# Be guided by the expert —use 'AVO' ELECTRICAL MEASURING INSTRUMENTS

REGD. TRADE MARK — BRITISH MADE

Radio engineers the world over rely upon "AVO" Instruments for rapid precision testing. In these AvoMinors that same precision is available for the benefit of the keen amateur and serious experimenter. Combining high accuracy with unquestioned reliability, they are unrivalled in providing such comprehensive test facilities at so moderate a cost.

## The UNIVERSAL AVOMINOR

Electrical Measuring Instrument.

**Provides 22 ranges of direct readings. Has an accurate moving-coil movement and a 3-inch full scale deflection. The total resistance of the meter is 200,000 ohms. Complete with leads, interchangeable crocodile clips and testing prods and instruction booklet .. .. £5 10s.**

*(Leather carrying case 10/-)*

| D.C. VOLTS | A.C. VOLTS | MILLIAMPS |
|---|---|---|
| 0— 75 millivolts | 0— 5 volts | 0—2.5 milliamps |
| 0— 5 volts | 0— 25 ,, | 0— 5 ,, |
| 0— 25 ,, | 0—100 ,, | 0— 25 ,, |
| 0—100 ,, | 0—250 ,, | 0—100 ,, |
| 0—250 ,, | 0—500 ,, | 0—500 |
| 0—500 ,, | | |

| RESISTANCE | |
|---|---|
| 0— 20,000 ohms | 0— 2 megohms |
| 0—100,000 ,, | 0— 5 ,, |
| 0—500,000 ,, | 0—10 ,, |

*All 'AVO' Instruments are available on Deferred Terms*

● WRITE FOR FULLY DESCRIPTIVE PAMPHLET.

## The D.C. AVOMINOR

Electrical Measuring Instrument

**A precision-built moving-coil D.C. instrument with 13 ranges, providing adequate testing facilities for checking valve performance, batteries and power units, etc. In case complete with leads, interchangeable crocodile clips and testing prods and instruction booklet .. .. 45/-**

| CURRENT | VOLTAGE | RESISTANCE |
|---|---|---|
| 0— 6 m/A. | 0— 6 v. 0—240 v. | 0— 10,000 ohms |
| 0— 30 ,, | 0— 12 v. 0—300 v. | 0— 60,000 ,, |
| 0—120 ,, | 0—120 v. 0—600 v. | 0—1,200,000 ,, |
| | | 0—3 megohms |

### "RADIO SERVICING SIMPLIFIED"

*Written in the light of present-day knowledge, this book gives the whole routine of testing modern receivers, and explains causes of faults in receiving and amplifying apparatus. Also shows how to use effectively all radio instruments. 150 pages with numerous diagrams and graphs.*

Price 2/6 *(Post free 2/10)*

*Sole Proprietors and Manufacturers:—*

**The Automatic Coil Winder & Electrical Equipment Co., Ltd.,** Winder House, Douglas Street, London, S.W.1 — *Telephone: Victoria 3404/7*

# MULLARD TRANSMITTING VALVES


Transmitting valves to meet amateur requirements can be selected from the Mullard range comprising :—

**ULTRA-SHORT-WAVE TRIODES**
**SCREENED R.F. PENTODES**
**MODULATOR TRIODES**
**MERCURY VAPOUR RECTIFIERS**

The valve illustrated is a double triode, each anode rated at 5 watts, for use on ultra-short wavelengths.

For a copy of the latest list of low and medium power transmitting valves apply to:—

**TRANSMITTING DIVISION MULLARD WIRELESS SERVICE CO. LTD.**

**225 TOTTENHAM COURT ROAD, LONDON, W.1**

# MAZDA TELEVISION VALVES

MAZDA Engineers have now produced a complete range of valves for use in television receivers. Each one has been designed with special application to its particular function in the receiver and the combination of Mazda Valves and Cathode Ray Tubes assures the amateur constructor of results comparable with those of the best commercial receivers.

The following is a list of types :—

**SP.41.** A screened H.F. pentode for use in the I.F. and H.F. stages. The input loss is minimised by the use of the British Octal Base.

**SP.42.** A screened H.F. pentode for use in the video output stage.

**P.41.** A new triode of low amplification for use as an oscillator in the frequency changing stage of superhet. receivers.

**D.I.** A single diode of small dimensions and low capacity for rectification and D.C. restoring.

**T.41.** Gas-filled thyratron for use in the scanning circuits of magnetically controlled C.R. tubes.

**AC/6. Pen.** An output pentode capable of withstanding high anode voltages for use in conjunction with the T.41 in frame and line scanning circuits.

**AC/5. Pen.** An output pentode for use in the sound receiver. This valve can also be obtained with combined double diode (AC/5. Pen. DD).

Full particulars of these and other valves in the Mazda range can be obtained from the Technical Service Department at the address below.

# MAZDA CATHODE RAY TUBES

MAZDA CATHODE RAY TUBES are used by leading set makers and home constructors on account of their exceptional efficiency and brilliance.

The full range now includes 7″, 9″ and 12″ tubes. Write for full particulars to the Technical Service Department, 155 Charing Cross Road, W.C.2.

*Mazda Radio Valves and Cathode Ray Tubes are manufactured in Great Britain for the British Thomson-Houston Co. Ltd., London and Rugby, and distributed by*

THE EDISON SWAN ELECTRIC CO. LTD., 155 CHARING CROSS ROAD, LONDON, W.C.2

R.M.348

No. 132 VOL. XII FEBRUARY, 1939

# TELEVISION and SHORT-WAVE WORLD

## Special Features



TELEVISION AND SHORT-WAVE WORLD

**Proprietors:**
BERNARD JONES PUBLICATIONS, LTD.

**Editor-in-Chief:**
BERNARD E. JONES.

**Editor:**
H. CORBISHLEY, F.T.S.

*Short-Wave Editor:* KENNETH JOWERS

**Editorial, Advertising and Publishing Offices:**
Chansitor House, 38, Chancery Lane, London, W.C.2.
*Telephones:* Holborn 6158, 6159.
*Telegrams:* Beejapee, Holb., London.
*Subscription Rates:* Post paid to any part of the world—3 months, 3/6; 6 months, 7/-; 12 months, 14/-.
Published Monthly—1/- net.
(On the first day of the month).
Contributions are invited and will be promptly considered. Correspondence should be addressed according to its nature, to the Editor, the Advertisement Manager, or the Publisher, "Television and Short-wave World," Chansitor House, Chancery Lane, London, W.C.2.

*IMPORTANT*

*"Television and Short-wave World" is registered at the General Post Office, London, for transmission to Canada and Newfoundland by Magazine Post. Entered as Second-class mail matter, Boston, Mass.*

# COMMENT OF THE MONTH

## *America Makes a Start*

FOLLOWING a statement made by the Radio Manufacturers' Association of America, in October last, the principal broadcasting concerns of that country have announced their intention of commencing broadcast television services to the public at the time of the opening of the New York World's Fair in May of this year. This statement read as follows:—

> "The technical developments and field tests on television have progressed to a point where, in the opinion of the Radio Manufacturers' Association, the next step in the development of the art consists in rendering an *experimental television service* to the public. This new service, which will be on an *experimental* and *limited service basis,* will be an *addition to existing radio broadcast service* and can be accomplished only through the installation and operation of television transmitters and the sale of television receivers."

Research and technical development have, of course, been proceeding in America for some years, and in these respects it is probable that America is as equally well informed as we are in this country. The final problem—that of trying out television on the public and thereby finding a means of financing it—remains to be solved and it is frankly admitted that the solution is not even in sight, especially as it is appreciated that a programme service on a national network basis, as is the case with ordinary radio in America is not at the present time practicable.

The provision of American television programme services will be watched with great interest here, and we should be able to learn a great deal despite our start of a couple of years. Factors of great importance are that it will be commercialised, and that there will be very keen competition between three very large concerns—Columbia, General Electric and the National Broadcasting Company. American television is bound to have a very great influence on its development all over the world, and we can be certain that no possibilities will be neglected. Many of America's television problems are greater than ours and not the least is that of coverage which with commercialised systems is vital; we may expect, therefore, the most intensive research to find a solution. We may be sure also that the potentialities of the large screen will receive attention and also the elimination of interference. It appears evident therefore that the commencement of television in America should provide a great stimulus, and in course of time a considerable amount of valuable information from which we in this country must ultimately benefit.

**NEXT MONTH: BUYING A RECEIVER—COMPLETE GUIDE**

# STORAGE METHODS IN TELEVISION RECEPTION

## AN OUTLINE OF SOME ENTIRELY NEW PROPOSALS FOR USING THE CATHODE BEAM AS A LIGHT RELAY

**By Manfred von Ardenne**

*One of the most important problems of television that has so far been awaiting solution is the application of the storage principle to the receiver. At the close of a lecture given about two years ago, the writer of this article, Manfred Baron von Ardenne, referred to this problem as the final solution for the projection receiver and hinted that there already had been some attempts in this direction, using a cathode-ray tube. The article gives some information about these investigations which since have led to a solution. Mr. von Ardenne has informed us that his arrangement has already functioned in practice.*

THE ideal solution of the problem of the storage principle in reception would seem to be approximately as follows: The fluorescent screen of a cathode-ray tube is replaced by a special screen, the light transmission (transparency) of which is controlled, point by point, by the scanning electron beam. After each scan the image thus "painted" has naturally to be extinguished again in order to enable the transmission of successive pictures. If an arrangement can be found where this extinction takes place just before the screen element is scanned again, we have arrived at the desired " storage " and gained a flickerless reproduction similar to that obtained from film projectors with continuous projection, and we can, therefore, reduce the frame frequency, as compared with present standards. The screen thus controlled is inserted into a projector arrangement and acts therein like a photographic transparency. In the ideal solution, sketched out above, the cathode-ray tube acts only as a two dimensional light relay for the luminous energy of some projection light source; only on the strength of the latter but not on the energy dissipation of the CR tube depends the brightness of the produced television image.

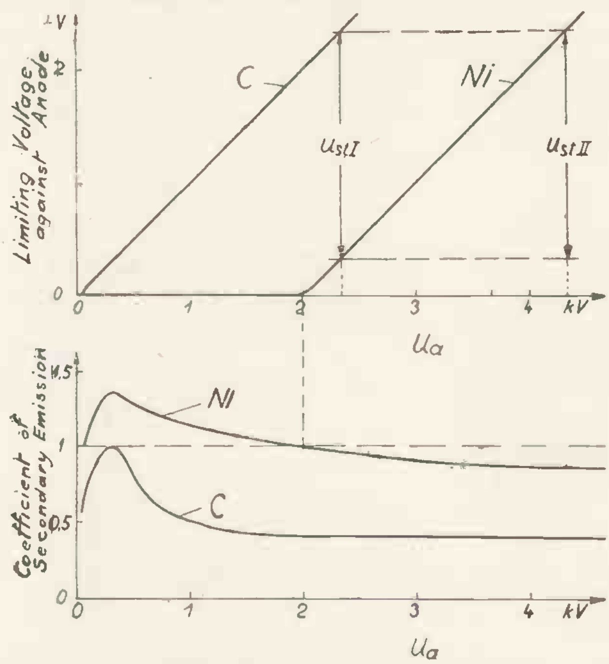



**Fig. 1. Production of the control voltage U on an isolated screen element :**
**(i) By changing the target material.**
**(ii) By changing the anode voltage.**
**(Values according to Knoll.)**

The probability of finding a technical arrangement corresponding to this ideal solution is greater, the larger the charges which one can produce (in the time available for scanning it) on an isolated element of the screen mentioned; the larger will be the field strength which is then produced between the screen element and an auxiliary plate opposite the screen (this charge and field strength being controlled by the signal voltage applied to the modulator grid of the electron gun). The higher the field strength the more numerous will be the electro-optical and electrostatical methods available for the required control of light transmission or light reflection. For this reason the first efforts were devoted to an investigation of methods for the production of large potential variations on the screen elements. Such a method was found in the Spring of 1936 and is explained below.

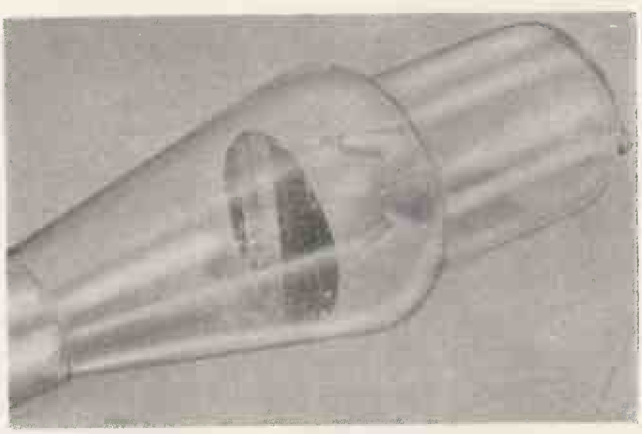


**Fig. 2. Cathode-ray tube with different screen metals (Experimental tube for the investigation of charging times).**

*Originally published in a special issue of " Telegraphen, Fernsprech, Funk- und Fersehtechnik, 1938."*

# SCREEN POTENTIAL AND BEAM VELOCITY

The method of obtaining these potentials is based on the use of secondary electron emission phenomena which were investigated earlier by Knoll. Two possibilities exist, illustrated in Fig. 1, both of which can be used for the production of potential variations of several thousand volts. The first method uses a shift of the impinging electron beam to surface spots of different secondary emission factor, the second uses a variation in velocity of the beam.

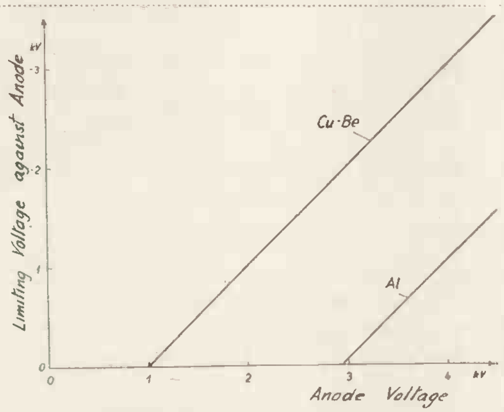



**Fig. 3. Charging potential, dependent on anode voltage for various materials.**

The first method needs no special controls at the electron gun and is therefore especially useful for the investigation of the time required for charging the screen elements and the way it is dependent on the capacity of these elements and the beam current. For this reason an experimental tube was made with two adjacent screens made of different metals. Fig. 2 is a photograph of this screen. Fig. 3 shows how in the case of an aluminium and copper-beryllium electrode the potentials obtained vary with changes in anode voltage. It is seen that with an electron velocity of more than 3 KV the changeover from the aluminium surface to the copper-beryllium surface produces a change of potential of more than 2 KV.

An investigation was also carried out into the important question of whether it is possible to obtain these changes of potential within such time intervals as are available for the scan of the screen element. The results of these measurements are shown in Fig. 4. It is seen from this graph that for a charging time of $10^{-6}$ sec., and a beam current of $10^{-4}$ amps., the capacity of a screen element may be as large as $10^{-2}$ μF. With the arrangements described below (zincblende of dielectric constant 8.3) the capacity of a screen element varies according to the crystal thickness (0.5 — 0.1 mm.) between $3.10^{-2}$ and $6.10^{-3}$μF. If we take as an average capacity for a screen element $2.10^{-3}$μF., the time of one picture element as $5.10^{-7}$ sec. (present standards) and a potential of the screen element of 4,500 volts (see below), the beam current must be of the order of $10^{-3}$ amp. This beam current can be obtained without difficulties with modern electron optical systems.

Further measurements were carried out to check up the influence of leakage between the screen element and the common auxiliary plate. These showed that with a beam current of $10^{-3}$ amp. the insulation resistance may go back to $10^7$ Ω without making the operating conditions for the screen element critical.

In the practical application the charge of the screen element must be preserved for the duration of the storage time and therefore the insulation resistance must be larger than the value just mentioned in the ratio storage time/time of one picture element. The resulting high values of insulation resistance can be easily maintained in a vacuum vessel, especially if the crystal screens described below are used. From what has been said above it can be seen that the new control principle just escapes the difficulties which might have arisen from the requirements of speed and from current leakage.

The same statement can be made with respect to arrangements where the potential of the screen element is not controlled by a change of the screen material, but by a variation of the beam velocity. The latter method is technically simpler and several possibilities of operating this second method are explained below.

## *Control of Screen Potential by Variation of Beam Velocity*

As soon as the screen elements show potential differences which are not small compared with the anode voltage, there will be a reaction from the screen on the beam deflection. Zones of the screen which are strongly charged against the anode form fields which act similarly to a very faulty concave lens and which produce a stronger deflection of the beam. This critical action of the screen on the beam can be avoided

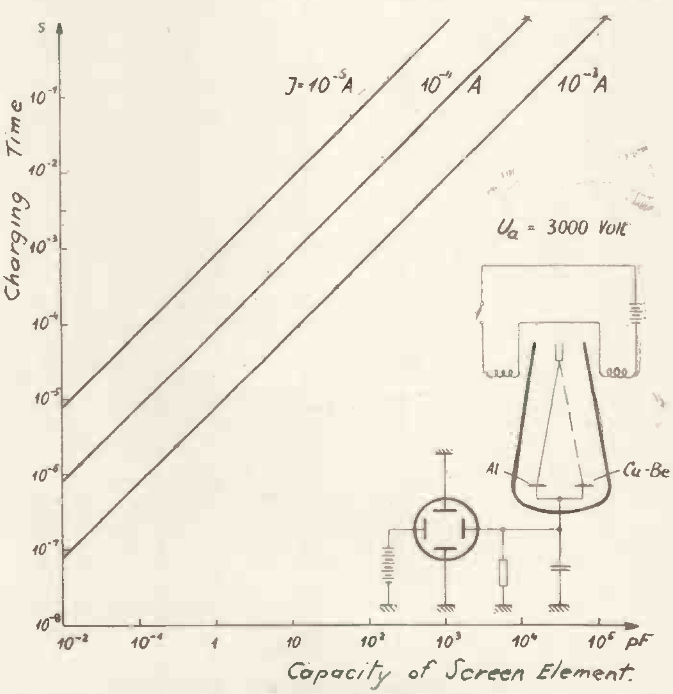



**Fig. 4. Charging time for screen elements dependent on their capacity for three different values of beam current and approximately 1,500-volt charge potential. (Charge potential produced by change over from A1 to Cu Be target. Charging time = time in which 63 per cent. of the limiting voltage change is obtained.)**

# STORAGE ARRANGEMENTS

without disturbing the operation of the tube in any other way by the insertion of a gauze screen of very fine mesh of very thin wire. A recent publication by Knoll and Weichardt has shown that such a mesh need not spoil the quality of the image, even if it were interposed in electron lenses.

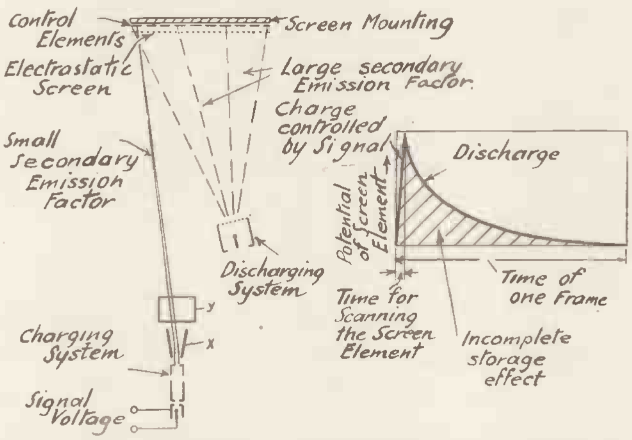



Fig. 5. Simple storage arrangement working with secondary emission.

If this gauze screen is made of sufficiently fine wire it is possible to achieve nearly perfect electrostatic screening and yet lose only 5-10 per cent. of the electron current. This small figure shows that the effect of irregularities in the mesh formation on the quality of the image can be neglected. The mesh width of this electrostatic screen should be small compared with the diameter of one screen element. In this way it will produce strong diffraction of the projecting light. It is therefore recommended that the position of the wire screen should be so arranged that the projecting light passes through it before it reaches the control screen or, if this should not be possible, to keep it as close to the control screen as possible.

A simple storage arrangement, incorporating the above-mentioned wire screen and a control screen of uniform surface is illustrated in Fig. 5. In this arrangement an electron beam of high velocity charges the screen elements strongly negative compared with the anode potential. The absolute value of this potential depends on the beam current and therefore varies with the signal voltage applied to the electron gun.

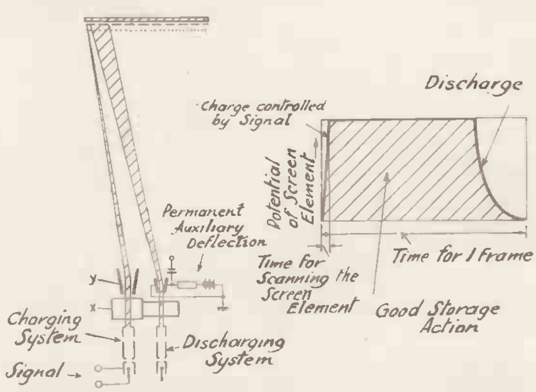



Fig. 6. Storage arrangement with two electron beams and good storage effect.

Similarly, as in the case of the Iconoscope, the ratio of the maximum beam current and capacity of the screen element must have a certain value. This ratio has to be adjusted in such a way that during the time of one picture element the screen element is never charged to the limiting value, as otherwise it will not be possible to achieve correct rendering of the brightness values of the picture. Immediately after the screen element has been charged it will start to discharge. This is achieved by means of an electron optical system, which delivers electrons of small velocity continuously and evenly to the entire screen. This discharge current is adjusted to such a value that it will just bring about a complete discharge of the highest charged screen element in the time of one picture.

In the arrangement just described care has to be taken that the sign of the signal voltage is chosen in such a way that the screen elements appear dark when they are discharged. Only then will it be possible to produce pictures of sufficient contrast. The same remark holds true, though to a lesser degree, for the arrangements described below.

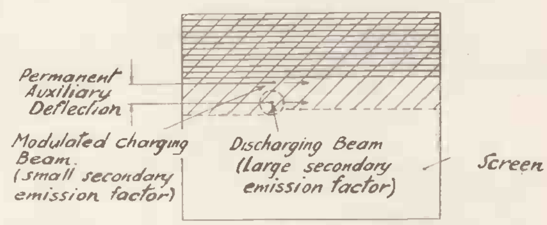



Fig. 7. How the potential distribution is built up.

The arrangement indicated in Fig. 5 has the disadvantage that the storage is incomplete, as the discharge starts immediately, and the picture is again produced intermittently. This disadvantage is avoided in the double beam storage arrangement of Fig. 6. Here the screen element is discharged by means of a second electron beam just before it receives its new charge. The position of the charging and discharging electron beam can be seen from the diagram of Fig. 7. The discharge spot has here been given a larger diameter in order to avoid the necessity of registering accurately two fine scanning patterns. This diameter should, however, not be larger than necessary, otherwise too large a zone on the upper edge of the picture is lost. The distance between charge and discharge spot is produced either by a permanent auxiliary deflection or by a suitable adjustment of the two electron optical systems when they are assembled.

The technical production of the arrangement described in Fig. 6, does not offer any real difficulties as cathode-ray oscillographs with two beams have been

# LIGHT CONTROL METHODS

in use for several years. In spite of this the arrangement shown in Fig. 8 is of interest as it achieves the same effect though with a more complicated control circuit. To facilitate the explanation, Fig. 9 shows the intended movement of the electron beam over the control screen. The action of this " one-beam " arrangement is as follows: The electron beam scans a picture

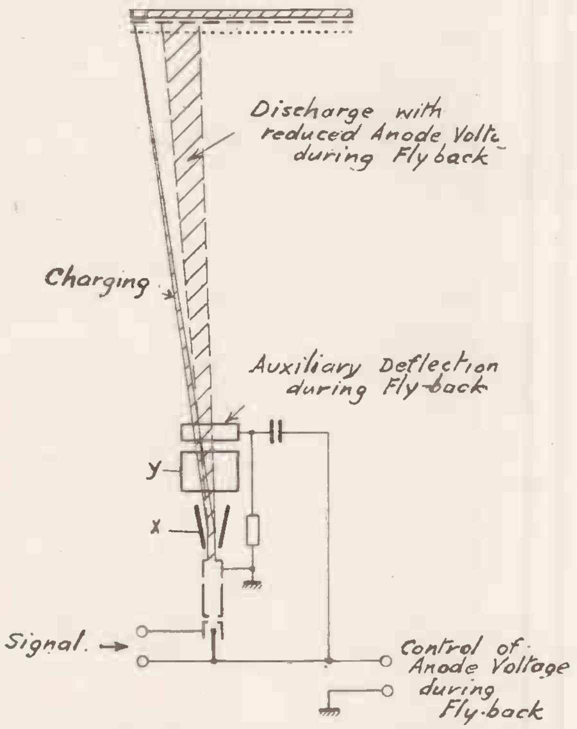



**Fig. 8. Storage arrangement with one electron beam.**

line with high electron velocity and high definition and produces the desired potential distribution; during the following short fly back the anode voltage is reduced and the spot is made to diffuse in order to effect the

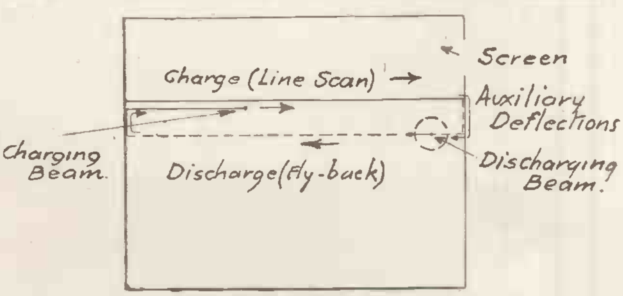



**Fig. 9. Shape and movement of the electron spot on the screen of the arrangement according to Fig. 8.**

discharge of the following picture line from the charges of the preceding picture. Due to the width of the diffuse spot the extinction is, in the same way as in the " double-beam " arrangement, extended over several line scans.

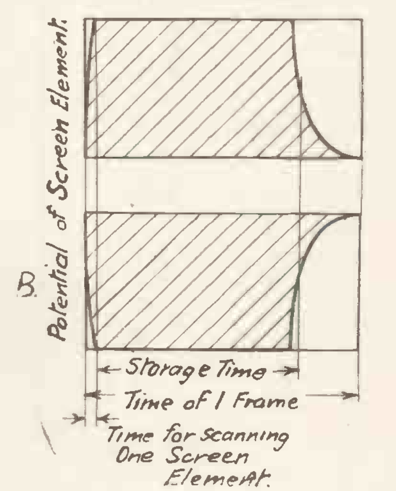
The auxiliary deflection for the fly back can be achieved either by using a corresponding part of the controlled anode voltage or by making use of the variation in deflection sensitivity, which accompanies the reduction in anode voltage during the flyback period. For the latter reason the discharging scanning pattern will be larger than the charging one so that a complete discharge will be achieved over the whole length of one image line.

This advantage, however, exists only when the signal storage is achieved by the beam with the higher electron velocity, as was the case in all the arrangements so far described. In principle it would be possible, as shown in Fig. 10, to operate in the reverse way, i.e., to charge the screen elements by means of an electron beam of high velocity and to discharge them immediately afterwards by means of a signal modulated beam of low velocity. However, a rule of prime importance for all the storage systems here described is to impress the signal modulation on the beam with the higher electron velocity, as this will produce a sharper spot.

We have just described arrangements which produce for the required time of one picture a field strength up to $10^5$ volt/cm. There are several ways of making the existence of such high field strength visible, i.e., of controlling a light beam.

A primitive method, introduced only in order to facilitate explanation, is shown in Fig. 11. Here the screen elements consist—as has been suggested in earlier publications—of minute electrometer leaves. Nearly all metals possess secondary electron emission characteristics which make them suitable for this purpose. Preferably metals of high optical reflection factor are chosen. The potential distribution, produced by any one of the methods previously described, is indicated

**Fig. 10. Screen modulation by the charging (A) or discharging (B) beam.**




by the electrometer leaves. According to their charges they will assume a more or less inclined position. The wire screen in front of the control screen acts here at the same time as the necessary second electrode of this electrostatic system. The control of the light beam is produced by the change in the direction of the reflected light in suitably arranged stops in the projecting system.

Another way, very promising in its optical system and its practicability, is shown by Fig. 12. Here the

# CRYSTAL SCREENS

screen consists of very transparent and insulating crystal layers which possess a suitable electro optical effect in the direction of the electric field. With this form of control screen there need be no metallic surface on to which the electrons impinge. The secondary emission of the insulating crystal surface or of an insulating auxiliary layer on top of the crystal layer can

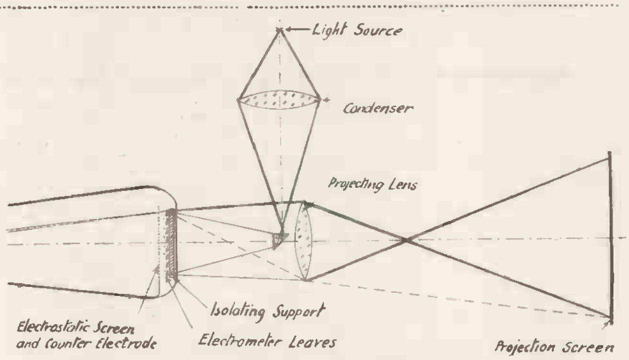



**Fig. 11. Projection receiver with "Electrometer" screen.**

be used just as well as the secondary emission of metals. Thus the advantage is gained that there is no conducting layer at the front of the screen, only the back of the screen must have a conducting transparent layer as counter electrode, consisting, for example, of a thin metal film or of a layer of perfectly transparent zinc-oxide.

The light control in these crystal screens is effected by the deformation of the electron arrangement of the crystal due to the high field strength applied to it which in turn produces a change in the light polarising properties of the crystal. The crystal screen is inserted between two polarising filters which are as a rule set at 90° to each other, i.e., so that the polarised light coming from the first filter is intercepted by the second filter. The electron optical effect which controls the light transmission is either birefringently produced or is varied by the electrical field or a rotation of the plane

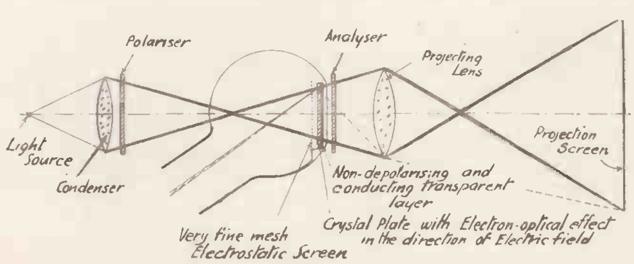



**Fig. 12. Projection receiver with electron-controlled screen.**

of polarisation. If the crystal is birefringent in its natural state it may be necessary to introduce a compensator crystal in order to obtain a good modulation characteristic.

From the investigations of F. Pockels several crystals have been found to possess an electro-optical effect as here required. By far the largest effect of this type is shown, however, by zincblende according to a recent investigation by C. Schramm. This substance has at the same time the advantage of a small dielectric constant. For a certain orientation of the crystal a mean value of the Kerr constant of $K = 2.6 \times 10 - 4$ was found. From this it follows that the crystal can be fully modulated by a voltage of $10^4$ volt, which can be achieved by the methods described above. It should be borne in mind that an increase in the thickness of the crystal does not bring any gain in this respect, as the electron optical effect varies linearly with the electric field strength.

In order to obtain equal brightness for equal applied potentials, the control screen must obviously possess equal electron-optical properties over its entire working surface. This can be achieved for instance either by building up the screen from small crystals of the same orientation, or by making it from one single large crystal plate.

As to the effect of transients it may be mentioned that the electron optical Kerr effect of zincblende is practically without time lag even at the highest modulation frequency used in television.

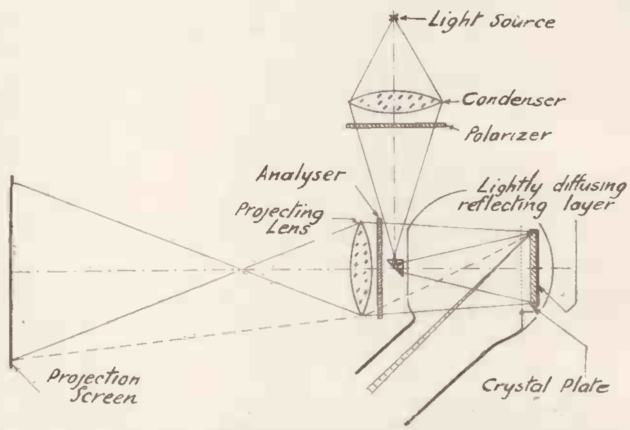



**Fig. 13. Storage projection receiver in which the electron optical effect is doubled.**

A still more favourable solution is represented in Fig. 13. Here the metallic layer on the back of the control screen is made reflecting. This may make it possible to double the electron-optical effect, as the light has now to pass twice through the crystal layer. The modulation voltage would therefore be correspondingly reduced. Whether actually a doubling of the effect is obtained in such an arrangement depends on the question of the change of sign of the effect when the light is reflected.

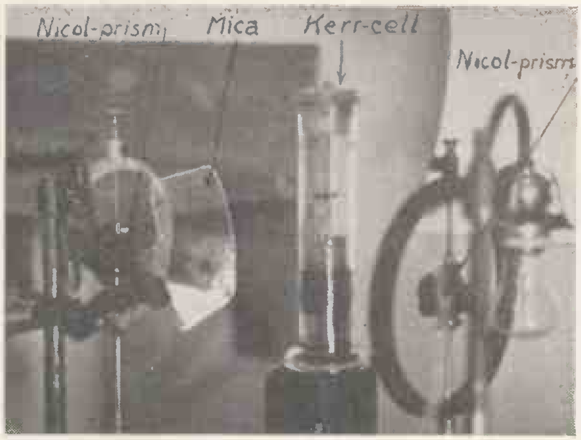
This doubling of the effect could be proved by extensive experimental investigation, which is in progress. These investigations show also that with zincblende a control screen potential of 4,500 volts is sufficient to obtain a transmission of 85 per cent. of the available light. The anode voltage required is, in this case, of the order 8,000-9,000 volts.

The arrangements discussed last combined with one of the scanning arrangements described above appear to provide a promising solution of the optical electron-optical method of reception. It may be expected that for the future technique of large screen television as well as for the use of the cathode-ray oscillograph they will be of fundamental importance.

# COLOUR TELEVISION WITH ELECTRICAL COLOUR FILTERS

**By T. de Nemes**

*Hungarian Post Office Research Laboratories.*




**Photograph showing arrangement of units.**

MOST proposed systems of colour television depend upon the projection of different coloured images following each other in rapid sequence; for instance, red, yellow and blue which, owing to the persistence of vision effect, unite to produce the complete coloured picture. With this type of system, colour filters of glass or celluloid, which must be changed as each image is projected, are employed. This can be achieved by using colour filters mounted on a rotating disc at both transmitter and receiver which revolve synchronously.

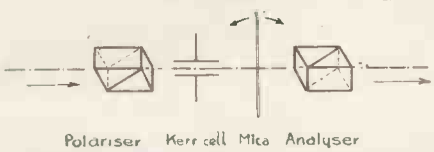



**Fig. 1. Simple diagram of system.**

A mechanical solution of the problem can be obviated by employing electrical colour filters. It is known that the birefringent effect of the Kerr cell is not the same with all light wavelengths but is greater at the blue end of the spectrum than on the red and by the employment of different voltages the extinction of all colours of the spectrum is possible. If green light is filtered out from white light, red light, which is called complementary of the green, remains. By the extinction of a colour from the white a complementary colour appears.

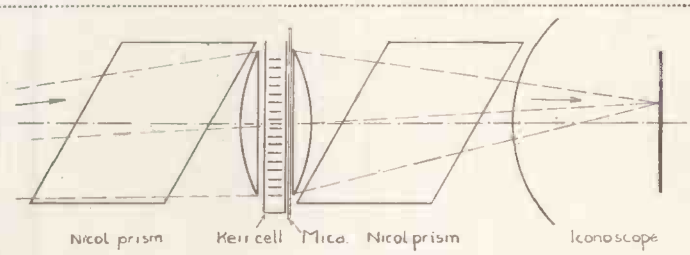
In the case of normal voltages applied to the Kerr cell the path-difference is so small that no light passes through the cell, but by applying higher voltages, the path-differences become perceptible, and the colours are extinguished after each other as the voltage is increased. Since the corresponding complementary now becomes visible, it is possible by simply changing the voltage to produce different colours. This principle, however, has the great drawback that very high voltages are necessary.

High voltages, however, can be avoided by producing one part of the path-difference by a crystal plate (Fig. 1).

Each colour produces two rays, ordinary and extraordinary, which travel with difference velocities. If the two rays meet in reverse phase then they annul each other and the colour is extinguished. Upon the thickness of the crystal depends the colour which will be extinguished. In the case of thin crystals, only one colour is extinguished and the complementary is visible. With thicker crystals, two or more colours are extinguished.

If a mica sheet is placed between the polarising prisms of a thickness, for instance, that will produce a red colour, by applying a suitable voltage to the Kerr cell, change of colour will result. With this *instantaneously* controlled colour filter, it is possible to produce any colour by applying three or more different voltages successively, without any mechanical movement.

**Fig. 2. Schematic diagram of transmitter.**



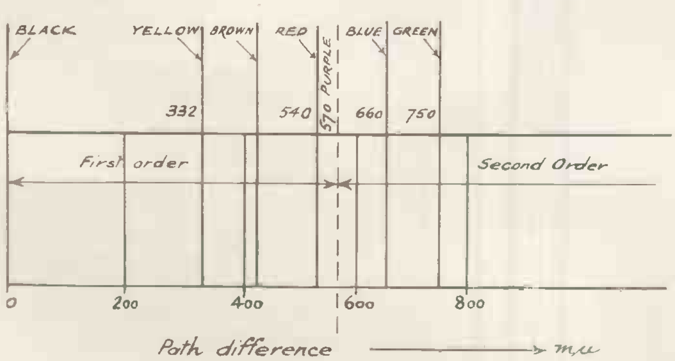




Fig. 2 shows the transmitter. The multielectrode Kerr cell is placed in the middle of the objective in order to save space, the image is projected by the lens on an Iconoscope plate. At the receiver (Fig. 3) there is a similar filter-lens in front of a cathode-ray tube which has a *white* screen. During operation, assuming that the

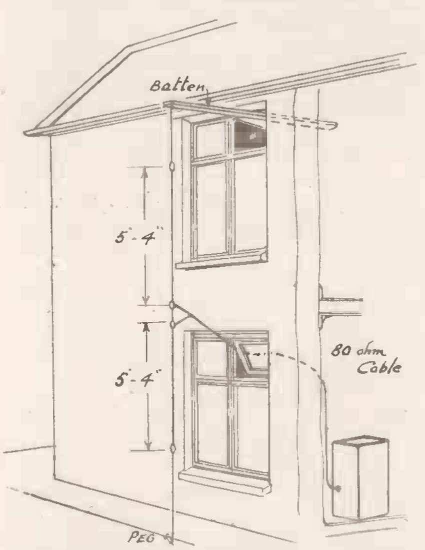
(*Continued on page 75*)

**[This article was received on July 5, 1938, and it is understood that since that date a similar system has been proposed in Germany.—Ed.]**

# IMPROVISED TELEVISION AERIALS

*Here are some simple di-pole aerials which can be erected with a minimum of trouble.*

IT frequently happens that it is desired to put up a temporary aerial to test out a receiver, one, that is, that can be erected in a few minutes and from material which is ready to hand.




**A simple di-pole consisting of two tensioned wires.**

At short distances (say, up to 10 miles) from the Alexandra Palace, it is quite feasible to use a length of wire slung round the room. Theoretically, of course, such an arrangement is entirely wrong if only by reason of the fact that it is more or less horizontal but at reasonable distances, it works, though inefficiently. The length of the wire should approximate to a half wavelength (10 ft. 8 in.) or a multiple of this. One end is attached to one of the ordinary dipole terminals of the receiver and the other terminal can be connected to earth. Greater efficiency will probably be secured if the aerial can be arranged vertically, but in any case, it should only be regarded as a temporary expedient.

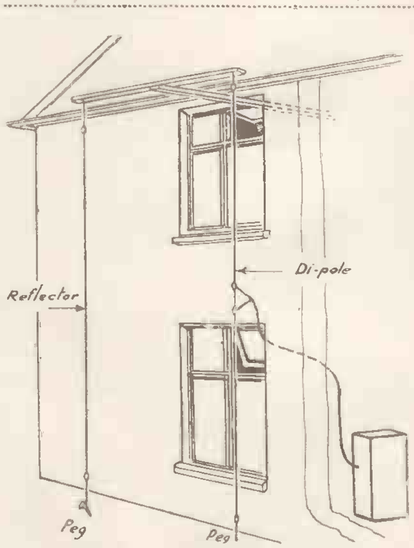
An aerial which can be rigged up in a few minutes and is really quite efficient need only consist of two lengths of wire each 5 ft. 4 in. long separated by an insulator and having an insulator at each end. This assembly can be hung from an upper window, the bottom end being secured by a length of wire or cord attached to a peg driven into the ground.

