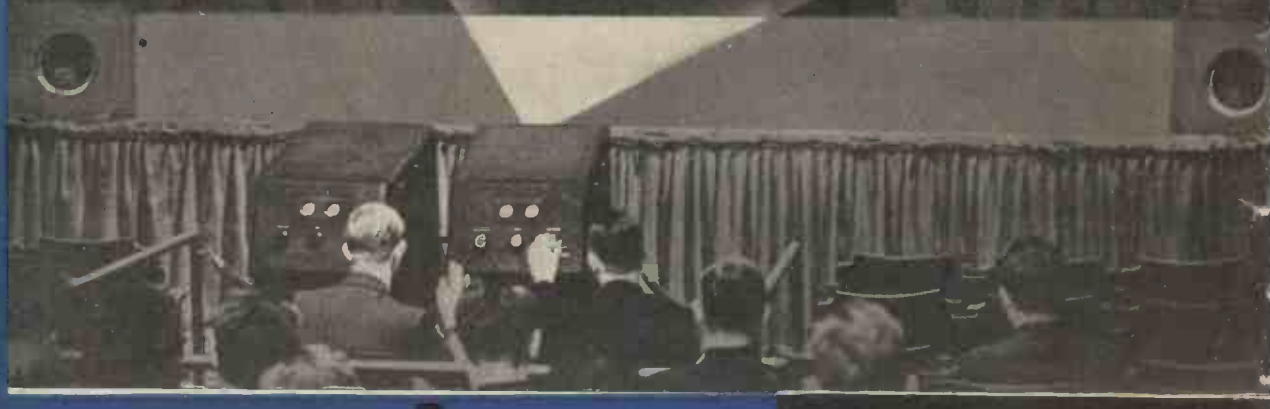
SMALL TELEVISOR MADE FOR A FEW POUNDS

Television and SHORT-WAVE WORLD

AUGUST 1938
No. 126. Vol. XI.
1/-

BAIRD BIG-SCREEN TELEVISION

SPECIAL ARTICLE
(See page 459)



OLYMPIA PROMISES SURPRISES

THE SUPERSONIC CELL SIMPLY EXPLAINED

INCREASING VISION RANGE

SHORT WAVES
- THE BEGINNER'S FIRST RECEIVER
- 1¼ METRE TRANSMISSION & RECEPTION
- SIMPLE 10-WATT TRANSMITTER

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

THE FIRST TELEVISION JOURNAL IN THE WORLD

No. 126 VOL. XI AUGUST, 1938

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Special Features

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IMPORTANT

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COMMENT OF THE MONTH

The Big Problem.

ONE hears all sorts of reasons stated why the demand for television receivers is not greater, but each one can be countered by a perfectly rational argument—and so the problem still remains a mystery. Take, for instance, the matter of price which is perhaps the argument most often advanced. The price of a television receiver may be beyond the pocket of the average man in the street, but there must be ten thousand people in the London area to whom it would be but a trifle, and another ten thousand who could well afford it. In the early days of broadcasting these were the people who were paying amounts up to a hundred guineas for very indifferent receivers. And this raises another question. Do the moneyed classes want television or must it be assumed that potential viewers are among those who cannot afford a receiver?

Then there is the very common argument regarding picture size. Viewed at a short distance and under home conditions, however, the television picture is practically the equivalent of the cinema screen viewed from the best seats in the average cinema. So there does not seem to be a great deal in that point. Admittedly the screen could be rather larger with advantage, but the discrepancy does not yield an answer to our problem, particularly in view of the fact that television can provide in the viewer's home pictures of events actually taking place, which no other medium can do.

Many people are under the impression that prices of receivers will fall, but a little reasoning should show them that any material reduction is most improbable. The television receiver is the equivalent as regards materials and workmanship of four high-class broadcast receivers, and if we base our ideas of price on this comparison it seems clear that any worthwhile reduction in cost is most improbable for a long time to come, especially as most of the components used are wireless types for which almost the last word has been said in production methods.

The argument that television is still in an experimental stage is a frequent one, but it is an argument due to sheer ignorance. Both transmission and reception methods are based on sound principles and even the most carping critic cannot find fault with technical development. Undoubtedly, improvements will be made in the future, but there is not the slightest reason to suppose that they will be of such a nature as to render receivers obsolete at an early date.

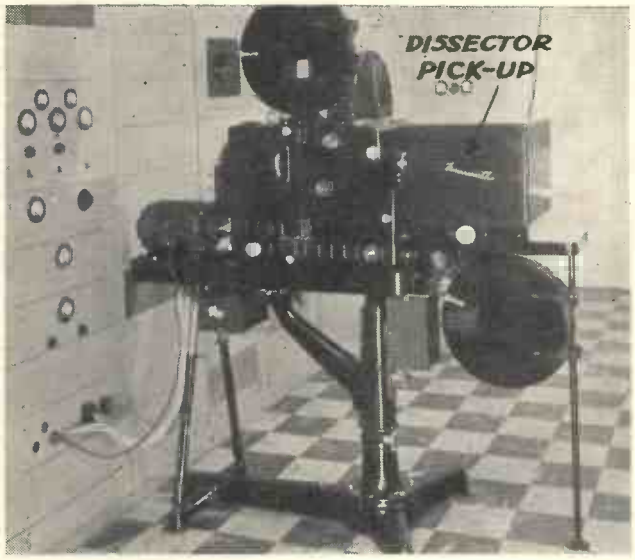
Finally, there is the matter of the programmes. At the present time they may not appear to justify much expenditure from the purely entertainment point of view, and studio productions certainly do not bear comparison with the cinema. But the television receiver is becoming more and more a utility instrument in providing pictures of topical events at the same time that they are actually taking place. No other medium can provide at first hand actual pictures of such events as the Derby, Wimbledon tennis, the Test Matches, etc., which alone make a receiver worth while. Can any reader provide the real answer to the problem of the poor demand?

NEXT MONTH: SPECIAL TELEOLYMPIA EXHIBITION NUMBER

CONTINUOUS FILM TELEVISION

A NEW METHOD

Here are details of a new method of film transmission developed by the Farnsworth Company of the United States. It is claimed that it gives exceptionally good definition.



The Farnsworth telecine transmitter.

TAKING the view that transmission of motion pictures by means of films will always be an important factor in television programmes, the Farnsworth Company have of late been devoting a great deal of attention to the development of a method that it is claimed will give better results than those obtained at present.

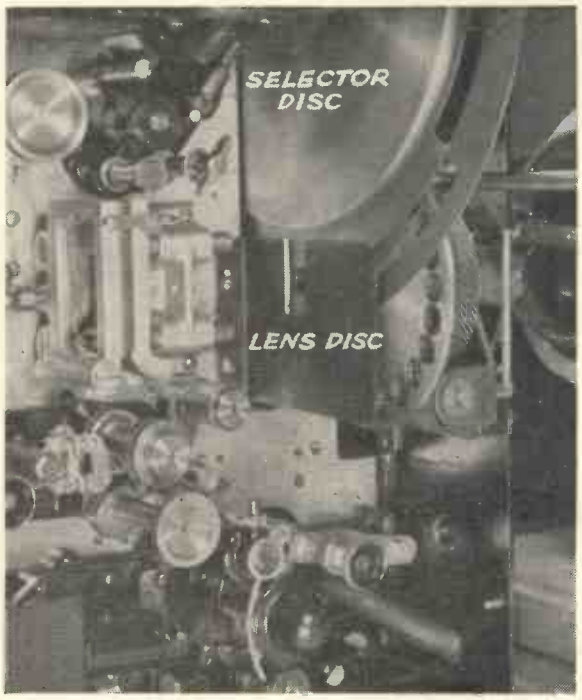
The Farnsworth Company are of the opinion that eventually films will be specially produced for television which will bring into the home a type of entertainment not available by other means.

This, of course, does not necessarily mean the transmission of motion pictures as they are now produced, but motion pictures made up of subjects especially adapted to television purposes. The limited range of transmission presents many difficulties in providing adequate coverage, and it argued that suitable films can be readily transported from station to station and transmitted without the necessity of special cables and relay systems.

The development of a new model picture projector for telecine operation, including many novel features, has just been completed.

This projector is of the "continuous" type, and the film, therefore, passes through it at a constant rate of speed without interruption. The projector focuses its picture upon the cathode area of a dissector tube, though as a matter of fact, any other type of pick-up tube, such as the Iconoscope, can be used equally well with this apparatus.

Continuous projection is accomplished by two lensed discs, each carrying a total of 24 lenses, and rotating in opposite directions, but overlapping sufficiently so that at any instant two lenses are acting in conjunction with each other. These lensed discs act both as an optical compensator and as a projection lens. A shutter in the form of a slotted disc, termed the selector disc, is provided, which masks all lenses except the two functioning at a given moment.



Photograph showing the two lensed discs and the selector disc of the Farnsworth transmitter.

The projector is synchronised with the scanning system of the dissector tube, so that alternative frames are scanned two and three times respectively, providing an interlaced picture at a rate of 30 frames per second (American standard).

The transition period, i.e., the times required to change from frame to frame, occurs coincidentally with and during, the "flyback" of the scanning system, during which period no television signal is transmitted, so that this does not detract in any way from the excellence of the transmitted picture. The transition is accomplished in less than 1/600th of a second, as compared with approximately 1/120th of a second for the most rapid intermittent-type projector.

During transition, the image of the leading frame is momentarily superimposed upon the image of the trailing frame, which condition maintains for the small fraction of a second indicated.

Since the picture projected on the cathode surface of the pick-up tube is stationary and continuous, this projector can be adapted to camera tubes operating on the storage principle, as well as the dessector type tube. However, the projector provides sufficient illumination, so that the storage type tube is not essential, and more than ample illumination is obtained from a concentrated filament incandescent lamp.

A SIMPLIFIED TELEVISION RECEIVER

USING A 1 in. CATHODE-RAY TUBE

by D. E. Osman

This article describes the construction of a miniature television receiver employing a 1-in. cathode-ray tube. Despite its smallness excellent pictures are produced which are capable of magnification by means of a lens. The receiver is constructed upon orthodox lines and will provide a cheap and economical introduction to television.

THERE are many keen experimenters who have the ability to construct and understand the functioning of a television receiver but are not in a position to spend the amount of money necessary to build the usual type of receiver employing a 10- or 12-in. tube. It is to these enthusiasts that the receiver to be described here will make an appeal. This is a simplified television receiver using the R.C.A. 913 1-in. cathode-ray tube.

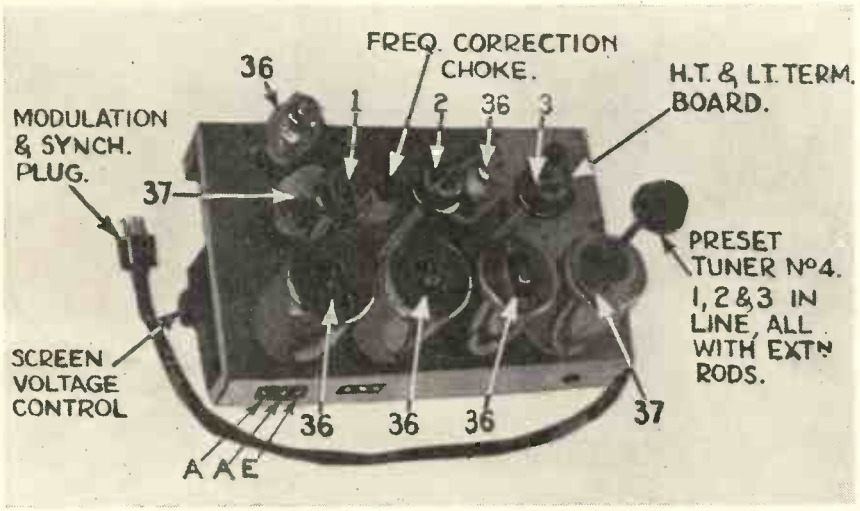


Fig. 1. This photograph shows the details of the vision receiver unit. A 6J7 pentode Amplifier can preferably be used although the older type 36 tetrode as shown is suitable.

It will, of course, be understood that on such a small screen as the 1-in. tube offers, the pictures received cannot compare with those received on the larger tubes; nevertheless, the pictures are very good and valuable information on receiver construction can be obtained in a practical manner. Also the low voltages required for operation enables standard radio components to be utilised, thereby saving considerable expense.

Definition, as a matter of fact, is very good and with the use of a magfier the pictures received have definite entertainment value.

Also, it may be pointed out that very little change is necessary to associated apparatus should the experimenter wish to invest in a larger cathode-ray tube at some future date.

American type valves have been used throughout in this miniature receiver because some saving in cost is thus possible: also the receiver has been built on a standard chassis in order to make construction easy.

The Vision Receiver

The photograph, Fig. 1, shows the general layout of the equipment, which has been mounted on a standard

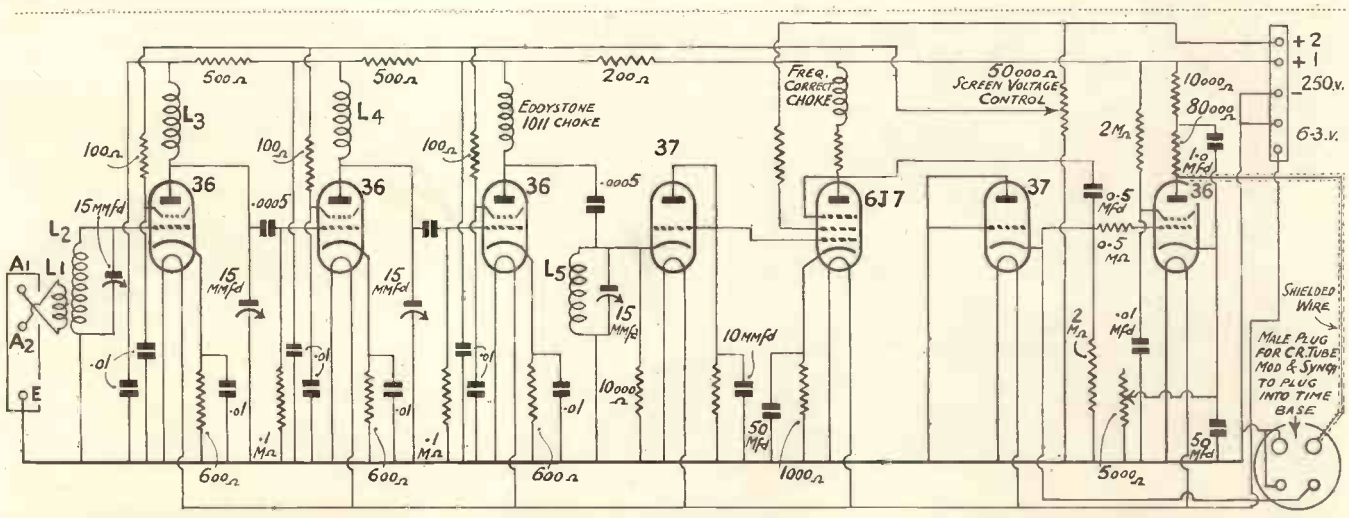


Fig. 5. The circuit of the vision receiver. The coupling condensers between stages have a value of .0005 mfd. In the anode-grid circuit of the 37 is a resistor of 5,000 ohms, while in the 6J7 anode circuit is a resistor of 10,000 ohms and in the screen circuit a resistor of 500,000 ohms.

BUILDING THE VISION RECEIVER

wireless chassis. This was fitted with six 5-pin and one octal American type valve holders in place of the existing English type; it may be noticed that the valve positions are not quite symmetrical; this is because the original drillings were utilised.

Copper screening cans are fitted to the radio frequency and detector stages. The aerial and secondary coil and final tuned stage are covered by the screen, as well as the valve. This is clearly indicated in Fig. 2 where the chassis is shown minus valves and screens.

The extension handles are made of ¼ in. round brass rod with suitable couplings to fix to the condenser spindles.

The photograph, Fig. 3, shows the underside of the chassis and the positions of the tuned anode coils and tuning condensers. Although it is perhaps unnecessary to emphasise the importance of keeping the radio frequency circuit wiring as short as possible, especially to those accustomed to ultra-short wave receiver construction, it is as well to make this the main feature in wiring in order to avoid instability.

The valves used are standard American 36 and 37 and 6J7 types which are now obtainable in this country. The coils are easily constructed from 18 s.w.g. tinned copper wire on a ½ in. former; when removed from the former, they will be found sufficiently rigid to be self-supporting. Where the secondary and final tuned stage coils pass through the holes in the chassis, a piece of sleeving should be used for insulation. The aerial coil is made of the same gauge wire except the wire is the covered type (Glazite).

The purpose of the frequency correction choke connected in the anode circuit of the video stage is to improve the frequency response and give greater detail to the received picture. The dimensions and windings are shown in Fig. 4, which also gives the coil construction data. The schematic diagram, Fig. 5, shows the complete circuit of the vision receiver.

The Power Pack

The power pack is conventional in design. Two chokes are used, for the ripple content must be very low in the vision receiver, otherwise frame synchronism will be upset and the picture received will tend to be synchronised by the 50 cycle ripple which will lock the picture half way across the screen.

The transformer used is a standard 350-0-350 with two 4-volt windings which have been altered to give 5 volts for the 80 rectifier and 6.3 V for the 36's and 37's (Fig. 6). This modification is easily made by winding 3 or 4 turns of wire on the outside of the transformer bobbin and measuring the voltage across this temporary winding. From the voltage measured it is a simple matter to calculate the number of turns per volt used by the maker of the transformer and to wind on the extra turns necessary to raise the voltage to the required amount. As a rule sufficient space will be found between the bobbins and the stampings to accommodate this extra winding.

Alternatively, transformers giving the required voltages can easily be obtained.

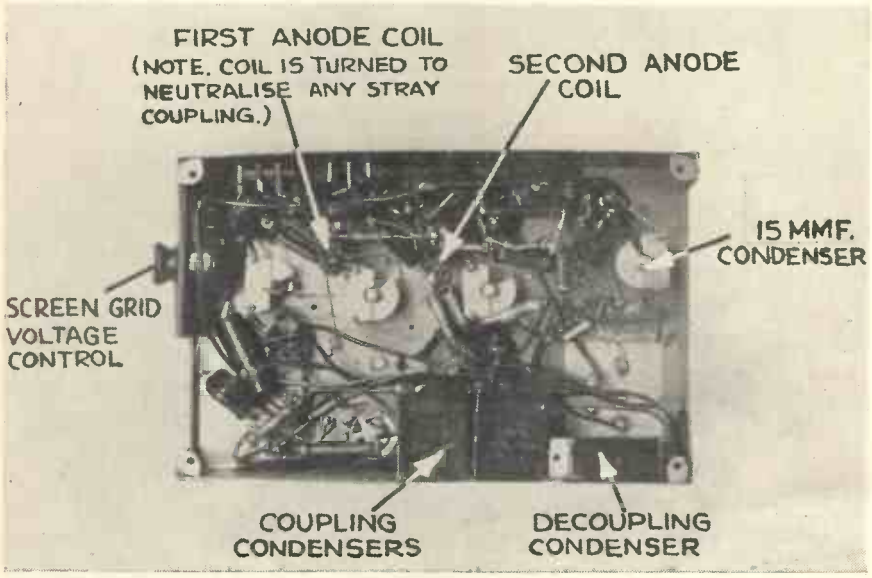


Fig. 3. Photograph showing the underside of the vision chassis.

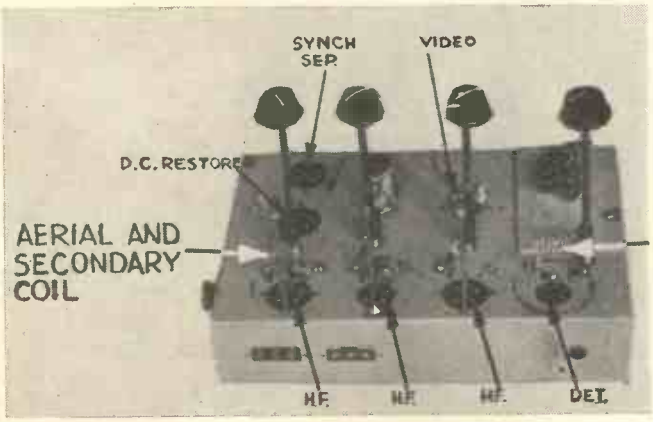


Fig. 2. Vision chassis with valve screens and valves removed showing how 1st and 4th., tuned circuits are mounted on the chassis. Arrow at right indicates last tuned circuit coil.

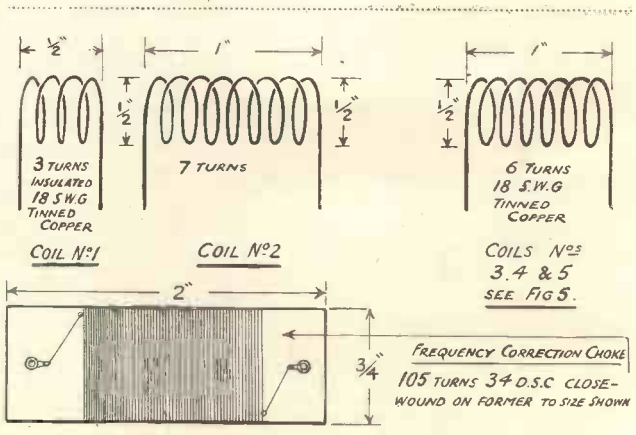


Fig. 4. Constructional details of the coils.

DETAILS OF TIME BASE

A 10,000-ohm power potentiometer serves the dual purpose of stabilising the voltage to the receiver and limiting the screen voltage supplied to the control on the receiver (See Fig. 6).

If constructors wish to utilise one power pack for vision and sound receiver, this is quite permissible and depending on the current required another resistance of a higher value passing a smaller current can be substituted. The total consumption of power by the vision receiver is negligible and there will be some waste if the power is not used for the dual purpose.

