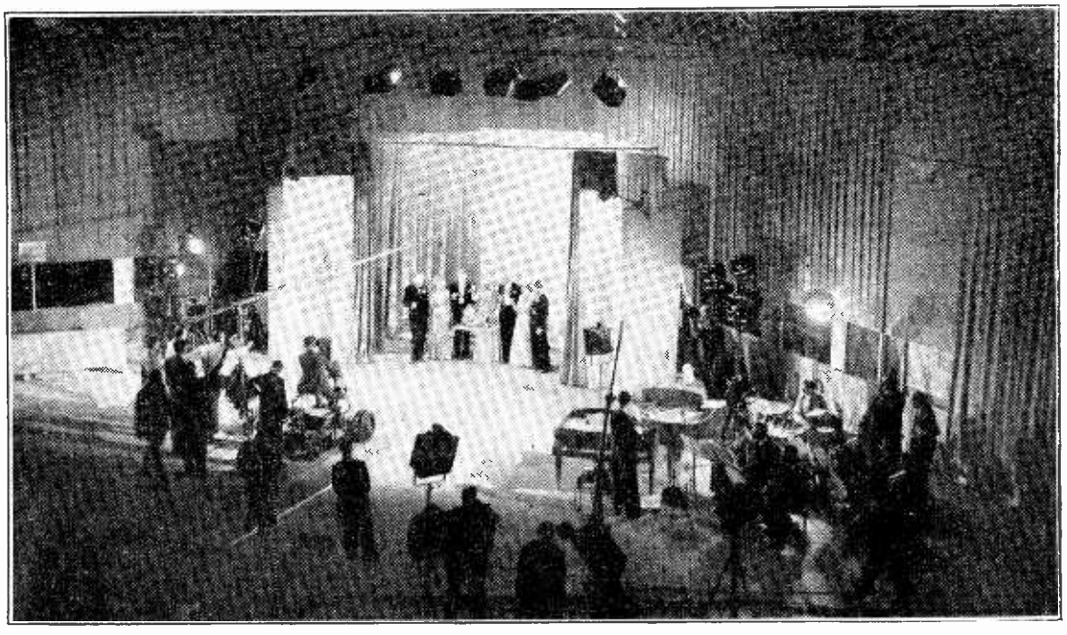
The difficulties have apparently been successfully surmounted in New Zealand, where the proceedings of the House of Representatives have been broadcast for several months past.

As is suggested in *The Nottingham Guardian*, it is not improbable that such broadcasts would do something to promote public interest in Parliament and to increase the identification of Parliament with the people.

It is claimed in New Zealand that the Parliamentary broadcasts, which frequently occupy several hours of the day's programmes are very popular.

NORWEGIAN "ALL-PEOPLES' SUPERHET"

A 2-VALVE regenerative receiver was put on the Norwegian market some time ago with the support of the State



THE FOCAL POINT of the Radio Exhibition is television. The glass-walled studio gives visitors to the show a very good idea of working conditions during a normal broadcast. Times of transmission from the Radiolympia Studio are given in the Television Programmes on page 160.

News of the Week—

broadcasting organisation in order to lower the general price level of receivers and to increase the number of licences. This, however, seems to have been something of a failure.

Norwegian manufacturers have now pooled their resources to produce a superhet to be known as the "Folkesuper," which is expected to sell at from 180 to 200 kroner (£9—£10).

SYNCHRONISED TRANSMITTERS

CONSTANCY of oscillator frequency between the synchronised B.B.C. transmitters radiating the London, North and Scottish programmes can be maintained to 1 part in 1,000,000, but until recently it was considered that any increase in the power of London and North Nationals might cause intermittent or constant interference between them. On August 9th their power of 25 kW each was raised to 40 kW. No phase distortion has been reported, and the desired effect for a better service for the areas covered by the stations has been effectively accomplished.

ALPINE NETWORKS

FRENCH Alpine guides are at present discussion the possibilities of establishing a network of wireless transmitter-receivers in the more remote mountain refuges to make it possible for climbers to summon assistance in cases of emergency.

These discussions follow the decision taken by the Post Office to install wireless equipment in the recently completed refuge, located 1,472ft. below the 15,782ft. summit of Mont Blanc, and it is hoped that the scheme will receive the support of clubs associated with climbing.

FROM ALL QUARTERS

Calcutta on Short Waves

THE opening of the Calcutta short-wave broadcasting station of All-India Radio by the Prime Minister of Bengal, Mr. Fazl ul Huq, on August 16th, brings the number of transmitters in operation to twelve, eight of which have been inaugurated during the past eight months. The station VUC2, working with a power of 10 kW, will transmit from 8 to 10 a.m. (B.S.T.) on 9,530 kc/s (31.48 metres), and from 12.30 to 6 p.m. (B.S.T.) on 4.880 kc/s (61.48 metres).

Radio Entertainment Tax

A TAX of 1 per cent. of their value is to be levied on wireless receivers installed in taverns and other places of public recreation in Germany. Apparatus in factories, hairdressers' establishments, and so on, will not be taxed.

Mobile Radio's New Use

FIVE New York telephone exchanges were recently put out of action when a workman inadvertently pierced several telephone cables with a compressed air drill. To alleviate the difficulties of hospitals and other important public institutions, which were deprived of the use of their telephones, twenty police cars equipped with short-wave wireless apparatus controlled from four principal stations were used to relay the more urgent messages.

British Association Meeting

LORD RAYLEIGH'S presidential address at the opening of the British Association meeting last Wednesday was mainly concerned with natural vision and vision aided by science. During the course of his address he made frequent reference to the progress of television and the various applications of the Iconscope.