The usual feeder is, of course, taken from the centre and for this it is preferable to use the Belling-Lee 80-ohm cable, though for an improvisation a length of ordinary twisted flex will serve. It is desirable to keep the aerial away from the wall and this can easily be managed by supporting it on a length of wood projecting from an upper window.

Provided that the position in which an aerial of this type is erected is suitable, it is possible to add a reflector on the same lines and this should consist of another length of wire equalling the total length of the aerial and placed at a distance of either 2 ft. 8 in. or 5 ft. 4 in. The reflector should be the farther away from the transmitting station.

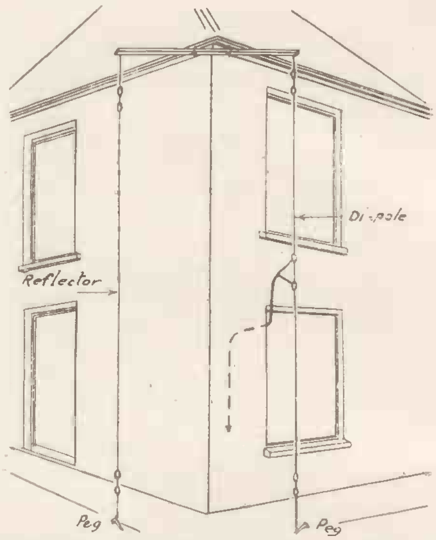
With such an assembly direction is of great importance but it is frequently possible to obtain this suitably by erecting either the aerial or reflector at a greater distance from the wall by the simple expedient of using a longer support at the top end for either the reflector or aerial as the case may be, or even arranging one member on the adjoining wall round the corner.

Height is, naturally, of importance if greater efficiency is to be secured, and it is frequently possible to increase this by very simple methods, as for instance, supporting the wire on a length of wood which is placed nearly vertically.




**How a reflector may in some cases be made directional.**

Another idea is to attach such an aerial to a length of horizontal wire which is supported like an ordinary broadcast aerial; in fact, the usual broadcast aerial can be pressed into service for this purpose, provided it



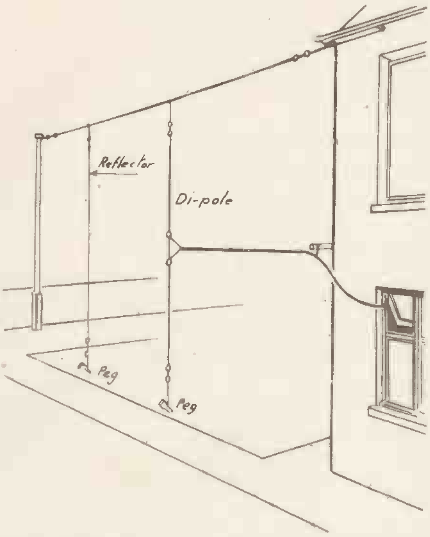

**Using the corner of the house to obtain a directional effect.**

is sufficiently high, without any detriment to its prime purpose.

If a suitable directional run of such a supporting wire is possible, then it is a simple matter to arrange a reflector in the same manner. For any stays or tension arrangements it is preferable to use cord rather than wire, and if the installation is to be at all permanent the cord should be weather-proofed, which can easily be accomplished by soaking it in melted candlewax. If the cord is not made damp-proof, its length will vary according to the state of the weather and at times become sufficiently slack to allow the aerial to sway about and upset the tuning if it is in the vicinity of a wall.

Another type of improvised aerial can be made from a couple of lengths of bamboo cane of the correct length with a wire run down either inside or outside, preferably the former. It is a fairly simple matter to break through the divisions at the knots by driving in a light iron rod, working from both ends. The wire can then be threaded through and the two canes supported on a small piece of wood by means of clips.

Such an assembly is remarkably light and rigid and as, in addition, it

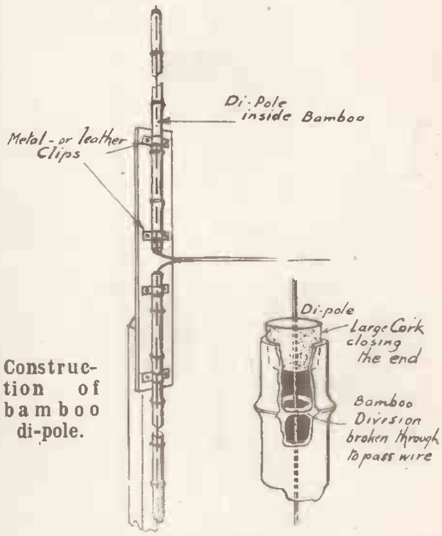



**Using the broadcast aerial as a support for the di-pole.**

offers very little wind resistance, it can be erected on the most flimsy support without the necessity of taking any special precautions. Also, it is extremely portable on account of its light weight and if the ends are sealed up after insertion of the wires, it will be durable and weatherproof.

These suggested improvised aerials it will be noted employ wires instead of the more usual metal tubes. Electrically, however, this is not detrimental unless the wires are allowed to become corroded and therefore, if they are to be used permanently the wire should preferably have some protective coating and all joints should be soldered and also be protected from corrosion by wrapping with insulating tape.

Mechanically, they are not so strong and durable as the tubular metal type, but this is offset to a great extent by their lightness and small surface offered to the wind. All those of the dipole type have been tested at a distance of twenty miles from the Alexandra Palace and have given excellent results; they are particularly useful in carrying out tests of aerial position before making a permanent erection and as some were




**Construction of bamboo di-pole.**

operated only a few feet above ground level, they provided an excellent idea of receiver performance under adverse conditions.

## British Television for the Eiffel Tower

IN the December, 1938 issue, the following paragraph appeared on page 732:—

"Extensive changes are to be made in the transmitting equipment at the Eiffel Tower, for a decision has been made to instal the Marconi E.M.I. system as used at the Alexandra Palace. The apparatus, however, will be supplied by the French Thomson-Houston Co., which controls the rights in France of the E.M.I. Co. The cost is estimated to be £90,000."

This statement might have given the impression that the 30 K.W. ultra-short wave television transmitter installed at the Eiffel Tower for the P.T.T., has been taken out of service and replaced. This is not a fact and it is understood that the order which was placed with the French Thomson-Houston Company concerns the camera equipment installed at the studio in the Rue de Grenelle, which hitherto had been loaned to the P.T.T. by the Thomson-Houston Company.

Le Material Telephonique, an associated company of Standard Telephones and Cables Limited, who installed the transmitter, have not been in any way concerned with the camera equipment at the studio, but they have been completely responsible for the design, manufacture and installation of the transmitting equipment at the Eiffel Tower and also the high-frequency cable which conducts the signals from the transmitter to the aerial at the top of the tower. No change whatever has been made in this equipment; neither is this contemplated.

## "Colour Television"

(*Continued from page 73*)

trichromatic method is used, three successively different voltages are applied. At the receiver, the frame

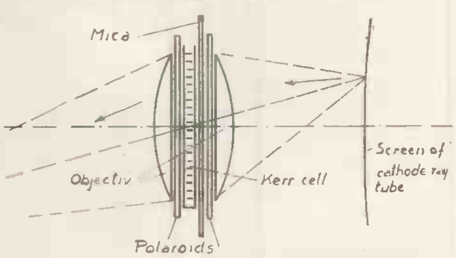



**Fig. 3. Schematic diagram of receiver.**

signals are enough to maintain the cyclic change, but a separate generator must be used to furnish the voltages necessary for the filter.

The system has some outstanding advantages: (1) It is possible to use more than three colour components. (2) Colour-changing is possible, not only according to frames but also to parts of images and even to lines or image elements.

## Television O.B.'s.

Although most of the outside broadcasts on television wavelengths have been very satisfactory, occasionally some of the broadcasts of football matches have not been up to the mark. This has been caused generally by poor light and weather conditions and not through any technical difficulty at the transmitting end that could easily have been overcome. As so many potential viewers have their first glimpse of television on Saturday afternoons, it seems a pity that transmissions are allowed to go on when the picture is poor. A case in point was the England v. Wales Rugby match at Twickenham. Owing to rain and bad light this transmission could hardly be called satisfactory and there must have been quite a large number of people who obtain a wrong impression of television by viewing this match. Surely it would have been better to have stopped the match early or to have commented on the bad picture at frequent intervals. The play that followed the Rugby match was excellent in every respect.

# THE PHYSICAL SOCIETY'S EXHIBITION

*The annual exhibition of the Physical Society was inaugurated in 1909 for the purpose of enabling research workers and scientists to see the developments which had taken place in scientific instruments during the year. The number of exhibitors has grown from 17 to over 100, and the exhibition represents the best in scientific practice in this country and abroad.*

THE increase in the number of applications for stands at the Physical Society's Exhibition is causing the Exhibition Committee of the Society some concern, especially as the space available is by the courtesy of the authorities of the Imperial College. As a result it is probable that the restrictions on the nature of the exhibits will be more rigidly enforced in future exhibitions and they will be confined to new products or apparatus which has been developed within the last two to three years. It is hoped also to develop the Research Section, which in the recent exhibition consisted of only 27 exhibits.

It is realised, however, that some manufacturers may have difficulty in providing suitable examples of research without disclosing important secrets, and the absence of a particular firm from the section would not imply that no development had taken place during the previous year!

## *Trade Section*

Several newcomers to this section included A.E.W., Ltd. (makers of electric furnaces), Londex, Leland Instruments, and H. S. Simons.

Leland Instruments are importers of radio and electrical test equipment made by well-known American firms and the stand showed examples of oscillographs by Clough-Brengle, and signal generators by Ferris. An excellent valve voltmeter is made by Clough-Brengle: the Model 88A, covering 0-1.2 volts r.m.s. and 0-10-100 volts peak. A probe valve is included for r.f. measurements.

A similar type of instrument, termed the "Thermionic Test Set" was shown by Salford Instruments, Ltd., associated with the G.E.C. The ranges covered $10^{-4}$ to 1 amp. D.C. and 5 mV. to 500 volts D.C. or A.C. up to 20 m.c. The circuit has been specially designed to prevent change in the calibration due to valve replacement.

## G.E.C.

A new transmitting triode, type DET.14, was shown, operating down to 2.5 metres. The tentative characteristics are as follows:

Fil. volts, 7.5
Fil. current, 3.0
Anode voltage, 1,500 max.
Dissipation, 55 W.
Amplification, 21
Impedance, 9,550

Of particular interest to short-wave experimenters is the new G.E.C. low-loss terminal with a bushing of special ceramic material.

The capacity to earth is only 2.5 mmfd. and the dry insulation resistance is $10^{14}$ ohms. The overall dimensions are 1 5/32 in. above panel with a bush diameter of 1¼ in.

## *Marconi-Ekco*

The stand of Marconi-Ekco Instruments showed no less than 36 different types of instrument for research and precision measurement. Television interests are catered for by the new oscillator type TF.410 which covers a frequency range of 25-2 m.c. and has a maximum output of 10 volts.

The ultra-short wave measuring set shown in the figure covers a band of 3-15 metres and operates on the "substitution" method.

The input from a local station is substituted by a signal of known strength supplied from an oscillator in the equipment and the equipment is thus independent of external calibrating devices.

Cossor Model 3339 oscillograph.

## *Cossor*

The most novel feature of the wide range of Cossor oscillograph instruments is the new double-beam tube. This is of the high vacuum type and has two separate beams which can be focused on different points on the screen. Two simultaneous traces of any related phenomena can thus be obtained. The complete equipment includes a tube with the necessary controls, a high gain amplifier and magnetic deflecting coils. The time base used is the well-known hard valve circuit developed by O. S. Puckle, and covers a range of 5 to 200,000 c.p.s.

A separate time base is also available, with control of amplitude for all sizes of tubes. This is fitted with a "black-out" device for masking the return trace.

## *Griffin and Tatlock*

This well-known firm of scientific apparatus suppliers are marketing portable oscillographs made by the Furzehill Laboratories under the name "Microid." The price of the complete oscilloscope is £15 15s. od. and a beat frequency oscillator is available, price £17 10s. od.

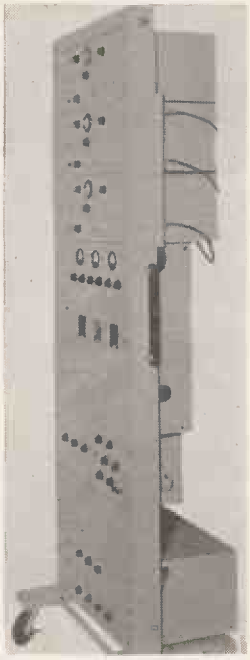
## *Automatic Coil Winder Co.*

A machine on this stand which excited great interest was a special toroidal coil winder in which a hank of wire, previously wound on a special former, was threaded through a toroidal coil. The instrument shown was an experimental model, but finished models will shortly be available. New additions to the range of AVO instruments included a test bridge for the measurement of resistances of 10-10 megohms and capacities of 10 mmfd. to 10 mfd. The bridge operates from 50 cycle mains. A new oscillator for operation from A.C. mains is also available.

A new measuring instrument is the AvoMinor.

This D.C. instrument is similar in appearance to the well known 2½ in. scale D.C. AvoMinor, but has an extremely high current sensitivity.

As a voltmeter six ranges are available from 2.5 to 1,000 volts all at 20,000 ohms per volt, the consumption of the meter at full scale being 50 microamps. This extremely high sensitivity allows it to be used for practically all cases of voltage measurement, where the inclusion of a meter alters the circuit conditions.



**The Ediswan-Walter Electroencephalograph for investigation of brain activity.**

Such cases frequently arise in the measurement of grid, screen and anode voltages, and also in television.

Two ranges of current are available of 50 and 250 microamps. On the lower range a deflection of approximately 1 millimeter is produced by a a current of one microamp., thus making the instrument suitable for indicating grid current.

Resistance ranges of 5 and 50 megohms are provided, an external source of voltage being necessary. The voltages required are from 10-13 volts on the lower, and 100-130 volts on the higher range, adjustment being provided for incorrect value. The price is £3 10s. od.

## *Ediswan*

Apart from the usual range of transmitting valves and special thermionic devices, an interesting exhibit on this stand was an electro-encephalograph made to the design of W. Grey Walter, Esq., of Maida Vale Hospital. A three-channel amplifier of exceedingly high gain feeds three cathode-ray tubes with long afterglow screens. Electrodes are placed on the skull of a patient and the electrical activity of the cells of the brain is recorded on the tubes. By the aid of this apparatus it is possible to diagnose the site of brain abnormalities, and several equipments have already been ordered by the principal hospitals in the country.

## *Mullard Wireless Service Co.*

A complete range of this company's oscillographs and testing equipment was shown, in addition to a special "detonation meter" intended for the investigation of internal combustion engines.

A neat oscillograph is the type GM.3153, employing a 3 in. tube with an amplifier and time base from 10-20,000 cycles. The maximum sensitivity of the instrument is 1 cm. for 150 mV.

One of the finest forms of precision audio frequency oscillator was seen on the Sullivan stand. The Ryall-Sullivan oscillator (see *Wireless Engineer*, 11, 1934, p. 234) has an accuracy of 0.1 per cent. on the frequency calibration and a stability of 1 cycle per second over a day ! the frequency settles down immediately on switching on and is not affected by valve replacement, power supply variation or load variation. The output is constant to 0.1 db. throughout the frequency range—truly a precision instrument.

## *Research Section*

Experimenters who despair of achieving results with simple equipment should take heart from Dr. Leyshon's research exhibit.

For investigating ultra-high frequency oscillations she has constructed a plane electrode structure of parallel grids and tungsten cathodes with nothing more elaborate than a pair of pliers and a bodkin !

The research section provides interesting contrasts of this type when one turns to the G.E.C. exhibit, provided by the resources of the Wembley Research Laboratory. Here is a complete apparatus for plotting the dynamic characteristics of high power valves under conditions of positive grid potential. The point-to-point method is used, the accuracy being dependent on the moving coil meter used.

Another apparatus is used for the measurement of signal handling capacity of receiving valves, showing the proportion of third harmonic introduced into the signal by the valve under test.

A selection of self-generating selenium photo-cells was shown, including apparatus incorporating such cells. These included illumination and exposure meters.

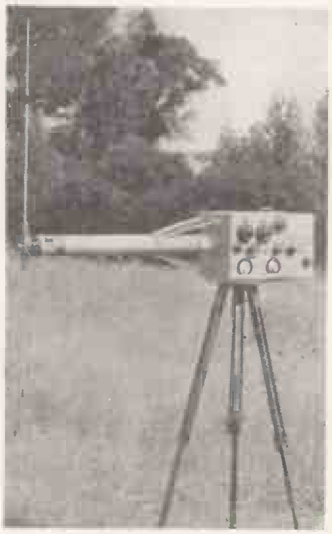
## *H.F. Terminal*

A new type of terminal has been developed specially to meet the need for low losses in h.f. apparatus of all types. Ceramic insulation is employed, but the proportion in the electrostatic field is small, whilst the whole mechanical design is robust. Other G.E.C. exhibits included valve voltmeters, universal Q meter, valve-operated test set, rectifier ammeters and voltmeters, photometers, etc.

The Physics Department of the University of Bristol have two novel forms of microscope designed by Dr. C. R. Burch. These employ reflecting surfaces instead of the usual lenses, and have the advantage that the primary images are completely achromatic.

Dr. O. Schmitt, of the University College, exhibited an amplifier rack for the investigation of nerve potential changes. A novel circuit for the fine adjustment of small motor speed was shown and will be found described in the Journal of Scientific Instruments for September, 1938. This should be very useful for experimenters using scanning discs for research work.

The greatest credit is due to Dr. Lang, the Secretary of the Exhibition, and to the Exhibition Committee for arranging such an important and representative collection of scientific apparatus, and readers of this Journal are urged to visit the next exhibition which takes place in the early days of January, 1940.

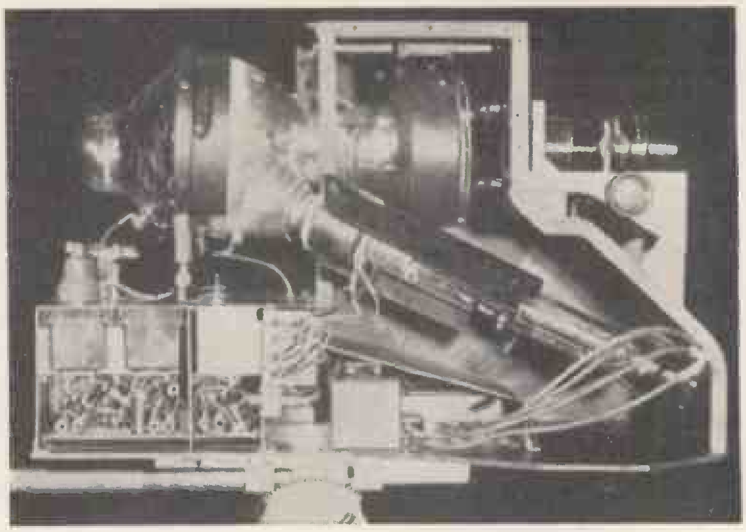


**Marconi-Ekco field test equipment for ultra-short waves.**

# HOW THE EMITRON WORKS

## E.M.I. CATHODE-RAY TELEVISION TRANSMISSION TUBES

*By*
*J. D. McGee, M.Sc., Ph.D., and H. G. Lubszynski, Dr.Ing.*



*The following is an abstract from a paper read before The Institution of Electrical Engineers by the authors named above. It probably provides the most complete information on the construction and functioning of the Emitron yet published. We acknowledge our indebtedness to the Institution of Electrical Engineers for permission to publish this paper.*

APART from cathode-ray scanning the most important development in television transmitting tubes is the introduction of charge storage. The essence of the principle is that during part at least of the picture-frame period the photo-electric emission due to the light from each picture point of the image is stored up as a charge on a mosaic of photo-electric cells, each associated with a condenser. The condensers are discharged in sequence by some switching mechanism such as a beam of electrons; the sequence of electrical pulses thus produced constitutes the "picture signal."

This principle appears to be implied in Campbell Swinton's suggestions (Nov. 1911).

The first published description of a successfully operated television transmitting tube employing both cathode-ray scanning and charge storage is due to Zworykin in 1933. Though difficult to manufacture and operate, this transmitting tube, named the "Iconoscope" by Zworykin, is a great advance on the earlier mechanical methods. Only 5 to 10 per cent. of the possible increase in sensitivity due to charge storage is realised in this tube, but nevertheless it is sufficiently sensitive to enable high-definition pictures of studio and outdoor scenes with moderate illumination to be televised.

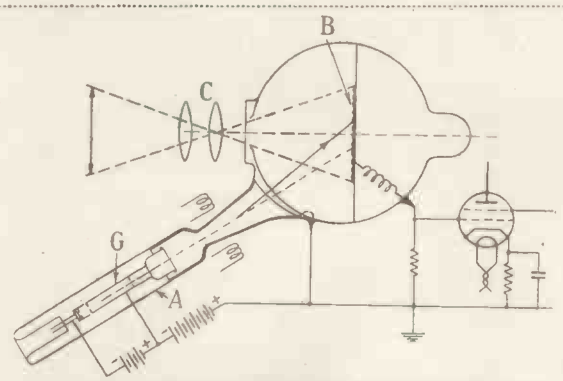



**Fig. 1. Schematic diagram showing the constructional and operating principles of the Emitron.**

About a year before Zworykin published his description of the Iconoscope, experiments had been begun in the E.M.I. Research Laboratories on the charge-storage type of transmitting tube. These experiments, carried on independently of Zworykin and his co-workers, soon showed that it was possible to generate picture signals in this way. Briefly, the method employed was as follows. An aluminium plate was coated with a thin layer of aluminium oxide by anodic oxidation, and a mosaic of patches of silver was formed on the surface of the oxide by evaporating silver on to the oxide surface through a grid. This mosaic was mounted as target in a tube, which was then evacuated, and the silver patches were oxidised and activated photo-electrically with caesium. When an optical image was focused on the mosaic while it was being scanned by an electron beam, picture signals corresponding to the optical image were obtained and an image was reproduced on the screen of a cathode-ray tube.

These experiments led to the development of the Emitron, which is believed to be different in several respects from the Iconoscope and has been in regular service at the London Television Station since its inception in August, 1936. A further development is the "Super-Emitron," which was put into service for the first time during the outside broadcast from the Cenotaph in November, 1937. This tube shows a considerable increase in sensitivity and flexibility over the standard Emitron.

### Construction of the Emitron

The main constructional features of an Emitron are shown in Fig. 1. A spherical bulb of Pyrex glass about $7\frac{1}{2}$ inches in diameter is provided with a neck A in which is fitted an electron gun G which directs a sharply-focused beam of electrons on to the photo-electric mosaic B. A polished flat glass window is sealed on to the bulb as shown, so that an undisturbed optical image of the scene to be transmitted may be focused on the mosaic by means of the lens system C.

The photo-electric mosaic is formed on the surface

# THE EMITRON ELECTRON GUN

of a sheet of mica about 0.001 in. thick and 4 in. by 5 in. superficial dimensions. This sheet of mica is carefully selected for uniformity of thickness and freedom from blemishes of any kind. The reverse surface from that on which the mosaic is deposited is coated with a conducting, highly reflecting metallic layer, generally by painting on several coats of commercial "liquid

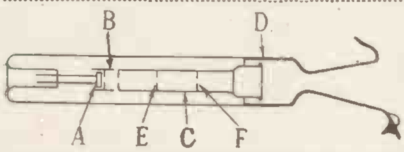



**Fig. 2. Diagram of electron gun arrangements.**

silver." This sheet of mica is supported on a second circular sheet which fits closely into the bulb. The assembly is flexible and can be rolled into a cylinder while being inserted into the bulb, where it is fixed in position.

## *Electron Gun Design*

A diagram of the electron gun used in the Emitron is shown in Fig. 2. The cathode A is of the indirectly-heated oxide-coated type and is placed immediately behind an aperture in a modulating electrode B. The first anode C extends from the modulator to a short distance within the second anode D, which is formed by depositing a layer of silver on the inside of the neck and part of the bulb as shown.

Since the dimensions of the mosaic which is scanned by the electron beam are approximately 10 by 12.5 cm., the scanning lines being parallel to the longer sides of the rectangle, it follows that for a 405-line picture the scanning spot must ideally be 0.25 mm. in diameter. Since the scanning beam falls on the mosaic at an angle of 35° to the normal, the actual diameter of the electron pencil on reaching the mosaic surface must be kept less than about 0.20 mm. Referring again to Fig. 1, it is clear that the distance travelled by an electron from the main electron lens of the electron gun to the mosaic is greatest when the electron beam is at the top of the mosaic and least when it is at the bottom. Since the electron beam is in focus at one distance only from the electron lens it follows that if it is focused at the centre of the mosaic it will be slightly out of focus at both the top and the bottom, and the reproduced picture will lack detail in these regions. This can be corrected by using in the electron gun an auxiliary electrode which is modulated synchronously with the scanning fields in such a way as to change the focal length of the electron lens slightly—sufficiently to keep the beam in focus over the whole mosaic.

It is found, however, that this can be achieved more simply by taking advantage of the fact that a comparatively small beam current of the order of 0.10 $\mu$A is required for scanning the mosaic. It is therefore possible to reduce the "aperture" of the electron lens to a very much smaller diameter than is possible in a cathode-ray tube for television reception, and consequently very much greater depth of focus of the electron beam can be obtained. Referring to Fig. 2, the aperture E limits the electron beam to a diameter of approximately 2 mm. in the region of the electron lens, which is about 40 mm. in diameter. The aperture F is provided to prevent most of the secondary electrons liberated from the walls of the gun or from the aperture E reaching the mosaic. If such stray secondary electrons reach the mosaic they reduce the efficiency of the tube and produce spurious signals which interfere with the required signals. The fact that a beam of small cross-section suffices has the further advantage that the electron lens need not be carefully corrected, since only a small portion of its cross section is used.

## *The Mosaic Mounting*

As before described, the mosaic is formed on a sheet of mica which is attached to a second sheet serving to anchor it to the bulb. This construction is not completely rigid and in practice it is often necessary to operate tubes under conditions where they are subjected to considerable vibration; for example, on a movable truck in a studio or in a high wind out of doors. It was soon found that such vibration produced spurious microphonic signals which could be divided into two fairly distinct classes: (1) a low frequency signal at about 100 cycles per sec., and (2) a higher-frequency signal at about $10^4$ cycles per sec. The low-frequency micro-phonics were found to be due to the vibration of the mica disc supporting the signal plate. Any considerable vibration of this kind would have the effect of throwing the optical image rapidly in and out of focus, and hence would result in a blurred picture.

In operation, the signal plate is held at a positive potential relative to the second anode, and the small changes in its capacitance to its surroundings due to vibration set up voltage fluctuations across the signal resistance. This was eliminated sufficiently for all practical purposes by anchoring the supporting mica disc to the glass walls at four points by soft damping wires.

## *Spurious Signals*

The high-frequency microphonic signals were eventually traced to a similar effect due to movement between the signal plate and the surface of the mica disc on which it is supported. This movement is partly in the plane of the disc and partly normal to it, and the microphonic signals may be produced in two ways. Firstly, friction produces electrical charges between the signal plate and the mica surface. Slight movements of the signal plate normal to the surface of the supporting mica sheet produce changes of the capacitance between these two surfaces. Thus varying potential differences are set up which lead to spurious signals. Secondly, charges may be produced on the surface of the supporting mica sheet owing to electrical leakage over its surface. Any small movement of the surfaces normal to one another would then produce signals. This type of microphonic signal was effectively eliminated by covering the surface of the supporting mica disc, with which the signal plate is in contact, with conducting metallic coating. This coating is connected electrically with the signal plate and hence held at the same potential.

Emitrons in which these precautions have been taken can be used under conditions where they are subjected

# HOW THE MOSAIC IS PRODUCED

to a considerable vibration without microphonic signals being generated.

## *The Mosaic Surface*

The silver mosaic may be formed on the clean surface of the mica by depositing a continuous sheet of silver and causing this to aggregate by heating in air to a temperature of about 700° C. If the layer is sufficiently thin it breaks up into a series of discrete areas under surface-tension action, even though the temperature be below that at which bulk silver melts. This phenomenon was first observed by Faraday and was investigated more fully by Beilby. The process of aggregation can be clearly seen in the microphotographs shown by Fig. 3. These illustrate a series of layers of silver of decreasing thickness each heated to the same temperature. It is seen that when the silver is thick the effect of the heating is to cause a number of holes to appear. As the layer is made thinner these holes increase in size until they merge with one another, leaving islands of silver completely separated. With still thinner layers these islands disintegrate to form still smaller areas.

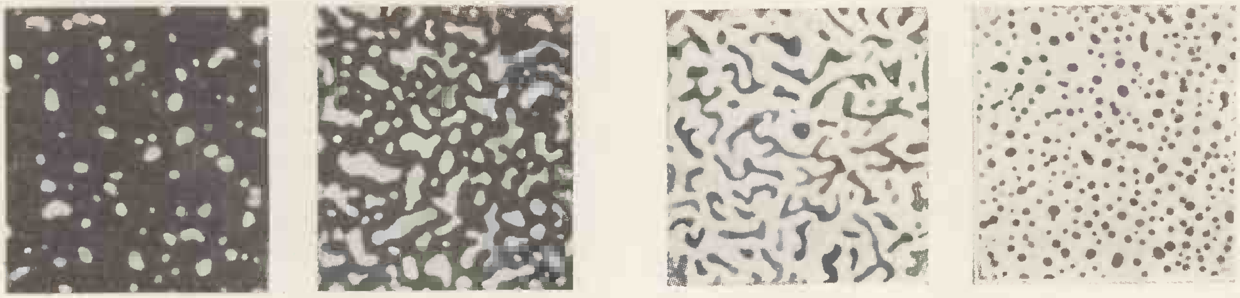


**Fig. 3. Microphotographs showing processes of aggregation of mosaic surfaces of different thicknesses**

Exactly the same process is observed in a single silver layer as the temperature of baking is raised from a low value to about 700° C. At comparatively low temperatures (200°-300° C.) the holes appear; as the temperature is raised these increase in size until they merge, leaving the discrete mosaic areas which break up further as the temperature is raised still higher.

Although photo-electric mosaics formed in this way are in many ways satisfactory, there are a number of disadvantages such as the difficulty of ensuring that the mosaic, which must be formed before being sealed into the tube, is kept clean and free from spots and other blemishes.

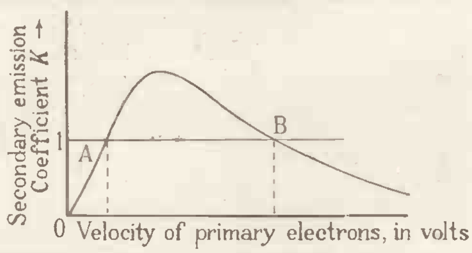
There is a more satisfactory way of forming the mosaic.

When a photo-electric mosaic of the type described above is scanned by an electron beam of about 1,000 volts velocity, each primary electron liberates several secondary electrons from the surface. The behaviour of an insulated conducting target of mosaic character when bombarded by electrons may be shortly recapitulated. Fig. 4 shows a typical curve of the ratio of the number of secondary electrons released per primary electron as a function of the velocity of the primary electrons. The curve possesses a maximum, the position of which, for most substances, lies between 300 and 400 electronvolts. There are two values of the velocity of the primary electrons for which the secondary emission coefficient is unity, viz., those represented by the points A and B in Fig. 4. We may call A and B the " first and second cross-over points " respectively. Under the influence of the primary beam and the loss of secondaries the target takes up a certain equilibrium potential. There are three different points on the characteristic for which the potential of the target will be stable.

First, if the primaries hit the target with a velocity below that corresponding to A, they will charge the target negatively, until it stabilises at the potential of the cathode from which the primary electrons emerge, i.e., at the potential represented by the point O on the curve.

The second possibility occurs when the velocity is between those corresponding to the points A and B. In this case the secondary emission coefficient is greater than unity, and equilibrium will be attained when, for each primary electron striking the target, one secondary electron (of the number released) reaches the collecting electrode. This equilibrium potential depends mostly upon the geometrical configuration of the tube and the secondary emission coefficient. The equilibrium potential of the target will be in the neighbourhood of that of the collecting anode—a few volts above or below.

**Fig. 4. Secondary electron ratio curve.**




The third possibility occurs when the primary electrons reach the target with a velocity greater than that corresponding to the second cross-over point B. In this case the number of secondaries released will be less than the number of primaries which strike the target, and the target potential will, therefore, become more negative until the primaries are decelerated to a velocity corresponding to the second cross-over point. When this point is reached one secondary electron will be released per primary and the potential of the target will be stable. In this case the equilibrium potential is independent of the potential of the collecting anode

# BAIRD RECEIVERS SET A PERFORMANCE STANDARD BY WHICH OTHERS ARE JUDGED

Model T.18 is a complete Television Receiver combined with a very selective and high quality All-wave Radio, yet the compact cabinet housing the complete equipment is little larger than the usual Table Radio. The most recent developments in Television design are included, yet the price is below that of many modern Radio-gramophones. The set is easy to operate—and without any technical knowledge you can be confident of good results.

**TELEVISION CONTROLS:** These have been reduced to one which operates the Picture Contrast, and this will only need very occasional adjustment.

**TELEVISION SOUND AND RADIO:** The sound receiver is a superheterodyne covering the Television sound waveband, and three bands for Radio programmes (Short: 16.5—51 metres; Medium: 198—550 metres; and Long: 850—2,000 metres). It is possible to receive the sound on the Television waveband either with or without the Picture by means of a switch integral with the Picture Contrast control. For Radio, stations are calibrated by name, and each waveband is individually illuminated. The reproduction is exceptionally fine since the set is capable of delivering an 8 watt quality output.

**PICTURE SIZE:** 10 in. wide by 8 in. high. Viewed direct.

**POWER CONSUMPTION:** 150 watts.

**CABINET:** The cabinet measures approximately 25 in. high, 18 in. wide and 16 in. from back to front. It is attractively designed as illustrated and is standard in walnut.

**PRICE 44 GNS.**

VISIT OUR STAND AT THE INVENTIONS EXHIBITION
15th to 25th FEBRUARY
ROYAL HORTICULTURAL HALL, WESTMINSTER, S.W.1

**PRICE 35 GNS.**

Model T.20 proves that Television for home installation need be neither a complicated nor a costly business, for here is a complete receiver no larger than a Radio set, yet capable of giving an excellent picture with all that wealth of detail for which Baird receivers are known, together with quality sound reproduction. Controls have been reduced to a minimum and no skilled technical knowledge is needed to operate the set and get the best out of it.

The very attractive price should make this model the means of bringing Television into many homes where the interest of this most modern source of entertainment has as yet not been enjoyed.

**CONTROLS:** The T.20 has two main controls on the front of the cabinet. Picture Contrast and Sound Volume.

**POWER CONSUMPTION:** 150 watts.

**SOUND:** A superhet radio receiver is fitted and this is pre-set to receive Television sound.

**PICTURE SIZE:** 7¾ in. wide by 6¼ in. high. Viewed direct.

**CABINET:** The Walnut Cabinet measures approximately 22 in. high, 18 in. wide and 13 in. from back to front. It is beautifully made and well finished.

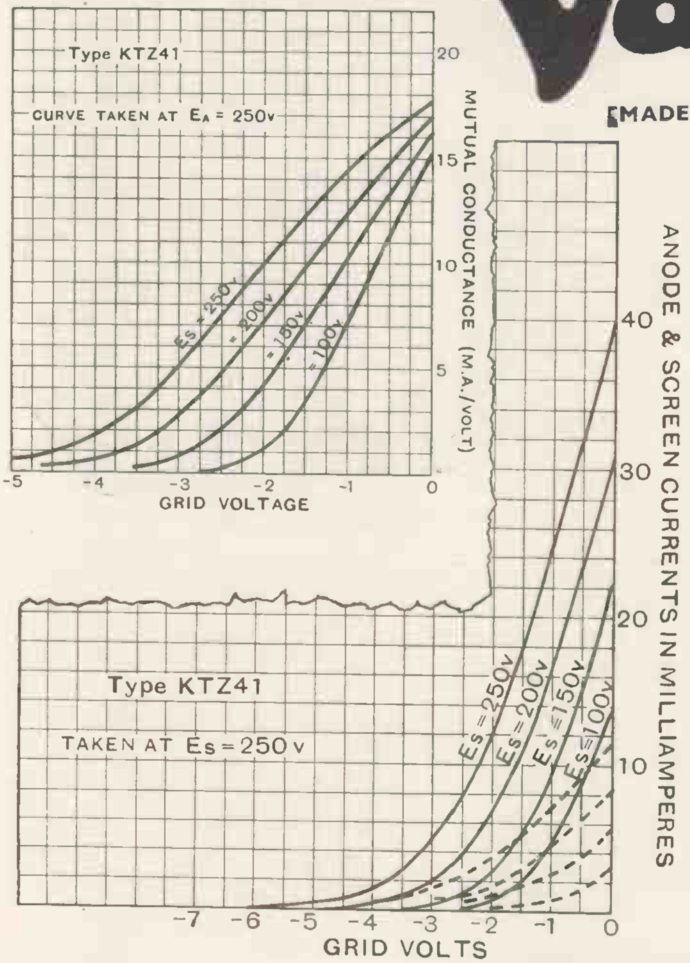
*Send for full descriptive literature.
Post Free.*

# BAIRD TELEVISION LTD.

## Lower Sydenham, London, S.E.26

*Telephone:* HITHER GREEN 4600. *Telegrams:* TELEVISOR, FOREST, LONDON.

# Osram valves




MADE IN ENGLAND

## TYPE KTZ41

### SCREENED TETRODE

### With Indirectly Heated Cathode

The KTZ41 is an Indirectly Heated "Kinkless Tetrode," suitable for use in an I.F. amplifier, or as a Detector.

The valve is designed with a high value of mutual conductance, thus enabling considerable gain to be obtained at ultra-high frequencies with relatively low effective impedance of the anode load.

Type KTZ41 is therefore particularly suitable for use in wide band television amplifiers, but is not recommended in H.F. amplifiers with high efficiency coils.

Owing to the high ratio of mutual conductance to cathode current, a further feature of importance in the KTZ41 is the low noise to signal ratio in operation.

In this type the control grid is taken to a top cap connection.

## CHARACTERISTICS

| | | | |
|---|---|---|---|
| Heater Voltage | | | 4.0 |
| Heater Current | | | 1.5 amps. approx. |

| | As TETRODE | | As TRIODE (Anode to screen through 50 ohms) |
|---|---|---|---|
| Anode Voltage | 250 | 250 | 250 |
| Screen Voltage | 250 | 250 | — |
| Grid Voltage | -1.5 | -2.5 | -2.0 |
| Anode Current average | 18 mA. | 8.0 mA. | 15 mA. |
| Screen Current average | 5.25 mA. | 2.25 mA. | — |
| Anode Dissipation (watts) | | 4.0 max. | 3.8 |
| Bias Resistance (in resistance coupled L.F. Amplifier) | 65 ohms | 244 ohms | 1,000 ohms. |
| Stage Gain | | 350 | 54 |
| Amplification Factor (At Ea 250 Es250) | | — | 80 |
| Impedance (At Ea 250 Es250) | 1.0 megohm | 1.0 megohm | 6,250 ohms. |
| Mutual Conductance (At Ea 250 Es250) | 12.0 mA/volts | 7.5 mA/volt | 12.8 mA/volt |

**Interelectrode Capacities** (As Tetrode):

| | |
|---|---|
| Grid to Anode | 0.008 micro-mfd. approx. |
| Anode to other Electrodes | 10.5 ,, ,, |
| Grid to other Electrodes | 14.0 ,, ,, |

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

# SIGNAL GENERATION

but has a value fixed with respect to that of the cathode. It is thus possible to set up a potential difference between the target and the collecting electrode.

The problem is complicated when a target consisting of an insulator or of a mosaic of minute conducting elements deposited on an insulator is scanned by a fine pencil of electrons. This is the condition which occurs in the Emitron. The potential across the surface of the target will no longer be uniform but will vary from point to point, and from instant to instant as the scanning beam explores the surface. The average potential of the target at any instant will be determined by the secondary emission coefficient of the surface and the geometry of the electrodes. For example, at a velocity of the primary electrons for which the ratio of secondaries to primaries is greater than 1, the potential will be such that on an average during at least one scan the number of secondaries arriving at the collecting electrode will be equal to the number of primaries which reach the mosaic. In the Emitron, where the collecting electrode is the second anode of the gun, it has been found that the average potential of the mosaic when scanned in the dark is about 1.5 volt negative with respect to the collecting anode. The value obtained by Zworykin and his co-workers for the Iconoscope is in agreement with this figure.

On the other hand, the potential of an elementary area on the target of the size of the scanning spot will vary periodically as the beam scans the surface. Each primary electron liberates $K$ secondaries which have a velocity distribution varying from almost zero to the velocity of the primary electrons, but the great majority of these secondaries have velocities of the order of 2 to 4 volts. It is clear that, if the point on the mosaic on which the beam impinges is initially uncharged, it will at first lose practically all the secondary electrons liberated from its surface, and consequently will begin to rise rapidly to a more positive potential. As it rises in potential the slower secondary electrons will find it impossible to escape to the surrounding parts of the mosaic, and finally the element will reach a potential such that only one secondary electron can escape per primary arriving. It is found that in this state the elements immediately under the electron beam are about 4 volts positive with respect to the surrounding parts of the mosaic. This rise in potential of a scanned mosaic element is shown in Fig. 5.