D.C. Restorer

Some confusion exists as to the necessity for the inclusion of a rectifier to restore the D.C. component,

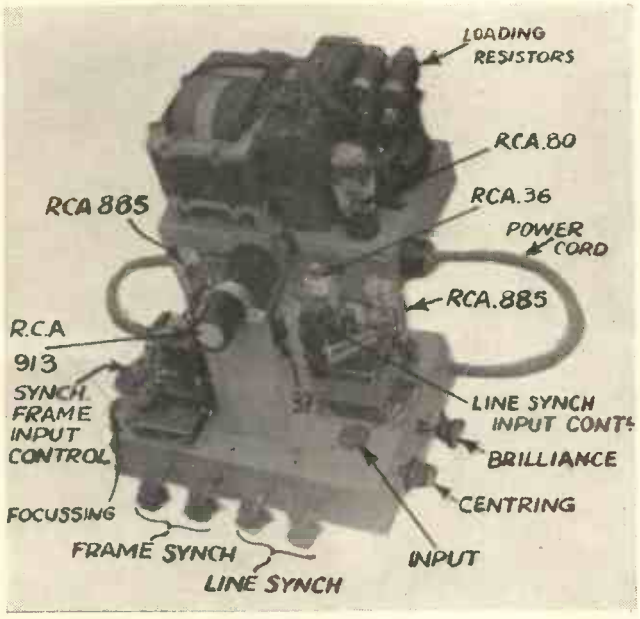


Fig. 8. Photograph showing the time base chassis and the power pack chassis. The 1 in. cathode-ray tube can be seen on the former.

and the following simplified explanation is an endeavour to clarify the reason.

The cathode-ray tube operates in the same manner as a radio receiver valve in so far that the grid must be biased to a certain negative potential to control the electron stream which, in the case of the cathode-ray tube, bombards a specially prepared screen which glows when the impact takes place. If the bias is made more positive from this operating position, a brighter spot is apparent on the screen. Alternatively, if the bias is made more negative, the spot is dimmed. From this it will be seen that without the rectifier in this circuit adding or subtracting from the preset bias on the control grid, the transmitting station cannot take complete control of the picture brilliance, for this D.C. value varies according to the contrast of the picture transmitted.

It has, no doubt, been noticed by those who have viewed a television programme that after the closing announcement the cathode-ray screen darkens and the raster can only be brought back to the same brilliance it had when the picture was received by operating the brilliance control manually. This demonstrates clearly how this control action takes place, but for readers who construct this receiver and wish to have a practical demonstration of the effect, it is recommended that they remove the D.C. restorer valve during the reception of the television programme when it will easily be seen how the control action is lost, particularly when a fade-over takes place from one subject to another with different lighting effects.

The sync. separator is very important and without this valve operating in the manner required difficulty will be experienced in holding the received picture in synchronism. Actually, by using a simple filter circuit and by suitably biasing the valve only, the synchronising impulses are passed on to the time base, and once the preliminary adjustments are made, the valve will function without any necessity for making further correction. The value of bias resistance in the case of the 36 used in this stage is normally about 2,500 ohms, or half-way between maximum and minimum on the 5,000-ohm variable biasing resistance.

The Time Base

The time base for use in conjunction with the vision receiver already described is a simple type using a

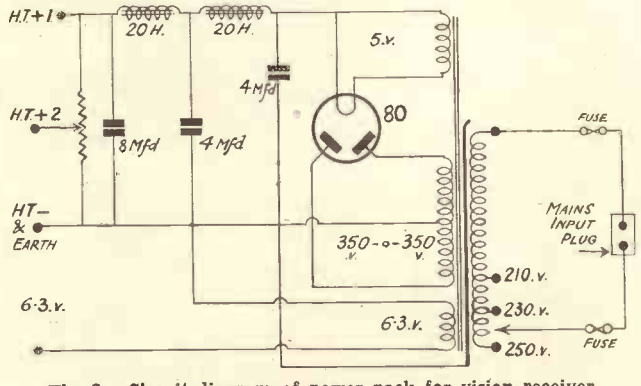


Fig. 6. Circuit diagram of power pack for vision receiver.

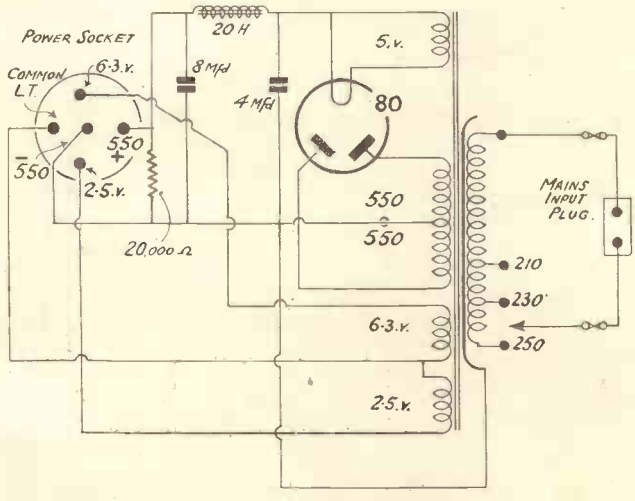


Fig. 9. Circuit diagram of power pack for tube and time base.

COMPONENTS FOR COMPLETE RECEIVER

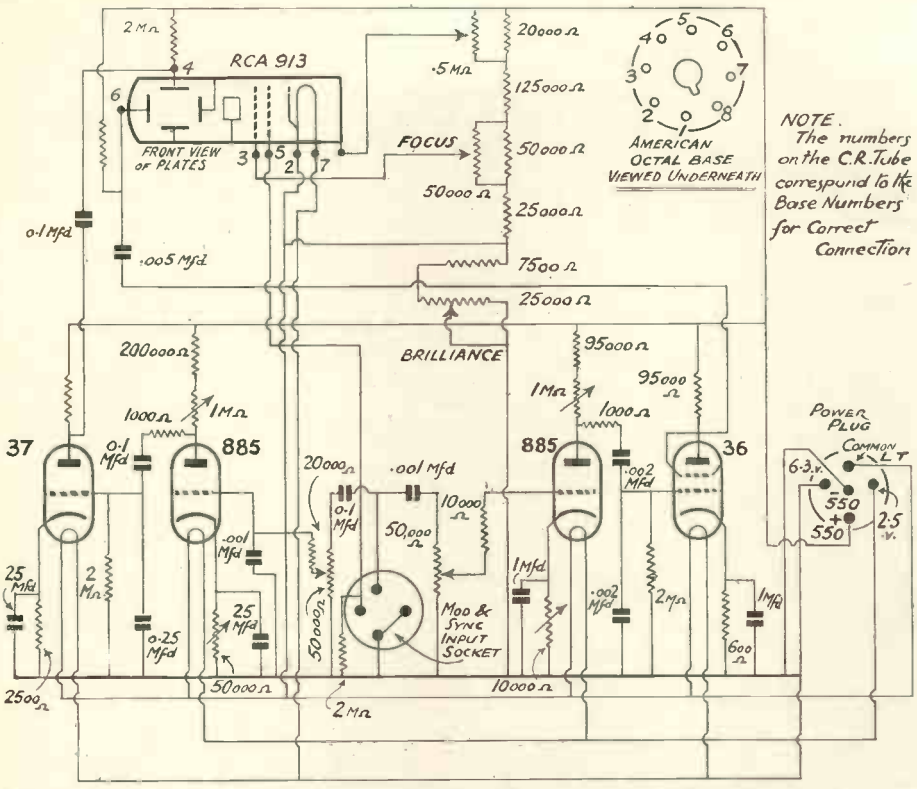


Fig. 7. Circuit diagram of time base, power pack and cathode-ray tube connections. The resistor between pin No. 6 and positive H.T. has a value of 2 megohms. Pin No. 1 on the octal base is actually the metal screen of the 913 tube. In the anode circuit of the 37 triode is a fixed resistor of 100,000 ohms.

COMPONENTS

VISION UNIT

CHASSIS.

1—Steel chassis (Radio Clearance).

CHOKE, HIGH-FREQUENCY.

1—Type 1011 (Eddystone).

CONDENSERS, FIXED.

10—.01-mfd. type 691 (Dubilier).
3—.0005-mfd. type 690W (Dubilier).
1—50-mfd. 12 volt electrolytic type 402 (Dubilier).
1—50-mfd. 50-volt type electrolytic 3004 (Dubilier).
1—.5-mfd. type 4608/S (Dubilier).
1—1-mfd. type B770 500 volt (Dubilier).

CONDENSERS, VARIABLE.

4—18-mmfd. type 1094 (Eddystone).
1—Trimmer condenser type 1100 (Eddystone).

HOLDERS, VALVE.

6—5-pin American-type chassis (Clix).
1—8-pin American-type octal (Clix).

PLUGS.

5—Top-cap anode connectors (Bulgin).

RESISTANCES, FIXED.

3—100-ohm ½ watt (Erie).
1—200-ohm ½ watt (Erie).
2—500-ohm ½ watt (Erie).
4—600-ohm ½ watt (Erie).
1—1,000-ohm ½ watt (Erie).
1—5,000-ohm ½ watt (Erie).
1—10,000-ohm ½ watt (Erie).
2—100,000-ohm ½ watt (Erie).
2—.5-megohms ½ watt (Erie).
2—2-megohms ½ watt (Erie).
2—10,000-ohm 1 watt (Erie).
1—80,000-ohm 1 watt (Erie).

RESISTANCES, VARIABLE.

1—5,000-ohm potentiometer (Reliance).
1—50,000-ohm potentiometer (Reliance).

SUNDRIES.

½ lb. 18-gauge tinned copper wire (Webbs Radio).
3 Yards 1-mm. sleeving (Webbs Radio).
1 Strip pressphan 2-in. by ¾-in. (Webbs Radio).
2 oz. 34 S.W.G. D.S.C. wire (Webbs Radio).
1—4-pin plug (Bulgin).
1 Yard screened cable (Webbs Radio).
3 Yards 2-mm. flexible wire (Webbs Radio).
4—Insulated terminals type B (Belling-Lee)

VALVES.

4—Type 36 (Radiographic).
2—Type 37 (Radiographic).
1—Type 6J7 (Radiographic).

VISION UNIT POWER PACK

CHASSIS.

1—Chassis (Radio Clearance).

CHOKES, LOW FREQUENCY.

2 Type-20 Henry (Sound Sales).

CONDENSERS, FIXED.

2—4-mfd. type LEG (Dubilier).
1—8-mfd. type electrolytic 550 volt working (T.C.C.).

HOLDER, VALVE.

1—4-pin American (Clix).

RESISTANCE, VARIABLE.

1—10,000-ohm power potentiometer (Varley).

TERMINALS.

4 Insulated terminals type B (Belling-Lee)

TRANSFORMERS, MAINS.

1 Special type to give 350-0-350 volts. 5 volts 2 amps. 6.3. volts 3 amps. (Raymart).

VALVE.

1 Type 80 (Radiographic).

TIME BASE

CATHODE RAY TUBE.

1 Type 913 (Webbs Radio).

CHASSIS.

1 Steel chassis (Radio Clearance).

CONDENSERS, FIXED.

2—25-mfd. 25-volt type 3016 (Dubilier).
3—.1-mfd. type 4603/S (Dubilier).
1—.25-mfd. 500-volt working (Dubilier).
2—1-mfd. 500-volt working (Dubilier).
2—.001-mfd. type 690W (Dubilier).
2—.002-mfd. type 690W (Dubilier).
1—.005-mfd. type 691 (Dubilier).

HOLDERS, VALVE.

4—5-pin chassis-mounting American valve holders (Clix).
—4-pin chassis-mounting America n valve holders (Clix).
1—8-pin octal American valve holder (Clix).
1—5-pin chassis type VI (Clix).

PLUGS, SOCKETS, ETC.

4 Top-cap anode connectors (Bulgin).
1—2-pin mains connector and socket (Clix).
1—5-pin plug (Clix).

RESISTANCES, FIXED.

1—600-ohm ½ watt (Erie).
1—10,000-ohm ½ watt (Erie).
1—20,000-ohm ½ watt (Erie).
5—2 megohm ½ watt (Erie).
2—1,000-ohm 1 watt (Erie).
1—2,500-ohm 1 watt (Erie).
1—7,500-ohm 1 watt (Erie).
1—20,000-ohm 1 watt (Erie).
1—25,000-ohm 1 watt (Erie).
1—50,000-ohm 1 watt (Erie).
2—95,000-ohm 1 watt (Erie).
1—100,000-ohm 1 watt (Erie).
1—200,000-ohm 1 watt (Erie).
1—125,000-ohm 1 watt (Erie).

RESISTANCES, VARIABLE.

1—25,000-ohm potentiometer (Reliance).
4—50,000-ohm potentiometer (Reliance).
1—.5-megohm potentiometer (Reliance).
2—1 megohm potentiometer (Reliance).
1—10,000-ohm potentiometer (Reliance).

TIME BASE POWER PACK

CHASSIS.

1 Steel chassis (Radio Clearance).

CONDENSERS, FIXED.

1—4-mfd. type LEG (Dubilier).
1—8-mfd. type BE355 (Dubilier).

CHOKE, LOW-FREQUENCY.

1—20 henry (Webbs Radio).

HOLDERS, VALVE.

1—4-pin type American chassis (Clix).
1—5-pin type chassis VI (Clix).

TRANSFORMER, MAINS.

1 Special type to give 550-0-550 volts. 5 volts 2 amps. 2.5 volts 3 amps. 6.3 volts 2 amps (Premier).

VALVE.

1 Type 80 (Radiographic).

(*Continued from page 455*)

minimum number of valves. Push-pull working is not possible with the 913 cathode-ray tube because two deflecting plates are internally connected. Consequently

deflection is non-symmetrical, and although it is recognised that non-symmetrical deflection is not so good as symmetrical, very little distortion of the picture shape is introduced, especially if care is taken in balancing the coupling resistances which connect the two free plates to the positive 550 volts. This presented some difficulty, and to correct for slight displacement, the .5-megohm resistance is included as shown in the resistance chain (Fig. 7), with the result that the picture can be exactly centred on the screen.

It will be noted that the focus control comprises a 50,000-ohm potentiometer in parallel with a 50,000-ohm fixed resistance.

As the cathode of the 913 is internally connected to one side of the heater, it is necessary to connect this side of the heater to the resistance chain as shown with a variable resistance (brilliance control) between its connection and ground for biasing the cathode-ray tube.

Care should be exercised in mounting the cathode-ray tube as the metal casing round the outside is live to ground for it was originally designed for use in apparatus having the plus H.T. grounded.

A study of Fig. 8 will show the method used in mounting the tube on a wooden support with a strap. This allows it to be completely revolved if necessary.

It will be noted that some of the time base components have been mounted on the chassis. There is, however, no need to keep to this arrangement.

The 4-pin receptacle on the time base is an American valve socket, and the plug, which is inserted when the vision receiver is connected, is a 4-pin American type valve base.

The sync. line from receiver to time base must be of shielded wire to avoid any interference with the modulation output.

None of the adjustments on the frame controls is critical, in fact on this receiver once the relative input controls to the time base are set and the picture received, the only control which occasionally needs adjustment is the line sync.

The Power Pack for Time Base and C.R.T.

The transformer for the power pack is a 550-0-550 type with L.T. windings suitably altered to give 5 volts for the 80 rectifier, 6.3 volts for the 36 and 37, and 2.5 volts for the 885 gas-filled triodes. The same procedure is adopted as outlined in the notes on the receiver power pack with regard to the additional windings for the voltage required. Alternatively a suitable transformer can be obtained.

A stabilising resistance of 20,000 ohms is included across the H.T. output (see Fig. 9).

Operation of the receiver and time base is simplicity itself, and although, perhaps, a little strange at first to those handling the controls, it soon becomes second nature to build up the picture from the received impulses. As previously pointed out, very little controlling is required after initial adjustments, for in the case of the actual receiver described, after switching on the only adjustment necessary is the brilliance setting and an occasional correction to the line synchronism.

All the original experiments with this receiver were carried out using an indoor aerial, but it is recommended that a good dipole with reflector be erected as high as possible outside, for although it is possible in the London area to receive a picture under almost any conditions, the erection of a good outside aerial will give much more satisfactory results, especially where motor traffic is constantly passing.

The tuning of this receiver is comparatively broad and no difficulty will be experienced in tuning the television synchronising pulses by connecting a pair of phones across the D.C. restorer output when transmissions are taking place.

In conclusion, the use of a 1 in. cathode-ray tube may suggest to readers that projection of the image would be possible, but this is not practicable owing to the low voltages used, and it is a better plan to use a lens of 4½ in. focal length in front of the screen if it is wished to enlarge the picture.

PROPOSED AMERICAN TELEVISION SYSTEM

ACCORDING to *Radio Craft* application has been made by the General Electric Company (U.S.A.) to the Federal Communications Commission for permission to institute a television system which it is estimated will cost 500,000 dollars.

The application states that the company proposes to investigate on a broad developmental scale the type of apparatus, method of transmission and propagation characteristics that will be necessary to properly broadcast television programmes. One station will be located near Albany (N.Y.), two in Schenectady (N.Y.), and one in Bridgeport (Conn.). Plans for erection of 150-ft. aerial towers at all stations have already been approved.

In more detail, the plan is as follows:

Erection of a 10 kW television broadcast station in the Helderbergs, 12½ miles west of Albany and 13½ miles from Schenectady. It will probably operate on frequencies of 66 and 72 mc. with 10 kW on the video channel and 3 kW on the audio channel, for an unlimited period, day and night. The cost of the vision transmitter is estimated at $70,000; of the studio, $50,000, sound transmitting, $20,000; aerial, $40,000; and land and buildings, $15,000. It is expected that the Helderbergs station will serve the cities of Albany (capital of New York), Schenectady, Rensselaer, Cohoes and Troy, with a combined population of about 400,000.

The second station with a power of 10 kW is planned for Bridgeport. Operation will also be on 66 to 72 mc. with 10 kW on the video channel and 3 kW on the audio channel, for an unlimited period, day or night. This station, like the one in the Helderbergs, will, it is estimated, involve an expenditure of $70,000 for the vision transmitter; studio, $50,000; sound transmitter, $20,000; aerial, $40,000; land and buildings, $50,000. Bridgeport's television station will serve about 1,000,000 persons.

The third proposed station in the system is a 50-watt television relay station in Schenectady, to investigate the possibility of relaying programmes from the studious of WGY to the big station in the Helderbergs, thus obviating the necessity for interstation coaxial-type cable. In addition, a 40-watt station in a building of the G.E.C.'s Schenectady plant is proposed to be used temporarily for transmission of television and synchronised sound broadcasts to nearby experimental receiving points.

1938—TELEOLYMPIA

THE RADIO AND TELEVISION EXHIBITION AUGUST 24 to SEPTEMBER 3.

IT is probable that this year's exhibition at Olympia will mark the real introduction of television to the public so that in course of time there will be a gradual change over from sound to the real entertainment of sound *and vision*. How quickly this change over will take place it is impossible to forecast, but it is inevitable. What hope of audiences would a cinema type of theatre have that only presented mechanically-produced sound programmes? Contemplation of such a condition may seem absurd, but the parallel is not unreasonable. The future home entertainment will be provided by *sound and vision* and how soon the realisation of this will come about largely depends upon the public.

A Television Exhibition

Olympia this year will abound with television surprises. In the first place as a radio show there is to be a departure from the entertainment aspect and a return to a more technical demonstration of radio. There will be no theatre nor any attempt to run side-shows of the entertainment type.

Television will occupy a large place. For the first time manufacturers will be able to demonstrate television reception to the public on their stands. Those interested will not have to go into darkened booths, located in another part of the building. Each television receiver manufacturers' stand will be a television demonstration theatre, for television will not be segregated in an enclosed section as last year. Arrangements are being made for exhibitors to display and demonstrate television receivers on their stands. The B.B.C. are co-operating and demonstrations will be possible at Radiolympia almost the whole time the show is open to the public. These demonstrations will prove that television does not need to be viewed in a darkened room, for exhibitors will so arrange their stands that programmes will be seen in full daylight.

A Studio in Olympia

Special television programmes will be radiated from the exhibition during the whole period of the show (August 24 to September 3 inclusive). For this purpose the R.M.A. is erecting in the National Hall a large television studio, with glass walls which will enable visitors to see television programmes in production on the studio floor.

The two principal programmes will be "Cabaret Cruise" and "Queue for Song." The setting for the "Cabaret Cruise" is the deck of a cruising liner, and the talented "passengers" will include Steve Geray and Magda Kun, the comedy cabaret artists; Ernest Shannon, the impressionist; the Five Lai Founs, a family of oriental jugglers; Walsh and Barker, the popular American duettists; and Reine Paulet and Trudi Binar, the Continental cabaret stars. The ship's "Captain" will be Commander A. B. Campbell, who will compere the show.

"Queue for Song" will feature Douglas Byng, the popular comedian, and the cast will include Queenie Leonard, Jackie Billings, and Diana Chase, Graham Payn, and Edward Cooper.

"Picture Page," television's weekly topical magazine, will be produced in its entirety at Radiolympia each Thursday, and Fashion Parades will be included daily.

NEXT MONTH
SPECIAL EXHIBITION NUMBER. FULL REPORT OF TELEOLYMPIA

Visitors to Olympia will be invited each morning to face the television cameras so that their friends can see them on demonstration receivers in different parts of the Exhibition and at home.

Two mobile television units will be in use during the Exhibition period. One will be installed at Olympia to relay the programmes thence to Alexandra Palace for re-transmission, and the other will be operating first at the Kennington Oval for the final Test Match, and later at the Zoo to provide two half-hour animal programmes daily.

The Teleolympia transmissions will supplement the normal programmes, which will be radiated from Alexandra Palace for half-an-hour in the afternoon and one hour in the evening. Regular viewers will also be able to pick up the Exhibition's transmissions, although these will be to some extent repetitive. Between five and six hours of television programmes will be transmitted daily, during the period of the Exhibition as compared with two as at present.

Many Surprises

Although at this early date we are not permitted to reveal the secrets of technical development which Olympia will show, we can assure our readers that these will be considerable and come as a surprise.

A full report of the television exhibits will be given in next month's issue.

Modern Tuning Systems

Many years ago a British manufacturer introduced a permeability system, which, although it was quite satisfactory, was produced rather before the British constructors were ready for this revolutionary development. This year, a considerable number of manufacturers are embodying this system of tuning even though it has not been widely publicised in the Press. The system is very similar to that originally evolved except that instead of having one large coil, with a wide movement centre bar of soft iron, the new arrangement makes use of one coil with a pre-set soft iron centre controlled by a press button tuner so that a six station set would want six coils and six press buttons.

