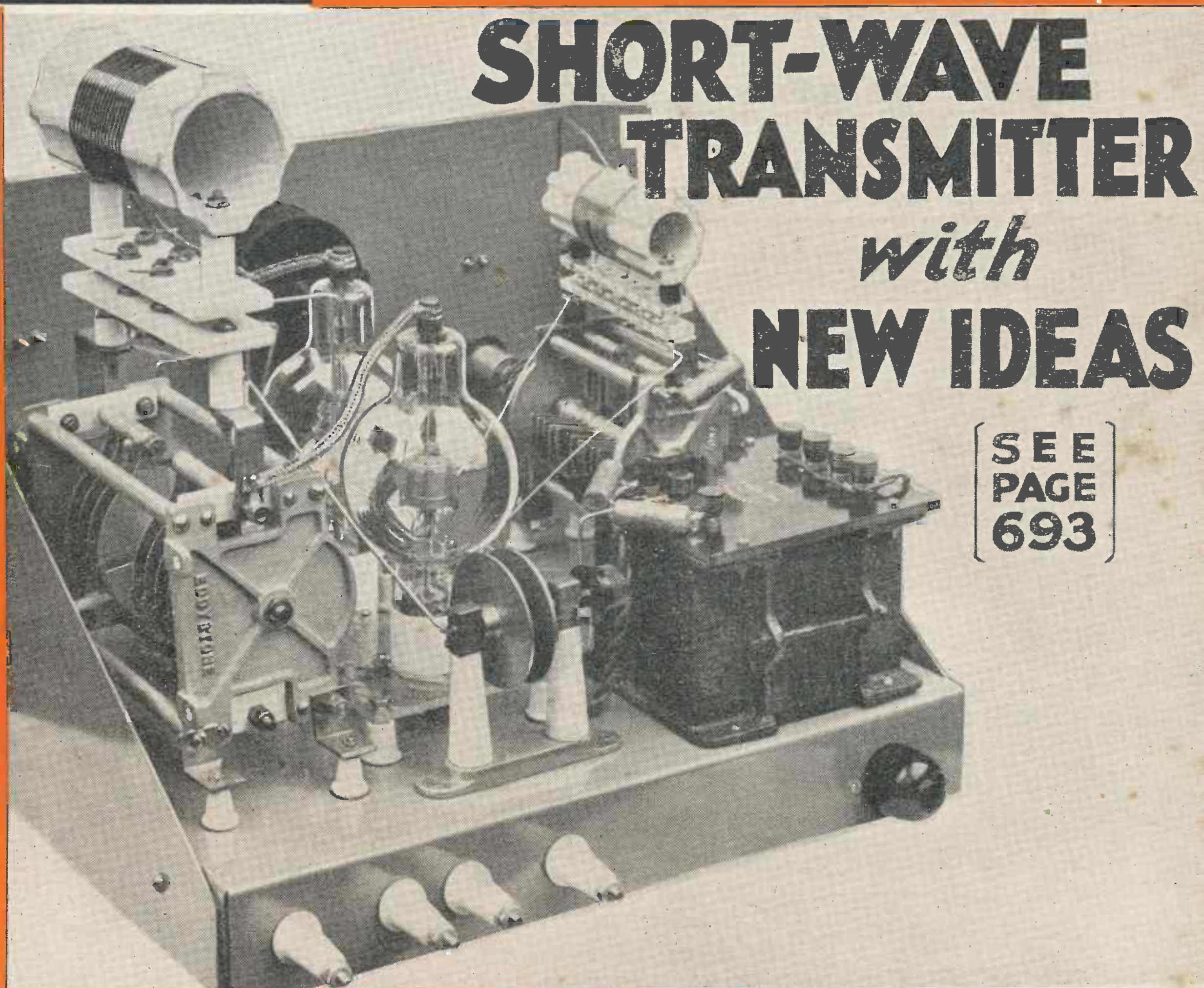
REVOLUTIONISING KINEMATOGRAPHY! SEE PAGE 675

Television and SHORT-WAVE WORLD

NOVEMBER 1938
No. 129. Vol. XI.
1/-

SHORT-WAVE TRANSMITTER with NEW IDEAS

SEE PAGE 693



REDUCING MOTOR-CAR INTER-FERENCE

SIMPLE METHOD OF INCREASING RANGE

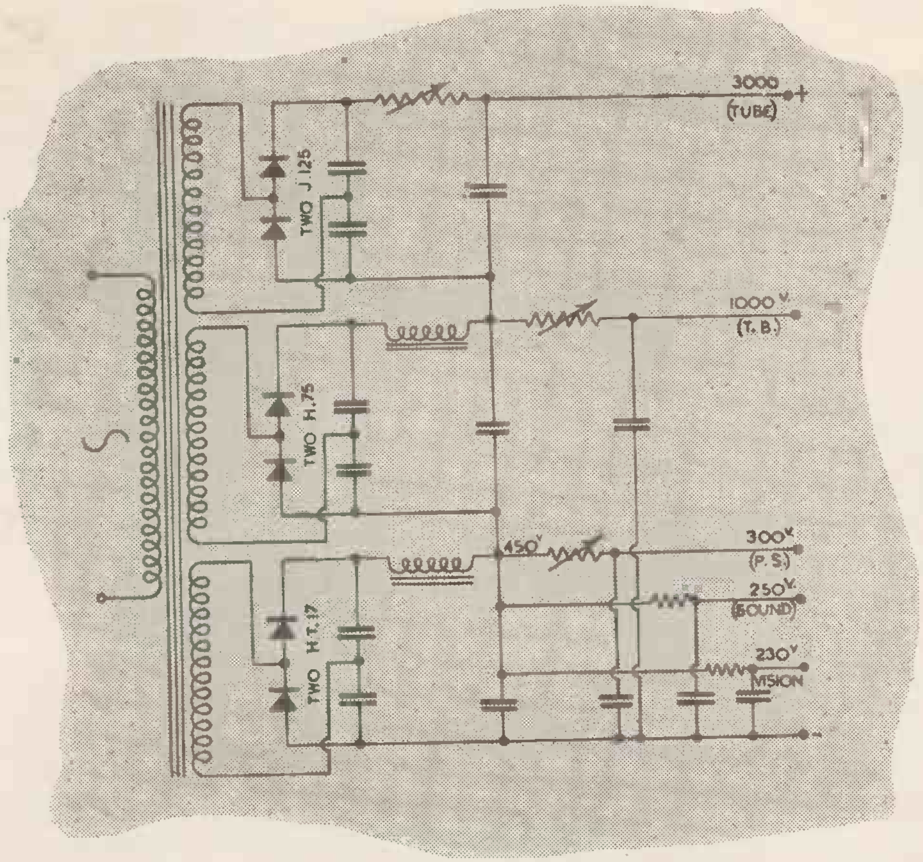
SHORT WAVES

25-WATT C.W. TRANSMITTER

CRYSTAL MICROPHONE PRE-AMPLIFIER
BATTERY-OPERATED TRANSMITTER
A.V.C. ON SHORT-WAVE RECEIVERS

BERNARD JONES PUBLICATIONS LTD.
CHANSITOR HOUSE, CHANCERY LANE
LONDON W.C.2.

THE FIRST TELEVISION JOURNAL IN THE WORLD


3000 (TUBE)
TWO J.125
1000 (T.B.)
TWO H.75
450
300 (P.S.)
250 (SOUND)
230 VISION
TWO H.T.17

No. 129 VOL. XI NOVEMBER, 1938

TELEVISION and SHORT-WAVE WORLD

Special Features

PAGE

TELEVISION AND SHORT-WAVE WORLD

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H. CORBISHLEY, F.T.S.

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IMPORTANT

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COMMENT OF THE MONTH

Television and the Cinema

ON other pages in this issue we publish a lengthy extract from a paper read by Capt. A. G. D. West, M.A., B.Sc., before the British Kinematograph Society. Captain West, in addition to being the President of this Society is, of course, the Technical Director of Baird Television, Ltd., and he is therefore eminently entitled to speak of the probable future link between television and the cinema. His paper, particularly the portion which we publish, is chiefly concerned with the technical aspects of the relation between television and cinematography and it foreshadows a time, perhaps very soon, when the present impasse between cinema interests and the B.B.C. will have to be removed. The means now exist for large-screen television in public halls, and three important cinemas in the West End have been equipped with apparatus capable of projecting a reasonably large television picture on the screen. The apparatus cannot, however, be used for public showing because the B.B.C. owns the copyright of the television transmissions and have vetoed public paid-for reproduction. Clearly there are reasons for this in the case of the reproduction of performances by artists when complicated questions of copyright would arise, but it would not appear to be detrimental to B.B.C. interests to permit events of a topical nature to be reproduced in cinemas.

The benefit that would accrue as a result of such a course would be enormous. Not only would it lead to further intensive development of this class of apparatus and the creation of a large amount of business, but it would also be a means of securing the goodwill of the cinema trade and ultimately removing the ban which it has placed upon the televising of British and American films. In the past television has been regarded by cinema exhibitors as a potential rival but it is becoming apparent now that this opinion is no longer held in any real degree and the trade is prepared to regard it as an ally rather than a rival.

The New Director General and Television

RECENTLY we had the pleasure of meeting Mr. F. W. Ogilvie, the new B.B.C. Director General. Naturally the subject chiefly discussed was television and it at once became apparent that Mr. Ogilvie has the progress of the new service very much at heart. Even at that early time he had found time to visit Alexandra Palace and make himself acquainted with both the staff and the place. Incidentally he is also a viewer. We certainly gained the impression that Mr. Ogilvie regards the further development of the television service as one of his many duties, and his attitude gives us cause to hope that the days of the service as the Cinderella of broadcasting are now definitely past.

AN EFFICIENT DIPOLE AERIAL

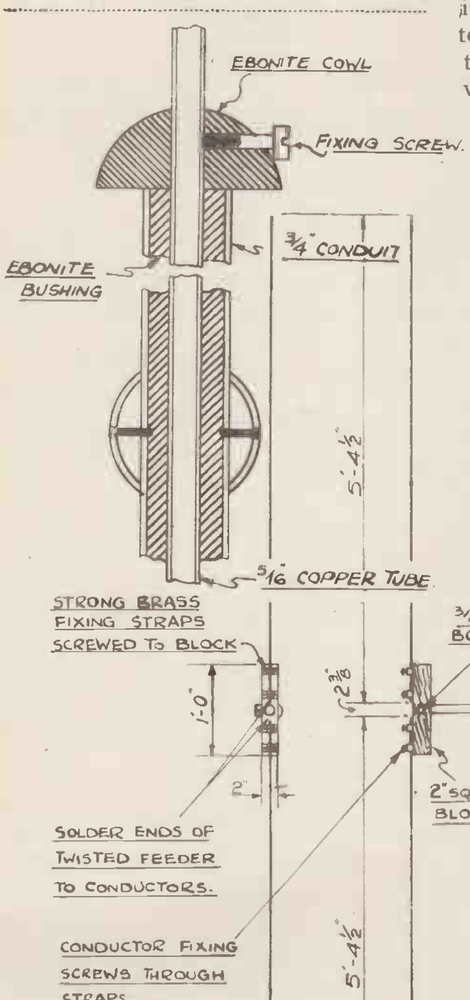
FULL DETAILS AND DIMENSIONS

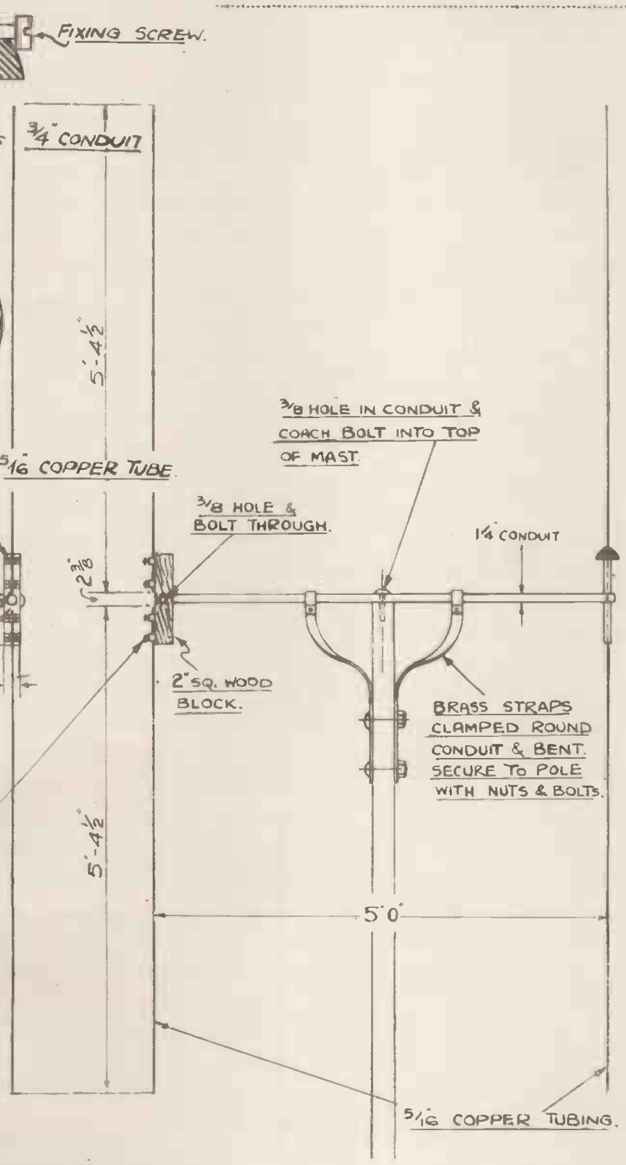
THE television dipole aerial shown by the photograph and drawings meets the demand of those who dislike unsightly erections which often spoil the appearance of the property where they are erected. It is not only neat in appearance, but strongly made to withstand severe strain and will last many years besides being very efficient and giving a good signal to noise ratio.

The large drawing is self-explanatory and gives all the necessary constructional details.

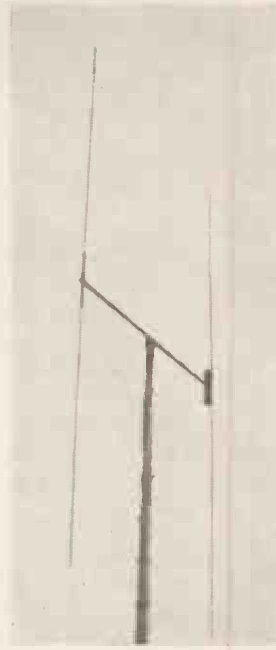
A reflector has been included because the designer has found this necessary to minimise the effect of interference from car ignition systems. The reflector should be pointed towards the source of interference when erecting the aerial, and usually this means that this end of the dipole is pointed towards the roadway outside the house.

The height of the mast used is left to the discretion of the constructor, but the pole used by the writer is 25-ft. and proves to be more than adequate at a 10-mile range from the transmitting station.





The inset shows how the two units of the aerial are secured.



The aerial erected.

A 60-ft. Belling-Lee feeder is used for connection between the dipole and receiver, but this is not shown in the drawing. The two ends of the feeder are soldered to the fixing clamps nearest to the centre of the wooden block and tied to the 1¼-in. conduit and thence taped to the pole downward for several feet.

Tests have shown that with the feeder disconnected from the dipole, pickup on this line is so small that only the semblance of a picture could be received. With the dipole attached to the feeder the pickup and transference of energy to the receiver is more than adequate.

The photograph shows the actual installation which has been in use nine months and has given entirely satisfactory results.

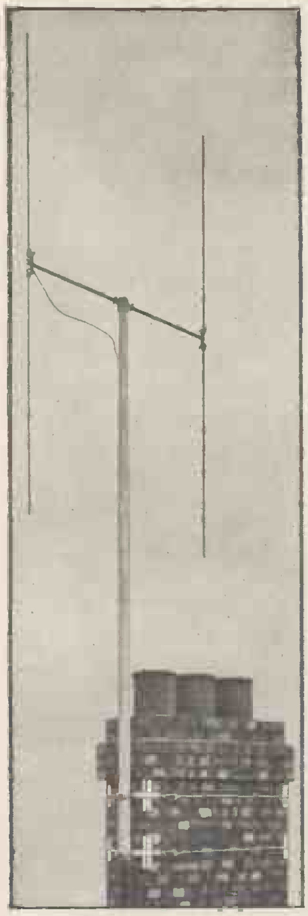
The total cost of the aerial, including the pole, is approximately 25s., but no doubt this price can be considerably lessened by those constructors who already have some of the material required.

The fitting of the dipole to the mast was carried out while the mast was flat on the ground, and the erection of the mast with aerial attached proved to be quite a simple single-handed task.

FOR THE NEW VIEWER

THE TELEVISION PICTURE AND INTERFERENCE

HOW INTERFERENCE TROUBLES CAN BE REDUCED



The Belling-Lee dipole with reflector equipment of this type properly installed will do much to reduce interference.

THERE are three main sources of interference which will both mar the television picture and spoil the quality of the accompanying sound. These are electrical ignition systems of motor cars or of other internal combustion engines which are fired by an electric spark, electro-medical apparatus and small electric motors such as are used in refrigerators, vacuum cleaners, hair dryers, etc.

Interference Sources

The most common interference comes from motor car ignition systems and it is the worst because it is not only the most prevalent but it seems to have the greatest effect both on the picture and sound. In really bad cases the picture is entirely slashed up and the sound is almost unrecognisable; this state of affairs is usually only experienced in the vicinity of main roads when a number of cars are passing at the same time and when no steps have been taken to mitigate the trouble. More usually the screen is covered by a series of bands of splashes of light accompanied by cracking noises produced by the loudspeaker. The interference makes itself really apparent when the car is about two hundred yards away, rises to a maximum at the nearest position and then fades away as the vehicle gets farther away. It may be so bad as also to upset synchronism for an appreciable period.

Interference from electro-medical apparatus reveals itself as a watered silk appearance evenly distributed all over the screen with deterioration of the quality of the sound, usually as a crackling or low-pitched hum. It is not so disconcerting as that due to ignition systems but the picture suffers badly in definition, and also it is continuous so long as the apparatus is working. In addition its range is greater and it can be experienced up to a distance of about a couple of miles. It is, however, not so common and is usually only experienced in the vicinity of large hospitals.

The interference caused by small motors is not really serious and mostly is not consistent. Provided the location of the motor can be found, a remedy (given the owner's consent) is quite simple.

Finally, mention should be made of the interference caused by aeroplanes. With these there is not only that due to the ignition but also fading effect due to the machine being in the path of the waves. Only in those cases where planes are almost constantly overhead, however, is the trouble really serious and with a plane at any considerable height, interference from the ignition system is very trifling and of short duration.

Undoubtedly, the worst source of interference is the motor car and it is particularly troublesome at distances from the transmitter where it is essential to operate the receiver with a high gain. Interference is a factor which must be taken into serious account if long-distance reception is desired.

Suppression

It is possible entirely to suppress car ignition interference at its source and in this respect the circuit given (Fig. 1) showing the method employed, will be of interest. It is, however, useless to expect that car owners will be prepared to go to this trouble and expense and the only remedy, therefore, at present is for the owner of a television receiver to take certain steps which will mitigate the trouble to a considerable extent and in some cases cure it entirely.

It has been found possible to

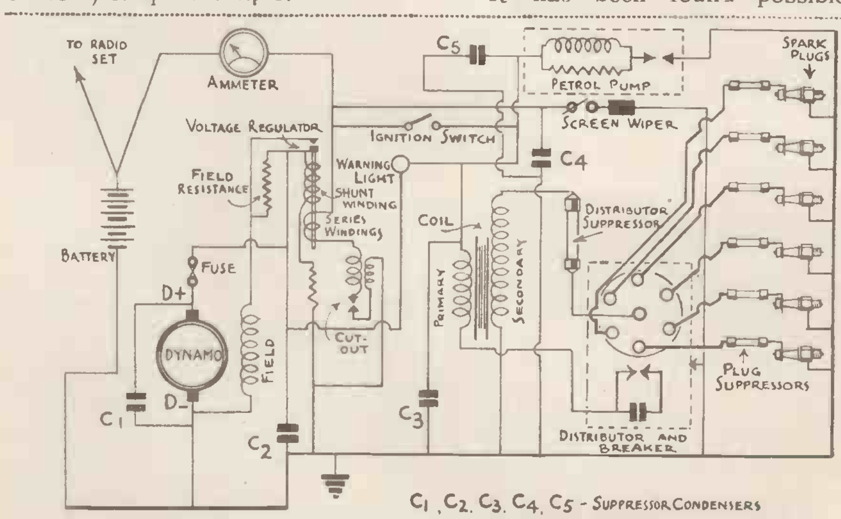


Fig. 1. The electrical system of a motor car fitted with interference suppression devices as recommended by Dubilier.

REFLECTORS AND DIRECTORS

reproduce television pictures in the heart of London, quite close to the main roads, entirely free from interference, and this has been fully demonstrated time after time.

The secret of this is not any special

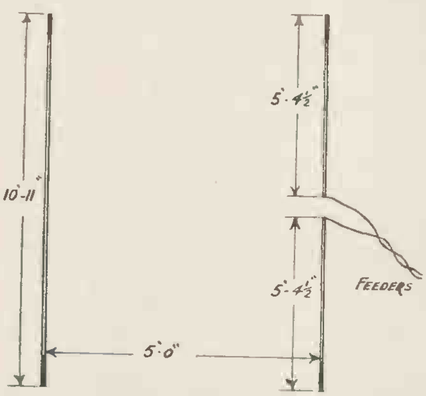


Fig. 2. The units of a dipole with reflector.

virtue of the receiver or aerial system but simply aerial height and a reasonably powerful signal. At greater distances from the transmitter, that is outside the accepted service area, precisely the same conditions would not obtain, for the receiver would have to be operated with increased gain and the result would be that interference which previously was hardly noticeable would be accentuated.

Reflectors and Directors

Obviously. when interference is present the two essentials are to place the aerial so far as is practicable outside the sphere of the interference and take the fullest advantage of the receivable signal which can be done by the use of a reflector and, in some circumstances, in addition a director. Typical schematic arrangements of reflector and reflector-with-director aerial systems are shown by Figs. 2 and 3 and the dimensions given on the drawings are important.

The standard dipole aerial consists of two lengths of metal tube, rod or wire, each 5 ft. 4½ in. long and separated by a space of 2 in. The reflector is a single piece of similar metal 10 ft. 11 in. long placed 5 ft. behind (that is farthest from the transmitting station) the dipole. A director may consist of two lengths of tube rod or metal each 9 ft. 6 in. long spaced 8 ft. 2½ in, from the aerial and each other, and placed in front of the aerial, the tops of the various elements being on the same level.

The aerial arrangements outlined are probably the most suitable that can be used under ordinary conditions and the selection must depend upon circumstances. At distances up to about 25 miles the simple dipole will suffice provided its position is remote from interference. Above this distance, a reflector will be useful and when it is erected it should be remembered that it is directional both to the transmission and interference. Its position, therefore, should receive careful consideration in order to obtain the best orientation both as regards reception and interference. In addition, although aerial height is of prime importance, the situation of the aerial should be as remote as possible from the area of likely interference.

Practically all interference can be suppressed at its source; for instance, small motors can be fitted with condensers to absorb the offending spark. The remedy therefore in the case of motor driven apparatus such as vacuum cleaners, refrigerators, etc., is simple though if they are the property of other people consent, of course, must be obtained as no one can legally be compelled to fit interference suppression devices to any apparatus however simple a matter it may be.

Suppression of interference caused by electro-medical apparatus is difficult and costly, as usually it is necessary entirely to screen the apparatus and place filters in all leads passing beyond the screen.

Within reasonable limits, the length of aerial feeder employed is immaterial and it is advantageous therefore, generally speaking, to select the most suitable position for the aerial irrespective of feeder length.

There are several matters regarding feeder installation which require attention. On no account, if it is found necessary to increase the feeder length should a joint be made: the correct procedure is an entirely new length of cable or if a joint is unavoidable one of the special connecting sockets should be used. Also the length of ends required for attachment either to the dipole or the receiver terminals should be the minimum possible and each short end necessary should be taken in a direction at right angles to the main feeder.

When co-axial cable is used for the feeder and interference is present it can generally be reduced by earthing the outer metal casing of the feeder at intervals of six feet and installing the main run either close to the ground or even burying it a few inches below the surface. In the latter case, of course, some steps must be taken for its preservation if the installation is to be permanent. Numerous tests have shown that under most ordinary conditions and at reasonable distance from the transmitter all troubles due to interference can be obviated providing suitable steps are taken; the real difficulties arise at distances greatly in excess of the normally accepted range, but even these can be overcome to a considerable extent if care is taken in installation.

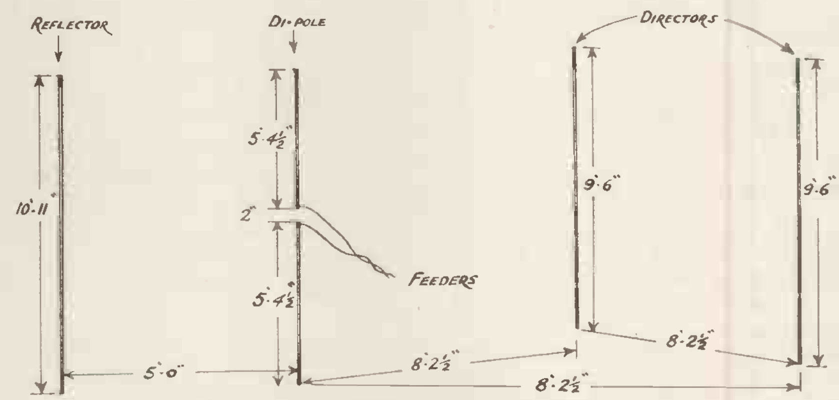


Fig. 3. The units of dipole, reflector and director.

SIMPLE TELEVISION TRANSMISSION WITH A DISC

FUNDAMENTAL REQUIREMENTS OF THE SYSTEM

This article describes the elements of film transmission with a Nipkow disc. It is based upon researches carried out in the Philips Research Laboratory and deals primarily with the physical requirements of scanning by disc.

THE Nipkow disc can be employed in a transmitting system with very good results and its use for transmitting films up to a very high line frequency results in a marked simplification of the apparatus required in the system.

The System

The path of the rays in the experimental television transmitter employing a disc scanner is shown diagrammatically in Fig. 1.

Close to the edge of the disc small holes are located at uniform intervals and at equal distances from the centre. The light from the elongated light source L is thrown on the perforated disc by the condenser C_1, in such a way that the line through the centre of the image touches the circle passing through the centres of the apertures. Part of the light thus passes through one of the holes and is projected on the film by the object lens O. When the disc revolves the light spot sweeps nearly a horizontal line on the film. The film is moved in a downward direction at a uniform velocity, so that the luminous line produced by the next hole on the film lies above the first line.

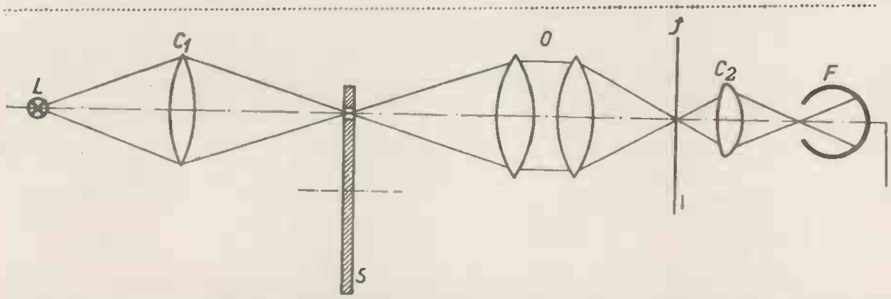


Fig. 1. Path of rays in film-scanning system using the Nipkow disc ; L light scource (high-pressure mercury lamp) ; C_1, C_2 condenser lenses : S Nipkow disc ; O lens ; f film ; F photo-electric cell.

The object lens O consists of two standard film-projection lenses with the sides which in normal use are directed towards the screen placed opposite each other. The use of two lenses requires in the first place the provision of a wide beam angle. The lenses are designed for use where the rays of the issuing pencil are approximately parallel and also are accordingly corrected.

The disc and film are each situated at the focus of one of the lenses, and the scale of reproduction is determined by the ratio of the two focal lengths.

Finally, the transmitted light is condensed by C_2 and projected on to the photo-electric cell, where an electrical signal is produced, which after amplification is passed to the transmitter. It is apparent that the disc and film can be interchanged without any modification in the principle of the system or any diminution resulting in the maximum light intensity.

It is possible to calculate the maximum amount of light which can be obtained for controlling the photo-electric cell. Neglecting consideration of the absorption of light by the film, it is evident that the amount of light falling on the photo-electric cell is determined by the brightness of the lamp, the width of the aperture, the solid angle of the beam included at the disc, and the various losses sustained in the whole optical system.

If the brightness of the lamp is H, the solid angle of the beam passing through the hole Φ, the absorbed fraction of light a and the area of the hole o, the luminous flux incident on the cell is given by the expression:

$$H \cdot \Phi \cdot a \cdot o \quad \ldots\ldots\ldots\ldots \quad (1)$$

Brightness H.—An elongated source of light with a high brightness value is required in the system under consideration: a very suitable illuminant for this purpose is the water-cooled high-pressure mercury lamp, which has a brightness value of 30,000 candles per sq. cm. or about three times the brightness of a standard carbon arc.

Solid Angle Φ.—The solid angle Φ is limited by the capacity of the optical system, in fact by that lens of the two forming the compound objective O which has the shortest focal length. In the present system this is the lens on the side nearest the disc, so that an enlarged image of the disc is thrown on the film. In the experiments use was made of a lens with an aperture of 1 : 2, i.e., $\Phi = 0.2$.

Size of Aperture o.—For a given number of picture elements, the size of the aperture is related to the peripheral velocity of the disc at the location of the holes. The width of the holes d bears the same ratio to the width d of the picture element determined by the scanning method employed, as the velocity of the disc V_s to the scanning speed V_b which is similarly determined:

$$d_s = d_b \cdot \frac{V_s}{V_b} \quad \ldots\ldots\ldots\ldots \quad (2)$$

The peripheral velocity of the disc is, however, limited by the maximum stresses which the material can sustain and in the apparatus constructed is approximately 130 metres per sec. at the periphery of the circle swept out by the holes.

The size of the holes is then arrived at as follows: In Fig. 2 the picture area to be scanned is reproduced; the ratio b/h will be termed β. Assuming that during scanning, n horizontal lines are successively traversed and that each hole is a square of side h/n, i.e., with a width equal to the interval between two consecutive lines, we then have:

$$d_b = \frac{h}{n} = \frac{b}{\beta n}.$$

The total distance to be traversed by

Construction of Disc Transmitter

the aperture in scanning the picture is $n \cdot b$, i.e., the velocity V with N pictures per second is $V_b = N.n.b.$

Since $b = V_b/nN$, we have:

$$d_b = \frac{V_b}{\beta n^2 N}$$

From equation (2) we thus get for the size of the hole the expression:

$$o = d^2 = \left(\frac{V_s}{\beta n^2 N}\right)^2 \ldots\ldots\ldots \quad (3)$$

This formula indicates that the size of the hole diminishes in inverse proportion to the fouth power of the line frequency, and that a high disc speed is desirable.

On inserting the following numerical values:

V_b = 13,000 cm. per sec.
n = 405 lines per picture
N = 25 pictures per sec., and
β = 1.2

we get:

$$o = \left(\frac{13,000}{1.2 \cdot 25 \cdot 164,000}\right)^2$$
$$= (2.64 \cdot 10^{-3}\text{ cm.})^2 =$$
$$= 7 \cdot 10^{-6}\text{ cm.}^2;$$

The length and width of the hole are therefore 26.4μ. The total luminous flux according to equation (1), assuming that $\rho = 0.5$, is therefore:

$$30,000 \cdot 0.2 \cdot 0.5 \cdot 7.10^{-6} = 2.1 \cdot 10^{-2}\text{ lumen.}$$

If we assume that the sensitivity of the photo-electric cell for the light-source employed is 20μA per lumen, the signal strength is found to be 0.42 μA. which is quite adequate.

If the holes in the disc were placed a greater distance apart than the width of the film, and hence the lens were to throw a reduced image on the film, the cone of light would have a greater solid angle on the side towards the film than on the side towards the disc. When, therefore, the maximum aperture obtainable with the optical system has been achieved on both sides, it is useless to increase the speed of the disc still further. In practice this limit is usually not reached when using standard film as well as a high line frequency.

Current Intensity

The permissible minimum intensity of the signal current is determined by the fact that the signal during scanning a picture element must generate such a large number of electrons that the statistical irregularities of the photo-electric effect cannot cause any distortion. In the present case with 197,000 picture elements the duration of scanning an element is:

$$\frac{1}{25 \cdot 197,000} = 2.10^{-7}\text{ sec.}$$

Since the charge of an electron is $1.6 \cdot 10^{-19}$ coulumb, the number of electrons liberated per picture element is:

$$0.42 \cdot 10^{-6} \cdot 2.10^{-7} \div 1.6 \cdot 10^{-19} = 500,000.$$

For the dark portions of the picture the number of electrons may be 40 times less. Yet in the case under consideration the number is always so large that the statistical deviations can be neglected.

Where, for instance, it is desirable

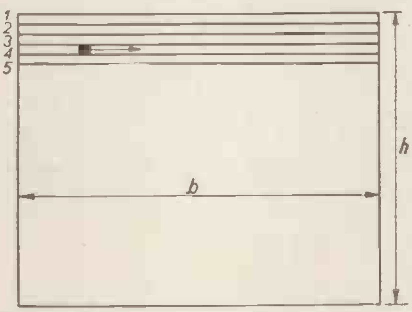


Fig. 2. Traverse of light spot over picture area of film.

to increase the number of picture elements, it is important to know how far the intensity of the signal current can be reduced. If the number of electrons emitted during scanning a single picture element with constant illumination is on an average a, it follows from the theory of least squares that this number varies on the average by $\sqrt{a}$; this places a lower limit to the number of electrons still of practical value. Assuming that in an area of the size of a picture element in the dark sections of the picture, fluctuations of approximately 20 per cent. are still imperceptible, the minimum number of electrons is found to be 25. Where a maximum ratio of light to dark of 40: 1 has still to be transmitted, this gives a total of 1,000 electrons at maximum illumination. In the film-production example worked out above, the actual number is 500 times greater, so that in this respect a very liberal reserve is still available.

This favourable state of affairs is largely due to the exceptionally high brightness of the light source. If a system of this type were employed for direct scanning, the brightness values in the scanning room would have to be at least 10,000 times smaller, which would introduce considerable difficulties as regards the signal strength.

Constructional Details

The circle of holes in the disc is 35 cm. in diameter and the disc revolves at a speed of 125 r.p.s. Thus for a line frequency of 405, 81 holes are required round the periphery of the disc. The interval between the holes is 13.5 mm. while the width of the film picture to be scanned can be a maximum of 23 mm. The disc is thus reproduced with an enlargement of 1 : 1.7. This calculation has been made on the basis of square holes.

In scanning for transmission, as opposed to reproduction, the shape of the holes is not of paramount importance. In practice round holes are quite satisfactory, and may have a diameter roughly equal to the distance between the lines or slightly larger than this interval. The greater ease with which this type of disc can be made is more than compensated by the slight loss in light.

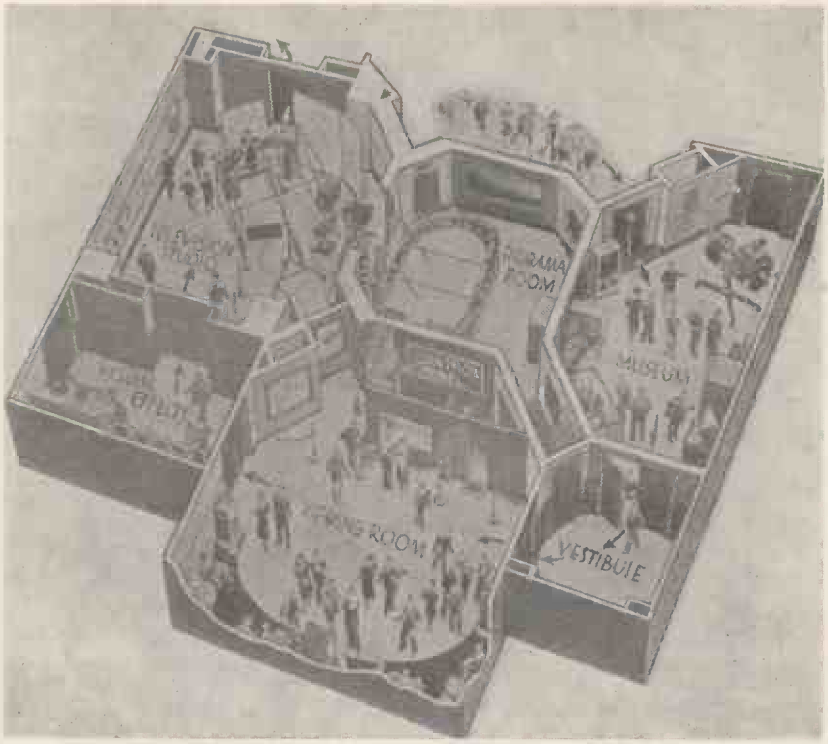
It is absolutely essential for the holes to be all exactly the same size, as otherwise disturbing dark and bright lines will be produced in the picture.