When the scanning beam has passed an element the latter will collect secondary electrons from other elements being scanned, and its potential will soon return to approximately the average potential.

It follows that there is quite a strong electric field between the mosaic element which has reached this positive potential under the scanning beam and the surrounding elements. Hence any photo-electrons liberated by the light from the elements that are about to be scanned will be collected by the elements that are being or have just recently been scanned, and the electric field is sufficient to saturate all such photo-electrons up to a distance of the order of 1 cm. in front of the scanning beam. Thus the scanning beam builds up a positive potential front as it scans over the mosaic, which in turn builds up a distribution of electrostatic charges in front of it, corresponding to the light distribution in the image, thus giving very efficient charge storage over a small fraction of the total frame period.

This phenomenon was called "line sensitivity" by Zworykin. In the authors' opinion the Emitron operates almost entirely on this line sensitivity. The integrating sensitivity, i.e., that part of the signal which is due to storage over the whole of the frame time, is comparatively low. This can be seen from the following observations.

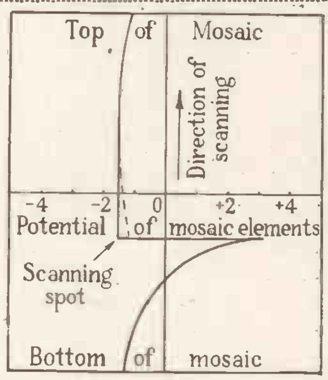



**Fig. 5. Diagram showing how the picture signal is derived.**

A fast-moving object which moves in a direction parallel to the scanning lines is imaged on the receiving screen as a series of pictures, each of which is perfectly sharp, with no signal between the single pictures. This is due to the mosaic elements becoming substantially sensitive only immediately before the scanning beam reaches them. If an integrating sensitivity were present to any appreciable degree, the picture of the object would have a sharp leading edge with a blurred trail behind extending to the leading edge of the next picture.

## *Film Transmission*

In transmitting pictures from cinematograph film it is found that if the image is projected continuously on to the mosaic while the electron beam is scanning the mosaic, very much smaller light intensity is required than if the separate pictures are projected on to the mosaic during the intervals between frames when the electron beam is suppressed. Even when allowance is made for the difference in the time that the mosaic is exposed to the light image, the efficiency of the tube appears to be of the order of 10 times greater in the former case.

Finally, the result of applying a positive potential to the collecting electrode leads to the same conclusion. It can be seen by reference to Fig. 5 that the actual picture signal is derived from the differences in the potential changes which occur when a dark and when an illuminated element is scanned by the beam. If the potential of the second anode, which acts as the collecting electrode in the Emitron, is suddenly raised to a positive potential with respect to the signal plate which is sufficient to ensure saturation of photo-electrons liberated from the mosaic, it is found that a strong signal is obtained, which slowly dies away.

Now a signal can only be obtained if the stream of secondary electrons leaving the mosaic varies according to the distribution of light in the optical image. Hence, the secondary electron emission cannot be

(*Continued on page* 95)

# Scannings and Reflections

### SUNDAY AFTERNOON TRANSMISSIONS

SUNDAY afternoon transmissions will largely consist of outside broadcasts. The first of these on January 15, was a television visit to Watford Junction, L.M.S., to examine some of the activities which are rarely seen by railway travellers. Other broadcasts of a similar nature are being arranged. The "courtesy cops" will be seen at work on one of London's arterial highways on February 5. A spot has been chosen where accidents occur frequently and it is expected that the majority of road users who drive unknowingly into the picture will provide the officials with all the necessary examples of good and bad driving. Also, in February, visits will be paid to the Exhibition of Inventors at the Horticultural Hall, Westminster, and to Hanworth Air Park, where the civil air guard are in training. Life on canal barges and the thrills of dinghy sailing will be televised in March.

### PICTURES ACROSS THE ATLANTIC

The Alexandra Palace vision signals have been received in New York, a distance of about 3,300 miles and recognisable pictures obtained. This is a record for authenticated long-distance reception of high-definition television, although last year it was claimed that they had been received in South Africa. The pictures were picked up at the Riverhead receiving station of the Radio Corporation of America on Long Island, where a series of tests has been in progress. This may be regarded as freak reception only possible under exceptional conditions. When the best pictures were seen the accompanying sound was very weak, whereas a few days later the sound could be heard well but no picture could be obtained.

### TELEVISION IN JAPAN

The Japanese Broadcasting Association has announced that it will begin a regular service of television transmissions during the year. A studio for television is to be reserved in the new Radio City Building, which is already being constructed at Uchisaiwaiko. The actual transmitter will be on Mount Atago, the site of the present broadcasting station JOAK. Some difficulty is anticipated in the erection of the aerial mast and there is the possibility on this account of the choice of another site. Trial transmissions are at present under the direction of Mr. Kenjiro Takayanagi, Senior Professor at the Technical High School at Hamamatsu. The first public transmissions will be made with a power of 1 kilowatt, but it is hoped to increase the power to 20 kilowatts. It is expected also that, later on, the programmes will be relayed into the other parts of the country. A commercial television receiver of Japanese manufacture is already in existence and is priced at from 1,000 yens; research is being carried out in the hope of putting on the market a set at a popular price.

### DEAF AND DUMB CONVERSE BY TELEVISION

The deaf and dumb are, of course, unable to speak by telephone, but television provides a link which will allow afflicted persons to converse at a distance. Recently, two deaf mutes visited the N.B.C. television studios —one stood before the transmitter, the other at the receiver—and with his fingers, the man being televised gave his impressions to his friend at the receiver.

### NATIONAL AND REGIONAL PROGRAMMES ON TELEVISION SOUND WAVE

The B.B.C. have announced that, as from Monday, January 2, the television sound wave of 7.23 metres (41.5 Mc/s) will transmit the National or Regional programme each evening (Sundays included) from about 8.0 p.m. until 9.0 p.m., when the normal television programme opens. It is hoped by this means to demonstrate the high quality of sound reception on television sets. As far as possible, a choice will be made from programmes of musical interest in preference to talks, as it is in the transmission of music that the wider frequency range obtainable without interference on ultra short wave receivers can be more easily appreciated.

### FINNISH TELEVISION

As the Finnish Government are going to make arrangements for Olympic Games in 1940, they have decided to instal television equipment at an early date. They are negotiating with a German firm for the installation of a television transmitter and also for the erection of a number of television viewing rooms in various parts of Helsingfors.

### DEATH OF LORD SELSDON

We regret to announce the death of Lord Selsdon, Chairman of the Television Advisory Committee, who died in his home at Grosvenor Square, London, W., on December 20th. Lord Selsdon was sixty-one, the first Baron Selsdon of Croydon, a title created in 1932. He was born in Edinburgh. He was chairman of the Television Advisory Committee since its formation in 1934 and, as Sir William Mitchell-Thomson, was Postmaster-General from 1924 to 1929.

### BRITISH TELEVISION AT U.S. WORLD FAIR

A suggestion that the B.B.C. should stage a television demonstration at the U.S. World Fair has been rejected on account of the cost. Suggestions have been made to the Television Committee of the Radio Manufacturers' Association that a representative collection of British televisors should be shipped to New York and the matter is under consideration. It will be possible to demonstrate receivers as they can be fairly easily altered to conform to American standards.

### THE D.G. AND PROVINCIAL TELEVISION

The Director-General of the B.B.C., Mr. F. W. Ogilvie, speaking at Leicester on January 2, said

## MORE SCANNINGS . . . . . . .

that work was going on definitely and deliberately, designed to give a national service. The first "jump," when it was possible, would be to the Midlands. The B.B.C., had an option on a site at Birmingham and they hoped that Midland Regional would not have much longer to wait before it was installed in a new home.

### ALEXANDRA PALACE

The Islington Borough Council have renewed their contribution of £500 for the maintenance of the Alexandra Palace for one year only instead of for three. This, of course, relates to that part of the Palace not occupied by the B.B.C., which is in a considerable state of decrepitude. The council consider that it is possible that the financial position of the Alexandra Trust will improve by the transference to the Palace of functions which formerly were held at the Crystal Palace.

### TELEVISION IN ITALY

Building has now been commenced for a television transmitting station in Italy. The site is on the heights of Monte Mario, which overlook Rome. No technical details are as yet available, but it is stated that the most modern developments will be included. It is expected that it will be ready in the late summer.

### CINEMA TELEVISION IN LANCASHIRE

Three cinemas in East Lancashire, the New Roxy at Burnley, and the Savoy and Hippodrome at Colne, recently taken over by Mr. Harry Buxton, of Birkdale, have been wired for television. Mr. Buxton, who has recently taken control of £80,000 worth of entertainment houses in Lancashire, Yorkshire and Cheshire and is negotiating a further £250,000 deal in the same area, is understood to be in touch with the Baird Company regarding possible cinema television developments.

### A.P. ALTERATIONS

During the past two or three months considerable modification has been made to the arrangements at Alexandra Palace in order to facilitate the production of programmes and permit of smoother working. The most notable alteration is probably the building up of the face of the first floor colonnade, which looks out on the terrace, and so providing a long room in which are placed sound and vision apparatus for Studio B. This not only provides additional room, but also serves to damp out sounds produced in the grounds outside the Palace. The original Baird sound equipment, with some remodelling, has now been installed in Studio B, and it is arranged for the use of five microphones and the playing of records for music and effects purposes.

### RETAILERS AND TELEVISION IN U.S.A.

Even in the absence of scheduled television programmes at this early date, many television sets have already been sold to retailers in the New York metropolitan area, reports the DuMont organisation.

"Keen public interest in forthcoming television is something which wideawake retailers have not failed to capitalise on," states Allen B. DuMont. Despite the absence of programmes, we have been pleasantly surprised with the response of radio and allied trades to our television sets. Dealers are buying our sets even without programmes. They are using these sets at the moment for store and window display purposes. Many dealers are anxious to be the first to introduce television to their local public. Their stores are being jammed by curious people who want to see what a television set will be like, and when video signals are available, there are record crowds."

### TRIBUTE TO TELEVISION SOCIETY SECRETARY

The Gold Medal of the International Faculty of Sciences, which is awarded annually in recognition of outstanding contributions to scientific progress, has been awarded for 1938, to Mr. J. J. Denton, Secretary of the Television Society, and Vice-President of the Institution of Electronics. The award is in recognition of nearly 50 years' continuous devotion to scientific and technical education. The presentation was made on January 27th, by Dr. J. A. Darbyshire, M.Sc., Ph.D., etc., at the Annual Dinner and Dance of the International Faculty of Sciences and associated institutions.

In addition to many contributions to scientific research in the fields of wireless transmission and reception, metallurgical and high temperature technique and the design of educational instruments, Mr. Denton has been closely associated with scientific education since 1889, when he was appointed honorary lecture demonstrator for "Old Vic" science lectures and also as chemistry and physics lecturer at Morley College. For over fifteen years, from 1894, he was assistant and lecture demonstrator in physics and chemistry at Bedford College (University of London).

In 1895 he was appointed teacher in Physics at Morley College, a post which he held for over 40 years, and for 23 years he was also teaching physics at Working Men's College, London, N.W. He founded the Faraday Society, Morley College, of which Professor Carey Foster, F.R.S., was president. Later, in 1927, he was Founder Honorary Secretary of the Television Society, a position which he still holds.

In 1931 Mr. Denton was appointed lecturer on Television at the Borough Polytechnic, the course being the first of its kind to be recognised.

Mr. Denton's pioneer research work included photographic images obtained by means of electrical oscillations; the first educational film; the melting of tungsten and the making of tungsten targets for X-ray tubes for the War Department; the isolation of uranium by a smelting process; the production of crucibles to withstand a temperature of 2,500 deg. C.; and the wireless control of aircraft. He founded the London Branch of the British Radio Institution (later incorporated as The Institution of Electronics).

### THE SCOPHONY SYSTEM

Scophony Limited, have issued a very fine brochure containing a full explanation of their system profusely illustrated with diagrams and photographs. Copies of this brochure can be had free on request and mention of "Television and Short-wave World."

### THE R.M.A. AND TELEVISION

In the Radio Manufacturers' Association's Annual Report the following statement concerning the development of television appears:

Early in the year a Television Development Sub-Committee of the R.M.A. was appointed with terms of reference as follows:—

## . . . . . AND MORE REFLECTIONS

"To formulate and discuss means of developing the interests of Television, including the regular issue of propaganda to the Press, and the fostering of television in the trade."

The first meeting of that sub-committee was held on March 8. It has met regularly once a fortnight ever since. Its general policy has been to develop television by every means in its power. Groups of viewers have been formed from whom criticisms of every television programme have been received. These have been considered regularly by the committee, and agreed comments have been forwarded to the B.B.C. Recommendations as to television policy have gone from the Television Development Sub-Committee to the General Purposes Committee, and thence to the Television Advisory Committee for discussion at the quarterly meetings with that body.

As a result of the close liaison established with the B.B.C., the assistance of the corporation has been secured in many ways in the development of television propaganda, to the trade, and also over the microphone.

At the annual general meeting Mr. C. O. Stanley, speaking on behalf of the Television Sub-Committee, said that an advertising campaign is to commence early this month, and 1,000 bills featuring the slogan "Television is here—you can't shut your eyes to it," were to be displayed on the underground railways.

The new industry would affect about 95 per cent. of R.M.A. members and there would be profits in three or four years' time. In a recent month, he said, the list prices of televisors sold amounted to £75,000.

He paid a special tribute to what he called the new spirit of co-operation from the B.B.C. and said that the television manufacturers were greatly indebted to the trade press for its co-operation.

### EASTERN CABARET

"Eastern Cabaret" television variety show will be given in the afternoon programme on February 14, and repeated in the evening on February 18.

The television cameras will take viewers to the tourist bureau in London. The aeroplane will then be seen leaving Croydon Airport and thence on a whirlwind flight with a burlesque commentary.

Flashing back to the television studio viewers will see the travellers landing, and no time will be lost in the short trip through oriental streets to the hotel. The gala programme will include Reine Paulet, the charming French soubrette, who will sing in Arabic; Stone and Lee, an American comedy act new to television; and two amazing Arabians, Effy and Halima, who, among other things, eat cotton wool.

### "1066 AND ALL THAT"

"1066 and All That," the stage adaptation by Reginald Arkell of the famous "history" by Sellar and Yeatman, is to be televised in the afternoon programme on January 31 and repeated in the evening on February 4.

Charles Heslop, Hugh E. Wright, and Cyril Ritchard will take part, and although some compression will be necessary, all the highspots will be retained. The cast also includes William Stephens, Max Oldacre, Basil Cunard, Valerie Hay and Yvette Pienne.

The scenes to be televised will include William the Conqueror at "Hastings and St. Leonards," King John Signing on the Dotted Line, Henry VI and his Eight Wives, Columbus on Trial for Discovering America, etc.

### "THE TEMPEST"

Peggy Ashcroft will appear as Miranda in a special version of Shakespeare's "The Tempest" which will be televised from Alexandra Palace in the evening on February 5 and the afternoon on February 8. This production by Dallas Bower will be notable for the use of the incidental music of Sibelius. It is believed that this will be the first performance in this country with the music which Sibelius wrote for a production of the play in Sweden in 1925. A concert programme of the music was given by Sir Thomas Beecham in the recent Sibelius Festival.

In addition to Peggy Ashcroft, the cast of this production will include Richard Ainley as Ferdinand, John Abbott as Prospero, Stephen Haggard as Ariel and Richard Goolden as Trinculo. Caliban will be played by George Devine.

The play, which will be televised in ten scenes without an interval, will involve the use of two studios. Scenic effects will be built up with the penumbrascope, a shadow device.

### POLICE BOXING AT HARRINGAY

Police of five countries will box before the television cameras at Harringay Arena on the evening of February 1, when the Police Open Boxing Championships are fought out.

Representatives will come from France, Germany, Holland, Northern Ireland and Belgium. The British contingent will include members of the Metropolitan and City of London Police and of the Forces at Derby, Nottingham and Colchester.

### GENERAL ELECTRIC (U.S.A.) TELEVISION

A television transmitter will be put into operation within the next three months by General Electric at Indian Ladder in the Helderberg Hills, 12 miles from Schenectady, N.Y.

Built on top of a 1,500-foot hill with an antenna strung on 100-foot towers, this station will be at least 250 feet higher than the one in the Empire State building in New York. To the south are high hills which, with a directional antenna, will tend to prevent the signal from causing any possible interference with stations in New York City. With a power output of 10 kilowatts, its coverage will be the area comprising Schenectady, Albany, Troy, Amsterdam, and Saratoga, known as the Capital District, with a combined population of more than 500,000.

The television studio will be located in Schenectady in quarters occupied by WGY until this station was moved into its new broadcast home last summer. The wavelength will be about 4½ metres.

---

### B.B.C. Television Propaganda

It is noteworthy that of late the B.B.C. has done a good deal of television propaganda work both on the air and in its publications. Just as we go to press we learn of a new effort that is to be made to popularise television, and this is giving demonstrations of reception in small halls in the outlying districts of London, the idea being, we assume, to convince the people of these areas that excellent reception is easily possible. To what extent this programme is to be carried out we do not know, but the scheme is obviously a sound one and we congratulate the B.B.C. on its inception.

# TELEVISION PICTURE FAULTS AND THEIR REMEDIES—III

*By S. West*

*This is the third article of a short series dealing with faults in television receivers, the effect of which on the pictures is illustrated by actual photographs.*

UP to the present, in this series, we have been mainly concerned with the various faults likely to occur in the time base. It was intended in this article, to describe the defects likely to be encountered due to incorrect sync. pulse conditions in the vision unit, but actually no such nice distinction for a certain class of fault can be made. Also a very prevalent fault, even in quite carefully constructed apparatus, attributable to slow " flyback " in the horizontal scan circuit, has not yet been dealt with. As a consequence, we have perforce to continue with time bases for the time being.

Dealing first with the effect of slow line flyback. The result of this in the received picture is depicted in Figs. 1 and 2. The latter photograph being a somewhat severe case. Fig. 1 is the more usual form in which this trouble manifests itself. It is not unusual for the fault, in mild forms, to be tolerated, for unless interesting subject matter extends completely to the left edge of the picture, the defect passes unnoticed.

A brief explanation for the cause of this fault follows, the remedy being afterwards outlined.

The picture is scanned from left to right in 405 lines every 1/25th of a second. Upon completion of a single line, the light spot flies back to the left ready to commence the next line of its frame. For the complete, correctly interlaced picture, this actually is the next alternate line, but this point does not concern us for the present.

Each line including the return of the light spot, is completed in approximately 100 microseconds, 15.5 per cent. of this time being assigned for the retrace, i.e., $15\frac{1}{2}$ microseconds. This involves quite high frequencies, and it is failure on the part of the system to accommodate these frequencies, that causes the fault.



**Figs. 1 and 2. Two photographs showing effect of slow line fly-back.**

To clarify our conception of what takes place to cause this apparent loss of some part of the picture, let us consider what happens when the line re-trace occupies too long an interval.

A line commences reproducing a section of the picture in sympathy with the transmitted intelligence. Upon completion of the line the sync. pulse arrives and the light spot, now blanked by this negative sync. pulse, commences its return. Before it is enabled to reach the left picture edge the intelligence for the next line commences, thus, a part of the retrace is modulated and results in a brightening and often, depending on the shape of the retrace curve, a confusion of the left-hand picture edge. It is obvious also that this part of the modulation is lost as far as the left edge is

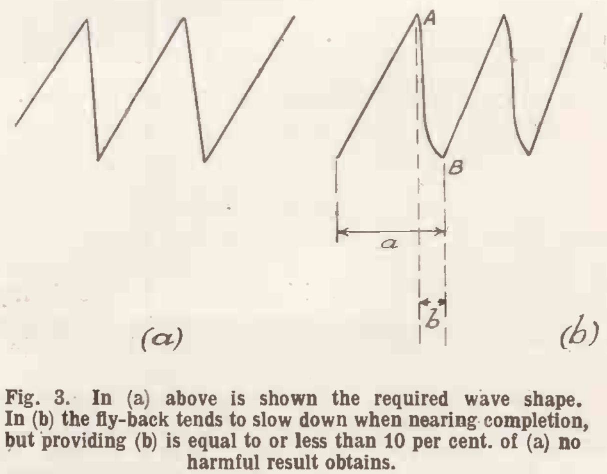



**Fig. 3. In (a) above is shown the required wave shape. In (b) the fly-back tends to slow down when nearing completion, but providing (b) is equal to or less than 10 per cent. of (a) no harmful result obtains.**

# SYNCHRONISING FAULTS

concerned, hence the effect depicted in Figs. 1 and 2.

A little consideration shows that no deleterious effect results from a too rapid flyback.

It should be appreciated fully from the foregoing that it is the left-hand picture edge that is affected and is revealed, with modulation, as a loss of or confusion of the picture detail of this edge; or in the plain

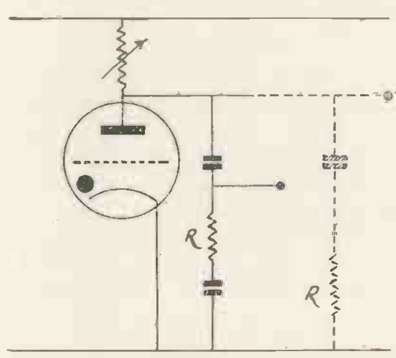



**Fig. 4. Inclusion of a resistance R increases the fly-back speed. An alternative arrangement often employed is shown by the dotted connections.**

" raster " as a bright vertical band at the extreme left edge.

The writer has encountered this fault upon innumerable occasions invariably finding it to result from a too conscientious adherence to orderliness in the finished outfit.

Laced leads to the horizontal deflecting plates must be immediately suspect. These leads should be well spaced from earthed objects and preferably kept

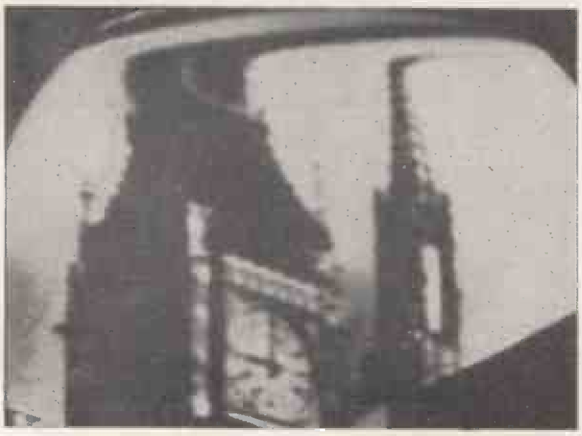


**Fig. 5. The type of picture produced by poor line synchronism.**

short. The main thing is to avoid any unnecessary capacity to earth between the deflecting plates, their connecting leads and the anode circuits of the associated amplifying valves. It is bad practice to have the output from the horizontal amplifiers connected to a plug-and-socket arrangement having appreciable capacity to chassis and it is inviting trouble to lace tightly the various C.R. tube leads together. Excessive capacity in the grid circuit of the second amplifying valve also must be avoided.

In isolated cases, a very similar effect may result from a poor wave shape output from the blocking oscillator (gas relay, etc.). If all efforts to cure the fault fail with attention to the points enumerated above, this section must be suspect.

An oscilloscope is very desirable in order thoroughly to investigate the wave form of this oscillation. The resourceful will have no difficulty in providing this with the frame time base and remaining equipment. The waveform should be substantially as shown by Fig. 3 (a). No particular concern need be felt if that shown in b results providing the slope AB is steep, i.e., occupies 10 per cent. or less of the period of the cycle. This is simply ascertained by actual measurement. Bear in mind it is 10 per cent. (a 1/10) of the complete cycle.

To improve matters, should this waveform be poor, re-arrangement of the layout will help. If a resistance, R in Fig. 4, which can have a value of about 1,000-4,000 ohms, 2,000 ohms being an average value, is not fitted, its inclusion will greatly improve matters. Some experiment to ascertain the optimum value will be required in obstinate cases.

It can be added in terminating this description of faults due to slow flyback that troubles of this nature do not occur in the vertical scanning circuits. The available time for the frame fly back being relatively lengthy.

## *Synchronising Faults*

As earlier remarked, it is difficult in certain cases of unstable synchronism, to state exactly to what cause the fault can be attributed. Similar effects result from poor sync. pulse filtering, where such arrangements are employed, and incorrect sync. pulse application networks. It is intended, therefore, in the fol-

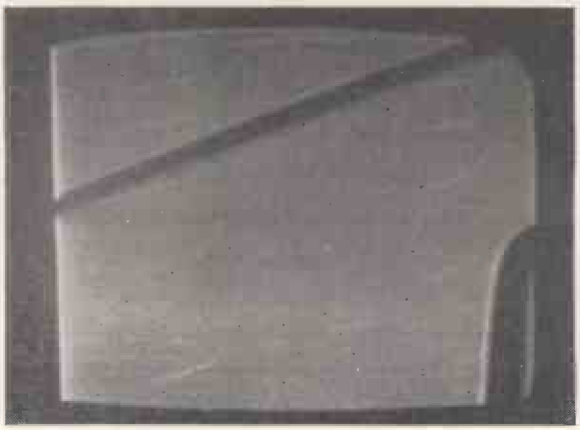


**Fig. 6. Effect of bad line synchronism on plain format.**

lowing, where the above applies, to deal with the fault shown for each section of the receiver that may be responsible. The reader must then determine which is applicable to his own case.

Fig. 5 depicts the effect of poor line synchronism. This fault is similar in appearance to one later to be described, and is not to be confused with this. In this case, it is seen that the top of the picture is falling to the right. This is not a stable condition, a few seconds later the picture usually will slip across the screen. This fault is due to insufficient amplitude of sync. pulse. The hold is not sufficiently positive. In general where the circuit arrangements permit variation in amplitude of these pulses, re-adjustment of the controls will effect a cure. Where fixed networks are included, some change of the constants may prove desirable or, readjustment of the sync. pulse filter may be required. The main point is to increase, in the most convenient way, the amplitude of the sync. pulses applied to trip the blocking oscillator.

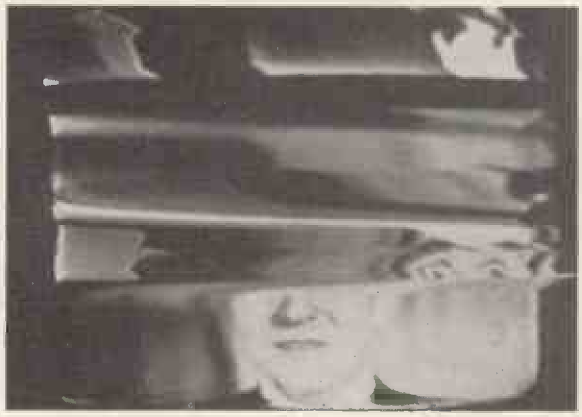


**Fig. 7. Picture due to operation of receiver with pronounced unstable line synchronism.**

Fig. 6 gives the same fault in a slightly more advanced state. In this case for the plain picture format. A few seconds later the raster will dissolve into unintelligibility. In passing, it is interesting to note in this photograph, the diagonald white streaks superimposed on the vertical flybacks. These are due to the change in shape of the sync. pulses during the framing period. They actually are caused by the half-line pulses, maintained during the vertical pulses, to ensure the lines are kept in step during these intervals. We shall have occasion to refer to these later.

The fault of Figs. 5 and 6 is due then to insufficient amplitude of pulse. Now it is not unusual for a receiver to be operated in this condition, unstable synchronism being tolerated, for the simple reason that if more positive control is attempted, the instability becomes worse. The appearance of the picture is, then, that of Fig. 7. It is seen that the effect is as though one side of the picture is pulled sideways. This is caused by the presence of picture modulation in the sync. circuits. This modulation being positive, causes the time bases to fire irregularly. Naturally, as the modulation changes, e.g., scene changes or subject movement take place, this tearing of the picture will vary.

It should be added that the above applies only to conventional sync. pulse filtering arrangements of the amplitude separator or unilateral type. More recent methods for securing synchronism do not suffer from this defect, though they, nevertheless, have their own failings.

To ensure that no picture modulation is applied to the blocking oscillators, care in adjusting the operating conditions of the filter circuit is required. Again, an oscilloscope is an invaluable ally and the frame time base and equipment can be pressed into service. It is a simple matter then, to adjust the filter conditions until all picture modulation is removed.

This condition is readily apparent for, with correct adjustment, the base line of the pattern is perfectly level. As the same time a check on the regularity of amplitude for the pulses can be made; that is to say, the tops of the pulses should be substantially of equal height. It is necessary to retain the D.C. component to secure these results. A direct connection to the deflecting plates will ensure this.

With a little practice it is possible to adjust sync. filters with the aid of headphones only. Adjustment in this method is continued until no audible change in pitch of the pulses occurs during the picture modulation.

*(To be continued)*

---

## Television and the Motion Picture Producing Industry

THE Research Council of the Academy of Motion Picture Arts and Sciences (Hollywood) recently issued its third annual report on television and the motion picture industry. The report contains a very complete review of development, particularly in England, and sums up the present position as follows:

Experiment now takes on a larger scope, with the emphasis shifting from technical research (although technical development will simultaneously be intensified) to economic and social aspects. The public, from the role of spectators, will become participants in the project, and on the extent and manner of that participation the effects on the motion picture industry will depend.

That such effects will be evident in the next two years is altogether to be expected. That the repercussions will result in revolutionary changes in motion picture production and exhibition within that period is unlikely. The complexity of the television field and the magnitude of its artistic and financial problems are an automatic brake in this respect, and it might be added that this is true of competitive and co-operative potentialities alike. As regards the latter, when television comes into its own it may well open up a vast market for films especially designed for television distribution.

Should competitive factors predominate, it is quite obvious that the strongest interests in the television field cannot afford to ignore their own very substantial stake in the business of aural broadcasting. Although radio is nowhere near the end of its growth, financially it has become a mature industry, mindful of its investment in the present while looking into the future, and this tendency constitutes a protection, if one is needed, for the other entertainment industries as well.

And yet modern technology has its own dynamic imperatives. It will not, and should not, stand still. New industries are needed, and if their coming is troublesome, it will be far more troublesome if they do not come. Television is one of them and it is a year nearer. The situation is one which calls for continual observation and analysis by the motion picture industry, and to an increasing degree as events take their course. Accordingly the Committee is of the opinion that the Academy Research Council should *immediately proceed to a more thorough consideration than has been undertaken in the past* of the prospective relationships between television and motion picture production and exhibition.

In the opinion of the Committee this investigation should cover the artistic, technical, legal, and economic phases of the subject.

# RECENT TELEVISION DEVELOPMENTS

## A RECORD OF PATENTS AND PROGRESS

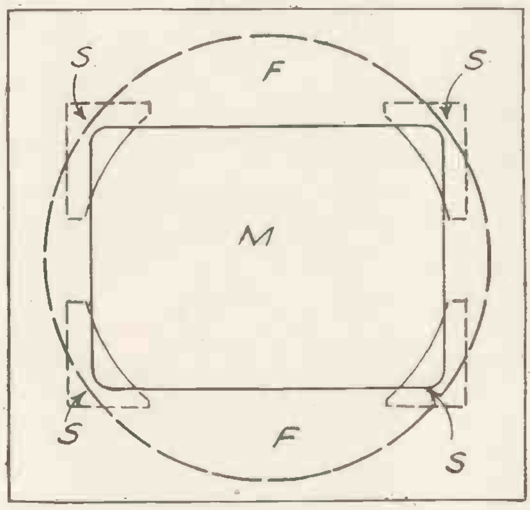
*Specially Compiled for this Journal*

***Patentees: Baird Television Ltd. and A. H. Gilbert :: Radio-Akt. D. S. Loewe :: F. B. Dehn (Zeiss Ikon Akt.) :: N. V. Phillips Gloeilampenfabrieken :: A. Blumlein***

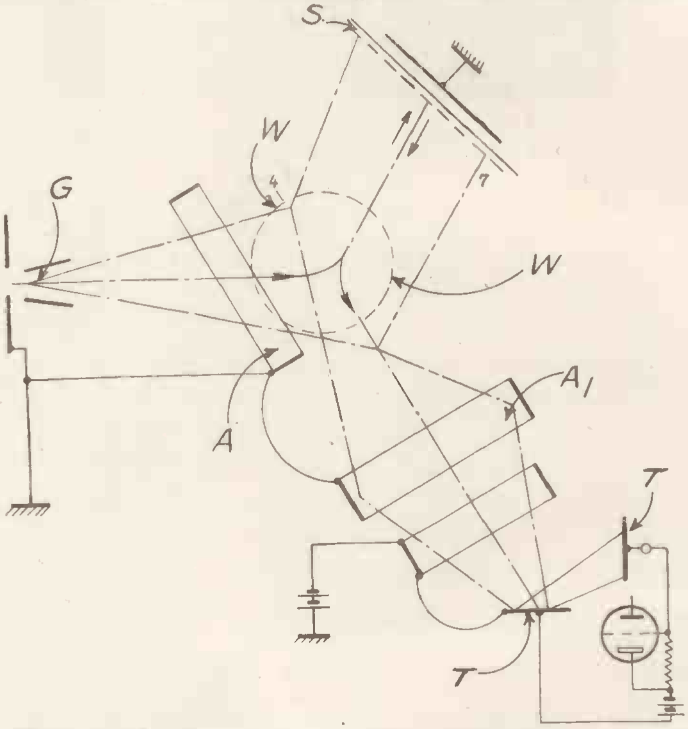
### "Curvature" Distortion

(Patent No. 491,886.)

OWING to the curvature of the bulb on which the fluorescent screen of a cathode-ray tube is deposited, the outer edges of the picture usually appear distorted. It is now proposed to screen these marginal parts in such a way that whilst the distorted picture details are not seen, they still contribute their proper share of general illumination to the screen.




**Screening edges of picture. Patent No. 491,886**




**Secondary emission transmitting tube. Patent No. 492,961**

As shown in the drawing the received picture is arranged to fit within the "mask" aperture M. At each corner, where the greatest curvature occurs, a screening strip S of ground glass is inserted between the mask and the fluorescent screen F. The screens cut off the distorted picture detail, but are sufficiently transparent to allow diffused light to pass through without forming a definite shadow.—*Baird Television, Ltd., and A. H. Gilbert.*

### Television Signals

(Patent No. 492,961.)

A picture to be televised is focused on to a photo-sensitive screen S, where it is scanned by the electron stream from the gun G of the tube. The scanning stream is bent into the curved path shown, by the effect of the magnetic field from an external coil W. The electrons released from the screen S by the scanning action are accelerated by the anodes, A, A1. In passing back through the magnetic field of the coil W, the returning electrons are deflected away from the oncoming ones (since they are now travelling in the opposite direction). The incoming and outgoing paths are indicated by the arrows.

The "picture" stream is focused on to an electrode T, which may be followed by other "target" electrodes such as T1, so that amplification by secondary emission is secured before the output is finally taken off. —*Radio-Akt D.S. Loewe.*

### Double Scanning

(Patent No. 493,232.)

In the Iconoscope type of television transmitter, the picture to be transmitted is first projected on to a mosaic-cell electrode where it is automatically converted into an equivalent electric image, which is then scanned, point-by-point by an electron stream. In the electron camera, on the other hand, the picture is projected on to a photo-electric cathode, and the electrons emitted from the whole surface of the cathode are focused electron-optically, so as to preserve the picture-formation, and are then swung to and fro past a scanning aperture in an anode at the far end of the tube.

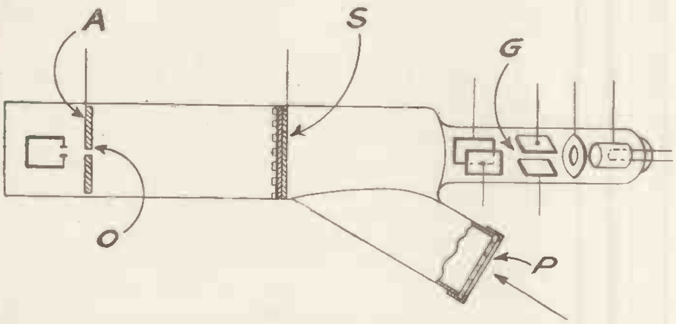
In the present case both these scanning operations are performed simultaneously in the same tube, with the object of deriving a stronger signal from a given amount of available light.

As shown in the Figure the picture is projected from outside the tube at P on to one face of a "transparent" mosaic screen S, which is then scanned point-by-point by an electron stream from the gun G of the tube.

Electrons are discharged from

The information and illustrations on this page are given with permission of the Controller of H.M. Stationery Office.

corresponding points on the rear face of the screen S and are focused to preserve the cross-section of the picture, and then traversed by a pair of deflecting plates (not shown) across an aperture O in an anode A located at the far end of the tube. *F. B. Dehn (Zeiss Ikon Atk.)*




**Tube employing two scanning systems. Patent No. 493,232**

### Light-saving System

(Patent No. 494,298.)

The light generated by the impact of electrons on the luminescent screen of a cathode-ray tube is radiated outwards in all directions. That is to say the image point acts as a spherical radiator, though only the light contained within a small " cone " is utilised.

It is possible to increase the size of this cone by using " graded " objective lenses, but this has the effect of enlarging the picture to an extent which leaves the surface brightness unaltered, so that there is no effective gain in brilliance.

According to the invention an effective increase in available light intensity is secured by depositing the luminescent material used in the projector tube on the cathode side of a compound lens. This acts as a " pre-concentrating " lens of large aperture, and so refracts a greater light-content on to the " collecting " lens system mounted outside the cathode-ray tube. Provision is made to correct for " pincushion " distortion.—*Radio-Akt D. S. Loewe.*

### Incandescent Screens

(Patent No. 494,375.)

In one type of television receiver it is usual to drive the scanning stream at a uniform speed over a fluorescent screen and to vary the velocity of its impact in order to produce the necessary differences in light and shade which go to make up the televised picture. Another possible method is to vary the speed of the scanning stream in accordance with the brilliance of the detail it is reproducing; but since this means that the time of each scanning traverse is not constant it adds considerably to the difficulty of synchronisation.

The invention is concerned with the second or " velocity " method of scanning. The difficulty mentioned is overcome by using a screen which has a non-linear response, in the sense that the intensity of the light it produces under the action of the scanning stream increases as the square (or some other higher power) of the time of impact. In variable-velocity scanning, a " bright " detail usually takes more time to reproduce than a dark one, but with the type of screen in question the balance is restored. The invention is particularly applicable to television receivers in which the received picture is reproduced by incandescence.—*N. V. Phillips Gloeilampenfabrieken.*

### Time-base Circuits

(Patent No. 494,677.)

When a back-coupled valve is used to generate the saw-toothed scanning oscillations for a television receiver, it is difficult to apply the synchronising or " triggering " impulse without upsetting the correct phasing. The synchronising circuit also tends to load the scanning oscillator, and so cuts down the amplitude of the output voltage. Finally it is essential to prevent feed-back from the oscillator to the separator valve, particularly in the case of interlaced scanning.

According to the invention these difficulties are overcome by inserting a diode between the anode of the separating-valve and the grid of the scanning-oscillator. The diode follows a resistance-capacity coupling which has a time-constant such as to ensure that triggering occurs on the " front " of each synchronising impulse and prevents the " back " from affecting the scanning-oscillator.—*Baird Television, Ltd., and A. H. Gilbert.*

### Television in the Theatre

(Patent No. 495,724.)

When interlaced scanning is used for large-scale reproduction, say in a cinema theatre, where some of the audience are seated at comparatively close range, a curious effect is observed. A person fixing his gaze at a certain point on the screen gets the impression that the scanning lines are moving bodily, either upwards or downwards. If the lines are fairly bright the whole picture appears to be " dithery."

This is really due to the fact that in ordinary interleaved scanning, the series of lines used to produce one frame are spaced apart from each other by a distance sufficiently wide to allow the set of lines forming the second frame to fit in between them. In other words each separate set of lines covers only half the total area of the picture screen, though, of course, when interleaved they cover it all.

According to the invention the width of each set of scanning lines is doubled, so that each frame covers the whole of the viewing screen. The process of interleaving does not then produce any perceptible " overlap " though it does avoid the objectionable " dithery " movement referred to.—*A. Blumlein.*

### Summary of Other Television Patents

Patent No. 492,302.

Television system in which a single vibrating mirror scans the picture along lines which radiate outwards in all directions from the centre.—*J. W. Garside.*

Patent No. 493,007.

Televising from moving-picture films by using infra-red rays.—*Farnsworth Television Inc.*

Patent No. 493,279.

Applying synchronising impulses to television signals by means of a circuit including a secondary-emission valve.—*Baird Television, Ltd., and T. C. Nuttall.*

Patent No. 493,687.

Large-screen television system in which a " bank " of lamps is energised by signal currents of different frequencies.—*Standard Telephones and Cables, Ltd.*

Patent No. 493,868.

Means for preventing loss of definition due to time-lag on the luminous screen of a cathode-ray tube.—*Radio-Akt. D. S. Loewe.*

Patent No. 495,185.

Cathode-ray tube in which a " weak " electron-optical lens is followed by a stronger lens to focus and control the electron stream.—*Radio-Akt. D. S. Loewe.*

The information and illustrations on this page are given with permission of the Controller of H.M. Stationery Office.