This photograph shows the Baird projection unit incorporating the tube, time base, final stage vision amplifier and intermediate vision frequency amplifier.

THE BAIRD BIG-SCREEN THEATRE RECEIVER

COMPLETE TECHNICAL DETAILS

LAST month we published a report of the remarkable results achieved by the Baird Company with their large-screen television system at the Tatler Theatre, Charing Cross Road, and gave some brief particulars of the apparatus used.

We are now able to show photographs of this apparatus and amplify the description.

The system, of course, employs a special type projection cathode-ray tube, developed in the Baird laboratories. The tube itself has a very high degree of vacuum and the picture which is built up on the fluorescent screen on to a remote screen by means of a special projection lens. There are, of course, no moving mechanical parts whatever and the apparatus is of such a type that it is within the capabilities of the average cinema operator to manipulate.

The complete receiver consists of three main units:—

(A) Projector unit.
(B) Receiver and power supply rack.
(C) Extra high-tension rectifier unit.

Projector Unit

The projector unit which is placed in the theatre about fifteen feet in front of the screen, is mounted on a four-legged stand and comprises the projection cathode-ray tube and lens, together with the time-base and focusing chassis. The final stage vision amplifier is also incorporated in this unit, the output from which provides modulation signal for the C.R. tube

Also in a compartment underneath the projector there is the intermediate vision frequency amplifier, together with both vision gain control and main sound control. The output from the main sound control is fed to the loudspeaker amplifiers accommodated at the base of each speaker. These in turn operate their respective speakers, which can be placed in any convenient position, so that it is possible for the projectionist to have full control of both the picture and sound.

Receiver and Power Supply Rack

A rack which is entirely separate from the projector unit supplies the latter with vision, synchronising and sound signals, together with power supplies, with the exception of extra-high tension, the latter being supplied from a separate unit.

The following units are contained in this rack, from top to bottom:—

(1) Sound radio receiver.
(2) Vision radio receiver.
(3) Power supply unit.
(4) Power supply unit.
(5) Power supply unit.
(6) Main contactor panel.

The received signals (from the dipole aerial) are fed to the sound and vision receivers, and after amplification to the main distribution panel contained in the vision rack. From here they pass to the main vision and

The rack containing the sound and vision receivers and their power supply units.

sound controls situated below the projector head.

Except that they have different ratings the three power supply units are almost identical in design. The topmost supplies the H.T. and heater current to the vision and sound receiver chassis. The next unit supplies H.T. to the vision amplifier (contained in the projector unit) while the bottom unit supplies H.T. to the time-base.

Extra-high Tension Unit

For the high voltage for the anode of the projection tube, a special high tension rectifier unit has been developed, embodying a voltage doubling circuit using two valves. It is capable of giving an output of 60 kV at 10 mA., but the normal working voltage of the tube is 30,000 volts at 300 microamps. The valves are mounted above the unit, each being supported by special insulators, which are removable for transport purposes.

Separate transformers are arranged to heat each of the filaments and both these and the main extra-high tension transformer, as well as all smoothing arrangements, etc., are immersed in one common tank filled with insulating oil. A safety or ballasting resistance is connected across the output supply of the extra-high tension transformer in order to protect the winding, should a short circuit occur. The output is then fed via a control to the anode of the projection tube.

The extra-high tension unit. Note the special precautions taken for insulating.

The extra-high tension unit is housed in a safety cage so that when the door of the cage is open the supply is automatically switched off, and the positive E.H.T. terminal earthed. Also, it is not possible to restart the equipment unless the door is correctly shut. The whole equipment is designed to work off A.C. 50 cycle mains, 200-250 volts, and as the total consumption is only 2 kilowatts it is quite economical.

The picture size is 8 ft. by 6 ft. with a degree of brilliance which precludes any possibility of eye strain.

Each loudspeaker amplifier is capable of delivering 15 watts undistorted signal to each speech coil. The overall frequency response from the aerial to the loudspeaker speech coil is within ± 4 db. from 30 cycles per second to 20,000 cycles per second.

AMERICAN TELEVISION STATIONS

THE following is a list of experimental television broadcasting stations which have been licensed in the United States by the Federal Communications Commission. Some of these stations work to regular schedules but all are of an experimental character.

Call letters.	Name and location.	Power, Vision.
W9XAK	Kansas State College of Agriculture & Applied Science, Manhattan, Kans.	50 w.
W9XG	Purdue University, Lafayette, Ind.	1½ kw.
W9XK	University of Iowa, Iowa City, Iowa	100 w.
W2XAX	Columbia Broadcasting System Inc., New York, N.Y.	50 w.
W6XAO	Don Lee Broadcasting System, Los Angeles, Calif.	1 kw.
W3XPF	Farnsworth Television Inc., Springfield, Pa.	250 w.
W9XAL	First National Television Inc., Kansas City, Mo.	300 w.
W1XG	General Television Corp., Boston, Mass.	500 w.
W2XBS	National Broadcasting Co., Inc., New York, N.Y.	12 kw.
W3XE	Philco Radio & Television Inc., Philadelphia, Pa.	10kw.
W2XDR	Radio Fictures Inc., Long Island City, N.Y.	1 kw.
W3XEP	R.C.A., Mfg. Co., Inc., Camden, N.J.	30 kw.
W1OXX	R.C.A. Mfg. Co., Inc., Camden, N.J	50 w.
W8XAN	The Sparks-Withington Co., Jackson, Mich.	100 w.
W9XUI	University of Iowa, Iowa City, Iowa.	100w.
W9XAT	Dr. George W. Young, Minneapolis, Minn.	500 w.
W2XBT	National Broadcasting Co., Inc., Portable (Camden, N.J., and New York, N.Y.)	400w.
W3XP	Philco Radio and Television Corp., Philadelphia, Pa.	15 w.
W3XAD	R.C.A. Mfg. Co., Inc., Portable (Bldg. No. 8 of Camden plant).	500 w.

Television for Employees.

Mr. A. F. Bulgin, managing director of A.F. Bulgin & Co., Ltd., the well known radio component manufacturers, has a televisor in his office. A limited number of employees, selected by drawing lots, are allowed to watch big sporting events during business hours.

Co-axial Cables.

The London-Birmingham co-axial cable is now in partial use as a 40-line telephone circuit and the work on the London-Manchester section is now nearly complete. The latter will accommodate 300 two-way circuits. Orders have been placed for further extension to Newcastle.

LIGHT MODULATION WITH THE SUPERSONIC CELL

A SIMPLE EXPLANATION

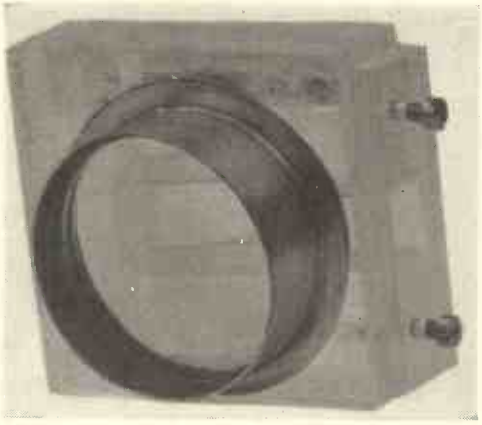
In 1936 we published the first details of the then newly invented supersonic light control which was developed by the Scophony Company and is employed in their receivers. The issue in which that information was given is now out of print and in response to many requests we publish here a resumé of the original article with certain additional particulars of this type of cell which is playing such an important part in modern high-definition television.

BEAMS of light, produced by apertures, lenses and so on, follow paths that can be calculated by assuming light to be waves of very short wavelengths of about one fifty-thousandth of an inch. When the lenses and apertures are of ordinary sizes, thousands of times larger than these wavelengths, light behaves for most practical purposes as rays, and travels in straight lines. When, however, it encounters small structures, of the order of size of these wavelengths, it may behave quite differently.

For instance, if we focus an image of a bright filament on a screen with a lens, we have a beam which we can consider as a bundle of rays of light, stretching from each point of the lens aperture to each point of the filament image. We may reflect this beam at some point by interposing a flat mirror, without otherwise disturbing the phenomenon. Suppose, however, we divide the mirror into a large number of small elements, about half of which, taken at random, are raised up one two-thousandth of an inch above the level of the remainder (without tilting them at all), then the result will be quite different from what we would expect of a bundle of rays of light. The filament image on the screen will now almost disappear, while round it, at some distance depending on the size and arrangement of the small elements into which we have divided the mirror, will be a coloured halo, formed of the light previously concentrated in the image.

If we raise the mirror elements gradually, from zero to one two-hundred-thousandth of an inch, we shall see the filament image gradually fade out and the coloured halo gradually appear. If we cut a hole in the screen, large enough to pass the filament image but not the halo, we can control the brightness of the light passing through it, from full brightness to fairly dark, by a movement of one two-hundred-thousandth of an inch in the mirror surfaces.

Similar small differences are produced in the path of a light beam if it is passed through a liquid in which supersonic waves are propagated. Supersonic waves of wavelengths



Photograph of a simple type of supersonic light relay.

down to a fraction of a millimetre are readily produced in liquids by the agency of piezo-electric crystal plates, for instance, of quartz or tourmaline, and are propagated from a flat crystal as plane wave-fronts of compression and rarefaction.

A light beam, passing through the liquid parallel to these wave fronts,

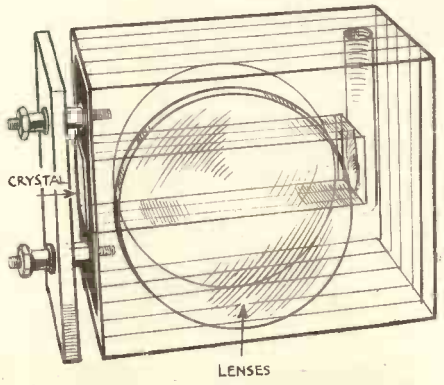


Diagram showing construction of supersonic light cell.

is retarded more by the compressed regions than by the rarified ones, as the amplitude of the supersonic waves is increased. This principle can, therefore, be used as a practical light relay, either by passing the central beam through a screen which stops the diffraction spectra or by letting the spectra pass and stopping the central image with a wire.

Moreover, the supersonic waves move in the liquid with a definite velocity of propagation. This means that when, in accordance with a television signal, we modulate the electric oscillation applied to the quartz crystal plate, we get groups of supersonic waves moving along the liquid, each group corresponding to one of a series of successive modulation values, which are thus strung out in space in their correct order in the liquid.

Simultaneous Light Spots

If we had a series of light relays, controlling a series of scanning spots following one another on the receiver screen, and if we could delay the modulation of each relay after the first, by the amount of time by which its spot follows the first spot, then we would be able to scan the screen with several light spots instead of one, and get a proportionately brighter picture. This is what the supersonic relay automatically does. Any point in the liquid, at a certain distance from the quartz crystal, will modulate light with a delay equal to the time needed for the supersonic waves to travel from the crystal to that point.

If we arrange our optical system rightly, we do not even need to divide the liquid column into a series of separate light relays. We can pass a beam of light through the whole column, along which supersonic waves are travelling, and then focus it on a slit or wire to separate out the diffraction spectra. We then have

QUARTZ CRYSTALS FOR MODULATION

a scanning system which forms on the screen a line of light which is an image of the whole column of liquid.

The size and magnification of this image is such that the images of the supersonic waves, could they be seen in it, would be seen to pass in the opposite direction to that of scanning, and at the same speed. When this line of light (which may be fifty picture elements long, or more) is caused to scan the picture, the modulated groups of waves travelling along the liquid show up as stationary picture details, each produced by the co-operation of what is equivalent to a row of fifty light relays or more.

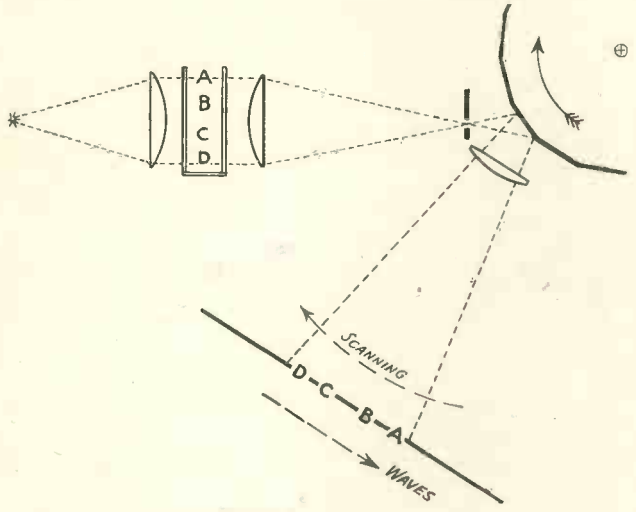


Fig. 1. Diagram explaining simultaneous production of fifty picture details on the receiver screen.

A simple arrangement is shown in Fig. 1, in which A, B, C, D represent successive picture details as transmitted to the receiver. (The scanner is supposed here to be a mirror drum. The most varied kinds of scanners can be used in practice.)

Practical Application

In working out the practical application one of the first things to decide is the order of frequency to use. The higher this can be, the shorter the wavelength of the waves in the liquid. This is advantageous, since the angle at which the diffraction spectra are spread out is inversely proportional to this wavelength, being in radians, the ratio of the effective wavelength of light to that of the supersonic waves (for the first order spectra). Unfortunately a limit is set by the fact that high-frequency waves in liquids travel only a limited distance. At 10 mc. they are reduced to half their initial amplitude in about 20 cm. of water or 4 cm. of paraffin oil, and the attenuation increases as the square of the frequency. This makes 10 mc. the right order of frequency to use. The above two liquids are better than many others in this respect.

At this frequency the wavelength in water is about 0.15 millimetre, in kerosene 0.13 mm. Visible light has an effective wavelength of about 0.00055 mm., so that the diffraction angle is about 1/280 radians for water, 1/230 for kerosene. Though this may seem small, we shall see that it is adequate in practice.

Length of Liquid

Temperature changes affect the velocity of sound propagation in liquids; usually about 1 per cent. per 3° or 4° C. It is often advisable, therefore, to restrict the number of elements shown on the screen, so that normal changes of room temperature will not seriously impair the accuracy with which the scanning motion follows up the wave motion in the light relay. In many cases fifty elements is an adequate number to use.

At 240 lines, 25 pictures per second, fifty elements (assuming one element equals one line width) are scanned in about 0.000026 second, during which time supersonic waves travel about 3.4 cm. in kerosene. This shows the order of length of the liquid column useful at high definition in simple sets.

Resonance of Quartz Crystals

The next point is frequency response. Quartz crystals are sometimes supposed to be inherently unsuitable for light relays owing to their sharp resonance in air, but it is all a question of damping. Crystals generating supersonic waves in liquids are fairly heavily damped and show reasonably flat resonance curves.

Sharpness of resonance depends on what we may call the " acoustic refractivities " of crystal and liquid. This quantity is the mass of substance traversed by unit area of sound wave-front in unit time; the product of sound velocity and density, for each body. The ratio between the values for crystal and for liquid is the acoustic " refractive index " between them, and determines the resonance curve. For quartz-water it is about 9, for quartz-kerosene about 14, for quartz-air about 30,000. This explains the much sharper resonance in air.

To a first approximation the percentage off resonance, at which response falls to 71 per cent. is

$$\frac{100}{(n-1)\pi}$$

Where " n " is the acoutic refractive index. This gives 4 per cent. for water, 2.4 per cent. for kerosene. (The crystal is assumed to vibrate at fundamental frequency, not at harmonics, and to have one face in contact with the liquid.)

At an operating frequency of 10 mc. this means modulation frequencies of 400 kc. and 240 kc. respectively, for 71 per cent. response. Though sufficient for medium definition television this is not good enough for high definition.

There are various ways of getting over this difficulty, as in ordinary electrical and sound-transmission practice.

Characteristic Curve and Operating Voltages

Fig. 2 is the theoretical operating curve of the light relay. According as one uses either the central beam or the diffraction spectra one may consider either

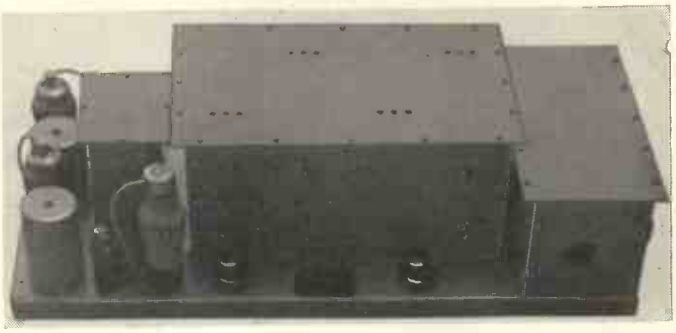
(*Continued on page* 464)

TELEVISION AND SHORT-WAVE WORLD

A LONG-RANGE VISION UNIT

By S. West

A short description of the theoretical features and the practical constructional details of a new long range television picture receiver unit.



The Spencer West Long-range Vision Unit.

THE two major problems arising in the design of a vision unit suitable for consistent reception at great distances from the transmitter are: (1) Securing adequate sensitivity whilst preserving a suitable response characteristic; and (2) securing stable operation of the sync. pulses filter section despite variations in the signal strength entailing large changes of operating conditions in the various circuits.

The overall limit to sensitivity is dictated by the various thermal and electron disturbances unavoidably occurring in the first stage of the receiver. This limit is reached earlier in a vision receiver than in one intended for reception of sound. Also the matter depends upon circuit arrangements and valves, in particular the latter. In general valve noise is related to the ratio of cathode emission and mutual conductance.

In the superheterodyne type of vision receiver the noise due to the mixer section can reach high proportions unless some R.F. amplification is used. Unfortunately, however, it is very difficult to achieve a good band-pass characteristic from an R.F. stage or stages, when normal R.F. pentode valves are used, at carrier frequencies of the order of 40 mc. and higher.

Noise and Band Width

A good characteristic is desirable, for the noise is proportional to the band width. In the writer's experience a single Acorn R.F. stage preceding the mixer arrangements is a partial, indeed almost a complete, solution of the difficulty. It is not necessary to include any circuit damping for the stage and that due to the valve is low.

Two direct advantages are derived from this. Firstly, the efficiency of the circuit is very much greater than it is for normal R.F. valves and, secondly, the response characteristic of the R.F. stage is simply controlled by a normal tuning control at the beginning of the receiver where the noise originates. Furthermore, it would appear that the acorn type of valve is less prone to generate undesired noise.

From the circuit noise viewpoint the increased gain from the single valve will reduce the pre-mixer circuit's complexity thereby reducing also the noise.

Noise due to the oscillator and mixer section is a somewhat more involved subject, but similar reasoning to the above will apply. Here again great benefit is derived if acorn valves are used.

For the I.F. amplifier of a sensitive unit a number of minor problems arise.

The three main features to be decided are: How many stages shall be used? What I.F. fundamental frequency is most suitable? What response characteristic is desirable?

It is quite a difficult matter to employ more than four stages, at the same time retaining a good frequency response characteristic that is not affected by variations of the gain control. Also the question of maintaining adequate stability becomes troublesome.

The frequency characteristic can admit both sidebands or be arranged for a form of single sideband reception.

Double and Single Sideband?

In the writer's view single sideband reception does not give such good results as double sideband; furthermore the gain is not a great deal higher due to circuit considerations. It is also a tricky business correctly to tune such a receiver.

These facts settle the question of the number of stages to be employed and the frequency characteristic to be aimed at.

It remains to decide upon the I.F. mid frequency. Here two desiderata are involved. Firstly, the I.F. frequency must be chosen with a view to avoiding visible feedback effects; it is redundant to state the need for observance of the lower I.F. frequency limit. Secondly, if a response frequency occupied by a number of short-wave stations is chosen, there is the possibility of direct pick up by the I.F. section of these signals and, where high gain is employed, the picture will be seriously marred by the amplification of these signals and their resulting beats.

Extremely elaborate circuit screening is required to avoid the first of these effects, whereas normal careful screening will enormously mitigate the latter. It is, therefore, well to be mainly concerned with the first desideratum, accommodating the second with careful mechanical layout and construction.

A receiver in which the pre-video detector arrangement is of the form outlined above and the post detector circuit comprised of two corrected V.F. stages will have a tremendous overall gain and excellent frequency response characteristics.

Consistent Reception at Long Range

In support of this is the fact that receivers constructed on these lines have provided reception of good pictures *at all times* at ranges of 100 miles from the transmitter. Moreover, the arrangement permits the performance to be repeated in production models without involving the

adjustment procedure. This is important from the commercial aspect.

For the synchronising filter the requirements are mainly as has been earlier indicated. That is, synchronism must be maintained despite any interference which may be received and any change of gain due to adjustment of the controls shall not affect the efficiency of the filter action.

To achieve this in the receiver to which this description pertains two valves are utilised. Their action is substantially independent of the magnitude of signal input and line voltage fluctuations. Furthermore, the operating characteristics are such as to render synchronism entirely stable even when heavy interference conditions are artificially simulated, interference, that is, which is sufficient entirely to destroy the picture intelligibility.

The mechanical arrangements of the receiver are straightforward, the only departure from more normal practice being the inclusion of double screening for certain sections of the apparatus. Actually the entire screening arrangements are somewhat elaborate as is natural in a receiver having high sensitivity. It will be observed from the photograph that the circuits are completely shielded both for prevention of inter-circuit coupling and external pick up.

Tuning is extremely simple. Due to the inclusion of an efficient detector filter, adjustment of the oscillator tuning control does not entail any particular skill.

The aerial input arrangements will permit attachment of either a Marconi type aerial or a dipole. For the latter type, which is to be preferred, provision is included where it is desired to employ a concentric feed line.

To conclude without divulging some reason for the design and commercialising of this rather unusual receiver unusual because of its phenomenal sensitivity, would leave this description incomplete. In the designer's experience a greater interest in television reception exists in the provinces. To retain this interest, once the novelty of installation has passed, absolutely consistent reception of high quality is demanded. This receiver will furnish such reception under all conditions.

For radio dealers some very valuable publicity can be derived from reception of television at great distances. A receiver of this type will make this possible.

The cost of the receiver, bearing in mind that such a unit like certain high performance automobiles is necessarily largely hand made, and entails considerable development expense, is not excessive.