To obtain a uniform definition over the whole area of the picture, the holes must lie in the same plane. The high centrifugal force (at 125 r.p.s. 12,000 times the force of gravity) ensures that even if the disc is initially slightly bent it will always rotate perfectly flat. Furthermore, to obtain a satisfactory picture, all holes, both in a tangential and in a radial direction, must be in their exact theoretical positions as well as retain these positions during rotation of the disc. To reduce the effects of air friction, the disc is enclosed in an iron housing which is evacuated.

The mechanism for moving the film is very simple, as the film motion must be continuous. The film is drawn across the film gate by means of a sprocket rotated at a speed of 1,500 r.p.m. through two gears by a

(*Continued at foot of next page*)

"BEHIND-THE-SCENES" TELEVISION IN U.S.A.



The N.B.C. studio and viewing room set up which is daily visited by large numbers of the American public.

A VERY definite move to establish television is being made in America and various tests are being made in order to obtain an idea of public reaction. The National Broadcasting Company have set up a behind-the-scenes television studio and already more than 14,000 people have been taken "behind the scenes" in television since its inauguration on September 1. The visitors are given an opportunity not only to view real broadcasts, but to participate themselves during their visit to the studios.

Trained guides take visitors on tour of the television studios, and they report that most people are incredulous when they see the wonders of television unfold before them.

Men are inclined to ask about technical details. Women are interested in questions of television make-up, etc.

It is a practice on the tours to divide the parties in half, putting one section in the viewing room, equipped with receiving sets, and the other in the television studio, where individuals passing before the camera are televised for the benefit of people in the adjoining room.

The tour in N.B.C.'s television studio begins in a television museum, where are displayed some of the early television devices. Next stop is the viewing room, where four receivers are working. The tour continues to the visual effects room, fitted with miniature sets used for panoramic shots, and finally to the television studio itself. This studio is equipped with cameras, stage sets and a small, glass-enclosed "theatre" for televising moving dioramas and puppets.

"SIMPLE TELEVISION TRANSMISSION WITH A DISC."

(*Continued from preceding page*)

small synchronous motor. Contrary to standard projector practice, it is unnecessary to provide a drive for the sprocket feeding the film to the gate. Sound scanning with sound films requires no special arrangements for maintaining a perfectly uniform film speed, in view of the continuous film motion employed.

Synchronising Signals

In addition to the picture signals, frame and line synchronising signals must also be transmitted. The synchronising signals are generated as follows:

A disc is mounted on the shaft of the synchronous motor which drives the film; it interrupts the beam of light between a lamp and a photo-electric cell, so that only during the time between two pictures does the light pass through a hole in the disc on to the cell. The cell current furnishes a signal which is amplified in the same way as the picture signal.

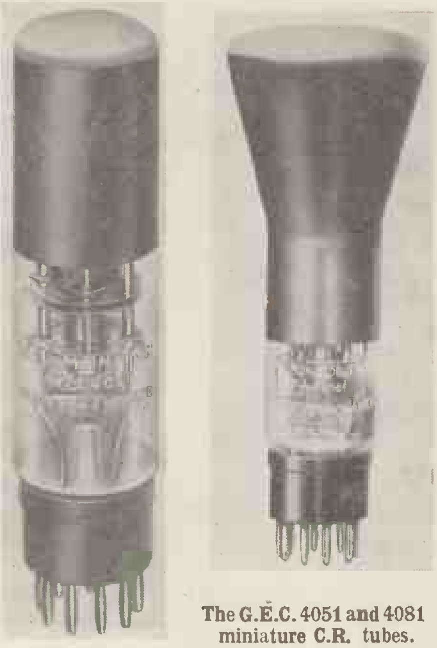
The line synchronising signal is generated in the same way, using, however, the apertures in the Nipkow disc. Images of the holes are thrown by means of a second optical system on a fixed aperture behind which a secondary electron multiplier is set up. In this way a short rectangular sigal is produced. To suppress the line synchronising signals during picture synchronising, a revolving diaphragm is arranged in the path of the beam used for the line synchronising signals.

"Television & Short-wave World" in U.S.A.

American readers should note that copies of this journal may be obtained from Hotalings News Agency, Times Buildings, 7th Avenue and 42nd Street, New York.

Mr. Wolfe-Murray, former Secretary of the Royal National Mission to Deep Sea Fishermen, has now officially taken up his position at the Alexandra Palace as B.B.C. television's first Public Relations Officer.

NEW MINIATURE CATHODE-RAY TUBES



The G.E.C. 4051 and 4081 miniature C.R. tubes.

SMALL cathode-ray tubes are being used to an ever-increasing extent for measurement and observation purposes covering an extensive field.

It is natural that with increased demand greater attention has been given to their development which has resulted in marked improvements in their characteristics. This is shown clearly by the characteristics of two new monitor tubes, as they are termed, produced by the General Electric Co., Ltd. The types bear the numbers 4051 and 4081, and they can both be employed for all purposes in which a visual means of studying transient or recurrent operations is required.

Important features of these new tubes are their small physical size and comparatively low operating voltage, as indicated by the characteristics set out below. In both types separate connections are provided for the four deflector plates so that push-pull scan can be incorporated if desired. The screen is of the medium persistence type having green fluorescence. The base is a nine-pin type (to British standard pin spacing and dimensions).

The characteristics of the type 4051 are:—

Heater voltage, 4.0 volts.
Heater current, 0.8 amp.
Accelerator (anode No. 2) voltage, 250 to 500 volts max.
Focusing electrode (anode No. 1), 50 to 100 volts.
Control electrode (modulator), 0 to −20 volts.
Deflection sensitivity:
Plates next accelerator (signal plates: Y1, Y2), $\frac{82}{V}$ mm. per volt.
Plates next screen (time base X1, X2), $\frac{73}{V}$ mm. per volt.
Where V = voltage on accelerator (anode No. 2).

Interelectrode Capacities.
Modulator to all other electrodes, 25 micro-mfds. approx.
Between Y plates (plates nearest accelerator: other electrodes earthed), 4 micro-mfds. approx.
One Y plate to all other electrodes, 13 micro-mfds. approx.
Between X plates (plates nearest screen: other electrodes earthed), 2 micro-mfds. approx.
One X plate to all other electrodes, 13 micro-mfds. approx.

Dimensions.
Maximum overall length, 160 mm.
Screen diameter, 39 mm. ($1\frac{1}{2}$ in. approx.).

The price of type 4051 is 45s.

The characteristics of the type 4081 are:—

Heater voltage, 4.0 volts.
Heater current, 0.8 amp.
Accelerator voltage (A2), 400 to 800 volts max.
Focusing electrode (A1), 80 to 200 volts max.
Control electrode (M), 0 to −40 volts.

Deflection Sensitivity:
Plates nearest to A2: Y1, Y2, $\frac{155}{V}$ mm. per volt.
Plates nearest to screen: X1, X2 $\frac{145}{V}$ mm. per volt.
Where V = voltage on A2.

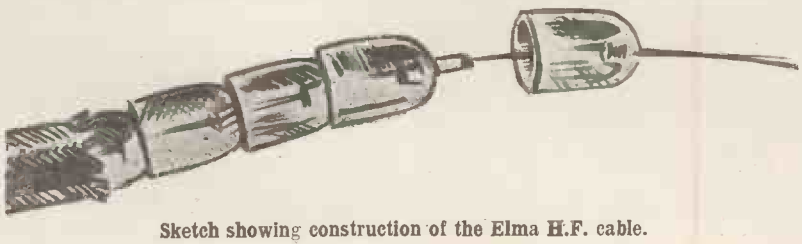
Interelectrode Capacities.
Modulator to all other electrodes, 25 micro-mfds. approx.
One Y plate to all other electrodes, 13 micro-mfds. approx.
Y1 to Y2 (other electrodes earthed), 3 micro-mfds. approx.
One X plate to all other electrodes, 13 micro-mfds. approx.
X1 to X2 (other electrodes earthed), 3 micro-mfds. approx.

Dimensions.
Maximum overall length, 190 mm.
Maximum diameter, 70 mm.

The price of type 4081 is 55s.

A New H.F. Cable

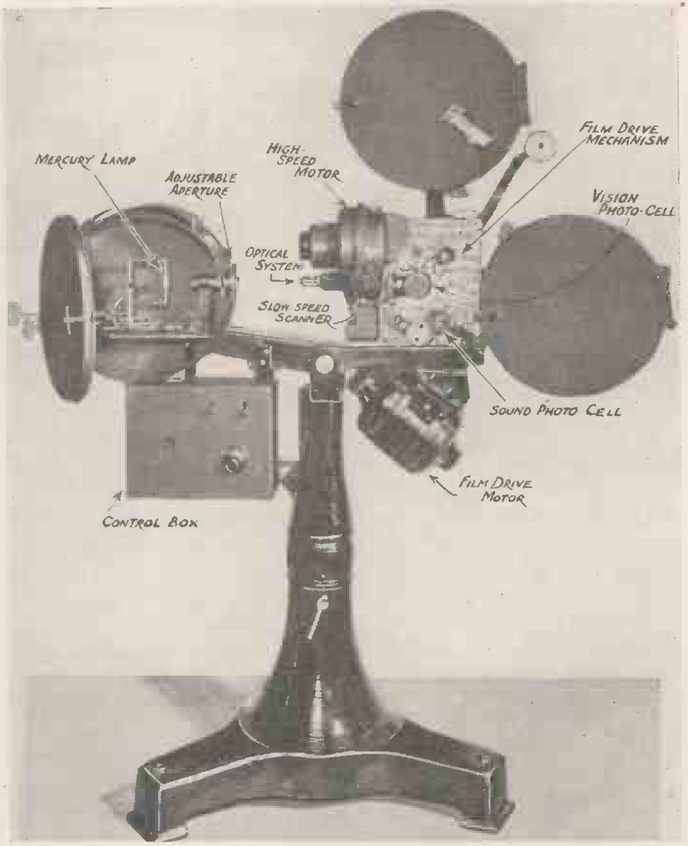
A novel type of high-frequency cable has been developed by Etablissements Elma of 10, Rue Theophr-Renaudot, Paris. As will be seen from the illustration, the cable consists of a central flexible conductor on which are threaded moulded trolitul thimbles, so shaped that they fit partially one within the other, and permit of a considerable amount of flexibility. There is an exterior covering of braided wire which provides the outer conductor and also keeps the trolitul thimbles in position. The cable is made in four diameters, viz., 5, 8, 12 and 20 millimetres and the capacities in micro-microfarads are 40, 30, 25 and 20 per metre respectively.



Sketch showing construction of the Elma H.F. cable.

A MECHANICAL-OPTICAL FILM TRANSMITTER

DETAILS OF THE NEW SCOPHONY APPARATUS WHICH IS ADAPTABLE FOR DIFFERENT STANDARDS



The Scophony mechanical-optical film transmitter.

IT is generally recognised that the system of film transmission at present employed at Alexandra Palace does not yield results which equal the direct transmissions. This is due to certain inherent defects in the system which have not been overcome and many authorities contend that better results could be obtained by the use of mechanical-optical principles instead of electronic as at present used.

Scophony, Ltd., have produced a mechanical-optical transmitter which in laboratory demonstrations has provided very fine pictures from film. It uses small and rigid revolving masses and provides a high light efficiency with full definition.

Optical System

The photographs show the details of the mechanical-optical apparatus and the complete transmitting equipment. An image of an illuminated aperture is formed on the film by a sphero-cylindrical optical system via two revolving polygons mounted at right angles to each other, one revolving slowly forming the vertical scan in conjunction with the film moving continuously in the opposite direction. This moving spot is picked up by another sphero-cylindrical lens system and reproduced as a stationary image on the cathode of an electron multiplier cell, the variations of intensity of the spot as it traverses the film giving rise to variations in output of the cell, so transforming every small section of the picture into an electrical impulse.

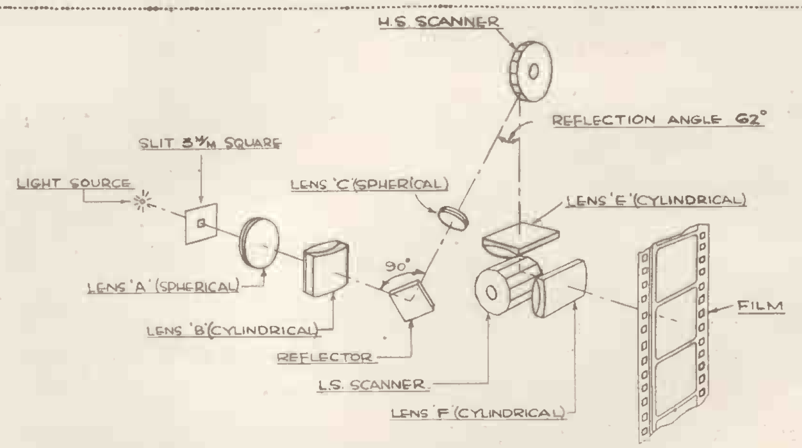
The transmitter can be adapted quite easily for different requirements. For instance, sequential scanning is obtained by choosing a line frequency which is an integral multiple of the frame scanning frequency. If the line frequency is an odd multiple of half the frame scan frequency the resultant picture is an interlaced one. The line frequency is governed by the synchronising generator. The frame frequency can be 50 when the slow speed scanner is running and 25 when stationary. Assuming 50-cycle supply frequency, the transmitter can be used for interlaced or sequential scanning with 50 or 25 frames per second.

By using a different gate the transmitter can be adapted to scan the film according to the U.S. standard, i.e., 60 frames from 24 pictures per second.

The source aperture is rectangular and of adjustable dimensions. Thus all types of spurious images (such as "beading") caused by the aperture can be completely eliminated. Spurious images may arise from the amplitude of vertical scan being not exactly equal to the film pitch. Films in general shrink with age. A continuously variable adjustment is provided to compensate for this.

The High-speed Scanner

The high speed scanner motor is driven by a specially designed valve

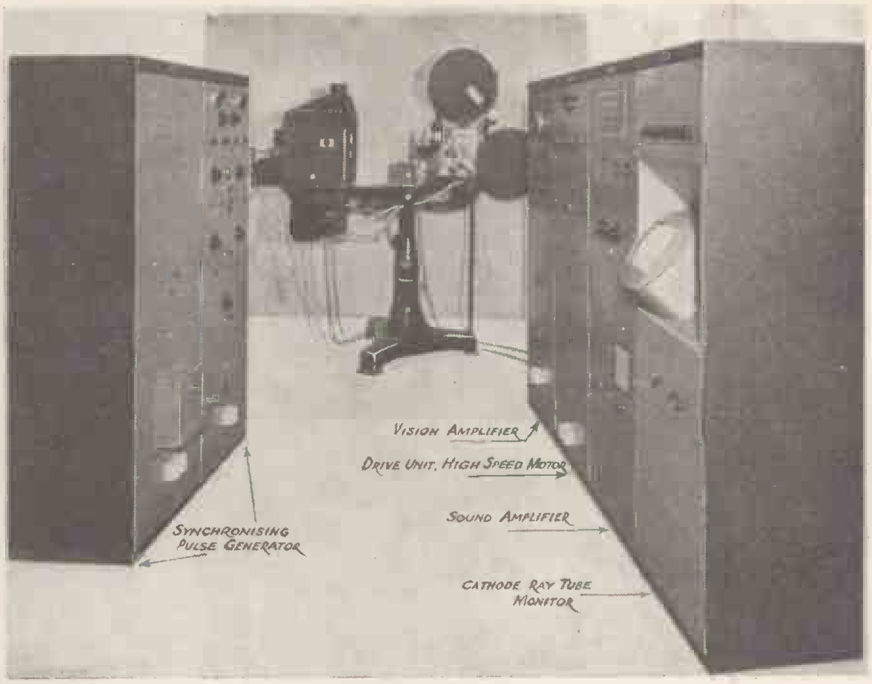


Schematic diagram of the optical system used in Scophony film transmitter.

amplifier from the line frequency supplied in sinusoidal form from the synchronising generator. The motor consists essentially of a phonic wheel tuned to resonate at line frequency. This is connected direct in the anode circuit of a pair of 60-watt valves in parallel operated in the class C condition. Direct current is also passed through the windings of the phonic wheel so as to prevent reversal of the magnetising flux. A subsidiary motor is mounted on the spindle to run the motor into synchronism.

Performance

The *spot definition* is such that an 800 *line picture* could easily be obtained by reducing the aperture and increasing the scanner speed. The focus of the spot is maintained up to the four edges of the gate and the illumination is uniform. In the model designed for the B.B.C. standard, a film containing *vertical lines with a spacing corresponding to* 600 *elements* can be resolved perfectly. The quantity of light incident on the photo-cell is approximately 0.0005 lumen. The photo-cell is of a multiplier type yielding approximately 0.01 volt picture current for the amplifier. The amplifier is of conventional design with flat frequency response from 0 to 2.5 m.c. but can be made to suit special requirements.



The complete Scophony mechanical-optical film transmitting apparatus.

A TELEVISION QUESTIONNAIRE

Some American Ideas

A TELEVISION questionnaire was recently sent out to radio retailers in the United States in order to ascertain the views of the trade on the effect the introduction of a television service is likely to have on the radio industry.

One question was: "Is the advance television publicity helping or harming business?"

Nearly half of the replies (45.6 per cent.) said it was retarding sales, while 3 per cent. stated that it was helping to sell radio sets now. The largest number (51.4 per cent.) stated that it had little or no effect on present business.

The response to the query as to whether the actual arrival of commercial television would help or harm business was more along expected lines. No less than 72 per cent. of the trade thought that the actual advent of television would cause a boom in radio, while 15.6 per cent. believed that it would be of little, if any, advantage to the trade. Only 12.4 per cent. thought that it would retard the radio business.

Prices at which television sets should sell well to the public, while allowing a reasonable profit, were from £5 to £100. These prices were arbitrarily divided into three groups. 34.5 per cent. of the replies put a maximum price of £20 on a good television receiver; 55.2 per cent. priced television receivers between £20 and £40, while the remaining 10.3 per cent. figured that a good set could not be sold under £40.

All answers indicated that pictures must be bright, clear, detailed, and free from flicker. The size believed adequate ranged from 4 in. by 4 in. to 3 ft. by 4 ft. The following tabulation shows the voting on picture size.

5 by 7 in. or less	6.5%
5 by 7 in. to 8 by 10 in. ...	36.5%
8 by 10 in. to 11 by 14 in.	24.2%
11 by 14 in. to 18 by 24 in.	26.2%
18 by 24 in. to 36 by 48 in.	6.6%

It would appear that a picture about 11 in. by 14 in., good in every respect, and produced by a receiver selling at £20 is the trade's ideal of television.

Potentiometers for Television Receivers.

Potentiometers used in television receivers have to be of the highest quality and at the same time be suitable for use in circuits where high voltages are employed. Reliance units have been designed to withstand voltages in excess of 4,000 between spindle and case.

They are to extend their range of products and have just moved into a new factory at Sutherland Road, Higham Hill, Walthamstow, E.17. In addition to variable resistances for radio and television work they have their own hydraulic plant for bakelite products. Full information regarding Reliance products can be obtained from the above address.

A SIMPLE METHOD OF INCREASING RANGE

By S. West

In this article the video-frequency stage is dealt with. Practical data is included enabling the circuit constants to be readily chosen to ensure desirable frequency response characteristics.

ONE of the simplest, though not necessarily one of the best ways, in which to increase the range of a television receiver, is by adding a stage of V.F. amplification.

Such an addition necessarily involves some structural alterations to the receiver and may, for reasons given later, also entail some changes in the power supply unit of the vision receiver.

In order to determine whether the addition of a V.F. stage is worth while and likely to effect an improvement in results, the following notes will be useful.

For the case of a commercial outfit which generally does not lend itself very well to structural changes (apart from possible controversy with the maker on matters relating to guarantees) there is little doubt that the more preferable scheme, when an increase in range is desired, is the installation of some form of pre-amplifier. Particularly is this desirable where no signal frequency amplifier is already included in the assembly. In any event the reduction in the noise level is very marked even where a stage of R.F. amplification is already included.

From the point of view of efficiency, i.e., relative degree of gain for each arrangement, the V.F. amplifier makes a better showing. But in this connection it should be borne in mind that where the noise level already is fairly high or where there is a tendency for the receiver to produce I.F. harmonic screen patterns, addition of a V.F. stage will produce some very objectionable results.

In general, therefore, addition of a V.F. stage to a sensitive receiver is inadvisable but it is a little difficult to give any hard and fast rules. Where, therefore, doubt exists the best plan is to conduct tests.

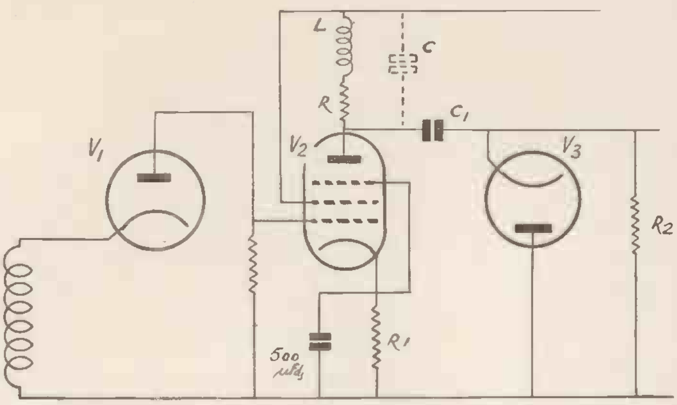


Fig. 1. Circuit arrangement for single stage of V.F. Amplification.

Fig. 1 shows the conventional circuit arrangement for a single stage of V.F. amplification.

By reason of the higher gain obtainable from a R.F. pentode having a high value of mutual conductance, this valve is almost exclusively used in this position. This is quite permissible for we are concerned with voltage amplification and not power.

Valves expressly intended for use in the radio and intermediate-frequency sections of the receiver are eminently suitable for use as V.F. amplifiers and invariably are used.

In considering the value for the cathode resistance cognisance of the operating conditions for the valve, which will depend upon the circuit arrangement, must be made.

If the V.F. amplifier's grid is connected directly to the diode load as shown in Fig. 1, it is obvious from the nature of the rectified signal that the V.F. valve grid will always be driven negative with respect to the initial bias of the valve. Consequently it is desirable to operate the valve not at the customary centre point of the Ia, Vg parameter but to reduce the standing bias, for the grid excursion due to the signal voltage is always negative.

Account must be taken of the fact that it is desirable to have at least a small value of negative bias, however, partly to restrict the current consumption, but mainly because grid current will flow where the negative bias is lower than a certain value which is usually about −1 volt.

A small initial bias is provided by the diode's no-signal anode current, but this is likely to be quite small and it is convenient to ignore it.

If we arrange for a standing negative bias of about 1.5-2 volts we shall be on the safe side. A resistance having a value of the order of 100-150 ohms is satisfactory for most valves and the cathode resistor by-pass condenser should, in the interests of restricting the phase shift at low frequencies, have a large capacity. Something of the order of 300-500 mfds. is satisfactory.

To ensure accuracy the value for the cathode resistance should be got from the characteristics of the valve it is intended to use. This is a straightforward procedure and usually it is only necessary to consider the current taken by the valve at −2 volts bias and to calculate the cathode resistor from this figure.

Operating Conditions

It is well, of course, to ensure that the operating conditions chosen are such as to avoid the possibility of amplitude distortion occurring before a modulating voltage of the requisite amplitude for the tube to be used is obtained. This statement will apply to valves whose screen voltage normally is less than that for the anode.

Such a valve is the Mazda AC/SP3.

With a screen potential of 160 volts a cathode resistance of 160 ohms would appear to be satisfactory. If the screen is to be at the same potential as the anode, and this will simplify the decoupling arrangements, the cathode resistance should be increased to about 250 ohms.

The two other points of interest in the circuit diagram of Fig. 1 are the anode load resistance R and the correcting inductance L. The question of assigning to these components suitable values is not easy. The obvious approach is to determine in the first place what frequency response characteristic is required.

Without entering into the technicalities of the subject it will suffice to state that a response of some −4 dbs. at 2 mcs. is probably satisfactory. Perhaps it is desirable to aim higher than this, particularly if two stages are to be employed.

Anode Load

Now the complex anode load comprised by the resistance R and the inductance L can introduce objectionable effects unless their values are carefully deduced.

Bearing in mind that the combined capacities of the valve and certain of the wiring are in combination with the L and R components, it is easily seen that a circuit resonant to a certain frequency is formed. It is then apparent that any suddenly applied voltage, i.e., a transient, will cause this circuit to oscillate at its natural frequency. The effect is objectionable inasmuch as the light spot can render it on the screen. When it is further remarked that the description, that a television modulation voltage is one long transient, is very apt, it is obvious that we must be careful in our choice of circuit constants.

The impedance of the complex anode load at various frequencies is given by the formula:—

$$\frac{1}{Z} = \frac{1}{R + j\omega L} + j\omega C = \frac{1 - \omega^2 LC + j\,\omega CR}{R + j\omega L}$$

whence

$$Z = \frac{R + j\omega L}{1 - \omega^2 LC + j\,R\omega C} = R\,\frac{1 + j\omega L/R}{1 - \omega^2 LC + j\omega CR}$$

Where R, L and C are as indicated in the diagram, Fig. 1, and $\omega = 2\pi f$. The stage gain is best expressed as:

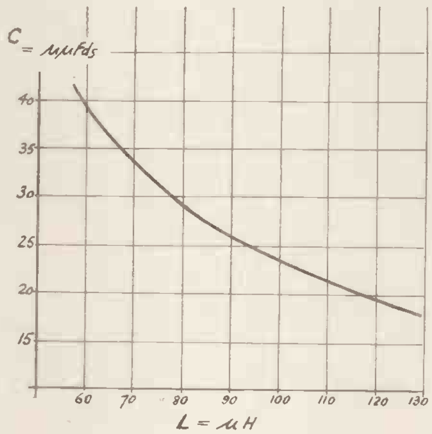
$$A = gR\,\frac{1 + jxy}{1 - xy^2 + jy}$$

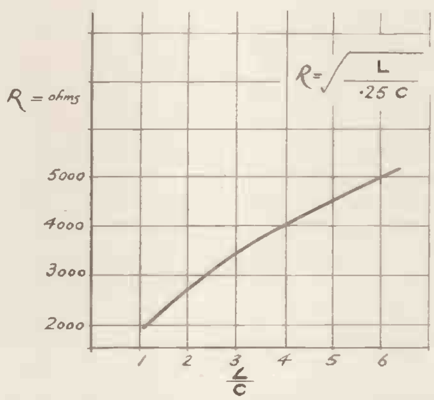
and for lower frequencies as A=gR, where

$$x = \frac{L}{CR^2} \text{ and } y = \omega CR$$

and g is the mutual conductance.

It is this expression for x, namely, L/CR^2 that is important from the point of view of ensuring that oscillation does not take place when the circuit is "hit" by a transient. Furthermore, the phase shift at high frequencies is reduced by keeping its value low.





Figs. 2 and 3. Graphs showing the values for circuit constants.

If L/CR^2 is not permitted to exceed .25 satisfactory conditions are achieved and in practice it should not be permitted to exceed this value.

Calculation of the response characteristics of the stage utilising the above formulæ is not difficult but is extremely tedious and constructors will prefer something simpler.

"Television and Short-wave World" circulates in all parts of the world.

The graphs, Figs. 2 and 3, will furnish the values for the circuit constants with a minimum of calculation.

It must be admitted they are open to criticism inasmuch as they give data only for a fixed frequency response. Nevertheless their simplicity will commend them. Those desiring greater accuracy will employ the formulæ earlier given.

The graphs are based on the assumption that for a response at 2 mcs. of about −2 dbs., the resonant frequency is approximately 3.25 mcs.

$$f = \frac{1}{2\pi\sqrt{LC}} \text{ therefore } LC = \frac{1}{(3.25 \times 6.28)^2}$$

The graph of Fig. 2 gives this relationship between capacity and inductance. Knowing the combined total of the valve and stray capacities, the value of inductance necessary can be instantly ascertained from it.

In the graph of Fig. 3 the ratio of L/C is plotted against R to satisfy the equation $L/CR^2 = .25$.

In order to show the manner in which these graphs are used, the following example is given.

The value for the valve capacity can be secured from the maker's data sheet and approximately 5-10 mmfds. should be added for the stray capacities of the wiring. Assuming that the total capacity present amounts to about 30 mmfds., and this is a usual figure, from Fig. 2 we see that for a capacity of 30 mmfds. an inductance of 80 microhenries is required.

The ratio of L/C is thus 80/30. That is 2.66. From Fig. 3 we find that R is then 3,200 ohms and we should choose 3,000 ohms as being the nearest standard value.

In a second and concluding article next month the addition of two V.F. stages will be dealt with.

Miniature Ball Bearings

We have received from Miniature Bearings, Ltd., a catalogue of ball bearings of small dimensions such as are suitable for mechanical scanning devices. The catalogue contains a great deal of data concerning the use of this type of bearing in addition to complete particulars of sizes and kinds. The address of Miniature Bearings, Ltd., is 243 Duke Street, St. James's, London, S.W.1.

Scannings and Reflections

CYRANO DE BERGERAC ON NOVEMBER 4

LESLIE BANKS is to make his first appearance in television in the name part of "Cyrano de Bergerac," which will be performed in the Alexandra Palace studios on November 4. Constance Cummings will play the part of Roxane.

George More O'Farrall, who is producing this famous play by Edmond Rostand, will take advantage for the first time of the new studio equipment to use two studios simultaneously, and the production will be on a correspondingly large scale. Three control rooms will be in operation and eight camera channels —double the number yet used in television. Use is being made of the script specially prepared by the late Robert Loraine, whose superb acting in the rôle of Cyrano will not soon be forgotten. Incidental and ballad music by Jean Nougues will be played by the Television Orchestra, conducted by Hyam Greenbaum.

"Cyrano de Bergerac" tells the story of that gloriously gallant, "nose conscious" figure who, despite his cruel affliction, carries his "Panache"—the spirit of bravery, the wit of courage, the humour of heroism. Feared by all his adversaries in war, he is doomed to unhappiness in his love of the beautiful Roxane who loves the young Baron Christian de Neuvillette.

THE TELEVISION CABLE

Post Office engineers have now laid the special multi-channel cable as far as Northallerton via Birmingham, Leeds and Manchester. This cable, which has been laid to handle up to 400 telephone conversations simultaneously, may still be suitable for relaying television, if some of the difficulties can be overcome. Although the cable is capable of handling a wide band of frequencies used in television transmission, the main difficulty appears to be phase reversal along the cable. If this can be overcome, then there may be a possibility of television programmes in the North of England.

B.B.C. TECHNICAL TALKS

It is interesting to note that the B.B.C. are giving technical talks on how to make the most of a television receiver. The first of these talks was on October 24 by T. H. Bridgewater, the Senior Maintenance Engineer at Alexandra Palace. The second talk is scheduled for November 7. It is hoped that these talks, which will deal mainly with operating the television receiver, will enable viewers to know exactly how to make the most of their receivers. It is rather interesting that the television section should be the first to sponsor these technical talks, for discussion under similar lines, but dealing with radio sets, have not been broadcast for a great number of years.

ULTRA SHORT-WAVE ACTIVITIES

Although it was anticipated that conditions on short and ultra-short waves would deteriorate this year, surprising results are being experienced on 28 mc. Amateurs are finding that even with extremely low power they are able to maintain very long-distance contacts during the day. Signals from Australia and in particular California are being picked up in this country at a strength equal to that of local stations.

It must be admitted, however, that this waveband is erratic and that late in the afternoon it fades out extremely rapidly. However, at the moment, conditions are good between 10 a.m. and 4 p.m., while on occasions, stations can be heard during the early evening. It is hoped that the 10-metre band will remain open during the winter, in order to take the place of the now unreliable 20-metre band.

There is also a report that signals on 5 metres are being heard fairly regularly in California from Australia, and if this should be so, it may be possible for European amateurs to make contact in both directions with America. Although to date, two-way contacts have not been possible between Europe and America, several British amateurs are erecting special equipment in order to make a special endeavour to make two-way contacts before present conditions disappear.

TELEVISION FROM EARLS COURT

On two occasions viewers were able to see what was going on at the motor show at Earls Court. The lighting, however, was rather poor and on the second day when motor car accessories were televised, it was rather difficult fully to appreciate some of the finer points dealt with by the commentator. When conditions for transmission are not too favourable it would be better to inform viewers so that they would not doubt the efficiency of their receivers.

The outside broadcasting vans were televised from Alexandra Palace and it was practically impossible to see very much of what was going on inside the vans owing to lack of light. Viewers seeing television for the first time would gain rather a bad impression, which could easily be removed by a short announcement mentioning the fact that the transmission was being made under difficulties.

TELEVISION SCREENS IN CINEMAS

Capt. A. G. D. West (Baird Television, Ltd.) in his Presidential Address to the British Cinematograph Society, prophesied that before very long television pictures of current events would be seen on full-size screens in every cinema. It is hoped that television will not be considered a competitor but rather an aid to the cinema for it will be of the greatest advantage to be able to see events as they occur. Cinema goers in and around London are able to see the latest newsreel sometimes only two or three hours after the important event, but the smaller cinemas in the provinces are by no means so well-served, and in some of the larger country towns newsreels are often seven days late. This could be overcome by the use of television in the way suggested by Capt. West.

THE GROWTH OF AMATEUR BROADCASTING

It is pleasant news to hear that there are now well over 5,000 trans-

MORE SCANNINGS . . . .

mitting licences in existence in this country. These licences are, of course, all issued by a special branch of the Post Office and include in addition to amateur licences, special permits to manufacturers and Army, Navy and Air Force Reserves. However, the fact that the number has doubled in the last two or three years, has no doubt influenced component and valve and set manufacturers to take considerably more interest in the requirements of short-wave amateur experimenters. At the present time, amateurs are being well looked after and can obtain their specialised components and equipment at quite a reasonable cost. The manufacturers have also realised that amateurs can utilise the equipment which is being made specially for government services, so that the market is by no means as limited as was at first expected.

AMERICAN TELEVISION

It would be interesting to find out whether or not transmissions from the new Columbia Television station can be received in Europe. This new transmitter, located in New York, will have the call letters W2XAX. The power input will be 300 kilowatts, a phenomenal figure for an ultra-high frequency station, and to ensure maximum efficiency during the winter the aerials are to be heated from the inside and thermostatically controlled.

As the British television transmissions have been received by R.C.A. in New York, there is every possibility of British experimenters, especially those with beam receiving aerials, being able to pick up at least the sound portion from the new Columbia station.

BAIRD COLOUR EQUIPMENT

Mr. J. L. Baird has presented to the Science Museum, South Kensington, part of the original colour equipment including the mirror drum which revolves at 6,000 revolutions per minute and has twenty mirrors, together with the colour filter disc. Both of these were used at his demonstrations of colour television at the Dominion Theatre.

Most of Mr. Baird's early equipment can now be seen at the Science Museum.

NEW TELEVISION SYSTEM

A new system of television transmission is being experimented with at Morecambe Bay to a point nine miles away at Overton. This new system is based on vision rays and has nothing to do with the normal electrical wave. A picture has been received and special towers are being erected at the two points mentioned. It is hoped that before very long complete information on this new scheme will be available.

TELEVISION "WAR EYE"

American technical experts are of the opinion that television will be of immense value in time of war. It is stated that television cameras could be fitted in aeroplanes and balloons and on high vantage points so that pictures could be transmitted of enemy territory to the staff headquarters several miles behind the actual front line. There would, of course, be enormous difficulties, but it is claimed that these could be overcome.

NEWS BY TELEVISION

Those who saw the return of Mr. Chamberlain to Heston Airport, the motor car racing at the Crystal Palace and similar events of general interest, agree that this is the type of programme that will make television popular. News films are also excellent entertainment, particularly when they are changed frequently. Viewers who are rather outside the normal service area and live in country places find that they can obtain considerably more news via television than from the normal small cinemas. It is hoped that this aspect of television entertainment will be carefully considered by the B.B.C. and augmented as far as possible.

THE ARMISTICE SERVICE

It is expected that the Armistice Day service from Whitehall will make an excellent television transmission, particularly if the cameras are erected to good advantage. There are one or two Government buildings close handy in which the cameras can be placed and it is felt that a record number of viewers will be obtained on that day.

A RELAY FROM NORTH WEALD AERODROME

The cameramen concerned deserve considerable credit for their work in televising the fast type of planes from the North Weald aerodrome. They had very great difficulty in following some of the faster planes travelling at well over 400 miles per hour, but viewers were able to gain a very good idea as to the life in an up-to-date aerodrome. Many viewers noticed that ghost planes followed the televised planes, and this, it is stated, was due to interference from the electrical systems in the planes actually being televised.

TELEVISION IN THE PROVINCES

On many occasions it has been claimed that television will soon be an established fact in the provinces. Potential viewers in Birmingham in

Lord Nuffield being televised at the Motor Show at Earls Court.