# THE HOME-BUILT MECHANICAL OPTICAL TELEVISION RECEIVER—II

*By J. H. Jeffree*

## CONSTRUCTIONAL DETAILS OF THE UNITS EMPLOYED

THE accompanying figures show the simple mountings recommended for the optical parts, which can be obtained ready made if desired from H. E. Sanders and Co. Constructors who are used to accurate metal work and prefer to make their own will find the essential measurements shown on the accompanying illustrations, and 16 gauge brass is a suitable material to use for them. The mounts for the lamp, light relay, small and large cylindrical

**Light relay with crystal, showing angle-brass mount. (*Note:* In this photo the brass angle is turned the other way from that recommended in the drawings, as this was a first model, and drilled slightly differently.**

lenses are not difficult to make if a vice and other tools are handy; but the phonic wheel for the second scanner is better bought ready made.

A few points should be noted in connection with these optical mounts. The light relay is mounted by one hole only, to facilitate turning to get the best black, without upsetting the other adjustments, but this result will only be attained if the hole is in the right place, directly under the optical centre of the light relay lens system. This is provided for in the recommended form, but if a different construction is adopted, the point should be remembered. The desirable positioning of the lenses relative to the hole and the rest of the system are shown in the accompanying sketch, and it is assumed that all the lenses are mounted on the relay cell and move with it.

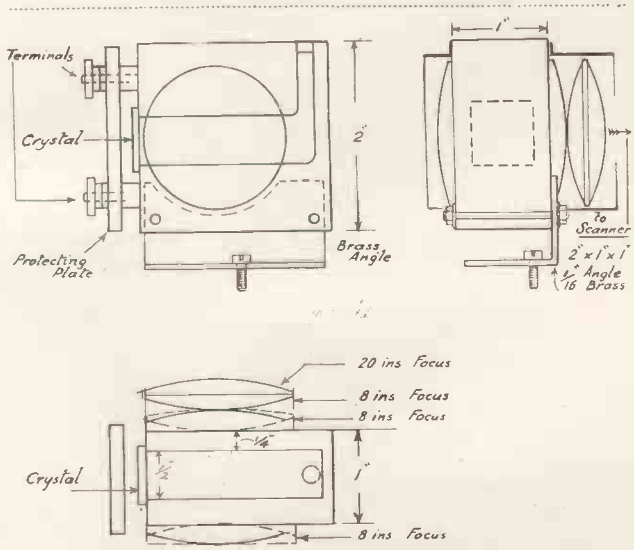
The light relay is a patented device, at least in the present application, and for this reason it must only be used experimentally. Suitable crystals for such cells, ground to about 10 mc/s, are obtainable, and also a container of the correct dimensions for this set, with the associated lenses, and the method of affixing the crystal to such a container to produce a complete cell was given in the September, 1938, issue of this journal and is summarised here.

### Cell Construction

The container is a flat-sided cell with one end open, as shown in the figure, and the crystal is stuck over the open end so that it sends supersonic waves into the cell horizontally. The inside size of the liquid space in the cell should be about $\frac{1}{2}$ inch square, so that a $\frac{5}{8}$ inch. square crystal will cover it. Electrodes are needed on the crystal, and may be thin metal foil (from cigarette wrappings), stuck on with seccotine or other cements. It is advisable to lay the crystal on a piece of plate glass, place on it a little cement and then the smoothed out slip of foil, and stroke out the excess cement from the middle to the two sides with a flat edge of card.

On the side of the crystal in contact with the liquid the foil should cover the crystal surface, and extend on one side for an inch or so beyond, to form a connection; on the other side it should be stuck down over about the central $\frac{1}{2}$ inch square corresponding to the liquid channel in the cell, but should also extend to form a connection in the opposite direction from the former side. In this way power is not wasted in exciting the edges of the crystal which are in contact only with the cell walls; effective vibration can only occur where there is an electrode on each side, well stuck down. The crystals specially obtainable for this purpose have such electrodes already affixed.

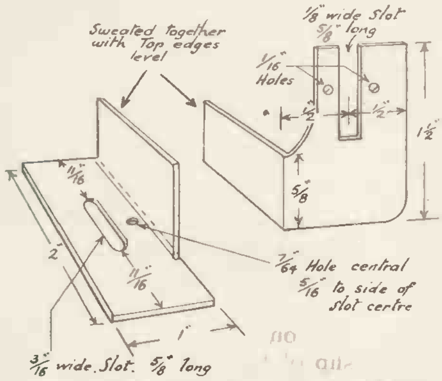
The crystal can be stuck on the cell opening with seccotine, which is more suitable than some other glues because it remains a trifle damp and therefore is less liable to separate from the cell surface and let paraffin creep through. The writer has also found the celluloid-type cement "Premofix" to be suitable, but not all such cements, nor all glues, will permanently hold paraffin without leaking. If leaks occur, the cell should be emptied and drained, and left for a day or so to let paraffin evaporate; then the surfaces round




**Constructional details of light relay cell.**

the leak should be scraped, and a coat of cement applied and allowed to dry before refilling the cell.

In using glues for the above purposes it should be remembered that they are conductors of electricity, and must not be thickly applied so as to short-circuit the two electrodes of the crystal. If a cell fails to work, and greatly damps or even stops the applied

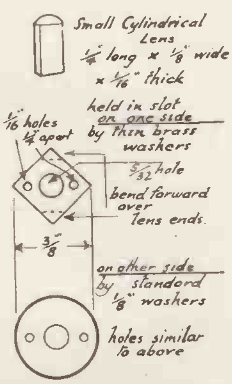



First lens mount.

oscillation, it is usually because there is a short circuit of this nature. The remedy is obvious; but in removing the excess cement in such cases care should be taken not to break the rather fragile crystal.

The crystal electrodes should be carefully secured to firm terminals, to avoid tearing them off.

The main point about the cylindrical lens mounts is that their axes should be fairly truly vertical and horizontal respectively, or, at least, at right angles to each other; so long as this is the case a reasonable tilt of both lenses in the same direction would not greatly affect the definition. The first lens, of $\frac{1}{4}$ inch focus, can be a 1/3 in. diameter glass rod, but the plano convex form now obtainable is on the whole better and allows room between it and the steel ball scanner for the addition of a further lens whereby, as described below, the necessary increase of light for a




Details of first lens system.

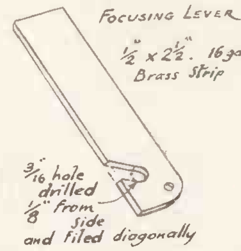
larger picture can be obtained. Provision is made for adding this lens in the mounting now available, as the illustrations show.

Constructors of this mounting should ensure a vertical axis by making the slot, that carries the lens, exactly $\frac{1}{8}$ in. wide. The lens is only $\frac{1}{4}$ in. long by $\frac{1}{8}$ in. wide, so that if the slot is too big it will be free to move out of alignment. This must be avoided, or cured by packing with paper strips.

The simple focusing device provided is a convenience, though not essential. It is also desirable, for convenience in focusing, to observe precision in the positioning of the fixing hole and slot, so that the lens mount slides sweetly in contact with the edge of strip A of the frame. The same applies to the second cylindrical lens mount.

The positioning of the second scanner is not very critical, but it ought to be fairly centrally placed on the optical axis, especially if the larger picture is to

Detail of focusing lever.




be obtained as described below. It will be as well at this stage to describe the simple additions needed to enlarge the picture, and also what is necessary to double the definition.

## Getting a Larger Picture

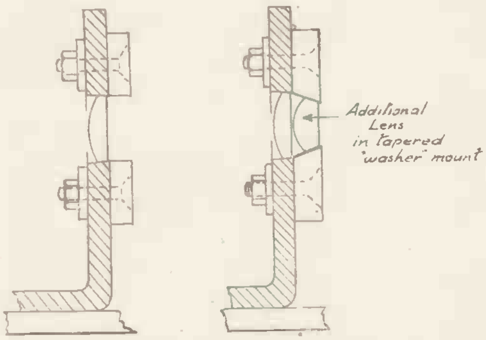
As was shown in the July, 1938, issue of this journal, the light obtainable from the optical arrangements so far described suffices for a 2 in. wide picture of reasonable brightness. To enlarge it without sacrifice of brightness involves collecting more light from the steel ball scanner, which is perfectly feasible since we are only collecting an " f/3 " cone so far, and there is far more than that coming from the steel balls. At the same time, to enlarge the picture without enlarging the receiver as a whole, the focus of the smaller cylindrical lens must be shortened, thereby increasing the magnification of the line scan on the screen; an alteration must also be made to the frame scan to

Second lens mount built up from sheet brass.

obtain a corresponding vertical enlargement. Fortunately two very simple measures suffice to produce these effects.

A plano-convex spherical lens of $\frac{1}{4}$ in. focus is inserted between the ball scanner and the small cylindrical lens, at a distance, optically, of $\frac{1}{8}$ in. from the images in the balls. This has the effect of magnifying these images as viewed by the rest of the optical system, by two in both directions. The line scan is therefore doubled in length on the screen, and the light collected from the balls is increased four times, as is necessary for a doubled width. At the same time the original definition of detail is not seriously reduced.

Vertically, the line *width* is also doubled, but the frame scan, of course, is not, and to do this necessitates doubling the thickness of the plate glass slab, making it 1¼ in. thick. This could be done by sticking two ⅝ in. pieces together with Canada balsom; or a form made of transparent plastic is now available. Not only does the increased thickness double the frame



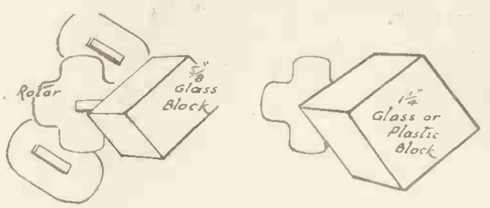

Alteration of lens for larger pictures.

scan, but it helps to correct the optical aberrations of the second cylindrical lens, improving the line definition.

Only one other alteration is needed to double the picture size, without loss of brightness, and that is to cut away a portion of the vertical web of arm A of the frame, near the screen, where it would otherwise obstruct the light at one edge of the 4 in. picture. This operation does not affect any of the mountings. A length of 3 in. should be cut away as shown in the figure.

## *Doubling the Definition*

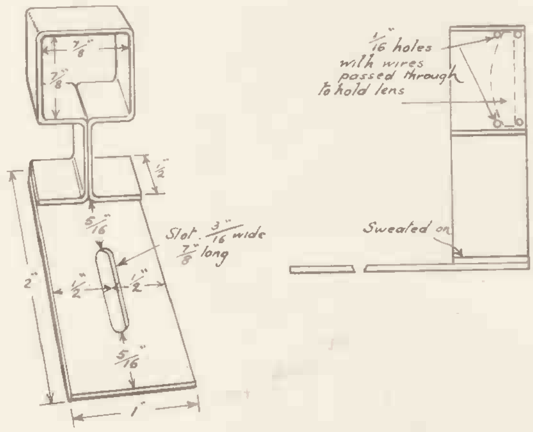
The definition can be doubled by using the full 135 lines of the two interlaced frames, instead of rejecting alternate frames as the present arrangement does. The design considerations here involved were explained



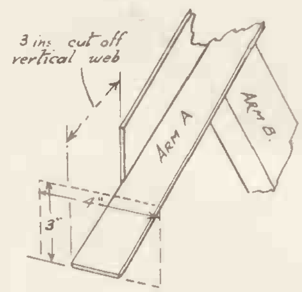

Frame scanners for small and large pictures.

in the July, 1938, issue of this journal, and it will be recalled that unless a ball scanner of high accuracy can be provided it is necessary to ensure that the same ball element scans the same line at each frame, otherwise errors in displacement and centring will produce doubling of the vertical details. To avoid this the alternate frames were cut out, and this permitted the use of the 67½ element scanner driven direct from the mains.

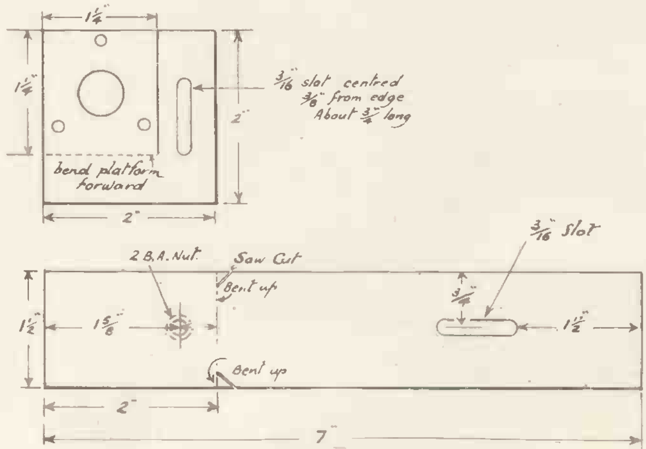
To restore the interlace with this scanner necessitates correction by a device incorporated in the second scanner, for the half frame difference of horizontal position which it necessarily produces in successive frames. While this is fully feasible, it leaves the question of synchronisation untouched. Recent experiments have suggested that a cheaper way of getting both the desired improvements, synchronisation and doubled definition, is to use a smaller ball scanner with a whole number of balls, say, nine, driven solely from




Above: Details of second lens mount.




Right: Alterations to optical frame for large pictures.




Parts of lamp mount.

the amplified synchronising signals. This involves producing it with sufficient accuracy to avoid perceptible errors of alignment or centring, but this appears to be practicable; and the alterations required to the second scanner are then reduced to the substitution of a square prism, ⅝ in. or 1¼ in. thick, as the case may be, for the glass slab of the same thickness: so that all four faces operate instead of only two. Arrangements are being made to supply such a prism of a synthetic material for fixing to the phonic wheel second scanner motor instead of the plate glass slab, and the same prism can be used when an enlarged picture is desired

(Continued on page 127)

# "HOW THE EMITRON WORKS"

(Continued from page 83)

saturated, since then no signal would be produced, although the potential between the second anode and mosaic is sufficient to saturate slow electrons liberated from the mosaic in the absence of the scanning beam. It follows that the flow of secondary electrons from the mosaic to the second anode must be controlled by the potentials of the mosaic elements in the immediate neighbourhood of the scanning spot, rather than by the potential of the second anode, since a potential difference of 3 or 4 volts between the element which has just been scanned and the element which is just about to be scanned requires a field of the order of 100 volts/cm., while the field due to the saturating potential on the second anode is only of the order of 10 volts/cm. at the mosaic surface.

The application of the saturating potential will, however, result in almost all photo-electrons which are liberated by light at points of the mosaic some distance from the scanning spot being collected by the second anode. Hence, a stronger electrostatic image will be built up than is obtained in the normal working of the tube, and the signals will be proportionately stronger.

Because of the saturating field the proportion of secondary electrons that escape from the mosaic will be slightly increased, and the average potential of the mosaic will drift towards the potential of the second anode. Eventually it will reach a new equilibrium potential of a few volts negative with respect to the second anode, and the signals will return to normal. The time taken for the mosaic to reach its new equilibrium potential depends on the scanning beam current and the capacitance of the mosaic elements to the signal plate.

If the potential of the collecting anode could be raised to a sufficiently high potential to saturate all the secondary as well as photo-electrons, the number of electrons leaving the mosaic will be independent of the illumination of the scanned element, and consequently no picture signal will be produced.

It has not been possible to apply a sufficiently high potential between the second anode and signal plate to realise this state completely, but an applied potential of 750 volts was found to produce initially a weak signal which increased considerably as the mosaic potential drifted towards second anode potential, passed through a maximum, and then returned to normal.

## *The Super-Emitron*

As described, the Emitron operates with a low efficiency, of the order of 5 per cent. of the theoretical maximum. The reason for this low efficiency is the lack of saturation of the photo-emission from the mosaic during most of the frame period. Another reason, though probably not so important, is the spread of secondary electrons released by the scanning beam from the mosaic. These secondaries neutralise the charges stored on the mosaic elements and also generate spurious signals, as, for instance, a low-frequency component known as "tilt" which is super-imposed on the picture signals. The tilt may be corrected by suitable electrical circuits.

It was considered that by separating the two functions of photo-emission and charge storage it might be possible to improve upon the efficiency of the Emitron.

A tube which enables this suggestion to be carried into practice is shown diagrammatically in Fig. 6. The optical picture to be transmitted is focused on a continuous transparent photo-surface P. An electron beam is generated at this surface which varies in density across its cross-section according to the illumination. This electron beam is accelerated by the electrode $A_2$ and focused electron-optically by means of the magnetic lens L on to the storing mosaic M, which is backed by

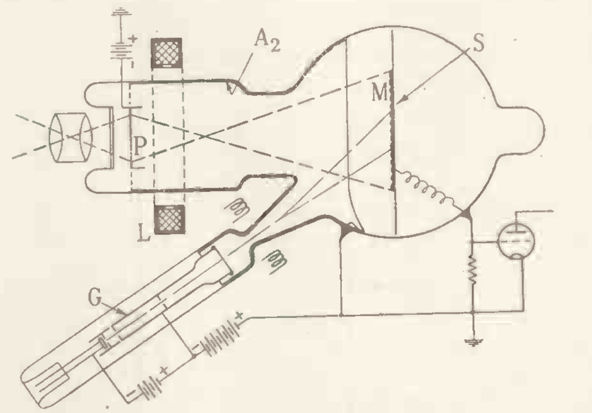



**Fig. 6. Schematic diagram of the Super-Emitron.**

a signal plate S. The mosaic is not photo-sensitive. The beam of photo-electrons projected on to the mosaic generates there a charge distribution which corresponds to the optical picture on the photo-cathode P. The mosaic is scanned in the usual manner by an electron beam from a gun G, thus restoring the elements to an equilibrium potential.

There are three striking advantages in the new tube; (1) the improvement in the efficiency of the photo-cathode; (2) the multiplication of the charges on the mosaic by secondary emission; and (3) the improved optical conditions.

In the normal Emitron the photo-sensitivity is limited to about 12 $\mu$A/lumen. Continuous photo-cathodes can at present be made with photo-electric sensitivities more than twice that obtained from mosaics in the Emitrons. There are several reasons for this. For one thing the ratio of the surface covered by photo-electric material in a mosaic to the total area is only of the order of 50 per cent. Furthermore, the Emitron mosaic has to carry out two functions—it has to emit photo-electrons and to store charges. For storing charges efficiently the insulation between the mosaic elements must be high, and the quantity of caesium which is applied in forming the photo-mosaic is therefore limited as a compromise between sensitivity and insulation.

The other main feature of the new tube is the secondary amplification at the mosaic surface. Under the impact of each photo-electron from the cathode P a number of secondary electrons are liberated at the mosaic and the elements are left with a net positive charge. The sign of the charge stored on the mosaic is the same as in the Emitron, and the signals therefore have the same sense. The amount of charge stored is multiplied according to the secondary emission coefficient $K$, the multiplication factor being $(K - 1)$. For caesiated surfaces the factor $K$ is of the order of 7 to 9 for an optimum primary velocity of the electrons of about 400 volts. Therefore, under the same condition and for equal photo-sensitivities it is to

# OTHER TRANSMITTING TUBES

be expected that the signal from the new tube should be 6 to 8 times stronger than that from the standard tube.

Comparative measurements have been made on the signal output of a number of Emitrons and Super-Emitrons for equal conditions of illumination and beam current. These measurements showed that for equal photo-sensitivities the new tube gave about 10 to 15 times the signal amplitude of the Emitron. In a few cases the ratio was considerably higher.

This factor, therefore, is too large to be explained in terms of secondary emission amplification only, but is satisfactorily explained if account is taken of the different velocities of the photo-electric and secondary electrons. As was shown above, the mosaic elements are brought to an equilibrium potential by the scanning beam, which potential is very close to that of the second anode of the gun. The integrating efficiency of the Emitron is small compared with the "line sensitivity," since the photo-electrons can only escape from the elements a short time before the scanning beam strikes them. The photo-electrons released by visible light from the photo-sensitive mosaic have velocities corresponding to approximately 1 electron volt.

In the new tube secondary electrons are released from the mosaic elements. The bulk of these have velocities of several electron volts, and a certain proportion have much higher velocities. They will, therefore, escape more readily under the same field conditions and reach the second anode. This will result in an increase of the integrating efficiency, since a substantial number of electrons will be able to leave the elements between scans. This is confirmed by the observation that fast-moving objects imaged by the new tube leave a blurred trail behind them in the picture, the leading edge being sharp.

## *Construction*

A diagram of this type of tube as now in production is shown in Fig. 6.

The electron gun and the mosaic are arranged in the same relative positions as in the Emitron. The chief difference is the addition of the projection neck for the electron optical conversion of the light picture into the electron picture. At the end of this neck is an optically flat window in front of which the photo-cathode is fixed. It is of the transparent type formed on a mica disc approximately 60 mm. in diameter. The cathode is surrounded by a short cylinder for concentrating the photo-electron beam. The second anode of the scanning gun is extended into the projection neck and serves to accelerate the photo-electrons. It is formed by depositing a silver coating on the walls of the tube.

The beam of electrons from the photo-cathode is focused on the mosaic by a magnetic lens L of the ironclad type. The coil, however, also produces a rotation of the picture about its axis, and, in order to correct for this rotation, the tube is rotated in the camera through the same angle, and in the same sense. A photograph of the tube in the camera is shown on page 78; the focusing coil and the rotation of the tube in the camera are clearly visible. The electron optical magnification between mosaic and photo-cell is approximately 4:1. The mosaic consists either of an aggregated aluminium layer on mica or of plain mica which is coated on the back with the usual conductive coating to form the signal plate.

As the size of the optical picture on the photo-cathode is much smaller than that on the mosaic of the Emitron, lenses with shorter focal lengths are used. Furthermore, owing to the increased sensitivity of the new tube smaller lens apertures can be used for the same illumination, resulting in greatly increased focal depth.

Careful screening in the camera is necessary to prevent interference between scanning and focusing magnetic fields.

The sensitivity of the new type of tube can be still further increased if the electron beam forming the picture is amplified by secondary emission one or more times before reaching the mosaic. Development along these lines is being carried out and shows considerable promise.

## *Other Forms of Tube*

A number of other forms of television tubes which may be mentioned here have been constructed and used experimentally.

The type of tube described above may be used under different operating conditions from those mentioned. Referring to Fig. 4, if the photo-electrons are accelerated sufficiently to strike the mosaic with a velocity much beyond that corresponding to the second cross-over point B, they will release only a few secondaries and will charge the elements negative. The scanning beam strikes the mosaic with a velocity corresponding to a point between A and B and restores them to an equilibrium potential. A tube operated in this way produced signals the sense of which was opposite to those produced by the standard tube. This method, however, does not give secondary amplification.

Another method is to scan the mosaic with a beam the velocity of which is greater than that corresponding to the second cross-over point. A potential difference is then established between the mosaic and the second anode, which is equal to the difference between the potential of the latter and that of the second cross-over point. If this difference be made large enough, the whole of the emission from the mosaic will be saturated and collected on the second anode. There would be no spread of secondary electrons and, therefore, no tilt. Furthermore, there would be the full theoretical efficiency due to the complete saturation of all the electrons from the mosaic. The photo-electrons are projected on to the mosaic with a velocity corresponding to the peak of the secondary emission characteristic in Fig. 4. Those elements which are hit by photo-electrons in the intervals between scans rise in potential and the scanning beam restores them to their equilibrium potential at the second cross-over point. The sense of the signal is the same as that of the standard tube.

Other forms of tube have been constructed and used in which the necessity for scanning the mosaic at an angle is avoided. In this way it is unnecessary to supply circuits to correct for trapezium distortion. In the normal Emitron this was done by making the signal plate transparent and projecting the image on to the mosaic through the signal plate. The sensitivity of such a tube is, however, comparatively low.

# BOOKS ON TELEVISION

## —AND ASSOCIATED SUBJECTS

*In response to a number of requests we publish below a brief summary of television literature. The remarks are not intended as reviews but merely to indicate the scope of the various works.*

**First Principles of Television,** by A. Dinsdale (1932). (Chapman and Hall, Ltd.). 12s. 6d.

A book that up to the time of its publication (1932) covered the entire field of television in a very thorough manner. The major part of the book deals with mechanical systems. For reference purposes and an explanation of fundamental principles, it will be found most useful.

**Television—Theory and Practice,** by J. H. Reyner (1934). (Chapman and Hall, Ltd.). 12s. 6d.

This book was first published in 1934 and has since been brought up to date and revised. It provides a fairly complete survey of the subject from a practical point of view and is not historical.

**Televiewing,** by Ernest H. Robinson (1935). (Selwyn and Blount, Ltd.). 6s.

A handbook on television intended for the average person who has no knowledge of the subject. Historical development is combined with practical explanation and although now not entirely up to date, it provides all the information that the non-technical person is likely to require and in a form he can easily understand.

**Radio Receiving and Television Tubes,** by James A. Moyer and John F. Hostrel (1936). (McGraw-Hill Publishing Co., Ltd.). 24s.

A comprehensive treatise on valve design and probably the only one that also includes the cathode-ray tube and acorn valve. It is essentially technical and in its 635 pages there are chapters including valve construction, fundamental principles of design, valve testing and applications, cathode-ray tubes and their applications.

**Television Up-to-date,** by Robert Hutchinson (1936). (University Tutorial Press, Ltd.), obtainable from H. Sanders and Co., 4 Grays Inn Road, London, W.C.1. 2s. 10d., post free.

First published in 1936 and since revised this is a practical handbook which will be found very useful to the serious student with which to start his studies.

**The Cathode-ray Tube at Work,** by John F. Rider (1935). (Holiday and Hemmerdinger, 74/8 Hardman Street, Deansgate, Manchester).

Of American origin and largely concerned with the use of the cathode-ray tube in the servicing and checking of radio receivers. A complete explanation is given of the various types of cathode-ray tube and their operation. The design of cathode-ray oscilloscopes is dealt with also, but primarily the object of the author has been to explain their applications.

**Television,** by M. G. Scroggie (1935). (Blackie and Son, Ltd.).

An easily understandable handbook of 68 pages dealing with principles, equipment, mechanical and cathode-ray systems and special devices explained in non-technical language. The book can be recommended as a simple introduction to the subject.

**Popular Television,** by H. J. Barton-Chapple (1935). Sir Isaac Pitman and Sons, Ltd.). 2s. 6d.

A useful book for the beginner. In a book of this size (109 pages) the treatment is necessarily brief but the author who is a well-known writer on the subject covers all the essentials in an informative manner and provides just that information that the novice requires.

**Photo-electric and Selenium Cells,** by L. J. Fielding (1935). (Chapman and Hall, Ltd.). 6s.

A practical treatise on light cells and their application. Information on the construction of associated apparatus is provided.

**Television Reception,** by Manfred von Ardenne, translated by O. S. Puckle (1936). (Chapman and Hall, Ltd.). 10s. 6d.

Of German authorship this was one of the first books to describe in detail the construction and operation of a modern high-definition cathode-ray receiver. It is thoroughly practical and of a somewhat advanced nature.

**Television Technical Terms and Definitions,** by E. J. G. Lewis (1936). (Sir Isaac Pitman and Sons, Ltd.). 5s.

This book explains the meaning of technical terms in the fullest possible manner, using illustrations where necessary. There are over 1,000 definitions. A useful source of reference.

**Television Cyclopoedia,** by Alfred T. Witts (1937). (Chapman and Hall, Ltd.). 7s. 6d.

Provides concise information and is really a practical outline of the science and practice of television arranged in alphabetical order of terms and expression. It is illustrated and is a really useful reference, the subject being covered extremely well.

**The Perception of Light,** by W. H. Wright, D.Sc., A.R.C.S. (Blackie and Son, Ltd.). 6s.

An analysis of visual phenomena in relation to technical problems of vision and illumination. General lighting, the cinema, the headlight problem, television, night vision, etc., are included in the survey.

**Television with Cathode Rays,** by Arthur H. Halloran. (Pacific Radio Publishing Co., San Francisco).

A practical handbook on the use of the cathode-ry tube with particular reference to television transmitters and receivers. Contains a large number of circuits and practical designs of apparatus.

**A Simple Guide to Television,** by Sydney A. Mosley and H. J. Barton-Chapple. (Sir Isaac Pitman and Sons, Ltd.). 1s.

A simple handbook outlining the development and principles of television in a manner that can be understood quite easily by any reader. A very useful guide and introduction to television for the novice.

**Testing Television Sets,** by J. H. Reyner. (Chapman and Hall, Ltd.). 9s. 6d.

Primarily intended for the service man who desires knowledge on the adjustment and repair of television receivers. Possible faults and their remedies are dealt with and information given on testing equipment.

**Principles of Electricity and Magnetism,** by Gaylord H. Harnwell (McGraw-Hill Publishing Co., Ltd.). 30s.

A most comprehensive treatise of-a theoretical and experimental nature of modern ideas of electricity and magnetism. For the serious student who requires a complete conception of modern electrical development and general application it is outstanding. It contains over 600 pages.

**Electron Optics and Television,** by I. G. Maloff and D. W. Epstein (McGraw-Hill Publishing Co., Ltd.). 21s.

Covers the complete theory of electron optics and the principles employed in the design of electronic apparatus. Intended for the research worker, it is probably the most comprehensive work on the subject of electron optics and their practical application.

**Engineering Electronics,** by D. G. Fink (McGraw-Hill Publishing Co., Ltd.). 21s.

The first part of this book deals with the fundamental principles of electronics, emission, electrons in gases, control of free electrons, and electron tubes. The second part is concerned with electronic sources of light and the third with electron tube applications.

**Television Reception Technique,** by Paul D. Tyers (Sir Isaac Pitman and Sons, Ltd.). 12s. 6d.

Devoted to the design, operation and testing of cathode-ray television receivers. Basic principles are first dealt with followed by their practical application. A useful section on receiver faults is included.

**Television — A Guide for the Amateur,** by Sydney Mosley and Herbert McKay (1936) (Oxford University Press, Ltd.). 5s.

A non-technical book for amateurs who have radio knowledge. The whole subject is covered and the information given is that which the average person who wishes to obtain a general knowledge of television requires. The modern (1936) aspects are given the greatest prominence and very little space is devoted to historical development.

# Sir Maurice Bonham Carter, Mr. Soloman Sagall and Oscar Deutsch on the General Television Situation and Scophony's Prospects

SIR MAURICE BONHAM CARTER, Chairman of Scophony Limited; Mr. Solomon Sagall, Managing Director of Scophony, Limited; and Mr. Oscar Deutsch, Chairman of Odeon Theatres, Limited, and a Director of Scophony Limited, recently addressed the annual general meeting of Scophony shareholders. The views expressed by the heads of leading television companies are no doubt of importance to all those interested in television, and for that reason we reproduce some extracts from their addresses.

*Sir Maurice Bonham Carter's views*:

## General Television Situation

We are now in a position to review the result of the first two years of the London television service, and one is justified in describing the service as an unqualified technical success, though naturally there is still room for considerable improvement, and there are still shortcomings to be overcome. However, the results so far achieved entitle this country and the British Broadcasting Corporation to a considerable measure of satisfaction.

We in Scophony and other companies engaged in television have not hesitated from time to time to emphasise to the B.B.C. and the Television Advisory Committee the view that in the main public response is proportionate to the quality of entertainment offered.

One must acknowledge the fact that the B.B.C. fully appreciates the situation and, indeed, is doing its very best with the means available to improve the quality of the programmes.

However, I do not consider the problem insoluble. It might have been fairer to the B.B.C. and better for a number of reasons to have treated the London Television Service in its first few years as an "experiment" merely. Now as an experiment the London Television Service in its first two years is undoubtedly a success, and consequently we are encouraged to face the future of television with optimism.

I think the time may be appropriate to make a few suggestions for the consideration of the authorities as well as for public discussion

(1) The B.B.C. should consider the gradual introduction of television as pictorial illustration to normal broadcasting of sound, with a view perhaps to merging ultimately the sound and vision services.

(2) The experience over many years of the cinema industry in the art of providing entertainment should be enlisted

(3) The possibility of "sponsored programmes" by advertisers should be seriously considered.

## Scophony's Position

Let me now deal with the position of Scophony in television. In television large revenue will be derived mainly from the manufacture and sale of receivers and from the grant of licences for manufacture and sale of such receivers. Outside Scophony there is only one method used in television—by means of the cathode-ray tube.

## Large Pictures

Scophony originated, however, with the conception that nothing smaller than pictures approximating in size and in appearance to the home cinema would eventually satisfy the viewing public.

The Scophony home receiver giving a picture 24 in. by 20 in. was demonstrated at Radiolympia at the end of August, 1938, since which date considerable further improvements have been made.

## Cinema Television Prospects

Mr. S. Sagall and myself dealt at some length last year with the prospects of cinema television. We are pleased to note that in this field the Scophony ideas are gradually beginning to meet with the consideration of leading cinema interests. It is our view, however, that the cinema industry cannot take its entertainment from the B.B.C. There must be established sooner or later an independent television service for cinemas

Your company hopes to play its part in the provision of transmitting equipment for television stations. We have developed television film transmitters which give a high degree of picture excellency, and also synchronising gear and associated equipment.

*Mr. S. Sagall's impressions from his visit to the U.S.A.*:

The United States, owing to the vastness of the country, has far greater problems of television finance than those which confront us here, and due to the fact that broadcasting is a private enterprise in the United States, there was a great deal more hesitancy on the part of the broadcasting companies in making a start. It is for this reason that the United States to-day has not yet a television service.

The two leading broadcasting companies in the U.S.A., the National Broadcasting Company and the Columbia Broadcasting Company, recently decided, however, to introduce television by the time the World Fair opens, and so on April 30, 1939, two stations will commence transmissions

At the commencement the service will be on a somewhat modest scale with only two hours a week from each station. As a result of my investigations, I am, however, satisfied that once a start is made television will develop and grow rapidly in the United States.

I have a great deal of confidence in the future of television in the United States, and would venture to predict that within a year or two American

(*Continued in 3rd col. of next page.*)

# Telegossip

## A Causerie of Fact, Comment and Criticism

*By L. Marsland Gander*

PROGRESS with the scheme for a national service is slow. I hear that the Post Office has not yet had delivery of the experimental apparatus with which it is to make tests of the radio link, using a wave-length of approximately two metres. In fact the Television Advisory Committee has not even received full details of the Marconi-E.M.I. scheme on these lines. I hear that the E.M.I. plan may envisage the use of miniature, automatic transmitters mounted, for the sake of height, on pylons. On the other hand, I have the best reasons for saying that the Post Office would not be easily persuaded that it is necessary to elevate the transmitters in this particular way.

Looking still further ahead, there is a difference of opinion as to the best site for the first provincial transmitter. Mr. F. W. Ogilvie, Director-General of the B.B.C., suggested in a recent speech that the station would be in Birmingham. His words were, moreover, generally interpreted to mean that a site had actually been chosen in the Midlands.

I understand that the D.G. did not intend his remarks to be construed so positively. It is not by any means certain that the first transmitter will be in the Birmingham district. There is strong official support for the suggestion which I made in these columns that the station should serve the dense populations of Yorkshire and Lancashire.

I hear also that the B.B.C. will shortly be supplied with yet another new type of Emitron camera. Sir Noel Ashbridge, at a recent lecture, showed photographs which illustrated the remarkable improvement in the quality of reproduction since transmissions first began from Alexandra Palace. We may look forward to still better pictures from the new cameras, and in this progress there is continual confirmation that we have not by any means exhausted the possibilities of 405-line television.

### Real Long Distance

The television sensation of the month was the revelation that pictures from Alexandra Palace had been received at the Riverhead station of the Radio Corporation of America on Long Island, New York. This information was actually contained in a series of reports sent to Mr. L. W. Hayes, of the B.B.C. Engineering Department. I am able to give some of the details which confirm beyond a shadow of doubt the authenticity of the reception. The American engineers' log ran as follows: November 3. "Received picture of old gentleman with wig or bushy hair; head of girl looking directly at screen, girl appeared to have large mouth. Short haired old gentleman with handkerchief in pocket showing above pocket. Young man with pointer in right hand pointing at a screen."

All these observations were confirmed by the B.B.C. except the last, as items in the afternoon programme. The "old gentleman" first mentioned was the chief character in the play "Cast Up by the Sea," by Stephen Leacock. The girl was Joan Miller in "Picture Page," whose charming smile had evidently been distorted by Transatlantic transmission. The next item referred to was also in "Picture Page." Perhaps the most convincing piece of confirmation is the fact that the Americans' log noted signing off time as 16.16 G.M.T. The B.B.C. log-book at Alexandra Palace showed that the station closed down at 16.16 and 5 seconds!

There were further entries in the log relating to November 5 when, it was stated, a "magician waving a cloth" had been seen. This was also confirmed by the B.B.C.

### Alterations at A.P.

The B.B.C. continues to spread throughout Alexandra Palace, the latest acquisition being the old art gallery alongside the theatre, which measures approximately thirty feet wide by 300 feet long. Another section near the theatre has also been taken over. These further extensions might give rise to the belief that in time the B.B.C. will occupy the whole Palace and that on the site, one day, an immense new Palace of Television will arise. This is not, however, correct.

I am told that the B.B.C. does not intend to take over more than one-third of the existing building. The carpenter's shop in the vestibule of the old theatre will be shifted, with many improvements and additions of up-to-date machinery, into the former art gallery. The offices behind the stage, faintly reminiscent of the Black Hole of Calcutta and at present occupied by Mr. Philip Dorte and the O.B. boys, will be vacated and new offices are to be constructed in the space occupied by the present carpenter's shop. These new offices will be as light and airy as those on the other side of the building and they happen to overlook the beer garden which may, or may not, be an advantage.

This month will see the launching of a big co-operative television drive in which Mr. F. W. Ogilvie, Director-General of the B.B.C., is co-operating with Mr. C. O. Stanley, chairman of the R.M.A. Television Committee. Dealers are to be the first object of attention for it is recognised both by the B.B.C. and the manufacturers that demonstration in the home is incomparably the best way to sell sets. I understand that Mr. Howard Marshall may give another series of broadcasts on sound wavelengths dealing with television as the last series was considered to have had very satisfactory results.

---

### "Scophony's Prospects"

(*Continued from page* 98)

television will outpace developments in this country and anywhere else in Europe.

It would not be desirable to go into detail now, but I can say that I am greatly encouraged by Scophony prospects in America. Contacts have been established with leading interests which necessitate a further visit by me in a few weeks from now. The formation of an affiliated American Scophony company which would engage in the exploitation of the Scophony rights in the United States is now under discussion.

*Mr. Oscar Deutsch on Cinema Television*:

Mr. Oscar Deutsch said that he shared the chairman's views with regard to the potentialities of the Scophony system in the television field. He, as chairman of Odeon Theatres, Limited, was very interested in the chairman's remarks about the cinema end of the business, because he personally was of opinion that therein lay, as far as Scophony Limited, was concerned, very great potential value.

# Our Readers' Views

Correspondence is invited. The Editor does not necessarily agree with views expressed by readers which are published on this page.

## *Home-built Receivers*

SIR,

I am enclosing one or two photographs, taken with my 16 mm. camera and enlarged, of the results obtained on the Home Built Televisor as described in October, November and December, 1937, issues of your magazine. As you will realise, I am at least 35 miles from A.P., but excellent results are obtained equal to, and, I think, superior to many commercial models. The only trouble experienced is interference from cars, as I am situated alongside a main road and near a junction, all in line with A.P. The aerial is the usual dipole and reflector, home made from copper tube and mounted on a 40-ft. mast; fed by Belling-Lee twin feeder, it is about 50 yards from the road, but this is not sufficient to prevent interference. A 12-in. tube is used mounted upright in a cabinet with mirror in lid for indirect viewing. The picture remains very steady and practically no trouble is experienced with synchonising even during complete black-outs due to heavy interference. I would not like to close without expressing my appreciation of the help received from the designer, Mr. West, during the first stages of operation when I had a few queries.

HAROLD R. EAST (Aylesbury, Bucks).


## *Interference Suppression — A Good Move*

SIR,

Everyone who has had experience of television appreciates the menace of interference, 90 per cent. of which is due to motor vehicles. It is probably the worst handicap to television expansion.

We have promises that government department vehicles will soon be suppressed and we hope that motor manufacturers will shortly follow suit voluntarily without waiting for legislation. Can we in the radio industry help to make motorists suppression conscious and spend a few shillings on their cars to help televiewers? We think we can. Anyway, it is always good to practice what we preach and do our own little bit to help start and push this ignition suppression snowball.

To this end we and other suppressor makers have decided to reduce the price of plug and distributor suppressors from a small quantity price of 2s. 6d. each to a mass production list price of 1s. 6d. each. Next, we have issued a rule that every one of our representatives fits suppressors to his car, and further, that suppressors are fitted by every employee who makes use of the firm's car park.

We have written to every dealer on our list within the television area urging them to fit suppressors to their service vans and to insist that every car belonging to the staff is suppressed. We would like to think that cars owned by the staff of your paper were also so treated.

We would like to make the following additional suggestions:—

1a. That every manufacturer of television receivers insists that their staff and every representative fits suppressors to his car.

1b. That they all press home the point with dealers.

2. That dealers be asked to drive home the point to their television customers, and to sell each customer a set of suppressors. By making the television user realise the importance of suppression they will talk about it to their neighbours and so the campaign will spread.

3. We would also like the B.B.C. to issue a rule that *all* their vans *and* employees' cars are suppressed, and then tell the tale on the air both from the B.B.C. and in picture form from Alexandra Palace.

BELLING & LEE, LTD.
(Enfield, Mdx.).