A full technical specification and section photographs are available from the designer as also are particulars of an interesting scheme whereby the unit can be tested for a period at a low hire charge.

"LIGHT MODULATION WITH THE SUPERSONIC CELL."

(*Continued from page 462*).

top or bottom as full black, but the shape of the two ends is not very dissimilar. How far it is realised in practice will be described below. It is calculated by usual optical theory, for monochromatic light, assuming sinusoidal variations of wave path along the liquid, and holds fairly well in most practical cases.

The required operating voltages are most easily calculated from the Lorentz and Lorenz law connecting refractive index and density changes, and from the piezo-electric pressure constants of quartz, since a crystal, in contact with a liquid on one side only, transmits to it, when vibrating at resonance frequency under a given voltage, pressures equal to those producible statically in the crystal by the same voltage. This is a short cut method of calculation, but correct under the above conditions.

Omitting the working out, we arrive at voltages (reduced to r.m.s. values) of approximately $\frac{E}{20\ \gamma\ T}$ for liquids of refractive index about 1.43, such as kerosene.

(E=elastic coefficient of liquid, T= thickness of column of waves, γ = operating frequency.)

This formula agrees pretty well with observation. The variation due to refractive index is not very important.

We may note in passing that the pressures needed for full control are not very great, being of the order of half to one atmosphere in practical cases. The amplitude of the liquid vibrations is also of interest: it is of the order of 10^{-5} centimetres or less, or hardly more than of atomic dimensions.

Thickness of Liquid

To control as much light as possible, the central beam should have an angular spread about equal to the angle of diffraction of the first order spectra. This enables one just to separate the beam from the spectra when focused on a slit or screen. This angular spread causes the rays of the beam to stray from a crest of the supersonic waves towards a hollow, or vice versa, in passing through the liquid: they are not all parallel to the supersonic wavefront. The shorter the supersonic waves, the greater the angle of diffraction, which is the desirable angle of spread for the central beam, and the less room there is between successive supersonic wave crests for the light rays to spread. Hence we have to reduce the liquid thickness in proportion to the square of the supersonic wavelength.

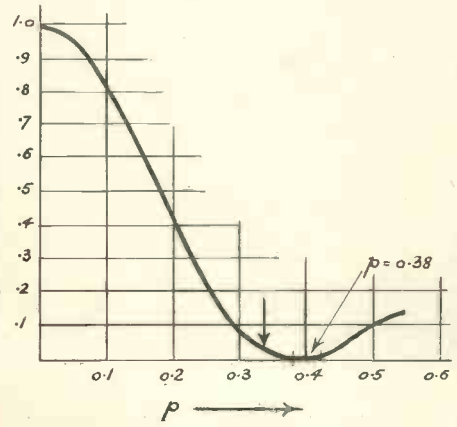


Fig. 2. Operating curve of supersonic light cell.

The permissible thickness of liquid in accordance with this criterion is about

$$T = 1.3 \times 10^{4}\ \lambda^{2}$$

where λ = wavelength of supersonic waves.

This is a maximum value, but it is usually better to use a smaller thickness, especially when the light in the undiffracted beam is being used. For kerosene at 10 mc. the maximum T is 2.2 cm., and the minimum operating voltage therefore comes out about 34 volts r.m.s. In practice it may be two to six times this, according to the arrangements used.

THE TELEVISION RECEIVER AND ITS MAINTENANCE

NEW PROBLEMS FOR THE SERVICE ENGINEER

The advent of television has presented the service engineer with many new problems and a considerable amount of instruction is being provided both in this country and the U.S.A. to equip him with the necessary knowledge. This article which is an abstact from Radio Retailing (New York) gives an outline of general procedure in receiver repair.

THREE entirely new problems, other than those encountered in ordinary wireless practice, are presented in the maintenance and repair of television receivers. These are the maintenance and adjustment of sweep circuits, the importance of phase shift, and wide band pass. Some of the old problems are greatly simplified. At present there is only one waveband. Ganging of the tuning control will be fairly simple. The bands passed are so wide and the intermediate frequencies so high, approximately 10 megacycles, that slight misadjustment in the line up is not as important from a frequency standpoint as it is from that of phase distortion.

Where formerly a serviceman was generally in the dark as to the ultimate result of his adjustments, with television, a great deal can be told by observing, on the screen, the changes in the quality of the picture as adjustments are made. This ability to see what is happening is of the greatest importance and it will greatly simplify the servicing problem.

Let us start at the beginning of a television receiver and see what adjustments have to be made in order to properly line up the receiver. It will be assumed that this receiver is a super-heterodyne, capable of receiving sight and sound at television frequency.

Avoid Phase Distortion

To pass the necessary band without phase distortion, care must be taken in adjustments of the I.F. transformers. The importance of avoiding phase distortion is perhaps not familiar to the average service man and can be best explained by saying what difficulties will arise if this type of distortion is present. If one stage of intermediate frequency is tuned to one frequency, and the next to another frequency, and so on, in order to pass a wide band, the phase of the frequencies being passed will not be the same and will result in certain frequencies arriving at the grid of the cathode-ray tube earlier than other frequencies.

It is not necessary that there be no phase shift. Just as long as phase shift is proportional to frequency no difficulty will arise. The result of one frequency arriving at the cathode-ray tube grid earlier than it would without phase shift is that some picture elements will be displaced three or four lines with the result that the edges or outlines of objects may be turned black where they should be light or even displaced to right or left as much as eight to ten picture elements.

The second detector of the receiver can be a diode as the input to this tube will seldom be less than 1 volt. The linearity of a diode at this level is very good. The output of this second detector, in the case of the vision will be coupled to one or more stages of video amplification. The word video is used rather than the word audio to differentiate between the two types of amplification after demodulation. This amplifier must be capable of passing a wide band similar to the I.F. stages.

Other Circuits

After video amplification the signal is applied to the cathode-ray tube grid circuit which sets the average brightness, and to the synchronising signal selection and separation circuit. From the average brightness setting circuit, sometimes called a D.C. restoring circuit, the signal passes to the synchronising impulse separation circuit. In order to separate the synchronising impulses from the picture content of the transmitting signal, it is necessary to have an amplitude discrimination circuit, such as a diode biased so that only the peaks of the signal will be passed through this circuit, eliminating the video picture portion. The peaks or synchronising impulses are then allowed to enter the synchronising impulse selection circuit. This circuit

BRITISH TELEVISION RECEIVERS FOR U.S.A.

A consignment of Cossor television receivers leaving the factory at Highbury on their way to New York. A fine tribute to the excellence of British receivers.

is a simple frequency separation circuit, one filter to pass the high or 13,000 cycles synchronising impulse and the second filter to pass the low or 60 cycle field synchronising impulse. These two signals are applied to the grids of the sweep circuit oscillators in order to synchronise them.

To check the high frequency sweep oscillator, it is necessary to employ a beat frequency oscillator adjusted for some frequency which is a multiple of 13,320 cycles. The other oscillator can be compared with the a.c. line frequency in order to make certain that it is operating at 60 cycles. The output of these oscillators is fed into a power amplifier tube and from there transformer coupled to a pair of deflecting coils on the cathode-ray tube.

Magnetic Deflection Popular

It may be interesting and new to some servicemen that magnetic deflection is used in television, rather than electrostatic. Magnetic deflection is used because it is much easier to obtain a wide deflection of the beam, and because the spot focus is less distorted during deflection.

A few words regarding average brightness restoring circuits are in order. These circuits are essentially peak detectors as they detect the peak amplitude of the synchronising impulses. The amplitude of these pulses is slowly changing, according to the average brightness of the picture transmitted and is measured automatically and applied to the cathode-ray tube grid as bias, setting the background or average brightness of the picture. In modern television receivers, seldom less than 4,000 volts are used on the final anode of the cathode-ray tube. Care and new standards of insulation are required. The employment of such high voltages need not alarm the serviceman as the currents used are very small. In fact, these voltages, with the exception of those used in projection tubes are not much higher than the voltages employed in the average ignition system of the family car. All modern television receivers that have been brought to the notice of the writer employ interlocks, which, when the back of the receiver is open in order to service, automatically cut off the high tension.

Test Instruments

It is very difficult to foresee what new instruments will be used in the servicing of a television receiver, but it is very easy to tell in which direction the development of those instruments will lead. Possibly the cathode-ray oscilloscope will be the basic tool, around which other instruments could be built. There will probably be one or more multi vibrators, one oscilllating at 13,000 cycles, and one at 60 cycles to test the deflecting coils of the receiver that is being serviced. At the same time, these same signals will deflect the beam of a tube in the instrument which looks like a cathode-ray tube, except for the screen, which is an aluminium plate with a design marked on it consisting of bars and lines properly interlaced with each other to cause a signal to be developed when the beam crosses. This tube is known as a Monotron, and the signal is generated because the secondary emission from the aluminium plate rises and falls, depending upon whether the beam strikes the bare aluminium or the black carbon ink which makes up the markings. Obviously, the secondary emission is higher from the aluminium than it would be from the carbon and this is amplified by an amplifier. The signals thus developed can be applied to the grid of the cathode-ray tube in the receiver under adjustment so that the image or exact duplicate of the image drawn on the plate in the monotron should appear on the screen of the cathode-ray tube being serviced.

From the resulting pattern, a great deal can be told. Vertical and horizontal resolution in any or all portions of the screen can be monitored and corrections applied to the video amplifier of the receiver to bring this resolution to maximum. It is possible to note from this image the high frequency cut-off of the video amplifier and associated circuits, the amount of phase distortion present, the focus of the spot at any time on any portion of the screen, the quality of the half tones, the aspect ratio and the linearity of the sweep circuit.

The signal generator used to service a television receiver will be in itself a high quality transmitter capable of wide band modulation. This same oscillator will also be capable of frequency modulation. With this instrument, it will be possible to measure the overall response curve of the radio frequency section and see it on a normal cathode-ray tube screen in the same manner as visual aligners are used to-day.

Does the Ether Exist?

WHETHER the ether, the supposed medium in which radio waves and other forms of radiant energy are assumed to travel, really exists has never been settled. One school argues that the ether is a fiction, pure and simple. The other explains the passage of energy through space by assuming the existence of the ether because it is a convenient device and provides the only physical explanation.

Assuming the existence of the ether, there is the question whether it is stationary in space and the earth drifts through it, or that the ether moves with the earth. The latter seems extremely unlikely, since if the ether moves with the earth it must be moving past all other celestial objects.

Many experiments have been made in attempts to settle these questions and recently Dr. Herbert E. Ives, of the Bell Laboratories, experimenting with the spectra produced by high-speed hydrogen ions, has provided new evidence which revives the possibility that the ether may be a reality after all, but the question is still an open one. On the one hand radiant energy propagation seems to demand a medium. On the other hand it is realised that the medium must behave very differently from any ordinary elastic medium. The odds at present seem to be about 11 to 9 in favour of the ether. For real proof of its existence, however, the world still waits.

Television-Telephone

A television-telephone service is now available to the public between Berlin and Munich. Fourteen television booths have been provided in Berlin. The charge is 8s. 6d. for three minutes. The Berlin-Munich service is to test the feasibility of linking up all large cities by public television service. The picture definition is 180 lines 25 pictures per second and the result, therefore, compared with modern standards, rather poor. Transmission is by co-axial cable.

Scannings and Reflections

EUROPEAN SWIMMING CHAMPIONSHIP

AN international aquatic contest will be televised for the first time on August 8 when the B.B.C.'s mobile television unit comes into action at the Wembley Swimming Pool to show the European Swimming Championships each afternoon till August 13. More than twenty-eight nations will be represented and competitors will have come from France, Ireland, Poland, Italy, Greece, Turkey and many other countries. For the first time six swimmers from Iceland are competing.

Two television cameras will be mounted on the concrete side of the bath to give an overhead view only ten feet from the water; one of them at the starting and finishing post and the other at the diving boards at the opposite end. A third camera mounted high up at the end of the pool will give a general view.

The events which viewers are likely to see will include men's and women's swimming races in back-stroke or free style, high diving, water polo, spring-board diving for men and women, and relay races. The biggest test of endurance will be the 1,500 metres race for men in free style, which should make an exciting picture on the television screen.

LORD HIRST ON THE FUTURE OF TELEVISION

Speaking as chairman and managing director at the annual general meeting of the General Electric Co., Ltd., Lord Hirst, of Witton (who is also president of the R.M.A.), said: "The future of television seems largely bound up with the ability of manufacturers to place models on the market having entertainment value and yet coming within the range of the public purse."

GERMAN TELEVISION STANDARDS

It is expected that the German television service will start this month and operate on the following standards:—441-line definition and 25 frames interlaced scanning, giving 50 frames of 220.5 lines per second. The Berlin and the Feldberg transmitters will operate on the same wavelengths, 6.6 metres for sound and 6.28 metres for vision. The Brocken transmitter will operate on 7.5 metres for sound and 7.28 for vision. Modulation will have a band width of 2 megacycles. Positive modulation will be employed, producing white at the maximum and black near the minimum. A blacker than black area has been provided for the transmission of the synchronisation impulses. The D.C. component will also be transmitted.

TELEVISION IN CZECHOSLOVAKIA

A television transmitter has been built by the Czechoslovak Ministry of Posts. Experimental transmissions are to be made at an early date and in view of these two public televiewing rooms will be opened in Prague to enable the public to witness the new development. Upon the reaction of the public will depend the decisions regarding the introduction of television in Czechoslovakia. The standards to be employed are the same as those in this country, viz., 405 lines interlaced 25 pictures per second.

TELEVISION IN THE U.S.A.

Considerable attention has been given in the U.S.A. to television during the past month or two. Not only have several demonstrations been staged, but television receivers have been placed on the market.

The latest developments in the R.C.A. system were shown recently by the Radio Corporation of America and the National Broadcasting Company at Radio City. The demonstrations were for the purpose of showing the progress made by the two companies during the past seven months. While no startling innovations were presented it was evident that considerable improvement has been made in the R.C.A. system.

A demonstration was also given by Kolorama Laboratories in Irvington, N.J. Television pictures transmitted by wire from standard motion picture film were shown in sizes of 3 ft. by 4 ft. The Kolorama pictures were scanned with 225 lines, interlaced 2 to 1. The field frequency is 24 and the frame frequency is 12 per second.

A TRANSMITTER FOR MOSCOW

A complete television transmitter and studio is nearing completion in Moscow. The equipment is of American manufacture. The camera and equipment is similar to those used

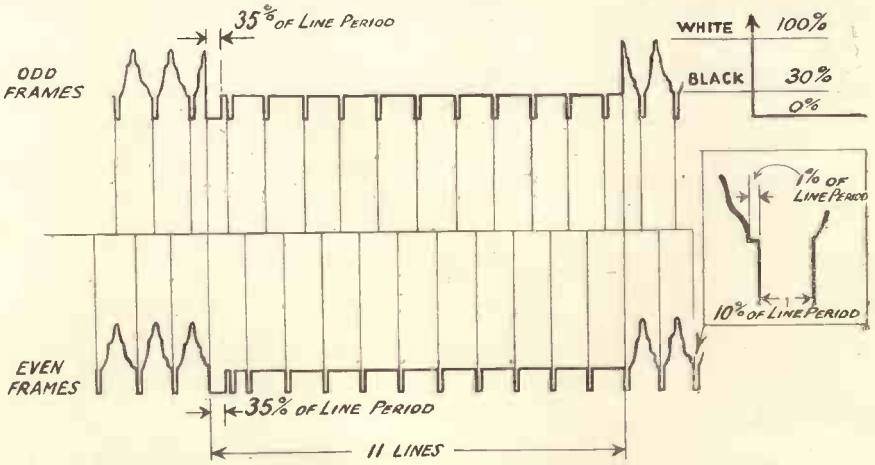


Diagram showing the characteristics of the signals radiated by the German television system.

MORE SCANNINGS

in the N.B.C. television studios in New York.

VIEWERS SEE STAR COLLAPSE

Viewers watching a programme last month, saw Miss Joan Collier, the singer, collapse in the studio at Alexandra Palace while singing in a performance of "The Rogues' Gallery." She had to be carried out of the studio.

The programme was immediately suspended and a news reel substituted for 10 minutes, after an announcement had been made. Later, however, Miss Collier revived and was able to appear again.

TELEVISION AT THE MANSION HOUSE

During the Test Match television was installed at the Mansion House so that the Lord Mayor of London and a number of luncheon guests could watch the transmission from Lords. Three receivers were used so that a large number of people could see the play.

THE LARGE SCREEN

It is stated that as a result of the large-screen demonstrations by the Baird Company at the Tatler Theatre more than 100 cinema exhibitors—not inclusive of Gaumont houses—desire instalment of apparatus as soon as price, installation dates, etc., can be arranged. An announcement regarding these matters will be made shortly. A service organisation for equipment and maintenance has already been developed. Gaumont-British Equipments, Ltd., are handling the apparatus. Baird large-screen television is now being installed in the Tivoli, and the Marble Arch Pavilion cinemas, London.

AMERICAN RECEIVERS ON SALE

Both the Allen B. DuMont Laboratories and the Television Corporation of America have placed television receivers on sale in the larger New York department stores. The prices of the latter range from $125 to $275, while the DuMont receivers are priced between $350 and $700. The DuMont receivers provide black and white images.

SCHOOL LESSONS BY TELEVISION

During the past few months boys at Leigh Hall College, Southend, have been taking lessons by television. The boys watch suitable programmes, such as those dealing with crafts, industries, travel, etc., and these are then followed by explanatory lessons. There is a suggestion that when a number of schools are equipped with television sets, the B.B.C. will set aside a short period for transmitting illustrated lessons.

A LEG CUE

Joan Miller, who conducts "Picture Page," now receives her cues from a buzzer attached to one of her ankles. The device is known at Alexandra Palace as an "ankle teaser." Operated from the electric mains, it actuates a tiny button which vibrates at the rate of 50 times a second, giving a very positive signal without causing any discomfort. To give a cue the producer presses a button and she receives a signal just like an electric shock on the side of her leg. The buzzer vibrates at the rate of 50 times a second and therefore is silent. The buzzer was introduced because flashlight cues were rather distracting.

MOTOR-CYCLE RODEO ON BANK HOLIDAY

The Crystal Palace grounds will be the venue for the television programme on August Bank Holiday afternoon, when the cameras will be present at a Motor-cycle Rodeo and Pageant, and at the adjoining Fun Fair. A musical ride on motor cycles similar to the famous ride of the Royal Scots Greys, will be among the features which it is hoped to televise. Darts played on motor cycles should make another good picture on the television screen, for the dart board measures eight feet in diameter and the darts are two feet long. "Tilting the quintain," a mediæval game, will be played on motor cycles, with the riders wearing full sets of sixteenth-century armour. The quintain consists of a pole stuck in the ground carrying a rotating rod, on one end of which is a shield, and the other a sword. As the rider strikes the shield with his lance he accelerates to avoid being struck by the sword, which, of course, swings round from behind. In the motor-cycle version of the game a bag of flour will be substituted for the sword.

A chariot race is another event which it is hoped to show viewers; the riders will be dressed as Vikings and Romans and each chariot will be drawn by two motor cycles. The Rodeo is organised by a number of war-time comrades who, on leaving the Royal Air Force, took to flying, then to motor-cycle racing and, when they grew too old for the latter sport, found an outlet for their energies in trick-riding.

"IN THE DENTIST'S CHAIR."

"In the Dentist's Chair," a thriller by Anthony Armstrong, author of "Ten Minute Alibi," will again be televised in the afternoon on August 5. The excitement begins from the moment the play starts, for into the empty surgery there creeps a man who has just killed another. Seeing a chance to create a perfect alibi, he has just time to put back the hands of the clock and sink into the dentist's chair before the owner of the surgery comes in. Luckily for the visitor he has a bad tooth which the dentist decides to extract, but when the gas is administered things begin to happen! Viewers may expect an exciting twenty minutes.

BRIDES' SCHOOL TELEVISED

Brides of Hitler's black bodyguard—the SS— who are at present attending the brides' school on the peninsular of Schwanenwerder, in the Wannsee Lake, near Berlin, provided the feature of a Berlin transmission. People of Berlin were able to see the "S.S. brides" in the Post Office Museum at a free demonstration.

TELEVISION MAKE-UP.

In the early days of television, there was much ado about the various colours and combinations of colours which it was supposed would have to be used in make-up for television broadcasts. Greens, blues and browns were used and make-up artists devised special creams and pencils for treating the face to be televised.

The make-up question for television is reminiscent of sound effects in the early days of radio broadcasting. An example of this is one

. . . . . AND MORE REFLECTIONS

classical case where sound engineers struggled for days to find a sound effect which would properly express a kiss. Many ingenious devices were used but none of them seemed to hit the mark until someone made a simple enough suggestion that hadn't been tried. He suggested using a kiss in front of the microphone. It was done and the sound effect was perfect.

Experience has shown that ordinary street make-up for women serves as well as anything else. There has been much discussion about blondes being difficult subjects for television because of the neutral colour of the hair, but a blonde apparently televises as well as a brunette.

That the make-up question is just a minor one is just as well for it would be hard to conceive television being of general utility if every speaker and subject had to undergo a special treatment.

SINGLE SIDE-BAND RECEPTION

It is rather interesting to note that certain aspects of commercial practice and design are slowly filtering into new season's receivers. The new Phillips' large-screen television receiver which uses a 4 in. projection tube uses a radio circuit which operates on the single side-band system. This circuit has an R.F. amplifier for both sound and vision with separate frequency changers and a push-pull oscillator.

This type of circuit has been used for many years in commercial point-to-point communication receivers, but it is the first time that the idea has been embodied in a wide-scale production receiver.

PROGRAMMES FROM RADIOLYMPIA

Many well-known artists have been engaged to take part in the special television programmes which are to be radiated from the studio in the National Hall at Radiolympia. The programmes from this studio will be in addition to the normal programme sent out from the Alexandra Palace Studios, and it is anticipated that there will be between five and six hours of television each day. Amongst the artists whom viewers will see are, Steve Geray and Magda Kun, Ernest Shannon, Walsh and Barker, and the Continental singer Trudi Binar.

Two mobile television units will be in use during the Exhibition period. One will relay the programmes from Radiolympia to Alexandra Palace for re-transmission, while the other will be operating first at Kennington Oval for the final Test Match and later at the Zoo to provide two half-hour animal programmes daily.