KT66

THE VALVE WHICH IS SETTING A NEW STANDARD FOR POWER OUTPUT AND HIGH EFFICIENCY

OSRAM KT 66

ALIGNED GRID BEAM TETRODE

Single Valve Class A

Anode / Screen Voltage 250	.. .. ..	7.25 watts Audio output

Push-pull Class AB 1 (2 valves)

Anode / Screen Voltage 250	.. ..	17 watts Audio output
Anode Voltage 400 / Screen Voltage 300	.. ..	32 watts Audio output

Also useful as an Indirectly Heated Triode

(screen joined through 100 ohms to Anode).

Anode Voltage 250	.. ..	2.2 watts Audio output
Anode Voltage 400	.. ..	5.8 watts Audio output

Heater voltage 6.3.
Heater Cuirent 1.27 amps.
Mutual Conductance 6.3 mA/volt.
Very low screen currents.
Fitted with International Octal Base.

REDUCED PRICE 15/-

Osram valves

MADE IN ENGLAND.

Write for leaflet OV 8075 giving full technical and operating data

Advt. of The General Electric Co., Ltd., Magnet House, Kingsway, London, W.C.2.

. . . . . AND MORE REFLECTIONS

particular have had their hopes raised time after time. There does, however, seem to be a general changing idea that before very long attempts will be made to erect a second television transmitter. An alternative scheme to using the special low-loss cable has been discovered by Post Office engineers. They find that they can cover long distances by a combination of microwave transmitters plus co-axial cable.

It has been realised that there is probably a greater market for television receivers in the provinces than in the London area where there is a wealth of entertainment.

AMERICAN TELEVISION AGAIN

A limited television service to the public has just been announced by the Radio Corporation of America. This service will only last for about two hours each week. This is not due to technical difficulties but due to the fact that television, as with ordinary radio in America, must be self-supporting, so until they are sure of a large number of viewers, programmes cannot be sponsored and revenue obtained.

SALES OF BATTERY SETS

During the past few weeks there has been an extraordinary increase in the number of battery-operated receivers sold. These sets generally have been of the ordinary broadcast type using three or four valves and costing between £5 and £8. It is stated that the receivers have been bought by listeners who need an alternative source of reception in case of emergency. Listeners know that should there be a break in the power supply service that they are completely cut off from radio reception. An accumulator can, however, be kept on hand and in addition a dry battery will have a fairly long life, despite the fact that they deteriorate if not used.

A NEW ANNOUNCER

Listeners to the London Regional programmes will have probably realised by now that they have a new announcer. He is David Hoffman whose face and voice are both very well known to viewers. David Hoffman succeeded Leslie Mitchell as the only male announcer from Alexandra Palace. He is thirty years of age and was at one time announcer with the Canadian broadcasting system.

B.B.C. FILM TELEVISION

The B.B.C. are continuing their policy of broadcasting full-length films, When this scheme was originally mooted viewers were rather sceptical as the film transmissions from Alexandra Palace have not been all that they might be. However, there has been a distinct improvement recently and now films have an excellent entertainment value.

Anton Wallbrook, in the "Student of Prague," and Maurice Chevalier in the sensational French production " La Kermisse Heroique " were particularly good productions.

FORTHCOMING TELEVISION PROGRAMMES

A—Afternoon. E—Evening.

Oct.

31 SMOKY CELL, an Edgar Wallace thriller (A).

Nov.

1 THE LAST VOYAGE OF CAPT. GRANT, a new form of television presentation, by Denis Johnston (E).

2 FIRST AFTER-DINNER SPEECH BY TELEVISION: Mr. J. B. Priestley at Alexandra Palace addresses Festival Dinner of the Royal Photographic Society in London. ALL-STAR CABARET with Gracie Fields, Douglas Byng, Oliver Wakefield and Jean Colin (E).

3 CAST UP BY THE SEA, a Stephen Leacock burlesque (A).

4 Feature Film: SO ENDED A GREAT LOVE (E).

5 ICE HOCKEY and CABARET, from Earl's Court (E).

6 THEATRE PARADE (E).

9 LORD MAYOR'S SHOW.

10 EASTERN CABARET (E).

11 CENOTAPH CEREMONY. Special production of Reginald Berkeley's " The White Chateau " (E).

13 THE "WHITE CHATEAU" (repeat performance)

15 RE-VIEW: songs and sketches from the old revues. (E).

16 WEST END CABARET (A).

18 GALLOWS GLORIOUS: a play by Ronald Gower (A).

AFTER-DINNER SPEECHES BY TELEVISION

Mr. J. B. Priestley, the novelist, will give the first after-dinner speech by television on November 2 on the occasion of the Festival Dinner of the Royal Photographic Society at the Dorchester Hotel, presided over by the Duke of Kent. Immediately after the dinner, Mr. Priestley will go to Alexandra Palace and will speak for ten minutes before the television camera. Receivers installed at the Dorchester will enable the guests to see and hear the speaker.

Following the speech an all-star cabaret will be televised, with Gracie Fields, Jean Colin, Oliver Wakefield and Douglas Byng.

This will be Gracie Fields' second visit to the Alexandra Palace studios. Alexandra Palace itself, however, is familiar ground, for it was in the old Alexandra Palace theatre that Gracie Fields scored her first successes in the Archie Pitt shows, " Mr. Tower of London," " Too Many Cooks," and " Safety First."

TELEVISION AT THE "STAR"

Great interest has been taken lately in pictures at the Star and Garter Home. In response to an appeal launched by Eileen Ashcroft in the *Daily Mirror*, for television sets in homes such as this, several sets have already been received—one the day after the appeal was made—and nearly £1,000 has been subscribed. One set was presented by the Gaumont-British News Film Company in co-operation with the Baird Television Company.

TELEVISION'S O.B. AERIAL

During the recent transmissions, the viewer was shown the aerial used for outside broadcasts. This aerial is fitted to the end of an extension ladder of the type originally used by fire brigades. It can be extended to its maximum height in under four minutes as compared with two or three hours taken in erecting an aerial on top of a mast. This aerial also has the advantage that it can be rotated quite quickly in order to obtain radiation in the right direction. Incidentally the motor on which this ladder is mounted was first put into service in 1916 and it is not very likely, therefore, that the manufacturers had any idea of the ultimate destination of this fire escape.

TELEVISION DRAMA

A big television drama "push" is also contemplated, but there is a deplorable paucity of original material and of plays written specially for the medium. Reginald Berkeley's famous " White Chateau," which has been broadcast many times, is on the list. An interesting point about this production is that the grounds of Alexandra Park will be used for one of the sets. It is more than probable that a Territorial unit will take part and bring along a six-inch gun.

COLUMBIA BEGINS INSTALLATION OF 300-KILOWATT TRANSMITTER

AFTER a year's exhaustive tests, both of the transmitter and of a new type of television antenna for distributing the signal evenly over the entire city and its suburbs, Columbia engineers have begun the work of installing the 100,000-lb. equipment on the 72nd and 73rd floors of the Chysler Tower in New York. The transmitter will broadcast a high-definition picture signal as powerful as that of any transmitter now in operation.

Arrangements also have been made for a coaxial cable connecting the transmitter with the C.B.S. television studios in the Grand Central Terminal Building nearby.

The installation is to be completed early in 1939, but as additional time will be required for final tests, no date has been decided upon when the first programmes will be put out. When the new station goes on the air next year, it will be the climax of nearly ten years of television experiment by Columbia which, in 1931, broadcast the first regular schedule of television programmes in America when 60-line transmissions were put out. The new station will send out pictures of 441-line definition.

The new C.B.S. television transmitter has been built at a cost of approximately $500,000 and it is estimated that it will cost another $150,000 to instal. From the Chrysler Tower, which was picked as the ideal location after careful study of the whole New York skyline, the station will provide primary coverage within a radius of about 40 miles over a total area of about 4,800 square miles.

A New Aerial

A new type of antenna system, designed under the direction of Dr. Peter C. Goldmark, Columbia's chief television engineer, is to be employed and it is stated that this will distribute the power evenly over the area to be served. The new aerial consists of 16 independent dipoles—8 for sound radiation and 8 for visual images. To assure maximum efficiency during the winter, all antennas will be heated from the inside and thermostatically controlled so that ice cannot form on them. The antennas will be practically invisible from the street.

Auxiliary to the new transmitter are electrical transformers now being installed, which will supply 1,500,000 watts of power. Of this amount, the transmitter will use about 300,000 watts for sending out the powerful, high-definition picture signal.

Because of the very high voltages employed, operators will be protected by an elaborate system of safety devices. All doors to the transmitter room proper, as well as all panels over high-voltage equipment, will carry interlock switches to cut off power automatically when the doors or panels are opened.

A further precaution is the "shorting plug" arrangement, placed near the door leading behind the transmitter panel. When a man goes to work behind the panel, he takes one of these plugs along, thereby disconnecting the circuit. Only when each man has returned and all plugs are in place will the circuit be completed. On the master control desk, a panel of 20 control lamps indicates the exact location of any operator working near high-voltage equipment. Forty additional control lamps indicate the operating condition of the various power units.

Installation is proving a difficult matter for it was found that the freight elevator—although it had been restrung with heavier cables and rebalanced with additional lead weights—was unable to lift the mammoth electric transformers for the transmitter. This necessitated the draining of thousands of pounds of oil from the transformers to lighten them. But now C.B.S. technicians are worrying about the fact that this oil must be especially filtered and all traces of moisture removed before it can be replaced.

The new transmitter will operate under the call letters, W2XAX, supplanting the low-power equipment which has been used for experimental purposes at Columbia's television laboratories in the C.B.S. Building at 485 Madison Avenue.

MECHANICAL-OPTICAL RADIO GEAR

IT is interesting to note that the Scophony receiver employs entirely separate apparatus for the reception of vision and sound signals.

The Vision Receiver

Tuned radio frequency amplification is used for reception of the vision signals. A tuning control is dispensed with. Eight valves are used of which four are R.F. amplifiers and two are diodes for rectification and separation of synchronising impulses.

The ouput from the vision radio receiver is via a low impedance output valve and co-axial cable to the light control drive unit, which consists of video amplifier, oscillator R.F. amplifier and D.C. reinsertion valve.

The R.F. amplifier valve is connected to the quartz crystal on the light control and is grid modulated by the video amplifier. The apparatus is so designed that the full 5 megacycles of the two sidebands are fed to the light control.

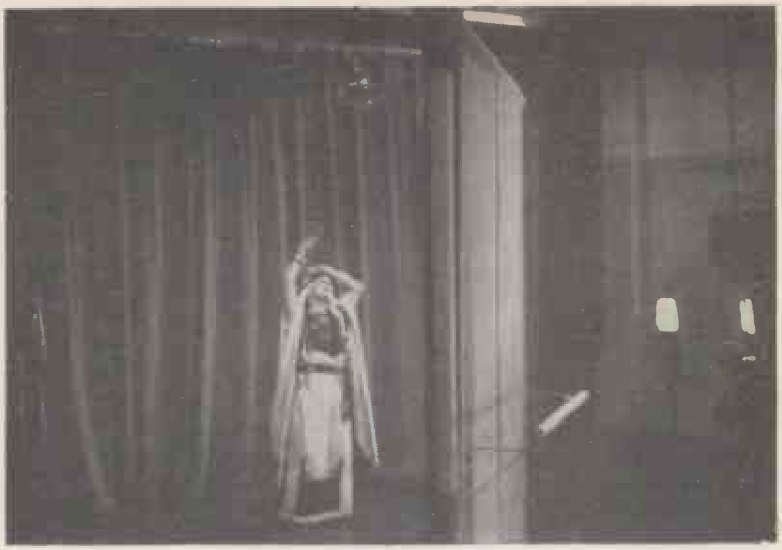
This is the valve arrangement at present used, though other alternatives are possible.

The Sound Receiver

For the sound, six valves are employed utilising tuned radio frequency amplification at carrier frequency. This method was adopted in order to avoid constant retuning necessary in a receiver of the super-heterodyne type, which arises from frequency drift of its oscillator. Anode bend rectification is employed and is fed to two output valves which work the 10-in. loudspeaker. The sound receiver has very high fidelity in order to make full use of the high quality which is transmitted.

IT is always of interest to obtain first-hand information on television development in other countries and compare their results with our own efforts. Recently I had the privilege of visiting the television studio in Paris and examining all the apparatus.

For some considerable time the French Government have been testing various systems at the Eiffel Tower station and they have now finally decided on the equipment developed by The Materiel Telephonique Company.



Dancer being televised in Paris television studio. The screen in the middle foreground of the picture is for the use of close-ups or announcers.

with respect to the synchronising pulses. This is kept constant at 30 per cent. of peak carrier.

The definition used is 455 lines interlaced at 50 frames per second. On the present radio transmitter the full band is not transmitted, but in new equipment which is now being constructed this will be remedied.

The output from the vision transmitter is fed by means of a balanced feeder to the Tower where a transformer is used so that coaxial cable can be used to carry the

A VISIT TO THE EIFFEL TOWER TELEVISION STATION —*By Our Special Representative*

This company is associated with the Standard Telephones & Cables, Ltd., of London.

The Eiffel Tower station is working daily and transmitting programmes from the P.T.T. studio about a mile away. Only one room is used for the studio as there are difficulties in allocating sufficient space in the present building. The studios are situated in the main Post Office building.

One Camera Only

One camera is employed for all programmes and there are no film transmissions. The camera is of the same type as used by the B.B.C., and was obtained from this country. It is mounted on a "dolly" and the operator has to focus his camera either on the announcer or the artists as may be necessary. The lighting is similar to that used at Alexandra Palace. The photograph reproduced shows the studio during a transmission.

The control room is situated outside the studio which can be viewed through a plate glass window. The programme during the afternoon, when I was present, consisted of two juvenile acts and dancers. It was apparent that the use of only one camera severely limited both the programme material and method of presentation. This limitation was particularly noticeable during the dancing turn.

The signals are fed by coaxial cable to the main transmitting station built underground at the side of the base of the pylons of the Tower. The transmitter comprises similar equipment to that at Alexandra Palace. The vision unit derives its frequency from thermal-frequency crystal control and by frequency doublers to the final stages; this is grid modulated and the peak power output is in the order of 30 kilowatts. Positive transmission is used, that is, peak white represents peak power output.

The Sound Transmitter

The sound transmitter is a conversion of an old vision-transmitter which has been modified. This at present is situated in a separate room. In another room is the line termination and picture control gear. One of the racks contains a monitor and the engineers can switch from line or radio pick-up at will so that a direct check of transmitted picture quality can be made. Two other cathode-ray tubes are used, also in the control room, one for modulation depth, and the other for checking the D.C. level

power to the di-poles on the top of the Eiffel Tower.

There are few, if any, receivers in use by private viewers. I witnessed reception in a viewing room provided by the French Post Office in a building near the studio. This viewing room is provided for the use of the public so that they may obtain an insight into television progress. I arrived there on "crisis" day, which may have accounted for the fact that only a few people were taking advantage of the facilities provided. Three receivers were demonstrated. Two of them were cathode-ray receivers of the direct type with screens approximately 10 in. by 8 in. The pictures were black and white, and were standard type receivers as manufactured by two large French concerns. The quality was definitely worse than that seen on the check receiver at the transmitter and was spoilt by intense phase distortion.

The third receiver was interesting in that it was a British-made cathode-ray projection type instrument giving a picture approximately 20 in. by 16 in. The screen was greenish in colour. It was on this that the picture quality could best be studied. Definition was definitely below that which is transmitted by the B.B.C., the camera technique also was poor.

Television Digest

Interesting Abstracts from the World's Television Literature

Colour Matching (Electronics, New York)

THE instrument described by this article was constructed to designate colour matches with high precision either by reflection or transmission methods.

A sensitive bridge circuit employing two R.C.A. photo-cells of the vacuum type was used and is shown in Fig. 1. A voltage divider across the charging voltage of the photo-cells balances the system. By adjusting the voltage divider, the meter needle may be made to rest at mid-scale zero with no light on the tubes. Because the tubes are in series and must pass the same current, a larger quantity of light imposed on one tube as compared to the other decreases or increases the mean total bias on the amplifier, a 38 pentode operating at 4 volts on the heater to increase stability.

The photo-cells, type 919 and 917, are especially sensitive in a balanced circuit of this nature. These photo-cells have top-cap connections, the anode being brought out to the cap on the one tube, the cathode on the other tube. As indicated in the circuit, the grid cap of the amplifier tube connects only to the top-caps of the two photo-cells. Short top-cap connections to the three tubes, result in an extremely high resistance leakage path. Leakage may be further decreased by coating the bulbs with a non-hygroscopic wax. The windows of the photo-cells should be free from wax.

A bias voltage divider on the pentode compensates for differences in photo-cell sensitivity by allowing shift of the grid-plate characteristics of the amplifier valve.

The lamp house is located some distance from the main body to insure stability by reducing thermal variations in circuits. It contains the light source, a Mazda lamp of the concentrated filament type. The double condensing lens and light balancing shadow vane are also contained in this compartment.

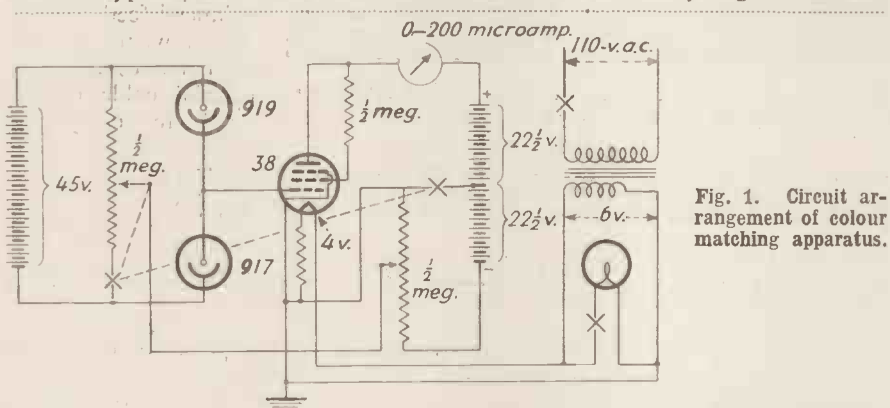


Fig. 1. Circuit arrangement of colour matching apparatus.

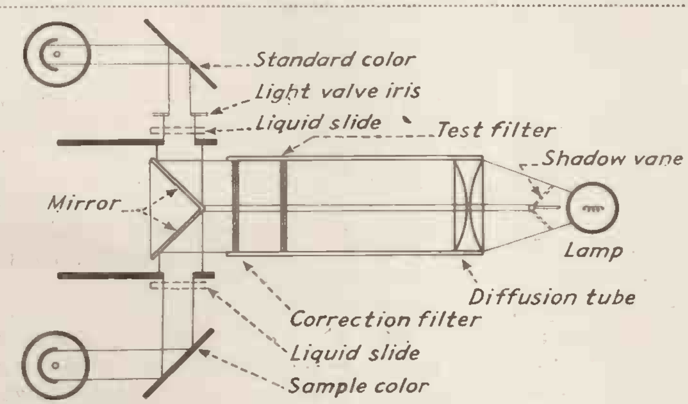


Fig. 2. Optical layout of colour matcher.

A description of the operations entailed in making a routine colour test or match should be of help in explaining the functions of the light valve and shadow vane in the lamp house.

With all switches in the "off" position the main power switch is put on and the apparatus given several minutes to heat up. The balancing circuit knob is now turned into the "on" position and the meter needle centred on mid-scale. A reflector is placed in the back window trap. One of the colour filters is placed in the slide and the standard colour is placed in the front window trap. The light source is next switched on and with the calibrated light valve set at zero mid-scale the shadow vane in the lamp house is adjusted to bring the meter needle back to zero.

The standard is now replaced with the sample to be matched against it. If the meter needle deviates from zero it indicates a mis-match, plus or minus. Again the meter needle is brought to zero by an adjustment of the calibrated light valve or iris diaphragm. When this condition obtains the reading on the light valve scale is indicative of the percentage difference in the tonal range of the sample and standard as far as that particular band of the spectrum is concerned.

Picture Sizes (Murphy News)

The ratio of picture width to height at the B.B.C. transmitter is 5 to 4. With this knowledge we can work out for any diameter the theoretical maximum dimensions of picture than can be accommodated, and columns 2 and 3 of the table give these dimensions for a number of sizes of screen diameter.

In practice, of course, the end of the tube is not flat and since the extreme corners of the picture seldom contain anything of very great interest, a certain amount may be sacrificed to increase picture size. The limits which we have set ourselves

(*Continued in first col. of next page.*)

HOW THE PICTURE IS SYNCHRONISED

Since the whole success of television reproduction depends on the accuracy of synchronising, the circuit by which the pulse is applied to the scanning generator must be as carefully designed as any part of the receiver. In this and succeeding articles G. Parr describes the various forms of circuits used and the effect on the pulse.

IF the chart of the wave-form of the E.M.I. transmission is examined (Fig. 1) two types of synchronising pulse will be seen. Between the line signals occurs the line sync. pulse, which is a short pause of 10 microseconds during which the carrier wave drops to zero. The frame sync. pulse, occurring at the end of each frame is a composite one consisting of eight broader pulses, each of 40 microseconds duration with an interval between each. The duration of each line signal is 100 microseconds, including the time allotted to the pulse, and since the time occupied by each broad pulse is 50 microseconds, these will occur at intervals corresponding to half a line. For this reason they are usually referred to as "half-line pulses," and their object is to maintain the line scanning generator in step during the operation of the frame flyback.

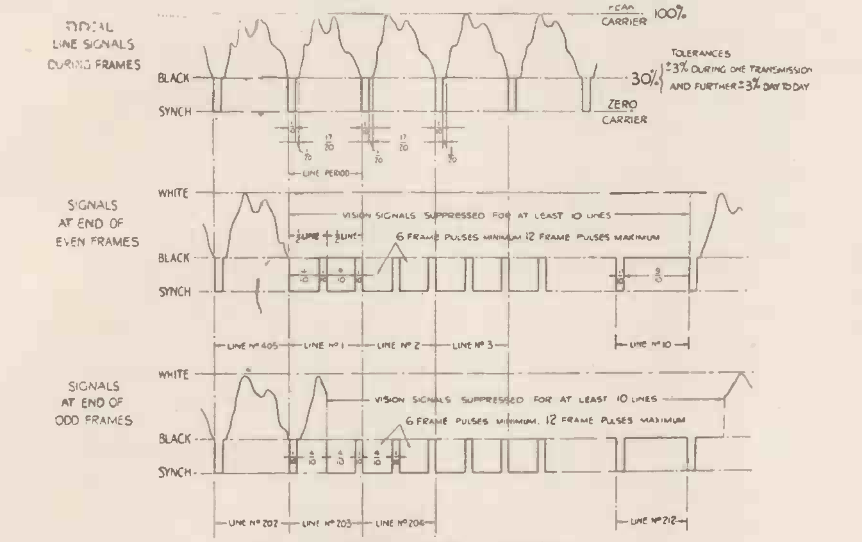


Fig. 1. Marconi-E.M.I. waveform.

If the half-line pulses were absent, the frame sync. pulse would consist of a long break in the transmission lasting for 400 microseconds. This would be sufficient to ensure the return of the beam at the end of the frame scan but during the return the line scanning would be out of control and would continue to traverse the screen at the natural frequency of the scanning circuit. This might be very different from the frequency of the standard pulses with the result that at the end of the frame flyback the lines would be badly out of synchronism and would require several pulses before they settled down again to normal running.

This effect was sometimes noticeable in the early days of high-definition transmission before the present system was standardised, and was shown by a flapping of the top edge of the picture which occupied the first few lines of each frame.

Again referring to Fig. 1 it will be noticed that the pulses at the end of the odd and even frames are spaced differently, the odd frame ending at half a line and starting again with half a line, while the even frames have the last line completed and interpose a line pulse before the start of the lines of the new frame.

As is now well-known, this staggering of the pulses and line signals results in the interlacing of the lines in the frames and it is therefore of the utmost importance that the pulses are transmitted correctly to the scanning generator if the accuracy of the line spacing is to be maintained.

To do this, special precautions have to be taken in the design of the synchronising circuit, which has for its object the separation of the line from the picture pulses and their application, undistorted, to the line and frame scanning generators.

Before dealing with the methods by which the pulses are separated and amplified it is convenient to consider the value of the average pulse in volts and the most convenient points at which it may be led off to the scanning circuit.

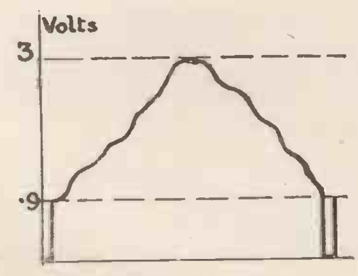


Fig. 2. Waveform applied to diode showing relative value of sync. pulse to signal.

"TELEVISION DIGEST"

(*Continued from preceding page*)

are that the maximum sacrifice is that corresponding to 10 per cent. increase in picture dimensions. This is given in columns 4 and 5 below.

(1) Tube screen diameter	(2) Theoretical maximum picture width	(3) Theoretical maximum picture height	(4) Practical maximum picture width	(5) Practical maximum picture height
4"	3·1"	2·5"	3·4"	2·7"
5"	3·9"	3·1"	4·3"	3·4"
6"	4·7"	3·8"	5·2"	4·2"
7"	5·5"	4·4"	6·0"	4·8"
8"	6·3"	5·0"	6·9"	5·5"
9"	7·0"	5·6"	7·7"	6·2"
10"	7·8"	6·2"	8·6"	6·9"
11"	8·6"	6·9"	9·4"	7·6"
12"	9·4"	7·5"	10·3"	8·2"
13"	10·0"	8·0"	11·0"	8·8"
14"	10·9"	8·7"	12·0"	9·6"
15"	11·7"	9·4"	12·8"	10·0"

If the dimensions are exceeded, not only does this result in excessive distortion at the corners of the picture, due to bulb curvature, but also part of the picture will be actually cut off. The safest figure to take when assessing picture size is undoubtedly the true screen diameter so that a fair comparison can be made.

Value of Pulse

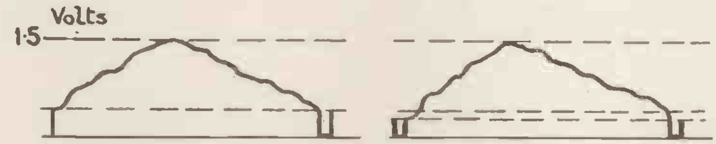
To arrive at an approximate value of the amplitude of the pulse we can take first of all the voltage required at the output of the video amplifier to modulate the grid of the cathode-ray tube. The majority of electrostatic tubes require 20 volts to modulate the beam fully and magnetically focused ones require less.

This figure is not often attained in practice as the average "looker" does not operate the tube at full brilliance on the white portion of the pictures and the input to the grid is usually reduced by the control. If one video amplifying stage is employed, the gain will be in the neighbourhood of 12-15, so we can estimate the input to the grid of the video amplifier by assuming an output of 20 volts peak value and dividing this by 12. This will give a peak value of approximately 1.5 volts on the grid.

If the efficiency of the diode detector is 50 per cent. this output will be given by an input of 3 volts peak, and we can then sketch the waveform of the signal applied to the diode detector in terms of voltage amplitude as in Fig. 2. The proportion of the sync. impulse to the total carrier amplitude is 30 per cent., so that we can draw a line at 0.3 times the height of the peak amplitude and mark this as the level of the sync. pulse.

It might be considered at first sight that the diode load resistance was the most convenient place from which to take off the sync. pulses as, after rectification of the carrier, a voltage of 30 per cent. of 1.5, or 0.5, would be available for synchronising. In practice, however, this figure is seldom reached, as the foregoing approximate calculations have not taken into account the curvature of the diode characteristic.

This can be seen from the diagram of Fig. 3, and it will be noted that with low values of input, such as we are working with, the output from the diode load is not linear in relation to the input. The result of this so far as the sync. signal is concerned will be to reduce its effective value to below the theoretical figure.



Figs. 4 and 4a. The signal at the output of the diode. (a) The same signal altered by diode characteristic.

If the diode were linear throughout its working range, the output waveform across the load would be as shown in Fig. 4, which is half the amplitude of that in Fig. 2 (assuming 50 per cent. only of the rectified voltage appears across the load resistance). Due to the curvature of the characteristic, however, the output waveform will be more nearly that of Fig. 4a, in which the amplitude of the sync.. pulse is reduced in relation to that of the signal.

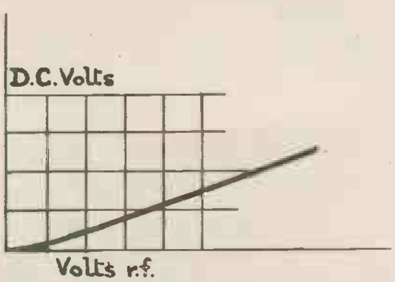


Fig. 3. Characteristic of diode showing the curvature which gives distortion at low inputs.

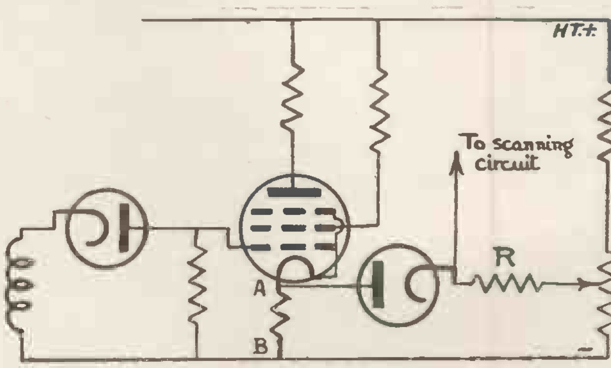


Fig. 5. Diode and video amplifier showing a method of separating the sync. pulse.

This reduction will be increased still further if any form of amplitude control is used in the receiver, as we have assumed so far that the full voltage of the video stage is required for modulating the tube, and, as said above, this is seldom the case.

The diode load resistance is therefore only suitable for supplying the sync. pulse voltage in cases where the output is reasonably high, unless a form of amplification is used before the pulse is applied to the scanning generator.

It is certainly possible to adjust the frequency of the scanning generator to such an accurate value that a sync. pulse of only a fraction of a volt is sufficient to trip the discharge valve, but in designing the sync. circuit the extremes of variation must be taken into account and it is preferable, particularly in the case of home constructed receivers, to have ample margin on which to work.

To amplify the value of the pulse we may use a separate valve connected to the output from the diode, but there is no need for the extravagance if the video amplifier stage is available. Most receiver circuits have the video stage directly coupled to the diode load, in order that the D.C. component may be passed through the amplifier* and it is therefore just as convenient to take the pulse from the video amplifier circuit with the added gain introduced by the valve.

There are two points from which the connection may be taken—the cathode resistance or the anode load resistance. In the first case the level of the sync. pulse is still maintained in its correct relation to the rest of the signal owing to the direct connection between the diode load and the video valve, while in the anode load resistance it will be necessary to interpose a condenser in the output to keep the H.T. from the valve in the scanning circuit. On the other hand the gain will be higher, and this is an important consideration.

* See "T. & S.W.W." March, 1938, p. 157.

(*Continued on page* 679)

Telegossip

A Causerie of Fact, Comment and Criticism

By L. Marsland Gander

WHEN the crisis had reached its most explosive stage and parks and commons were being turned at a feverish pace into a fair imitation of No Man's Land, the B.B.C. decided to close down its television service if war broke out. The ultra-short wave sound channel would in all probability have been retained for the transmission of news, official announcements, etc.

Why the television service should close immediately any more than theatres, cinemas and music-halls I do not know. Places of entertainment in wartime play an invaluable role in maintaining civilian morale and providing recreation for men of the fighting services. It is as well for those who have the interests of television at heart to realise that they have just escaped by a hair's breadth a staggering blow to their hopes.

Importance of Short Waves

Another reflection that follows the lifting of the war clouds is that it has become a national necessity to set up a country-wide chain of ultra-short wave transmitters. Owing to the limited range of ultra-short waves foreign transmitters could not interfere with British broadcasts on these frequencies, nor could they easily overhear any information intended specifically for the home audience. This is one of the strongest arguments in favour of creating a national television service, for in no other way can the public be persuaded to buy ultra-short wave receivers on a big scale. And, of course, if only a handful of listeners have the equipment to receive ultra-short wave broadcasts the plan breaks down.

It is time the Government realised the importance of this point. The B.B.C. is relying on boosting the power of its long- and medium-wave transmitters in the belief that the local wipe out would compensate for any interference from distant sources. But in any case the service area would be greatly restricted and nothing jags the nerves of listeners more than constant niggling interference either by heterodynes or Morse signals.

Deliveries

During those days of war threat many girl employees at radio and television factories were "conscripted" for work of national importance such as the assembly of gas-masks. What time their male colleagues were set to digging trenches and refuges.

All of which means another hold-up in the supply of television sets to customers. It is delicious irony that after beseeching the public to buy sets for years without much success the manufacturers have found themselves unable to meet the demand immediately and are now having to ask customers to wait. It is all the more remarkable that this state of affairs should have followed immediately upon Radiolympia, held with the avowed object of persuading the public to buy television sets.

But the plain fact is that the makers were so uncertain of public response to their blandishments that they waited for orders before perfecting production plans.

However, I hear that within the next few weeks all production troubles will have been smoothed out in the industry and as a prelude there is the possibility of another big publicity campaign in which the B.B.C. will co-operate with the Radio Manufacturers' Association. B.B.C. sound wavelengths will be used for publicity purposes. Somebody has hit on the novel idea of eye-witness accounts of popular television products. Mr. John Snagge has already given a running commentary on "Picture Page" for Empire listeners, and Mr. Thomas Woodroffe, from a special booth in the studio, is to do the same for National listeners early in November.

The New D.G.

It is a good augury for television that Mr. F. W. Ogilvie, the new Director General, has already shown his great personal interest in the B.B.C.'s newest branch. Not only did he inspect the television equipment at Radiolympia but he also paid a personal visit to Alexandra Palace, visited all departments and had an informal chat with practically every member of the staff.

When I met him at Broadcasting House a few days ago he told me that he had had a television set installed at his Hampstead home and was watching the programmes on any night when he could spare the time from the duties of Director General.

I was invited recently to talk to the Television Society on the subject of B.B.C. programme improvements since the service started. Inveterate grousers may say that there is nothing to choose between the pictures of champion birds, beasts and fishes transmitted in the early days and third rate studio material to-day. I prefer to think of the progress from the time when the B.B.C. showed us how to repair a broken window to the recent Test matches; from the first crude adventures in television drama to "Libel," "Rush Hour," etc.

But it came as a rude shock to realise that in one respect there had been no progress. When I gave that talk a few days ago the B.B.C. was as badly off for studio accommodation as it was when the service started two years ago. Since then re-equipment of No. 2 studio has been completed and both studios were to be used together in the presentation of the play "Cyrano de Bergerac."

As regards the theatre conversion the plans are still all on paper. I understood last month that orders for the work and equipment had been placed. Yet it appears even now the B.B.C. has failed to sign on the dotted line and everything is held up. The delay is quite inexplicable after the official assurances that no more time was to be wasted.

Since the service began the only real and solid progress in the provision of extra facilities with substantial effect on programmes has been the purchase of the two complete mobile units. These vans are capable of extending programme time with an immense variety of interesting topical and sporting programmes. There is talk at Alexandra Palace of a whole fleet of these mobile units, at least half-a-dozen, and it may be that this is the solution of the whole programme problem.

The B.B.C. has come to a parting of the ways when it is necessary to decide whether to proceed without further delay on the projected extension of studio space or to provide more mobile units. The great snag with outside televising is, of course, the quality of picture.

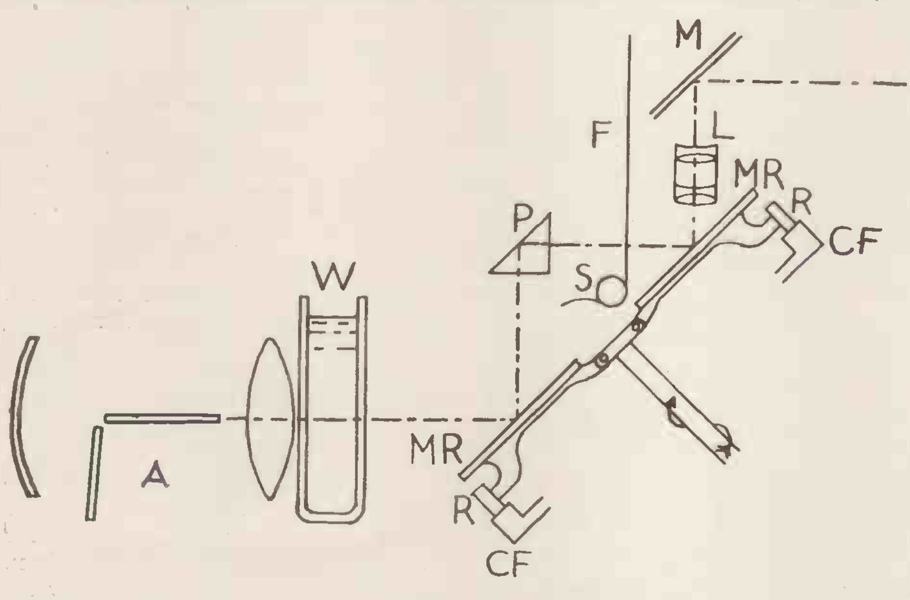
(*Continued in third col. of next page.*)

A NEW FILM TRANSMITTER FOR A.P.