## *Noise Suppression in Television Receivers*

SIR,

We noted with interest in "Scannings and Reflections" appearing in the current issue of TELEVISION AND SHORT-WAVE WORLD a reference to noise suppression circuits on television sound.

It may interest you to know that all our television receivers are fitted with automatic noise suppression on the sound channel and have been for some considerable time.

We considered it more important to have noise suppression on the sound than on the vision, since the "irritation value" on sound is far greater than on vision.

PYE, LIMITED (Cambridge).

## *Transatlantic Television*

SIR,—Widespread publicity has been given to the recent transmission of television across the Atlantic. This has been claimed to be the first time that television has been sent between London and New York. This is not the case. Television was transmitted from London to New York in 1928 by Mr. Baird. The widest publicity was given to this demonstration at the time and its importance fully recognised.

May I ask that in the interests of truth and in justice to British pioneer enterprise you will be good enough to give this letter or the facts it contains the publicity necessary to correct the false impression created.

Full technical details of this demonstration were published in *Nature*, dated February 18, 1928, and in the March issue of the same year of TELEVISION. For your information, I enclose a copy of the article which appeard in TELEVISION.

I would also add that this demonstration was followed by the transmission of television to the *Berengaria* in mid-Atlantic when several of the officers and passengers saw the images of persons transmitted from the London studio, among them the fiancée of the wireless operator, who was recognised by him when she appeared on the screen.

CLARENCE TIERNEY, D.Sc.
Chairman of the Council of the Television Society.

# Long Skip

*G5KA would like reports from any amateur logging new DX Stations.*

THE feature in ham radio over the last few weeks has been the DX coming through on the lower frequency bands. Over 40 "G" stations are said to have got over to the U.S.A. on the 1.75mc. band during the recent c.w. contest. W1BB and W1AW both worked a line of our stations, and W1DIZ got through well on 6 watts. The most consistent signal from this side was put over by G6WY. G3MD tells us that during the night of the contest he heard W1BAD and W1SU, both on 'phone, at R6, QSA4, QSB to R2. He also lets us know that he hooked G5CZ in the Isle of Man, on this band; this was a phone QSO, with input at 5 watts from G3MD.

This is a very good view of W9DXX, showing the operating position.

Gi6TK has been doing well on 3.5 mc. c.w., having worked most districts of the U.S.A. and Canada. He has received a report from the Federated Malay States on his 'phone. Dennis Tyler, of Ilford, reports having heard VE4CA on 'phone at R7; his log for this band includes plenty of W's and VE's all at R7 or over.

In case you have not yet moved up to 7mc., there is all the DX there you want—if you search for it! G8TV heard YV, XE, VU and W4 all around 2300. He has worked several W's and a few VE1's and 2's. He also worked TA1AA who was around 7,050 kcs., but was rather disappointed when he heard that this one is probably phoney. This station has been very active on 14 mc. in the past, and until we see his QSL he will be regarded with suspicion!

On 14 mc. the outstanding signal has been TG9BA; he is to be found sitting in the American 'phone band. Dennis Tyler reports this one, together with a list of the finest 'phone DX we have ever seen. The list includes VQ3TOM (Tanganyika) in the American 'phone band, VQ4WES (LF), VP5AG (APB), K4ERY, Virgin Island (APB), HH2X (APB), J7CT (APB), CX1AA (LF), K7AWT, HK4EC, VQ8AFQ and FM8AF, Martinique, all in "W" 'phone band. Then there is VS7RP, HI3U, and CE4AM up the LF end. Dennis usually provides us with something unusual, and this month he presents TAIN, a Turkish commercial, heard working CN8AV. Look for him HF end.

BSWL 387 has been doing good work with his 2 tube job. He lists nearly all the ZS's in the Callbook! Others are KA3KK and KA7EF both around 2300. Bob tells us that both these QSL and that KA3KK's card is well worth going for (if you hear him, of course!), as there are three nice photos on same. QRA is P.O. Box 22, Baguis, Phillipine Islands. Other 'phones from Asia are XU8ET (HF end), reported by SWL Mallett, of Kirby Cross, Essex, and XU6AL, who was worked by G6QX. Others run off by 6QX are VE5PD, ZC6EC, LU6AF, LZ1ID (Bulgaria—QSL via HB9CE), CP1AA, ZB2A, XU8CM and CR7AF. G6QX runs 150 watts on 4 bands, and 4 separate final stages are used all link coupled from a 45 watt Bi-push exciter. Bob uses 10 Xtals. Each final stage has a separate tuned antenna tank, and QSY from one band to another can be effected in 2 minutes. Receiver is a Comet Pro. with Preselector, and a 137′ end fed antenna 46′ high is used on 14, 7 and 3.5 mc. bands, while a 33′ Windom 46′ high completes the job for 28 mc. As for his DX record, Bob has worked 82 countries in 35 zones, 35 countries on 28 mc. and is WAC, WBE on 7, 14 and 28 mc.'s. New Mexico and Nevada are the only two States wanted for WAS. This is the sort of station most hams dream about, but very few own!

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

G5ZG has been busy again and landed TG9BA, ZC6EC (approx. 14,270), K4FAY, K4ERC and VP7NS in Nassau, Bahamas; all these were on phone. On 28 mc. he worked all "W" districts, but could not hear much from other parts of the world. He notices this band closes a good deal earlier this year than last, "W" signals going out about 1800 against 2100 last year.

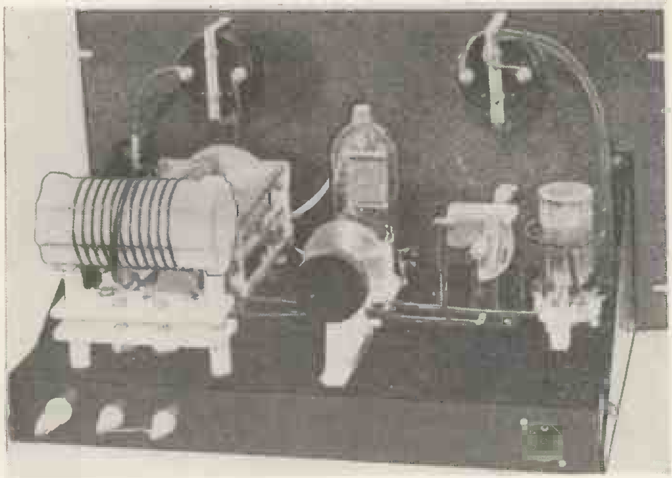
G3BS is in for the "Radio" DX Marathon, and so far has worked 14 zones and 23 countries. This Marathon started January 1 and goes on until December 31. Hector is rather annoyed, because the day before the contest started he raised VP7NT in Nassau (c.w.) which would have given him another zone. VP7NT is to be found near 14,000 kcs. with a T9 note. G3BS tells us that G5RV has now worked 119 countries, the latest being OY4C in the Faroe Islands.

G2KG, who spends most of his time on 28 mc., says his DX has been confined to local "W's" who are nearly as tired of working him as he is of them! He says that HI7G, to be found near 28,110 kcs., always gives an interesting QSO and is always on the look out for "G's." W2JCY asks him to broadcast the fact that he is trying to contact "G" on 56 mcs. and is radiating a 250 watt c.c. signal right in the middle of the band. He is on every Wednesday from 1,700 GMT.

G2VZ lets us know about VK9VG (14,360), CX2AJ (14,400), EL2A (14,340), XU7CW (14,285) and SV6SP (7,125), all on the key. Some unusual ones are ZP1A (HF) and PX1AA, Andorra, who seems to have come to life again. No, he does *not* QSL. Between 14,390 and 14,250 kcs., G2VZ has been running across T4TWO quite a lot. This one and another phoney, POPI, appear every now and then. One good point in their favour, however, is that they certainly don't mind letting everyone know they are pirates!

Thanks to all those others who sent in reports. Owing to great pressure of space, we regret we have been unable to use them.

*This transmitter designed and built by G2HK and 2FIU, is extremely flexible so that it is suitable for use by amateurs who only hold comparatively low-power licences. It is suitable for phone or C.W. operation and will cover 40, 20, 10 and even 5 metres in its present form. A large number of R9 plus reports from America and Canada were received during initial tests.*



**The final stage uses a Taylor T40 and occupies one complete chassis.**

# A Complete 50-watt Phone or C.W. TX

This transmitter has been built on commercial lines but designed so that it is extremely flexible and can be used on phone or C.W. with either two or three stages, as required. Despite the fact that it is built in a rack and does not appear on the surface to be at all experimental, we have a considerable number of experiments to carry out and we consider that by having numerous separate chassis in this way, individual stages could be modified without completely wrecking the entire transmitter.

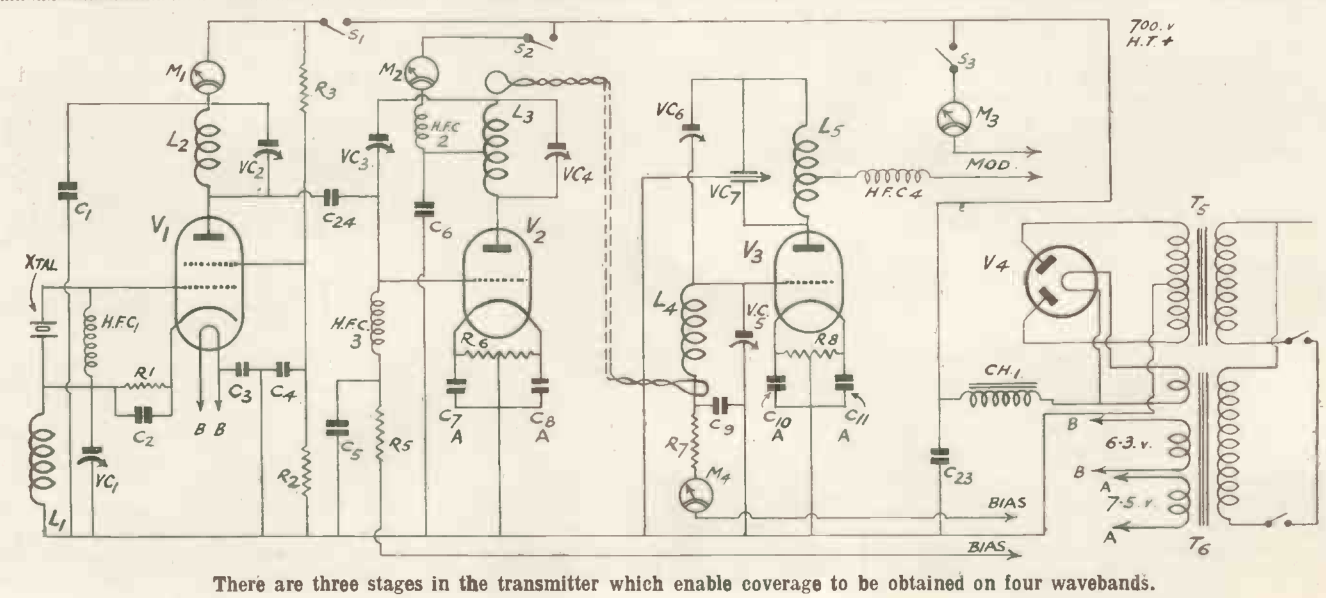
It must not be considered from this that because we have further experiments to carry out that the transmitter is not complete and entirely satisfactory in its present form. Our experiments are merely with valves of different kinds and coupling circuits, and are being made for the purpose of obtaining first hand data. To prove that the transmitter is satisfactory, we should like to point out at this early stage that when the transmitter was first air tested a large number of telephony contacts were made with W and VE, some of the reports saying that our signals were the loudest from Europe at the time. This, with an input of a little under 50 watts.

### The R.F. Circuit

The circuit of the R.F. section with its power unit is shown on this page and although it is complete, it must be remembered that this portion of the transmitter accounts for three distinct chassis, one for the crystal oscillator and doubler/buffer, a second for the T-40 power amplifier, and a third for the high-voltage power pack, which gives 700 volts at 250 mA.

### Two Stages

For those who do not wish to use the full 50 watts, it should be appreciated that by omitting the link between V2 and V3, and coupling L3 to the aerial, the transmitter will with two stages operate effectively on two wavebands with an input not exceeding 25 watts. With a little care and reduced modulation, the input can still further be reduced to 10 watts. This is rather an important point for the amateur who is

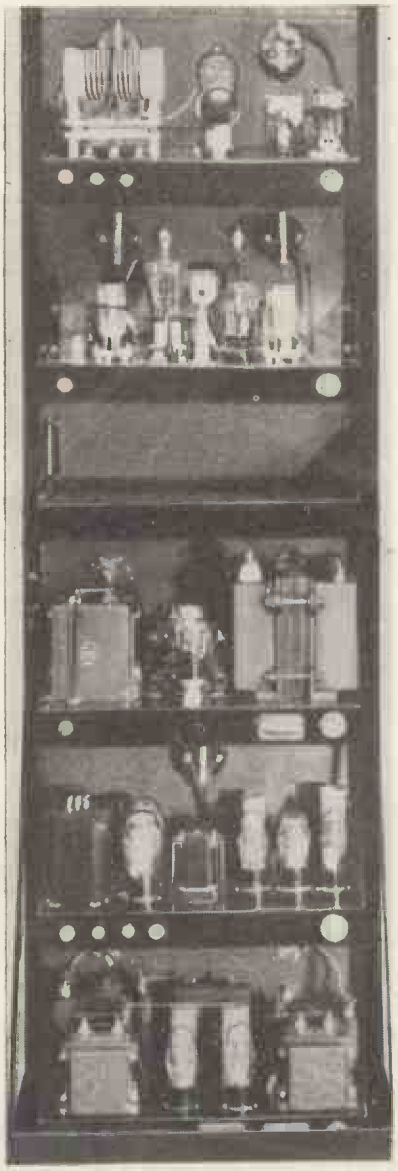



**There are three stages in the transmitter which enable coverage to be obtained on four wavebands.**

# 3-Wave Bands

just licensed can start building this transmitter and as his power permits are increased, add additional stages up to 50 watts. This merely means link-coupling to V3 and does not mean any alteration at all to the existing stages.

We consider this to be of value for so



**This back view of the complete transmitter shows that there is ample space and that it has a commercial appearance.**

many amateurs are inclined to build a transmitter for low-power use and then when they are granted a higher power permit have to scrap the bulk of early equipment. This always means a considerable expense which is quite unwarranted should the design be good in the first instance.

It is simpler to consider this transmitter, chassis by chassis, and not as a whole, for very few readers are prepared to go to the expense of building a complete rig straight away. In any case, we are of the opinion that at least 70 per cent. of British amateurs are at the present moment restricted to an input of 10 watts.

The first chassis of interest is that which takes the crystal oscillator and buffer-doubler. The illustration quite clearly indicates how the components are laid out and we strongly advise readers strictly to adhere to this layout. It is most important that the driver stages be smooth in operation, so for this reason, we have shown a second illustration indicating just how the smaller components under the chassis are located.

## The C.O.

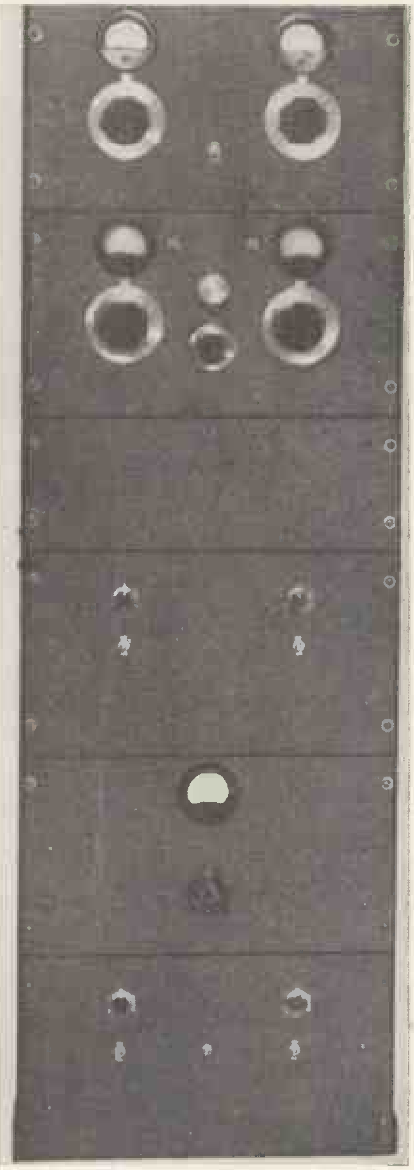
The crystal oscillator uses a 6L6G made by Tungsram in a tri-tet circuit which provides practically the same output on 20 metres as it does on 40 metres. L1, the cathode coil is mounted directly across VC1 which has a capacity of 160 mmfd. so dispensing with a coil former and holder. One of the rota plates of VC1 is bent at the tip so that by having the plates fully in mesh the cathode is short-circuited so allowing the C.O. stage to work on fundamental frequency.

This C.O. works so effectively that approximately 2 to 3 watts can be obtained on 10 metres and between 10 and 12 watts on 40 and 20 metres. For this reason, the first two valves can be used in a number of ways. For example, with 10 metres at L2, the second stage can either be a doubler to 5 metres, or a sub-amplifier on 10 metres. With L2 at 20 metres, L3 can be tuned to 20 or 10 metres. If the final valve is omitted it is still possible to obtain quite a healthy R.F. output on 40, 20 and 10 metres with only two valves, although our original design did not allow for this.

The values in the C.O. circuit are important and must not be varied, particularly R1, which is 300 ohm 4-watt resistor. The by-pass condensers, C1, C3 and C4 are all grounded at the same point which is also the terminal point for VC1, R2 and the earthy end of L1.

In the anode circuit of the oscillator is L2 wound on a 4-pin coil former of which only two pins are used. The coil is as close as possible to VC2, so making very short leads. VC2 has a capacity of 100 mmfd. and it is not suggested that readers use a lower capacity in this circuit.

The screen voltage for the oscillator is obtained by means of a fixed potential divider made up of R2, R3 and R4. This actually is a 75,000 ohm resistance at 75 watts rating, the correct voltage being obtained by adjusting the tapping clip. A switch is connected in series with the H.T. supply to the oscillator stage and notice particularly that the fixed potential divider is on the valve side of the switch so that the anode and screen voltage is removed at the same



**Notice that the crystal is mounted on the front panel and that separate switches are supplied for all power units.**

time. The voltage on the screen of the 6L6G does not exceed 275 which is the optimum working value.

The output from the crystal oscillator is fed into the grid of V2 through condenser C24 which is of the Bulgin short-wave type having a capacity of .0002 mmfd. This condenser is of the air-spaced variety which is rather important. However, in our original

# The P.A. Stage

hook-up a mica condenser of 100 mmfd. proved satisfactory.

In the grid circuit of the T20 is HFC3 and R5, a resistance of 4,000 ohms which is by-passed to earth by C5. Our original experiments showed that if R5 was made 20,000 ohms and anchored to earth, this would provide sufficient automatic bias. But in view of the doubt which exists in so many constructors' minds regarding the advisability of auto-bias, we have for the purpose of the description modified the circuit to use a combination of grid leak and battery bias.

As with the oscillator stage the earthy sides of C5, C6, C7 and C8 should all be earthed at a common point, and then joined to the common earth point in the oscillator stage by means of a heavy busbar.

As V2 is generally used as a sub-amplifier, it has to be neutralised, hence VC3 which has a capacity of up to 8 mmfd. When used as a doubler, VC3 is unnecessary, but it will be found that it can be left in circuit without detrimental effect. The coil L3 is similar to the oscillator coil, but has more turns as it is centre tapped and is provided with a link winding. This link winding as can be seen from the illustration is not fixed to the coil. It has a diameter of 2 in. and is permanently fixed so that the coil can be plugged in and out without touching the link. It is terminated in a stand-off insulator mounted upside down so that the two mounting holes which are fitted with nuts and bolts and soldering tags are the connections for the link winding.

This coil is also mounted very close to VC4 which has a capacity of 40 mmfd. This value is lower in this instance in order to obtain ample R.F. output, particularly when the valve is used as a doubler.

**Both the crystal oscillator and the first amplifier are mounted on a common chassis in this way. The layout is quite straightforward and the wiring extremely simple.**

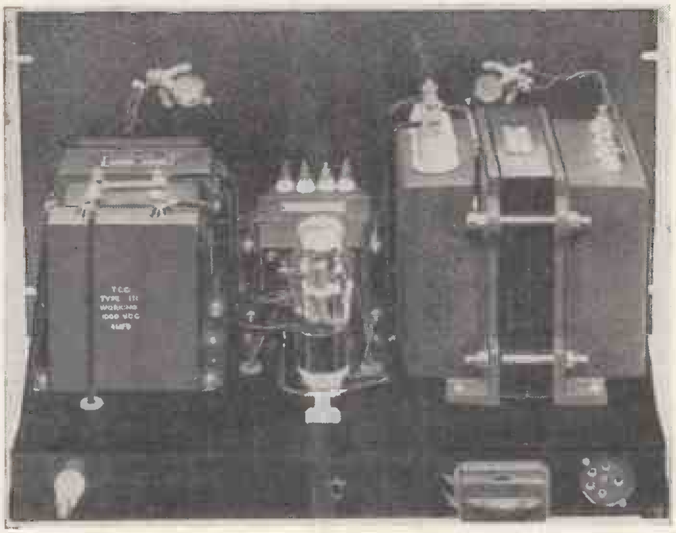
In series with the H.T. supply is the mA. meter, M2, which has a maximum deflection of 100 mA. and should this meter be used it can be connected as shown, but if a cheaper meter is substituted, it will be advisable to shunt the meter with a condenser having a capacity of at least .001 mfd.

## *Crystal Mounting*

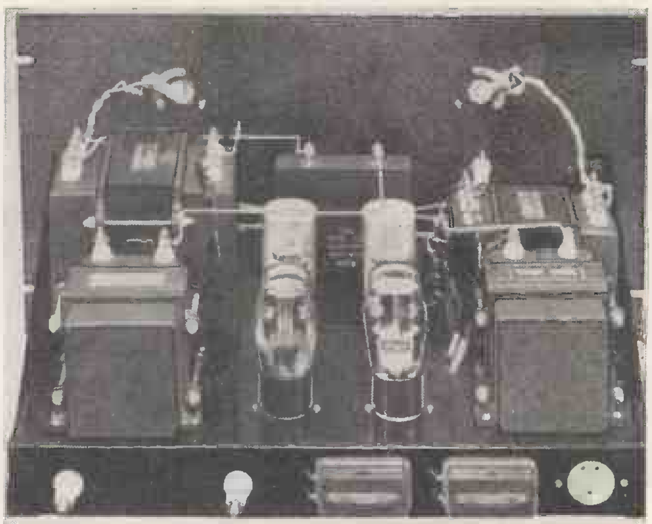
Another interesting point is the crystal and its holder. This is mounted on the front panel and should the recommended crystal be used, it will fit a standard 5-pin American ceramic valve holder and will oscillate quite freely mounted on its side. It is certainly a distinct help to be able to change crystals from the front panel and is a feature worth considering, not only in this Tx, but in others amateurs may build.

Several high-voltage leads have to go through the chassis, such as for the meters and switches, and although heavy rubbered cable is used, we strongly recommend as an additional protection, rubber grommits to be fitted to the chassis.

Filament supply is terminated in a valve socket, while the 700 volts H.T. for the two valves is taken to a feed-through insulator which can be seen in the illustration. That completes the first two stages, but before this section can be put on the air, a power supply has to be built. This is shown in the theoretical circuit and consists of T5, T6, CH1 and V4. Transformer T5 provides 750 volts at 250 mA. T6 gives



**This is the large power unit for the R.F. portion of the transmitter. It provides between 700 and 750 volts at 250 m/A.**



**Two power units are needed for the speech amplifier equipment and these are mounted in this manner.**

# Two Power Units

the heater voltage to the 6L6, T20 and type 83 rectifier. The power unit is mounted on its own chassis complete with twin fuse holder, indicator lamps across the primary of the filament and H.T. transformer and a value mounted off the chassis on stand-off insulators.

The construction of this unit is perfectly straightforward and does not need any further explanation. As the voltage developed is at least 700, constructors may wonder why such a high voltage is applied to the anode of a 6L6G. They will appreciate that these valves are rated for a maximum of 500 volts, but under the conditions recommended, the valve has had quite a long life already, while the crystal current is low. However, as the output is rather higher than necessary, a resistance of 5,000 ohms can be connected in series with the main feed to V1 if required. This resistance should be of the 20-watt type.

**In the output stage of the speech amplifier is a Varimatch transformer; modulator valves are type 46's in class B, while provision has been made for either crystal or high output microphones.**

## *The* P.A

Next refer to the illustration of the power amplifier stage. This shows quite clearly how the various components are laid out and as built works extremely well with a high degree of efficiency.

First of all the grid coil L4, this is constructed on the same lines as L3, that is a 4-pin former is used with a link coil mounted separately on an inverted stand-off insulator. It is tuned by VC5, a Johnson condenser which can be seen alongside the coil, and this con-

### Components for A COMPLETE 50-WATT PHONE or C.W. TRANSMITTER

**CHASSIS**
6—Steel type 1109 (Eddystone).
6—Pairs steel brackets type 1110 (Eddystone).
1—Panel type 2 (Eddystone).
1—Panel type 4 (Eddystone).
5—Panels type 6 (Eddystone).
1—Rack type 1107 and 1108 (Eddystone).

**COIL FORMS**
3—4-pin type CT4 (Raymart).
1—Ceramic form type 1090 with 1091 sub-base and 1092 base (Eddystone).

**CONDENSERS, FIXED.**
1—.001 mfd. mica type M (C1) (T.C.C.).
1—.001 mfd. mica type M (C2) (T.C.C.).
1—.001 mfd. mica type M (C3) (T.C.C.).
1—.01 mfd. type 451 (C4) (T.C.C.).
1—.001 mfd. mica type M (C5) (T.C.C.).
1—.001 mfd. mica 1,000 volts (C6) (Dubilier).
1—.001 mfd. mica type M (C7) (T.C.C.).
1—.001 mfd. mica type M (C8) (T.C.C.).
1—.001 mfd. mica type R (C9) (T.C.C.).
1—.001 mfd. mica type M (C10) (T.C.C.).
1—.001 mfd. mica type M (C11) (T.C.C.).
1—10 mfd. 50 volt type FT (C12) (T.C.C.).
1—.01 mfd. type 451 (C13) (T.C.C.).
1—8 mfd. type 0281 (C14) (Dubilier).
1—8 mfd. type 0281 (C15) (Dubilier).
1—.01 mfd. type 451 (C16) (T.C.C.).
1—25 mfd. 25 volt type FT (C17) (T.C.C.).
1—.05 mfd. type 341 (C18) (T.C.C.).
1—25 mfd. 25 volt type FT (C19) (T.C.C.).
1—8 mfd. type 0281 (C20) (Dubilier).
1—8 mfd. type 0281 (C21) (Dubilier).
1—4 mfd type 111 1,000 volt working (C22) (T.C.C.).
1—4 mfd. type 111 1,000 volt working (C23) (T.C.C.).
1—type SW82 (C24) (Bulgin).

**CONDENSERS, VARIABLE.**
1—160 mmfd. type 1131 (VC1) (Eddystone).
1—100 mmfd. type 1130 (VC2) (Eddystone).
1—Type 1088 (VC3) (Eddystone).
1—40 mmfd. type 1129 (VC4) (Eddystone).
1—40 mmfd. single spaced (VC5) (Johnson).
1—Neutralising condenser high-voltage type (VC6) (Eddystone).
1—40-0-40 mfd. type 1080 (Eddystone).

**CHOKES, R.F.**
1—Type CHM (RFC1) (Raymart).
1—Type CHM (RFC2) (Raymart).
1—Type CHM (RFC3) (Raymart).
1—Power type CH500 (RFC4) (Raymart).

**CHOKES, L.F.**
1—250 mA. 20H. (CH1) (Woden).
1—100 mA. 20H. (CH2) (Woden).
1—300 mA. 5/25H. (CH3) (Woden).

**CRYSTAL.**
1—7 mc. with enclosed holder type U (Q.C.C.).

**DIALS.**
4—4-in. type 1077 (Eddystone).
1—Type 1097 (Eddystone).

**DIAL LIGHTS.**
2—Type D7 (Bulgin).
1—Type D35 (Bulgin).

**HOLDERS, FUSE.**
3—Type F19 (Bulgin).

**HOLDERS, VALVE.**
3—4-pin type 949 (Eddystone).
6—4-pin ceramic (Amphrenol).
8—5-pin ceramic (Amphrenol).
1—6-pin type ceramic (Amphrenol).
1—7-pin type ceramic (Amphrenol).

**JACKS.**
3—Insulated closed circuit (Premier).

**METERS.**
1—0-100 mA. 3-in. (M1) (Howard Butler).
1—0-100 mA. 3-in. (M2) (Howard Butler).
1—0-150 mA. 3-in. (M3) (Howard Butler).
1—0-50 mA. 3-in. (M4) (Howard Butler).
1—0-250 mA. 3-in. (M5) (Howard Butler).

**PLUGS, SOCKETS, ETC.**
1—Anode connector type 313 (Belling-Lee).
6—5-pin plugs (Hammarlund).
2—Plugs type P15 (Bulgin).
2—Black wander plugs type 5 (Clix).
1—Red Wander plug type 5 (Clix).

**RESISTANCES, FIXED.**
1—300 ohm 4-watt (R1) (Premier).
1—75,000 ohm 75-watt (R2, 3 and 4) (Webbs Radio).
1—4,000 ohm 10-watt (R5) (Premier).
1—50-ohm variable resistor (R6) (Webbs Radio)
1—4,000 ohm 8-watt (R7) (Webbs Radio).
1—50 ohm variable resistor (R8) (Webbs Radio).
1—1-megohm type WE16 (R9) (Bulgin).
1—3,500 ohm 1-watt (R10) (Dubilier).
1—.25 megohm 1-watt WE14 (R11) (Bulgin).
1—50,000 ohm 1-watt WE7 (R12) (Bulgin).
1—.25 megohm 1-watt WE14 (R13) (Bulgin).
1—10,000 ohm 1-watt type WE2 (R14) (Bulgin).
1—500,000 ohm wire-wound potentiometer (R15) (Reliance).
1—50,000 ohm 1-watt (WE7 (R16) (Bulgin).
1—2,000 ohm 1-watt (R17) (Dubilier).
1—20,000 ohm 1-watt WE7 (R18) (Bulgin).
1—1,500 ohm 2-watt (R19) (Bubilier).
1—250,000 ohm 1-watt type WE14 (R20) (Bulgin).
1—50 ohm variable resistor (R21) (Webbs Radio)
1—50 ohm variable resistor (R22) (Webbs Radio)

**SWITCHES.**
3—Type S80T (Bulgin).

**SUNDRIES.**
36—4BA roundhead bolts with nuts and washers (Webbs Radio).
48—6BA roundhead bolts with nuts and washers (Webbs Radio).
24—Lengths 2 m/m sleeving (Webbs Radio).
6—Lengths 4 m/m sleeving (Webbs Radio).
1—lb. 14 gauge tinned copper wire (Webbs Radio).
3—Yards 5-core cable (Webbs Radio).
18—feed-through insulators type FT1 (Raymart)
13—Stand-off insulators type SS (Raymart).
4—Extension outfits type 1008 (Eddystone).
3—Adjustable brackets type 1007 (Eddystone).
1—Knob type Hallicrafter (Webbs Radio).
1—Crystal type microphone (Webbs Radio).

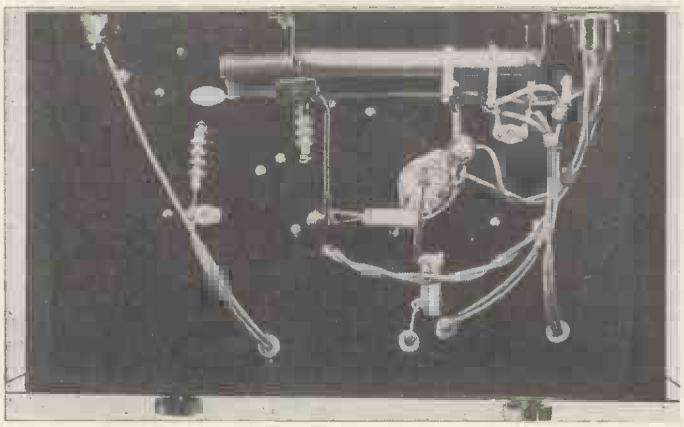
**TRANSFORMERS.**
1—Type AF17 (T1) (Ferranti).
1—VM2 (T2) (U.T.C.).
1—Special type
300-0-300 volts 150 mA.
5 volts 2 A
2.5 volts 2 A
2.5 volts 3 A
5 volts 3 A (T3) (Woden).
1—550-0-550 150 A (T4) (Woden).
1—750-0-750 250 mA. (T5) (Woden).
1—Special filament 5 volts 3 A
6.3 volts 1 A
7.5 volts 1 A (T6) (Woden).

**VALVES.**
1—6L6G (V1) (Tungsram).
1—T20 (V2) (Taylor).
1—T40 (V3) (Taylor).
1—Type 83 (V4) (Raytheon).
1—Type 57 (V5) (Raytheon).
1—Type 53 (V6) (Raytheon).
1—Type 45 (V7) (Raytheon).
1—Type 46 (V8) (Raytheon).
1—Type 46 (V9) (Raytheon).
1—Type 80 (V10) (Raytheon).
1—Type 83 (V11) (Raytheon).

# Speech Equipment

denser has a capacity of 40 mmfd. with single spacing.

One side of VC5 is at earthed potential and is coupled to the earthy side of L4 by means of C9. The same remarks apply to the grid circuit of V3 as to the grid circuit of V2, for there is no reason at all why automatic bias should not be employed, and should constructors wish to do so, merely ground the negative side of M4 and increase the value of R7 to 10,000 ohms with a 15-watt rating. The earthy side of C9, VC5, C10 and C11 are all joined to the same point, but notice that there is no by-pass condenser as with the previous two stages. This is due to the fact that L5 is tuned by a split stator condenser which automatically supplies the correct amount of by-pass capacity.



**This is the underside of the crystal oscillator and doubler stages. The large resistance is actually R2, R3 and R4.**

L5, as it is in the final stage, has to be rather substantial, so that it is built on one of the new large Eddystone coil forms and wound with 12-gauge wire. This is amply large enough and there is absolutely no need to use copper tube inductances providing the R.F. is actually fed into the aerial.

In series with HFC4 and M3 is injected the audio from the modulator for modulating purposes. Two feed-through insulators are provided which are bridged together for CW and connected to the secondary of T2 when phone is being used. M3 has a maximum deflection of 150 mA. and does not require any shunt condenser. The neutralising condenser VC6 is of the high-voltage type with rather large plates. This condenser is not now being made as a standard component, although they are still available from Messrs. Webb's Radio. Should, however, difficulty be experienced in obtaining this condenser, a type 1,088 can be substituted without alteration.

That completes the construction of the rig for C.W. operation and has already accounted for three of the racks.

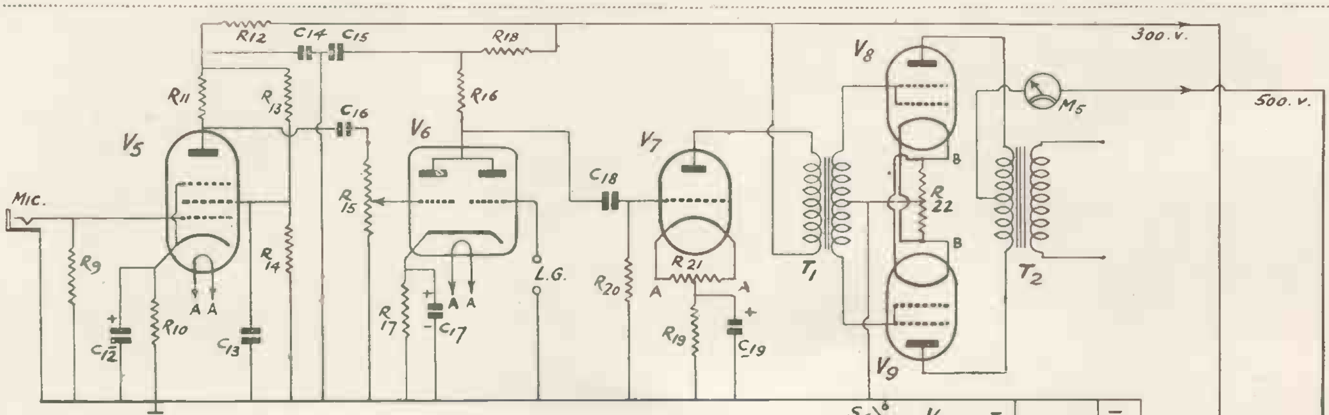
Of the remaining three, one is used for the speech amplifier and modulator, a second for the associated power pack for the audio section, while the third is left blank, but can be utilised for bias batteries or a bias pack, as required.

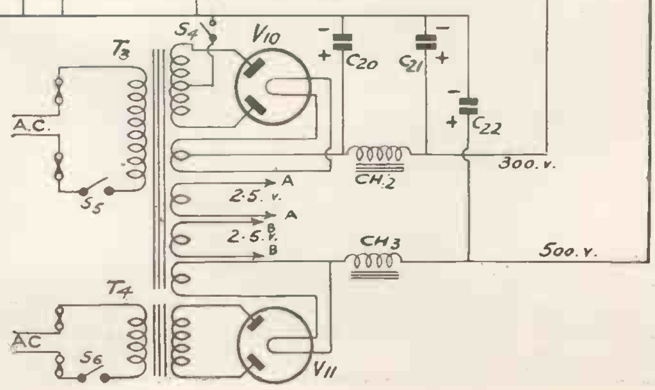
### *The Speech Amplifier*

The audio section and its power units are shown as one complete circuit, but build, first of all, the power unit. A 300 volt pack is needed for V5 a 57, V6 a twin triode type 53 and V7—a power amplifier, type 45. Then there is a second power unit giving 500 volts for V8 and V9, which are class B 46's. The 300 volts power unit can be seen in the illustration and it consists of T3, CH2, V10 and two high-capacity condensers. This provides ample smoothing which is very necessary to the driver stages, and owing to the low-voltage does enable electrolytic condensers to be used.

The 500 volt pack uses as a smoothing condenser C22 which is a 4 mfd. 1,000 volt working condenser of the jelly filled type. Choke input is also essential in order to maintain a steady D.C. voltage. It will be remembered that as a Class B output stage is used, there will be a very considerable current variation and that the quality can only be maintained if voltage is steady despite this variation. V11 is a type 83 rectifier and is quiet in operation without buffer condensers. Next comes the last constructional work of the speech amplifier and modulator. The layout of this is extremely good, while components have been arranged not only for appearance, but for simplicity for

(*Continued on page* 128.)




**The speech amplifier has a twin-triode valve one-half of which follows the crystal microphone circuit and the second half for a carbon type microphone. The 500 volt power unit has been designed to provide a very stable voltage with a wide variation in current.**

# R9 Plus with Parasitic Elements

By Dr. W. L. Hector, G8MX

*In view of the interest created by G8MX with his low power 10-metre experiments, he has prepared this information on the antenna systems. It should be of particular use to those who wish to work DX on this band with a power of 10 watts and under.*

IT is becoming an increasingly obvious fact that antennas with close spaced parasitically excited elements are "plus a little something which others haven't got." Their advantages have been realised more quickly in America than in this country and many designs have appeared in the American radio magazines. In that country the tendency has been towards the development of rotatable beams using a single half-wave antenna with one or more parasitic elements. GM6RG has erected an antenna of this type and with it puts a most outstanding signal on ten metres into America.

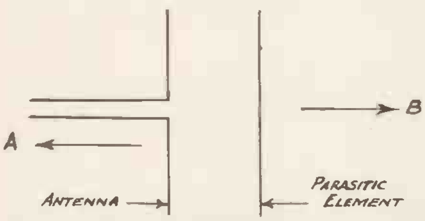



**Fig. 1. Parasitic elements with phased radiators co-linear.**

This article has been written for the benefit of those who are unable to erect a rotatable array of this type and who have room to erect a rather longer antenna than a single half wave. The general functions of parasitic elements will be summarised and alternative tried types of antenna described.

In Q.S.T. for May, 1938, a very interesting article was published giving a resumé of data on gain variation with spacing of parasitic elements and part of this has been reprinted in the new A.R.R.L. Radio Amateur's Handbook.

The description which follows pictures only horizontal antennas and the drawings are of the arrays seen from above. They can all be used vertically, but will require considerable height for erection.

In Fig. 1 is shown a horizontal antenna with a parasitic element parallel to it, for the moment the parasitic element is shown as a single line to distinguish it most easily from the antenna. When maximum radiation is in direction A the element is called a reflector, and when in direction B a director.

When the spacing between antenna and element is less than .14 wavelength and the element is tuned to resonance radiation will be in direction B and the element acts as a director. The best gain is obtained when the spacing is .1 of a wavelength and is about 5.3 db. better than a single half-wave antenna. Now a very important point, if the parasitic element be lengthened beyond the resonant length by a few inches we find that radiation is now maximum in direction A and that it is now a reflector with a gain of about 4.8 db.