TELEVISION SALES

In the autumn the B.B.C. are to co-operate with the radio manufacturers in an endeavour to increase the sales of television receivers. Existing sales are still rather slow mainly because would-be purchasers have no idea as to the state of perfection the modern receiver has reached. Once a prospective customer has had home demonstration he invariably realises the value of the vision accompaniment to a sound programme. However, until a large section of the population have been able to have home demonstrations it is not likely that there will be any drastic rise in sales. While public demonstrations are quite satisfactory and give some idea as to picture definition, they do not have the effect of making a viewer realise just how important it is that he should have a receiver in his own home. During Radiolympia, over 2,000 dealers are to be invited to a Convention in order that they will be in a position to advise their customers on all the latest developments and news.

The outside broadcasts of recent months have been extremely good, while the transmission of the final Test Match from Kennington Oval should convince the general public that television has actually arrived and has come to stay. Initial cost is certainly not a detrimental factor for it is possible to purchase a television receiver for well under thirty pounds and even then with simple hire-purchase terms. It has also been recognised that a television receiver is more reliable in use and more simple to operate than the average normal broadcast receiver.

AMATEUR RADIO AND PITCAIRN ISLAND

Dorothy Hall, the well-known American radio amateur, who owns and operates W2IXY in New York, has been maintaining a regular schedule with VR6AY on Pitcairn Island. She has made over 300 contacts during the short time that this station has been installed. Actually it was supplied by American amateurs, who sent it out to Pitcairn Island last March where it was erected by two American engineers. During the following few weeks several thousand contacts were made with stations in all parts of the world. In view of the fact that this transmitter cost around £2,000 it was rather interesting to note a report in a national paper to the effect that it was built from a case of rusty car magnetos, which had been washed up from a wreck! Dorothy Hall, who has a 1 kilowatt station, several of the finest multi-valve communication receivers and an immense estate on Long Island, was described as a "suburban housewife." However, the daily Press never did appreciate amateur radio!

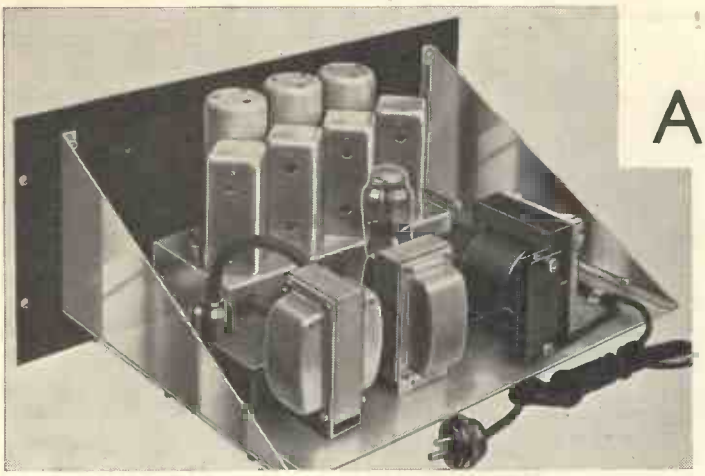
TRANSMISSION ON ULTRA-HIGH FREQUENCIES

The recent 5-metre field day in which a large number of amateur operators took part, was quite successful, in so much as numerous contacts were made between stations up to 70 miles or so in distance. However, despite the fact that efficient equipment was used, no new long-distance records were made. This raises an interesting point, for in America, using very similar power and circuit arrangements, distances in excess of 500 milles are covered with the greatest of ease, while in good locations, 1,000-mile coverage is not exceptional. Considerable distances have been bridged by British amateurs, but not with any degree of consistency. Climatic conditions may account for the difference in results.

THE GERMAN RADIO EXHIBITION

The German Radio Exhibition, to be held in Berlin between August 5 and 21, will be the largest of its kind ever held in Germany. It does, of course, include, for the first time, the products of Austrian radio firms, and it is claimed that the floor space of 67,200 yards is more than three times the area of the last Radio Exhibition held in London. Programmes are to be broadcast from 9 a.m. onwards, while a special attraction is a free telephone service between the Radio Exhibition and cruising liners. There is also to be large scale television demonstrations in two theatres.

A TELEVISION AERIAL AMPLIFIER FOR FLATS



The Baird aerial amplifier for flat distribution.

AN ultra high-frequency amplifier with a very wide band pass has been specially developed by the Baird Company for television redistribution in flats. Distribution is by standardised types of high-frequency cables.

The installation of this amplifier and a standard television aerial, together with suitable high-frequency cabling, enables a complete block of flats to be very economically supplied with a television aerial service. Receivers operating on the system are ready to work by merely plugging into the wall socket, and any type of receiver may be used.

The Baird amplifier is designed for television redistribution at 41.5 and 45 megacycles from a single aerial. Each receiver on this system is supplied with a signal similar to that obtained direct from the main aerial and each operates exactly as though fed from a separate aerial.

Precautions are taken against the possibility of interaction between adjacent receivers by maintaining an attenuation of 40 db. between them.

The amplifier is designed to work in conjunction with medium- and short-wave amplifiers. In this way it is possible to distribute ordinary broadcast signals over the same cable by the addition of filters supplied for this purpose.

The amplifier, as the photograph shows, is mounted on a steel panel 8 ins. by 19 ins., black crystalline finished and the total weight is 22 lbs.

Performance Characteristics

When fed from a 100-ohm input circuit and coupled into a 25-ohm output circuit, the following figures are obtained:—

Overall gain at 45 megacycles: 40 ± 2 db.

Variation of gain: less than 2 db. between 43 and 47 megacycles.

Overall gain at 41.5 megacycles: 40 ± 2 db.

Variation of gain: less than 2 db. between 41.3 and 41.7 megacycles.

Maximum output: 1.5 volts peak carrier.

Mains Variation

The gain of the amplifier falls within the above limits provided that the mains voltage does not differ by more than 10 volts to which the tapping is set. The three tappings on the A.C. mains input transformer are for 200, 220 and 240 volts, 40 to 60 cycle supply.

No gain control is fitted. A gain adjustment is necessary only for an unusually strong signal (e.g., 20 mV) in which case an adjustment is made before installation.

The amplifier is designed for parallel feed of a number of main cables laid through the building, with tappings along each cable for the individual receivers. It is suitable only for single concentric cables and not for screened pairs.

Distribution from Radio Amplifier

Provision is made on the television amplifier for parallel operation with medium- and short-wave amplifiers. The output of the television amplifier is taken through a few feet of low-loss 25-ohm concentric cable to a special filtering circuit. This filter has a very low impedance between 41.5 and 47 megacycles, but the output impedance from 20 megacycles to 150 kilocycles is greater than 200 ohms. The radio-frequency amplifier can be connected in parallel with the filter output and to the distributing lines without undue shunt loss. By the use of the 25-ohm flexible output line the television filter can be mounted adjacent to the radio frequency amplifier, and this is recommended to avoid undesirable effects from a length of cable between the television filter and the radio frequency amplifier.

Constancy of the performance characteristics eliminates the necessity of any tuning adjustments or the use of monitoring apparatus, but it is recommended that a periodical check be made of the bias voltages of the valves means for which are provided by jacks situated on the front of the amplifier.

Televising the Fifth Test Match

The fifth Test Match at the Oval will not only be fought to a finish, but televised to a finish. The B.B.C. mobile television unit will be installed on the Kennington ground on the opening day, August 20, and it is believed that even better pictures will be obtained than in the case of the Lord's Test Match, since the two principal cameras, besides being appreciably nearer the field, will give shots more nearly along the pitch. Viewers may thus be able to see which way the ball is turning. The special television commentary will again be given by Captain H. B. T. Wakelam.

As the Oval is certain to be filled to capacity, viewers will share the excitement of approximately 80,000 people in the stands. If the match should run to four or five days visitors to Radiolympia, which opens on August 24, will also be able to watch play. The transmission will last daily from three to four hours, beginning at 11.30 a.m. As at Lord's, telephoto lenses will be used, so that, besides general views of the field, the home screen will show bowlers, batsmen and fielders in comparative close-up.

RECENT TELEVISION DEVELOPMENTS

A RECORD OF PATENTS AND PROGRESS

Specially Compiled for this Journal

Patentees: N. V. Philips, Gloeilampenfabrieken :: G. Sylven :: Sturdy-cage Projects Inc :: Marconi's Wireless Telegraph Co. Ltd. and E. W. B. Gill :: Murphy Radio and H. A. Fairhurst :: C. H. Matz :: Baird Television and V. Jones

Incandescent Pictures

(Patent No. 481,556.)

THE picture is produced on an incandescent screen, which is made to " glow " by the impact of the scanning beam. The screen is usually made of very thin metal, only a few thousandths of a millimetre thick so that it will easily heat up to incandescence under the action of the scanning stream, and then rapidly cool off again.

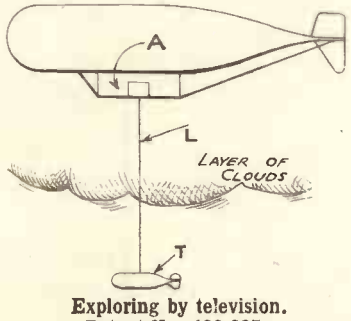
Cooling must not, however, take place too quickly because this will reduce the brilliance of the picture, neither must it be too slow, on the other hand, because then the heat tends to " spread " and the picture loses definition.

As the best possible compromise the inventors use a screen made of tungsten 1.2 microns (or 0.0012 millimetres) thick. This will stand a temperature of 2,800° K. without damage, and will reproduce sixty pictures a second, each with a mean brightness of 13 candles to the square centimetre.—*N. V. Philips, Gloeilampenfabrieken.*

Exploring by Television

(Patent No. 482,835.)

In a combined receiving and transmitting set, the transmitter is connected to the receiver by flexible cables so that all the operating voltages required by the transmitter are



Exploring by television. Patent No: 482,835.

supplied from the point at which the transmitter to be lowered, say, from the deck of a salvage ship, in order to survey a wreck resting below the level to which a diver can safely descent. Or the outfit can be used to make a preliminary survey of a sumberged object, before the diver descends.

Alternatively, the transmitter could be released from a submarine, floated to the top, and used instead of a periscope.

As shown in the figure, the transmitter is carried in a torpedo-shaped casing T suspended by a supply cable L from an airship A on which the receiver is carried. This allows the navigator to view the ground from above the level of the clouds.—*G. Sylven.*

" Seeing " Through Fog

(Patent No. 482,876.)

The methods used in television are applied to the problem of " seeing " objects normally obscured by fog or darkness. Use is made of infra-red radiation, which is always present, even at night, and which unlike ordinary light is able to pass freely through fog, cloud, or mist. The infra-rays are focused on a fluorescent screen, which responds to them more or less as it does to ordinary light.

At the same time the picture formed on the screen is scanned by the electron stream from a cathode-ray tube. The combined effect of the infra-red rays and the electron stream is stated to produce an image in " differential values " of light-intensity.

This image is projected on to a photo-electric cell, the output current from which is amplified and used to control the intensity of the electron stream through a second cathode-ray tube. The final result is that the first image is reproduced in intensified form on the fluorescent screen of the second tube, so as to give a clear view of the originally-obscured object or landscape.—*Sturdy-cage Projects Inc.*

Light-sensitive Tubes

(Patent No. 484,310.)

The drawing shows a photo-electric tube of the gas-filled type in which ring-shaped electrodes R are inserted between the light-sensitive cathode K and the anode A in order to allow amplification through ionisation by the emitted electrons, without risk of sparking.

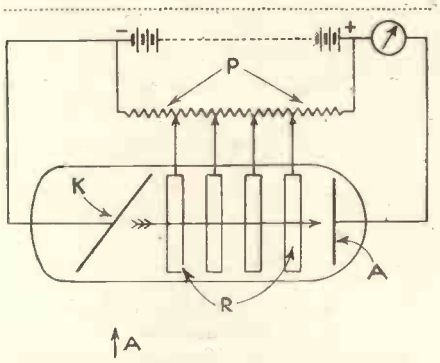


Photo-electric tube. Patent No: 484,310.

Light falls from A upon the cathode K, and the liberated electrons are forced by the magnetic field from an external winding (not shown) to pass through the rings R towards the anode A. The rings are tapped to progressively-increasing voltages along the resistance P. The arrangement allows ionisation to occur by collision, with a corresponding increase in the current originally emitted from the cathode. At the same time the applied voltages are graded and so kept below the point at which the tube is likely to be damaged by sparking.—*Marconi's Wireless Telegraph Co., Ltd.*, and *E. W. B. Gill.*

Time Base Circuits

(Patent No. 484,412.)

In interlaced scanning it is particularly important that there should be no reaction between the line synchronising and frame synchronising impulses, and no tendency for them occasionally to fall into step. In straight scanning, this could only

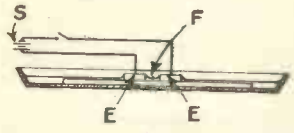
occur at the end of a framing interval, where it would not matter much. But in interlaced scanning the framing impulse takes place in the middle of the line, where any interlocking is definitely undesirable.

In order to prevent it, the signal frequencies are first separated from the picture signals and the line impulses are then developed across one branch of a double diode and led away to the line oscillator. The framing impulses are developed across a second branch of the same diode, and are passed via a "delay" circuit to a rectifier so biased that it cannot respond to the line impulses. The time-constant of the delay circuit is of the order of one-third of a line interval, so that the two different timing impulses are effectively kept apart.—*Murphy Radio, Ltd.*, and *H. A. Fairhurst.*

Light Valves

(Patent No. 484,482.)

Two metal electrodes E and E are arranged to enclose a film F of alcohol or other liquid, about one-fiftieth



Liquid light valve. Patent No: 484,482.

of an inch in width, and of any convenient length. Owing to surface-tension, the film takes up a definite curvature, so that if a ray of llight is passed through the slot it will be brought to a focus at a definite point.

Any variation of the voltage applied from the source S across the two electrodes then has the effect of altering the curvature of the film, and therefore the focus of the light. If the source S is replaced by a microphone the arrangement can be used for modulating a beam of light, or for making sound records for reproduction by the well-known variable-density process.—*C. H. Matz.*

Television Transmitters

(Patent No. 484,574.)

The picture to be transmitted is focused upon a transparent photo-electric cathode K, and the resulting stream of electrons is concentrated by an external magnetic winding W, and accelerated by a ring-like electrode A, so as to form an electron image of the original picture upon a mosaic screen M.

The screen consists of a backing-plate M of mica, upon which a thin layer L of transparent conducting material is laid, on top of which, in turn, are deposited a large number of small photo-sensitive elements P.

The screen is then scanned by a light-spot so as to produce signal voltages across the resistance R. As the screen is transparent it can be scanned from either its front or rear

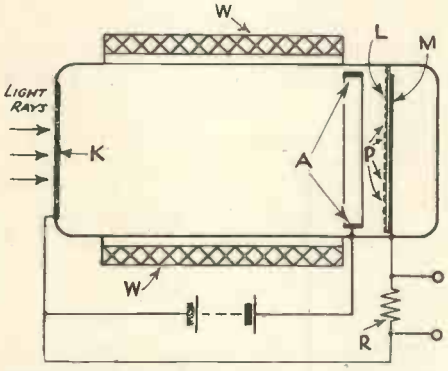


Photo-electric pick-up tube: Patent No: 484,574.

surface, preferably by light of a different colour or actinic quality from that forming the image on the cathode K.—*Baird Television, Ltd.*, and *V. Jones.*

Summary of other Television Patents

(Patent No. 482,049.)

Preventing trapezium or "keystone" distortion when scanning a film by a rotating disc.—*The General Electric Co., Ltd., D. C. Espley*, and *D. O. Walter.*

(Patent No. 482,168.)

Method of forming an alkaline-earth electrode capable of giving a high ratio of secondary emission from each impact by a primary electron.—*Farnsworth Television Inc.*

(Patent No. 482,195.)

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

(Patent No. 482,208.)

Light-sensitive device consisting of a condenser with a layer of phosphorus as the dielectric.—*Telefunken Ges. Für Drahtlose Telegraphie m.b.h.*

(Patent No. 482,724.)

Producing a saw-toothed scanning wave from an oscillating circuit of the "relaxation" type.—*Cie Pour La Fabrication Des Compteurs*, etc.

(Patent No. 483,332.)

Compound optical-lens system for television scanning.—*E. Traub.*

(Patent No. 483,999.)

Saw-toothed oscillation generator particularly designed to prevent "keystone" distortion.—*Telefunken Ges Für Drahtlose Telegraphie m.b.h.*

(Patent No. 484,575.)

Mosaic screen, built up of separate particles of selenium, for use in a cathode-ray television transmitter.—*Baird Television, Ltd.*, and *D. M. Johnstone.*

(Patent No. 484,598.)

Iconoscope tube combined with an electron-multiplier having a photo-electric cathode, in order to obtain a high degree of amplification free from the so-called "Schrott" effect.—*Fernseh Akt.*

(Patent No. 485,111.)

Conical-shaped control electrode used in place of a Wehnelt cylinder in a cathode-ray tube.—*Ferranti, Ltd.*, and *J. C. Wison.*

(Patent No. 476,311.)

Cathode-ray tube in which a photo-senstive grid is arranged across the path of the electron stream to control it electrostatically.—*R. Koempfner.*

(Patent No. 476,437.)

Applying powdered fluorescent material to the bulb of a cathode-ray tube, and fixing it by means of water-glass.—*Baird Television, Ltd., B. Hodgson* and *W. O. Williams.*

(Patent No. 477,561.)

Scanning system in which use is made of a photo-electric cell having a characteristic curve with a sharp upper bend to distinguish between different degrees of illumination.—*E. Michaelis.*

(Patent No. 477,604.)

Scanning system in which a light-cell is subjected to supersonic mechanical vibrations, and each line of picture signals is immobilised for a short period of time.—*Scophony, Ltd.*, and *F. von Okolicsanyi.*

(Patent No. 478,153.)

Voltage supply arrangement for an electron multiplier of the secondary emission type.—*The General Electric Co., Ltd.*, and *D. C. Espley.*

(Patent No. 478,238.)

Television tube in which the electrons emitted from a light-sensitive surface are projected on to a screen which is fluorescent and emits secondary electrons.—*V. Zeitline, A. Zeitline* and *V. Kliatchko.*

TELEVISION AND SHORT-WAVE WORLD

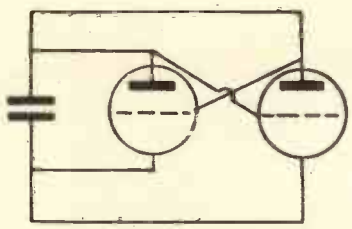


Fig. 1. A hard valve usually requires a second valve to assist discharge action.

HARD VALVE SCANNING CIRCUITS

By G. Parr

In the various designs published in this journal the scanning circuit has usually been of the thyratron type on account of its relative simplicity. In this article the writer reviews the various types of vacuum valve scanning circuits and gives some suggestions for practical experimental work.

THE use of the thyratron* for generating the sweep voltage for cathode-ray tubes has been the practice for many years and for ordinary oscillographic work the results are very satisfactory.

With the introduction of high-definition television the requirements of the sweep circuit became more stringent and the early types of thyratron were found to have minor defects which made their application to television scanning difficult. The modern type has successfully overcome the disadvantages of the older type, but the early experiences led to the development of alternative circuits using vacuum valves of known reliability. In the modern commercial receiver the thyratron scanning circuit and the hard valve scanning circuit appear to be equally favoured and the advocates of the latter type claim that the greater constancy of the circuit offsets the simplicity of the thyratron.

The hard valve scanning circuit is an interesting example of adapting the oscillatory circuit to the special requirements of television and it is of importance as providing a much wider range of frequency than can be obtained with the thyratron. Valve circuits have been made to operate at a frequency of 1 megacycle or more and for this reason have an application to ordinary oscillographic work apart from the television receiver.

Oscillator Circuits

Oscillatory circuits are usually classified as " relaxation oscillators" or "blocking oscillators" according to the nature of the action which takes place when they are oscillating. In the relaxation oscillator a gradual rise in potential across the oscillatory circuit is followed by an abrupt drop to zero, or " trip-over." The circuit then relaxes until the next trip occurs. The saw tooth wave is typical of the potential pulse produced by this type of oscillator and the thyratron circuit itself must therefore be included in this class. The Germans have given the name " Kipp Circuit " to such oscillators, the word "kipp " meaning the same as our " trip-over."

The second class of oscillatory circuit is that known as the " blocking oscillator." In this a series of highly damped oscillations are produced which are cut off by the alteration of potential on the grid of the oscillating valve. The grid charges and " blocks " the oscillations until the charge leaks away, when a fresh burst commences.

The characteristics of a blocking oscillator can be altered within wide limits by the constants of the circuit and a variety of waveforms is possible from sinusoidal to saw tooth.

The relaxation oscillator, being of a type with which we are already familiar, can be dealt with first.

The thyratron itself acts as a relaxation oscillator valve owing to the delay which can be introduced by the action of the grid bias. As is well known, the flow of anode current through the thyratron does not commence until a critical value of anode voltage is reached, but once the conduction has been established in the valve the discharge takes place at a rapid rate.

To obtain the same effect with a single triode used in place of the thyratron is impossible as the anode current would commence as soon as the anode voltage rose beyond the cut-off value determined by the grid bias. To act as a discharge valve the triode must be controlled by a second valve which will serve to accelerate the flow of current as soon as it is started, while at the same time the bias of the triode is fixed at a value which will prevent the anode current flowing at the commencement of charge. The action is shown by the diagram Fig. 1. The triode V1 is biased well beyond the cut off value and therefore is of practically infinite impedance. The condenser C charges until the anode potential across V1

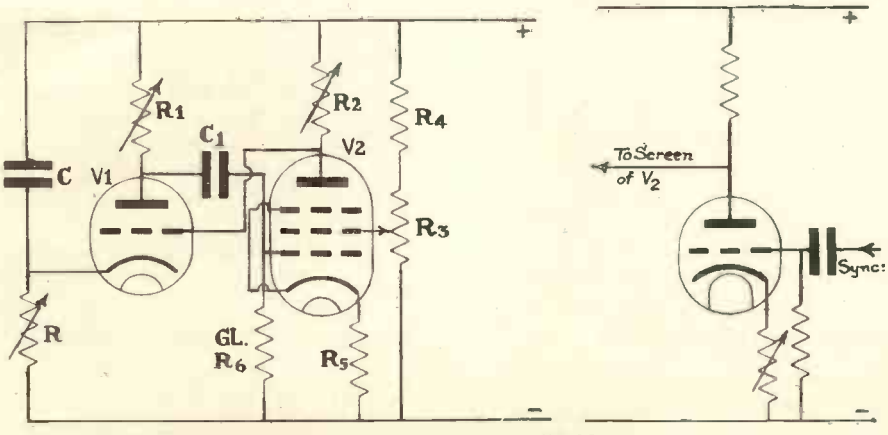


Fig. 2. Cossor hard valve circuits developed by Puckle.
Fig. 3. A method of synchronising using an extra valve.