EVER since the electronic system was exclusively adopted at Alexandra Palace, viewers have complained that the quality of the film transmission was not equal to that of direct transmissions. The reason for this is that films have always been transmitted by means of an ordinary intermittent-motion film projector, used in conjunction with an Emitron; in order to provide the interlaced scanning, it has been necessary for the image to be projected upon the screen of the Emitron for only a very short space of time, the storage effect of the mosaic screen providing signals for the double traversal.

Many engineers have felt that this storage principle was not too satisfactory, and in a new transmitter installed at A.P. a few weeks ago, the film is moved continuously, and is imaged all the time upon the screen, there being no dark period. An official description of the new equipment —also of a new control room linking up the two studios, telecine, and O.B.—will be published next month, but the following is a description of the former by a TELEVISION AND SHORT-WAVE WORLD representative who was granted facilities for examining the equipment.

The optical compensating system used is of a type originally made some ten or twelve years ago for kinematograph projection, and known as the Mechau; it is not today used for that purpose in this country, owing to the difficulty of adapting it to sound reproducing systems, but is apparently used on the Continent for television work by A.E.G.



Schematic diagram of continuous-motion film projector.

In this mechanism, the film runs from a horizontal take-off, and is fed by a continuously moving sprocket through the gate. A system of oscillating and rotating mirrors which are interposed both between the illuminant and the film, and between the film and the objective lens, gives a stationary picture on the screen.

The principle of this optical system will be clearly seen from the sketch reproduced, which is however by no means to scale, and moreover shows an arc instead of an incandescent light source. The light of the arc *A* is focused through the water-cell *W* upon the lower part of the mirror ring *MR*; this comprises 64 pivoted mirrors, rotating on an inclined spindle, and each tilted by the rollers *R*, working on the cam face *CF*.

The light beam is reflected from the lower mirror, which tilts to enable the beam to follow the film travel. After reflection from the prism *P*, the light is focused through the film *F*, fed continuously by the sprocket *S*, and upon the upper mirror of the ring *MR*, which is also oscillated during the rotation of the ring by the movement of the roller *R* on the cam face *CF*, in order that the picture may appear stationary on the screen. The image passes through the lens *L* and is again reflected from the mirror *M*, in the present case upon the screen of the Emitron.

It is difficult to say as yet that this new system has much improved film transmission; one still sees the unsightly grey blotches in the corners, and half-tone reproduction still compares unfavourably with direct transmissions. However, it is early to give a definite opinion as possibly with further experience improved results will be obtained.

"TELEGOSSIP"

(*Continued from preceding page*)

I was at North Weald aerodrome when the B.B.C. televised Hurricane fighters in action. Bands of interference marred the pictures as received on televisors. Had viewers seen those beautiful streamline machines soaring like gulls and speeding in line abreast across the sky as I saw them on the windswept aerodrome they would have had a memorable thrill. Then poor lighting marred the pictures from the Motor Show at Earls Court. It was necessary to instal batteries of special lamps for the film *Première* from the Carlton.

The vans will work overtime at Christmas on a programme scheme vaguely described in official circles as "original and seasonable." A series of transmissions will come from the West End.

How many viewers have noted and wondered about the disappearance from the television programmes of announcer David Hofman? He has been transferred to Broadcasting House and I have heard his voice many times in the sound programmes. There is no immediate intention of filling his place at Alexandra Palace and in the meantime the two girls, Miss Jasmine Bligh and Miss Elizabeth Cowell are carrying on.

TELEVISION TO REVOLUTIONISE KINEMATOGRAPHY!

"RECENT ADVANCES IN ELECTRONICS AND THEIR APPLICATION TO KINEMATOGRAPHY"

By A. G. D. West, M.A., B.Sc., President of The British Kinematograph Society

A. G. D. West, Esq., M.A., B.Sc. (Baird Television Ltd.), the President of the British Kinematograph Society, opened the winter session by giving an address on October 20, on " Recent Advances in Electronics and their Application to Kinematography. Mr. West took as his theme, the subject of the increasing influence of electronic methods on the technique of the kinematograph industry and the following is an abstract of his address :

MR. WEST opened his address by expressing his thanks to the members of the Society for his election to the Presidency. After giving a technical summary with regard to the operation, manufacture and use of electron tubes, he indicated that as the electronic art was now progressing at such a rate it would not be many years before a complete and satisfactory electronic system could be used in the taking of moving pictures, the distribution throughout the country, and their reproduction on the screens of cinemas.

We define electronics, said Capt. West, as that branch of science which relates to the conduction of electricity through gases or *in vacuo*. Many large industries depend entirely on established and commercialised uses of electron tubes: such industries as those of radio broadcasting, radio broadcast reception, and world-wide communications, which would not exist without the electron tube.

The processes taking place in an electron tube in every case consist of three distinct stages:

1. The release of electrons from conductors into the tube.
2. The control of these free electrons as they move about inside the tube.
3. The making use of their movement and the energy which they represent in a specific way.

Their movement is subject to control in three ways:

1. By the presence of an electrostatic field of force.
2. By the presence of an electro-magnetic field of force.
3. Due to the presence and motion of other nearby electrons.

Finally, we can make use of their energy by methods such as the following:

1. By making them enter a conductor and charge it up, resulting in a flow of current from the tube.
2. By causing them to bombard something in the tube to heat it up.
3. By causing them to impact on a screen consisting of fluorescent material, giving rise to light.

The use of tubes employing thermionic emission, such as amplifying valves, and the use of tubes employing photo-electric emission, such as photo-electric cells, are very familiar and therefore I would like to draw attention to the special study of two other particular processes, namely, the secondary emission of electrons, and the study of electron optics, which is concerned with the motion of electrons in travelling from their point of entering the tube, called the cathode, to their point of exit from the tube, called the anode. These two processes have, during the last few years, attained very considerable importance in electronic work.

Let us consider in more detail the three stages in operating the electron tube. So far the photo-electric cell is mainly known for the purpose of converting the variations of light passing through the sound track of the combined print into corresponding electrical variations which in turn operate the loudspeaker. But the photo-electric surface now plays an increasingly important part in converting the elements into which a picture may be divided into corresponding variations

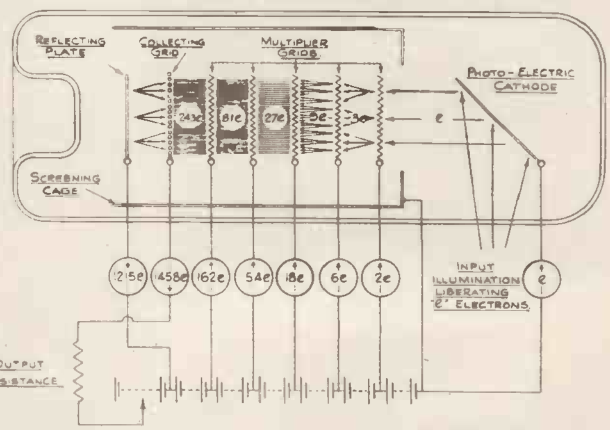


Fig. 1. Schematic diagram of action of Baird Multiple photo-electric cell. Arrows denote direction of electrons. Secondary emission multiplication per grid -3. Secondary emission multiplication per plate -6. Total gain 1,215 times.

of electrical current. The process of transmitting a picture by television involves the scanning of the picture or, in other words, the regular division of the picture into a definite number of elements which are dealt with in turn in accordance with some arbitrary rule.

Secondary Emission

Now, taking the next important principle—that of secondary emission—it has been found that if a stream of electrons is allowed to bombard a metallic surface

USING THE MULTIPLIER PRINCIPLE

having certain definite characteristics, each electron can be made to displace a definite number of electrons, depending on the type of surface which is used. This effect is having a growing amount of importance in overcoming some of the difficulties of electron tubes as, for example, the difficulty of lack of sensitivity of the average photo-electric cell.

The cold emission of electrons so far has not been made use of with advantage in developing electron tubes, but the use of electron tubes where the ionisation of gases is employed has made great strides in recent years, being used in new types of electric discharge lamps which are making great headway for illumination purposes where the question of economy is all important.

Now, coming to the control of the movement of free electrons inside the tube; the most important principle attracting our attention is that of election optics. It has been found possible to study the movements of electrons by making a very complete analogy with the corresponding principles of geometrical optics. The movement of an electron under the influence of electromagnetic or electrostatic fields is defined in accordance with certain well specified and well-known laws. It is the study of electron optics which has enabled television engineers to make great progress in the cameras and picture reproducers which they now use.

Fluorescence

As regards the uses to which the energy of the electrons can be put on arrival at the anode of the tube, I need only mention, Capt. West said, the phenomenon of fluorescence, whereby the impact of electrons on certain materials releases light which can be employed in building up a reproduced picture. The use of fluorescent materials of this nature at the present moment constitutes by far the most important of the methods employed for the reproduction of television pictures.

Multiplier Photo-electric Cells

We are interested in making photo-electric cells with much greater intrinsic sensitivity, in other words, having greater efficiency in the conversion of light values into electrical currents. The maximum sensitivity available at the moment for the type of cell which can be used for this purpose, namely, the caesium cell, is about 50 microamperes per lumen. It is now possible to employ the principle of secondary emission to increase this value of sensitivity many thousands of times. If electrons from the photo-sensitive surface, before being led out of the tube, can be made to strike a surface which has secondary emitting qualities, then the electron current can be magnified many times, in some cases up to 10 times. If this process can be repeated, then it is possible to obtain much greater effective magnification.

Fig. 1 shows a multiplier photo-electric cell manufactured by Baird Television, Ltd., in which the electrons from the photo-sensitive surface are led to strike in succession a series of parallel wire grids. Each impact results in the electron current being amplified by a factor of three. The total amplification of the electron current can be up to 10,000 times, using a reasonable operating voltage (say, 1,000 volts) but very much greater using a higher voltage.

A similar type of static multiplier cell has been developed by Zworykin of the Radio Corporation of America. In this case electrons are reflected successively by parallel surfaces of a special shape.

Multiple Thermionic Valves

The obvious question now is, "Can such principles be adapted to give high amplification thermionic tubes?" and the answer is, "Yes." One of the first practical examples of such a tube is the Philips-Mullard secondary emission valve, Type TSE4. The designers of this valve have formed their electrode system so that the stream of electrons is made to strike an auxiliary secondary emitting surface before arriving at the anode. This single stage multiplying valve has on that account an effective gain of three times.

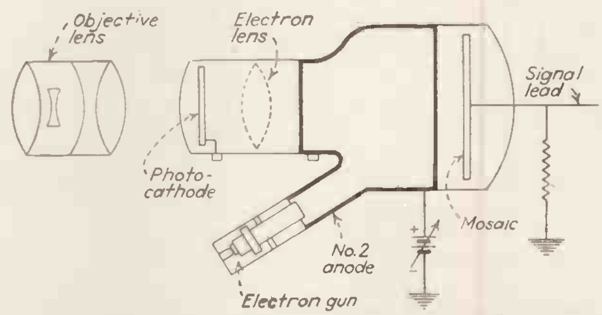


Fig. 2. Diagram of the image iconoscope or iconotron. The mosaic, bombarded by an electron image from the illuminated photocathode, emits secondary electrons, multiplying and storing the charge image. The mosaic is scanned, as in the usual iconoscope, by means of the beam from the electron gun.

The practical use of such a valve is best demonstrated by comparing what was regarded two years ago as a radio amplifier for television of the highest efficiency with to-day's product of the same type. The earlier chassis had eight high efficiency pentode valves. The present chassis has three of the multiplier valves and provides more gain with greater stability and greater band width.

Sensitivity

The problems of sensitivity in the pick-up (which specifies the lighting necessary on a scene to obtain a good picture free from disturbances) and of the brightness of the received picture, both depend primarily on the standard of definition selected. All the problems are rapidly increased by an increase in the number of lines chosen for the standard. As an example, if it is desired to double the number of lines for a given shape of picture, the number of picture elements is quadrupled and the performance of all the various pieces of equipment must be so many times improved.

STORAGE ACTION

Note that in this normal scanning process at any given instant of time only one picture point is being dealt with and this prescribes a limiting factor to the degree of definition due to deficiencies in the devices which are used. As we shall see later, the problem has been partially solved by applying a principle, which is probably of greater general importance than any other recent development, namely, the storage of the action of light in each element of the picture, for the full period of time between two successive traversals of the scanning beam over that element. In other words, after an element has once been scanned, a process of storage takes place in that element until the scanning beam comes its way again so that by that time it has a much greater quantity of light to deal with. Thus the use of the storage principle helps us very considerably in this connection with regard to sensitivity in the camera and brightness in the received picture.

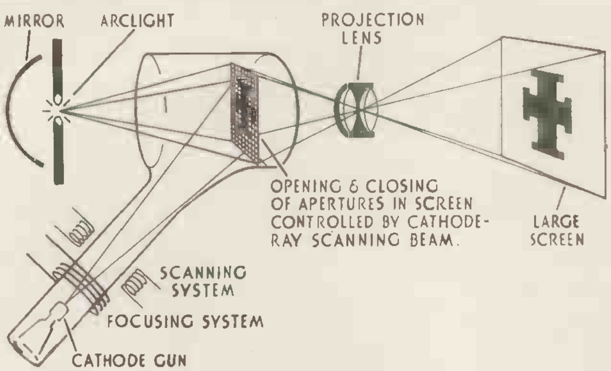


Fig. 3. Storage projection system.

Storage Camera

I want now to explain a device which goes a long way to providing a successful means of converting picture scenes under all conditions of lighting into their electrical counterpart. In other words—the kinematograph camera of the future.

The simple general principle of an electronic device which can act as a camera for the transmission of pictures, can be regarded as a bank of photo-electric cells in number the same as the number of picture elements into which the scene to be transmitted is divided up.

It is possible to visualise such an arrangement whereby an image of the scene is focused by a lens on to such a bank of cells, the output from each individual cell being connected by some commutator device to the electrical transmission system. Thus, the scanning of the picture is carried out in any predetermined manner by taking the response from each cell in turn, such a response being exactly in accordance with the value of light projected on it from the original scene. Many devices of this nature have been tried and they have in general all failed to deal satisfactorily with the transmission (on a high-definition basis) of the ordinary scenes encountered in practice, on account of the lack of sensitivity of the photo-electric cell.

The solution of the problem has been found in applying the principle of storage to such a device. If this is done the light received on any particular cell throughout a given time period gives an electrical output which can be hundreds or even thousands of times more than the output given by the instantaneous electron current from the cell element when it is in operation only for the short period of time corresponding to the moment of scanning.

A great deal of the work in bringing a device of this nature into a practical form was done by Zworykin for the Radio Corporation of America. He named it the Iconoscope, and tubes having a similar fundamental principle were independently developed by Electric & Musical Industries in this country under the Trade Mark " Emitron " and are used by the B.B.C. at the Alexandra Palace for the transmission of television.

The principle of operation of the Iconoscope and Emitron is as follows: The image of the scene is projected by the lens on to a mosaic formed with separate minute insulated photo-electric elements. The emission of electrons continues from each particle of the mosaic throughout a complete period of scanning, say, one-twenty-fifth of a second, during which time each element builds up charges until such time as the elements are discharged by the scanning cathode-ray beam which comes from the cathode gun at the base of the tube.

The act of discharging each element provides an electric potential varying in accordance with the lights and shades of the scene projected on to the mosaic, at the metallic backing plate of the mosaic, and this is used to control a thermionic amplifier which modulates the television radio transmission.

A later form of tube of this nature employs in addition to the storage principle the principle of an electron converter. The optical image is focused on to a transparent photo-sensitive surface and an electron image from that surface is formed on the storage mosaic which is then scanned off as in the original Iconoscope. This form of camera may have a sensitivity up to ten times greater than that of the original form.

Cathode-ray Tube as Reproducer

Turning now to the question of reproducing the picture: We have seen how a scan can be reproduced on the screen of a cathode-ray tube. It needs little further imagination to appreciate that by controlling the intensity of the cathode-ray beam in the tube or, in other words, the light value of the fluorescent spot, in accordance with the scanning currents developed by the television camera as it scans the light and shade parts of the subject, the picture can be reproduced on the screen of a tube.

Large-screen Pictures

Our next problem is to take such a picture and reproduce it in a form suitable for showing in a theatre, where the essentials are size and brightness. Tubes for direct vision are controlled in size by the limitations of glass technique and bulk. The largest tube made in this country is a Baird with a diameter of 20 in.

PROJECTION POSSIBILITIES

and as the pressure on the end is over two tons, the mind naturally turns towards the development of a small tube and the possibility of producing on its screen an intensely bright picture which can be used for projection by a lens on to a large theatre screen.

Colour and Brightness of Tubes

Recent researches on the subject of fluorescent screens for cathode-ray tubes have been devoted in general to two things:

1. The production of light of any colour.
2. The attainment of much greater brightness.

There is a modern type of cathode-ray tube which is used for projecting television images on to a large screen and it is fairly clear, as there are at the moment no vital stumbling blocks apparent, that results will eventually be achieved which will not suffer as regards brightness by comparison with the normal cinema projection. The problems of cost and serviceability are problems which normally arise in developing equipment of this nature and need not necessarily be taken into consideration at this moment.

Storage or Relay Projection Tubes

One of the limitations in this method is to be found in that the contribution of any particular element of the picture is only available for that minute part of time when it is being scanned. Our eventual hopes for the future are undoubtedly centred in obtaining some device which will introduce a storage or relay effect into the equipment. The suggestion of this general idea is also due to Zworykin, who has specified a receiving tube having a screen which consists of a large number of light flaps, there being one flap for each element of the picture.

A cathode-ray beam opens or closes these flaps in accordance with the vision signals received. The tube is thus not in itself a means of producing light but is a form of relay or, in simpler terms, a continuously changing lantern slide with which can be used an intense exterior source of illumination for projecting the picture thus formed on to the large screen of a theatre.

A special form of this principle has been suggested by Baird whereby each little element of the screen consists of a polarised light cell, the transmission of light through which is controlled by a cathode-ray beam modulated from the received vision signals.

Application of Electronics to Kinematography

Let us now consider each part of our present technical system and see how electronics comes into it.

First for the recording and reproducing of sound, the thermionic valve rules in this domain with the assistance of the photo-electric tube.

The Picture

For the picture in its progress through the camera, processing, printing and projection stages, even though a fixed technique exists which has little relation to the electronic art, I can see many minor uses for electronic methods which would be of great assistance in saving costs of production and providing a more uniform product. An interesting example of research is taking place in studying the grain size of various emulsions and the effect on grain of the processes to which the emulsions are subjected. This has been done very effectively by means of a recording microscope using a photo-electric cell, thus making it possible to give a reasonably true measurement of the grain size and of the distribution of different sizes of grain. The use of photo-electric methods of light measurement is by no means universal amongst cameramen, but I believe that if scientific methods were adopted in this connection and if film printers were available with an automatic photo-electric control of the printer light (which could be used in all cases except where special effects are desiged) then there would be much saving of time spent in the process of estimating printer exposures, and much greater uniformity achieved throughout prints distributed for projection.

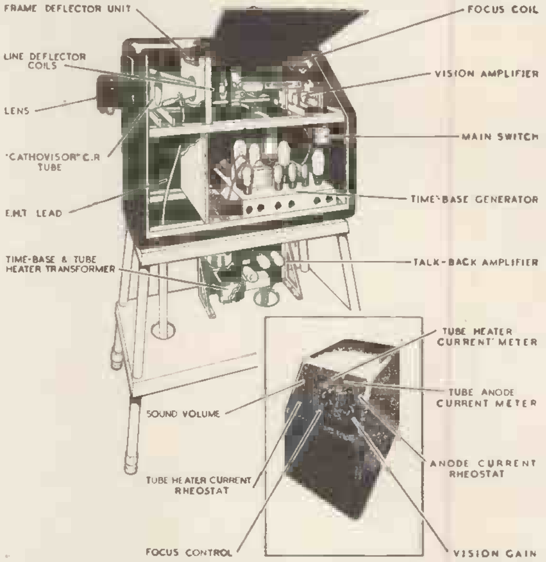


Fig. 4. Latest type of Baird cathode-ray tube projector for the cinema.

My paper, however, is not directed so much to the immediate future but rather to studying the general trend over a long period of time. Let us see if we cannot, from the information available and the state of technique at the moment, and with a perfectly detached point of view, summarise a completely electronic system for kinema entertainment and study its possibilities from the point of view of technical perfection.

Existing Equipment and its Capabilities

For this purpose we have the following general types of equipment available at the moment:

1. A camera which can be used under reasonable conditions of lighting. It has certain faults such as small depth of focus, and the presence of certain shadow effects which occasionally mar the picture, and insufficient detail for our purpose and also possibly a limited contrast range.

2. A method either by means of a short-wave radio relay or a cable connection of limited range, whereby the pictures provided by the camera, used either under fixed studio conditions or when rambling around for picking up news and interest items, are linked to a central distribution system in a manner which, though often successful, for the time being cannot be regarded as showing 100 per cent. reliability and quality.
3. A radio distribution system which though thoroughly effective as far as it goes, has a very limited range, say, only twenty miles or even less, where reception can be guaranteed free from interference. As an alternative we can visualise a high definition underground cable distribution system which can have a reasonable range but the setting up of which involves the expenditure of a very large sum of money.
4. A receiving and projection system which provides a screen illumination only a quarter or even less of what the average cinema requires and which uses equipment whose life and reliability have still to be proved.
5. A complete sound pick-up and reproducing system which can provide anything in quality and range that is demanded of it.

Thus we have in a completely electronic system in general, at the moment, and as far as the picture part is concerned, nothing to compare technically with what the present established system of cameras, negatives, prints and high illumination projectors provides.

But, fortunately, research does not stand still. The remedies for all the above-mentioned deficiencies are in their fundamentals envisaged not only by the research theorist but by the practical scientist—a camera giving a clear picture with sufficient definition, a system of satisfactory distribution of the picture to all parts of the country, a projection result indistinguishable from that given in the best West End house.

But the solutions of these problems (although I have hinted at some of them) are not just round the corner. Still much research work is to be done, followed by sound engineering development to arrive at a product (as we shall do in the course of the next few years) which is satisfactory to the producer, the exhibitor and, most important, the patron. Thus it is reasonably safe to predict that all the processes of taking pictures and of distributing them to large audiences which go to build up the present motion picture industry are likely to be revolutionised by the electronic method, which though now only in its early stages will undoubtedly in time provide, by less cumbersome methods, all the entertainment and education and interest required by the great cinema-going public.

"HOW THE PICTURE IS SYNCHRONISED"

(Continued from page 672)

Taking first the cathode load resistance, the sync. pulse is taken from the points marked A, B in Fig. 5. The polarity of the pulse will depend on the method of operating the video amplifier. In one method, which has been previously described,* the bias on the amplifier is nearly zero when no signal is applied to the grid and the signal increases the bias in the negative sense. The sync. pulse will therefore cause a reduction in anode current corresponding to an increase in bias, and this reduction causes a voltage drop in the cathode resistance.

It should be noted that the cathode resistance in this form of circuit is not a bias resistance in the usual sense, but is for the purpose of providing sufficient voltage drop with change of anode current in the video valve.

As the picture signal causes an increase of bias on the grid and a further reduction in anode current, means must be provided for separating the voltage variation due to the sync. signal from that of the picture signal. This is done by inserting a second diode with its anode connected to the cathode resistance as shown in Fig. 5. The cathode of this diode is biased by being connected to a potential divider across the main H.T. supply. The action is then as follows:

Suppose the diode cathode is biased negatively to about 20 volts, then no current will flow in it until the anode potential exceeds this value. The potential of the diode anode is that of the end of the cathode resistance in the video stage and this is adjusted so that the voltage drop is sufficient to pass current through the diode when the sync. signal is applied to the grid. When the picture signal arrives the anode current of the video stage falls still further and the voltage drop in the cathode resistance is no longer sufficient to pass current through the diode against the bias on the cathode.

The diode is therefore only conducting during the sync. pulse, and the pulses appear across the resistance R in the diode circuit, whence they may be transferred to the scanning generator.

This is one of the simplest and most satisfactory methods of separating the sync. pulse from the signal and is used in commercial receivers.

A further development of the circuit will be explained in the next article.

* See "T. & S.W.W." April, 1938, p. 214.

Zeitschrift der Fernseh A.G.

A publication has been issued by the "Fernseh Aktiengesellschaft" (Television Co.) of Berlin, and gives information on the research work and general progress of the company. The copy received is numbered Part I and it is understood that further editions will be published from time to time. It is intended to give in each issue a review of the progress made in television by this company. We were indebted to this publication for the information on the Fernseh film transmitter published in last month's issue.

The Radio Amateur Callbook

The new edition of the Amateur Callbook is now available from F. L. Postlethwaite, G5KA, 47 Kinfauns Road, Goodmayes, Ilford, Essex. This issue, which is right up to date and excludes the old O.E. stations, has most of the British amateurs down to G3P. The price of this callbook is 6s. per copy, post free.

G5KA also supplies a large number of handbooks written specifically for amateurs including "The Radio Amateurs' Handbook" price 5s. 6d. post free, published by the A.R.R.L., the "Radio Handbook" price 7s., which includes every aspect of short-wave radio, the "Radio" Antenna Handbook price 3s. 6d. post free, and many others.

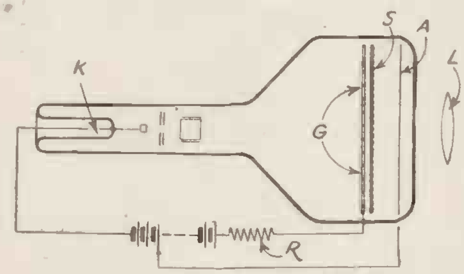
RECENT TELEVISION DEVELOPMENTS

A RECORD OF PATENTS AND PROGRESS
Specially Compiled for this Journal

Patentees: F. A. Lindemann :: N. V. Philips Gloeilampenfabrieken :: Marconi's Wireless Telegraph Co., Ltd. :: V. Zeitline, A. Zeitline, and V. Kliatchko :: E. W. Bull :: Baird Television, Ltd., and P. W. Willans :: Radio-Akt. D. S. Loewe

Cathode-ray Transmitters
(Patent No. 487,940.)

THE picture to be televised is projected through a lens L and a transparent anode A to the near face of a photo-sensitive screen S. This consists of a layer of small photo-electric particles deposited on a thin sheet of soda glass. The usual electric "charge" image is formed by the action of the light, and the lines of force from each charge pass through the glass sheet on to its rear surface, which directly faces the cathode K of the tube, so that it can receive the scanning stream. A "mesh" grid G is placed at a distance of about one millimetre from the screen S.



Pick-up tube Patent No. 487,940

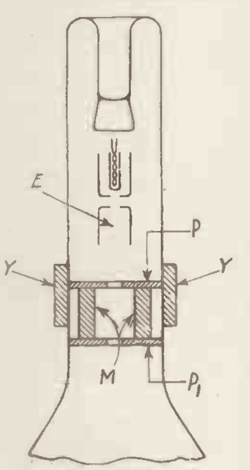
The picture "charges" are stated to act upon the electron stream in much the same way as the control grid of an ordinary valve, except that in this instance the grid G collects the electrons and uses them to produce a signalling current in the resistance R.

An advantage is that the screen S is arranged at right angles both to the received light and to the scanning stream, instead of being inclined to both as in the Iconoscope.—*F. A. Lindemann.*

Magnetic Focusing
(Patent No. 487,998.)

Instead of using external coils to control the electron stream, a permanent magnet made of an alloy which is capable of standing a high temperature without losing its magnetism, is permanently mounted inside the cathode-ray tube.

As shown in the figure, the magnet consists of a short steel-alloy cylinder M and two perforated end-plates P, P1. The main flux passes from one end-plate to the other, and then axially along the tube. To control the intensity of the field, an external yoke or shunt Y is moved over the end-plates, the field being weakest the more nearly the yoke closes the gap between the two plates.



Magnetically-focused tube. Patent No. 487,998.

The electron stream passes through the two central apertures to come under the influence of the field. The plate P may also be given a biasing voltage, in order to create an electrostatic control field between it and the nearest electrode E, in addition to the magnetic control.—*N. V. Philips Gloeilampenfabrieken.*

Producing "Trick" Effects
(Patent No. 488,268.)

In the future development of television, it may be useful to be able to "manipulate" the picture in certain of the ways already practised in cinema films. For instance, it may be desired to produce "ghost" effects by superposing one picture on another, or to dissolve one scene into another, or to insert advertising matter whilst the programme is in progress, and without disturbing the actors in the studio.

These and other effects are made possible by a method in which several different pictures, or selected "scanning areas," are fed into the same transmission channel, and are then combined to produce the particular "pattern" or composition required on the viewing-screen.—*Marconi's Wireless Telegraph Co., Ltd.*

Electrostatic Focusing
(Patent No. 488,416.)

To secure uniform focusing of the electron stream of a cathode-ray tube, a succession of apertured discs are mounted between the cathode and the screen. These are arranged in two series, in one of which the apertures increase gradually from left to right, whilst in the other the apertures gradually decrease in the same direction.

The discs are interlaced one with the other, those forming one series being strapped together and given the same biasing-voltage, whilst those of the other series are similarly strapped together and given a different bias. The result is that the electron stream is uniformly refracted throughout the whole of its cross-section, so that all the electrons are brought to a focus at one and the same point on the screen.—*V. Zeitline, A. Zeitline* and *V. Kliatchko.*

Safeguarding the Screen
(Patent No. 488,655.)

If the electron stream of a cathode-ray tube is allowed to form on the fluorescent screen before the scanning-voltages are applied to set it in motion, it is likely to damage the sensitive coating of the screen.

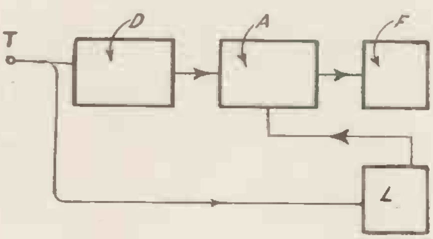
To prevent this from happening, when the cathode-ray tube is first switched on, the high-tension supply to the accelerator electrode of the tube is made to pass through a diode valve. The latter is biased in order to delay the building-up of the accelerating voltage until after the time-base circuit has come into operation on the deflecting plates of the C.R. tube. The scanning spot is therefore moving rapidly over the screen as soon as it is formed, so that there can be no risk of burning.—*E. W. Bull.*

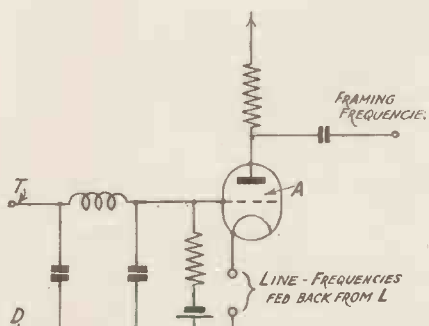
Time-base Circuits

(Patent No. 489,102.)

Both " line " and " frame " synchronising impulses are applied from a terminal T, Fig. 1, through a delay network D to a common amplifier A. They are also fed simultaneously to the " line " saw-toothed oscillator L, where the comparatively-slow " framing " impulses have no effect, but the more rapid " line " impulses set the line oscillator into action.

During the flyback stroke of each scanning line, a sharp impulse is fed back from L, as shown by the arrow, to the amplifier A and arrives there in time to block the passage of the line-frequencies as they arrive from the delay circuit D.





Line base circuits Patent No. 489,102

Accordingly the line frequencies cannot get through to the " frame " saw-toothed oscillator F, though this does, of course, respond to the framing impulses passed through from A. Both sets of impulses are therefore confined to their proper channels. The circuit arrangement of the amplifier A is shown separately in Fig. 1*a*.—*Baird Television, Ltd.*, and *P. W. Willans.*

Television Transmitters

(Patent No. 489,422.)

In the ordinary type of cathode-ray transmitter, the picture is focused on to a mosaic screen, where it forms an electron image, which is then scanned by a moving beam of electrons.

According to the invention, the mosaic screen is mounted in a tube where it is exposed to the steady emission of electrons from a photo-electric cathode located at the opposite end of the tube. There is no gun and no rapidly-traversed stream of electrons, the scanning action being performed by a rapidly-moving ray of light, projected from a rotating disc fitted with spiral apertures.

The action of the light on the mosaic screen develops signalling currents which correspond to a reversed picture, the strongest currents representing dark portions and the weakest currents the high-lights of the original scene.—*Radio-Akt. D. S. Loewe.*

Other Television Patents

(Patent No. 481,865.)

Tube in which the electrons liberated from a photo-sensitive screen are projected on to a fluorescent screen set at right-angles to the first screen.—*N. V. Philips Gloeilampenfabrieken.*

(Patent No. 481,944.)

Means for preventing leakage fields of force from distorting the picture produced by a cathode-ray receiver.—*E. Michaelis.*

(Patent No. 482,007.)

Cathode-ray receiver in which the return stroke of the scanning spot is extinguished.—*Farnsworth Television Inc.*

(Patent No. 482,725.

Producing saw-toothed oscillations for scanning from a relaxation valve arranged in the diagonal of a Wheatstone Bridge.—*Cie Pour La Fabrication des Compteurs,* etc.

(Patent No. 483,348.)

Circuit for separating synchronising impulses from the picture signals in a television receiver.—*The General Electric Co., Ltd.,* and *G. W. Edwards.*

(Patent No. 483,622.)

Two-way television system which can also be used for the one-way transmission of higher-grade pictures.—*Marconi's Wireless Telegraph Co., Ltd.*

(Patent No. 483,650.)

Arrangement of the magnetic deflecting coils used in a cathode-ray tube.—*A. D. Blumlein.*

(Patent No. 487,501.)

Method of transmitting sound and picture signals, from point to point, partly through a cable and partly through the ether.—*Fernseh Akt.*

(Patent No. 487,833.)

Mounting the electrodes of a cathode-ray television transmitter so as to avoid relative or " microphonic " movement.—*H. Miller.*

(Patent No. 487,974.)

Method of mounting, spacing, and aligning the electrodes of a cathode-ray tube by means of insulating washers and flanges.—*The General Electric Co., Ltd., J. E. B. Jacob, L. C. Jesty* and *G. W. Seager.*

Patent No. 488,221.)

Rotating disc with two or more spiral turns of lenses for high-definition interlaced scanning.—*Radio-Akt. D. S. Loewe.*

(Patent No. 489,028.)

Electrode arrangement for the " gun " of a cathode-ray tube designed to increase the sensitivity of grid control.—*Radio Akt. D. S. Loewe.*

(Patent No. 489,199.)

Television transmitter of the image-dissector type in which the part of the scanning stream that is not absorbed on the sensitive screen is returned and made to do useful work.—*P. T. Farnsworth.*

(Patent No. 489,231.)

Separating circuit for the line and frame scanning impulses in which irregular operation due to the effect of adjacent impulses on each other is avoided.—*Electric and Musical Industries, Ltd.,* and *C. L. Faudell.*

(Patent No. 489,428.)

Cathode-ray tube in which the electron stream is reflected, as from a mirror, by a " lens " system of electrodes.—*F. H. Nicoll.*

The T.I.G.B.

We have received from the Technological Institute of Great Britain a souvenir booklet on the coming of age (1917-1938) of this institute. The souvenir which will be sent post free on request, contains a large number of congratulatory messages from editors of technical publications and also from home and overseas students who have gained successes in various spheres as a result of tuition given by the T.I.G.B. The address is Temple Bar House, London, E.C.4.

New Designs in Amateur Equipment

The fact that the Post Office have now issued over 5,000 transmitting licences has no doubt done much to make manufacturers realise that there is an amateur market for valves and components. Some of the latest equipment is discussed in this article.

MORE and more equipment is being designed for amateur use by most British and American manufacturers. We do not think that at any time has there been such a variety of apparatus available from stock which can be used for transmitting and receiving purposes.

During a recent visit to WEBB'S RADIO we saw a large number of cases being unpacked, all full of brand new equipment not previously available to amateurs in England. To quote a few examples, there is a most interesting range of complete transmitters for C.W. and telephony operation produced by the R.C.A. Manufacturing Company and also Hallicrafters of Chicago. One of the most interesting models was the R.C.A. ACT-20, which in appearance looked very similar to the average large receiver.

It is completely self-contained with all power supplies and modulator and only has one completely variable tuning circuit. This is in the final stage as all the previous stages are pre-set tuned. The valve line-up for C.W. operation is 807 oscillator, 807 R.F. amplifier, 802 buffer-doubler and a pair of type 83 rectifiers. For telephony operation, four additional valves are used, being a 6F5 amplifier, 6F6 driver, and a pair of 6L6's as modulators. The ACT-20 operates on five bands from 1.7 to 28 mc. with a nominal power output of 20 watts for C.W. and 16 watts on telephony.

The price of this transmitter is extremely competitive and is supplied with coils for all bands.

The new HALLICRAFTER transmitter was also being demonstrated and this is a revelation in design. It is entirely self-contained for both telephony and C.W. and although conservatively rated at 50 watts phone carrier, and 100 watts C.W. carrier, can be run considerably in excess of these figures.

Very complete system of band-switching is employed, so arranged that the transmitter can be used on one of three bands as required. The final valve is an RK47, while in the modulation circuit there are four 6L6's in push-pull parallel, giving 50 watts of audio.

Valpey crystals are now available for doubling into the new 5-metre amateur band. These crystals are in the first instance ground for 20 metres and have the standard American fitting. We were very pleased to notice that Webb's Radio have now installed equipment for accurately measuring the frequency of crystals supplied so that they are in a position to give a guarantee of frequency when a crystal is obtained.