If the spacing is greater than .14 wavelength and the element is again resonant it is found to act differently. Instead of radiating in direction B it acts as a reflector and gives at .2 wavelength spacing and a gain of 4.8 db. At these spacings of over .14 wavelength the element must be shortened from resonance to alter the direction of radiation. If this be done radiation becomes more or less equal towards both A and B, in other words the array is bi-directional and no tuning of the element will give a useful gain in the direction B.

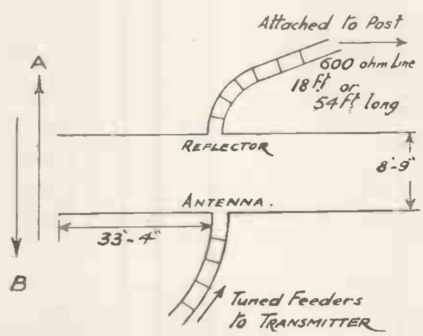



**Fig. 2. Two half-waves in phase with parasitic elements.**

It may be well to recapitulate these points as their thorough comprehension is essential.

1. Spacing between antenna and element of less than .14 wavelength gives considerable gain by altering the length of the element either in direction A or B at will.
2. Spacing greater than .14 gives excellent gain as reflector only.
3. At less than .14 wavelength spacing, resonance of the element results in its acting as a director.
4. At greater than .14 wavelength spacing, resonance of the element reflects.
5. A simple rule to remember is that the length of the element is always greater as a reflector.

The gains mentioned above are theoretical and in actual practice appear to be considerably exceeded. The reason is not clear, but is almost certainly due to the concentration of radiation at lower and more useful angles. From experiments made the gain has amounted to several R points at a remote point.

Early in 1938 the possibilities of using these elements in conjunction with phased half waves were realised and the antenna shown in Fig. 2. was designed. Owing to various delays it was not erected until midsummer when it was put up directed on Australia. No doubt some readers will know of the excellent reports received by G8MX of the signal put "down under." The signal was considerably better than that previously obtained with an 8JK two section beam. The antenna has not been described in any radio amateur magazine and as far as the author knows was first erected at G8MX.

The dimensions given in Fig. 2 are for operation on the twenty metre band, but those desiring to use it on other bands may calculate the measurements from the formulæ at the end of the article. The actual lengths are not critical and those used are given in the diagram.

The antenna itself is simply two half-waves in phase and is most conveniently fed by tuned feeders connected to the transmitter in the ordinary way. The parasitic elements are exactly similar in length to the antenna and are suspended horizontally at a

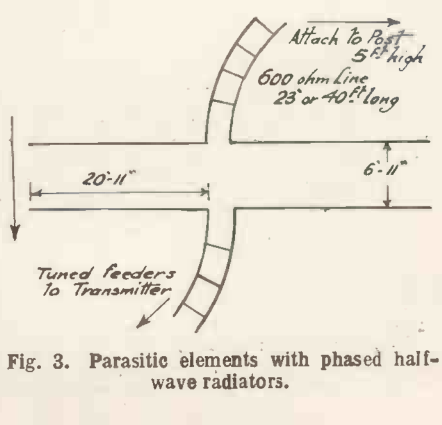



**Fig. 3. Parasitic elements with phased half-wave radiators.**

# The Alford Beam

spacing of .125 wavelength. These elements are phased and tuned by means of a 600 ohm line just over three-quarters of a wavelength long. This line is brought down from the centre of the element and tuning is effected by shorting the line at the point of maximum current. This has the effect of tuning the elements to resonance and also ensures that they, like the two halves of the antenna, are in phase.

Now for the practical aspects of erection. The antenna and the elements can very conveniently be spaced by bamboo spreaders of about $1\frac{1}{2}$ in. diameter at each end and a thinner spreader in the centre to prevent distortion by the two lines. The bamboo spreaders should be varnished to obviate changes due to rain or fog.

The antenna feeder goes to the transmitter, while the 600 ohm line from the elements is attached to a 5 ft. post or convenient tree by insulators leaving the portion near the end well within reach from the ground.

Tune up the antenna in the usual way and with the antenna excited proceed to find the current point on the element line. This can readily be found near the end of the line by an R.F. meter or electric bulb of small wattage. The bulb is attached to a pair of clips and these are slid up and down the line until the bulb lights most brightly. Short the line temporarily at this point and retune the transmitter. Now once more check the current on the line and short again. Finally re-check the transmitter and antenna tuning. We have now got a beam antenna radiating a maximum in direction B. A few tests on transmission and reception will soon confirm this.

For transmission in the opposite direction move the short about 22 inches along the line away from the elements and radiation will be at a maximum in direction A. That is the elements are now reflecting. No alteration in the tuning of the antenna itself has been found necessary when changing over the elements from reflecting to directing or vice versa.

The gain of this antenna is very good indeed and only the position of the short has to be altered to give maximum gain where required. The end of the 600 ohm line can be brought into the shack and the shorts made in comfort by switches or relays. No trouble is caused by feedback as the part of the line used is at very low potential.

Experiments in the placing of the short for greatest gain or greatest discrimination will provide interest and also closer spacings may be tried. Closer spacings theoretically give greater gain, but the currents are so high that the increased losses set off the extra gain. It is strongly advisable to get the array working on the wider spacing of .125 wavelength before trying closer spacing, and further do not space closer than .1 wavelength.

When changing over to ten metres last autumn the question arose as to the best ten metre array that could be erected in a space of 50 feet between poles. The antenna already described fitted easily, but it seemed a pity to waste the space available and finally it was decided to erect an Alford type beam antenna which would just fit between the poles. This antenna was fully described in Q.S.T. for twenty metre operation in June and for ten metre operation in July. The antenna is shown in Fig. 3 with ten metre dimensions suitable for 28,000 to 28,500 operation.

This antenna is in reality two co-linear half waves in phase spaced with their centres further apart than in the ordinary two half wave in phase antenna. The two halves of the antenna should be theoretically .64 of a wavelength instead of .5 wavelength long. The end .5 wavelength of each is the effective half wave and the inner portion of .14 wavelength is only there for spacing. This arrangement actually gives a greater gain than the straightforward two half-waves in phase, and also a slightly narrower angle of coverage.

In this antenna the parasitic element is spaced .2 wavelength from the antenna, and when tuned to resonance will act as a reflector. From the data given earlier in this article it will be realised that by shortening the element slightly from resonance the array will become more or less bi-directional. This should be borne in mind in erecting the antenna and the array so erected that it bears on the desired direction with the element tuned as a reflector, the direction of radiation being as shown in Fig. 3 by the arrow.

Owing to the greater length of the elements the current points will appear on the line nearer to the elements. The first will be within about five feet of the elements and the others about 17 and 34 feet further along the line. The line should be cut accordingly depending on the height of the antenna to bring the desired portion of the line within reach of the ground.

Tuning of the antenna is carried out exactly as described for the antenna in Fig. 2 and the element tuned to resonance to act as a reflector.

This Alford beam is superior to the Fig. 2 antenna in this condition of tuning, but it has less gain than the first antenna for backward radiation. Therefore where it is desired to work well in both directions, Fig. 2 antenna is the best, but for radiation in one direction say to the U.S.A. the Alford beam is better.

Quite a few American phones have been raised and worked on the Alford beam on an input of $1\frac{1}{2}$ watts on ten metres.

For those who wish to work out the various dimensions exactly to suit their frequency the following formulæ will prove useful.

Spacing of the element from antenna in feet $\frac{Z \times 984}{\text{Freq. (Mc)}}$ Where Z is the fraction of wavelength spacing. Length of the elements in feet is $\frac{492}{\text{Freq. (Mc.)}} \times .95$. This applies to the plain half-wave type only. For the Alford beam the length is $\frac{600}{\text{Freq. (Mc.)}} \times .95$.

A half-wave length of 600 ohm line is approximately $\frac{492}{\text{Freq. (Mc.)}} \times .97$.

The formula for the Alford beam gives rather less than .64 wavelength for each element and this is advisable because the gain falls off rapidly if the elements are too long, therefore it is better to err on the safe side as most stations operate on more than one frequency.

## Cossor American Type Octal Base Valves

A very extensive range of valves with American characteristics with octal UX and UY bases have just been released by A.C. Cossor, Ltd. These valves are interchangeable with the American equivalents, and have been designed for replacement purposes in receivers of American manufacture.

As there are over 40 valves in this new range in both battery and mains types, amateurs will find that they will now be able to obtain their favourite American type valves but manufactured in this country. The prices are competitive and complete characteristics are available from A. C. Cossor, Ltd., Cossor House, Highbury Grove, N.5.

## Ilford and District Radio Society

Hon. Secretary, C. E. Largen, 44 Trelawney Road, Barkingside, Ilford.

A large number of well-known amateurs and commercial radio engineers belong to this society, which has its headquarters at St. Albans Church Room, Albert Road, Ilford. They have their own transmitting station with the call sign G3QU, and operated by R. D. A. Williamson. A very interesting Bulletin is issued to members and this contains quite a number of useful articles and hints and tips.

# A Low-noise Regenerative Pre-selector

*This pre-selector, using the Mullard EF8 low-noise R.F. amplifier, has been designed by Kenneth Jowers for use in front of existing receivers to improve signal to noise ratio and image rejection.*

MOST receivers, including the modern communication type with a good R.F. stage, can be very much improved by the addition of a regenerative R.F. stage.

The cheaper short-wave receiver without an R.F. stage always suffers from image interference and this can generally be improved and noise level reduced by the R.F. amplifier.

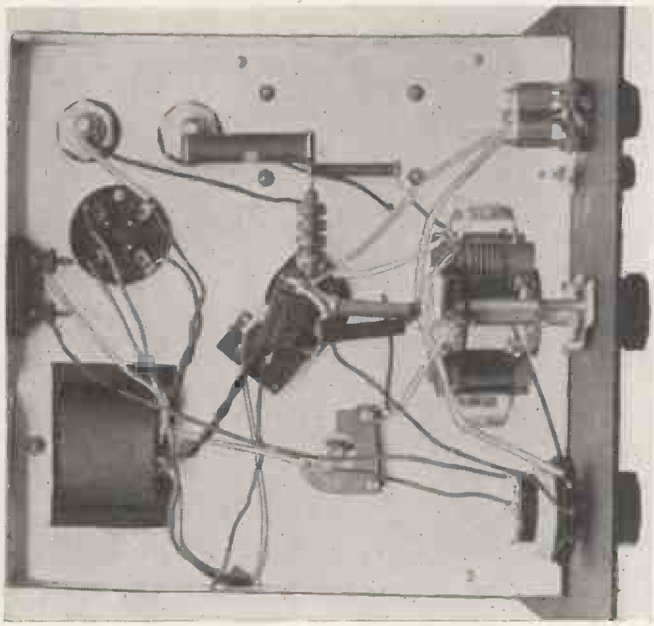
Most of the commercial pre-selectors are of the two-stage variety and generally are a little expensive for those whose pockets are not too deep, and I consider that one regenerative R.F. stage is all that most amateurs require.

There are two difficulties which have made the construction of a good pre-selector a little awkward; these are coil switching, to line-up with the main receiver and noise level. It is quite useless having a high-gain amplifier if the noise level is increased in ratio with the signal level. This noise is generally due to valve design so that there is little that can be done about it.

However, the introduction by the Mullard Company of their "E" series valves which includes an EF8 low-noise R.F. amplifier made it possible for an R.F. amplifier to be designed with an unbelievably low noise level. Almost at the same time, the Browning Company of America designed a small switched coil unit covering all amateurs bands from 10 to 160 metres and arranged for use in circuits where a cathode tap is required.

These tuners are of the limited frequency range type and are complete with series trimmers, parallel padders and a band-spread condenser. The frequency coverage is just the amateur bands and adjacent channels at either end.

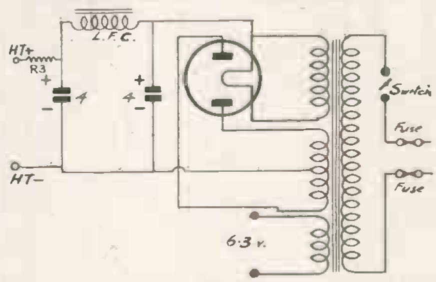
The whole unit is completely wired and merely has to be connected to the R.F. amplifying valve. The band spreading condenser has a capacity of 35 mmfd. and has connected to one side of it a grid condenser and resistor which has to be short-circuited in this instance. A series aerial condenser is included for use on the tuner when a Marconi type aerial is employed.



This chassis view shows the coil unit and the power pack wiring. See the text for the details regarding the special condenser included.

The pre-selector as designed, when properly operated near the oscillation point gives extremely good image rejection. It can be used in conjunction with any radio receiver and generally speaking the power supply can be taken from the main receiver. However, in this design a built-in power unit is used so making the unit quite self-contained.

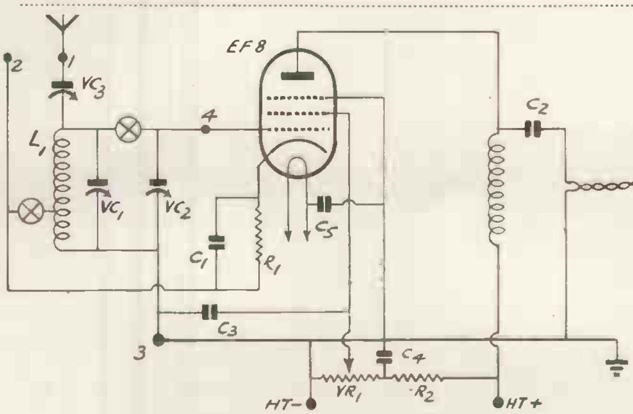
Another interesting point is that the pre-selector makes possible 10-metre operation of a superhet receiver having a wide 20-metre band and an intermediate frequency of not more than 500 Kc. Ordinary all-wave receivers that do not cover 10 metres, can be used in this way.




A power pack is optional, but here is the circuit if constructors wish to make the pre-selector self-contained.

The scheme is that the point shown as number four is connected to the grid of the convertor valve in the parent receiver and this grid connection disconnected from its normal point and provided with a grid leak of 500,000 ohms to earth. When the receiver is tuned to a given frequency, the second harmonic of the local oscillator will beat with the signal fed from the pre-selector to give the correct I.F. resulting in reception on the 10-metre band.

If the receiver is tuned to a frequency of 14 megacycles, the fundamental of




All the coil connections are carried out by the manufacturers so that this portion of the circuit only takes about half-an-hour to complete.

# Band Setting

the oscillator will be 14 megacycles plus the intermediate frequency, so should the I.F. be 456 Kc. this frequency will be 14,456 Kc. The second harmonic of this frequency will then be 28,912 Kc. allowing for reception on the incoming signal which has a frequency of 28,456 Mc.

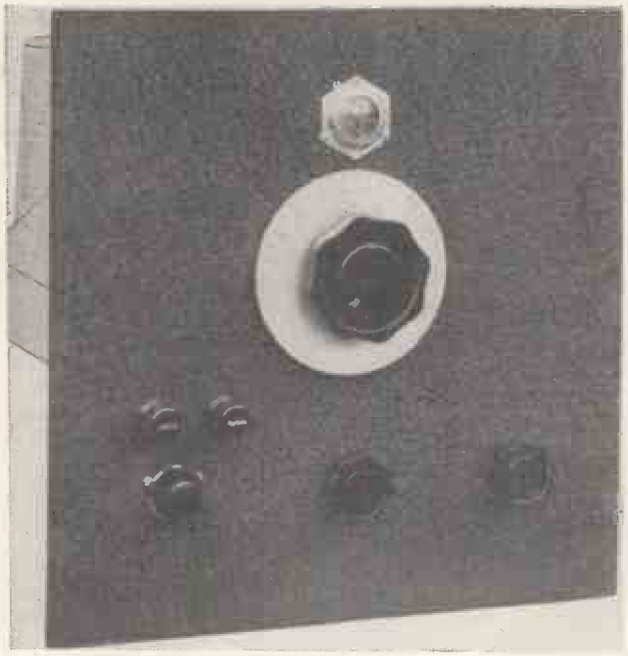
capacity of 200 mmfd. which is a good average value.

The cathode tap is already made so removing one of the biggest difficulties and provided VR1 has a value of 50,000 ohms, R2 10,000 ohms and R3 10,000 ohms, the amplifier will slide into oscillation very smoothly just before maximum travel point on the potentiometer is reached.

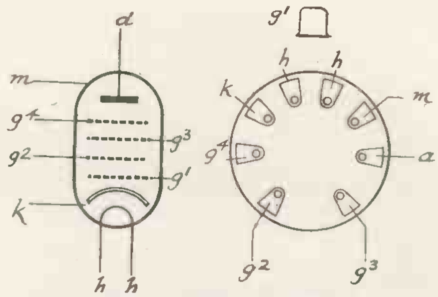
Very great care must be taken in the construction. It will be noticed that the tuning condenser has been moved from the bracket on the coil holder and mounted on the base plate. It is then driven on the front panel by means of a flexible coupler. The grid of the valve is the top cap and this lead should be kept as short as possible. Both the cathode condenser and resistance are actually wired directly to the cathode tap point on the body of the coil.

If the amplifier is being used without a cabinet, the series aerial condenser is quite useful, but should it be mounted into a cabinet then it is a good plan to include an additional series aerial condenser having a capacity of about 60 mmfd.

The potentiometer is mounted on the opposite side to the aerial condenser so allowing for a symmetrical panel and this has a make-and-break switch embodied. If a separate power unit is used, then there is no need for this switch, but with a built-in unit a separate mains switch is essential.



**The controls are: On the left aerial trimmer, centre, band-switching, and the right, regeneration control. The panel is of aluminium and 12-in. square.**



**Here are the connections for the EF8 valve**

The EF8 low-noise amplifier is actually shown as a pentode, although there are four grids. These should be connected as shown in the separate small circuit. Grids one and two are joined together and grid four is taken to the common earth point.

A resistance of 300 ohms is connected in the cathode circuit and by-passed by a condenser having a capacity of .01 mfd. The screen is also by-passed by a .01 mfd. condenser, while one side of the heater is connected to earth via C5. With the mains transformer recommended the centre tap of the 6.3 volt winding is connected internally, but should a separate power unit be used, care must be taken to see that either one side, or the centre of the heater is earthed.

In order to obtain optimum gain the R.F. choke has to have a high impedance and for this reason, the choke specified, an Eddystone type 1066, should be used. This choke has an inductance of 17.9 mH. and a very low self capacity.

The coupling condenser, C2 is rather flexible as regards value, and if greater selectivity is required, this should be reduced to approximately 50 mmfd. However, with most communication receivers this condenser should have a

The transformer provides 320 volts which is rather on the high side, so to reduce this to a more useable level, resistance R3 is included. This is of the 3-watt type having a value of 10,000 ohms.

Difficulty may be experienced in obtaining complete stability unless all earthy returns are taken to a common point, while by-pass condensers should

(*Continued at the foot of next page*)

### Components for A LOW-NOISE REGENERATIVE PRE-SELECTOR

**CHASSIS AND PANEL.**
1—Aluminium panel finished black to specification (Peto-Scott).
1—Aluminium chassis finished black with twin brackets to specification (Peto-Scott).

**COILS.**
1—Switched coil unit type BL-5H complete with tuning and padder condensers (Browning, Webbs Radio).

**CONDENSERS, FIXED.**
1—.01 mfd. type 619W (C1) (Dubilier).
1—.0002 mfd. type 690W (C2) (Dubilier).
1—.01 mfd. type 691W (C3) (Dubilier).
1—.01 mfd. type 691W (C4) (Dubilier).
1—.002 mfd. type 690W (C5) (Dubilier).
1—4 mfd. plus 4 mfd. type 0286 (C6 and C7) (Dubilier).

**CHOKE H.F.**
1—Type 1066 (Eddystone).

**CHOKE, L.F.**
1—20H. 25 mA. (Premier).

**DIAL.**
1—4-in. type 1115 (Eddystone).

**HOLDERS, VALVE.**
1—4-pin type V1 American less terminals (Clix).
1—8-pin side contact type VH24 (Bulgin).

**PLUGS AND SOCKETS.**
2—Terminals type B marked "aerial" (Belling-Lee).
1—Terminal type B marked "Earth" (Belling-Lee).
1—Top cap anode connector (Bulgin).

**RESISTANCES.**
1—300 ohm type 1-watt (R1) (Dubilier).
1—10,000 ohm type WE3 (R2) (Bulgin).
1—10,000 ohm 3-watt (R3) (Erie).
1—50,000 ohm variable potentiometer (VR1) (Reliance).

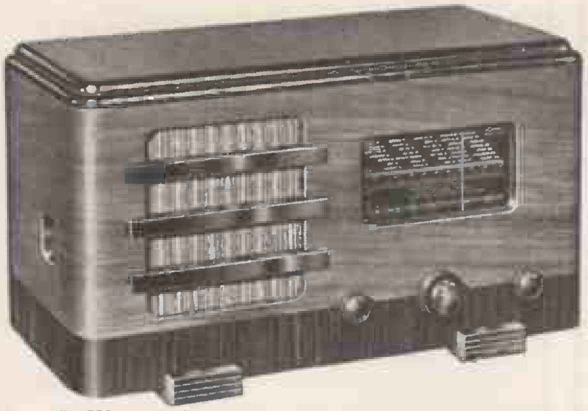
**SUNDRIES.**
1—Dial light type D.9 (Bulgin).
1—Twin fuse holder type 1033 (Belling-Lee).

**TRANSFORMER, MAINS.**
1—Special type octal (Peto-Scott).

**VALVES.**
1—EF8 (Mullard).
1—Type 80 (Premier)

A complete kit of components can be obtained from Messrs. Peto-Scott Limited of Pilot House, Church Street, N.16. or Webbs Radio of 14, Soho Street, W.1.

# A New Cossor All-waver



The new Cossor 6-valve super-het all-waver

A NEW receiver just introduced by A. C. Cossor, Ltd., is a 6-valve superhet of modern design. Looking at the circuit, the aerial is inductively coupled to a variable-mu R.F. pentode connected to the A.V.C. line. The reason for this is to make more certain of the A.V.C. action. A stage of R.F. amplification is used on all bands while the coverage is 810-2,085 metres, 195-560 metres, and 18.7-5.7 megacycles.

A triode-hexode frequency changer is used with the hexode section having variable-mu characteristics and connected to the A.V.C. circuit. Tracking of the oscillator section on short waves is accomplished by having shaped oscillator vanes in one section of the ganged condenser.

An intermediate frequency of 465 kc. is used and all I.F. coils are permeability tuned. There are three windings in the first I.F. coil and on the primary there are two windings. The primary proper has a small coupling coil which has the centre tap connected to the secondary. By operation of the switch which is on the tone control the coupling coil is made either to aid the secondary or oppose it. The former condition increases the band width and maintains high quality on local stations, while the latter decreases the band width and ensures adequate separation on distant stations.

A variable-mu R.F. pentode is used as an R.F. amplifier and as this is also controlled by the A.V.C. it will be seen that the first three stages are all A.V.C. controlled, so ensuring a very positive action. The output of the I.F. amplifier is coupled to a double-diode triode, the diode sections of which supply the delayed A.V.C. to the three preceding valves.

The triode section is the detector and is resistance-capacity coupled to a powper triode output valve giving high fidelity reproduction. A variable tone connector is across the output of the double-diode triode valve and ensures a wide range of cut-off without interfering with the output impedance of the receiver.

Bias is also supplied through the output valve by means of a second tapping on the same resistance line. An 8 in. moving coil loudspeaker of the energised type is accurately matched to the output valve, while there are two 16 mfd. condensers in the smoothing circuit to ensure complete freedom from ripple.

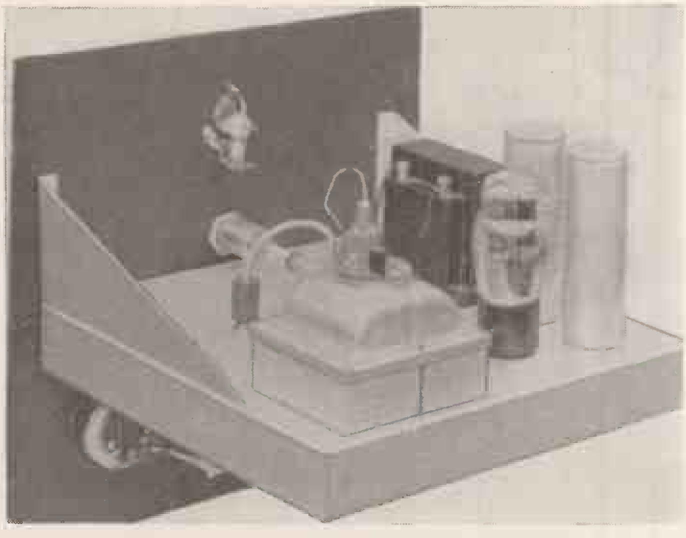
This receiver is for use on A.C. mains only of 200/250 volts 40/100 cycles, and is priced at 10½ gns. Full information can be obtained from Messrs. A. C. Cossor, Ltd., Cossor House, Highbury Grove, N.5.

---

(*Continued from preceding page*)

have very short leads on the tops and sides.

It is also necessary for the connecting wire between the amplifier and the receiver to be as short as possible in order to make the most of the pre-selector. If this wire is at all lengthy there will be a certain amount of pick-up so reducing selectivity.



The power unit is quite compact but takes up the majority of the base plate. Notice how the flexible coupler is fitted.

The front panel is made of aluminium and is 12 in. square and ⅛th in. in diameter. This has been chosen in order to prevent any possibility of movement on the 28-megacycle amateur band. The chassis is 10½ in. square turned down on four sides 2½ in and of 18 gauge aluminium. It is fitted with two side brackets and even though suspended from the centre of the panel it is quite rigid.

Most of the construction is with the power unit, for the R.F. section can be wired in under half an hour.

The method of operation is as follows: The amplifier has its chassis connected to the chassis of the parent receiver and the output from the valve connected to the aerial terminal of the receiver. Tune the station on the high-frequency end of the amateur band and tune the pre-selector to almost minimum capacity. Then adjust the parallel condenser across the coil until the unit is tuned to the same frequency as the parent receiver.

Repeat this on the low-frequency end of the band with the condenser at almost maximum capacity, and it should be possible to make the pre-selector come into line without retouching the padder condenser. This has to be done on each amateur waveband so that full coverage is possible with the 35 mmfd. band-spread condenser.

The total H.T. current is approximately 10 mA. at 200 volts, and this is generally within the scope of the average communication receiver. Two aerial tappings are provided, one in series with the grid of the valve via a small series condenser, and the other directly to the cathode tap. This latter division is generally more suitable for amateur use as it provides a greater increase in selectivity.

# The Short-wave Radio World

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

### A 5 AND 10-METRE C.C. TRANSMITTER

OVER 25-watts input is obtainable with a very compact mobile transmitter designed by W1AUB and published in the January issue of Q.S.T. This transmitter uses a 6V6 with a 20-metre crystal in a tri-tet circuit followed by an 807 as a sub-amplifier on 10 metres and a modulator doubler on 5 metres.

The audio section is made up of a 6J7, 6G6G and a 6N7 twin-triode in class-B. It is intended that the transmitter be used with a genemotor or vibrator providing 350 volts at 150 mA. Many British amateurs, however, could make use of this transmitter for normal U.H.F. work for it is extremely compact and does provide more than sufficient R.F. output for those who use low power.

The crystal oscillator will provide an output on the fundamental and the second harmonic, so generally, the final stage works as a straight forward amplifier. It is claimed that the crystal current is so low that a small pilot lamp barely glows while the loaded anode current of the oscillator is 25 mA. A grid current of 4 mA. is obtained in the 807 stage which is more than sufficient for this sensitive type of valve.

A switched circuit is included to tune the tank of the 807 so that series tuning can be used on 5 metres. This is a great advantage for it enables the inductance to be greatly increased.

Full constructional data is given in Q.S.T. with all component values and the circuit is in Fig. 1.

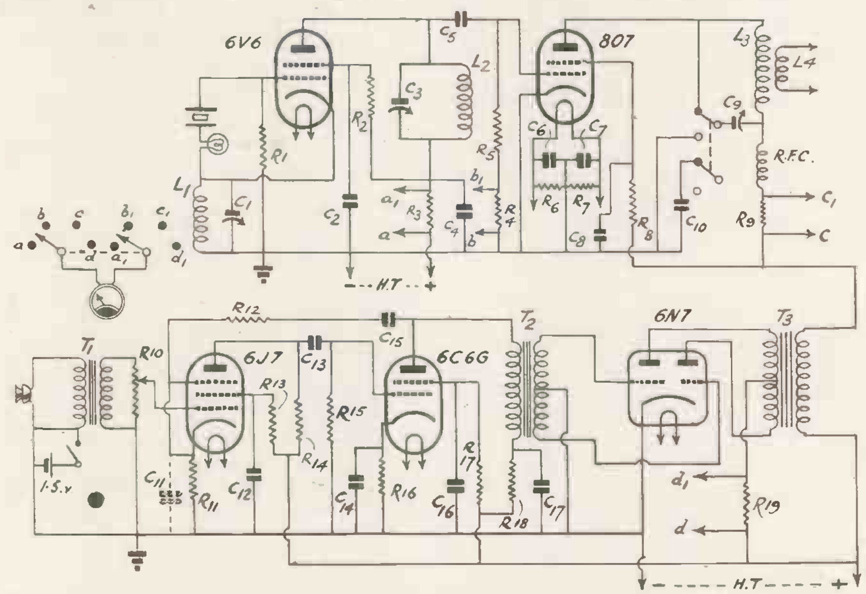



**Fig. 1. A most effective low power U.H.F. transmitter suitable for C.W. of telephony.**

### A LOW-POWER PHONE TRANSMITTER

A portable transmitter that can be built for less than 50s. is described in "Radio and Television" by W91BC. It will deliver 20 watts of modulated carrier into the aerial and operates on either 160, 80 or even 40 metres. The designer states that with the correct coil and crystal combination, 10 and 20-metre operation is possible. The circuit is straight forward using an 89 cystal oscillator driving a 6A6 twin triode, with the two triode sections wired in parallel.

The speech equipment is also very simple being an 89 speech amplifier and another 6A6 twin triode in class-B. This provides sufficient audio output to modulate an input of up to 30 watts. The transmitter is made on a simple chassis with a "T" shape dividing screen. One half accommodates the power pack equipment and of the remaining two quarters, one section is for crystal oscillator and the other, the power amplifier. In this way screening is complete.

The transmitter has been designed to operate from a standard A.C. supply or when used for portable operation, with a vibrator power unit running from a 12-volt accumulator. An ordinary tapped on aerial will be quite satisfactory on the higher wavebands for local working. Most of the component values are shown in the circuit but the transformers are a special Thordarson type for the valves used. The microphone has to be of the high output type energised from a small flash lamp battery. Only two coils are required, these being wound on 1½ or 2 in. formers with the usual number of turns for the band required. The circuit is in Fig. 2.

### 5-METRE EXCITER

We are very interested in the design of a simple crystal controlled exciter giving 20 watts of carrier on 56 Mc. The full constructional data appears in the January issue of "Radio" and is given by W6FKQ. The exciter is made on a straight forward chassis approximately 12 in. wide and is made up of three stages. The crystal oscillator with a 7mc. crystal uses a 42 type valve, which is capacity coupled to a 6L6G triode connected. This is in turn capacity coupled to a Taylor T21 tetrode operating at 56 Mc. The 42 pentode oscillator operates on a fundamental frequency in order to maintain a steady R.F. output without frequency drift.

The 6L6G as a triode of high gain serves as a most effective quadrupler;

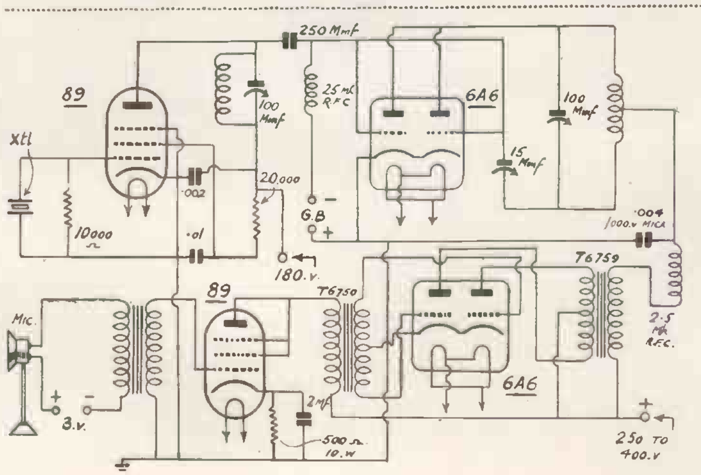
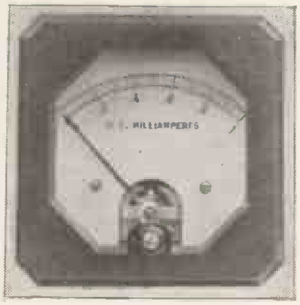



**Fig. 2. For those interested in lower frequency low power transmission this circuit is extremely interesting.**

# PREMIER 1939 RADIO



## 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 |

## VALVES

**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-Glass Octal Base tubes at 6/6 each, 210 and 250, 8/6 each.

**EUROPA MAINS VALVES,** 4 v. A.C. Types, A.C./HL., 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.

**U.S.A. CHASSIS VALVE HOLDERS**

4, 5, 6 and 7 pin, 6d. each. Octals, 9d. each
U.S.A. Ceramic Valve Holders, all fittings, 1/- each
Centralab Potentiometer, all values 2/,- with switch 2/9.

## The NEW PREMIER 10-15 WATT ALL-BAND TRANSMITTER

Designed 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.

## PREMIER 1938 HIGH FIDELITY AMPLIFIERS

**A NEW COMPLETE RANGE OF 7 HIGH FIDELITY PA AMPLIFIERS FOR A.C. or A.C./D.C MAINS OPERATION.**

**With the exception of the 3-watt models, all Premier Amplifiers incorporate the new Premier Matchmaker Output Transformer, enabling any single or combination of speakers to be used. 6, 8/10, and 15-watt systems are provided with two separate input channels which can be mixed to any level. The 30- and 60-watt systems have 3 input channels The built-in Pre-Amplifiers ensure that the gain is sufficient for any low level crystal or velocity microphone. The actual gain of the 6-, 15-, 30- and 60-watt amplifiers is over 100 decibels. Tone controls are also incorporated. Matchmaker Modulation Transformer can be substituted for Output Transformer at no extra cost.**

| | Kit of Parts with Valves. | Completely Wired & Tested. |
|---|---|---|
| **3-watt A.C. Amplifier** ... ... | **£2 : 0 : 0** | **£2 : 15 : 0** |
| **3-watt A.C./D.C. Amplifier** ... | **£2 : 0 : 0** | **£2 : 15 : 0** |
| **6-watt A.C. Amplifier** ... ... | **£5 : 5 : 0** | **£6 : 0 : 0** |
| **8-10-watt A.C./D.C. Amplifier** ... | **£4 : 10 : 0** | **£5 : 5 : 0** |
| **15-watt A.C. Amplifier** ... | **£5 : 15 : 0** | **£7 : 0 : 0** |

**Black Crackle Steel Cabinet 15/- extra.**

**30-60-watt A.C. Amplifiers or Modulators, completely wired and tested, in Black Crackle steel case. Power Pack in separate case to match.**
**30-watt £12 : 12 : 0 complete. 60-watt £15 : 15 : 0 complete.**

## Premier Mains Transformers

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

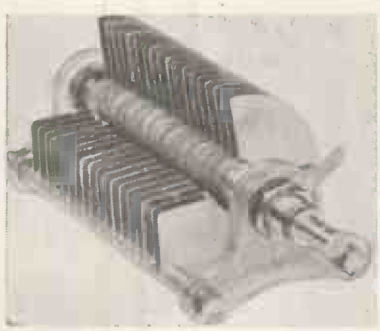
**S.P. 250, 250-250 v. 60 m/A.** 4 v. 1-2 a., 4 v. 2-3 a., 4 v. 3-4 a., all C.T., 10/-.
**S.P. 300. 300-300 v. 60 m/A.** 4 v. 1-2 a., 4 v. 2-3 a., 4 v. 3-4 a., all C.T., 10/-.
**S.P. 351. 350-350 v. 150 m/A.,** 4 v. 1-2 a., 4 v. 2-3 a., 4 v. 4 a., all C.T., 13/-.
**S.P. 352 350-350 v. 150 m/A.** 5 v. 2 a., 6-3 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/-.

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

Special Transformers wound to order.

A complete range of L.T. Transformers available from stock.

**Premier Battery Chargers. Westinghouse Rectifications.** Complete ready for use.
**To-charge 2 volts at ½ amp., 10/-; 6 volts at ½ amp., 16/6 ; 6 volts at 1 amp., 19/6 ; 12 volts at 1 amp., 21/- ; 6 volts at 2 amps., 32/6.**



## 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.

## 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.
20-30 Watt, 29/6.

**Have you had our 1939 Catalogue, Handbook and Valve Manual ? 90 pages of Radio Bargains and interesting Data.** **Price 6d.**

**ALL POST ORDERS to:— Jubilee Works, 167, Lower Clapton Road, London, E.5.** *Amherst* 4723.

# PREMIER RADIO

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

# 5-metre Exciter

from this it can be seen with a 40-metre crystal, the 10-metre harmonic can be taken out of the 6L6G anode circuit. The designer claims that with a small R.F. choke and mica condenser in the cathode of the quadrupler, this valve is

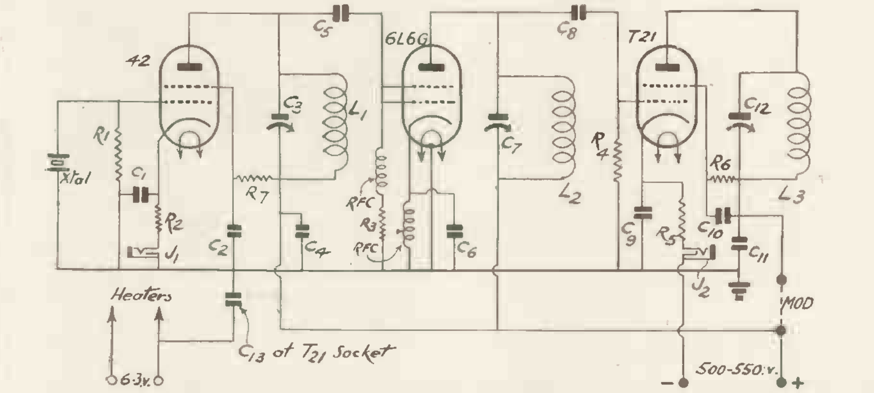



**Fig. 3. This is one of the most interesting 5-metre exciters that there has been for some time. It provides high carrier power on 5 metres from a 40-metre crystal.**

practically as efficient as a good doubler. All the earth returns are taken to a single earth point, while with the grids of the 6L6G tied together, the amplification factor is high enough so that the anode current drops to safe value should excitation be removed. When tuned to resonance, the anode current of the 6L6G is approximately 40 mA.

The 10-metre output from the quadrupler is fed directly to the grid of the T21 through the .001 mfd. mica coupling condenser. Grid leak bias is provided for the final valve by means of a 15,000 ohm resistor, while it will also be noticed that an R.F. choke is not included. It is claimed that at 56 Mc. a carbon resistance is as effective as most R.F. chokes. All coils are air-spaced, 1 in. in diameter, $1\frac{1}{2}$ in. long and mounted on feed-through insulators. The oscillator coil has 20 turns of 16 gauge wire while the coils in the quadrupler and output stages are both wound with 14 gauge wire, the former having 6 turns and the latter 4 turns.

Condensers C3 and C7 are both of the midget single spaced type while in the final stage, a double spaced condenser is essential. 500 volts at least are required at approximately 150 mA.

The T21 valve in the final stage is comparatively new and is the Taylor edition of the popular 6L6G and supplied with a low loss base. The circuit is shown in Fig. 3.

## A C.R. MODULATION CHECKER

A very simple oscilloscope for modulation checking is given in the 1939 edition of the Radio Handbook. It uses an R.C.A. 913 tube and complete with power supply is fitted into a cabinet 5 in. by 6 in. 9 in. It is claimed that the pattern can be magnified up to 2 in. in diameter. Three A.F. terminals allow connection of the oscilloscope to a modulator of any phone transmitter between 5 and 1,000 watts carrier power. In addition no external coupling condenser is required.

The resistance network recommended adapts the instrument for use with almost any transmitter while no trouble will be experienced in obtaining the correct amount of deflecting voltage. The resistors R5 and R6 are non standard, being made up of 1 megohm, 1 watt resistors in series. R5 needs 6 of these resistors, and R6 two only. When the voltage is applied to only one set of plates a thin straight line is obtained on the face of the C.R. tube when the 25,000 ohm and 50,000

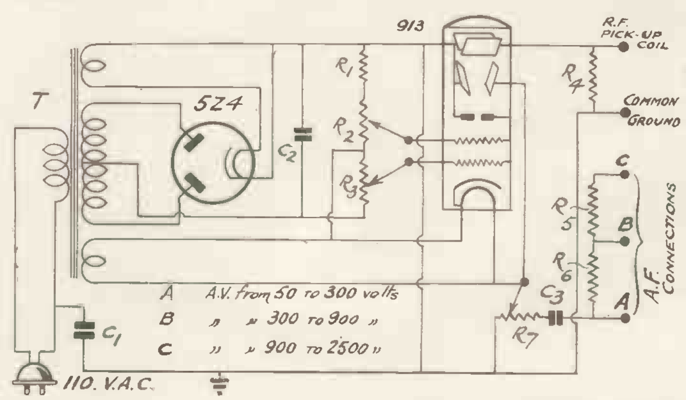



**Fig. 4. This C.R. oscilloscope has been designed for simple modulation checking.**

ohm potentiometers are correctly adjusted. When a modulated carrier voltage is applied to one set of plates and the modulating voltage applied to the other, a trapezoidal pattern will be produced during modulation. The radio-frequency voltage should have an amplitude of at least 50 volts in order to cause good deflection on the screen.