* The word " Thyratron " is actually a trade mark of the B.T.-H. Co., but is used here to denote all types of gas-filled relays.

TWO TYPICAL CIRCUITS

is sufficient to start the flow of current through the valve. This anode current is applied to V2, the "triggering" valve which feeds back a potential to the grid of V1 making its grid zero or even positive. The resulting rapid increase in anode current discharges the condenser until the potential across the valve has fallen to a low value. The current ceases and the grid bias of V1 takes control again.

This action is typical of the "tilt-over" effect obtained in hard valve circuits when one valve is used to control the anode current of the other, and it is the basis of the familiar multi-vibrator circuit.

Cossor Circuit

In a practical form this circuit has been developed by O. S. Puckle, of the Cossor Company,† and a diagram is shown in Fig. 2.

The discharge valve V1 is connected across the charging condenser, which is shown in series with a resistance although a pentode can be used for linear charging if required. The grid of the triode is connected to the anode of a pentode V2 which is connected across the H.T. supply with the screen potential adjustable. The grid of the pentode is connected back to the anode of the discharge valve through the condenser C1, the circuit being closed by the leak GL.

At the moment of switching on the potential drop across C is zero and the full potential of the H.T. is across R. The cathode of V1 which is connected to the upper end of R is thus several hundred volts positive to earth. The potential of the grid of V1 is the potential of the lower end of the anode resistance R_2, which is dependent on the anode current flowing through V2. This is adjusted so that the potential of the lower end of the resistance is, say, 200 volts above earth, making the grid of V1 negative with respect to its own cathode. The amount of bias applied to the grid is controlled by the anode current of V2 which is in turn governed by the screen potential, and this can be set to give a high negative bias. The valve V1 is thus inoperative while the condenser C commences to charge.

The potential across C rises until the anode current commences to flow in V1. This current immediately produces a potential difference across R1 which is applied to the grid of V2 through C1. The grid of V2 then becomes more negative, decreasing the current through V2, and decreasing the potential drop across R2. The grid of V1 then becomes less negative, increasing the anode current still more. This increase is again applied to V1 in the form of decreased bias until the grid swings into the positive region and the impedance of the valve V1 is reduced to a negligible value. The condenser discharges immediately through it and the potential falls. As soon as the potential falls to the cut-off value the flow of current ceases and the grid resumes its original bias potential.

The discharge action is accelerated by the fact that the impulse applied to the grid of V1 from V2 is magnified by the gain in the valve itself.

The potential at which the condenser discharges is governed by the value of R2, which therefore controls the amplitude of the sweep, while R1 varies the speed of discharge, i.e., the flyback time.

The synchronising of this circuit for television scanning can be accomplished by injecting the signal in the suppressor grid of V2 as any alteration in the impedance of this valve will be sufficient to start the discharge when the circuit is nearing its critical value of potential. A more satisfactory scheme is to replace the resistance of the screen circuit of V2 by a valve, as shown in Fig. 3. The synchronising impulse can be applied to the grid of this valve and will then be amplified in its effect on V2.

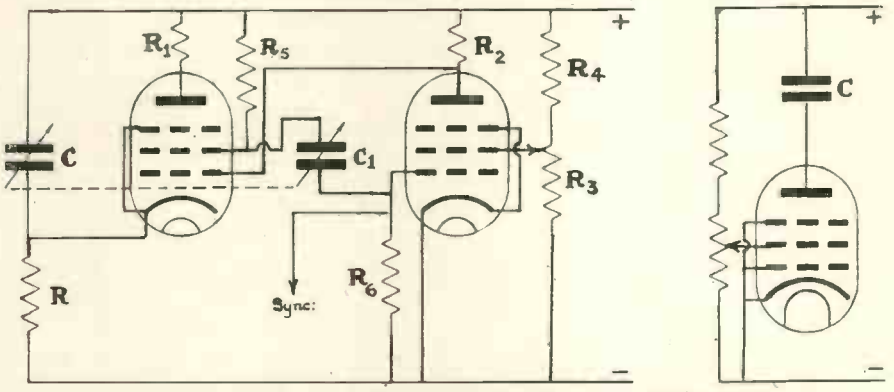


Fig. 4. This is similar to Fig. 2. but a pentode is used for discharging.
Fig. 5. A pentode valve is used for charging when the overall H.T. is low.

The following values of components are suggested for an experimental circuit built on the lines of Fig. 2:

Charging condenser C .001 mfd. for 10,000 cycles.

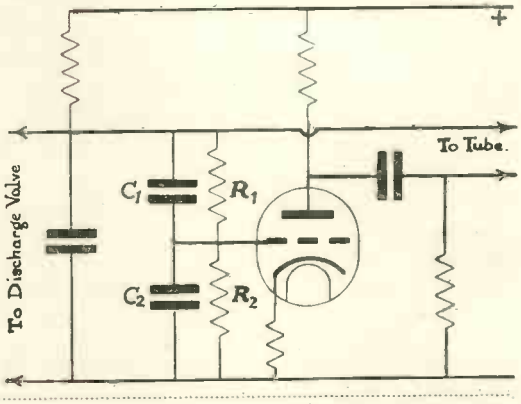


Fig. 6. An amplifier can be added to any of the foregoing circuits.

R1 2,000 ohms variable.
R2 100,000 ohms variable.
R3 50,000 ohms variable.
R4 100,000 ohms.
R5 1,000 ohms.
C1 .002 mfd.
R6 1 meg.

(*Continued on page 478*)

† Jour. Tel. Soc. Vol. 2 No. 5 p.145.

Telegossip

A Causerie of Fact, Comment and Criticism

AFTER an absence of a month on holiday it was heartening to visit Alexandra Palace and find signs of real progress with the reconstruction scheme. Inside the studio No. 2 work is being pushed ahead rapidly and when I entered, large sheets of sound-proofing material were being fixed to the walls.

Part of the new lighting system, apparently a replica of the arrangement in No. 1 Studio, has been installed. There will be a high gallery running round to provide positions for the lights and facilities for manipulation. The original glass-fronted control-room has been stripped and the upper storey considerably enlarged.

I gather that the idea is to use Studio 2 as an independent unit and not to embark on multi-studio production. The main advantage of having many sets in one studio, instead of scattering them through two or more, would seem to be that the producer has everything under his eye and does not have to depend upon a television screen for his impression of what is happening beyond his view.

The chief snag is, of course, that the studios are both far too small, and in any ambitious production the old problem of pressure on space will become intolerable. In fact, though many explanations and excuses, seemingly sound enough, may be offered, I cannot escape the conclusion that through financial stringency we are not planning for the future of television but merely making apologetic attempts to cope with the present. Not a stroke of work has been done on the projected conversion of the Alexandra Palace Theatre. I am beginning to believe that the idea must have been abandoned and that a search is being made for suitable premises elsewhere.

To solve the accommodation problem rehearsals are bieng held all over the place—at the Maida Vale studios, in hotels, at the Group Theatre, the Marylebone Music Studio, Broadcasting House, the Interval Club, the Arts Theatre, etc., etc.

Central Control

Continuing my tour I found that the former spot-light studio now bears on its door the impressive title "Central Control Room." Inside new grey racks were in position and the contractors' engineers were busy on the immensely complicated job of wiring. In fact, work here was considerably more advanced than in No. 2 Studio and No. 2 Control Room.

This central control room is the connecting link between the two studios. Though, as I have said, each will be used independently as far as possible, it does not follow that the two will never be used together.

As I passed the older Control Room I noticed an important change there also. The original small green pictures in the monitor panels had been replaced by larger black and white pictures on standard tubes giving a picture 10 ins. by 8 ins. These are easily the finest television pictures I have seen anywhere, and if reproduction of such quality could be obtained in the home it would mark a big advance indeed. Results of this order tend to confirm the existing impression that the definition of 405 lines will long continue to satisfy all reasonable requirements, and that there is no receiver on the market capable of doing full justice to the picture as it leaves the B.B.C. aerial.

By the way, the old green tubes have apparently been fitted into the B.B.C. transmitting van near the door to give producer Dorté a closer view of the screen without the necessity of scrimmaging in the darkness to get near the engineers' panels.

The New Mobile Unit

I am told that the second mobile unit, which the B.B.C. announce will be ready in time for Olympia, differs in no important respects from the first. It will consist of three vans, each of approximately the same size. This new unit will actually be used at Olympia for the transmissions from the glass-walled studio, also for the feature "Come and Be Televised," while the original unit is at the Oval for the final Test match.

"Come and Be Televised" is the adoption of a suggestion which I made in these columns. Visitors to Olympia will face the television camera while relatives or friends in other parts of the building will be able to see them on the screens of the various receivers. Incidentally, their faces will also be televised over the air so that Aunt Molly in Brighton, who has a television set, will be able to see how nephew Jack looks after his face has been electrically analysed and cast through the air.

But as the B.B.C. are only devoting an hour to this daily and expect to allot three minutes to each person, only twenty an hour can appear before the camera. It is, therefore, likely to cause dissatisfaction among the Olympia crowds if there is anything like a general invitation to "Come and Be Televised." Long queues waiting for hours would be most undesirable and Mr. Harold Cox, the producer, must think of some satisfactory method of selection, perhaps arranged through the standholders. Mr. Cox has an early opportunity of showing his mettle for he has only just joined the B.B.C. from London Film Productions. He specialised in working on foreign location and has been to the Khyber Pass, Rhodesia, the Transvaal and the Canadian Rockies.

The B.B.C. will be putting out the longest television programmes ever at the time of Radiolympia and here is the provisional daily time-table.

11 to 12—Demonstration Film.
12 to 1—"Come and Be Televised."
2.30 to 3—Direct from the Zoo.
3 to 3.30—Programme from A.P. studio.
3.30 to 4—Programme from Olympia.
4.30 to 5—Test match for first few days and then from the Zoo.
6.30 to 7.15—From Olympia.
7.15 to 7.30—Film.
8.30 to 9—From Olympia.
9 to 10—From Alexandra Palace.

Familiarity

In experimenting with television receivers over a considerable period one is perhaps inclined to get a little careless, despite the knowledge that there is close on five thousand volts floating round. Recently I had a sharp reminder that a little more care was desirable. On several occasions I have allowed my hand to come in contact with the high-tension lead without feeling anything; but this sort of thing, it is clear, can be done once too often and I got a "packet" which will certainly make me more careful in the future. Apparently the rubber covering of the cable was punctured; anyhow there was a flash.

(*Continued at foot of next page*)

"Hard Valve Scanning Circuits"

(*Continued from page 476*)

A similar type of circuit is used by Philips Radio and is described in their bulletin on Cathode-ray tubes. It differs from the Cossor circuit principally in that a pentode is used for discharging the condenser, but there are several points which are worth noting. It is shown in Fig. 4. The grid of the discharge pentode is coupled directly to the anode of the "trigger" valve as before but the control of the trigger valve is through the screen instead of through the grid as in Fig. 2. The coupling condenser C1 between the valves is made variable and controlled by a stud switch which is ganged to the main charging condenser stud switch. For television scanning at one fixed frequency this refinement is, however, unnecessary.

In the operation of the time base it is essential that the grid of V2 is restored to its normal potential during the charging of the main condenser C. If this condenser reaches its final potential with the grid of V2 still biased from the preceding pulse of anode current, the discharge will be delayed by the excessive bias on the grid of V1. The restoration of normal bias on the grid of V2 depends on the time constant of the coupling condenser C1 and the grid leak R6, and if this is excessive the amplitude of the sweep will vary with the frequency. To overcome this defect the condenser is made variable so that the time constant is adjusted to the frequency of sweep selected by the tapping switch of condenser C.

If C1 is too low there will be insufficient impulse given to the grid of V2, which will in turn alter the amplitude at low frequencies.

The recommended values for a given range of frequencies are as follows:

C	C1
0.5 mfd.	0.02 mfd.
0.1 mfd.	0.005 mfd.
0.02 mfd.	0.001 mfd.
0.004mfd.	0.0002mfd.

and for lower values of C the coupling condenser can consist of twisted insulated wires.

The remaining values in the circuit are as follows:

R2 100,000 ohms.
R3 50,000 ohms.
R4 80,000 ohms.
R5 25,000 ohms.
R6 50,000 ohms.
R_1 can be omitted if desired.

The synchronising impulse is fed to the grid of the trigger valve as shown in the diagram, although there is no objection to the use of the extra valve in the screen circuit, as shown in Fig. 3.

The overall H.T. voltage recommended is 500 volts and with low values of charging condenser a sweep frequency of several kilocycles can easily be obtained.

Pentode Charging Circuit

Both the above circuits can be used with a pentode valve for charging, as mentioned above. The advantage of this modification is that it enables a wider sweep to be obtained for a given anode voltage without loss of linearity. A typical pentode circuit is shown in Fig. 5 and this can be connected in place of the charging resistances R in Fig. 2 or Fig. 4.

Connection of Tube

The deflector plates of the tube are naturally connected across the main charging condenser in each case, and with small diameter tubes the sweep voltage will be found sufficient to give a full deflection on the screen without amplification. For precision work, however, it is preferable to add an amplifying stage to provide symmetrical deflection as well as increase the amount of the deflection. The most usual method is to add one valve, the grid being connected to the cathode of the discharge valve. One deflector plate is then connected to the anode circuit of the amplifier while the other is taken direct to the anode of the discharge valve. The diagram of Fig. 6 shows a typical amplifying stage connected to the time base of Fig. 2.

Since the voltage developed across the cathode-anode circuit of V1 is usually too high to be applied directly to the grid of the amplifier, it is usual to interpose a capacity potential divider as shown by the condensers C3 and C4.

These are chosen so that the voltage across C4 is 1/m., that across C where m is the amplification of the valve. This ensures that the swing applied to the grid of V3 gives an anode voltage change equal to that developed across the original discharge valve V1, and thus gives a balanced deflection.

In next month's article the use of blocking oscillators will be described with further examples of circuits.

"Telegossip"

(*Continued from preceeding page*)

from the cable to my hand and another flash where my arm was resting on the chassis, which perhaps was rather fortunate for the major part of the shock was confined to my arm. Unpleasant as it was, the incident provided a useful reminder and possibly it is just as well that it happened.

"Staying Put"

Of the many commercial receivers that I have tested there seems to be considerable differences in the consistency of operation. By this I mean that some when tuned in the first instance require practically no further attention, whereas others need a little touch either as regards tuning or synchronising throughout the entire course of the programme. Then again some receivers after they have been left correctly tuned and adjusted after the end of one programme merely need switching on for the next but others need entirely retuning and with perhaps adjustment to the synchronising controls. Particularly is this need for retuning necessary with the sound receiver. Of course, the reason for these slight inconsistencies is perfectly obvious, but it seems strange that they should be more in evidence in some receivers than others.

An Interested Spectator

At the Scophony demonstration of the Trooping of the Colour I ran across Lord Selsdon, Chairman of the Television Advisory Committee. Lord Selsdon rarely lets an opportunity of seeing some new television development pass and clearly he was impressed with the possibilities of what he saw. It is a pity that the Committee does not take the public a little more into its confidence by making regular statements regarding policy and progress and explaining the actual work it is doing.

EXPERIMENTAL MECHANICAL TELEVISION—III.

PROBLEMS OF SYNCHRONISING

By J. H. Jeffree.

In continuation of the series of articles on experimental mechanical-optical television this article reviews the requirements of arrangements for synchronising the receiver.

IN the two preceding articles of this series (June and July issues), a simple mechanical system was described, capable of receiving transmissions of the present type with a reasonable amount of light, but only in so far as they are accurately in step with the time controlled mains. In general, the accuracy in this respect actually suffices only for the frame scanner, but the line scanner needs additional direct control from the signal for satisfactory results, and it is proposed, in this article, to describe suitable synchronisation arrangements, and the general conditions governing their design, before going on with further optical developments and details.

The obvious way of controlling the line scanner is from the line sync. pulses, which are either directly amplified (in a timed amplifier) or better made to control a simple oscillator instead of the time base needed for a C.R. tube; the resulting current in either case is fed to a phonic wheel. It would be possible to fix this phonic wheel directly to the steel ball scanner, but since there are 202½ lines per revolution of this, a minimum of 405 teeth on the P.W. would then be needed, which would be rather cumbersome.

It seems an altogether better arrangement, therefore, to gear the phonic wheel to the motor, with a step up ratio, say, of 13½ to 1, whereby the phonic wheel does one revolution per 15 lines and needs 15 or 30 teeth according to operating conditions. This has the advantage, too, that thereby a very high speed drive (40,500 r.p.m.) is made available, on which it may later prove practicable to mount a very small 15-sided polygon mirror. That would at once open the way to much larger pictures.

Apart from electrical design, there are three respects in which a phonic wheel must be satisfactory, as follow:

1. When running at the correct speed, it must be capable of providing enough power to keep the speed correct.

2. When the *correct speed changes*, as, in the present case, through slight fluctuations in signal frequency, the wheel which must follow the changes quickly enough to avoid actual slipping out of synchronism. Whether it can do this or not depends on the kinetic energy of the system, which goes up as the square of the speed. The P.W. must have enough power to increase the kinetic energy in time, when the signal frequency increases.

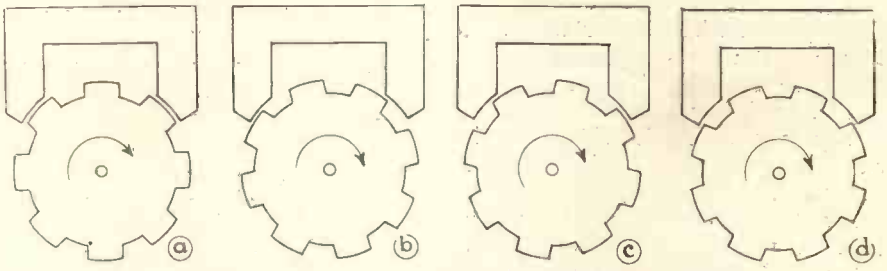


Diagram explaining the operating principles of the phonic-wheel motor.

3. When speed errors or changes are corrected as above, the tendency for speed oscillations above and below the correct value to occur, accompanied as they are by confined swinging of the picture, must be avoided as far as possible.

The Phonic Wheel

The action of a phonic wheel, which is, of course, well known, is illustrated by the diagrams. The toothed wheel, usually of laminated iron, runs between magnet poles excited by the controlling alternating current. When the current, and therefore roughly the magnetism, passes through its peak values, the teeth may be either, as in *a*, just passing the poles, in which the pull forwards as they approach balances that backwards after they have passed, and there is no average effect; or they may be, as in *b*, just approaching the poles at the current peaks, so that they are, on the average, pulled forwards more than back. Then the wheel exerts a positive driving power, and the teeth may be said to *lag* relative to the current. On the other hand they may pass the poles, as in *c*, before the current peaks, and be, on the average, dragged back. They then *lead* the current, and the wheel develops *negative* power, holding the motor back.

Now the power developed increases with the lag, or lead, until this becomes about a ¼ tooth pitch (depending on the tooth shape) but then decreases again, and falls back to zero when, as in *d*, the gaps between the teeth are passing the poles at the peaks of current. Therefore, the wheel will hold in sync. under forces which produce up to ¼ tooth lag or lead, but if they are increased beyond this point it will slip.

Though it can theoretically, and sometimes in practice, be fairly efficient, the average phonic wheel is rather inefficient, and may perhaps develop power, at full lag, equivalent to 10 per cent. of the volt-amperes supplied to it. If it has to control a driving motor whose power may be up to, say, 10 per cent. out, it will have to have 10 per cent. of the power of the driving motor, but if the latter is, say, 50 per cent. efficient, as against the 10 per cent. of the wheel, the volt-amperes supplied to the wheel may have to be half that supplied to the driving motor.

That is the usual sort of high speed scanner condition. For slow or frame scanners the phonic wheel is often the only drive: then one treats it merely as a rather inefficient motor

SYNCHRONISING CALCULATIONS

of suitable power. That covers the first point in a general sense.

Transmission Conditions

The second point is less important now, since changes were made in the transmissions for the convenience of mechanical receiving systems. The fluctuations in line frequency about the mean of 10,125 c/s., which have to be followed by the scanners, remain of the order of a few cycles per second, but now take place slowly in periods of half a minute or so, instead of suddenly, as in the early days. A change of 1 c/s. occurring in 10 seconds, say, is at the rate of 1/10 cycle, or 1/100,000 of the frequency per second, so that the kinetic energy of the system has to change by 1/50,000 per second to follow it. If the phonic wheel power would be enough to run the system up to speed in 50,000 seconds, it will be just enough to follow this change; if it is, say, 100 times, it will follow it with hardly any perceptible picture movement.

Our steel ball scanner is run up to speed in 1 second by a 1/200 h.p. motor (equivalent to 4 watts electrical energy at full efficiency), so that a 10 per cent. efficient phonic wheel would have power equal to that needed to speed it up in 4 seconds. It is, therefore, quite safe on point 2, and would probably have been so even before the transmissions were improved for mechanical systems.

If the geared-up phonic wheel itself is 2 cm. diameter, ½ cm. thick, its own kinetic energy will, at its higher speed, be nearly equal to that of the scanner. This will double the running up period, but is quite permissible.

It is possible, in slow scanners, to have *too little* kinetic energy to ensure smooth rotation from tooth to tooth. One can see this effect by putting too much power from the mains into a very light wheel, when the rotation becomes jerky. It is hardly possible in high speed scanners, and in any case the remedy is obvious.