One of the most popular valves amongst amateurs is the 6K7, which provides quite a high gain when normally used. It should, however, be remembered that the new 1851 pentodes designed for use in television amplifiers, are interchangeable with 6K7's even though the bias values are not quite the same. However, if an 1851 is used, for example, in a DB20 preselector in a single stage, there is an increase in gain equal to three R points. The price of this valve is 17s. 6d.

The New Mullard TZ08-20 priced at 17/6.

A complete range of Taylor valves are now available and while on the topic of valves, amateurs should remember that with rack-built transmitters, a long filament line from the power unit at the bottom to the valve at the top can cause a very severe voltage drop. It has been noticed that whenever there has been a case of valve failure it has invariably been caused by the heater being under run owing to voltage drop on the line. This point is worth remembering particularly when the valves are run up to maximum rating.

We have discovered many instances of amateurs being in difficulty in cutting holes in the conventional steel chassis and panels. For this reason we were more than interested in the special diecast aluminium chassis which EDDYSTONE are now in a position to supply. This chassis, measuring 8½ in. by 5¾ in. by 2⅝ in., is large enough for small receivers, pre-amplifiers and power packs, etc., and is already arranged so that valve holes can be quickly made. Holes have already been drilled to take bakelite terminal panels so that constructors should not have any difficulty in building equipment. The price of this chassis is only 5s. 6d.

A number of so-called communication receivers do not include a beat-frequency oscillator, so restricting their use. However, this difficulty can be overcome by embodying an Eddystone beat-frequency oscillator unit which covers frequency of 450 to 470 kc. If is designed for use in conjunction with a 6J7 valve and it is priced at 8s. 6d.

A new range of amplifiers suitable for public address or modulation use have been produced by PREMIER SUPPLY STORES. We were discussing the problem of cheap high quality audio with G2HK, who showed us an example of what can be done with the modern beam-power tetrodes. The latest Premier amplifier, which is designed for 15 watts of audio output, uses a pair of 6V6's with 7 per cent. feedback. It is supplied with a universal output transformer is built on a steel chassis and has an overall gain of 100 DB. The price complete is £7 15s., while a set of parts including valves can be obtained for £5 15s.

Premiers also have a rather novel moulded type enclosed crystal holder. We were privileged to see some of the early models and as the price is to be extremely low—it has not yet been definitely fixed, but will be much less than anything else on the market—it should be popular and fulfil the demand.

They also have in the course of production some interesting foundation units. These consist of a band-switched exciter which with one crystal covers three wavebands, plus a number of P.A. stages suitable for different inputs. Both the exciter and the P.A. stages are

(*Continued on page* 696.)

A 2-channel Pre-amplifier

By HUGH FRICKER, B.R.S. 1636.

Constructors interested in public address work and for high quality reproduction in conjunction with a transmitter will find this pre-amplifier design of particular interest. It is suitable for crystal and carbon type microphones and with a very slight modification can be used with a moving coil. Bass suppression is included.

A SELF-CONTAINED amplifier to increase the output from either crystal or carbon type microphones before it is applied to the main speech amplifier, is a unit which most amateurs require. Although in theory a crystal microphone can be used with a high-gain amplifier, all mains-operated, in practice this does not always work out according to plan.

Amateurs who have not had very much experience in the design of multi-stage high-gain amplifiers are rather inclined to become despondent over the difficulties involved in removing all traces of hum, and in obtaining complete stability.

For a long time, I have used a class-B modulator driven by a reasonably low-gain speech amplifier in conjunction with a flexible battery-operated pre-amplifier. The whole equipment has been used both for transmitting purposes and for public address use. As it is often necessary to use two microphones simultaneously, one close to the amplifier for control purposes and the other at a remote point for outdoor speakers, some type of amplifier with a double input is essential.

The usual scheme is to have a fader or two input valves. This is quite satisfactory if the microphones used are of a similar type with more or less equal sensitivity. If, however, two carbon microphones are used which have to be energised, then it is certainly a problem having to arrange for energising when the microphone is remotely connected. On the other hand, if crystal units are used, which is unlikely in both instances owing to expense, then higher gain throughout is required.

It has been my experience that while most amateurs have carbon microphones available, only a few will have two crystal elements although a number would probably go to the expense of one. For this reason, the amplifier I have built is designed to accommodate both crystal and high-gain carbon type microphones, with independent volume controls, a common tone corrector, and a common bass attenuator.

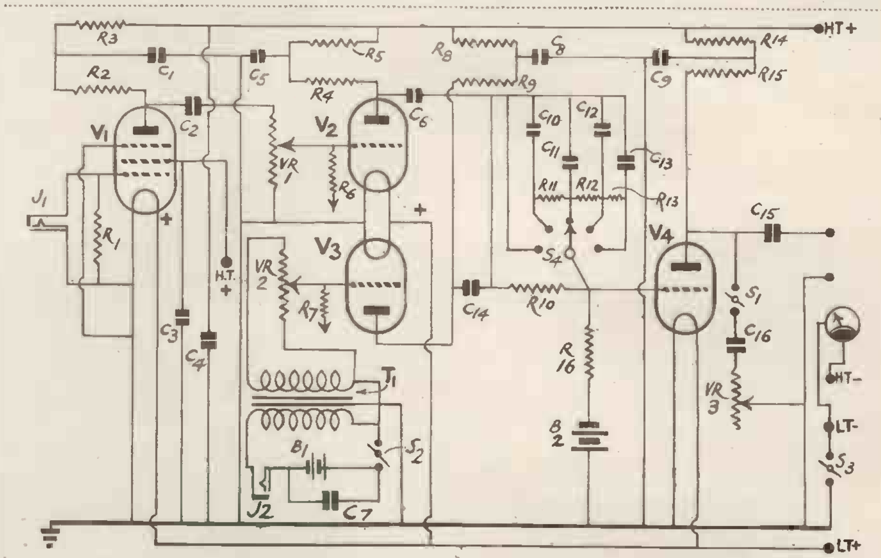
The entire amplifier is self-contained in a standard Eddystone steel cabinet. Separate volume controls for each microphone and a common tone corrector are embodied.

This bass attenuator is a most important refinement which will be discussed more fully later on.

The circuit of the completed amplifier is shown on this page. It consists of four valves, three triodes and a steep slope pentode. The first valve, the pentode, is used as a resistance-coupled high-gain, low-frequency amplifier into the grid circuit of which is connected a crystal microphone. The output from V1 is then coupled to the grid circuit of V2, a medium impedance triode, via a volume control VR1. A carbon type microphone is fed into the grid of V3 via a step-up transformer T1 and its own volume control VR2. So far, the circuits are independent but the speech output from V2 and V3 are joined together and ultimately taken to the grid of an output triode. In this way, both microphones can be run separately, or together, with varying sensitivity levels.

The output from the final valve is then taken directly to the mains speech amplifier through the blocking condenser C15.

Consider again the circuit which is built around V1. This valve, a Tungsram pentode with a fixed grid base, has the grid connection taken to the top cap. Between grid and earth is a resistance having a value of 3 megohms, which is a suitable load for the average crystal element. The screen grid is taken to its own H.T. tapping, the best value for which has to be determined by experiment, but generally speaking with the anode load recommended this voltage should be between 50 and 70 volts with 120 applied to the anode. It is most important, in order to obtain sufficient amplification, that the anode resistor R2 be of the correct value. This is 250,000 ohms.



This is the complete circuit, including an extra amplifying stage for a crystal microphone.

Circuit Details

The de-coupling resistance in this circuit, shown as R3, is not important and around 20,000 ohms is a suitable value. That is the whole of the first amplifying stage except that the screen is by-passed to earth by C3, the anode de-coupled by C1 while the coupling condenser between stages, shown as C2, has a value of .01-mfd.

Next comes V2, the second amplifying stage for the crystal microphone channel. The valve V2 is an HL2 Mazda triode. In its grid circuit is a volume control for a crystal microphone circuit, shown as VR1, which has a value of 500,000 ohms. Also in this grid circuit is a fixed resistor having a value of 100,000 ohms. This can be taken directly to earth if required but there is a distinct improvement in quality by applying 1½ volts negative bias.

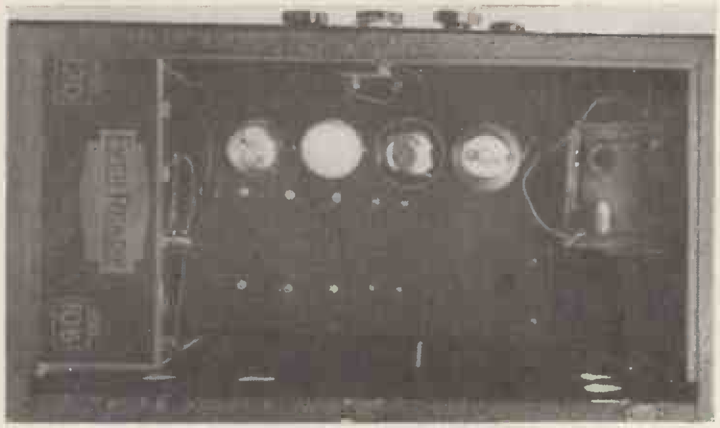
The volume control VR1 is quite independent of the second volume control so that the gain in either stage can be adjusted as required. In the grid circuit of the third valve are similar volume control and grid resistor, but, in addition, an input transformer of a multi-ratio type suitable for coupling the average carbon microphone to the input circuit.

In the primary of T1 is an energising source for the microphone, a closed circuit jack and a make-and-break switch to save running down the energising battery when the microphone is not being actually used. There is also a .01-mfd. condenser across the energising battery which tends to prevent background noise when the battery begins to deteriorate.

Both anode circuits are separately decoupled. R4 and R9 having values of 50,000 ohms each, provide sufficient gain with the low D.C. voltage available. De-coupling in each case consists of a single resistor having a value of 25,000 ohms and a condenser having a value of 2-mfd.

Coupling condensers C6 and C14 are joined together on the grid side but before being connected to the grid of V4, are joined to a bass-suppressor. This suppressor, although quite an old idea, is not very often used by amateurs. It is intended for inclusion when the amplifier is being used as a modulator.

It is a well-known fact that telephony signals are more difficult to read when there is a predominance of bass. Also when conditions are bad, and it is hard to hear weak stations, the intelligibility is very quickly increased by cutting off bass notes. The ordinary tone corrector is not too satisfactory for such a purpose, so I have embodied a conventional bass attenuator which I used many years ago when working on the design of cinema sound equipment. I noticed that not only was I able to receive many more QSA reports but in addition, owing to the strong low notes being eliminated, my average modulation level was considerably increased. The bass-suppression circuit is made up of resistors R10, 11 and 12 and condensers C10, 11, 12 and 13. In series with the output of V2 and V3 and the grid of V4 is a resistor R10 having a value of .5 megohms. Across this resistor is connected a fixed condenser of a value varying between .004 mfd. and .001 mfd. The switch of the rotary type, supplied by Peto-Scott, brings into circuit the condenser of the required value; for example, with a .004 mfd. condenser in circuit the suppression at 100 cycles is 4db., with a .003-mfd. condenser at 100 cycles is 6db., with a .002-mfd. condenser at 100 cycles 8db. and almost 10db. with a .001-mfd. condenser. The resistors shown as R11, 12 and 13 have a value of 5 megohms and can be of the half-watt type or even smaller. They are merely included to prevent a heavy click in the class-B stage when switching from one condenser to another.



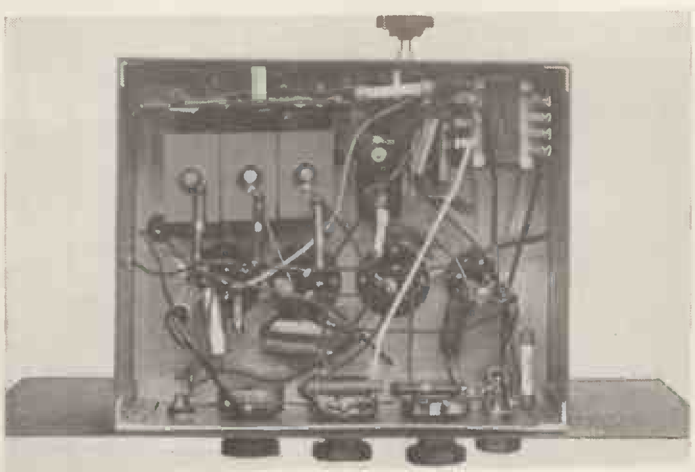
Inside the cabinet are the H.T. battery, accumulator and if required energising batteries for the microphone. Most of the components are underneath the chassis.

If no bass suppression is required, as for high quality audio work, then the fixed position of the switch converts the coupling stage to normal conventional practice. It is important with this circuit in order to obtain the given amount of suppression that the preceding anode resistors have the specified values, while the grid resistor in V4 circuit should have a value of .25 megohm.

I had considerable difficulty in picking a valve for use in the final stage. The ordinary HL triode overloaded far too quickly, whereas the power valve took a little too much H.T. current and at the same time did not provide quite sufficient gain. However, in the end I used an L21, a valve originally designed for battery-operated class-B driver work and this appeared to be the happy medium between output and overloading.

Although the maximum audio power is barely 200 milliwatts, it is sufficient to drive a high-slope valve which should follow in the first stage of the mains operated amplifier.

Before going into the constructional part of the amplifier, there are one or two points of interest regarding the application. The pre-amplifier can be used at quite a considerable distance from the main amplifier if a 500-ohm step-down transformer is used at both



How the various components are arranged can quite clearly be seen from this illustration. The bass suppression switch is mounted on the rear lid, alongside the grid bias battery.

Current Consumption

ends. In this way, for public address use, the pre-amplifier can be kept close to the speaker ready for immediate variations in volume level

For transmitting use, it can be kept on the operting table, and coupled by a screened line to the main amplifier which can either be in its own rack or an integral part of the transmitter. The meter shows the total H.T. consumption and is used merely as a guide as to the state of the H.T. or L.T. battery. Directly there is any marked decrease in the current consumption it is time to check the power supply.

The amplifier in skeleton form looks most business-like and as all the components of the smaller kind are protected by the chassis, there is very little likelihood of any breakdown.

The switch shown as S1 cuts out the tone corrector if not required. I notice that some of the volume controls are inclined to have a fair resistance even at minimum position so that slight top attenuation is unavoidable. However, the switch is mounted on the tone control VR3 so that the circuit can be broken if required.

The switch S2 which disconnects the energising battery for the carbon microphone is mounted on volume control VR2 so that when volume is decreased to zero the microphone battery is disconnected. Finally, comes the main on-off switch which is built into the volume control of VR1

Next comes, construction. The cabinet used is a standard Eddystone product which is fitted with the chassis 10 in. by 8 in. by 4 in. Messrs. Peto-Scott have the exact dimensions for this chassis and if it is obtained elsewhere, constructors will have to remove approximately half an inch along the front edge of the chassis in order to miss the edge on the front of the cabinet. Cutting out this strip is far more difficult than it sounds.

The chassis is mounted in the centre of the front panel and in this way allows ample space for an Ever-Ready 120-volt battery, a fairly large Everready accumulator and several batteries for energising the microphone. As the bass attenuation control is not consistently used, it has been mounted on the rear lip of the chassis out of the way.

Next examine the front panel. There are three jacks, two on the left being for crystal and carbon microphone and the one on the right the speech output to be taken to the main amplifier. The three controls are for volume, the first two from left to right, and tone correction.

Very few of the components can be seen from the top view of the chassis, in fact, except for the four valves, dial light and meter, the rest of the components are underneath the chassis. Examine the sub-chassis view. How the resistors and condensers are mounted can quite clearly be seen.. A bias battery mounted on the rear edge of the chassis and held in position by a Bulgin clip. The microphone transformer with its tapped primary is on the left-hand side while the anode resistors in each case are wired vertically with the de-coupling resistors wired horizontally. In this way, the components appear more or less neat and tidy, which is rather a problem when so few of the smaller components are actually fixed to the chassis.

The total H.T. consumption of the unit is approximately 10 mA. and providing a screened lead is used for both input and output circuits in addition to good metal cabinet, there is very little possibility of accidental hum pick up.

Suitable crystal microphones which I have used with this unit can be obtained from Messrs. Webb's Radio. These microphones require quite high stage gain, but this pre-amplifier plus an A.C. operated speech amplifier will be quite suitable. An excellent carbon microphone which gives good quality and is silent in operation can be obtained from Messrs. Premier Supply Stores.

Tonyrefail & District Radio Society

There are now four licensed members of this society under the call-sign GW3CR, GW3QB, 2FHJ and 2FKW. Morse practice is held at every meeting with 3CR or 3QB on the key. Full particulars can be obtained from the Hon. Secretary, C.W.3QB, 44 Pritchard Street, Tonyrefail, Glam.

Components for A 2-CHANNEL PRE-AMPLIFIER

ACCUMULATOR.
1—2-volt type GS70 (Ever Ready).

BATTERY, BIAS.
1—Type WIN 9 (Ever Ready).

BATTERY, HIGH-TENSION.
1—120 volt type 120L (Ever Ready).

CHASSIS AND CABINET.
1—Aluminium chassis finished black 10 ins. by 8 ins. by 4 ins. (Peto Scott).
1—Steel cabinet type 1034 (Eddystone).

CONDENSERS, FIXED.
1—2-mfd. type BB (C1) (Dubilier).
1—.01-mfd. type 4601/S (C2) (Dubilier).
1—.01-mfd. type 4601/S (C3) (Dubilier).
1—2-mfd. type BB (C4) (Dubilier).
1—2-mfd. type BB (C5) (Dubilier).
1—.01 mfd. type 4601/S (C6) (Dubilier).
1—.01-mfd. type 4601/S (C7) (Dubilier).
1—2-mfd. type BB (C8) (Dubilier).
1—2-mfd. type BB (C9) (Dubilier).
1—.0001-mfd. type 4601/S (C10) (Dubilier).
1—.001-mfd. type 4601/S (C11) (Dubilier).
1—.01-mfd. type 4601/S (C12) (Dubilier).
1—.1-mfd. type 4603/S (C13) (Dubilier).
1—.01 mfd. type 4601/S (C14) (Dubilier).
1—1.0 mfd. type 4609/S (C15) (Dubilier).

DIALS.
2—Type I.P.1 (Bulgin).
1—Type I.P.3 (Bulgin).

DIAL LIGHT.
1—Type D7 (Bulgin).

HOLDERS, VALVE.
3—4-pin less terminals type V1 (Clix).
1—7-piu less terminals type V2 (Clix).

JACKS.
3—Type J6 (Bulgin).
1—Type J2 (Bulgin).

METER
1—Type E66M to read 0-30 mA. (Sifam).

PLUGS, TERMINALS, ETC.
3—Plugs type P15 (Bulgin).
1—Type P43 (Bulgin).

RESISTANCES, FIXED.
1—3-megohm type ½-watt (R1) (Bulgin).
1—250,000 ohm type ½ watt (R2) (Bulgin).
1—20,000 ohm type ½ watt (R3) (Bulgin)
1—50,000 ohm type ½ watt (R4) (Bulgin).
1—25,000 ohm type ½ watt (R5) (Bulgin).
1—100,000 ohm type ½ watt (R6) (Bulgin).
1—100,000 ohm type ½ watt (R7) (Bulgin).
1—25,000 ohm type ½ watt (R8) (Bulgin).
1—50,000 ohm type ½ watt (R9) (Bulgin).
1—500,000 ohm type ½ watt (R10) (Bulgin).
1—5 megohm type ½ watt (R11) (Bulgin).
1—5 megohm type ½ watt (R12)(Bulgin).
1—5 megohm type ½ watt (R13) (Bulgin).
1—10,000 ohm type 1 watt (R14) (Bulgin).
1—20,000 ohm type 1 watt (R15) (Bulgin).
1—.25 megohm type ½ watt (R16) (Bulgin).

RESISTANCES, VARIABLE.
1—Potentiometer type J 500,000 ohms (VR1) (Dubilier).
1—Potentiometer type J 500,000 ohms (VR2) (Dubilier).
1—Potentiometer type J 10,000 ohms (VR3) (Dubilier).

SWITCHES.
1—5-point rotary (Peto Scott).

TRANSFORMER MICROPHONE.
1—Type LF35 (T1) (Bulgin).

VALVES.
1—SP2 Met. (V1) (Tungsram).
1—HL2 (V2) (Mazda).
1—HL2 (V3) (Mazda).
1—L21 (V3) (Osram).

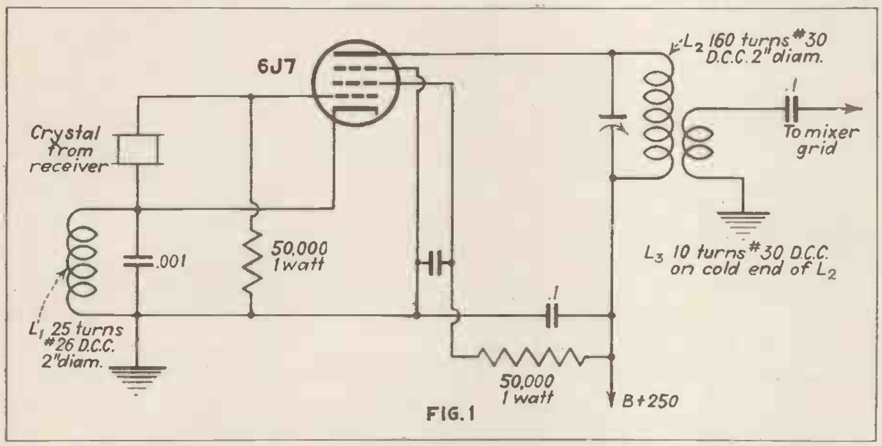
Improving the Performance of Communication Receivers

*The multi-valve communication receiver cannot provide maximum sensitivity unless every stage is correctly balanced. This arcticle by **H. D. Hooten**, which was first published in the American periodical Radio Retailing, explains how the average amateur receiver can be improved if correctly aligned.*

THE communications set has dominated the receiving field to such an extent that it may now be considered one of the most popular types of all-wave receivers. These sets are rapidly becoming more and more popular, and it is certain that before long the communications type of receiver, possibly installed in a console cabinet, will undoubtedly form a large percentage of the better all-wave receivers in use.

Practically all communications receivers are superheterodynes. Some of the less expensive models may or may not have a tuned pre-selector or R.F. stage preceding the mixer, but they all contain the usual oscillator, mixer, I.F. amplifier, second detector and audio stages. The fundamental circuit and principle of operation, therefore, is identically the same as for the standard all-wave receiver, except that these circuits have been more highly developed in order to obtain optimum stability, gain and over-all performance. However, the procedure to be followed when testing communications sets is not radically different from standard practice; the same analysers, valve testers, and measuring instruments are employed—the only important point is that these instruments must be extremely accurate, especially the test oscillator.

The usual symptoms of misalignment in the communications receiver are low over-all gain, evidenced by low meter readings on signals which were formerly capable of producing higher readings, off-calibration of the dial readings on known frequencies, unequal sensitivity on the different bands or the extremities of any particular band, and an excessive or extremely high noise level. Due to the tremendous gain available in the audio section of most of these receivers, a loss of gain due to misalignment may be noticed if the condition of the set is judged solely by the audio output since it is possible to turn the volume control to the maximum output position and still obtain a high volume level. Principal among the contributions to low gain is the part which the I.F. stages play in providing over-all sensitivity and selectivity of a high order.



With this oscillator the crystal out of the receiver is used in this way; the correct frequency is always obtained.

Loss of gain in the R.F. circuits is usually due to misalignment of the oscillator; in this case it is almost certain that the insensitive range or ranges will also be off calibration. It is always a good practice first to check the calibration of the receiver against known accurate frequencies before making any adjustments whatever in either the R.F. or I.F. circuits. If the calibration is correct, the trouble could be in the R.F. or mixer circuits; however, it is more than likely that the I.F. circuits are not properly aligned.

Aligning the Crystal

There are several methods by which the I.F. circuits may be aligned to the crystal frequency. It is absolutely essential that the I.F. transformers be aligned to the exact frequency of the crystal itself and not to any arbitrary calibration on the test oscillator; it has been found that commercial test oscillators for service work vary considerably, at least to an extent that will not permit the proper alignment of a quartz crystal filtered communications receiver. Radio Manufacturing Engineers, Inc., recommend the use of a standard 550 to 800 kilocycle broadcast signal of constant strength rather than an inaccurate oscillator, to furnish the test signal for alignment of the I.F. amplifier, using the quartz filter to establish the proper I.F. frequency. The Hallicrafters recommend that the receiver's own crystal be used in an external crystal-controlled oscillator for the I.F. circuit alignment. The latter method is especially desirable since the I.F. transformers will be peaked precisely on the crystal frequency. A suitable oscillator circuit is shown in Fig. 1. It is recommended that regeneration be used as shown; ordinary pentode 465 kc. crystal oscillators are sometimes a little difficult to start oscillating.

The coil, L2, may be of the plug-in type, if desired. This will permit the plate circuit of the 6J7 to be tuned to the second, third, fourth or higher harmonic of the crystal which will afford an accurate means of calibrating a portion of the R.F. and high-frequency oscillator circuits. Harmonics of a 465 kc. crystal higher than the fourth, however, are likely to be too weak to be of any practical value for alignment purposes.

In general, the following procedure is recommended: If the receiver is equipped with a crystal, place the crystal in a separate oscillator and align the I.F. circuits. Before aligning either the R.F. or I.F. circuits, be sure that: The A.V.C., crystal filter and beat oscillator switches are in the "off" positions; the selectivity control is in the "sharp" position; the audio and R.F. gain controls are set at maximum; and that the band switch is on position "one" with the tuning condenser open. Remove the oscillator tube from its socket. Remove the cap from the control grid of the mixer and feed the test signal directly to the tube throughout a 0.1 mfd. condenser. Adjust the I.F. trimmers for maximum output. If the receiver is aligned from the crystal oscillator's output, re-inserting the crystal in the circuit will show little

Practical Checking Methods

difference in output whether the crystal is "in" or "out" as indicated by the crystal switch.

The R.F. alignment is carried out as follows: Use either a .00025 mfd. condenser or a 400 ohms resistor in series with the output lead from the signal generator to the receiver as shown in Fig. 2. Be sure that one of the doublet antenna posts remains connected to ground during the alignment. Check

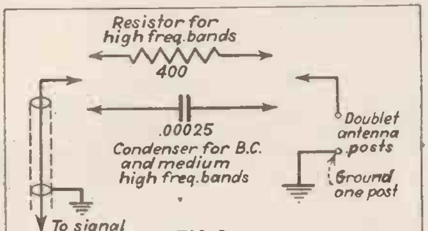


FIG. 2

A coupling circuit for a signal generator.

the calibration against accurately known frequencies (broadcast stations may be used if the oscillator is inaccurate) and adjust the high-frequency oscillator padder and trimmer condensers until the several known frequencies are received at corresponding points on the dial. Adjust the padders only for re-calibrating the low-frequency ends of the bands; the trimmers are for aligning the high-frequency portions (Fig. 3) Always "rock" the tuning condenser when making R.F. adjustments. It will be necessary to re-adjust each padder and trimmer several times; any small change in one will affect the other to a certain extent.

In some communications receivers, a high noise level may develop from a defective 6L7 mixer valve. This does not necessarily mean that the valve will test "bad" in the valve tester; it is not uncommon to find differences in the noise levels of brand new valves of the same manufacture when placed in the mixer circuit of a high-gain receiver. The usual procedure in cases of this kind is simply to try a number of valves in actual operation and then select the one that appears to be most suitable for the purpose.

To make a rapid check of the receiver, remove the grid cap from the detector-A.V.C. valve and touch the grid with the finger tip. A loud hum or squealing noise indicates that the audio section is functioning O.K. In circuits using 6H6 detectors, touch the grid of the first audio valve.

In servicing a dead set, check the output transformer first of all; if this is O.K., the usual service procedure of pulling out the valves for the "click" may be used. If the audio section appears to be operating, check the bias on the R.F. and I.F. valves, sometimes an open R.F. gain control will cause an apparently dead set due to excessive bias on the R.F. or I.F. grids.

In cases of violent oscillation, the offending circuit can usually be located by placing the finger on the grid cap of each R.F. and I.F. valve in turn. Check for an open screen or plate by-pass condenser. Check the valve, allowing plenty of time for each to thoroughly "warm up." As a last resort, replace the usual 300-ohm bias resistor with a higher value (400 or 500 ohms) or reduce the screen voltage slightly. It is best not to change values unless it is absolutely necessary; remember that the engineers who designed the particular receiver chose those values for a purpose. Oscillation is usually due to either valves or a defective by-pass condenser.

A low signal-to-noise level may be due to misalignment or a number of other causes: in about 75 per cent. of the cases, the condition can be improved by simply replacing the mixer valve. This is especially true where the receiver has been used around a high-powered transmitter; R.F. feeding back into the receiver tuned circuits frequently damages the valves causing them to be noisy even though they may test "good" on the valve checker.

A frequent cause of low sensitivity, especially in amateur receivers or those used in connection with commercial

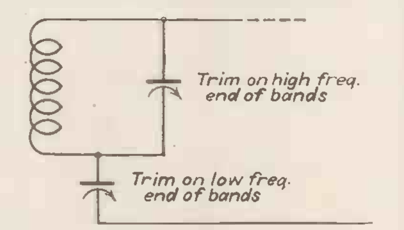


FIG. 3

Trimmer and padder adjustment.

stations, is due to the R.F. trimmer di-electric becoming punctured by R.F. voltage from the transmitter. In most cases of this kind the receiver will be sensitive on all bands except the one on which the transmitter operates. The trimmer may or may not completely short circuit; usually when tested for breakdown, a leakage of from 20,000 to 500,000 ohms is found. It is best to replace the defective unit with another one of the same type; however, the author repaired two punctured trimmers on a set by simply replacing the mica di-electric.

Noise Troubles

In some receivers, poor sensitivity and a high noise level can be caused by R.F. burns on the band-switch contacts. In one of these receivers, owned by a well-known 8th district operator, the switch points had been badly burned by feedback from a kilowatt transmitter. Although tests with an ohm-meter did not indicate a high-resistance contact, the sensitivity on the ten and twenty metre bands was only a fraction of normal; a careful cleaning with a small brush and carbon tetrachloride restored the sensitivity to normal.

Noisy operation when the receiver is jarred is usually due to poor contact at the tuning condenser wipers. Clean thoroughly with carbon tetrachloride and increase the wiper tension. If the noise is present on a single band only, lightly tap the trimmers of the particular band in use; once located, the trimmer should be replaced.

Microphonics are usually caused by sound waves from the speaker striking against some element in the receiver which is subject to variations in its electrical characteristics when placed in a strong sound field or a field where there is considerable vibration. A common source of this trouble lies in either or both the high-frequency oscillator and first audio valves. About the only remedy is to replace the faulty valves although glass valves can sometimes be made less microphonic by simply wrapping them with tape.

Another element likely to cause microphonics is the oscillator tuning condenser. These plates act like small diaphragms when the sound intensity is large, causing the oscillator frequency to shift at an audio frequency rate. This condition is especially noticeable when the crystal filter is being used and the selectivity is very high and at the higher frequencies where the possible frequency variation can usually be improved by placing the speaker at a distance from the cabinet on a soft sponge rubber pad or by turning the speaker in a direction that directs the sound away from the receiver itself. Usually, by breaking of a stiff physical contact between the speaker housing and the receiver cabinet will stop the howl.

Oxford University Wireless Society

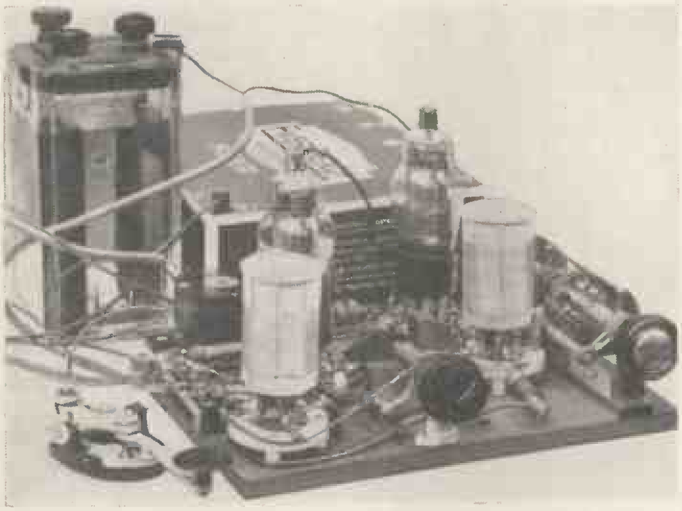
A society has just been formed for the purpose of encouraging interest in amateur radio amongst members of the University. The headquarters are at the electrical laboratory where the transmitting station, with the call-sign of G3MM, has been installed. Members are extremely keen and we advise all interested to get into touch with the secretary, Martin Ryle, Esq., Christ Church College, Oxford.

A PT7 Battery-operated Transmitter

The beginner who has not had previous transmitting experience will appreciate this design of a simple transmitter which provides an output of approximately 1.5 watts. Conventional components are used throughout with a standard H.T. battery and accumulator.

AMONGST the large number of new valves which amateurs will find suitable for their requirements, is a low power R.F. transmitting pentode with a directly-heated filment designed for battery operation. This valve is one of the first of its class and fier, are most suitable for Field Day work and provide a considerably higher carrier power than the ordinary receiving valves adapted for transmitting use.

For speech transmission, a PT7 can be modulated by anode, grid, or suppressor grid methods and even with anode modulation, requires the very minimum of audio power. For the beginner who has not had any previous experience of short-wave transmitting, we have produced this simple two-stage rig which, although designed primarily for C.W. operation, can quite quickly be modified so as to be able to transmit speech.



All the equipment required can be seen in this illustration. A special cheap McElroy morse key is used while the unit is frequency controlled by means of a quartz crystal.

must not be confused with the ordinary type of pentode used in receiving sets modified for transmitting use.

The new Osram PT7, as it has been designated, is an entirely new valve. Admittedly, it was designed in the first place for commercial use where it has been most satisfactory, but its characteristics are such that any amateurs wishing to experiment with really low power will find this pentode highly satisfactory.

The raw beginner who has not previously entered the transmitting field is often deterred from really getting going by the fact that the average transmitter being powered from public supply mains is comparatively expensive. There is also the danger of shocks from high voltage by those who are not too familiar with the circuit.

Ordinary battery-operated valves while being satisfactory do not compare with the PT7 around which it is possible to make an unusually simple low-power transmitter. It can be used as an oscillator or as a radio-frequency amplifier and has the big advantage that no neutralising is required. This right away overcomes one of the biggest difficulties which the beginner encounters.

Constructors of portable equipment will find that two PT7's, one as a crystal oscillator and one as an ampli-

First of all, the characteristics of the PT7 pentode around which the transmitter has been designed.

Filament voltage	... 2.0
Filament current	... 0.3 amp.
Anode voltage ...	... 240v.
Screen voltage ...	... 150v.
Anode current ...	... 12mA.
Screen current ...	... 3mA.
Anode dissipation	... 3 watts
Screen dissipation	... 0.5 watt
Anode impedance	... 250,000 ohms
Slope	... 1.7mA./volt

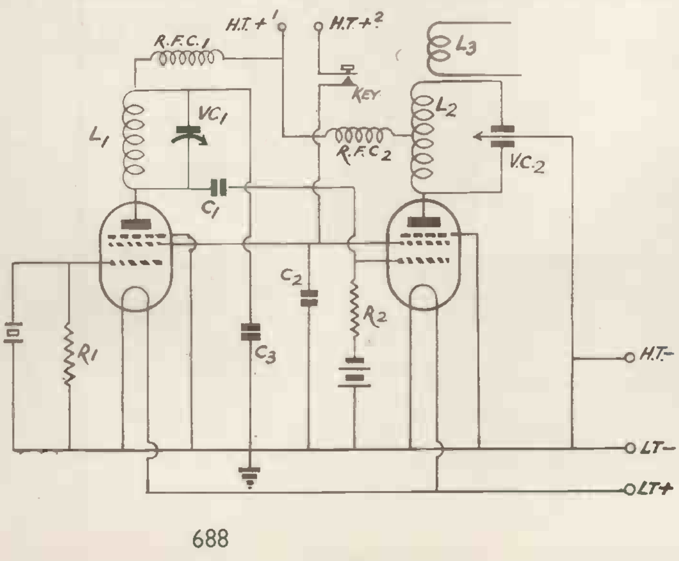
The valve is fitted with a normal seven pin base in which the electrodes are brought out to the pins in the following way. Control grid, pin No. 2 suppressor grid, pin No. 3, filament, pins Nos. 4 and 5 screening grid, pin 7 and the anode to the top cap. Terminals one and six are blank.

The following operating conditions will also be of use to the constructor for they give the comparative figures first when operating as an oscillator and second as a radio-frequency amplifier. As an oscillator at 40 metres, the conditions are as Table I (page 689).

As a radio-frequency amplifier for Class C telegraphy with a suitable drive valve such as the HL2, the operating conditions are shown in Table II.

Although these figures indicate that 240 volts H.T. are required, we have found that for normal low power amateur use, 150 volts and even as little as 120 volts can be used for C.W. operation. This means that the complete transmitter should not cost any more than the average receiver, for the only components which are not normally used are the crystal and the two valves.