Components values are as follows: C1 .01 mfd. C2 1 mfd. C3 .01 mfd., R1 150,000 ohms, R2 50,000 ohm potentiometer, R3 25,000 ohm potentiometer, R4 5 megohms, R5 6 megohms, R6 2 megohms, R7 1 megohm, and the transformer 350 volts each side of centre at 40 mA.

### *Radio Publications*

We have just received the special January number of the American publication *Radio* in addition to the Annual Short-wave Manual, produced by the same company. These two books are available in this country from F. L. Postlethwaite, G5KA, 41 Kinfauns Road, Goodmayes, Ilford, Essex. The *Radio* handbook this year consists of no less than 595 pages and includes a vast amount of quite new information. The chapter devoted to exciter construction is of particular use for it covers simple single valve oscillators up to the new Flextal conversion exciter. There are altogether 20 chapters covering radio receiver construction, valve characteristics, C.W. and telephony transmitter construction, a most comprehensive section on U.H.F. communication and also radio therapy. This chapter will appeal particularly to those engaged in radio medical work for it includes a 250 watt R.F. unit and a second unit tuned to about 7 metres, which will provide over half a kilowatt. Altogether this issue is an extremely fine one including a great deal of practical data in addition to the normal amount of theoretical data. It should be of interest to the beginner as well as to the advanced experimenter. The price, post free, is 7s. We make reference to the January edition of the American publication *Radio* for it is a special year book number of 194 pages. Amongst the contents are a long-distance receiver, a U.H.F. receiver, a 5-metre exciter, three element rotary beams, a T20 telephony transmitter and a 10-metre convertor. This copy is priced at 2s. 9d. and can also be obtained from G5KA.

# 15 HOURS' PERFECT *Soldering* FOR A PENNY ★

The Solon gives real economy—and all the advantages of electric soldering! Element clamped within the bit concentrates all heat at point. No flames or troublesome 'heating up.' Constant heat for as long as you want it. Solon electrically-soldered jobs are more reliable too . . .

**EFFICIENT.**
Heat at the point—where you want it.

**CLEAN.**
No flames, no dirt.

**SPEEDY.**
Ready in 4 minutes.

**CONVENIENT.**
All wearing parts easily replaceable.

★ **Based on a charge of 1d. per unit.**

*With solder, flex and lamp adaptor, 8/6.*

*It's Easier with a*

**SOLON** TRADE MARK

*Electric* **SOLDERING IRON**

W. T. HENLEY'S TELEGRAPH WORKS CO. LTD.
(DEPT. 110A/V) HOLBORN VIADUCT, LONDON, E.C.1.

---

*For Accuracy* Q.C.C. *and Reliability*

## 1939 FREQUENCY CONTROL UNITS


**All units are ready mounted in the type U holder illustrated, and are supplied to within 5 kc. of your specified figure in the 1.7, 3.5 and 7 Mc. bands. The actual frequency is given on the Frequency Certificate to an accuracy of 0.025 per cent.**

**Type S5.** The Standard X Cut Crystal. Temp. Co-efficient 23 cycles per Mc. Max. R.F. crystal current 100 m/A.
PRICE ... Type S5 unit ... ... ... ... ... **20/-**
Type S5 Crystal, unmounted ... ... **15/-**

**Type P5.** The well-known Q.C.C. Power-cut Crystal Temp. Co-efficient 20 cycles per Mc. Max. R.F. crystal current 140 m/A. Recommended for use in Tritet and similar circuits.
PRICE ... Type P5 unit ... ... ... ... ... **25/-**
Type P5 Crystal, unmounted ... ... **20/-**

**Type B100.** An improved version of our well-known 100 kc. bar. Ground and calibrated to within 25 cycles of 100.0 kc., and supplied in a modified type U mount with a fixed air gap.
PRICE ... Type B100 unit ... ... ... ... **32/6**

**Type U Mount.** A plug-in Mount (¾ in. centres). Fitted with stainless steel electrodes and a smart nickel and black enamel cover plate ... ... ... ... ... ... ... **6/-**

A Baseboard Fixing Mount for the **Type U** Holder is available at **1/3.**

**THE QUARTZ CRYSTAL CO., LTD.,**
**63 & 71, Kingston Road, NEW MALDEN, Surrey**
Telephone : Malden 0334

---

## Radio Frequency Electrical Measurements

By Hugh A. Brown

384 pages, 9 × 6, illustrated, 24/- net.

THIS combined laboratory textbook and manual for the student and practising electrical and radio engineer explains physical principals and procedures for making quantitative measurements.
Sections on measurements of coil resistance, antenna resistance. condenser loss resistance, frequency by approximate and precision methods, vacuum tube peramneters and performance, receiving set performance, have all be revised and brought up-to-date.

## Electron Optics in Television

With Theory and Application of Television Cathode-Ray Tube.

By I. G. Maloff and D. W. Epstein.

299 pages, 9 × 6, illustrated, 21/- net.

IN this book the authors develop the theory of electron optics from its fundamentals and cover its application in the design of the television cathode-ray tube, including an account of that part of the subject with which the authors have had first-hand experience.
From the book the reader should get an understanding of electron optics and be able to use electron optics in various problems of pure and applied physics. He also should get the basic principle of the design of television cathode-ray tubes and associated circuits. Most of the material has never appeared in book form and some of it has not been published previously.

## Practical Radio Communication

Principles—Systems—Equipment—Operation
Including Short-wave and Ultra-short-wave Radio

By Arthur N. Nilson
*Lieutenant (Technicist) (Communications) U.S.N.R. (Rtd.)*

and J. L. Hornung
*Formerly Radio Instructor, Guggenheim School of Aeronautics, New York University.*

754 pages, 9 × 6, 435 illustrations, flexible 30/- net

A handbook for engineers and technicians on Radio Station Operation,

COVERING practical radio communication completely and its essential theory, the book is in effect a handbook making available in concise, clear-cut form, adaptable for handy reference, a great deal of otherwise inaccessible material. The engineer and advanced technical worker will find here authoritative facts by which to check his familiarity with latest advances. Boiled down information is given on developments in systems and methods, the newer equipment and apparatus, advances in theory, the facts with which the radio rechnician will want to keep abreast.

## Engineering Electronics

By Donald G. Fink,

358 pages, 9 × 6, 217 illustrations, 21/- net.

Special Features Include :

1—A clear understanding and a working knowledge of electron physics.
2—A sound description of the engineering characteristics of all types of electron tubes.
3—An understanding and a comprehensive working knowledge of the application of these characteristics to electronic circuit design.
4—Gives descriptions of as many practical applications of electron circuits as could be included in one volume. These circuits have to do with power transformation, electrical communication, and industrial control and measurement problems.
5—In order to help the student in obtaining a working ability in the subject about one hundred problems of a strictly practical nature are included. Graphical and tubular methods of presentation are used freely and the book is written in a simple and descriptive style.

**McGraw-Hill Publishing Co., Ltd.**
**Aldwych House London, W.C.2**

This is the station owned by the author which has the call sign G6BW and is situated at Churchill, Somerset.

# The Peculiarities of 10 Metres

By

*Capt. Ben Wallich, F.R.G.S.*

FOR those who wish to work DX on low power and who are willing patiently to await good conditions, the 10 metre band is well worth active consideration. I have many times effected a W.A.C. and a W.B.E. on this band with telephony and have also obtained my certificates for W.A.S. on telephony on 10 metres as well as on 20 metres, but I would like to make it quite clear that the 10-metre band is full of queer moods rather like a stage star blessed with "Artistic Temperament," and unless one is prepared to take careful note of all its various idiosyncrasies there is little hope of obtaining all the interesting DX available.

This article is the outcome of long and regular experience of these frequencies taken over a period of some four years including the special summer tests which I carried out five times daily from May 1 to September 18 of last year—(a period hitherto looked upon as "dead" so far as 10 metre work is concerned). The results of these tests were as surprising as they were encouraging and during the entire period hardly a day went by without my contacting South America or the West Indies on telephony. In addition to this I was able to forecast within 24 hours a period of one or two days each month when I was able to work some 15 to 20 U.S.A. stations on telephony.

### *The F2 Layer*

The 10-metre band depends for its reflective qualities on what is called the "F2" layer. This layer is more or less efficient during the autumn, winter and early spring; but up to the time of the tests was deemed to be ineffective during the summer months. This theory was exploded after the tests had been carried out, and it was discovered that the phase of the moon was primarily responsible for the conditions prevailing on these high frequencies. Space does not permit my giving details in this article and I shall leave that for another time. I have merely mentioned it to show that the "Skip distance" is determined by the density or effective reflection of this F2 layer and in order to ascertain at what times certain countries or areas can be worked it is essential to understand the behaviour of the ionised layers.

The normal opening of the band commences about 11.30 a.m. G.M.T. and usually continues until about 21.00 or 22.00 in early autumn and till 18.00 or 19.00 G.M.T. during the winter season.

All signals have a tendency to come in from the south, then swing round to the west, where they gradually lengthen in distance till they reach the West Coast of U S.A. and Hawaii. After this skip shortens and finally signals move back towards the south just prior to the band fading out for the day. Bearing these points in mind will give an indication as to the most favourable time for listening to or working the countries or areas desired.

### *Australian Stations*

Australia does not altogether conform to this rule, but I can with perfect safety state that the Continent of Australia can be worked and heard under favourable conditions on 10 meter telephony between the hours of 10.00 and 11.30 G.M.T.

At 11.30 HI7G of the Dominican Republic (West Indies) starts to come in and I usually work him at this time almost every day. He normally starts to fade out as soon as the W's (American Stations) begin to come in usually around midday.

The 1st, 2nd, 3rd and sometimes 4th districts are the first to come in and they remain fairly consistent till about 15.30 or 16.00 G.M.T. at which time one can expect the skip to lengthen and the 8th and 9th districts reach maximum strength. After this the 6th and 7th districts appear and continued to be active for about one hour or a little more. Then they gradually begin to surge up and then fade down and their places are taken by the east coast stations. Finally before the W's go out altogether the 4th district comes back again. Any signals heard after this are usually from Porto-Rico or South America.

North and South Africa and Egypt are usually heard and worked about the same time as the West Indies, viz., 10.00 to mid-day G.M.T. Central America, which includes Mexico, Guatemala, Salvador and Canal Zone are usually worked about the same time as the West Coast of U.S.A. Any who are not conversant with the U.S.A. districts can find them in the Amateur Call Book.

European stations are seldom heard on 10 metres with the possible exception of Greece, Roumania and Yugo Slavia. French and Dutch stations are rare during the winter months owing to their proximity to this country.

It is almost useless to listen for the West Coast Stations of U.S.A. during the early morning or at a time when the skip has shortened towards late evening, and I normally take it to be a very bad sign when the 4th District (Florida, North and South Carolina, Georgia and Alabama) are the first W stations to put in an appearance during the very early period of the band opening.

---

### *A New Amateur Call-Book*

The December issue of the well-known publication "The Radio Amateur Call-book" is now obtainable from G5KA, F. L. Postlethwaite, 41 Kinfauns Road, Goodmayes, Ilford, Essex, priced 6s. post free. This issue is extremely comprehensive and covers all the new G3 call-signs. It has been brought right up to date despite the rapid changes of European countries and it also includes a large number of little known experimental call signs. For those who make a hobby of collecting QSL cards and sending reports to stations they hear or have worked, this December issue of the Call-book is absolutely invaluable.

### *Premier Supply Stores*

Readers who are in the habit of calling at Premier Suppy Stores, at 165 Fleet Street, E.C.4, should make a note that this business is being transferred to 169 Fleet Street, owing to expiration of lease and that new and more spacious premises are required. The new premises will be opened on February 8 and until that date a clearance sale is taking place at 165 Fleet Street.

INTRODUCING—

# THE LATEST "EDDYSTONE" COMMUNICATION RECEIVER

(Type E.C.R.)

We particularly invite every reader of this anncuncement—including YOU—to post the coupon for literature dealing with this new "Eddystone" Wonder—for we feel that here is a Receiver that in appearance, constructicn and performance will win the enthusiastic approbation of even the most critical user. We are proud to present it !

The Chassis, Coil Unit and Crystal Unit are die-cast and the most complete screening is employed everywhere. The layout is such that all leads are a minimum length. No more valve stages than necessary are employed and reduction of noise level has been an ever-present thought during the design.

The Superheterodyne circuit comprises 10 valves, including Rectifier, with the following stages :—High Frequency, Mixer, Electron Coupled Oscillator, two 465 Kc/s, I.F's, Double Diode Detector, Beat Frequency Oscillator, L.F. Amplifier, Tetrode Output and full wave Rectifier.

Switched Coils cover a waverange of 9.5 metres to 190 metres, 33 megacycles to 1.6 megacycles, divided into 4 wavebands. Electrical band pread tuning is employed. A crystal gate is fitted with phasing condenser and variable selectivity control. Volume controls for R.F. and L.F. adjustment. An "R" meter calibrated in decibels is on the front panel. B.F.O. control and switch and A.V.C. on and off. (3 Watts Output).

**PRICE £45**

Be sure to post this coupon for descriptive literature and performance specification of this wonder Model to :

**STRATTON & Co. Ltd.,**

**BROMSGROVE STREET, BIRMINGHAM, 5.**

London Agents : WEBB'S, 14, SOHO STREET, W.1.

**POST THIS COUPON**

Cut off and post in ½d. envelope

*To Messrs. STRATTON & CO., LTD., Bromsgrove St., B'ham.*
*Please send me literature regarding the new "EDDYSTONE" Communication Receiver, Type ECR.*
*Please also send me the "Eddystone" Component Catalogue*

*Name* ..............................

*Address* ..............................

.............................. *T.*

# Sound Sales and the C.W.R. Transmitter

This transmitter was fully described in the November issue of this journal. It was expressly designed for use in conjunction with the C.W.R. (Civilian Wireless Reserve).

In addition to operating on the special 116 band it will cover the amateur bands of 40 and 80 metres by simply changing coils and crystals.

*Sound Sales Transformers as specified*

| | |
|---|---|
| *HT/700/CW.* | 35/- |
| *LT/CW.,* | 13/9 |

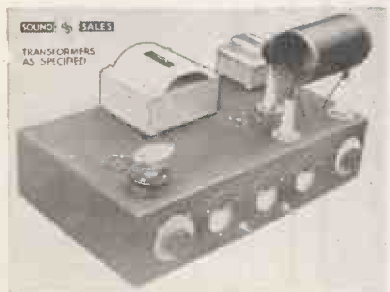



*Illustration shows Sound Sales Transformers as specified.*

THE C.W.R. TRANSMITTER COMPLETE WITH CRYSTAL
Can be purchased from
SOUND SALES LTD.

Price with crystal, for 2,580 Kc. (116 metres), **£15/10/0**

SOUND SALES LTD.

**Marlborough Road, Upper Holloway, London, N.19**
Phone : ARCHWAY 1661-2-3. (Contractors to the G.P.O., etc.)
(Nearest Station—Highgate Tube—15 Minutes West End).

T. R. McELROY, The Candler trained WORLD'S CHAMPION Telegraphist, on November 19th, 1938, held his title against all comers. He created a NEW RECORD of 75 w.p.m. McElroy says :—"I owe my success to Candler Training."

**3 FAMOUS COURSES that have made Champions.**

SCIENTIFIC CODE COURSE for beginners. Teaches all the necessary code fundamentals scientifically.

HIGH SPEED TELEGRAPHING for operators with speed from 12 to 35 w.p.m. who want championship speed and technique.

TELEGRAPH TOUCH-TYPEWRITING for those who want to become expert in the use of the typewriter.

# LEARN CODE

**You can become a fast, capable Operator at Home with the**

# CANDLER SYSTEM !

IT'S easy to learn code the Candler way. Here is a scientific system of code instruction, developed over many years of practical teaching experience, that is world-famous. Candler students are correctly taught right from the start, with the proper fundamentals, so that their progress is truly amazing.

With this system you learn to read code by sound, just as you read print by sight. In a few week's time, you will accomplish far more than with months of undirected practice.

Literally thousands of high-speed commercial and amateur telegraphists owe their remarkable proficiency to Candler Training.

*SEND FOR FREE "BOOK OF FACTS"*
It tells all about the famous Candler System !

**Write to H. FREEMAN, 121, Kingsway, London, W.C.2 (Room 55B)**

*London Representative :*

**CANDLER SYSTEM COMPANY**

*Asheville, North Carolina, U.S.A.*

# Trade News of the Month

*Many new components have been produced just recently specifically for amateurs, and some of these are discussed in this short review.*

IT is rather unusual for so many new communication receivers to make their appearance at one time. Most of the recognised importers of American receivers are now busy demonstrating the many new models that have arrived during the past month or so.

This HQ-120 is the latest receiver to be offered to amateurs by the Hammarlund Company. It includes a very special calibrated R meter and 12 valves.

Of particular importance is the introduction of the HAMMARLUND HQ/120, a brand new communication receiver with 12 valves covering 31 to 45 megacycles. Some of the more important features are a variable band width crystal filter for 310 degrees band-spread on all amateur bands, antenna compensating control for maximum signal to noise ratio and image rejection, noise limiter following A.V.C. for quiet reception and a calibrated signal-strength meter of unusual accuracy.

This Hammarlund receiver should strike a new high level in communication instruments for the R.F. and detector circuits have been so designed that they provide a practically uniform gain throughout the amateur bands. The S unit is actually a vacuum-valve volt meter calibrated up to S9 and also to 40 db above S9.

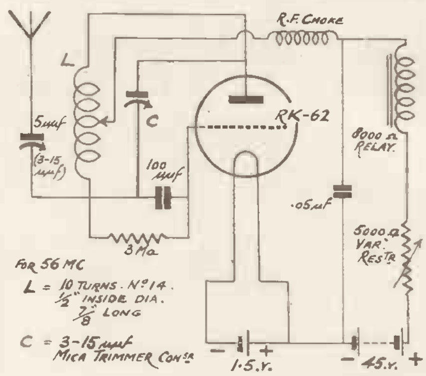
The receiver has many new ideas embodied such as crystal filter circuit with 6 ranges of selectivity from broad to single signal. With this scheme it is possible to employ crystal filter reception on telephony. Full data on this most interesting set can be obtained from Messrs. Webbs Radio, of 14 Soho Street, London, W.1.

We were very interested in the new RME-70, this being the first new receiver produced by RME since the RME-69.

It is priced at £36 15s. and it is claimed that the sensitivity is less than 1 microvolt on all high-frequency bands. The frequency coverage of the RME-70 is from .55 to 32 Mc. in five bands, while a db-R meter is included with a specially illuminated scale. The crystal filter is of the variable phasing type while at the same time a selectivity control is included to broaden or sharpen the response of the circuit. In this way the crystal can be in use when receiving telephony.

A very important inovation is the automatic noise suppressor. This circuit will allow the audio channel to operate with maximum fidelity up to 100 per cent. modulation, and yet reduces noise peaks to almost an inaudible level. No adjustment is necessary with this noise silencing circuit so that signals are automatically received with the minimum amount of noise. For this reason the RME-70 can be thoroughly recommended for those who are located near a main road or to machinery causing widespread interference. This receiver is being demonstrated by Webb's Radio and deliveries are from stock.

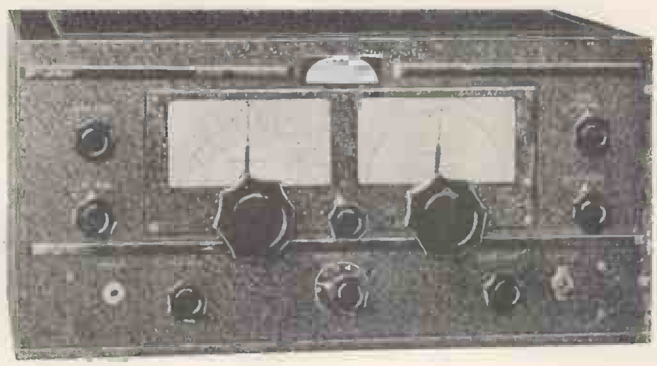
The NC-44 is a medium priced 7-valve communication receiver for general amateur use.




This is the remote control circuit using a new gas triode type RK-62.

Two new receivers are being handled by Messrs. Raymart, of Birmingham. These are the NATIONAL NC-5-10 and the NATIONAL NC-44. The NC-5-10 complete and ready for operation is priced at £45. It is a special type of communication receiver covering 28 to 64 Mc. in three ranges with each range calibrated in megacycles. Acorn valves are used in the R.F.-detector and high-frequency oscillator stages. The intermediate frequency is 1,560 Kc., while the performance on these ultra highs is equal to that given by the HRO on the lower frequencies.

A crystal filter provides variable selectivity from 300 cycles to 7 kilocycles, while the output tetrode delivers two watts of audio. A beat-note oscillator is included and a valve volt meter calibrated in signal strength units. This is a startling introduction for an ultra-high frequency receiver. A



It is quite an event to hear of a receiver other than the RME-69 from the RME company. The RME-70 is their latest effort and it includes a built-in noise silencer.

# Mullard MEASURING APPARATUS

## CALIBRATED AUDIO FREQUENCY OSCILLATOR TYPE GM.2304

*TO RADIO, TELEVISION AND COMPONENT MANUFACTURERS*

Audio Frequency Oscillator Type GM.2304 is a portable A.C. mains operated instrument with a high degree of frequency stability. Two directly calibrated frequency controls are provided, one reading up to 1,500 c.p.s., and the other up to 15,000 c.p.s., providing an open and easily read scale over the complete frequency range.

A six-position attenuator switch and a continuously variable potentiometer for fine control are provided.

Output constant within 2 dB between 50 c.p.s. and 15,000 c.p.s.

An electron beam tube is fitted as an indicator, for the purpose of checking the calibration against the mains frequency.

PRICE

**£25**

*For full specification write to:*

**MULLARD WIRELESS SERVICE CO. LTD.**

**Measuring Apparatus Section, 226 Tottenham Court Road, W.1. Phone : Museum 3484**

# ESSENTIAL

## for really worth-while listening

*Really very light. Three resistances—120, 2,000 and 4,000 ohms.*

*One Price* **15/-**

and by 'listening' we mean really hearing all that is going on in your radio in all its true tone-values.

In the days when telephone listening was universal, **Ericsson Super Sensitive Telephones** were far and away the finest of their kind. Today they are equally supreme in the opinion of those who prefer headphone listening.

Very comfortable in wear, very light, and have no awkward projections to catch in ladies' hair. Buy a pair or two to-day and enjoy what the loudspeaker often misses

*At all GOOD radio dealers. If you have any difficulty in procuring write direct to :*

**Ericsson**

**TELEPHONES LTD.**

**22, Lincoln's Inn Fields, London, W.C.2.** *Telephone: HOLborn 6396*

# Howard–430 :: Vibrator Unit

special model is also available with an inter-channel noise suppressor, if required. These receivers will be available for general distribution early this month.

Readers needing an inexpensive communication receiver should make a point of writing to Messrs. Raymart for data on the NC-44. It is a 7 valve superhet with two I.F. stages, beat-note oscillator and an A.V.C. control valve. There are separate switches for A.V.C. and B.F.O. and separate controls for R.F. and A.F. gain. The receiver is self-powered and suitable for use on A.C. or D.C. mains.

A battery model is also available to operate from a 6-volt supply. The frequency range is 550 Kc. to 30 Mc. and provision has been made for headphone or loudspeaker operation. Complete and ready for use off a 230-volt supply, the price is 16 guineas, which is extremely low in view of the sensitivity and general capabilities of this receiver.

A valve that has great possibilites is the Raytheon RK-62, a gas triode detector priced at 25s. This valve is designed for a heater supply of 1.4 volts D.C. with a heater current of 50 mA. The following operating notes should be of interest.

The valve must always be operated with a series resistance in the anode circuit to limit the anode current to 1.5 mA. When operating correctly the tube oscillates at audio frequency except during reception of a radio-frequency signal, whereupon the audio frequency disappears.

The circuit shown is recommended for remote control purposes and if desired the 45 volt anode supply battery can be omitted in favour of a 50 cycle A.C. supply. The average valve drop may be reduced by increasing aerial coupling by decreasing the L/C ratio of the tank circuit or both.

The maximum controllable current can be increased by increasing the anode by-pass condenser, by decreasing the grid leak resistance or both. If the capacity of the anode by-pass condenser is reduced and the relay replaced by a pair of phones, the circuit will operate as a conventional super-regenerative receiver with an anode voltage as low as 30. Messrs. Webb's Radio now have supplies of this interesting valve.

Post Office regulations make it very clear that all transmissions must be carefully logged for possible inspection. Log books are generally rather expensive, and in any case, do not last very long so we were glad to see that Messrs. Webb's Radio have now produced a Log book of no less than 80 pages for 2s. 6d. This is the very book for British amateurs and on the inside back cover is a complete reference chart showing the pin connections to practically every American type valve. At half-a-crown it represents very good value for money.

They also have a book entitled "The Globe and its Uses" which is invaluable to those who have purchased one of Webb's amateur globes. This book explains in simple language just how to make the most of the globe and the way in which calculations are made. The price is 1s. 6d.

The HOWARD model 430 receiver is perhaps one of the cheapest sets of its kind on the market at the present time. It uses 6 valves, covers .54 Mc. to 40 Mc. and gives a really good performance on 10 metres. It includes ceramic coil forms, iron-cored I.F. transformers, a beat-frequency oscillator, good band spreading and a send-receiver switch. For those who are limited to the amount of money they can spend on a receiver, this Howard 430 appears to be the answer to their problems. Radiomart have these sets in stock and anyone who is in the Birmingham area would be well advised to have a demonstration and see what can be done with a 9½ guineas receiver of modern design.

This is one of the Mallory-Masteradio vibrator power units. It includes as a rectifying valve the new filamentless Raytheon tpye AO4G.

The problem of obtaining ample H.T. for portable equipment is a very real one, but the MALLORY Vibrator Pack handled in this country by Masteradio, of Newton Street, High Holborn, W.C.2, is a very big step in the right direction. These packs are of the heavy duty type. One unit is available that provides 300 volts at 100 mA. with variable voltage output. They are of the valve rectifying type using one of the AO4G filament less rectifiers.

Some of the units are arranged so that the output voltage can be varied in four steps of 25 volts each. The model which we have tested priced at 6 guineas gives the high voltage of 300 at 100 mA., but there are many different types and we strongly advise readers to get some further data from Messrs. Masteradio.

The vibrators are very well suppressed so that there is no noise to interfere with a radio receiver, while it has been arranged that smoothing can be included in the receiver or amplifier.


This is a typical Aerovox resistor which is very robust in construction and will stand gross overload.

Aerovox resistors are available from most importers of American products and these resistors are particularly suitable where a high current has to be passed for long periods. We have used them with great success as anode and grid resistors in transmitters of all types. They will stand gross overload. These resistors are available in all types from 5 watts up to 200 watts and the higher rating types are suitable for use as fixed potential dividers to give screen voltage for a large number of tetrode valves.

Service engineers are generally in need of a good oscillator modulated or unmodulated as required. And we consider that the new oscillator produced by Messrs. Peto-Scott Electrical Instruments (Holdings), Limited, is excellent for general work.

This oscillator covers from 10 to well over 2,000 metres and is completely self-contained. Two valves are included, a simple triode and an octode. The oscillator is the triode and the octode a modulator-cum-buffer. This modulator-oscillator is compact and could easily be carried around by the average serviceman, while in addition to giving maximum frequency check, can also be used for lining up intermediate frequency amplifiers.

Full information on this equipment can be obtained from the manufacturers, who are also prepared to give very quick delivery. Although the frequency range is limited to approximately 10 metres, by using the second harmonic this range can be extended to 5 metres, so covering television and amateur channels. The price of this all-wave modulated test oscillator is £6 17s. 9d.

# TELEVISION ENGINEERING

By J. C. Wilson, F.R.S.A., Fellow of the Television Society, etc. With a FOREWORD by J. L. Baird.

This well-known textbook deals exhaustively with television theory and practice from its earliest days down to present developments. Comprehensive information is given on scanning methods and devices, optics, photocells and photo-sensitivity, the cathode tube, and special branches such as colour-television, and numerous photographs and diagrams are included. It is an invaluable book for practical engineers as well as students. 504 pages. 30/- net. (by post 30/6).

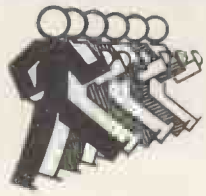
"Students will find within the pages of this work a wealth of accurate information and a host of references for further study . . . Experts should have the book at hand to be in constant touch with all the essential references."—*Journal of the Television Society.*

"This book is an excellent one."—*Electrical Engineer.*

Order from a bookseller or direct from

PITMAN

Parker St., Kingsway, London, W.C.2



# THEY ALL SAY A.C.S. . . FOR BETTER SERVICE

Why not drop in and inspect our stock of sets and Ham equipment? We shall be pleased to see you and there is no obligation to purchase.

**National's** Newest Receiver, Type Nc-44, 10 to 550 metres, 2 I.F. stages. Separate speaker, Vernier Band-spread control, A.C./D.C. operation, **£16 0s. 0d.**

**Hallicrafters Famous Sky Buddy,** Model S-19, 5 tubes, 16 to 550 metres, built-in speaker, BFO control, Send-Receive switch, complete, **£9 9s. 0d.**

**Meissner Signal Shifter,** exciter unit with built-in power supply, 6F6 ECO driving a 6L6 doubler, complete with one set of coils, **£12 10s. 0d.**

**National CRM Oscilloscope,** complete with 913 tube and power supply, **£6 0s. 0d.**

**Hammarlund Super-Pro,** SP-120-LX, 15-2,000 metres, 12-in. speaker, **£67 0s. 0d.**

**NEW TUBES AND COMPONENTS.**

**Taylor** T20 and TZ20, **17/6, Taylor** T21 Beam tube, **15/-.**
**Taylor** T40 and TZ40, **24/-**
**Hytron** HY25 **16/6,** HY40 23/-, HY51 **42/-,** 866Jr., 7/-. **Raytheon** RK-11, **15/-.**
**Raytheon** RK-39 **22/-,** RK23 and **RK25 27/-.**
**Eidson** "T9" crystals, 40-metre X-cut, 10/6. Eidson Ceramic Holders, 7/6.
**72-ohm Feeder Line,** $5\frac{1}{2}$d. per yard ; 350 ohm, 6d. per yard.
**Systoflex** 2 mm. FB quality, **1/1** per dozen yards.

**SEND FOR FULL DETAILS INCLUDING ALL HAMRAD LINES TO**

**A.C.S. RADIO** TECHNICAL MANAGER **G2NK**
16 GRAYS INN ROAD, LONDON, W.C.1
Telephone: HOLBORN 9894-5

# G5NI Communication — Receivers —

**NATIONAL NC-44**

This new NC-44 Communication Receiver combines capable performance with exceedingly low price. It employs seven tubes in a superheterodyne circuit with a 6K8 first detector and oscillator having exceptional stability and conversion gain, two 456 KC IF stages, diode second detector, AVC with ON-OFF switch, CW oscillator and 25L6G beam tube output (2 watts UPO). A coil switch with silver plated contacts selects the four ranges from 30 MC to 550 KC. A full vision dial is calibrated directly n frequency, and a separate electrical bandspread dial makes accurate tuning easy. There are separate controls for RF and Audio Gain. The self-contained power supply operates on 210-240 volts A.C. or D.C. **PRICE** *with tubes & speaker chassis* **16 GNS.**

**RME 70**
All the advantages of the 69 plus a Built-in Noise Silencer, Iron-cored IF's, Illuminated DB-R Meter, new type Crystal Filter with phasing and selectivity Controls, Relay and Break-in Control, new Cabinet with Chromium trim. Lower in **PRICE 35 GNS.**

**SPECIAL OFFER ! ! !**

Fully shrouded Transformers by America's largest manufacturer. While they last.

| | |
|---|---|
| T7260—400/400 v. 150 m/A., 6.3VCT. 4A. 5V3A ... ... | 12/6 |
| T7236—375/375 v. 120 m/A., 6.3VCT. 4A. 5V3A ... ... | 10/6 |
| T7326—350/350 v. 100 m/A., 6.3VCT. 3A. 5V3A ... ... | 8/6 |
| T7307—350/350 v. 80 m/A., 6.3VCT. 3A. 5V3A ... ... | 7/6 |
| T7000—320/320 v. 80 m/A., 6.3V4A. 5V3A ... ... | 7/6 |
| T464919—10V4A Primary Tapped 110-250V. ... ... | 5/6 |

Chokes interleaved and impregnated : 20 Hy. 500 ohms 100 m/A., 4/11 ; 15 Hy. 250 ohms 60 m/A., 1/11.

Our New Short-wave Catalogue, $1\frac{1}{2}$d. Post Free, or with G5NI 70 page Manual, $7\frac{1}{2}$d. Post Free.

**HOWARD 430**
Six Tubes, four Bands from .54 to 40 Mc. Iron-cored IF's, Ceramic Coil Forms, Beat Oscillator, Headphone Jack, Doublet Antenna Connections, Bandspread, Send-receive Switch, etc., AND IT COVERS 10 METRES. **PRICE $9\frac{1}{2}$ GNS.**

**Howard 450A.** 12 Tubes, 6 bands, 65 Mc to 540 kc., Dual IF channels with variable selectivity. 1,560 kc on the 5 and 10 metre bands and 465 on the others. Complete with Crystal Filter and Speaker. **PRICE 30 GNS.**

**"BLILEY" NEW VFI 40 METRE CRYSTAL.** At last a variable frequency 40 metre crystal, allowing 12 kc. shift on fundamental and giving 24 and 48 kc. on 20 and 10 metres respectively. Also 80 metre VFI. Price **45/-** each

**"OHMITE" LATEST 100-WATT DUMMY ANTENNA.** True 72-ohm impedance on all frequencies at any power up to 100 watts. Get to know the true efficiency of your Transmitter. Price **20/-** each.

RADIOMART G5NI (BHAM) LTD.
DIRECTORS: W. H. D. NIGHTINGALE L. NIGHTINGALE

**44, HOLLOWAY HEAD, BIRMINGHAM, I.**
Telephone : MIDLAND 3254

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

# A Special Philips Short-wave 5-wave Band Receiver

*This is the Philips model 362A, a special short-wave set priced at 20 gns.*

THERE are so few British built all-wave receivers suitable for amateurs that we were extremely pleased to hear that Philips have produced an instrument with a performance on all amateur bands better than that provided by many of the multi-valve American receivers.

This set, the 362A, is admittedly a special model designed for export use, but a limited number are available for amateurs in this country. It is a table superhetrodyne for A.C. mains from 100 to 250 volts, 50 to 100 cycles and uses the recently introduced " E " type valves.

There is a stage of R.F. on all bands in which the EF8 Silentron is embodied. This is followed by a hexode mixer, the EH2, an EBC3 double-diode triode used as a high stability oscillator, an EF5 pentode I.F. amplifier, another EBC3 as A.V.C. control and second audio amplifier, two EL3 pentodes in parallel, rectifier and tuning indicator.

This new Philips receiver is outstanding for its low-noise level and good performance on 10 and 5 metres.

## *5-580 Metres*

The wavebands covered are from 5 to 11 metres, 9.5 to 27 metres, 25 to 75 metres, 70 to 210 metres and 195 to 580 metres. It is, however, on the higher-frequency bands where this receiver is so outstanding. The 10-metre amateur band is exceptional, noise level practically negligible and sensitivity considerably higher than that of most so-called sensitive U.H.F. receivers.

The actual instrument tested by us was a standard model and in order to check our views it was carefully tested by several well-known amateurs, all of whom were loud in their praise of the receiver. It is quite capable of holding its own with practically any set on the market at the present time.

Going still higher in frequency, the performance on 5 metres is excellent, and this perhaps is of special importance to amateurs who generally find that the average communication set falls off in sensitivity above 25 megacycles. Amateurs, G2IS, G6DT, VP3AA and G2CG find the 362A quite suitable for communication purposes on 10 and 5 metres, a point which cannot be claimed for many commercial all-wave sets of this type.

Frequency drift is negligible owing to the inclusion of a frequency stabiliser, while quality for those who are interested is of a very high order, which is accounted for to a certain extent by the use of inverse feed-back in the L.F. stages. We took particular notice of second channel interference on amateur bands, and this was found to be completely absent. The automatic-volume control is also good and holds the signal steady until the last possible moment.

On some of the 10-metre American phone stations, an output of 2-3 watts can generally be obtained and even at this high output there is no trace of microphony. We noticed that the R.F. and mixer stages were mounted in a separately sprung chassis quite apart from the audio and power unit sections.

Provision has been made for a di-pole aerial so that the tuned aerials used by amateurs can quite efficiently be attached to this receiver. The number of controls have been reduced to minimum and these are all positive in action. Although no band-spreading is included, the scale width on 10 metres, for example, is quite wide and there is no difficulty in logging ordinary amateur stations of average field strength.

Our tests were made with a di-pole aerial cut to approximately 14,250 Kc. and on both 20 and 10 metres, we were able to log a very large number of amateur stations including VK, W6, HI, VE and very many others. To give some idea as to the extraordinary power and efficiency of the A.V.C. system, we tuned in the London Regional programme and arranged the volume control so that the output from the receiver was approximately 2 watts. The receiver was then switched to 13 metres and the Columbia station, W2XE on that wavelength was received. Without touching the volume control, the audio output was approximately $1\frac{1}{2}$ watts!

During a 14-day period, we were able to hear the 13-metre stations at a strength sufficient to overload the loudspeaker and with a complete absence of fading. Commercial stations on 9 and 11 metres were also receivable.

The sensitivity is such that the 9-metre American Police radios could be picked up at sufficient strength to provide an audio output in excess of 1 watt. Generally speaking, for 90 per cent. of the time, it is impossible to tell whether one is listening to the National programme or some of the more powerful American short-wave broadcasters. This is probably because of the exceptionally low noise level. Stations which would be lost underneath the noise in an average receiver can be received quite clearly with this Philips 362A.

We are sorry it is not made as a real communication set complete with Beat-frequency oscillator, but those amateurs who have to make one receiver fulfil two functions, that of short-wave communication and an ordinary broadcast receiver, will find the 362A entirely suitable.

Only a limited number of these sets are availabe and we advise readers to get in touch with Messrs. Philips Lamps, Limited, of 145 Charing Cross Road, W.C.2, for further data. Those who can arrange it are advised to have a demonstration and to notice particularly the exceptionally low noise level and remarkable performance below 14 metres. The price is fixed at 20 gns.

## MECHANICAL-OPTICAL-TELEVISION

*We Specialise in all Latest Components*

**A NEW FIELD OF EXPERIMENTS OPENED TO THE AMATEUR, WITH A LARGE PICTURE AS GOAL**

*We can supply The following Apparatus as illustrated in this Journal*

**SCANNERS FOR 67.5 LINES . LENS UNITS**
**LIGHT MODULATION CELLS . OPTICAL BENCH**
**SYNCHRONOUS MOTORS . INTERLACE GEAR**
**NEW TYPE FRAME SCANNER AND LENS UNIT**
**For Large Picture as Described in this Magazine.**

*Send us your requirements*
*Latest List Available*

**H. E. SANDERS & CO.** 4, GRAYS INN ROAD, LONDON, W.C.1.
Tele. Chancery 8778



*"Can be thoroughly recommended."*—WIRELESS AND ELECTRICAL TRADER

## TELEVISION RECEPTION TECHNIQUE

*By PAUL D. TYERS.* A comprehensive and valuable guide to television reception methods for experimenters and practical radio engineers. All the circuits described have been tested and proved successful. The text is easy to follow and is well illustrated with photographs and diagrams. 142 pages. 85 illustrations. 12/6 net (by post 12/11).

*Order from a bookseller or direct from*

SIR ISAAC PITMAN & SONS, LTD.,
Parker Street, Kingsway, London, W.C.2



## WODEN TRANSFORMERS

**SPECIFIED FOR THE 50 WATT TRANSMITTER IN THIS ISSUE.**

**TRANSFORMERS :—**

| | | |
|---|---|---|
| T.2. | 300-0-300 volts at 150 ma.<br>4 volts at 2 amps.<br>2·5 volts at 2 amps.<br>2.5 volts at 3 amps.<br>5 volts at 3 amps. | 25/- |
| T.4. | 550-0-550 volts at 150 ma. | 27/- |
| T.5. | 750-0-750 volts at 250 ma. | 56/- |
| T.6. | 5 volts at 3 amps.<br>6·3 volts at 1 amp.<br>7·5 volts at 1 amp. | 15/- |
| **CHOKES** | | |
| CH.1. | 20 HY–250 ma. | 25/- |
| CH.2. | 20 HY–200 ma. | 16/6 |
| CH.3. | 5/25 HY–300 ma. | 22/6 |

**NOTE**
All the above and other WODEN products may be obtained at Messrs. Webb's Radio, London and Birmingham.

**WODEN** "individually-constructed" Super Transformers are used by all discerning constructors who like "nothing but the best." You should incorporate them in all your apparatus.