Swinging

The third point, that of tendency to swing, should not be serious with the high-speed scanner, as there are few sudden changes in the signal; but it is well to reduce it as far as possible. It is connected with the tendency in slow scanners, started by hand, not to drop into sync. but to fall through the correct speed without locking in. Consider this in connection with the diagram. The wheel is spun at more than correct speed, and slows down till it is exactly correct. At that moment it may have any degree of lag or lead, at random, except that it cannot have a lag giving it enough force to speed up, or it would not have fallen to that speed. Therefore in practice it always slows down further, and because of this, changes its phase, relative to the teeth, until it gets a lag suitable to speed it up again. *Or else,* before reaching this, it has so much slowed down that it does not speed up in time, but slips right out of sync. This happens if it has to start slowing down from a phase too far removed from that of correct lag.

The chance of this happening is less, the less lag is needed to start it speeding up, or, in other words, the greater the reserve driving power of the wheel. It is not, strangely enough, controlled by the inertia, since what happens after the moment of *correct* speed, is merely caused to happen more slowly, but is not otherwise altered, by the inertia of a rigid (and undamped) system.

If, however, one could damp out any tendency to such speed fluctuations and consequent overshooting of the mark, it would help both starting and smooth running. Friction varying with the speed, such as air resistance and electrical damping, helps a little here, but not bearing friction. The most effective way, however, is by a flexible or sprung coupling, with reasonable friction, between wheel and scanner.

For instance, the wheel can be a smooth running fit on the scanner shaft, and be connected to it by a spring weak enough to permit one or two teeth movement under the controlling forces. There can be enough smooth (oily) friction to ensure that if it is rotated a little against the spring, it will not swing more than once or twice, appreciably; in fact one gets it in practice, in most cases, by sheer luck! Then when speed fluctuations are occurring, they are taken up unequally by the wheel and the scanner, and damped out in the friction between them; and in cases where a rigid system would overshoot the mark and fall out of sync., the wheel alone, being lighter, can hold in, against the pull of the spring, and pull in the rest of the system.

This arrangement is very generally advantageous, and can be used with our high speed phonic wheel. Where the signal is smooth, or the reserve of power adequate for starting, it can, of course, be dispensed with sometimes.

The First Radio Valve

IN 1878, Sir Joseph Swan exhibited at Newcastle-on-Tyne the first electric lamp, and in 1881 formed the Swan Electric Light Co., Ltd., to manufacture and market electric lamps.

Two years later marked an historic event in the electric lamp industry when the famous names of Thomas Alva Edison and Joseph Swan were coupled by the amalgamation of their interests and patents in the formation

The original Fleming valve

of the Edison & Swan United Electric Light Co., Ltd. A factory was established at Ponders End. In 1916 the company's name was changed to The Edison Swan Electric Co., Ltd. The first valve was an Ediswan lamp. About the time of the amalgamation Edison noted the irregular blackening of the inside of the lamp bulb during life. Later, this "Edison effect" was investigated in the laboratory by Sir J. Ambrose Fleming (then Professor J. A. Fleming) and a number of special carbon filament lamps were made for him, for experimental purposes. The result was, in 1904, the Fleming thermionic valve.

INCREASING THE RANGE OF THE VISION RECEIVER

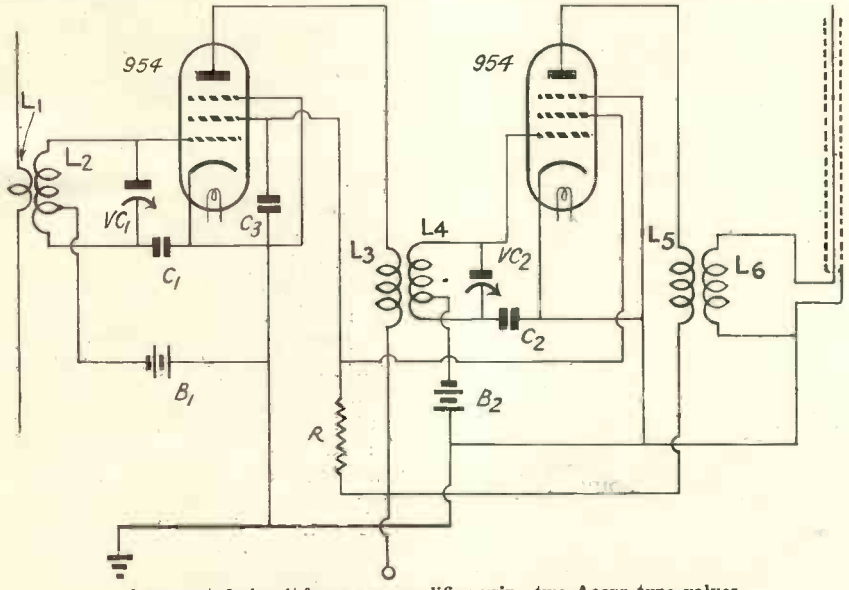
A NEW SYSTEM EMPLOYING A PRE-AMPLIFIER IN THE AERIAL

THE distance at which pictures can be received is governed largely by the amount of interference experienced from motor-car ignition systems and to a lesser degree noise level in the receiver.

It is generally assumed that interference from a motor-car's electrical system has a very wide coverage in a horizontal plane, but only 30 or 40 feet in the vertical plane. For this reason, manufacturers recommend that television aerials be erected as high as possible above any surrounding objects with a minimum of about 40 feet above the ground level. We have been conducting some tests to determine what sort of aerial height is necessary in order to eliminate local interference and whether or not this interference is picked up solely by the aerial system.

Preliminary tests showed that increasing the aerial height by 30 feet, that is from 40 to 70 feet, apparently decreased ignition pick-up. However, when this was carefully checked it was noticed that the interference level remained fairly constant irrespective of aerial height, but as the picture signal field strength increased in intensity, the receiver did not require the same sensitivity level to provide a good picture.

Increasing the aerial height does not decrease the amount of interference as much as would be expected. The apparent decrease is caused by the fact that the receiver is used with the gain control well retarded. For viewers living well within the service area, increased aerial height is a big advantage for the receiver can be used at a lower gain level, but with viewers who are over 100 miles from Alexandra Palace, this advantage is not so apparent for the receiver always has to be run with the gain control at maximum which also provides maximum pick-up of local noise. It must be admitted, however, that above 35 feet or so the field strength of the average motor car ignition radiation is attenuated but even with a low impedance feeder between aerial and receiver, there is quite an appreciable pick-up of interference on the feeder.



A suggested circuit for a pre-amplifier using two Acorn type valves

Screened Down Lead.

A co-axial cable is an advantage for the inside line is screened so decreasing the possibility of pick-up, but it is not always convenient to use this type of cable for difficulties are experienced in correctly coupling to a balance doublet aerial.

We have been experimenting with a scheme which appears to have considerable scope. The television aerial is erected well above the local noise level, and the output of the aerial is fed directly into a small pre-amplifier. The use of a twin down lead is then overcome. The output from the pre-amplifier is fed into a screened co-axial cable, the bottom end of which is connected directly to the input of the vision receiver. Our tests consisted of building a two-stage amplifier with acorn valves, fitted close to the centre of a doublet aerial which could be hauled up and down a 70-foot mast. In the original design, the power supply was made part of the unit, without any provision for switching. With this unit in circuit, the results obtained were vastly improved not only as regards the strength of the picture signals but also in respect to the lack of local interference.

In a location where the field strength is particularly low, it is possible to obtain a picture free from interference even when the sensitivity of the receiver is increased above the required amount.

This indicates that the noise pick-up in normal circumstances is very largely on the down lead and not on the aerial itself. If this be the case, then viewers a long distance from the transmitting aerial should be able to improve not only the performance of the receiver but the picture to noise level merely by embodying a pre-amplifier of this kind.

A suggested circuit which we have used with great success is shown on this page. It consists of two acorn type pentodes in a perfectly straightforward R.F. circuit. Valves are biased 3-volts negative with separate bias batteries, while the power supply is built in a small box, but as previously mentioned, without any arrangement for switching.

Experimenters can quite simply include a miniature power supply running from A.C. mains, which can be switched remotely or by means of a relay.

The variable condensers VC1 and VC2 are of the ceramic pre-set type

and once they have been adjusted they should be fixed with sealing wax. Coils L2 and L4 are wound across the condensers, and tapped so as to decrease damping. The coupling coils in each case consist of four complete turns, but the windings are not particularly critical owing to the receiver being broadly tuned.

This particular unit was built in a small weatherproof box, approximately 4 in. cube, but the problem of power supply and switching has not yet been overcome. The unit is purely experimental, but from our preliminary tests it appears to offer a solution to readers who are either too far from the transmitting station to expect good pictures or who are within a reasonable distance but are troubled with local interference.

The values of the various components are VC1 and VC2 15 mmfd., C1 and C2 .01 mfd., C3 .1 mfd., B1 and B2 3-volt flash-lamp batteries, L1, 3 and 5, three to four turns 1 in. diameter of 12 gauge wire. L2 and 4, six turns 1 in. diameter 12 gauge wire. L6 four turns 1 in. diameter 12 gauge wire. Valves shown are of the American type, but English valves of a similar type are quite suitable.

While it cannot be guaranteed that this type of amplifier is a cure for all television interference troubles, it is certainly a great help in increasing the signal voltage available and in reducing interference from local electrical sources.

THE FIRST INTERNATIONAL TELEVISION

EIFFEL TOWER TRANSMISSIONS RECEIVED IN ENGLAND

THE first international high definition programme was received at the Dyke Hotel, Brighton, on June 26. Reception was from the Eiffel Tower, a distance of approximately 200 miles. The forecast, made some months ago in this journal regarding the possibility of receiving this station has therefore been fulfilled.

The instrument used was a standard Marconiphone type 705, which sells for 80 guineas. It was used in conjunction with a di-pole aerial and reflector with a tilted wire aerial as an alternative. The height of these aerials, although only 30 feet above ground, was adequate, for the Dyke Hotel is approximately 600 feet above sea level. The receiver, before leaving the factory, was altered in wavelength to receive the slightly different transmission characteristics of the French transmitter, otherwise the instrument is identical with those that can be obtained from any wireless dealer in the television service area.

On the Sunday previous, reception proved to be extremely good, which gave confidence in the final tests scheduled for June 26. On this date, from 3.30 p.m. until 5 p.m., reception was fairly good although one or two periods of fading were experienced. These fades were of about one minute each in duration. From 5 p.m. until 5.30 p.m. the picture held perfectly and both sound and vision were at a level that could be accepted as very good entertainment.

The instrument was then removed from the public lounge to a basement in order to have a darkened room and to be relieved of the embarrassment of visitors crowding around the instrument.

Early Tests

It is interesting to note that since last October when French television was first available, tests have been carried out by Marconiphone engineers in an endeavour to obtain satisfactory picture reception from the Eiffel Tower in the south of England. The first test in October/November, 1937, was on Beachy Head, and unsatisfactory results were experienced, owing to the aerial being unsuitable.

However, these early tests provided fresh information and the Dyke Hotel was chosen for some more comprehensive tests because of its good elevation. Due to the good services of a local firm of dealers, Messrs. Page and Miles, it was arranged to have access to the hotel in order that the experimental work could be conducted.

While the great height of the Dyke Hotel and the surrounding country was an asset in providing a good signal level from the Eiffel Tower, it was also a good spot for reception of the Alexandra Palace transmissions. The field strength of the London station was such that with an aerial of the reflector type turned completely round the signals did not appear to diminish in any way. Even with the instrument sharply tuned to the Eiffel Tower, break through was experienced from Alexandra Palace. This meant, therefore,, that the tests had to be made when the London station was not operating.

A curious feature of the tests with the Paris transmitter was that on occasions the field strength was extremely high, yet on other occasions no sign of a transmission could be discerned. The solution was probably due to variations at the transmitter which is still in the experimental stage, but it made the tests very interesting.

There is no doubt that under favourable conditions on the South Coast a receiver could be installed with a guarantee of reception of television from the Eiffel Tower.

Learning Television by Post

A NUMBER of readers of this journal who have had difficulty in following the technical articles have probably wished at some time for a concise course of training in modern television theory.

Such a course has been prepared by the British Radio Engineering College and the prospectus which has just been issued shows that it has been written with a true understanding of the needs of radio engineers and students who require a working knowledge of modern television theory.

The course is issued in the form of handy booklets; twelve in number, each containing a lesson with additional notes and questions. The syylabus covers all the aspects of modern theory and practice and, an important point, much of the historical matter has been compressed into small space to allow more time to be devoted to up-to-date information.

From examination of the course we can confidently recommend it to readers, and for the amount of information which has been assembled into the covers of the booklets the price of £4 os. od. is very moderate. The fee can be paid by instalments if desired.

A syllabus and full information can be obtained by writing to the Principal, The British Radio Engineering College, 179 Clapham Road, S.W.9.

With the Amateurs

By G5ZJ

A means of counteracting some of the bad conditions existing at the moment are discussed in this article.

RECEPTION conditions on the higher-frequency bands have remained more or less constant during the past month or so. Amateurs interested in transmitting and listening are finding that it is extremely difficult to maintain constant communication on telephony with simple equipment, but those who have taken the trouble to improve the efficiency of their transmitters and to use specialised aerials that give an appreciable gain as compared with the straightforward doublet are still able to raise quite a large number of new stations.

It is now well-known that there cannot be any improvement in short-wave conditions for a few years. This is having the effect of making amateurs who are not too keen, migrate to 40 metres where they can still raise a large number of stations with almost any sort of apparatus and input. This will, of course, increase the congestion on this already over-crowded band so making it difficult for the ardent experimenter to carry out any serious tests.

In a way it is probably a very good thing for it is undoubtedly relieving congestion on 20 metres, so that those stations who have taken the trouble to modernise their equipment are now finding that they can make a large number of contacts without very much difficulty.

The point amateurs must appreciate is that the old type of zepp and doublet aerial is no longer suitable with these bad conditions and the comparatively low power used by British stations. In the future, instead of being merely advisable, it will be essential to erect beam aerials even if they are only a very simple type.

Beam Arrays

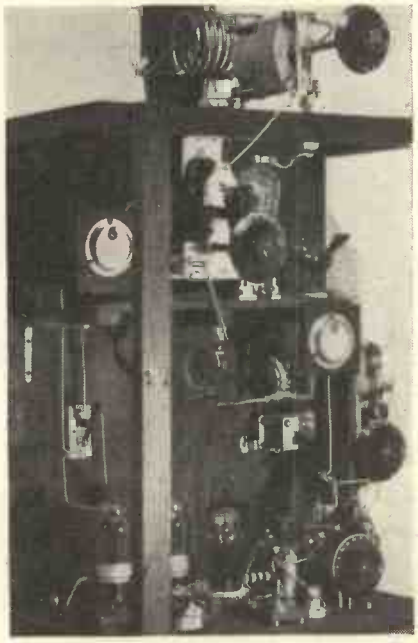
Two half-waves in phase with close spacing to two half-waves directors can be erected by almost every amateur for it takes up no more space than the normal 66 ft. zepp. Such an aerial will give an increase in gain of 4 db. in the required direction. The aerial is, of course, uni-directional and if bi-directional operation is essential then the W8JK beam is a more suitable type. This aerial gives a gain of 5 db. in two directions and is one of the simplest beams to get going. It can be fed with either tuned or untuned line and even with the very bad conditions at present existing has enabled a number of English amateurs on low power to maintain consistent communication with America when with the normal doublet aerial they would probably have been lost in the QRM.

A Better Doublet

Those amateurs who still believe that a doublet aerial has many advantages should consider the possibility of increasing the gain obtainable from this type of aerial by putting up three half-waves in phase with phasing sections. Such an aerial will again give a 4 db. gain in two directions and as no spreaders are required, the whole array is quite light.

In such certain circumstances it must be agreed that it is very difficult to erect any sort of array owing to very limited space. However, the solution obviously is a folded doublet with reflector or director. Such an aerial will be a vast improvement over the straightforward doublet.

These aerials are, of course, all single frequency, but the old-fashioned idea of making one aerial do for several wave bands is slowly but surely going out of fashion, for the advanced amateur is realising that it is far better to concentrate all the available R.F. energy into one or at the most two strong lobes, rather than to split it up into four lobes.



This station owned and operated by G3KG is run entirely from D.C. mains and has a carrier power of 10 watts.

Since true bearing maps have become readily available in this country, amateurs are erecting their aerials in the proper direction so that the main lobes radiate approximately in the direction of the country or continent one wishes to work. This is a big step in the right direction, although even now a number of amateurs who have been licensed for a considerable period still do not appreciate that in order to put a consistent signal into a given area the aerial must be correctly directed. I believe this point is considered, but not to the full extent. I have often heard amateurs remark that athough they could not erect their aerial in the correct direction it would not matter very much for amateur aerials are not particularly directional and would give good all-round coverage. Such amateurs would then try and work America on a half-wave aerial running east and west.

I propose during the next few months to devote a considerable amount of space to the design of beam aerials suitable for amateur use and will endeavour to convince those sceptical amateurs who consider that with the present bad conditions nothing very much can be done in the way of DX.

D.C. Operation

Despite difficulties some of the recently licensed amateurs are doing very good work and I have in mind G3KG, located at Luton, in Bedfordshire, who, although restricted to operation on D.C. mains still manages to obtain quite a healthy carrier power.

His transmitter consists of a 6A6 crystal oscillator wired in parallel followed by a 6L6 doubler driving a T20.

Although the maximum voltage available is not very much over 200 he manages to obtain a comfortable 10 watts input and with this low power has done exceedingly well on 40 and 20 metres.

His modulating system consists of a three stage pre-amplifier driving a pair of pentodes in push-pull. The aerial systems employed are a Windom and a doublet fed with 80-ohm cable, but these are being superseded by a full-wave beam aerial which will give a gain of 4 db. This aerial will actually be two half-waves in phase with a director to give a concentrated broadside beam in one direction.

Tank Capacity

In order to obtain maximum R.F. efficiency it is important that the tank capacity in the final stage be of the absolutely correct value. I have had many requests for details as to tank capacity when using the very popular T20 valve. A curve has been produced and provides the interesting data that when the valve is run under optimum conditions with 750 volts H.T., the tank capacity is exactly the same as the wavelength in metres. For example on 40 metres the total capacity should be 40 mmfd. On 20 metres, 20 mmfd. and on 10 metres 10 mmfd. This point is of considerable interest for it should be easy to memorize these capacities when building a final stage for any particular frequency.

Readers who have experienced interference from neon signs will be interested in some data obtained by the Aerovox Corporation of New York.

Radio Club News

They have come to the following conclusions :—

1. There is very little radio interference resulting from kick through the A.C. mains if the neon sign is properly designed.
2. All interference is caused by direct radiation from the neon tubing.
3. When the metal case and frame of the neon sign are not earthed the whole unit radiates interference.
4. The field strength drops off very rapidly and at 16 ft. should not be noticeable.
5. The insertion of R.F. chokes or condensers on the high voltage side of the neon increases the interference.

The best method of reducing interference is to clean the tube and earth the centre point by wrapping a small piece of foil at that point. The foil is then connected to the frame of the sign.

It has been noticed that an aerial erected well above the interfering sign and fed with low impedance cable or screened down leads, will provide little chance of pick up from this type of apparatus.

Most of the G3 call signs are in the latest call-book which G5KA, F. L. Postlethwaite has now in stock. This summer edition costs 6s., post free, and can be obtained from G5KA, at 41 Kinfauns Road, Goodmayes, Ilford, Essex.

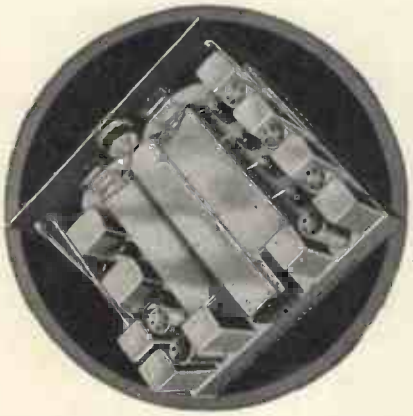
Amateurs who are interested in normal broadcast reception should make a note that on July 3 the Sunday radiating times of the Australian station VLR were altered. In future, VLR will be radiating from 8 a.m. to 1.30 p.m., and from 3 p.m. to 10.30 p.m. This service is an addition to the previously announced week-day programmes.

The G.E.C. ultra-high frequency broadcast station W2XOY, has been heard at distances in excess of 3,000 miles, so that there is every chance of listeners in this country picking up the broadcast. W2XOY is located in Schenectady and operates on 41 megacycles equal to 7.31 metres. The programmes are of a special type and are not relayed from the normal G.E.C. network. The power output is 150 watts, while the maximum frequency variation is less than 100 cycles so that the signal may be used for receiver calibration. Class B high level modulation is used and 100 per cent. modulation maintained. In order to increase the probability of receiving this station the aerial should be directed to Latitude 42 degrees; 34 minutes; 15 seconds North. Longtitude 73 degrees; 45 minutes; 38 seconds West.

Dorothy Hall W2IXY sent me a long letter regarding her contacts on 20-metre phone. Although she has only been active for about 18 months, she has worked 72 different countries with two-way telephony and has made almost 200 contacts with VR6AY on Pitcairn Island, with whom she has a schedule every morning at 8 hours G.M.T. A list of the countries she has worked is far too long to print, but includes such excellent contacts as TG9AA, HH2B, OX2QY, TI9OT, CR6AA, ZL2BI, FU8N, YN1OP, VP2CD, VK7CL and many others.

That well-known DX station, VK2XU, " in the Blue Mountains of New South Wales " has been silent for some time, the reason being that its owner, Mr. Gilbert Pollock, accompanied by his wife, has now arrived in England. Readers will join me in extending a sincere welcome to them, while it is understood that Mr. Pollock's familiar voice will soon be heard operating under a G call sign. Those of his many friends in Europe who wish to do so can communicate with him care of G6DT at the address given in the call book.

International Short-wave Club.—During recent 5-metre field day organised by the R.S.G.B., the London and Brighton chapters of this society, were using portable receivers. The London station had several receivers in operation on Box Hill, and amongst the stations heard were G5AU, G2NNP, G6SC, G2NHP. The Brighton chapter had two stations working in the Brighton area and amongst the calls heard were G2OD, G2HG, G2NMP, G5OJ, G2JK, G8KZP, G8oQP and G81X. These were all on C.W., while phone stations included G2NV, G6VA, G6LK, G2NMP, G5OJ, G5MAP, G8KZP and G2MC. Full information of this society can be obtained from the secretary, A. E. Bear, 100 Adams Garden Estate, S.E.16.