Refer to the illustration of the completed transmitter. In this illustration can be seen everything required, in-



This is the simple circuit of the two-valve transmitter which uses the minimum of components. The running costs are no more than that of the average short-wave receiver.

Operating Data

cluding the accessories, the Ever-Ready battery, accumulator and key.

The transmitter consists of a pentode crystal oscillator and a pentode power amplifier operating on a wavelength of 40 metres.

Wavelength Control

Between the control grid of the oscillator and the earth line is connected a 40-metre crystal and a resistance of 100,000 ohms. The crystal governs the wavelength on which the transmitter operates and it is a comforting thought to know that no matter how badly VC1 and VC2 are mistuned, the transmitter cannot work on the wrong wavelength. Mistuning merely decreases the available R.F. output. In this way there can never be any chance of the transmitter being operated outside the recognised amateur experimental wavelength.

In the anode circuit of the oscillator is the coil L1 which is tuned by the variable condenser VC1. This coil is of the plug-in variety with a four-pin base and should be tuned to the same wavelength as that of the crystal. H.T. voltage to the oscillator is fed to the anode via the coil L1 and the radio frequency choke. The voltage should not exceed 240 or be less than 120. The radio-frequency output from the oscillator stage is then fed into the grid of the amplifying pentode. In order that only radio-frequency is applied to the grid, a blocking condenser, C1, is included which passes R.F., but blocks D.C. This condenser has a capacity of 50-mmfd. which is much smaller than normally recommended, but the reason for this is to stop pulling.

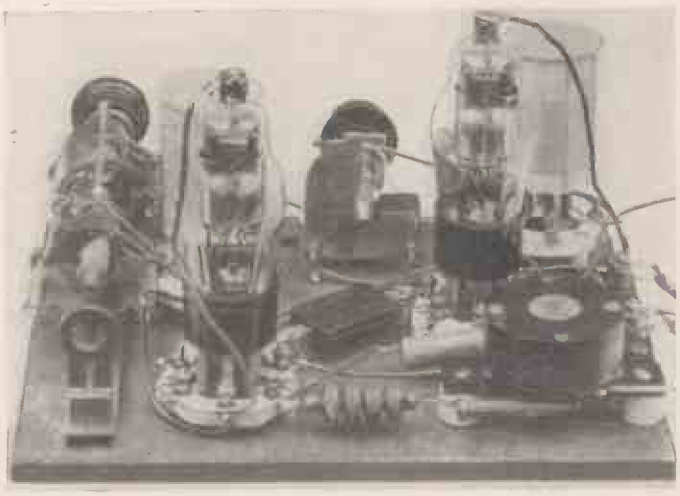
TABLE I

Ea.	Es.	Ia.	Is.	Esup	Ig1	Anode Efficiency.	Overall Efficiency.	Watts Output.
240 v.	150 v.	11 m/A.	3.9 m/A.	0	0.6 m/A.	50%	41%	1.3

TABLE II

Ea.	Ia.	Ea.	Es.	Esup.	Ia.	Is.	Ig1	Watts Outputt	Anode Effy.	Overall Effy.
80 v.	1.7 m/A.	240 v.	150 v.	0	11.7	5'6	0.85	1.5	54%	42

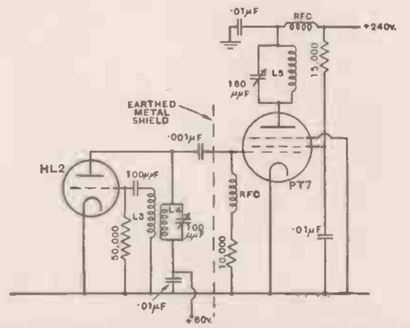
Grid bias for the amplifier is obtained partially by means of grid current flow across the resistor R2 and partially from an ordinary grid-bias battery. The grid resistor R2 has a value of 3,000 ohms, while the amount of bias applied by the battery depends entirely on the anode voltage used. However, there will be some further information on this point in the operating data.



The quartz crystal in its holder and the smaller components are illustrated in this photograph. On the extreme left is the Eddystone cradle in which the third mount is not used.

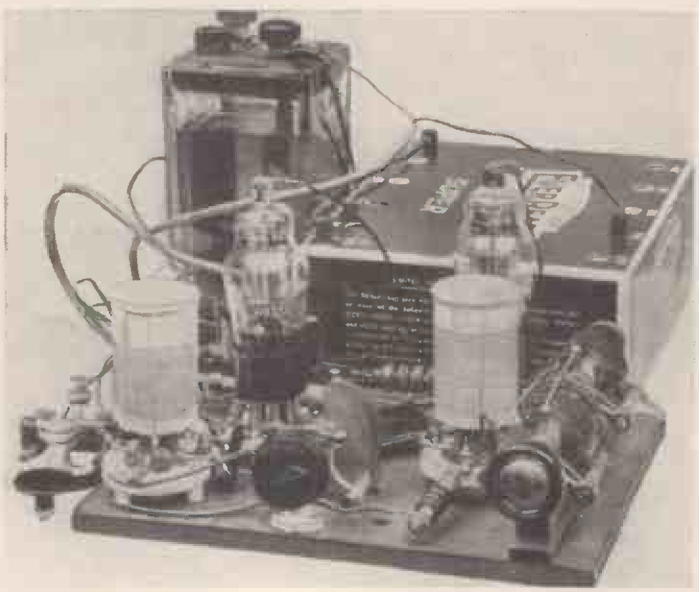
The screens of the two pentodes are joined together, by-passed to earth by means of condenser C2, which has a value of 0.1 mfd., and at the same time taken to the 80-volt tapping in the high-tension battery. This voltage is not particularly critical and should be adjusted to give maximum radio-frequency output to the coil, L3.

Next comes the composition of the radio-frequency amplifier. In the anode circuit is a straightforward coil which is centre tapped. The coil is tuned by VC2, a two-gang condenser made by two separate condensers plus a special cradle. These condensers each have a capacity of 60 mmfd. and as can be seen from the photograph are linked together with the common rotor taken directly to earth.



This is a circuit recommended by the General Electric Company which uses a triode driver and the PT7 radio-frequency amplifier. Designed mainly for operation on 160 metres.

High tension voltage, the maximum available, is applied to the anode of the amplifier through the choke RFC2, but it will be noticed in this instance that the anode by-pass condenser shown as C3 in the oscillator section, is not included. The reason for this is by using a split-stator condenser with the com-



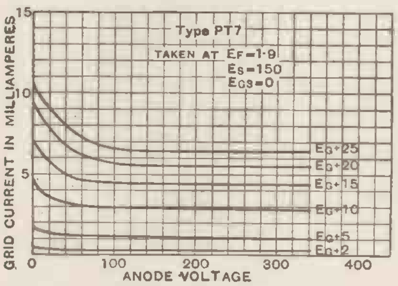
The power amplifier stage can be seen from this illustration while in the centre of the baseboard is the crystal oscillator and condenser.

Current Values

mon rotor earthed, the correct value of by-passed capacity is automatically obtained.

Construction

The average amateur should be able to build this transmitter during an evening which includes the winding of the three coils. First of all obtain a wooden baseboard 10 in. by 8 in. All



The grid current-anode voltage curve for the PT7.

the components which have to be fixed, such as the valve holders, are fixed with wood screws, while the smaller components such as condensers, resistors and R.F. chokes, are held in position in the wiring. Examine again the illustration showing the whole of the equipment. In the left hand back corner is the crystal with its holder.

Across the connections to the holder is mounted R1 the grid resistor. Next comes the oscillator valve with its 7-pin valve holder and in the front of the baseboard the anode coil, L1. On the extreme left-half edge can be seen a four-way terminal switch to which is taken all the battery connections. These four terminals are H.T.+1, H.T.+2, L.T.+ and joined together H.T.− and L.T.−.

In the front of the baseboard can be seen VC1, the anode tuning condenser in its crystal oscillator circuit. In order to minimise losses a small brass right angle bracket has been made and this is fitted to the condenser. The back of the bracket is mounted on a midget type stand-off insulator. This arrangement provides a rigid system of fixing without going to the expense of complicated mounting brackets.

On the extreme right is VC2. The cradle, an Eddystone product, is fitted with three insulated supports. One of these is unused, but the other two take the two condensers. The illustration showing the two-gang condenser more clearly shows how the condenser is made up. Close to the centre of VC2 is fixed the coil holder for L2 in order that the connecting leads between condenser and coil be kept short.

Behind the coil is the PT7 amplifier, while connecting the anode of the crystal oscillator to the grid of the power amplifier can be seen the coupling condenser C1. This is actually mounted between terminals without additional wiring.

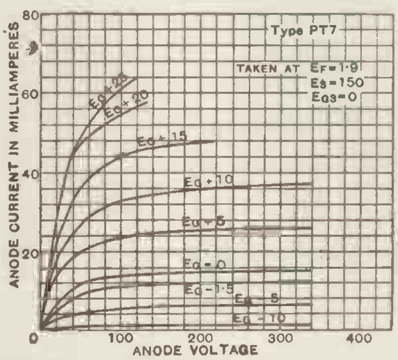
It will be appreciated that as the anode connection is to the top of the valve this would normally mean that several wires would be floating in the air. In order to overcome this, pin number one on the valve holder, which is normaly unused, has been used as the anchoring point for all anode connection. Then a single wire is merely taken from pin one to the top of the valve. In this way all connections are kept rigid, while there is only one comparatively loose wire.

The choke RFC2, which is joined to the centre of L2, also is rigidly fixed to a terminal on the coil holder. Again this can quite clearly be seen from the illustration.

The Morse key recommended, a McElroy product, is connected into series with H.T.+2, the screening voltage, and in this way, has proved to be quite satisfactory.

Wiring

Although it would appear more neat and tidy to wire the transmitter in square section, it is not anticipated that the beginner will retain the present



This is the anode current-anode voltage curve for the PT7.

design for very long. After some working experience has been obtained, we can quite easily imagine the constructor rebuilding on more ambitious lines. In any case, point to point wiring, as we have used, is quite satisfactory and does save probably half the construction.

Ordinary push-back wire can be used except where components are hung in the wiring, then it is a distinct advantage to use a short length of 14-gauge tinned copper wire in order to make quite sure that the components will not move.

Constructing the coils is the next job. L1, which tunes to approximately 41 metres, is made up of 18 turns of 16-gauge wire on a four-pin Premier former which is already threaded so that the turns are accurately spaced. The anode coil, L2, is similarly designed, only there are 20 turns and the tapping is made in the exact centre. Coil L3 is not illustrated for it is merely a single turn wire wound around the centre of L2. Ordinary thin rubber covered flexible wire will do for L3, for it is used merely to couple L2 to an aerial coil.

Operating is extremely simple, but remembering that this transmitter is for the very beginner, we propose to give more than the usual amount of detail. First of all remove the final amplifier. Check the wiring to the oscillator, apply 130 volts to H.T.+1 and 80 volts to H.T.+2 and connect in series with the radio-frequency choke a low reading mA. meter. The current registered will probably be 10-15 mA. The condenser VC1 should very quickly be adjusted until the current registered on the meter begins to drop. A point will be found where the current drops to a minimum and then begins to rise again. When the condenser is adjusted so that minimum current is obtained, the current tuning point has been reached.

Then insert the power amplifier valve and remove the oscillator valve. Take the meter out of R.F.C.1 circuit and connect it into the R.F.C.2 circuit. Apply 120 or 130 volts to H.T+1 and 80 volts to H.T.+2 and connect the free end of R2 to L.T. negative. There will be a current flow of 10 mA. or so and this must be reduced to zero by applying a slight negative bias to the grid of the valve. To do this, plug the free end of R2 into a small grid-bias battery and as the voltages increase so the anode current will drop. When there is no current reading the valve is then correctly adjusted.

(*Continued on page* 692)

Components for
A PT7 BATTERY-OPERATED TRANSMITTER

BASEBOARD.
1—Plywood baseboard 10 ins. by 8 ins.
CONDENSERS, FIXED.
1—.00005 mfd. type 690W (C1) (Dubilier).
1—.1 mfd. type 4609/S (C2) (Dubilier).
1—.002 mfd. type 690W (C3) (Dubilier).
CONDENSERS, VARIABLE.
1—40 mmfd. type TRO40 (VC1) (Premier Supply Stores).
2—60 mmfd. type 1093 (VC2) (Eddystone).
CONDENSERS, CRADLE.
1—Type 1114 cradle (Eddystone).
COIL FORMS.
2—Type 4-pin low loss (Premier Supply Stores).
CRYSTAL.
1. With Enclosed Holder (Q.C.C.)
HOLDERS, VALVE.
2—Type 7-pin SW 51 (Bulgin).
KEY.
1—Straight McElroy Key (Webbs Radio).
RESISTANCES, FIXED.
1—100,000 ohm type 1 watt (R1) (Erie).
1—3,000 ohm type 1 watt (R2) (Erie).
VALVES.
2—Pentodes type PT7 (Osram).

Automatic Volume Control for Short-wave Receivers

Some interesting facts on A.V.C. are discussed in this article supplied by the Technical Staff of the Mullard Wireless Service Co. Ltd.

THE circuits which have been commonly used for automatic volume control show certain drawbacks. When A.V.C. systems were first introduced the A.V.C. voltage was taken from the signal detector diode. With this method it is not possible to apply a delay voltage to the diode and the circuit suffers from the well-known disadvantages of undelayed A.V.C. Control commences at very weak signals and hence the control curve under these conditions has a flat characteristic, and the output valve does not become fully loaded until very powerful signals are received. The receiver will also appear to be insensitive.

To overcome this problem, a separate diode with a control voltage was incorporated for the A.V.C. system. This diode may be connected either to the primary circuit or to the secondary circuit of the final I.F. transformer. One of the outstanding advantages of connecting this diode to the primary circuit is that the apparent selectivity, when the receiver is de-tuned with respect to a certain station, is greater.

However, connecting a diode with a delay voltage to an I.F. circuit introduces a small percentage of distortion. This distortion is often too great for the desired quality of reproduction to be obtained so that a diode minus a control voltage must be employed thus again involving the original disadvantages. (For the moment we will not consider receivers in which a separate I.F. amplifier valve may be used for the A.V.C. system.)

For complete satisfaction the following requirements should be fulfilled:—

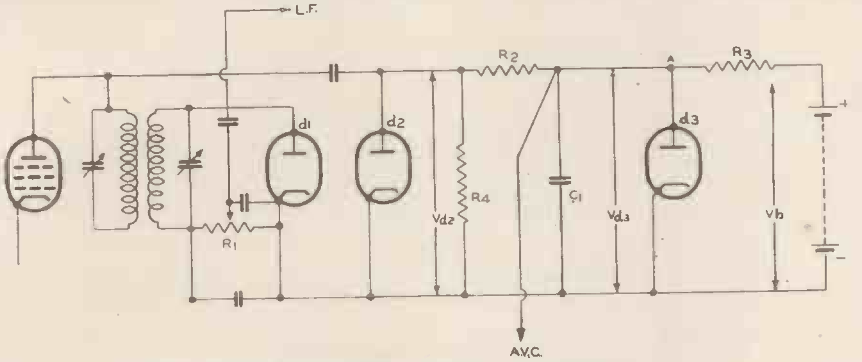
(1) The A.V.C. system should be connected to the primary circuit of the final I.F. transformer.

(2) Owing to the distortion which would otherwise occur no delay voltage should be applied to this diode.

(3) Delayed A.V.C. should nevertheless be introduced.

These requirements are satisfied by a circuit in which three diodes are used. The Mullard triple-diode EABI has been constructed specially for use in this circuit. This valve contains three diodes with a common cathode. The principle of the three-diode circuit is shown in Fig. 1 (in this figure, for the sake of clarity, three separate diodes are shown). Diode d1 is used in the ordinary way as a signal detector diode; diode d2 is the A.V.C. diode; it is connected to the primary circuit of the final I.F. transformer and receives no delay voltage. The final diode d3 produces the delay for the A.V.C. The resistance R3 is connected to a positive voltage which, in this figure, is indicated by a battery Vb. With small signals and the anode of d2 at a low negative value, a current flows through d3 under the action of the positive voltage Vb. Owing to the low resistance of diode d3 in this case, the voltage Vd3 becomes very small so that the point A is practically earthed. Hence the A.V.C. system does not function. With an increase in signal strength, the negative voltage Vd2 becomes greater and there comes a point at which the voltage on the anode of d3 is negative, and the current then ceases to flow through this diode. When the negative value of Vd2 is increased above this point the negative voltage also increases at A and the A.V.C. system operates. The voltage Vd3 is then given by:—

$$Vd3 = Vb \frac{R2}{R2+R3} + Vd2 \frac{R3}{R2+R3} \qquad (1)$$



In this circuit the three diodes are shown as separate valves.

The values of the resistance R2 and R3 and of the voltage Vb are determined by the voltage developed at the signal detector diode and at which A.V.C. should commence.

If this signal voltage is known, then Vd2 may be expressed as the peak value of the unmodulated carrier wave on d2. Now, assuming that current just ceases to flow through d3 when the negative voltage on this diode is 0.8 volts, equation (1) gives:—

$$-0.8 = Vb \frac{R2}{R2+R3} + Vd2 \frac{R3}{R2+R3}$$

As an example, we will assume that the detector is immediately followed by an output valve EL3 and that A.V.C. should commence when this output valve is fully loaded by a signal with a modulation depth of 30 per cent. In this case the signal voltage of d2 at the commencement of A.V.C. will approximately be equal to 10.5 volts, so that:—

$$Vd2 = -10.5\sqrt{2} = -15V.$$

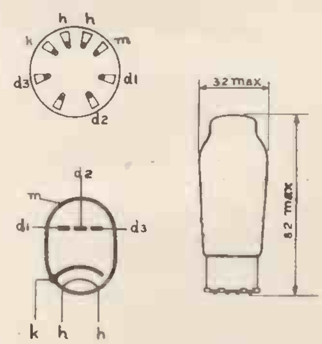
hence Vb, R2 and R3 should satisfy the equation:—

$$-0.8 = Vb \frac{R2}{R2+R3} - 15 \frac{R3}{R2+R3}$$

Values may, for instance, be assigned as follows:—

Vb = 98 volt.
R2 = 1 megohm.
R3 = 7 megohms.

In this case, after commencement of A.V.C. equation (1) gives:—



The triple diode is supplied with a side contact base of this type.

$$Vd\,2 = \tfrac{1}{8}\,.98 - \tfrac{7}{8}\,Vd\,2$$
$$= 12.3 - \tfrac{7}{8}\,Vd\,2.$$

If the same delay of A.V.C. was to be obtained by means of a delay voltage at d2, it would be necessary to make this voltage equal to −15 volts. In this case, the controlling voltage after commencement of A.V.C. would be $V_{AVC} = 15 - V_{d2}$.

On comparing the last two equations it will be seen that the three diode circuit gives a somewhat higher A.V.C. voltage at small signal voltages, whereas at larger signal voltages it gives a somewhat lower A.V.C. voltage. On the whole, however, the two methods give the same result for the control curve.

The three-diode circuit possesses a further advantage over the use of a diode with a delay voltage. The A.V.C. voltage obtained by means of a diode with a delay voltage is largely dependent on the modulation depth of the signal. This is particularly the case in receivers whose control curve shows a very flat shape, with the result that the signal strength on the detector diode increases only very slowly after commencement of A.V.C. The first consequence is that the A.V.C. voltage at full modulation depth is higher with the result that the contrasts are less marked. A still greater disadvantage, however, is the fact that, during control of a cathode-ray tuning indicator by means of the A.V.C. voltage, the width of the electron star is dependent on the modulation depth. This results in flickering of the indicator especially during powerful music passages. This flickering also occurs when the tuning indicator is connected to the signal detector diode because, since the controlling voltage depends on modulation depth, the power of the carrier wave on a detector is similarly dependent on modulation depth. Since, in the three-diode circuit, the A.V.C. voltage is obtained by means of a diode without a delay voltage, the above disadvantages are not encountered here.

Finally, the function of the resistance R4 must be considered. It appears at first that R4 might be omitted from this circuit since the anode of d2 already had a D.C. path earthwards via R2 and R3. However, omitting this resistance would result in the following difficulty.

When the signal strength of d2 increases as when tuning to a station, the condenser C1 will be charged by the diode d2 and the resistance R2. As the strength of the signal decreases as when detuning, C1 must discharge itself across R3. Since R3 must be several times greater than R2 (otherwise only a small part of the controlling voltage Vd2 is employed), the discharge of C1 may be so prolonged that the A.V.C. voltage decreases too slowly on small signals. Hence the receiver remains for a short time in the insensitive condition associated with greater signal strength. This difficulty becomes great when the variation of signal strength is rapid. Consequently, when the tuning is rapidly turned off a powerful station, some of the weak adjacent stations can be heard. If, as in the example, R3 = 7 megohms and C1 = 0.1 μF., the receiver will remain in this insensitive condition for about 0.7 secs. This period also proves very annoying when, after a sudden powerful interference, there is an interval equal to this period in the reproduction of music or speech. By introducing R4, the condenser C1 can discharge itself across R2 and R4, thus eliminating the last-mentioned difficulty.

Heater (this valve is suitable for D.C./A.C. operation) :	Vf	= 6.3 V.
	If	= 0.2 A.
Capacities :—	Cd1d2	< 0.65 $\mu\mu$F.
	Cd1d3	< 0.08 $\mu\mu$F.
	Cd2d3	< 0.4 $\mu\mu$F.
	Cd1k	= 1.5 $\mu\mu$F.
	Cd2k	= 1.3 $\mu\mu$F.
	Cd3k	= 2.2 $\mu\mu$F.
Limiting Values :—		
Vd1 max.		200 V.
Vd2 max.		200 V.
Vd3 max.		200 V.
Id1 max.		0.8 m/A.
Id2 max.		0.8 m/A.
Id3 max.		0.8 m/A.
Vfk max.		100 V.
Rfk max.		20,000 Ω
Vd1 (Id1 = 0.3 μA.) ..		−1.3 V.
Vd2 (Id2 = 0.3 μA.) ..		−1.3 V.
Vd3 (Id3 = 0.3 μA.) ..		−1.3 V.

"A PT7 Battery-operated Transmitter"

(*Continued from page 690*)

The next operation is to re-insert the oscillator valve, apply voltage to the anode and adjust VC2 until it is tuned to 40 metres. At this point it should be clearly understood that without the oscillator valve in circuit and the amplifier correctly biased, there will not be any anode current, but directly the radio-frequency output from the oscillator is applied to the grid of the amplifier, there will be a rise in anode current in the circuit where there was previously a zero reading in proportion to R.F. applied to grid.

When this current rises, the condenser VC2 has to be re-adjusted until minimum current reading is obtained, just as was recommended for the oscillator circuit. When the aerial is ultimately connected, this has to be tuned until the maximum current is obtained for the amplifier valve.

The figures previously given indicate just what sort of anode and screen current should be obtained with 240 volts H.T. These currents will be reduced in proportion as the H.T. voltage is reduced, but it must be remembered that the minimum voltage is 120 and the maximum voltage 240.

For those who do not wish to go to the expense of a special crystal, we have shown a recommended G.E.C. circuit for a transmitter that relies on tuned circuits for the wavelength covered. It is quite satisfactory from a technical point of view, but unless a wavemeter is available constructors are likely to have difficulty in knowing just when the transmitter is on the wavelength required.

However, an interesting leaflet describing this valve and the transmitting circuit can be obtained from the General Electric Company, Magnet House, Kingsway, W.C.2. We should also like to make it quite clear that before this transmitter can be built, a licence must be obtained from the Office of the Engineer-in-Chief, Radio Division, G.P.O. Aldersgate Street, E.C.

A Guide to Aerial Lengths

This table makes a handy and accurate reference guide for quick determination of aerial length for use at any frequency in the 3.5, 7, 14, 28 and 56 mc. bands.

Kc.	Metres.	Length of Aerial in Feet.	Kc.	Metres.	Length of Aerial in Feet.
3,500	85.714	133.714	28,000	10.714	16.714
3,550	845.08	131.832	28,100	10.676	16.655
3,600	83.333	129.999	28,200	10.638	16.595
3,650	82.191	128.218	28,300	10.600	16.536
3,700	81.081	126.486	28,400	10.563	16.478
3,750	80.000	124.800	28,500	10.526	16.421
3,800	78.947	123.157	28,600	10.489	16.363
3,850	77.922	122.025	28,700	10.452	16.305
3,900	76.923	120.461	28,800	10.416	16.249
3,950	75.949	118.480	28,900	10.381	16.194
4,000	75.000	117.000	29,000	10.345	16.138
			29,100	10.309	16.082
7,000	42.857	66.857	29,200	10.274	16.027
7,050	42.553	66.383	29,300	10.239	15.973
7,100	42.253	65.915	29,400	10.204	15.918
7,150	41.958	65.454	29,500	10.169	15.864
7,200	41.666	64.999	29,600	10.135	15.811
7,250	41.379	64.551	29,700	10.101	15.758
7,300	41.096	64.110	29,800	10.067	15.705
			29,900	10.033	15.651
14,000	21.428	33.428	30,000	10.000	15.600
14,050	21.352	33.309			
14,100	21.276	33.191	56,000	5.357	8.357
14,150	21.201	33.074	56,500	5.309	8.282
14,200	21.126	32.957	57,000	5.263	8.210
14,250	21.052	32.841	57,500	5.218	8.140
14,300	20.979	32.727	58,000	5.172	8.068
14,350	20.905	32.612	58,500	5.128	8.000
14,400	20.833	32.499	59,000	5.084	7.931
			59,500	5.042	7.865
			60,000	5.000	7.800

VK2NO

Dollis Hill Radio Communication Society

This Society holds its meetings at Braincroft School, Warren Road, N.W.2, alternate Tuesdays, at 8.15 p.m. Amongst the lectures arranged for the winter session are the following :

Nov. 1—Mr. D. N. Corfield (G5CD). Lecture and demonstration on the alignment of superhets.

Nov. 15.—Mr. A. Turner, M.I.R.E. (G2XO). Continuing lecture on short-wave transmitter and receivers.

Nov. 29.—Junk Sale.

Dec. 13.—Exhibition of home constructed apparatus.

Dec. 27.—No meeting this evening.

Full information can be obtained from the Hon. Secretary, F. Eldridge, Esq., 79 Oxgate Gardens, Cricklewood, N.W.2.

Modern Transmitter Construction

In view of the expected decline in conditions on the higher frequencies during the next year or so KENNETH JOWERS suggests that more attention be paid to the constructional side of the transmitter. Some interesting designs are discussed in this article.

AT a recent meeting of radio amateurs, there was a rather general complaint that far too many of the imported transmitters and transmitter designs utilised high-power equipment of little use to the average British amateur.

While this is so, there is another point of view which must not be overlooked. Amateur licences are granted for experimental use so that from this, I assume that the average amateur builds his own equipment. I also feel that while amateurs do appreciate the designs that are published and are obtained by devious ways, they very rarely build according to published data. It may be that they intend to build as they are instructed but by the time they have used their own components and made modifications to suit their own racks and panels, then the final design bears little resemblance to the original.

Another point noticed is that the bulk of amateurs who have presentable stations, well designed, robustly constructed and so on are those who use high power.

This may be because with a high power station it is essential that the design be good and that all the components be well arranged in order to prevent voltage breakdown to the chassis and parasitic oscillation, etc., which would undoubtedly occur if a multi-stage transmitter was thrown together as low-power rigs sometimes are.

Amateurs must appreciate that a final stage using a pair of valves that will stand a kilowatt input can be extremely interesting to the amateur who is restricted to 25-watts input. It stands to reason that any amateur who is going to spend a lot of money on a high-power transmitter will take every precaution to ensure maximum efficiency. Consequently if the layout and general principles are faithfully copied, the constructor of a 25-watt transmitter will also reap the benefit.

During the past year or so I have published several designs by British amateurs of efficient power amplifier stages which can be used with almost any type of valve. In many instances, readers have written to me saying that although they only had small valves such as 210's, etc., they found that by using similar constructional methods they were able to improve the performance of their transmitter very considerably.

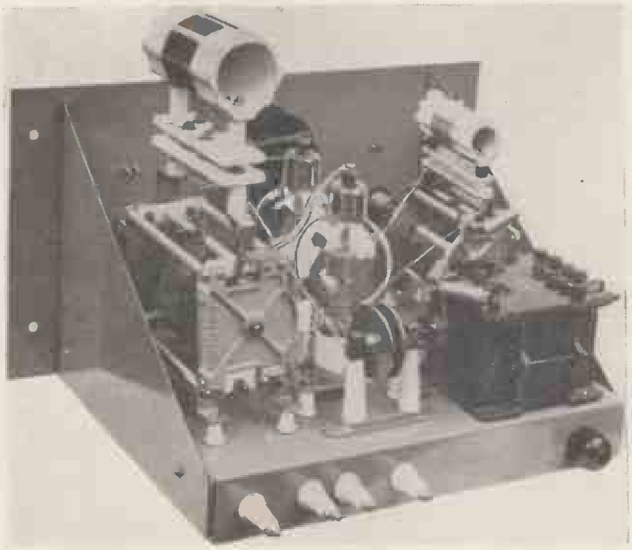


Fig. 1. This final amplifier is perfectly symmetrical in layout and although it uses a pair of 100TH's the principle can be applied to low-power valves.

My transmitter is at present undergoing a 100 per cent. re-build and I am embodying a number of ideas which have proved in practice to be well worth while.

Illustrated in Fig. 1 is the final stage of the transmitter using a pair of low-capacity triodes in push-pull. They are Eimac 100TH's suitable for an input of up to a kilowatt. But a point of interest is that this design is equally suitable for the user of a pair of 801's, T20's or similar low-power valves.

Notice how the wiring has been kept extremely short and arranged so that both anode and grid circuits are symmetrical. In this way, the stage functions perfectly from the very beginning without any alterations having to be made.

For the purpose of experiment two low-power triodes were built into this stage, a suitable H.T. voltage applied and then results were again satisfactory, but the efficiency was considerably higher than would normally be expected.

First of all, consider the constructional details of this final stage. The panel and chsssis are of the international standard, so fitting any relay rack. The grid and anode tuning condensers are mounted on their sides. This means making small brass brackets. Each condenser is actually supported by four feed-through insulators. Across the top of the condenser is mounted the plug-in coil. Again, two

Fig. 2. Despite the symmetrical layout of the chassis components, the panel also has a pleasing appearance. Constructors wishing to use metal-cased anode meters can connect in series with the centre tap of the filament transformer.

A Simple Transmitter

brackets are needed to support the base. In this way, the connecting lead between the ends of the coil and the fixed

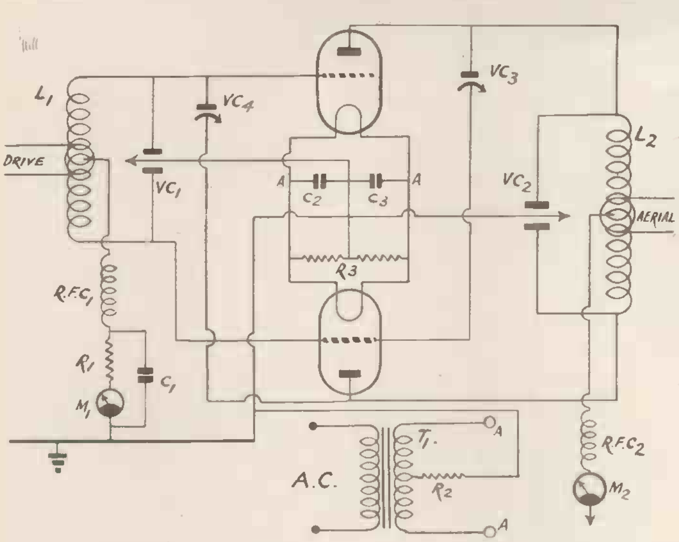


Fig. 3. The suggested circuit for the output stage in this case built around 100TH's, but fundamentally the same circuit is applicable to small valves of the type 10 class.

plates of the condenser are extremely short.

The grid condenser and coil is mounted in exactly the same way so it will be appreciated that although both rotors of the tuning condensers ultimately are connected to earth, there cannot be a difference in potential between the two earth points so a common earth connection, incidentaly insulated, is provided in each chassis. The two valves, whatever they happen to be, in this case 100TH's are mounted on a strip of Trolitul insulating material. Again, this strip is mounted on feed-through insulators and arranged so that the grid and anode leads are symmetrical.

Only one of the neutralising condensers can be seen from the photograph but the second is in exactly the same spot on the opposite end of the valve mounting strip. In this way, the connections of each grid are made very short while as the anode leads have to cross over, they are a little longer but equal in length.

Another point of interest is the fact that the filament transformer is actually mounted on the chassis. This is important when the filament current is on the high side, for if the transformer was made part of the power unit at the bottom of the rack there would be an appreciable drop in voltage owing to the long line.

Another feature which I do not find embodied in many amateur rigs is completely automatic bias. The only disadvantage of this scheme as far as I can see is a corresponding loss in H.T. voltage according to the amount of bias required by the valves, but if provision is made for this in the first instance, the difficulty disappears.

It is always advisble to make provision for bias in two ways so that in case of breakdown there is less possibility of damage being done to the valves. It will be noticed from the circuit that bias in this stage is obtained by means of grid current across R1, a resistor having a value of 2,500 ohms and by the cathode resistor, R2 which has a value of 200 ohms. In this way, the final stage is completely self-contained with the exception of a twin lead to the high voltage power unit. Also, if all stages are made identical in appearance with separate filament transformers, then the need for complicated switching devices is removed. In my station, every item of equipment has its own filament transformer, so that all can be switched off simultaneously by merely coupling the A C. lines to the H.T. transformers.

Despite the fact that the chassis has been made perfectly symmetrical, it has not caused me to have an unsymmetrical front panel. Refer for a moment to Fig. 2, showing the panel controls. There are two tuning condenser controls equally spaced. In the centre are two meters, the larger one for reading the anode current and

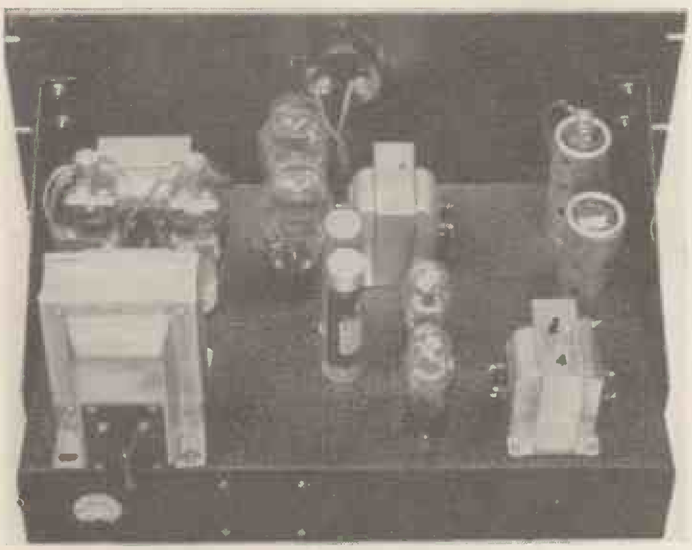


Fig. 4. The Taylor Valve Company designed this interesting modulator using a pair of T55's. Again, the layout can be copied to advantage by many British amateurs.

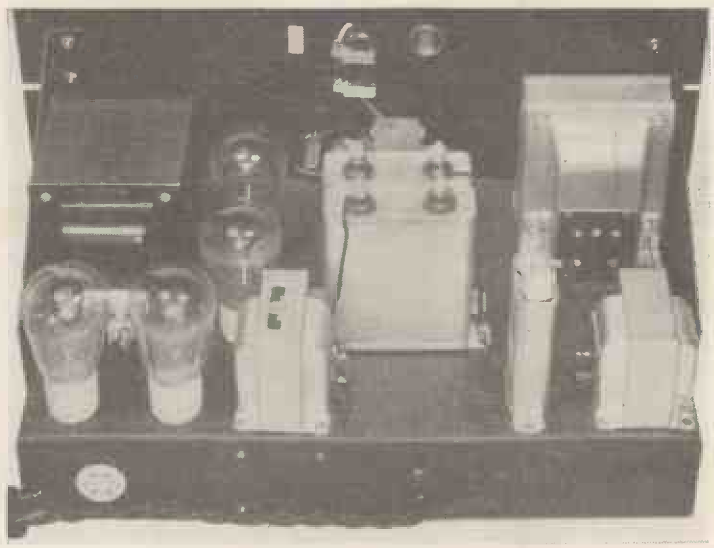


Fig. 5. An interesting design for a two-channel power unit giving low voltage for the exciter and high voltage for the final stage.

Constructional Pointers

the small one for the grid current. To balance up the base of the panel is an on-off switch for the filament transformer, and a dial light.

As I rely upon dial lights to give me indication as to when the filament transformers are in circuiut, I was rather troubled as to how I could find some reliable means of indication other than the ordinary flash-lamp bulb which appears to burn out with the slightest provocation. Messrs. Bulgin came to my aid with a new lamp they have just introduced. This lamp has the ordinary MES fitting, similar to a flash lamp bulb, but has a 250-volt filament so that it can be connected directly across the primary of the transformer.