They LOOK better—They ARE better!

Send for FREE descriptive literature.

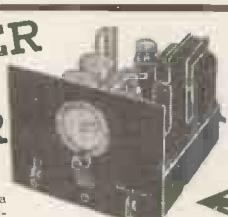
**WODEN TRANSFORMER CO.**
**ST. JOHN'S SQUARE, WOLVERHAMPTON**



★ **AN INSTANT HIT!**

## MEISSNER SIGNAL SHIFTER

VARIABLE FREQUENCY EXCITER UNIT



The Meissner "Signal Shifter" is a variable-frequency electron-coupled exciter unit which permits the amateur to move instantly to another frequency in the band when his signa is being QRM'd. Exceptional **frequency stability superior to that of many crystals is obtained.** The "Signal Shifter" eliminates one or two stages in the transmitter as the power output is ample to drive a medium power R.F. amplifier or final stage directly on the frequency desired. Every amateur will be delighted with the ease with which this unique device permits him to slide into "holes" in the band, to make his QSO's 100 per cent. It's easily done with the MEISSNER "SIGNAL SHIFTER."

COMPLETE £12·10·0 or 25/- DOWN SECURES

**Less Power Supply £10.0.0 (or 20/- deposit). Set of 3 coils for each amateur band 14/6 each set.**

## SPECIAL

**THE WORLD'S FINEST COILS.**
**Multi Wave Coil Assembly. Air Tuned.**
**Mono Unit Construction. 3.75-2,140 metres**

The finest coil unit made. Entirely air tuned. "Alignaire" air dielectric trimmers. Embodies all coils, 5-range switch, shunt trimmers, series padders, A.V.C. by-pass condensers. The entire front end of receiver less gang condenser and tubes. 7.5-2,140 metres or 3.75-555 metres.
List **£5.15.0** each YOUR PRICE 80/6 CASH.

***Completely Assembled***
## ALL WAVE TUNING UNIT

**The entire front end of the Radio Receiver.** Embodies the coil assembly shown above together with gang condenser, 8-in. de Luxe band-spread drive, R.F. aerial and oscillator stages completely wired with leads ready for connection to 456 or 465 kc I.F. channel. 7.5-2,140 metres or 3.75-555 metres.
List **£10.7.6** each YOUR PRICE £7.5.3 (or 14/- with order secures.)

*Just Arrived!*

## ★ 2 SENSATIONAL NEW LINES!

**The MEISSNER 7-station Push Button Tuner.**

Easily affixed to any radio receiver, T.R.F. or Superhet. Connections to top of gang condenser only. The finest push-button tuner made in the States. Any seven stations may be tuned in and they will not "shift." Automatic release GET YOUR P.B. TUNER NOW, 7/6 Deposit secures. Your Cash Price 47/6

A MARVEL IN RADIO DEVELOPMENT!
MEISSNER Remote Control Push Button Tuner
**Permeability Tuned.**

This unit may be used to control your main receiver from any distance, and gives you the choice of seven stations by merely pressing the buttons. Volume control and on-off switch incorporated. Stations set by merely rotating one small knob for each station. Unique permeability tuning ensures NON-DRIFT. Connects to A and E terminals of set. In beautiful two-toned cabinet, $5\frac{1}{8} \times 9\frac{3}{8} \times 1\frac{3}{8}$ complete with two valves, instructions, etc.
Price **£5.17.6** complete, or 12/- Deposit secures.

● **AN AMAZING BARGAIN!** $4\frac{1}{2}$-2,000 metres.

**6-Band Superhet R.F. Coil Assemblies.**

Completely aligned and balanced multi-wave coil assemblies, offered at a bargain price. This unit is undoubtedly one of the most efficient ever made to meet modern requirements. Special low loss construction employed throughout. Latest ceramic wafers used on switch. Complete with circuits instructions, etc. R.F. coils on 5 bands. Coverage $4\frac{1}{2}$-13, 12-35, 34-100, 91-261 200-557, 700-2,000 metres.
YOUR PRICE 49/- EACH. or 8/- Deposit secures

**2d. STAMP brings complete illustrated lists per return post. SEND ORDER NOW. TERMS Cash, C.O.D or small deposit with order.**
**Post and carriage charges paid to your address.**

Meissner **Anglo American Radio (and Motors) Limited** Meissner
(Dept. S.W.), Albion House, 59 New Oxford Street, LONDON, W.C.1.
*(Sole Meissner Agents in this Country)* Telephone: TEMple Bar 3231.

RESILIENCE

*For Perfect Contact*

Each individual socket in Clix Chassis Mounting Valveholders is formed with a definite waist, which in conjunction with the helical slots, affords unique resilience and gives perfect contact with every type of valve pin without possibility of collapse.

**CLIX VALVEHOLDERS AND WANDER PLUGS**

are specified for apparatus described in this issue.

*Complete List "T.S." Free for PC.*

CLIX

BRITISH MECHANICAL PRODUCTIONS LTD.,

79a Rochester Row, London, S.W.1.

**ELECTRADIX PHOTO-CELLS and other Bargains of interest.**

**PHOTO-CELLS,** for sound on Film, and Ray work, R.C.A., **25/-.** Beck, Angle Prisms, mounted in carrier, **5/6.** Micrometer adjusters for lens, **1/-.** Eyepieces with prism and lenses for photo-cell inspection, **12/6.** Service Set Headlamps with Battery Holder, **7/6.**
**LIGHT RAY CELLS,** Selenium, **5/-.**
**MORE BOTTLES, NEW VT13B** A fine 30-watter 6-v. 1½-amp., anode 1,500-v., imped. 35 thou., mag. 35. Less than half price, 25/-. AT50 5-guinea line, 7-v., 2½-a., 1,500-v., mag. 30, as new, **25/-.** Big Rectifiers, NU2, 5-v., 2½-a., 250 watts up to 20,000-v., **45/-**; 100,000 volts 2 m/A., **35/-.**
**X-RAY VACUUM DISCHARGE TUBES.** New Government Hospital, surplus, 7-in. dia. bulb. Big solid Tungsten Electrodes. Emission guaranteed. COST £5. SALE, 15/-. Packing, 2/6 extra.
**PORTABLE FIELD TELEPHONES,** Army Type, pigskin case, for speech, key for code. No. X135, half price, **30/-**; or two with 1 mile D2 unbreakable war cable, **£5.**
**COME TO US FOR Meters, Mikes, Testers, Rotaries, Switchgear, Chargers, Dynamos and Motors, etc.**

*Send for Illustrated List "T.S.," Post Free.*

**ELECTRADIX RADIOS**

218, UPPER THAMES ST., LONDON, E.C.4

*Telephone: Central* 4611.

A FEW ONLY FOR QUICK DISPOSAL

**AUTOMATIC MORSE CODE SENDERS**

C.V. Patent. No practice or preparation is necessary for any-one—even a child—to send immediately in any order perfect Morse signals at speeds from 5—30 w.p.m. Will operate buzzer oscillator or transmitter. 41 characters. International Code. Fitted with high grade buzzer and key for alternative manual sending. Indispensable to those learning the Code.

INSTRUMENT COMPLETE 7/6. Post 9d.

MIDLAND INSTRUMENT CO.,

75, GROSVENOR ROAD, BIRMINGHAM, 17

# Radio Society Activities

*Will Hon. Secretaries of Radio Societies who wish for news to appear in this column please send the information before the 15th of the month.*

## Stockport Amateur Short-wave Society

Hon. Secretary, E. Pearson, 89 Northcliffe Road, Offerton, Stockport, Cheshire.

This society has been formed to develop interest in short-wave transmission and reception amongst amateurs around Stockport. The society have arranged to provide lectures on short-wave topics, facilities for slow Morse code practice, visits to local places of interest, and ultimately to have their own transmitter for members to obtain operating knowledge. Particulars of the next meetings and qualifications for membership can be obtained from the hon. secretary.

## Romford and District Amateur Radio Society

Hon. Secretary, R. C. E. Beardow, 3 Geneva Gardens, Chadwell Heath.

The Romford Society meets at the Red Triangle Club, North Street, Romford, where complete series of lectures have been arranged. A recent lecture by Mr. Hollins, of the Mullard Wireless Service Co., was very well attended. Mr. Hollins gave a demonstration and a talk on modern cathode-ray tubes and equipment. A competition has been started for the benefit of artificial aerial members, while regular Morse code instruction classes have proved very popular. The society is applying for a portable transmitting licence, so that members can obtain some idea as to local conditions. Write to the hon. secretary for all information regarding membership.

## Wolverhampton Short-wave Radio Society

Hon. Secretary, V. C. Hayes, G3TI, 76 Darlington Street, Wolverhampton.

In 1935 when G6PC returned from Australia it was decided to form an active amateur society. At the moment there are no less than 50 members, including 19 with full radiating permits. The president is T. A. G. Margary, M.I.E.E., and the chairman, R. E. Speake, G5IQ. The society has an excellent club room made possible by 2BCD, which is equipped with a transmitter and receiver. Meetings are held at the headquarters each Monday at 8 p.m. with Morse classes at 7.30 p.m. Membership is 5s. per annum, but it has been decided that members under 16 can join for 2s. 6d. A very interesting programme has been arranged for the coming season including two field days, and a special lecture on television which will be held at the Public Library during this month. The last lecture of a similar type drew an audience of 350, so we would advise readers to get in touch with the hon. secretary for further information.

## Exeter and District Wireless Society

Hon. Secretary, W. J. Ching, 9 Sivell Place, Heavitree, Exeter.

A very interesting series of lectures has been organised for the members of this society which include not only short-wave radio and television, but associated subjects. It is probably the most active society in the West of England and any readers interested in short waves from either the receiving or transmitting angle should make a point of writing for particulars of membership from the hon. secretary.

The second half of the winter session started on January 30, while future items of interest are:—

A visit to the local telephone exchange.
A lecture by Dr. Wroth (Exeter Radiologist).
A lecture by D. R. Barber, B.Sc., F.R.A.S., entitled, "Atmospheric Electricity."
A talk by Mr. G. S. Bradley, entitled "Ultra-short Wave Links of the Post Office."

Meetings are held at 8 p.m. on Monday evenings at the Y.W.C.A., 3 Dix's Field, Exeter.

## Wirral Amateur Transmitting and Short-wave Club

Hon. Secretary, J. W. Williamson, 13 Harrow Grove, Bromborough.

"Modernising the Straight Receiver" was the title of an address by G8OC, at a recent meeting of this society. Mr. Rogers gave a circuit of an effective tuned radio-frequency receiver in which he uses cathode regeneration in both H.F. and detector stages. It is claimed that with this arrangement and special coupling circuits between H.F. and detector stages, extreme selectivity can be obtained. The receiver was demonstrated and found to be considerably more selective than the average straight receiver with less valve noise. The headquarters of this society are Beechcroft Settlement, Whetstone Lane, Birkenhead, and meetings are held on the last Wednesday evening of each month at 7.30.

## The Maidstone Amateur Radio Society

Hon. Secretary, P. M. S. Hedgeland, 2BDA, Hill View, 8 Hale Road, Maidstone.

The second annual general meeting of this society was held at its clubroom on January 10. The hon. secretary gave a report plus details of the 1939 programme. The new president is Mr. F. A. G. Cook, G5XD, who is a very well-known local amateur. This society has now two members with full call signs, and six A.A. calls, but it is hoped that their own transmitter, with the call sign G3WM, will soon be on the air and operated by G5UC. The following are four of the forthcoming items.

Jan. 31.—A junk sale.
Feb. 7.—A demonstration of products by Premier Supply Stores.
Feb. 14.—A lecture by W. H. Allen, G2UJ, on 56 mc. operation.
Feb. 21.—A lecture and demonstration of cathode-ray tubes by a representative of the Mullard Company.

Meetings are held every Tuesday at 7.45 p.m.

### Dollis Hill Radio Communication Society

Hon. Secretary, E. Eldridge, 79 Oxgate Gardens, Cricklewood, N.W.2.

Meetings are held on alternate Tuesdays at 8 p.m. at Braincroft School, Warren Road, Cricklewood, N.W.2. The meetings for February are on the 14th and 28th and readers are requested to attend if at all possible. The subscription is 2s. 6d. per annum, but full information can be obtained from the hon. secretary.

### Edgware Short-wave Society

Hon. Secretary, F. Bell, 118 Collin Crescent, N.W.9.

Amongst recent lecturers have been representatives of the General Electric Co., Messrs. Rothermel Corporation, Radio Society of Great Britain, Messrs. A. C. Cossor, Ltd., and T.C.C. This society is very active, is in a convenient position for our London readers, so we strongly advise anyone interested in short waves to go along to a meeting on any Wednesday at 7.30 p.m. at the Constitutional Club, Edgware.

### *Good DX Reception*

It has been our experience that for real long-distance reception under adverse conditions, the use of a sensitive pair of headphones is practically essential. Although most of the modern communication receivers have an extremely high degree of sensitivity and embody sensitive loudspeakers, weak stations are often lost underneath the noise level when the gain control is advanced beyond a certain point. In such circumstances, a pair of headphones connected into circuit before the output stage will usually enable the very weak signals to be heard above the noise level. As most receivers now include a tone corrector and a headphone jack, we feel that more headphones should be used for long-distance reception rather than to rely on the high audio power the average set does provide.

**The Ericsson Supersensitive headphones.**

Headphones which give good quality reproduction are extremely satisfactory for the reception of C.W. and for this reason we can recommend the use of reliable headphones such as the Ericsson supersensitive, which many government departments are now using. These headphones have a resistance of 4,000 ohms, and are priced at 15s. We advise readers to write to Messrs. Ericsson Telephones, Ltd., 22 Lincoln's Inn Fields, W.C.2, for information on their latest type headphones.

*Housewife*

*"And here's to the housewife that's thrifty. . ."*

**Housewife** is the first pocket-size magazine dedicated exclusively to the woman of the home. It caters for every aspect of the housewife's interest—her house, her children, her kitchen, her hobbies, her appearance, her social activities. No other monthly magazine of feminine appeal includes such a variety of subject matter treated from an essentially practical point of view and presented in such a highly condensed, yet readable form.

**HANDY, BRIGHT *and* SAVES YOU MONEY!**
**100 PAGES, 33 ARTICLES & FEATURES**

**6D MONTHLY**

**No. 1 NOW ON SALE AT ALL NEWSAGENTS**

PUBLISHED BY THE PROPRIETORS OF "TELEVISION & SHORT-WAVE WORLD"

# A Directory of British Radio Clubs

NO amateur should be without a copy of the new Wireless Diary which is published by Charles Letts and Co., of Diary House, Borough Road, London, S.E.1. We have made a point of using one of these diaries for many years in view of the large amount of useful information contained in it.

Some of the items include a time map of the world, a full list of weather forecasts and news bulletins transmitted by the British Broadcasting Corporation, a list of B.B.C. transmitters with frequency and power and a very complete list of European broadcasters. Then there are twelve pages devoted to the short-wave stations of the world followed by a list of international and amateur codes.

We find of particular use a complete colour code for resistors, condensers, mains transformers and even battery readings. Those who are interested in learning morse code will be glad to know there is included a complete international code.

This diary is in two types, price 1s. and 2s. 6d. The 1s. version has a cloth cover and is not supplied with a pencil, whereas the half-crown De Luxe edition is leather covered and has a pencil. Contents, of course, are identical in both cases. As we obtain a considerable number of letters from readers asking for the address of the nearest radio society, we are reprinting this complete directory by the courtesy of Charles Letts and Co.

**Battersea and District Radio Society.** Hon. Sec.: S. F. Harris, 93, Salcott Road, Battersea, S.W.11.

**Bec Radio Society.** 9, West Way, Grand Drive, Raynes Park.

**Bideford and District Short-Wave Society.** Hon. Sec.: W. G. Couch, Hillside, Glen Gardens, Bideford.

**Blackpool and Fylde Short-Wave Society.** Sec.: H. Fenton, 25, Abbey Road, Blackpool.

**Blackpool S.W. Club.** E. Sutcliffe, The Wellbeck Hotel, North Promenade, Blackpool.

**" Bon Accord " Short-Wave and Television Society.** Sec.: J. Horn, 4, Broomhill Avenue, Aberdeen.

**Bournville Radio Society.** Hon. Sec.: C. L. Bastock, c/o., Messrs. Cadbury Bros., Bournville.

**Bradford Experimental Radio Society.** Hon. Sec.: E. P. Burgess, 23, Baslow Grove, Heaton, Bradford.

**Bradford Short-Wave Club.** Hon. Sec.: G. Walker (2AWR), 33, Napier Road, Thornbury, Bradford.

**Brentwood Amateur Radio Society.** Hon. Sec.: N. K. Read, " Netherton," Herington Grove, Hutton Mount, Brentwood, Essex.

**Brighouse and District S.W. Society.** Royal Hotel, Buildings, Huddersfield Road, Brighouse.

**Bristol Amateur Radio Society.** Hon. Sec.: G. Williams (G8DP), Hartham Cottage, Almondsbury.

**Bristol Listeners' Club.** 21, Old Market Street, Bristol.

**British Short-Wave League.** Hon. Sec.: F. A. Beane, Ridgewell, Halstead, Essex.

**British Sound Recording Assoc.** Act. Sec.: J. F. Butterfield, 44, Valley Road, Shortlands, Kent.

**Cambridge Short-Wave Club.** C/o. Mr. F. A. E. Porter, 19, Trafalgar Street, Cambridge.

**Cardiff and District Short-Wave Club.** Hon. Sec.: H. H. Phillips, 132, Clare Road, Cardiff.

**Chadwell Heath and District Radio Society.** Ralphs Cafe, Tram Terminus, Chadwell Heath, Essex.

**City of Belfast Y.M.C.A. Radio Club.** C/o. F. A. Robb, 46, Victoria Avenue, Sydenham, Belfast.

**City and Guilds Eng. College Radio Society.** Hon. Sec.: R. H. Tanner, Exhibition Road, South Kensington, S.W.1.

**Clackmannanshire Short-Wave Club.** Hon. Sec.: D. McIntosh, 10, Cobblecrook Gardens, Aloa, Scotland.

**Coventry Amateur Radio Society.** C/o. H. J. Chater, 179, Alderman's Green, Coventry.

**Cranwell Amateur Radio Transmitting Society.** Radio Block, E. and W. School, R.A.F., Cranwell, Lincs.

**Croydon Radio Society.** Hon. Sec.: E. L. Cumbers, " Maycourt," 14, Campden Road, S. Croydon.

**Croydon Wireless and Physical Society.** Hon. Sec.: H. J. P. Gee, c/o Messrs. Gee and Co., Staple House, Chancery Lane, W.C.

**Darenth Valley Radio Club.** Hon. Sec.: K. M. Hollands, 14, Highfields Cottages, Wilmington, Dartford.

**Deptford Men's Institute Short-Wave Radio Club.** Hon. Sec.: A. S. Wilson, 11, Bennett Street, London, S.E.13.

**Derby S.W. Radio and Experimental Society.** Sec.: H. Turner, Nunsfield House, Boulton Lane, Alvaston, Derby.

**Dollis Hill Radio Communication Society.** Hon. Sec.: J. R. Hodgkyns, 102, Crest Road, Cricklewood, N.W.2.

**Dulwich Radio Club.** Hon. Sec.: E. Webb, 55, Upland Road, E. Dulwich, S.E.22.

**Ealing and District S.W. Dx'ers Club.** Hon. Sec.: W. J. Colclough, 31, Lancaster Gardens, W. Ealing, W.13.

**Eastbank Research Society.** Sec.: J. P. Blackwood, 77, Lemnex Avenue, Scotstown, Glasgow, W.4.

**Eastbourne and District Radio Society.** Hon. Sec.: S. M. Thorpe, 74, Broderick Road, Hampden Park, Eastbourne.

**East Sheen Radio Club** (Proposed). N. G. Anslow, 35, Gilpin Avenue, East Sheen, S.W.14.

**Empire Amateur Radio League.** Hon. Sec.: E. N. Adcock (G2DV), 206, Atlantic Road, Erdington, Birmingham.

**Exeter and District Wireless Society.** Hon. Sec.: W. J. Ching, 9, Sivell Place, Heavitree, Exeter.

**Folkestone Radio Amateurs.** Hon. Sec.: S. W. Thompson, 70, Sandgate Road, Folkestone.

**Gateshead Wireless and Television Society.** C/o. G. Wilkin, 4, Ravensdale Crescent, Low Fell, Gateshead.

**Glasgow and District Radio Society.** Hon. Sec.: J. Hair, 42, Maryland Drive, Glasgow, S.W.2.

**Glasgow Short-Wave Radio Society.** Sec.: J. Neilson, 14, Bolivar Terrace, Glasgow, S.2.

**Golders Green and Hendon Radio and Scientific Society.** Hon. Sec.: Col. H. Ashby Scarlett, 60, Pattison Road, Hampstead.

**Hackney and District Wireless Club.** Dist. Rep.: E. Penrose, 2, Coopersale Road, Homerton, E.9.

**Halifax Experimental Radio Society.** Hon. Sec.: J. B. Bedford, Oak House, Triangle, Halifax.

**Harco Radio Club.** Hon. Sec.: C. W. Kemp, 124, Rover Way, Greenwich, S.E.10.

**Hastings and St. Leonards Radio Society.** R. M. Sutherland, 59, Old Harrow Road, St. Leonards.

**Heathfield Radio and Television Society.** Hon. Sec.: R. J. Lee, 9, Theobalds Green, Heathfield, Sussex.

**Hollywood and Wythall Radio Society.** Hon. Sec.: I. Quilton, " Fesmond-Dene," Shawhurst Lane, Hollywood (Nr. Birmingham).

**Ilford and District Radio Society.** Hon. Sec.: C. E. Largen, 44, Trelawney Road, Barkingside.

**International Dx'ers Alliance.** 9, Stanton Road, West Wimbledon, S.W.20.

**International Short-Wave Club (Brighton).** Sec.: J. C. Bennett, 205, Braeside Avenue, Brighton, 6.

**International Short-Wave Club (Guernsey).** Hon. Sec.: F. S. Le Pavoux (2BTP), " Newlands," Rue Maze, St. Martin's, Guernsey.

**International Short-Wave Club (London).** Hon. Sec.: A. E. Bear, 100, Adams Gardens Estate, London, S.E.16.

**International Short-Wave Club (Manchester).** H. Wild, 1, Elm Street, Middleton, Manchester.

**Ipswich and District Amateur Radio Society.** Hon. Sec.: D. H. Barbrook (G8AN), Radio House, St. Peter's Street, Ipswich.

**Irish S.W. Club.** 3, Clare Lane, Dublin.

**Jersey S.W. Club.** Sec.: Martin G. Bonske, " Crediton," Samares, Jersey.

**Kentish Town and District Radio Society.** 46, Lady Margaret Road, Kentish Town, N.W.5.

**Kettering Radio and Physical Society.** C/o. Irving L. Holmes, " Miami," The Close, Headlands, Kettering.

**Kew Ministry of Labour Radio Society.** Ministry of Labour, Ruskin Avenue, Kew.

**Kidderminster and District Radio Club.** Hon. Sec.: H. A. Brown, 12, Stourport Road, Kidderminster.

**Kingston and District Amateur Radio Society.** Hon. Sec.: R. K. Shergold, " Reculver," Manor Lane, Sunbury-on-Thames.

**Knutsford Amateur Radio Club.** Hon. Sec.: J. McDermott (2AHH), Shaw Heath Cottages, Mobberley Road, Knutsford, Cheshire.

**Lambda Radio Society.** C. F. Lamb, 4, Howley Street, York Road, S.E.1.

**Leamington and Warwick Amateur Radio Society.** C/o. M. C. Bunting, " Rhuaine," Clarendon Square, Leamington Spa.

**Leeds and District Radio Society.** Hon. Sec.: J. Kavanagh, 63, Dawlish Avenue, Leeds.

**Leeds Radio Society.** Hon. Sec.: G. F. Webster, 14, Birfield Crescent, Leeds, 4.

**Leicester Amateur Radio Society.** T. Cribb, 55, Knighton Drive, Leicester.

**Liverpool Amateur Radio Society.** Hon. Sec.: J. McLelland (2CIP), 38, Andrew Street, County Road, Walton, Liverpool.

**Liverpool S.W. Radio and Transmitting Club.** Hon. Sec.: C. E. Cunliffe, 368, Stanley Road, Bootle, Liverpool, 20.

**Maidstone Amateur Radio Society.** Hon. Sec.: M. Hedgland, 8, Hayle Road, Maidstone.

**Medway Amateurs Transmitting Society.** S. Howell, 124, Trafalgar Road, Gillingham, Kent.

**Merchant Taylor's School Radio and Television Society.** Hon. Sec.: R. B. Gardner, 91, Clarence Gate Gardens, London, N.W.1.

**Midland Amateur Radio Society.** A. T. Martin, 2, Gladys Road, Yardley, Birmingham.

**Milnes Radio and Television Society.** Hon. Sec.: F. Ridler, 7, Royd Avenue, Gilstead, Bingley, Yorks.

*(The remaining list of Clubs will be published in next month's issue)*

## "THE HOME-BUILT MECHANICAL OPTICAL TELEVISION RECEIVER—II

*(Continued from page 94)*

without the doubled definition arrangements, by obscuring two of its faces with black paper so that it acts as a two-sided plate.

The development of the nine ball scanner and motor unit is not completed, but it is hoped to have it available quite shortly, the rotating part being only half an inch in diameter, and comprising scanner and phonic wheel motor in one piece. In view of its small size the peripheral speed is quite low, and there is no shadow of danger in using it although the "revs," are high, viz., 22,500 r.p.m.

To sum up: doubling of picture size is immediately practicable, by adding a small lens and using a thicker second scanner on the existing phonic wheel motor; doubling of definition can be done most satisfactorily by replacing the mains driven ball scanner by a smaller, signal driven type, and this then gives at the same time proper synchronisation.

## Correction

It is regretted that a fairly obvious slip occurred in the drawing given last month of the optical frame. The second lens fixing hole was marked thereon as being 1½ in. from the edge of strip A, whereas it is obviously only ½ in.

It has also been remarked that the unit nearest the ball scanner, in the photograph showing the various units on the optical bench, was not identified. This is, of course, the first cylindrical lens mount, shown in detail in this issue.

In subsequent articles it is proposed to give circuit and constructional details for the modulated oscillator, vision receiver and synchronised scanner driving equipment suited to this set.

**Indexes and Binding Cases for 1938 are now available**

*(see 3rd page of cover)*


# GALPINS ELECTRICAL STORES

**75, LEE HIGH ROAD, LEWISHAM, LONDON, S.E.13**

*Telephone:* **LEE GREEN 5240.** *Terms:* **Cash with order or C.O.D. charges extra**

**All Goods Sent on 3 Days' Approval Against Cash.**

**EX-NAVAL BATTERY WORKING DESK TELEPHONES,** in good order, **6/6** each or **11/-** per pair, post 1/6.

**EX-NAVAL 1-VALVE BUZZER HETERODYNE WAVEMETERS,** 200 to 24,000 metres, **6/6** each, C/F. Buzzer and variable condensers worth double.

**EX-G.P.O. TELEPHONES,** Pedestal Type, with automatic dial, 5/- each, post 6d. Ditto, without dial, make good home broadcasting "Mike," **3/6**, post free. Wall Pattern, with auto. dial, **6/-** each, post 9d. Telephone Wall Boxes, consisting of A.C. Bell and Mike Transformer, **2/-** P.F.

**MORTLEY SPRAGUE HAND-DRIVEN GENERATORS,** two separate outputs, 800 v. at 30 m/A., also 6 v. at 2½ amps., brand new in cases, **30/-**; a few secondhand.

**A.C. INDUCTION MOTORS,** for 200/250 v., 1 ph. 50 cy., 3 h.p., 1,425 r.p.m., complete with Starter, **£6 10s.** Ditto, 5 h.p., **£8 10s.**, in guaranteed condition.

**SHILLING SLOT ELECTRIC LIGHT CHECK METERS,** 200/250 volts 1 ph. 50 cy., in good condition, **15/-** each, C.F. Quarterly type ditto for 5 amps., useful for subletting, etc., **6/-** each, C.P.

**SPECIAL CLEARANCE OF SPARK COILS,** windings O.K., but ebonite slightly broken. Will work from 100/250 volt A.C. or D.C. mains. 12-in., **30/-**; 8-in., **20/-**. Also a few only brand new, 12 in., in mahogany portable case, **55/-**. Condensers to suit primary, **7/6** each. All C.F.

**X-RAY TUBES,** Tungsten Target, 7in. diameter in new condition, **12/6** each, packing free C.F. Ditto in S.H. condition, **7/6**, C.F.

**EX-G.P.O. AUTOMATIC DIALS** for selector station tuning, numbered 0 to 9 and complete with selector mechanism, **1/6** each; hand combination phones with finger switch, **4/6**; Western Electric microphone, **2/6**; microphone transformer, high ratio, **1/6**.

**STANDARD TELEPHONE CONDENSERS,** all new, 1 m/F. 400 volt working, **4d.** each or 4 for **1/-**, post 3d. 2 m/F. 600 volt working, **1/-** each, 3 for **2/6** post 3d. **Philips** 1 m/F. 4,000 volt working, **4/-** each. Muirhead 1 m/F. 2,000 volt working, **1/6** each, post 6d.

**EPOCH CINEMA MODEL MOVING-COIL SPEAKERS,** 6 volt field, 15 ohm Speech Coils, Cones slightly damaged, **25/-** each, C.F.

**MOTOR GENERATOR,** fitted on bedplate, 3 h.p. 220 volt 1 ph. 50 cy. motor and 200 volt 5 amp. Shunt Wound Dynamo, in good condition, **£8 10s.**, C.F.

**LARGE POWER MAINS TRANSFORMERS,** by "Foster" and other good makers, all in good condition Useful for spot welding, etc. 220 volt input from 10 to 240 volt output in steps of 10 volts at **3** kW., **65/-**. Another, same input, ½ to 5 volts at 1½ kW. output, **45/-**. Another, 1,000 and 2,000 volts at 2 kW. output, **75/-**. Ditto, 4 volts at 100 amps., **15/-**. Ditto, 4,000 volt-C.T. with two LTS 150 m/A., **22/6**. Ditto, with 8 tapping from 300 to 1,600 volts at 200 watts, **20/-**. Another, with 25 tappings, from 2½ volts to 50 volts at 400 watts, **20/-**. Ditto, 5 volts at 3 kW., **75/-** Another, 3, 5 and 8 volts at 2½ kW., **70/-**. Another, 200/240 volt input, 90 to 120 volts at 6 kW. output, **£6 10s.** Also a few 1,500 watt Cores for rewinding primary, O.K., sec. not known, **17/6** each. All carriage forward.

**JOHNSON & PHILLIPS 4 in. DIAL HOT-WIRE AMPMETERS,** 0 to 1.2 a. and 0 to 2 amps., **12/6** each. Also a large range of Switchboard type Volt and Ampmeters in stock.

**EX-R.A.F. ROTARY CONVERTERS,** D.C. to D.C., 12 volts input, 500 volts 100 m/A. output, **20/-**; ditto, 750 volts output, **25/-**. A few of each that need slight repair to brush holder, etc., windings O.K., **10/-** each. Post 1/-.

**EX-G.P.O. MAGNETIC RELAYS,** useful for keying, etc. Approx. 1 m/A. working current, Types A and B, **5/-** each. Also a few which need points which are easily fitted, **2/6** each.

**MOVING-COIL METER MOVEMENTS,** 4 in. and 6 in. dial, useful for recalibrating into multi-range meters, low m/A. scale, **6/-** each, post 1/-. Ditto, 2½ in. dial, **5/-** each.

**ERNEST TURNER & "WESTON" MILLIAMP METERS,** 2in. and 2½ in. dials, 0 to 3 m/A., **15/-**; 0 to 5 m/A., **12/6**; 0 to 200 m/A., **12/6**; 0 to 50 m/A., **12/6**. All fully guaranteed.

**EX-R.A.F. VISUAL TYPE WAVEMETER,** 300 to 2,500 metres, **3/6** each. Ditto, 1,000 to 9,000 metres, **3/6**. Sullivan, .002 mf. Mica Condenser, 7,500 v., will separate into 5 x .01 mfs., **2/-** each. Westinghouse Metal Rectifiers, 500 volt 250 m/A., in voltage doubler circuit, **17/6** each. Ditto, 100 volt ¾ amp., **15/-** each. Ditto, 100 v. 20 m/A., **2/-** each.

**SILVERTOWN HIGHLY SENSITIVE GALVANOMETERS,** **5/-** each. Sullivan Transmitting Variable Condensers, heavy brass vanes, mounted in glass tank, capacity .001 mf. and .0005 mf., **7/6** each, post 1/-.

**DIMMER RESISTANCES,** wound with Eureka wire, 500 watts, **15/-**; 1,000 w., **20/-**; 1,500 w., **25/-**; 2,000 w., **32/6**; 3,000 watts, **42/6**. All fully guaranteed.

**LARGE SLIDER RESISTANCES,** worm and wheel control, 2,500 ohms, 200 m/A., price **15/-**.

**CHARGING DYNAMOS,** all shunt wound and fully guaranteed. 100 volt 15 amp. 4-pole ball bearing, **£4 10s.** Another, 100 v. 10 a. 4-pole, 1,000 r.p.m., **75/-**. Ditto, 220 volt 8 a., 1,750 r.p.m., 4-pole, 1,000 r.p.m. **75/-**. Ditto, 220 volt 8 a., 1,750 r.p.m., 4-pole, **90/-**. Ditto, 12 v. 8 a., **17/6**. Ditto, 20 volt 8 amp., **27/6**. Automatic Cutouts to suit any of these dynamos, **7/6** each.

**GAS ENGINES,** ½ h.p., tube ignition, **40/-**. Ditto, 1 h.p., with magneto, **60/-**, C.F.

**A.C. BLOWER,** fitted ¾ h.p. 200/240 volt 1 ph. 50 cy. motor, with starter, 3 in. outlet, in good condition, **90/-**, C.F.

**ZENITH WIRE WOUND RESISTANCES,** 2,500 ohms 245 m/A., 255 ohms 500 m/A., 750 ohms 350 m/A., 10,000 ohms 50 m/A., 15,000 ohms 100 m/A., 5,000 170 m/A., all at **1/-** each, post 4d.

**BELL WIRE TWIN ENAMELLED TINNED COPPER,** 22 S.W.G., all new, 150 yd. coil, **5/-**,post free. Approx. 100 yd. coils of 22 S.W.G. Single Enamelled Tinned Copper, Copper Screened and Braided, **5/-** per coil, post free.

**VOLTAGE CHANGER TRANSFORMERS.** 100/120 v. to 200/240 volt or vice versa, 250 watt, **17/6** 500 watt **25/-**, 1,000 watt **35/-**, 2,000 watt, **52/6**, 4,000 watt **85/-**. All fully guaranteed.

**MOVING COIL and A.C. MOVEMENTS** 2½ and 3 in., dial need slight repair, **2/6** each.

**27/36 RUBBER COVERED FLEX AS NEW 100 YD. COIL.** **3/6**, post 6d. Microphone Buttons, 9d. each. Mains Power Packs consisting of 2 x 20 hy chokes and 2 x 2 mf. Condensers, **3/-** each. 4,000 ohm wire wound Resistances wound on mica, **1/-** each, Instrument wire 35 gauge enamel, approx. 1 lb. reels. **2/6**. Quartz tubes, 10 in. x 3/16 in., **2/6** per dozen.

**DUBILIER HIGH VOLTAGE CONDENSERS.** .25 mf. 8,000 volts, **7/6** each. .015 mf. 10,000 volts, **5/-** .005 mf. 30,000 volts, **12/6**. .002 mf. 20,000 volts, **7/6** each. C.F.

**"NEWTON" DYNAMO.** 220 volt 15 amp. shunt wound ball bearing 1,750 r.p.m. in good condition, **£5 10s.**, C.F. "Lyon Wrench" Dynamo, 70 volt 30 amp., 1,750 r.p.m., ball bearing shunt wound laminated fields. This dynamo with fields only rewound would make a good 1½ h.p. reversible A.C. motor, **£3 10s.**, C.F.

## A Complete 50-watt Phone or C.W. TX

(*Continued from page* 106)

wiring. A crystal microphone is intended which feeds into a type 57 pentode; this is R.F. coupled to the grid of a 53 in which the anodes are joined in parallel. If a higher output microphone can be employed, the 57 valve can be omitted and the high-gain microphone connected into the second grid of V6. V6 is then R.F. coupled into V7, a small power type valve which furnishes sufficient output easily to drive the final Class B stage.

Automatic bias is used for the first three valves, while the final pair operate under zero bias conditions. The resistance network in the first two stages is rather important as to value, while C4 and C15 should not be less than 8 mfd. These condensers are of the tubular electrolytic type, as can be seen from the illustration.

Only a single meter is used in the speech equipment and this, M5, should be capable of reading up to 250 mA. in order to take care of the high current swing of the Class B valve.

Some further information on operating this transmitter and the coil dimensions will be given in the March issue.

## *The Candler System of Morse Training*

Ted McElroy, the world's champion telegraphist, with a speed of 75 words a minute, is a Candler trained operator. Quite a large percentage of commercial telegraphists in America are trained by this system, while the American Government are taking it up for large scale training of wireless operators. Various courses are available, one for beginners showing how to send and how to recognise characters at high speed, and a special high-speed course for those who are already conversant with the Morse code. The interests of the Candler Company are being looked after in this country by Horace Freeman, Esq., who has for many years been closely associated with the radio industry. The Chander System Co.'s London office is at Craven House, Kingsway, W.C.2. We strongly advise any listener who wishes to learn More code or needs practice to increase his speed to get in touch with Mr. Freeman for information on these extremely sound courses of training.

Many English amateurs have already appreciated the Candler system, and the following letter from G2NS illustrates this point:—" When serving abroad as a cable telegraphist, the names of Candler, McElroy, and other old-timers were frequently brought up whenever contact was made with American cousins of the telecommunication world. As there is always room for improvement, I decided that one day I would take the Candler course and investigate for myself what the ' Short-Cut to Code Skill' was about. As an ex-instructor of a telegraph training school, I immediately saw the soundness of a system that would train the sub-conscious mind. I can recommend it to amateurs, students and radio operators alike. For the former it cuts out months of drudgery, develops receiving sense and teaches one to read code as easily as print. For the latter, it develops complete confidence, highest speed, and maximum efficiency in the minimum of time."

A 48 page " Book of Facts " is available for those interested in code work.

## A New Time Base Valve

Tungsram have introduced a new triode valve for use in time base circuits for the low price of 7s. 6d. It is designated the LI.4C and will stand a peak anode voltage of 1,200. It can be used in the conventional push-pull saw-tooth circuit when the peak to peak voltage may be increased to 2,000.

The valve is indirectly heated with a 4-volt 1.2 amp. heater and an anode dissipation of 9 watts or 12 watts intermittently. The slope is 3.5 mA./V. and the amplification factor 10.


# A Golden Opportunity !

If you are a keen radio amateur you must keep abreast of the times by joining the

**RADIO SOCIETY OF GT. BRITAIN.**

Membership brings with it a copy of **THE T. & R. BULLETIN** each month, and in addition many important privileges, including the facilities of **THE FREE QSL SECTION.**

**TO INTRODUCE** the Society's work to non-members, a copy of the **January** issue of **The T. & R. Bulletin** will be sent with a copy of

**THE AMATEUR RADIO HANDBOOK**

*to all readers of TELEVISION AND SHORTWAVE WORLD who forward a postal order for 3/-.*

**The Handbook** contains, 300 pages, 250 illustrations, and 25 chapters.

**Contents of January's Bulletin,** include :—

"The Cathode-Ray Tube and its Application, in Television and Oscillography," " A four band Exciter Unit," "Improving the Performance of Short Aerials," " Workshop Practice," part 3, " Aluminium Chassis work " (next month, " Tools," " The Helping Hand," part 17, " An Output Meter and Its Uses," and regular features such as : " The Month on the Air," "The 28MC Band," "The 56MC Band," "Contemporary Literature," " New QRA'S " " Book Reviews,)" etc., etc.

**SEND YOUR 3/- POSTAL ORDER TO-DAY!**

*Write :* The Secretary—Editor

**RADIO SOCIETY OF GREAT BRITAIN,**
**53, Victoria Street, London, S.W.I.**



# TELEVISION DEVELOPMENTS

Are you keeping abreast of modern television developments ? Whether amateur or professional you *must* be in touch with the latest trend of research.

**The Television Society** enables you to meet fellow workers in the field of television, both in this country and abroad.

Founded some 10 years ago **The Television Society** provides a scientific and non-partisan platform for discussion on all aspects of the subject. Meetings are held monthly during the session (October-June) and are reported in full in the Society's Journal which is sent free to all members.

The Society's activities are shortly being enlarged to meet the growing interest in the subject and members will have a unique opportunity of furthering their knowledge by contact with well-known television engineers.

Full particulars of membership qualifications may be had from the Hon. General Secretary:—J. J. Denton, 17, Anerley Station Road, London, S.E.20.

**THE TELEVISION SOCIETY**

(Founded 1927)

**President : Sir AMBROSE FLEMING M.A., D.Sc., F.R.S.**