Australia Enjoys Test Match via Hong Kong

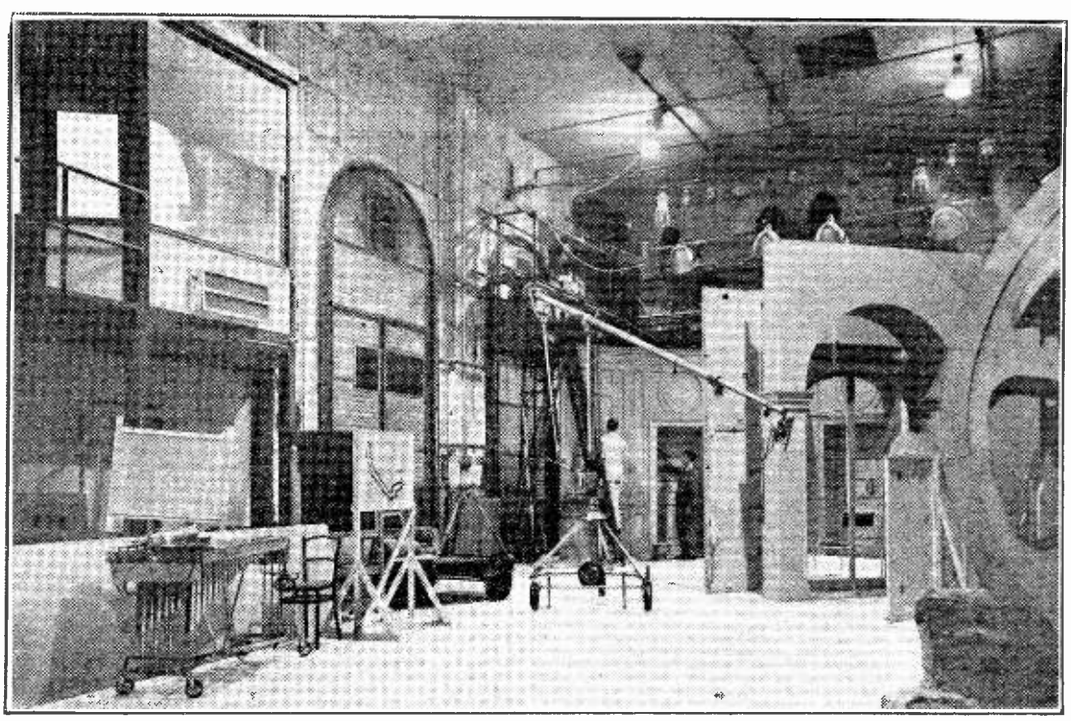
AUSTRALIAN reception of the Fourth Test Match broadcasts from Daventry appears to have been patchy. In Perth listeners were well served by their own National relay of Howard Marshall's description from Daventry, and a few stalwart souls picked up Daventry direct, but according to reports from Sydney the best ball-by-ball commentary was heard from ZBW, Hong Kong, on 31.41 metres.

The Radio Service Engineer

A CAMPAIGN is being launched by Electrical Trades Union, 11, Macaulay Road, Clapham Common, S.W.4, to organise radio service engineers. The object will be to improve and standardise the status of the service man.

Controlling the Ether

CONTROL of secret wireless transmitting stations and more comprehensive policing of the ether, figure among the revised counter-espionage services outlined in a note circulated by the Minister of the Interior to all authorities concerned in the control of foreigners in France.



A SECOND TELEVISION STUDIO for regular use is now nearing completion at Alexandra Palace. Originally built for the Baird intermediate film system, it is being remodelled and fitted with "sets" and will be in regular use by the middle of October. The new central control room, which was illustrated last week, has observation windows in both studios, thereby permitting the combination of the output of the two studios in one programme.

The New D.G.

AN interesting sidelight on the character of the New Director-General of the B.B.C. is that he wishes to be known to the staff as *Mr.* Ogilvie, not Doctor or Professor, though he is entitled to both prefixes.

African Relay Station

THE 30-kW station now in the course of construction near Tunis will relay all French national transmissions in Northern Africa. It will pick up programmes for retransmission at a receiving station about 1½ miles away and a studio has been hired in Tunis itself, which is fourteen miles from the transmitter. In the absence of suitable cables, programmes from Paris will be transmitted across France and the Mediterranean to Tunis by short waves.

Daventry Serves the World

THE B.B.C. has received a pat on the back from China. Writing in a Shanghai paper, a correspondent refers to the thoughtfulness of the British broadcasters in changing their Daventry wavelengths to suit listeners in the Far East at different times of the year. "The advertising stations in America," he remarks bitterly, "do not change their wavelength in this way to benefit reception here."

Another Noise By-law

UNDER a new by-law in Dunstable operators of excessively-loud speakers are liable to prosecution if the nuisance continues for a period of more than two weeks after the receipt of a complaint which has to be signed by only three affected neighbours.

Commercial v. National Broadcasting

THE National Broadcasting Service of New Zealand was severely criticised during a recent broadcast talk given by a director of one of the commercial broadcasting stations. The references were such that Parliamentary action has been urged in what is felt to be a gross misuse of the station's broadcasting licence.

Disaster in Denmark

THE production of the new season's receivers in Denmark has, we understand, been severely retarded by a serious accident at the Torotor variable condenser factory when a giant pressing machine crashed through one of the floors causing damage to several departments.

University Radio Workshop

THE New York University Radio Workshop is completing a six weeks' summer course designed to give practical training to persons interested in broadcasting as a career. The students represent many trades and professions.

Operators on Air Routes

NEGOTIATIONS opened in London last week between the Radio Operators' Union and Imperial Airways with the object of establishing a standard table of conditions and rate of pay for operators working on air routes. An exactly similar scheme has already been arranged between British Airways and the R.O.U.