With this new transmitter, I have one bulb across each filament primary and one bulb across each H.T. primary and I can rely upon these bulbs to give me a true indication as to when the circuits are all switched on.

Another interesting system of construction is the modulator and power unit produced by the Taylor Valve Co., shown in Figs. 4 and 5. The modulator is again one of those designs which lends itself to the inclusion of valves of all kinds. The original circuit makes use of T55's in class-B but they could be replaced by T20's, TZ20's or even type 10's, according to the audio output required. The design, however, is extremely good and as the power unit is a separate part, there is very little likelihood of the A.C. field from the power unit reaching the modulator. This power unit is again a very good example of how a unit should be built. It is arranged so that in the case of breakdown there is a minimum of difficulty in replacing the faulty components.

The valves are all get-at-able, while the switching arrangements are particularly simple. Merely separate H.T. and filament transformers which are switched independently.

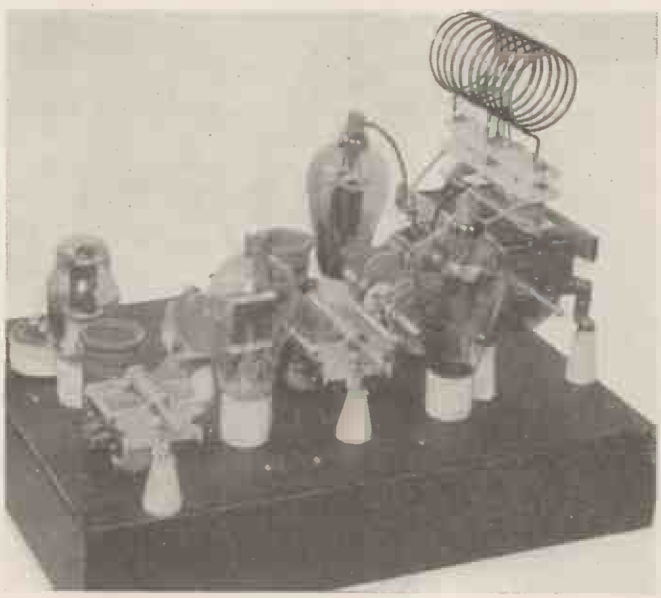


Fig. 6. This complete three waveband transmitter is no larger than the average 10 watt British station. It has, however, an input of over 400 watts.

Another interesting method of construction is illustrated in Fig. 6. This transmitter, with maximum H.T. voltage, is suitable for an input of over 400 watts. It is built on a 17 in. chassis and is no larger than the average British 10-watt station. The transmitter consists of a 6L6 crystal oscillator, T20 amplifier or doubler and a pair of T55's in push-pull. That, however, is by the way, for it is the constructional aspect that is of particular interest.

Notice how the final stage is again kept symmetrical and owing to this symmetry and perfect balance, it is possible to utilise a ganged neutralising condenser. All condensers are mounted on feed-through insulators so that there is a common earth point. This transmitter can be modified to use quite low-power valves even down to battery-operated types and as such will operate quite nicely on three wavebands.

In my opinion, this transmitter is ideal for British amateur use, for it is small, has plug-in coils for easy band changing, has the minimum number of components, is rigidly built and owing to the low losses, gives more than the usual amount of R.F. output for D.C. input.

Ceramic Insulation

Far too little use is made by beginners of ceramic materials and insulating pillars in order to reduce losses. I always find it is an excellent scheme either to sink the valves through the chassis or to raise the tuning condenser almost to the level of the valve anodes in order to reduce the length of lead.

On the 28-megacycle band, it is imperative that the tank condenser and coil be constructed almost as one unit with the coil bolted to the condenser itself. There is no need for very large grid coils for should the final stage be efficient, there is very little R.F. left in the grid circuit to cause heating.

Battery bias, although still widely used, should be discarded in favour of automatic bias, or at any rate, use a power pack with a low value bleeder in order to give a steady source of bias. The average grid bias battery cannot cope with the high grid current obtainable with properly driven modern valves.

As I have mentioned before, conditions on short waves during the next few years are likely to become alarmingly bad, and now is the time to increase the efficiency of the transmitter in order to try and counteract these bad conditions. A limited number of British amateurs are still maintaining world-wide communication on telephony despite the fact that there is a general feeling that this cannot be done.

Components for A LOW-LOSS FINAL AMPLIFIER

CHASSIS AND PANEL.
1—Standard steel chassis with brackets and panel, finished grey (Premier Supply Stores).

COIL FORMS.
1—Small ribbed ceramic coil form with base and sub-base (Premier Supply Stores).
1—Large ribbed ceramic coil form with base and sub-base, type 1090, 1091, 1092 (Eddystone).

CONDENSERS, FIXED.
1—.002-mfd. type 690W (C1) (Dubilier).
1—.002-mfd. type 690W (C2) (Dubilier).
1—.002-mfd. type 690W (C3) (Dubilier).

CONDENSERS, VARIABLE
1—Type 1081 (VC1) (Eddystone).
1—Type 1080 (VC2) (Eddystone).
1—Type 1088 (VC3) (Eddystone).
1—Type 1088 (VC4) (Eddystone).

CHOKES, HIGH-FREQUENCY.
1—Type SW69 (RFC1) (Bulgin).
1—Type HF22 (RFC2))Bulgin).

DIALS.
2—Type 1098 (Eddystone).

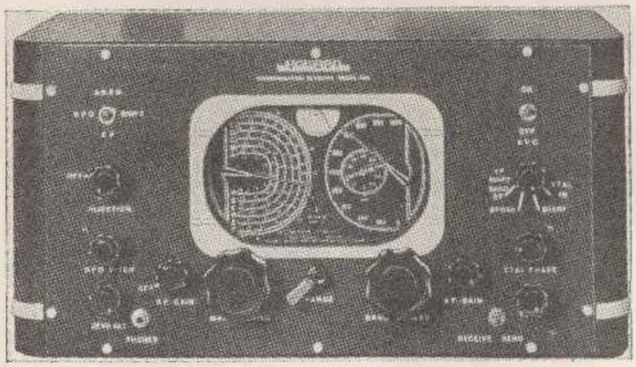
HOLDERS, VALVE.
2—Type ceramic 4-pin Amphrenol (Webbs Radio).
1—4-pin less terminals type V1 (Clix).

METERS.
1—Reading 0-500 m.a. (Ferranti).
1—Reading 0-100 m.a. (Premier Supply Stores).

PLUG.
1—Type P36 (Bulgin).

RESISTANCES, FIXED
1—2,500 ohm type 10 watt (Premier Supply Stores).
1—Type 200 ohm 25 watt (Premier Supply Stores).
1—30 ohm centre tapped (Premier Supply Stores).

TRANSFORMER.
1—Filament transformer to suit valve (Premier Supply Stores).



A New Communication Receiver

The New Howard 450A Handled by Raymart

DETAILS are now available of a receiver produced by a company very well known in America but not so well known amongst British amateurs. This set, the Howard 450A, built by the Howard Radio Company, of Chicago, appears to be an instrument of particular interest to those keen on long-distance working and also ordinary broadcast reception.

Short wave amateurs will find that it includes all worth-while refinements, while the short-wave listener who wishes to obtain as many confirmation cards as possible, will find that the Howard 450A is particuluarly good on the commercial wavebands.

There are 12 valves in the receiver, which covers six wavebands from 65 mc. to 540 kc. Unlike so many receivers which are supposed to be efficient under 10 metres, the Howard is designed to have a reasonably level degree of sensitivity right down to 65 mc. In order to do this, a special oscillator-mixer system has been included, plus a dual channel variable selectivity I.F. circuit in which an entirely separate 1,560 kc. I.F. stage is switched in when receiving signals between 5 and 10 metres.

There is also a switchable crystal filter providing broad or extreme selectivity and this is all accomplished by means of one control knob.

Electrical band-spreading and a micrometer bandspread scale with a total of 47 in. divided into 1,000 divisions is included. There is also a calibrated R meter, an R.F. stage on all bands, except 5 metres, air-tuned R.F. and oscillator circuits, and iron-cored R.F. coils.

We were particularly interested in features such as separate aerial terminals for 5-metre operation, output terminals for impedances of 5 and 500 ohms, a pair of beam power output tetrodes giving 9½ watts for those who need maximum audio on programme broadcasters and flywheel tuning on both controls.

The receiver as it stands with 12 valves and all these refinements is priced at 30 guineas and we feel sure before very long it will be one of the standard sets used by amateurs. There is a pitch control for the beat-frequency oscillator, plus an injection voltage control. The position of the wave-change switch is indicated on the tuning dial so that the band on which the receiver is switched can quickly be determined.

A 3-inch Scope

Supplies of these receivers are now available from the British importers, Raymart (G5NI) Birmingham, Ltd., and we advise readers to get in touch with this company for full information. At the same time, inquire about the new Raymart 3 in. oscilloscope which is complete with a 3 in. cathode-ray tube and power supply providing 1,000 volts H.T. The price complete is £4 19s. 6d. so that no amateur should now be without one of the most important pieces of test equipment used at the present time.

There are four operating controls including brilliancy, focusing, sweep control and sweep switch while the overall size is 8¾ in. high by 6 in. wide by 3 in. deep, so matching up in size and finish with the HRO, RME69, and Hallicrafter receivers.

The horizontal and vertical plates are brought out at the sides of the cabinet, while a 50-cycle sweep circle is provided.

This oscilloscope is sufficiently large to enable accurate measurements to be made of modulation percentage, signal distortion, and peak voltages, while the user will be able accurately to give reports on percentage modulation of incoming signals.

Raymart have just issued a new manual describing all latest equipment and written in a practical way by G2AK, G8HO and G5NI. It is post free for 7½d.

New Designs in Amateur Equipment

(*Continued from page* 682)

entirely self-powered and complete. In this way, amateurs interested in transmission can purchase the exciter, which will probably give an output up to 10 watts, after which they can add a power amplifier stage suitable for their licensed power.. Should, at a later date, they require additional power, they can either modify the existing unit or add a third.

In our October issue, on page 622, was published some preliminary data on the new Mullard amateur valve TZ08-20. We have now been able to put this valve through its paces. It is without question one of the most robust triodes available at the present time in this class of valve. It has an extremely large anode, a generous filament emission and has undoubtedly been conservatively rated. It is similar to the popular T20 type of valve, but is fitted with a British four-pin base.

The appearance of the valve is a very great feature in its favour and we feel before long it should become popular amongst amateurs. The price has now been fixed at 17s. 6d.

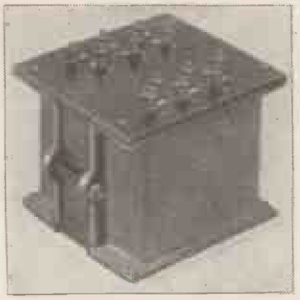
Crystal michophones have a big advantage of not requiring energising voltage and at the same time do prevent feedback.. There is now no need for amateurs to feel that this type of microphone is beyond their means for we have just purchased an extremely good unit, priced 39s. 6d., from Messrs. Radiographic, who have a branch in Dean House, Dean Street, W.1, as well as at 66 Osborne Street, Glasgow.

We advise amateurs to inspect these microphones and at the same time to make inquiries about the extensive range of Hytron transmitting valves.

More 4-metre D.X. Records

The current issue of "Break-in," official organ of the N.Z.A.R.T.L., reports that Mr. P. A. Morrison, of Wellington, logged the American W6ENC on telephony, calling "CQ DX 56 mc." at QSA5 R4, and copied VK2NO (experimental station of D. B. Knock, *The Bulletin's* radio editor) for an hour on C.W. at QSA5. This makes the first time that an American signal has been heard and identified on five metres across the Pacific.

PREMIER 1938/1939 RADIO



PREMIER MATCHMAKER UNIVERSAL MODULATION TRANSFORMERS

Will match any modulator to any R.F. Secondary Load. Triodes, Tetrodes, and Pentodes Class A. Single or Push-Pull Class "AB1" and "B" in Push-Pull or 500 ohms line input, can easily be matched to any of the following Radio Frequency final stages requiring modulation.

Triodes, Tetrodes or Pentodes operating under Class "A," "B" "BC" and "C" conditions either Single or Push-Pull.

Totally enclosed in cast cases with engraved Panel, and full instructions. Ratings are based on R.F. inputs.

50 Watt, 17/6. 150 Watt, 29/6. 300 Watt, 49/6.

A new range of "Matchmaker" Universal Output Transformers which are designed to match any output valves to any speaker impedance, are now ready.

11 ratios, from 13 : 1 to 80 : 1.
5-7 Watt, 13/6. 10-15 Watt, 17/6. 20-31 Watt, 29/6.

Premier Mains Transformers

Screened primaries 200-250 volts. Fully Guaranteed. Wire end types.

S.P. 250, 250-250 v. 60 m/A. 4 v. 1-2 a., 4 v. 2-3 a., 4 v. 3-4 a., all C.T., 10/-.
S.P. 300. 300-300 v. 60 m/A. 4 v. 1-2 a., 4 v. 2-3 a., 4 v. 3-4 a., all C.T., 10/-.
S.P. 351. 350-350 v. 150 m/A., 4 v. 1-2 a., 4 v. 2-3 a., 4 v. 4 a., all C.T., 13/-.
S.P. 352. 350-350 v. 150 m/A. 5 v. 2 a., 6 v. 2 a., 6-3 v. 2 a., 6-3 v. 2 a., all C.T., 13/6.
The above can be supplied fitted with Panel and Terminals, at 1/6 extra.
S.P. 500. 500-500 v. 150 m/A., 15/-.
S.P. 501. 500-500 v. 150 m/A. 4 v. 2-3 a., 4 v. 2-3 a., 4 v. 2-3 a., 4 v. 3-5 a., all C.T., 21/-.
S.P. 502. 500-500 v. 150 m/A. 5 v. 3 a., 4 v. 2-3 a., 4 v. 2-3 a., 4 v. 3.5 a., all C.T., 25/-.
S.P. 503. 500-500 v. 200 m/A. 5 a. 3 a., 6.3 v. 3 a., 7.5 v. 3 a., or 2.5 v. 5 a., all C.T., 25/-.
S.P. 1,000. 1,000-1,000 v. 250 m/A., 21/-.
S.P. 1,250. 1,250-1,250 v., 250 m/A., 27/6.
S.P. 2,000. 2,000-2,000 v. 150 m/A., 50/-.

The above can be supplied fitted with Panels and Terminals, at 2/- extra. Details of complete range available.

Special Transformers wound to order.

Premier Smoothing Chokes

60 m/A. 40 hy., 6/6. 150 m/A. 40 hy., 11/6.
80 m/A. 30 hy., 7/6. 250 m/A. 40 hy., 15/-.

Premier Swinging Chokes

150 m/A. 160 ohms, 3,000 v. Insul., 10/6.
250 m/A. 80 ohms, 2,000 v. insul., 15/-
500 m/A. 100 ohms, 4,000 v. insul., 18/-

Premier Short-Wave Kits

Are all sold complete to the last detail. All valves and coils are included as well as theoretical and wiring diagrams, and lucid instructions for building and working. Thousands are giving excellent results all over the world.

Each Kit uses plug-in Coils and the Coils supplied tune from 13 to 170 metres. All Kits are supplied with a steel chassis and Panel.

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The NEW PREMIER 10-15 WATT ALL-BAND TRANSMITTER

Designed by G2HK to meet the demand for a really compact self-contained T.X., which can be used for 'Phone or C.W. on all bands.

A 6L6 is used as a modulated oscillator in a Tritet circuit, allowing a fundamental and second harmonic operation, without coil changing, from any one Xtal. A 6C5 speech amplifier is R.C. coupled to a 6L6 modulator, giving approx. 9-10 watts audio. A 400-volt power supply with generous smoothing gives completely hum-free output.

Housed in steel cabinet, in black crackle finish, 12 in. x 9 in. x 8 in.

Complete with Xtal and Coils for 7 and 14 mc. operation **£10-10-0**

Write for details of all Premier Transmitters.

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American Valves.

We hold the largest stocks of U.S.A. tubes in this country and are sole British Distributors for **TRIAD** High-Grade American Valves. All types in stock. Standard types, 5/6 each. All the new Metal-Class Octal Base tubes at 6/6 each, 210 and 250, 8/6 each.

EUROPA MAINS VALVES, 4 v. A.C. Types, A.C./HI., A.C./L., A.C./S.G., A.C./V.M.S G., A.C./H.P., A.C./V.H.P., A.C./P., and 1 watt D.H. Pentodes, all 4/6 each. A.C./Pens., I.H., 5/6; A.C./P.X.4, 6/6; Oct. Freq. changers, 8/6; Double Diode Triodes, 7/6; Triode H. ex. Freq. Ch., 8/6; Tri. Grid. Pen., 10/6; 3½ watt I.H. Triode, 7/6.

UNIVERSAL TYPES, 20 v. .18 amps., S.G., Var.-Mu., S.G., Power, H.F. Pen., Var.-Mu. H.F. Pen., 4/6 each.

13 v. .2 amps. gen. purpose Triodes, 5/6; H.F. Pens. and Var.-Mu. H.F. Pens., Double Diode Triodes, Oct. Freq. Changers, 7/6 each. Full-Wave and Half-Wave Rectifiers, 5/9 each.

New Taylor Tubes

T.40. TZ.40. NOW IN STOCK. Price, 24/- each. Prices now reduced on 866 Rectifier, now 10/-; 866 Junior, 7/6; T55, 45/-; 203Z, 52/6; 745, 65/-; T.20 and TZ.20, 17/6 each.

PREMIER MOVING COIL METERS

Guaranteed Accuracy within ± 2 per cent.

Model No. 2 (as illustrated), Bakelite Case, 3 in., by 3 in. square, with Zero Adjuster.

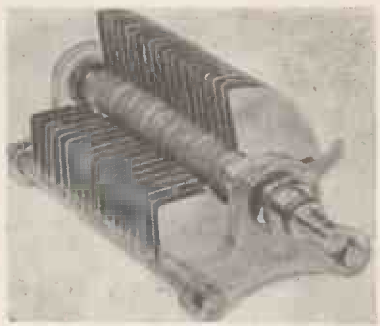
0,500 Micro-amps.	31/-
0-1 m/A.	25/-
0-10 m/a.	22/6
0-50 m/A.	22/6
0-100 m/A.	22/6
0-250 m/A.	22/6
0-1 m/A. movements with calibrated scale volts—ohms—m/A.	27/6

MODEL No. 21. 3-in. square case.		MODEL No. 311. 3½-in. diameter round case.	
0-1 m/A. ...	18/6	0-1 m/A.	22/6
0-10 m/A.	17/6	0-10 m/A.	20/-
0-50 m/A.	17/6	0-50 m/A.	20/-
0-100 m/A.	17/6	0-100 m/A.	20/-
0-250 m/A.	17/6	0-250 m/A.	20/-

MODEL 311. 0-1 m/A. movement, with calibrated scale, volts-ohms-m/A., 27/6.

VOLTAGE MULTIPLIER RESISTANCES, guaranteed accuracy ± 2 per cent. All standard ranges. 1/3 each.

TAPPED SHUNT to provide readings of 5 m/A., 25 m/A, 250 m/A., and 1,000 m/A., 5/6.



SHORT-WAVE CONDENSERS

Trolitul insulation. Certified superior to ceramic. All-brass construction. Easily ganged.

15 m.mfd.	1/6	100 m.mfd.	2/-
25 m.mfd.	1/9	160 m.mfd.	2/3
40 m.mfd.	1/9	250 m.mfd.	2/6

All-brass slow-motion Condensers. 150 m.mfd., Tuning, 4/3; Reaction, 3/9.

Double-Spaced Transmitting Types.

15 m.mfd., 2.9. 40 m.mfd. 3/6. 160 m.mfd. 4/6.

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CALLERS to:—Jubilee Works, or 165 Fleet St., E.C.4. *Central 2833* **or 50 High St., Clapham, S.W.4.** *Macaulay 2381.*

The Short-wave Radio World

A Review of the Most Important Features of the World's Short-wave Developments

A COMPACT ROTARY BEAM AERIAL

ONE of the most outstanding American amateurs is W2AZ, who to date has worked 36 zones out of 40 and no less than 75 countries on 20-metre phone. A very big percentage of his 20-metre telephony is quite recent despite the bad conditions that have prevailed. W2AZ, operated by Frank Carter, at East Rockaway, Long Island, has until quite recently been using three fixed-beam aerials which, although they have been entirely satisfactory, are no better than a small half-wave rotary beam in use at present.

Generally, rotary beam aerials are much too long and cumbersome for English amateurs to consider, but in this instance, as the total span is under 33 ft., it should meet the requirements of quite a number of experimenters. It overcomes the big disadvantage of beam antennas in that it can be used on two bands merely by moving the tap point on the stub section and in one instance using a shorting bar. In our opinion this beam is very similar in design to the narrow spaced W8JK aerial which has proved so effective. It consists of four quarter-wave sections spaced 8 ft. 8 in. with a gap of 2 ft. between centres. There is the conventional cross over between the four elements, with a stub section connected at the point of cross over.

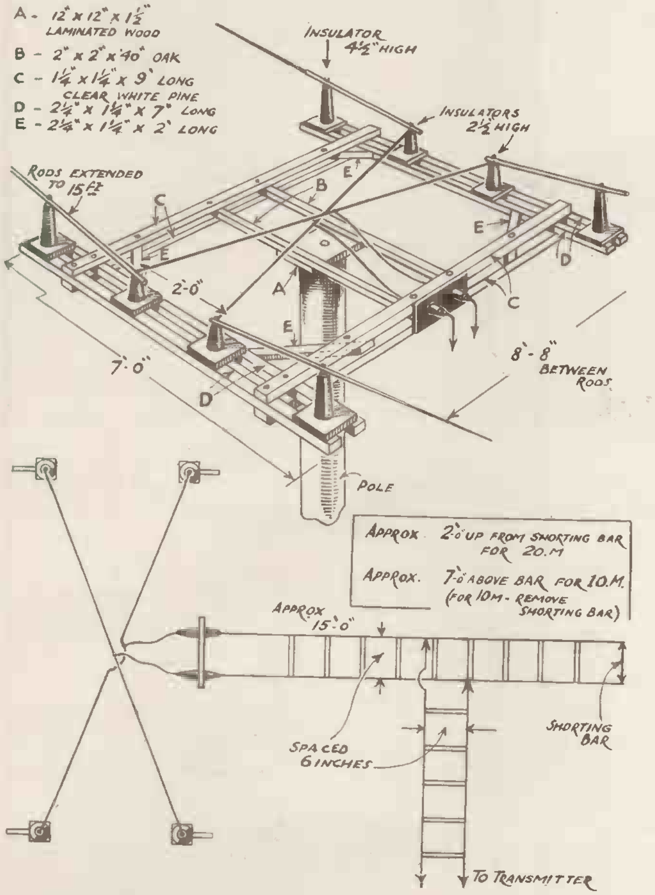

Fig. 1. This compact rotary beam provides a gain of 4db in two directions. It need not be more than 35 to 40 ft. above ground and only occupies a width of 32 ft. It is similar in design to the W8JK beam which has become so very popular.

The radiating element should be light aluminium, although it is claimed that galvanised iron tubing can be used without appreciable loss in efficiency. The advantage of the galvanised iron tubing is that it prevents most of the sagging and that it is very much more rigid. However, the weight goes up out of all proportion to these advantages.

A light wooden framework is required on which to support the radiating elements, which if they are to be sufficiently rigid, must be anchored at the centre and also at a point 7 ft. or 8 ft. along the radiator.

The method of construction can quite clearly be seen from the illustration in Fig. 1. According to W2AZ this rotary beam gives similar results to the three large fixed beams which were twice the size and at least 25 ft. higher above the ground. On the receiving side, interference is considerably reduced, the actual attenuation being approximately 4 db.

With regard to the mechanical construction of this beam, either the supporting element can be rotated or if it is conveniently possible, the pole can be mounted on a motor car wheel or something similar. In such an event, however, the pole would have to be entirely self supporting.

This type of aerial can also be used to cover one given direction and will provide quite an appreciable power over the normal doublet or zepp. aerial. If constructors should decide to erect the aerial in a given position, spreaders can be used with 14-gauge wire, for tubing then becomes unnecessary. The stub section is 15 ft. long spaced approximately 6 in. and the untuned line is tapped on at a point 2 ft. from the shorting bar for 20 metre operation or 7 ft. for 10 metre operation with the shorting bar removed. Full constructional data on this aerial can be found in the October issue of the American publication *Radio and Television*, but principal details can be found in Figs. 1 and 2.

A MONITOR AND MODULATION METER

The Australian amateur VK2MO has published in *The Australian Radio World* some interesting data on a mains operated monitor and modulation meter. This meter, which uses two straight forward diodes and a 6E5 tuning indicator, is quite easily constructed from normal B.C.L. com-

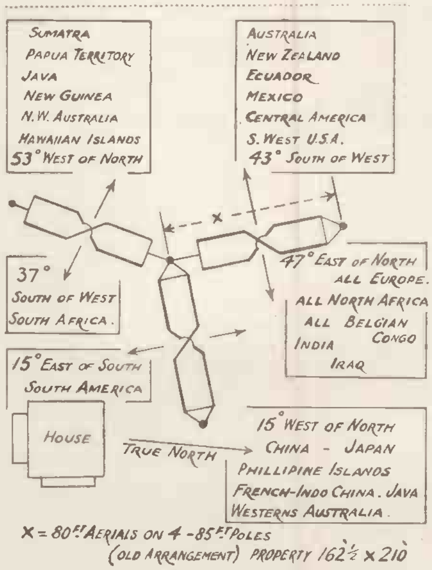

Fig. 2. The rotary beam is equal in performance to the three fixed beams shown in this illustration. This should give some idea as to the performance that can be expected.

MULLARD TRANSMITTING VALVES

TZ08-20

Transmitting valves to meet every requirement can be selected from the Mullard range comprising:—

SHORT-WAVE TRIODES
SCREENED R.F. PENTODES
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Ask for a copy of the latest list of low and medium power transmitting valves.

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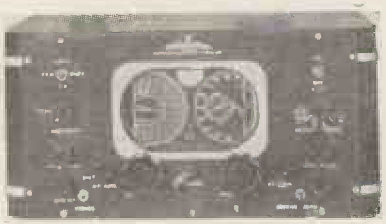
G5NI Introduces the New 450A HOWARD



12 TUBES 6 BANDS
(65 MC.—540 KC.)

This new Communication Receiver designed and built by America's oldest manufacturer is bristling with refinements which all short-wave amateurs will appreciate.

When you compare the eatures of the 450A Howard with those of other makes you will agree that it is exceptionally fine value for money.

Here are a few of the Howard features :

- Electrical Band Spread.
- Illuminated Dual-Dial accurately calibrated, with new S.L.F. calibrations.
- **Micrometer Band Spread.** Band Spread scale has a total length of 47 inches divided in 1,000 divisions.
- B.F.O. Shift Switch providing beat oscillator on each of the I.F. circuits (1,560 Kc. and 465 Kc.).
- Flywheel tuning on both controls.
- Calibrated R Meter.
- R.F. Stage on all bands except five-metre band.
- **Air-Tuned R.F.** and oscillator circuits.
- Iron-Core I.F. Coils.
- Dual channel, variable selectivity I.F. circuits, providing crystal switching, 1,560 Kc. I.F. for the five-to-ten-metre bands, broad and sharp for other bands, all accomplished with one control knob.
- Push-pull Beam Output, 9½ watts.
- B.F.O. with amplitude and pitch controls.
- Output terminals for 5 and 500 ohms
- Separate five-metre antenna connection.
- Relay connection for break-in work.

Price 30 GNS. Complete *

HERE IS SOME GOOD NEWS FOR AMATEUR TRANSMITTERS

Prohibitive prices have prevented many amateurs owning the most useful piece of apparatus for any radio shack—namely, the Cathode Ray Oscilloscope. "RAYMART" has removed this price obstacle by producing

The NEW "RAYMART" RCO. 3" OSCILLOSCOPE

It gives you a picture of operating conditions in your Transmitter, answers such questions as percentage modulation, signal distortion, and peak voltage; will allow you to give accurate reports on percentage modulation of incoming signals. It is complete with 3 in. Cathode Ray Tube and self-contained power supply for 220/230 volt operation. 1,000 volts is available to operate the Tube at full sensitivity. Horizontal and vertical plates are brought out to the side of the Cabinet and a self-contained 50 cycle sweep is provided.

Full operating controls include Brilliancy, Focussing, Sweep control and sweep switch are provided, and the whole is mounted in a case 8¾ ins. high by 6 ins. wide by 13 ins. deep, exactly matching in size and finish the HRO., RME.69 and Hallicrafter Receivers.

PRICE, COMPLETE with all tubes and ready for operation on 220/230 volt 50 cycle mains, is **£4 - 19 - 6**

A charge of 10/- is made for the Tube Container to ensure safe arrival of the Cathode Ray Tube. This is refundable in full subject to the case being returned to our premises within four days of receipt.

* For further interesting details of the 450A Howard and the "Raymart" RCO 3" Oscilloscope, see the editorial article on page 696 of this issue.

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THE SHORT-WAVE SPECIALISTS. We are the oldest Distributors for Bliley, Thordarson, Taylor Tubes, RME, Bassett Concentric Cable, Hoyt Meters, Collins, National, etc. Send us your enquiries. Large stocks carried.

Mains-operated Modulation Meter

ponents. The problems of hum level do not arise for the monitor is housed in a separate cabinet to that of the power unit. The circuit is shown in Fig. 3 from which it can be seen that it has been designed to overcome the numerous drawbacks of conventional diode monitors, which are lacking in the ability to register over modulation peak of short duration. Percentage modulation is a peak voltage phenomenon and consequently, any meter that does not take this into consideration is not a true indicator. A reversed rectifier connected to the anode return of the final amplifier, when it is being plate modulated is an exception to these remarks as it immediately indicates when the anode of the final valve becomes negative, a condition producing no carrier output over a fraction of an audio cycle and an indicator of over modulation.

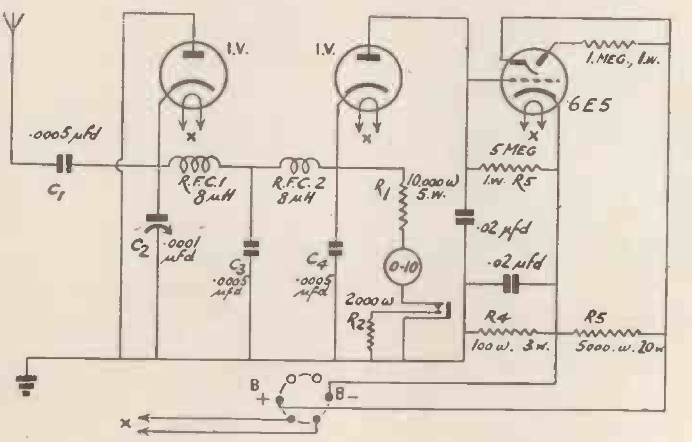


Fig. 3. Two diodes and a tuning indicator are required in this circuit. The diodes, however, can be triode valves with the grid and anode electrodes connected together. The meter should read up to 10mA.

Many amateurs have realised that it is the negative peak of over modulation that causes the most serious types of interference. It can be readily understood when one considers that during a negative peak of over modulation, the carrier is completely cut off with a resulting chopping-up effect each time the negative peaks are cut. It is this effect which produces the interference which can extend many kilocycles each side of the carrier. In order to obtain a quick and accurate indication of over modulation some form of peak vacuum valve-volt meter to give a visual indication is required. The 6E5 tuning indicator can be adapted for this purpose and as it is a voltage operated device, will give an effective visual indication. In this unit the 6E5 is used as the actual peak indicator.

The aerial in the first stage is loosely coupled to the transmitter, but has in series with it a blocking condenser of 500-mmfds. The input circuit is also tuned by C2 which governs the amount of R.F. applied to the first diode, which is used as a straight forward radio-frequency rectifier in which it rectifies the positive half of an incoming carrier.

The output from the rectifier is filtered to provide modulated D.C. by means of chokes and condensers in the cathode circuit. The second rectifier is for audio peaks when they exceed a certain value.

The power unit gives approximately 320 volts D.C. from a power transformer having a 300-0-300 volts secondary which completely smooths and the switching circuit has been arranged so that the voltage can be switched as required. Both the modulation meter and the power unit can be housed in metal cabinets of the Eddystone type 1033 and will then form a useful accessory to the average amateur station. There will probably come a time when equipment of this type will become compulsory as it is in America.

For those who have not suitable diode valves, ordinary triodes will be quite suitable providing the anodes and grid electrodes are strapped together.

Transmissions from Australia

A schedule has been fixed for the month of November with the Australian short-wave stations VK2ME, Sydney, VK2ME, Melbourne, VK6ME, Perth. These are as follows:—

VK2ME, Sydney.

Sunday	06.00-08.00 09.30-13.30 14.00-16.00

VK3ME, Melbourne.

Monday Saturday Inclusive	09.00-12.00

VK6ME, Perth.

Monday Saturday Inclusive	11.00-13.00

All times in G.M.T.

The following wavelengths and frequencies are to be used:—

Sydney, VK2ME, 31.28 metres—9590 Kc.

Melbourne, VK3ME, 31 5 metres—9510 Kc.

Perth, VK6ME, 31.28 metres—9590 Kc.

Of these stations VK2ME is the most reliable during its first or third period. For the most satisfactory results a half-wave aerial should be arranged so that the maximum pick up is from a line running through Peru for the morning transmission or through India for the evening transmission.

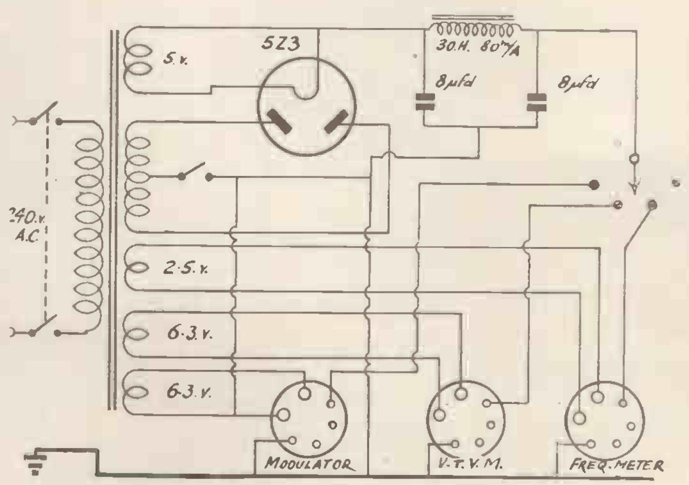


Fig. 4. This is the power unit for the modulation meter and it has been arranged so that the D.C. output is switchable. The unit provides 320 volts D.C.

PETO-SCOTT

MANUFACTURERS of— TRANSMITTING & RECEIVING GEAR to H.M. GOVERNMENT

BRITISH and BETTER

EST: 1919

"It's the years behind that puts us years ahead."—This slogan has never been more apt than now. Our vast experience in the design and production of Ultra Short and Short Wave apparatus has once again resulted in our being chosen to design and produce high efficiency short wave gear for H.M. Government.

It is with that knowledge and a deep sense of our responsibility to you our clients, that we unhesitatingly recommend the Trophy 8 for your serious consideration. It is a really satisfactory British-made communication receiver, that will fill a long-felt want among D.X. fans. It gives us great pleasure to sponsor this new receiver, because we know that to buy British is to buy the best. The Trophy 3 and 5 receivers, although not possessing all the features of the communication type, will give equivalent satisfaction to the newcomer to short-wave listening.

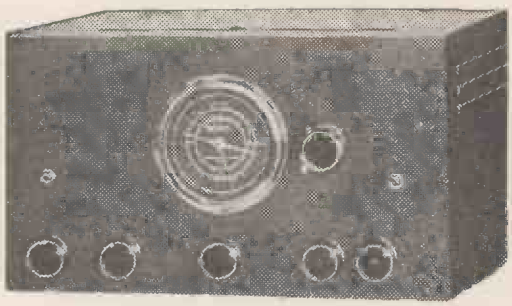
Rear Chassis View of Trophy 8.

- 8 Valves.
- 5 Bands, 43 mc. to 545 kc.
- Continuous Band-spread Dial.
- R.F. on all bands. Separate Oscillator.
- Beat Frequency Oscillator with separate Pitch Control.
- A.V.C. and B.F.O. on-off switches.
- High impedance output sockets for generally preferred separate P.M. speaker. Headphone Jack.

12 GNS.

TROPHY "8"

COMMUNICATION TYPE A.C. RECEIVER



SPECIFICATION :

8 valves, 5 wave bands, 7-550 metres (43 m.c. to 545 k.c.). Continuous mechanical bandspreading by the employment of a newly developed geared positive drive with entire absence of backlash. Large illuminated scale engraved in Kilocycles with divisions permitting of settings of 800 deg. in 1 deg. steps. R.F. on all bands. Separate oscillator. Beat frequency oscillator with separate pitch control. A.V.C. and B.F.O. on-off switches. International Octal valves are used throughout with 6L7G as frequency changer, 6K7G as IF amplifier, 6B8G as 2nd detector, A.V.C. and audio amplifier, 6F6 output pentode. Self-contained smoothing circuit. High impedance output sockets are provided for use of separate P.M. speaker and a jack is incorporated for alternative headphone use. Receiver chassis with all smoothing equipment is housed in a pleasing black crackle finish steel cabinet, size 17¾ in. long by 9½ in. high by 12 in. deep. Despatched accurately aligned and aerial tested. Fully guaranteed for 12 months, including all valves.

YOURS FOR 15/6 DOWN & 18 monthly paym'ts of 15/7

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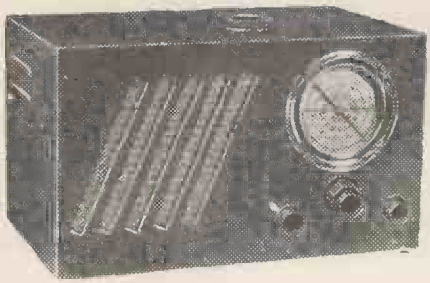
BATTERY and A.C. MODELS



- Wave range 6.2 to 550 metres.
- Proved amazingly sensitive circuits.
- New and improved slow-motion tuning method free from backlash.
- High-fidelity incorporated speaker.
- Phone Jack.

BATTERY MODEL.

Highly efficient 3-valve straight circuit with pentode output, mush and background noise free. Metre calibrated large scale. Housed in pleasing black crystaline finish steel cabinet, size, 13½ in. by 8 in. by 8 in. Supplied with self-locating 6-pin inductors for 12.52 metres. Guaranteed, fully tested. Cash price **£5 15 0**

TERMS: 7/- down and 18 monthly payments of 7/-.

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Highly efficient 2-valve straight circuit plus rectifier. Dual slow-motion tuning, reaction and sensitivity controls. Built-in speaker, illuminated metre engraved scale. Pleasing cabinet and self-locating inductors as battery model. Fully guaranteed.
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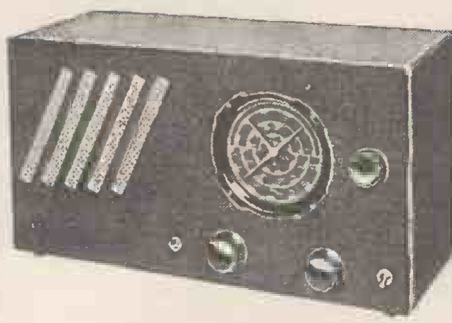
TROPHY "5" Short Wave RECEIVER

For A.C. Mains Only

- 5 valves.
- Wave range 10-550 metres continuous.
- Improved method of Bandspread tuning.
- A.V.C. and B.F.O. on-off switches.
- For single wire or doublet aerial use.
- Built-in speaker and phone jack.



SPECIFICATION—5-valves. 4 bands. Band 1. 10-23 ; band 2. 23-70 ; band 3. 68-200 ; band 4, 200-550 metres. Triode-hexode frequency changer followed by triode-pentode used as I.F. amplifier and beat frequency oscillator. Double-diode-triode providing rectification. A.V.C. and L.F. amplifier. Pentode output. F.W. rectifier. Separate power-pack and special screening, ensuring absence of mains hum. A.V.C. and B.F.O. on-off switches. Improved mechanical band-spreading absolutely free from back-lash and providing an effective scale length equivalent to 8 feet. Large full-vision illuminated scale engraved metres and kilocycles. Built-in moving-coil speaker. 'Phone jack. Black crackle finish steel cabinet, size, 17 in. by 9 in. by 8½ in. deep. For A.C. supplies only, 200/250 volts 40-100 cycles. Fully guaranteed.

£9

TERMS: Deposit 10/9 and 18 monthly payments of 10/9.

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SEND NOW.—Order with complete confidence: all post orders by return. TROPHY lists and complete details covering the Peto-Scott range of short-wave and all-wave equipment, post free on request.

Tel: CLI 9875, Clerkenwell 5911

A Transmitter for the C. W. R.

This transmitter is intended for amateurs working on the C.W.R. frequency of 2,580 K.c. It will however operate on the 40, 80, and 160 metre amateur bands by changing coils and crystal. The designer is G5ZJ.

WHEN the preliminary announcements regarding the C.W.R. were made in our last issue it was tentatively decided that the wavelength of approximately 60 metres would be employed. Based on this wavelength a suggested design was published on page 646, which would be quite satisfactory for operation up to 35 or 40 watts. However, as the frequency to be used has now been changed to 2,580 kc. equal to 116 metres, the need for high power does not arise.

The three meters shown are optional for jacks can be substituted if the meters are not available.

Consequently, the design has been slightly modified and simplified, but not to such an extent that those who have already started construction will have to make drastic alterations to the equipment.

The main alteration is in the power unit where the twin 81 type rectifiers have been omitted in favour of a single type 83 which although designed for 500-volt operation at 250 mA. will stand 700 volts input with the reduced anode current taken by this transmitter.

This also enables one valve holder to be left out and calls for a slight modification to the filament transformer. Two special transformers have been made for this transmitter by Sound Sales and are of a new inexpensive type which should appeal to constructors. They have been arranged so that all the leads are underneath the chassis while expensive casings have been altered in order to effect a considerable saving in the manufacturing cost.

The transformers required are, one for filament voltage only and the second for H.T. voltage. It should be appreciated at this point that the frequency chosen for C.W.R. use, that is 2,580 kc., does not come within the restrictions imposed on amateurs using the 1.7 mc. band For this reason, amateurs can use their licensed power and not be restricted to 10 watts input as on 1.7 mc. The filament transformer is designed to give 5 volts at 3 amperes, 7.5 volts at 1.75 amperes, and 6.3 volts at 1 ampere. All tapped.

The H.T. transformer provides 120 mA. and either 700-0-700 volts or 500-0-500 volts by means of a double tapped winding. In this way amateurs can have a transmitter with quite a moderate input or up to the maximum permissible merely by changing over two transformer tappings.

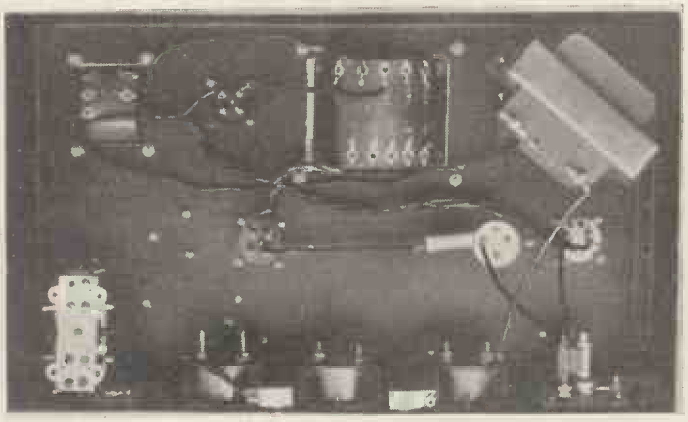
Wavelength 116 Metres

The transmitter has been designed primarily for use on 116 metres and the tuning capacities are of optimum value for that wavelength. However, the efficiency is such that the transmitter can be used on 80 or 40 metres by merely plugging in two new coils and a crystal for the band to be covered. The amount of R.F. output on 20 metres is not sufficient for serious working unless a tuned cathode circuit is employed, so converting the 6V6G to a tri-tet oscillator, or by using a 20-metre crystal.

The oscillator circuit consists of a 6V6G tetrode in a straightforward circuit with bias obtained automatically by means of a resistor of 100,000 ohms across the grid-earth circuit. The 6V6G is merely a low-power version of the 6L6G and should operate with approximately 300 volts on the anode and 180-200 volts on the screen. A key is connected into the cathode circuit and in this position it will be found that a condenser of .001-mfd. across the contacts is sufficient to stop key clicks.

In the anode circuit is L1, a coil wound on a four-pin plug-in former. If this coil is tuned by the suggested condenser which has a capacity of 60-mmfd. it should be wound with approximately 45 turns of 22-gauge enamel-covered wire without gap between windings.

H.T. voltage is fed into the anode of the 6V6G via RFC3, an optional meter and the switch S1. As, however, there is a maximum voltage of

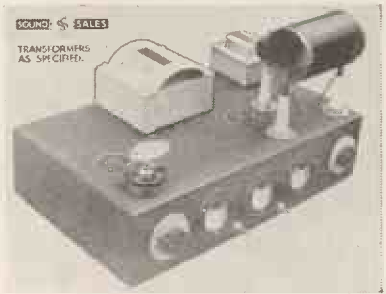


This partly wired sub-chassis view gives a clear idea as to the layout of the components and the underside of the power transformer.

A Real Precaution!

The G.W.R. Transmitter has been expressly designed for use in conjunction with the Civilian Wireless Reserve and the necessity for unfailing reliability will be appreciated together with the significant fact that the designer has paid us the sincere compliment of specifying "Sound Sales" H.T. and L.T. transformers.

Incidentally, we have a Department devoted to the design and construction of special transformers for the Government Departments, Laboratories and well known Amateurs all over the World, and at the moment there is approximately one thousand hours of continuous work in progress.



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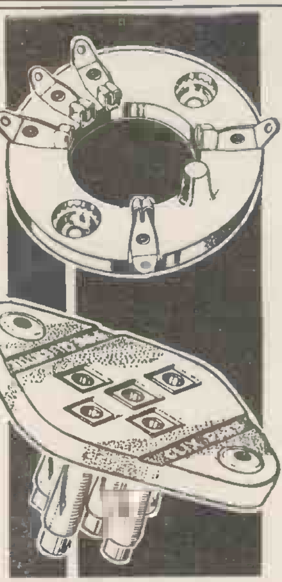

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- Television
- Acoustics
- Appendix
- Index

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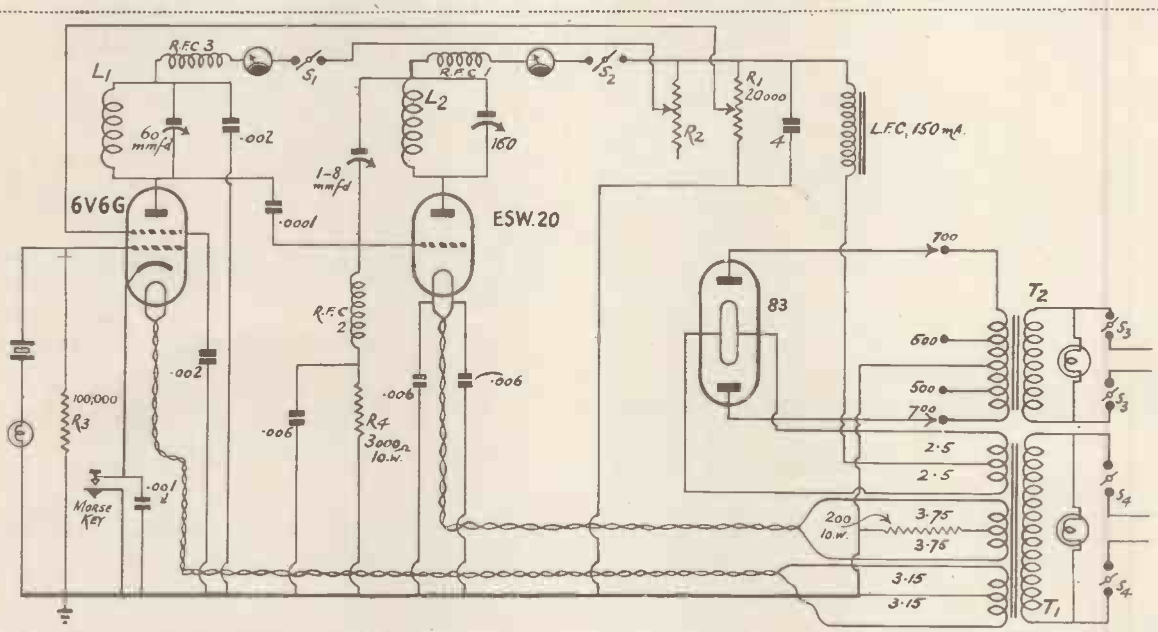
Multi-band Operation

700 available, this must be reduced by means of a resistance, R2, which has a value of 10,000 ohms. This resistor is supplied with tapping clips which should be adjusted until the correct anode voltage is obtained.

Similarly, with the voltage for the screen of the 6V6G. As this must remain reasonably constant, a potential divider is connected across the total H.T. supply. This divider, shown as R1, has a value of 20,000 ohms and is supplied on request with an additional tapping clip which should be moved up and down the resistor until, under load, the correct voltage is obtained. This potential divider serves a dual purpose for it also acts as a low-value bleeder and keeps the voltage comparatively steady when the transmitter is being keyed.



A type 83 rectifier although rated for 500 volts does not show any signs of stress at 700 volts, provided the current output is reduced and there is a slight time delay in the H.T. circuit.

As mentioned previousuly the meter in the oscillator-anode circuit is optional. If it is decided that a meter should be included, then it should be of the Sifam type E66M, which is quite inexpensive but does the job quite satisfactorily. It should have a maximum deflection of 100 mA.

If, on the other hand, a meter is not to be used, then a closed-circuit jack should be connected into circuit so that the current can be read by means of an external meter with a plug.

As the transmitter is being used on a comparatively low frequency, then capacity coupling is quite satisfactory. A good average value for the coupling condenser is .0001 mfd., which allows of sufficient R.F. transfer without too big a load on the final stage. During tests it was noticed that with this value condenser, there is practically no pull between stages with the ESW-20 properly neutralised.

Next comes the amplifier stage which uses a 20-watt triode valve with automatic bias. A resistance of 3,000 ohms in the grid circuit plus a resistance of 200 ohms between the filament mid tap and earth provides sufficient bias without making use of an external source.

It must be remembered, however, that the amount of bias required by the ESW-20, in this instance approximately 40 volts, must be subtracted from the D.C. voltage applied to the anode. For example, should there be a theoretical voltage of 500 on the anode of the ESW-20, by using automatic bias in this way, the actual voltage will only be 460.

It is most important that there be a good R.F. choke in the grid circuit of the ESW-20 and in addition that this circuit be by-passed to earth. A suitable value for the by-pass condenser is .006-mfd.

An alteration has been made in the design of the power pack for it will be remembered that in the original circuit using vacuum type rectifiers, condenser input was suggested. As the 83 rectifier is of the mercury vapour type, the power unit has had to be changed to the choke input. This causes a slight decrease in voltage but does not permit of high peaks, which may cause condenser breakdown.

The power unit is extremely simple and as the transmitter is not being used on telephony the smoothing circuit need not be so comprehensive. A single choke followed by a capacity of 4-mfd. is ample.

The final tank coil is wound on a 2½ in. diameter paxolin former with 42 turns of 18 gauge enamel-covered wire close spaced. It is suggested that the aerial be coupled to this coil by means of a single turn link wound around the centre of the coil. This link should then be taken to an aeriel coil located at a point where the feeder lines enter the radio room.

In operation it will be found that the 6V6G has an off resonant current of 60 mA. which drops to a little under 20 mA. when correctly tuned. As the amplifier stage is brought into resonance, the anode current in the 6V6G circuit will rise to a value of 35 mA.

A grid mA. meter is shown in the illustration but here again as with the anode meters it is a refinement not strictly required providing a closed-circuit jack is included in the grid circuit. It will, however, be found that a grid meter is most useful for checking the amount of drive available and when trying to locate the correct setting for the neutralising condenser.

When the 6V6G is operating efficiently, there will be a grid current of 18 mA. in the ESW-20 circuit, without H.T. voltage to this valve. Under normal working conditions with the aerial connected the grid current will drop to 14 mA. These figures are, of course, only approximate as they depend on individual valves and components.

It is essential that the ESW-20 be correctly neutralised. If the grid meter

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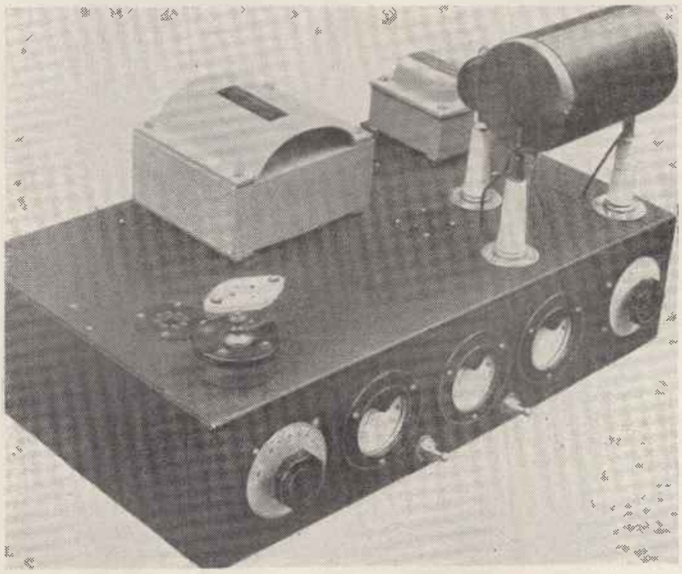
Coil Winding and Operating Data

is available, connect this in series with the 3,000-ohm grid resistor. Tune the tank condenser across L2 to resonant point indicated by a minimum current reading on the above meter, and then



If the transmitter is carefully wired most of the connections can be kept under the baseplate.

swing the tank condenser slightly over either side of resonance. If the stages are correctly neutralised, the grid current reading will remain constant. If it is not correctly neutralised, then the reading will flicker in sympathy with the movement of the anode condenser. The neutralising condenser should then be adjusted until a position is found where the grid current flow remains steady when the anode condenser is being adjusted.

Tuning Notes

When incorrectly tuned, the maximum current flow in the ESW-20 anode circuit will be approximately 120 mA. but this drops down to 10 mA. when tuned to resonance. The aerial circuit should then be tuned until the ESW-20 takes approximately 20 mA. if the licence restriction is 10 watts, or to a higher wattage if so required. It is not recommended, however, that the valve be run continuously at more than 35-40 watts.

Switches are connected in the primary circuit of T1 and T2. T1 is switched into circuit approximately one minute before T2 in order to allow the valve heaters to reach the correct temperature. During operation the switch in the primary of T2 can be used for standby purposes.

For those who prefer primary keying this is permissible as the filament transformer is entirely separate. However, it will probably be noticed that a carefully adjusted key-click filter will be necessary with this system. It can, however, be made quite satisfactory owing to the fact that the power pack delivers a steady voltage.

The aerial recommended for 2,580 kc. use should preferably be of the Marconi type, with a counterpoise erected 6 ft. above ground. The length of the aerial should be either 112 ft. or 56 ft. with the counterpoise of similar length. However, owing to the fact that a large coil with a series tuned counterpoise should be used, the aerial and counterpoise lengths are not particularly critical.

If an aerial is already in existence cut for use on amateur bands, then generally speaking, this can still be used providing a series-tuned counterpoise is employed.

The average C.W.R. member will find that with this transmitter there will be sufficient R.F. power for it is not intended that the control stations will have to cover an area of more than 20 miles. However, should at any time there be a need for greatly increased power then a simple high-power final stage could be added and driven by the ESW-20. No blueprint is to be issued for it is felt that the circuit is sufficiently simple for CW.R. members to handle without assistance, but arrangements are being made for Messrs. Sound Sales to supply a completely wired transmitter, air-tested, on the frequency of 2,580 kc.

The Exeter and District Wireless Society

At the last meeting of the Exeter and District Wireless Society held on Monday, October 3, various members brought along their short-wave sets for demonstration, discussion and trial. Several interesting sets were brought and members were particularly interested in those operated on ultra-high frequencies, i.e., 56 mc. and 112 mc. Both straight and super-regenerative sets were shown and tried.

A slight alteration in programme has been arranged and it is that Messrs. Voight are giving a demonstration of their loud-speakers on November 21. This is one of the most interesting lectures that the Society has ever been able to obtain and it is hoped that members will come in full force.

Meetings are held every Monday at 8 p.m. at No. 3 Dix's Field, Exeter, and all those interested should get in touch with the secretary, Mr. W. Ching, 9 Sivell Place, Heavitree, Exeter.

Components for A C.W.R. TRANSMITTER

CHASSIS.
1—Aluminium 17 ins. by 10 ins. by 4 ins. finished black (Peto Scott).
CONDENSERS, FIXED.
2—.002 mfd. type 1,000 volt tubular (Dubilier).
1—Type SW82 (Bulgin).
4—.006 mfd. type tubular (Dubilier).
1—4-mfd. type LEG 800 volt (Dubilier).
CONDENSERS, VARIABLE
1—60-mmfd. type 1093 (Eddystone).
1—160-mmfd. type TROT (Premier Supply Stores).
1—Type 1088 (Eddystone).
CRYSTAL AND HOLDER.
1—Standard type, 2,580 KC. (Q.C.C.).
COIL FORMS.
1—4-pin plug-in type CF4 (Raymart)
1—Length 2½ former (Peto-Scott).
CHOKES, HIGH-FREQUENCY.
2—Type 1010 (Eddystone)
2—Type SW68 (Bulgin)
CHOKE, LOW-FREQUENCY.
1—150 m.a. (Premier Supply Stores).
COIL HOLDERS.
1—Type 1073 (Eddystone)
2—Type 1095 (Eddystone).
DIALS.
2—Type 1097 (Eddystone).
HOLDERS, VALVE.
1—Type Octal (Clix).
2—Type American 4-pin (Clix).
JACK.
1—Closed circuit type J6 (Bulgin).
KEY.
1—Type McElroy (Webbs Radio)
METERS.
1—Type E66M 0-50 mA (Sifam).
1—Type E66M 0-100 mA (Sifam).
1—Type E66M 0-200 mA (Sifam).
PLUG.
1—Type P15 (Bulgin).
RESISTANCES, FIXED.
1—20,000 ohm type PR13 (Bulgin).
1—10,000 ohm type PR11 (Bulgin)
1—5,000 ohm type 15 watt (Premier Supply Stores).
1—100,000 ohm type 1 watt (Erie).
SWITCHES.
2—Toggle type S80T (Bulgin).
2—DPST type S89 (Bulgin).
TRANSFORMER H.T.
1—Special type (Sound Sales).
TRANSFORMER FILAMENT.
1—Special type (Sound Sales)
VALVES.
1—Type 6V6G (Tungsram).
1—ESW 20 (Ediswan).
1—83 (Premier Supply Stores)

LONG SKIP

This new feature for the transmitting and receiving amateur is by the well DX worker G5KA

IT is with some diffidence that your scribe enters upon his duties of building up for your benefit this collection of DX notes. The recent crisis, and the poor conditions prevailing on most bands during the last few weeks have not made the task easier.

This is to be your column, you hunters of DX, and its continuance and success depends on your co-operation, since the writer is only a vehicle for compiling and presenting in tabloid form the snappiest catches of the month, and such items of news as will be of interest to all hams. So please come forth with your logs and let us hear of those call signs, which, while filling our hearts with envy, will help to swell our columns. As far as this last month is concerned, we are indebted to a few friends and fellow amateurs for helping to compile, rather hastily, the following notes.

G5RV is rigging a formidable 14 mc. rotatable beam on a 30 ft. tower. He feels this will drill good deep holes in the ether, and we wouldn't wonder, since gear at that station has a quaint way of working about 100 per cent. plus. 113 countries worked prove that! Like many others, Louis works a good percentage of DX early mornings, and he and his neighbour G3BS can be heard filleting the 14 mc. band most days around dawn. The latter station has raised 70 countries in 10 months' operating, but let us whisper that the XYL there has a second ops. ticket, and an insatiable appetite for the lesser known calls!

And talking of rare ones brings us to K6PMP in Guam, who, on a frequency of 14,300 put a FB signal over here at the beginning of October for a few days. Several delighted G's worked him, but after announcing that he was putting up a better antenna, he vanished, and as far as we know hasn't been heard since. Several good signals jumped off from the Pacific earlier this month, K6OQE and K6PLZ being well heard from Hawaii, while KA1RP, KA1BC and KA1HS (the latter on phone) consistently represented the Phillipines.

During the recent poor conditions, one G5 we know caused despondency among his fellow hams by his story of working XZ2EM on phone "R9 plus both ways, cross me heart." Upon pressure, however, he confessed that the contact was over a few miles of land line as XZ2EM is home on leave. He can be heard testing his new transmitter on 7 and 14 mc with the call G3NF, prior to his return to Burma.

Many hams seem to waste valuable time these days listening to CQ calls, which eventually sign ON4 or PA. It's a very queer thing that while the rest of the Europeans are unmistakably locals, both Belgian and Dutch stations more often than not have that peculiar remote ring which quickens the pulse of the DX addict. Why? Propagation experts please forward. Yes, and addict isn't an unsuitable word at that. DX seems a drug to some of the boys, and the various certificates offered nowadays certainly encourage the attitude of "no play, food or sleep while the band is open." The latest scrap of parchment is the W.A.C.C. or Worked all Counties of California. As there are 58 of these and nothing but W6's in them, the attainment of this diploma will be no easy matter.

That giant of DX, G6WY, still leads the field in the Century DX Club with 137 countries, a really notable achievement, and a few G stations have now obtained W.A.S. W9BRD says he heard one of the lads call "Test Nevada" for three hours solid a few weeks ago! Can this be the same G we know who sometimes puts his automatic sender on a test call and forgets to switch off?"

During the crisis period, many DX stations were asking difficult questions as to our personal views and reactions, and pats on the back are duly administered to the several of our hams who were heard being courteous and tactful without endangering their licences. Incidentally, some of the R.N.W.A.R. operators who were mobilised were going to land in soft spots should trouble have come. We know several who were going out to man W/T stations in palm fringed tropical islands.

G5KA asks, "What's the use of directional calls?" To quote: "A few weeks back I put out a Test W6/7—back comes a W9. Out goes a similar call and a W5 answers. I worked him and after signing, called Test W5—result, back comes a VE5." Well, with DX like that, we wouldn't grumble!

How many G's have worked ZL on phone? G6ID is one, at least. He clicked ZL4GF at 19.30 B.S.T. on 14 mc. late in September.

From Dorothy (W2IXY) we understand that Pitcairn Island is shortly issuing its first set of postage stamps. She was heard working VR6AY the other morning and arranging a system of barter for a certain G who wanted an unused series.

G8MX has worked 28 zones on 20 metre phone. Here are a very small selection of some cards received which cover more than 20 zones

CN1AF (Tangiers) is causing a lot of sore throats among the phone men. G5RV worked him recently and shortly afterwards received a letter from the G.P.O. stating they had had a communication from the authorities in Tangier to the effect that CN1AF is a pirate and requesting "G" hams not to work him. Despite all the trouble he seems to be causing, 1AF is still going strong.

Coming nearer home, we have a most saddening report that that very popular padre, EI3J, may be forced to close his station owing to a strong anti-ham spirit among those in authority around his present QTH.

A Low-power Tx. for A.D.-D.C. Mains

An interesting transmitter suitable for the beginner has been designed by Messrs. Premier Supply Stores, which is suitable for use on A.C. or D.C. mains. The maximum input with a 200-volt supply is 18 watts. The valve line-up is 25L6 tritet crystal oscillator driving two type 18 pentodes in parallel with a 25Y5 rectifier—used on A.C. mains only—and a barretter. Also, by using 25L6's in the final, an input of 10 to 12 watts can be obtained on 110-volt D.C. mains.

When used on 110 volt D.C. mains the input is in the region of 10 to 12 watts rising to 22 watts on 250 volts A.C. or D.C. The transmitter can be used on the C.W.R. frequency of 2,580 Kc.

The transmitter is completely self-contained, as can be seen from the illustration, and the two controls are, on the left, crystal oscillator tank condenser, and on the right, power amplifier tank condenser. The condenser across the cathode circuit in the oscillator is pre-set and is mounted on the back of the chassis. When the oscillator is used in a straight forward manner on fundamental frequency, then the cathode condenser is adjusted to its maximum capacity when it automatically short circuits.

The three jacks are for metering the two anode circuits and for keying the cathode of the type 18 pentodes. In this way, there is no need for an expensive key-click filter. Also, if the operator should wish to key in either the anode oscillator or anode of the power amplifier, then the meter packs can be used for this purpose.

On the left-hand side can also be seen the on-off switch while a second switch on the right-hand side merely breaks the H.T. supply and is for stand-by operation.

On the rear of the chassis are three stand-off insulators, which are so arranged that the final tank can be link coupled or used with an end-on aerial.

All coils are of the plug-in type so that any band between 20 metres and 170 metres can be covered quite quickly. Although there is an appreciable output on 10 metres when using the final amplifier as a doubler, this is not actually recommended by the manufacturers.

The transmitter, as supplied, is ready for immediate operation, the only accessory being a Morse key. The price is £8, which is extremely low in view of the fact that it is suitable for multi-band operation.

The transmitter is also suitable for operation on the new Civilian Wireless Reserve frequency of 2,580 kc. Full information on this transmitter can be obtained from Messrs. Premier Supply Stores, of 165 Lower Clapton Road, London, E.5.

The Simplest Radio Receiver

In response to requests we have built this extremely simple receiver which uses a small metal detector and does not require power supply of any kind. It is intended for emergency use and with one or two pairs of headphones.

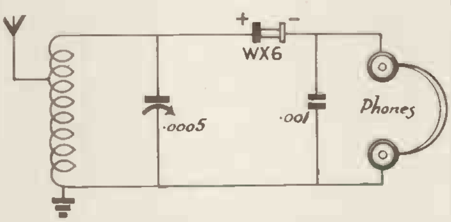
A good idea as to the size of the instrument can be gauged by comparing it with these Brown type headphones. The Westinghouse rectifier can be seen on the right-hand side.

IT is considerably over four years since a receiver suitable for broadcast reception has been published in this journal. Being devoted to the interest of short-wave amateurs we do not concern ourselves with the design of receivers intended only for programme reception on medium and long waves. The simple set to be described has been built to fulfill the large number of requests received during the past few weeks. A number of our readers have asked for a circuit of an extremely simple radio set that will give good volume from a local station and be suitable for use in time of emergency.

There are a large number of listeners who are dependent for their radio on mains-operated instruments so that should there be an unforeseen failure in power supply they are without means of reception. Also, in time of emergency, users of battery-operated sets will find considerable difficulty in having their accumulators charged.

As this country is now well served by means of local Regional stations, the old familiar crystal set can be of use, for it provides good headphone strength from local stations at distances of 50 miles. However, there is quite a shortage of good permanent crystal detectors, and in any case it is not at all definite that these permanent crystals will retain their sensitivity over long periods. There are, of course, some extremely good permanent crystals, but they are not readily obtainable in out of the way places. We have made use of the Westinghouse metal detector, which takes the place of the more conventional crystal rectifier. The Westinghouse element type WX6 has the big advantage that it is absolutely permanent and does not deteriorate.

The little unit that we have made up when tested at a distance of 35 miles from London and on an indoor aerial gave very good headphone strength from London National, London Regional and Midland Regional transmitters, so readers can safely assume that with a good aerial and favourable conditions the maximum range will be considerably in excess of 35 miles.



This circuit is so simple that it does not require any elaboration. The coil dimensions are given in the text.

The illustration on this page gives some idea as to the extreme simplicity of the unit, also of its compactness. The baseplate is actually a strip of bent aluminium, $6\frac{1}{2} \times 3\frac{1}{2}$ in., turned over on four sides approximately $\frac{1}{2}$ in. in order to take care of the nuts and bolts which go through the baseplate. On one end is mounted a pre-set condenser with a capacity of .0005 mfd. This tunes the simple coil mounted in the centre of the chassis which has been designed to cover medium waves only. The heart of the receiver, the Westinghouse WX6 rectifier, can be seen mounted on one side of the tuning condenser. On the other end of the chassis are two terminal blocks, one for the aerial and earth and one for a pair of headphones.

For those who have not had any experience with metal rectifiers, we should like to point out that the sensitivity is slightly less than that of the crystal detector, but it is absolutely permanent and is still sufficiently sensitive in view of the power output of the modern Regional stations.

Across the headphones is a fixed condenser having a capacity of .001 mfd. and although this value is not critical do not omit the condenser otherwise there will be quite an appreciable deterioration in quality. The only component which is not standard is the coil and this can be very quickly made at home. It consists of a piece of paxolin former, $1\frac{3}{4}$ in. diameter and 3 in. in length. Around the centre is wound a coil which is made up of 52 turns of 32-gauge enamelled covered wire, with a tapping point to the aerial 12 turns down the coil.

The ends of the wires are taken directly to the correct points while the coil itself is mounted off the baseplate on two small pillars. These pillars are actually the insulated ends of wander plugs. Construction is extremely simple and it should not take more than half an hour to have the unit in working order. Do, however, wire it up robustly for it is intended that this unit be kept in case of emergency so that it will probably have to withstand a fair amount of rough using.

It is also important that a sensitive pair of headphones is used and those which we find particularly suitable are the Brown type A which have adjustable ear-pieces in order to give maximum sensitivity.

Readers who are within a range of 25 miles or so of a local Regional station, will find that a short indoor aerial will be sufficient providing there is good earth connection available. Certain readers who have made up some advance models of this unit and are living in London, find that it is an excellent idea to have it in a bedroom, when 10 or 12 ft. of wire along a picture rail gives sufficient volume. Readers, however, who are dependent on B.B.C.

relay stations for their entertainment will probably require a conventional elevated aerial. The length of aerial affects the tuning of the receiver, but once the tuning has been fixed, there should not be any need to make further adjustments.

If, however, the receiver is to be used with several aerials, then it would be a good scheme to connect in series with the aerial a fixed condenser having a capacity of .0003 mfd.

The components for this simple receiver only amount to a few shillings and are available from Messrs. Peto-Scott and consist of two Bulgin terminal blocks, one Dubilier .001 tubular condenser, one Westinghouse metal rectifier type WX6, the coil former as previously mentioned, about one ounce of wire, simple bent chassis, the .0005 mfd. pre-set condenser, and a pair of Brown type A headphones.

Radio Club News

Ilford and District Radio Society

It is well worth while joining this society in order to obtain their journal, which is published monthly. This journal includes a wealth of technical and practical information of particular interest to the transmitting amateur in addition to those who are keen on making the most of their short-wave receivers.

The chairman of this socieity is H.T. Stott, A.M.I.R.E., 2COT, who is so well known in technical circles. The Ilford and District Radio Society are very active and have their headquarters at St. Alban's Church Room, Albert Road, Ilford, and full information can be obtained from the Hon. Secretary, C. E. Largen, 44 Trelawney Road, Barkingside, Ilford.

The society have their own transmitter in the course of erection under the call sign G3QR, and have recently added a library section. Meetings are held regularly throughout the year every thursday at headquarters.

South London and District Radio Transmitter Society

The summer season did not cause any falling off in activity in the South London district and their lectures were well attended. They included Mr. Nixon, of the G.E.C., on modern valve manufacture, the Chairman, G2NH, describing a portable crystal controlled transmitter for 56 mc., while the first talk in the winter programme was by Capt. Thorpe, ZS1AH, who has just returned from Cape Town, and spoke to members on October 5. The meetings are held in the Brotherhood Hall, West Norwood, on the first Wednesday every month. All short-wave amateurs are invited to attend and they can obtain further information from the secretary, H. D. Cullen, G5KH, 164 West Hill, S.W.15.

The R.A.F. C.W.R.

This is the badge issued by the R.A.F. to C.W.R. members. Badges are despatched as members qualify.

THE organisation of the Civilian Wireless Reserve is now nearing completion and it seems that members who have enrolled will find the scheme will be a most interesting one. The C.W.R. do not merely require ordinary key-punching operators. In one group, the Experimental Section, they will be able to do a considerable amount of interesting work on lines suggested by the R.A.F. This section will include a number of the more prominent amateurs in addition to a large number of members who have specialised knowledge on a given subject.

A number of tests have already been made over the air by local control stations who have the call-sign MQ followed by a third letter. Twenty-four stations with these call-signs are now in operation and are being trained by the main control station GJW. Members who have enrolled but have not yet received full notification of this plan will find that by listening on a frequency of 2,580 kc. they will be able to hear the exercises being broadcast. These control stations are widely spread from Devonshire and Kent to Scotland, North Wales and all over the centre of England, so that comparatively simple receivers will be satisfactory.

The originally suggested wavelength of 60 metres is not now being used owing to various internal reasons and also owing to the fact that it is not too satisfactory for reliable local working after dark.

Over 650 operators have already been accepted and the number is increasing rapidly every day. To these is being alloted a badge, the design of which is shown at the top of this page.

On the committee who are dealing with the organisation of this reserve are three well-known amateurs, looking after amateur interests, in addition to five R.A.F. members. The existing committee is :—

Chairman, Air Commodore C. W. Nutting, O.B.E., D.S.O.
Deputy Chairman, S/Ldr. H. W. St. John, D.F.C.
Members : Flight-Lt. J. R. Brown, D.F.C.
Chief Signal Officer, No. 26 Group R.A.F.V.R.
Mr. J. C. Hosburn.
Mr. H. C. Page (G6PA).
Mr. K. Jowers (G5ZJ).
Secretary, Mr. L. P. Elmer (G6LR).

A number of readers have queried one or two points regarding the C.W.R. but the main query appears to be the length of service. Originally it was intended that members should enrol for a period of five years, but a proviso has been added that members can resign if three months' notice is given. At present, there are no hard and fast rules regarding the amount of time spent in training, for this depends on the members concerned. A speed of 18 words per minute should ultimately be obtained and sufficient training should be taken in order to reach this speed. Also, despite the fact that 2,580 kc. is close to the low-frequency amateur band, power restriction does not apply. Amateurs can use their licensed power on 2,580 kc. and it is immaterial whether the input is 10 watts or 250 watts.