In our laboratory we are testing one of the new amateur band Super-Pro receivers. Our test report will be published very shortly

Dollis Hill Radio Communication Society.—There are 60 members of this society and they are planning a most ambitious 5-metre field day which will be open to all societies. Full information can be obtained from the honorary secretary, Mr. E. Eldridge, 79 Oxgate Gardens, Cricklewood, N.W.2. Amongst the active members of this society are G6OV, G3FS, G6KQ and G3KZ, who are all most eager to help amateurs to obtain full transmitting licences.

The Southend and District Radio and Scientific Society.—A 5-metre field day was recently held by this society, and the transmitter hidden in a wood was operated by G5UK. All the entrants managed to obtain true bearings so that they were within 20 ft. of the hidden transmitter, but owing to the way it was covered, difficulty was experienced in locating it until bearings actually indicated the spot. Further tests were made with transceivers and it was possible to follow the conversation when it was mounted on a bicycle at a distance of 2 miles from the main receiver.

The next 160-metre direction finding contest is to be held on August 28, but full information can be obtained from the honorary secretary, Mr. J. M. S. Watson, of 23 Eastwood Boulevard, Westcliff-on-Sea.

The Radio Society of Northern Ireland.—This Society are holding their annual contest for the Leonard Trophy during October. This contest is open to all licensed amateurs, but only one operator is allowed at each station. If more than one operator takes part scores must be counted separately. For the leading Irish station the Leonard Trophy will be awarded for one year, for the leading station outside Ireland there will be an award of a gold medal and for the runner-up a silver medal. Contest times are October 1 at 12.00 G.M.T. to October 2, 24.00 G.M.T., October 8, 12.00 G.M.T. to October 9, 24.00 G.M.T., October 15 at 12.00 G.M.T. to October 16 at 24.00 G.M.T., and October 22 at 12.00 G.M.T. to October 25 at 24.00 G.M.T.

The method of scoring is one point for European contacts, two points for African contacts above the Equator, three points for African contacts below the Equator, three points North American contacts, four points South American contacts and four points for Oceanic contacts. All logs must reach the Hon. Sec. of the Society at 19 Queen Victoria Street, Belfast, on or before December 31, 1938.

West Herts Amateur Radio Society.—At this Society, Mr. D. G. Martin is continuing his series of talks on television. At the July meeting, his subject was " Scanning." The Society had two exhibits at the West Herts Hospital fete, Berkhamsted, which were interconnected by land line. Messages were accepted and charged for at the rate of 3d. per twelve words.

An Efficient Vertical Antenna

By G6DT

This description of rather an unusual type of antenna is by R. T. DEALY, one of the foremost amateur experimenters in this country. The number of stations worked by the author in the past few months is ample proof that this antenna is all that he claims it to be.

THE majority of transmitting amateurs in this country appear to rely on antenna systems of the single element type, i.e., doublets and harmonically-operated wires two or more half-waves long, in or out of phase. The writer's experimental work with directional arrays on 14 mcs. has satisfied him that some form of multi-element system is very necessary if more or less consistent DX work is desired on this amateur band, and details are given of a small, compact unidirectional array which has been in use at his London station for some months with eminently satisfactory results over a period during which conditions have been far from good.

The diagram shows the space and direction available; ample length from east to west, with just under a half wave-length from north to south, decidedly unsatisfactory in a part of the world where the greater number of DX stations lie in a general westerly direction.

Long wire Antennae

Many types of long wire antennæ were tested, but results were unsatisfactory, particularly in comparison with those obtained with the use of flat top beams and reflector-director systems at the No. 2 station at Horndean, Hampshire. For instance, it was found quite impossible to contact Australia on telephony, despite the fact that such stations as VK2XU (now on his way to England), VK3WA and VK3KX were specially listening for London signals.

The erection of a high mast was considered, since the existing pole at the western end of the garden was but 30 feet, and there are many trees in the immediate vicinity, but this expense was postponed, there being a suspicion that the location itself might be a thoroughly bad one. So it was decided to erect a 20 ft. pole at either end of the house, as high as possible, and to try a single section flat top beam which could just be squeezed into the 29 ft. 6 in. available between the two poles. The top of these poles, when erected, was found to be 43 ft. from ground level, but only 14 ft. above the highest part of the roof.

Results with this array were somewhat better, but not much, and Australian contacts were nil, except on c.w., the strongest reports being R7; telephony was impossible, and eventually the arrangement shown in the diagram was erected, with gratifying results.

The Suggested Array

The array is quite a simple one, just a half-wave radiator, end-fed with short feeders of the tuned Zepp. type, and with a parasitic director spaced one-eighth of a wavelength to the west, at an average height of about 30 ft., the ends of both elements being bent back in order to get the array into the space available. In actual fact only 19 ft. of the radiator and 16 ft. of the director are "in the straight," but this does not appear to affect the efficiency of the system to any appreciable degree.

Consistent communication is now obtainable with all stations to the N.W., W., and S.W., at the times when they are heard in the country, and the coverage is wide enough to include VE5, W 6 and 7 in the north-west, down to PY and LU in the south-west. Australian contacts present no difficulty, and schedules with VK3WA and VK6MW are kept regularly.

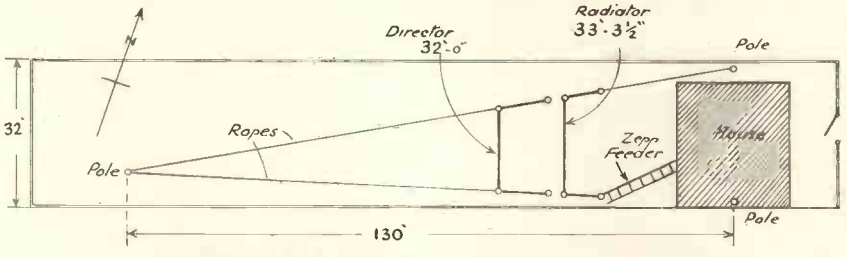
A Uni-directional Array

In a uni-directional array of this kind maximum gain is theoretically obtained when the director is self-resonant, but at this adjustment, backward QRM is more in evidence than when the director is shortened to a length where such QRM is least. However, the writer made no attempt to adjust the director length to this critical point, since the array was put up as an experiment to decide whether or not the building and erection of a lattice mast with a similar, but rotatable system would be worth while. As a result of the experience gained with this array, a 40 ft. lattice mast has been built and erected, and by the time this appears in print, will probably have a similar antenna system on it, but with the one-tenth wavelength spacing which current literature indicates as being the most efficient.

Antenna Impedance

A word of warning to those who may try this uni-directional array. The centre impedance of the radiator element is much lower than the usual 70-100 ohms of the normal single element, due to the nearby director element. When the latter is at resonance, the centre impedance of the radiator is believed to be in the neighbourhood of 30-35 ohms, but this value increases when the director length is shortened. The use of low-impedance cable for feeding the system may therefore give rise to unsatisfactory results if the usual formula is applied.

An interesting experiment would be to make the director length exactly one half-wave in length (by the usual formula) and to insert a stub in its centre, one half-wave long for accessibility, with a variable condenser across the end of the stub. Varying condenser capacity would electrically alter the director length, making for inductive or capacitive reactance according to the amount of capacity inserted, and should, in fact, turn the director into a reflector, if desired, with consequent radiation in the opposite direction. A half-wave stub is suggested for convenience, but if this is tried the tuning condenser should have adequate spacing and insulation, since high-voltage is present, which is not the case if a quarter or three-quarter stub is used.

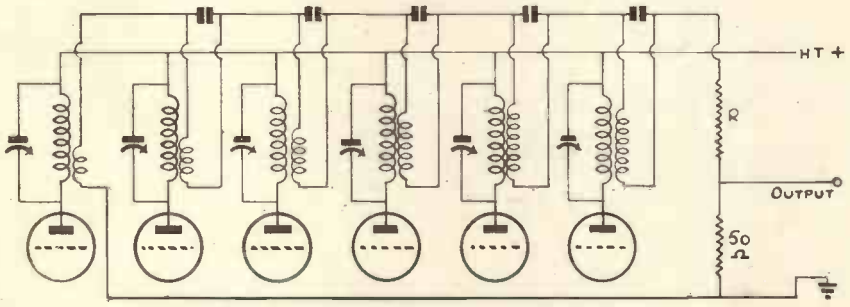


The antenna used by the author and described in this article.

Building A Stable Signal Generator

In this article R. K. Budge describes how set manufacturers obtain stable signals on all wavelengths with simple apparatus. Much of the equipment is suitable for amateur use.

WITH the standardisation of 465 k.c. for super-heterodyne intermediate frequency the writer considered the possibility of a fixed frequency, fixed voltage signal for alignment and gain measurement on receivers. For comparison of two receivers it is, of course, essential that the intermediate-frequency amplifiers be precisely identical otherwise the alignment is affected even by quite small changes.



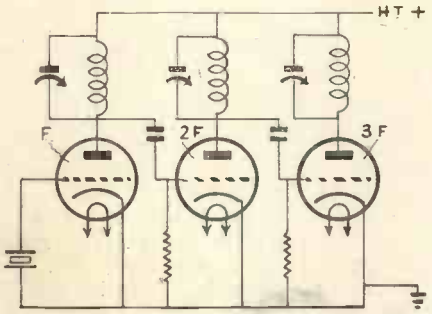
The circuit of the coupling coils and fixed attenuator

A unit was constructed consisting of a quartz controlled triode oscillator of 465 k.c. modulated at 400 c.p.s. An ordinary I.D.H. triode was employed for the R.F. oscillator, while for the modulation it was found preferable to employ a small battery triode owing to limitations of standard components. The results achieved were encouraging, the advantages of 465 k.c. "laid on" are definitely considerable, when one is constantly handling receivers.

The success of this unit led to considering the possibility of providing several fixed frequencies for checking alignment and sensitivity of receivers and through the process of evolution a Signal Generator providing modulated R.F. at 14 fixed frequencies between 60 M.C. (5 metres) and 150 k.c. (2,000 metres).

In all, four quartz crystals are employed with frequency doublers and the total number of R.F. oscillator valves is nine. Choosing the frequencies called for some hard thinking, the problem being solved in the following manner:

In aligning a superhet it is usual to adjust the trimmers at the high frequency end of the scale and the tracking condensers at the lower frequency end of the scale, while in a straight receiver the trimmers are adjusted at the high frequency end and the accuracy of the inductances is checked by the alignment at the lower frequency end. Frequencies are therefore required at the high and lower frequency ends of each band of the receiver to be tested. With most receivers the long-wave range is 800-2,100 metres, the region between 800 and 1,200 is of little importance from the broadcasting point of view so the first frequency chosen was 232.5 k.c. (1,290 metres) which doubled equals 465 k.c. This frequency provides the intermediate frequency and one essential long wave check point. The next frequency chosen was 150 k.c. (2,000 metres) which doubled provides 300 k.c. (1,000 metres). These cover the I.F. and long waves, the medium waves tracking signal being provided by doubling the 300 k.c. to 600 k.c. (500 metres). The trimming signal required for the medium waves is 200 metres, and as a tracking check was required a 750 k.c. crystal was employed with a doubler to 1,500 k.c. (200 metres).



A quartz controlled oscillator with two doubler stages. Standard receiving valves are used.

So far we have the following fundamental signals on:—

150 K.C.
232.5 K.C.
300 K.C.
465 K.C.
600 K.C.
750 K.C.
1,500 K.C.

As the design is based on harmonic generation there must, of course, be harmonics with which to contend. With frequency doubling the second harmonic is very small compared with the output of the doubler and is of no consequence, while the third harmonic is so much weaker than the fundamental signals that it is easily distinguished. The harmonics which do occur in the medium wave-band are known and are used as a further check on accuracy of calibration.

On the short waves a crystal provides 7,500 k.c. (40 metres) which is doubled to 15 megacycles (20 metres). The harmonic generation of this pair is such that the third harmonic of the 40-metre crystal occurs at 13.3 metres, the second of the 20-metre oscillator at 10 metres, the third at 6.67 metres, and the fourth at 5 metres. The third harmonic of the 200-metre signal occurs at 66.7 metres and the grand total is:—

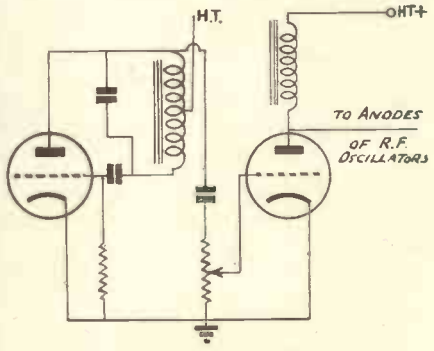
66.7 metres.
40 metres.
20 metres.
13.3 metres.
10 metres.
6.66 metres.
5 metres.

The harmonics mentioned here all provide workable signals.

The generator is enclosed in a metal box to prevent radiation and the next problem was how to feed all the available frequencies to a common output terminal.

The scheme finally adopted was to wind a coupling winding on each oscillator coil and connect them all in series.

One end of the short wave coupling winding is earthed, the coils are connected in series in wavelength order and the output taken from the highest wavelength oscillator. The 150 k.c. coupling coil will, of course, act as a high frequency choke to the passage of the



The audio oscillator and modulator circuit.

(*Continued on page 512*)

An Electron-coupled 5-metre Transmitter

This two-stage transmitter provides considerable R.F. output with very little frequency shift. It has been designed and is being used by G2HK.

CRYSTAL control on 5 metres is now conventional practice amongst advanced experimenters. Technical difficulties are now no greater than crystal control on say 40 metres, and the only reason amateurs do not make more use of properly stabilised transmitter is the slightly greater expense or else the general feeling that there is not sufficient interest in the ultra-high frequencies to warrant building a separate transmitter for this band.

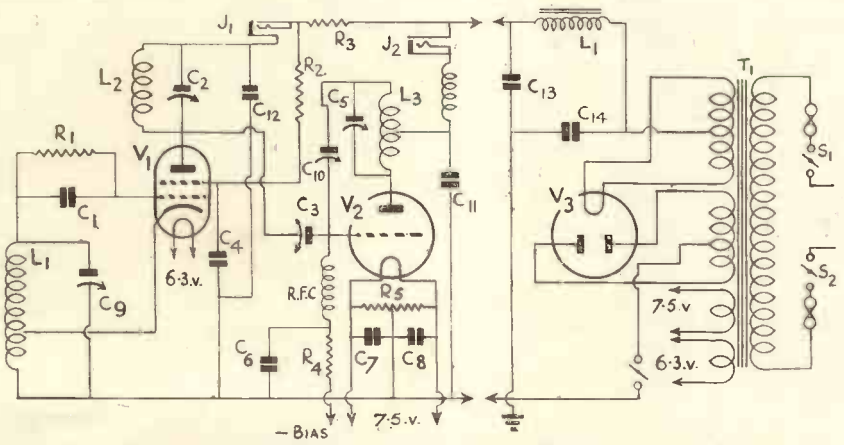
Dx Work

This point is a matter of argument althought it must be mentioned that any amateur who has broken the long distance transmitting records has always used a crystal controlled transmitter. The big advantage of a stabilised transmission is that it can be received on a muti-valve superhet so that the gain is two-fold.

When a self-excited oscillator is employed it is necessary at the receiving end to have a simple type of super regenerative receiver which will handle these transmissions. As the sensitivity of this type of receiver is not particularly high and the noise level is inclined to drown weak signals, the possibility of DX with a self-excited transmitter is rather remote.

However, excellent results are obtainable with an electron-coupled transmitter the design of which is comparatively simple and should the modulation level be kept down to a reasonable percentage, it is still possible to use a superhet or a sharply tuned set at the receiving end.

During the last 5-metre field day and for the 5-metre tests made in the recent months a two stage transmitter has been used embodying an electron-coupled oscillator. The frequency stability of this rig has been highly satisfactory and as the input can be as much as 25 watts it is an excellent beginning for amateurs who have not previously experimented on the 5-metre band.



This is the complete circuit including power-pack. The values are not critical but for maximum R.F. output they should be strictly adhered to.

As the transmitter has been in use for several months, all the snags have been located and eliminated so that the transmitter in its present state is completely fool-proof and the constructor can go ahead and build, confident that there need not be any changes in components or coil values.

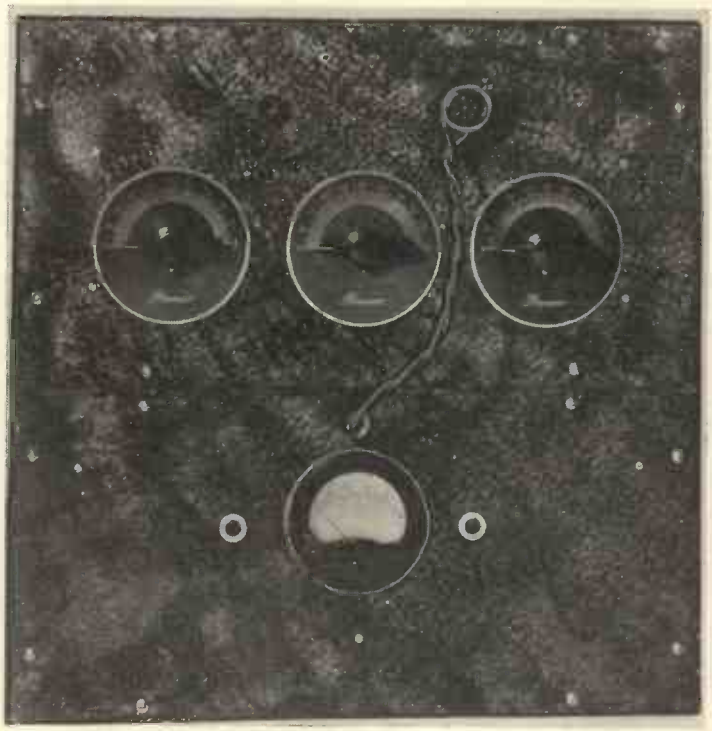
The rig is self-contained with power supply on a small two-tier rack so that it is transportable with the minimum amount of trouble. This rack measures 19 in. by 15½ in. and is fitted with panels which are 9 in. deep. This means that standard relay rack panels can be used or the transmitter can be actually built into an existing relay rack if one is available.

Only one meter is required to check the entire receiver while provision has been made for phone or C.W. operation as required. The modulator is, of course, a separate unit with its own power pack which can be built into a similar sized rack.

To give some idea as to the portability of the equipment, it was erected and in full working order with a beam aerial, etc., within an hour. All controls were pre-set and marked before the transmitter was moved so that it was merely a matter of adjusting these controls to the pre-determined figures in order to have the transmitter correctly adjusted.

The Circuit

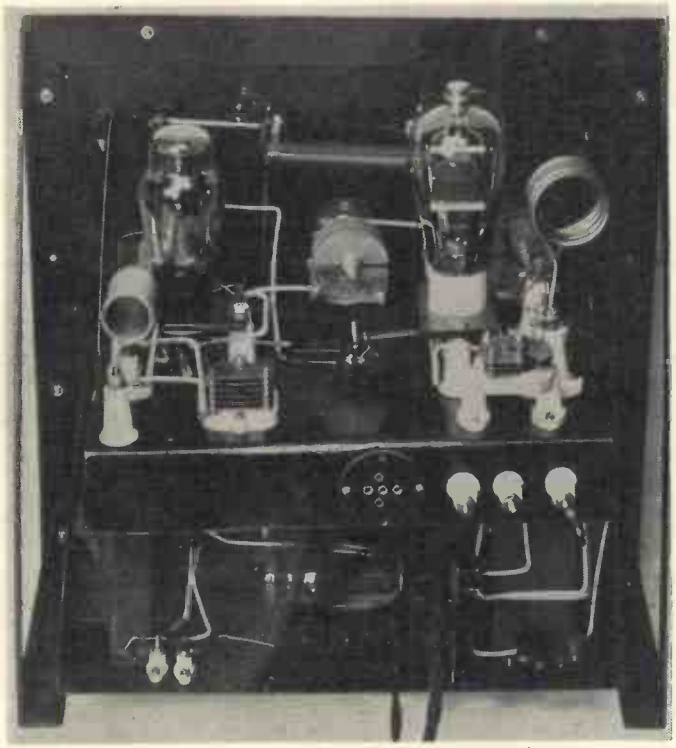
The circuit of the complete transmitter plus power pack is shown on this page. Consider first all the electron-coupled oscillator circuit as a separate



The controls are to the left, P.A. tank condenser, in the centre coupling-condenser and on the right the oscillating anode control. The meter in the centre reads up to 100 mA.

Oscillator Control

section. It will be seen that L1 is tapped and tuned by C9, a condenser having a capacity of 101-mfd. The coil consists of 10 turns with a cathode tap 1½ turns from the earthy end. The diameter of the coil is 1 in., while the total winding space is approximately 2 in. 14-gauge wire is used throughout.



A good indication as to the layout of the components can be seen from this plan view. Notice how the rectifying valve is mounted horizontally in order to overcome the difficulty of running the connecting leads underneath the chassis.

The grid condenser and leak, a condenser having a capacity of .0001-mfd. and the leak value of 100,000 ohms, are connected in the wiring as close to the grid of the 6L6G as possible.

In the anode circuit is L2 tuned by C2 which has a capacity of 40 mfd. and this coil doubles down to 5 metres. It consists of 4 turns of 1 in. diameter spaced 2½ in. and untapped. Both L1 and L2 are mounted on stand-off insulators so that the coils are absolutely rigid. If the stability of the circuit is to be worth while, it is essential that both the wiring and the components be absolutely free from movement.

Incidentally at this point it is well worth mentioning that once the frequency has been decided upon the condenser C9 is left set for it is of the preset variety and has to be adjusted by means of an insulated screwdriver. This provides a feature somewhat comparable to crystal control for providing the condenser across the cathode coil is not touched, the remaining tuned circuits need only be adjusted to provide maximum R.F. Should, however, C9 be made fully adjustable, the constructor has always to be on the alert for out of band operation, while a frequency meter has to be continually employed.

In the anode circuit of V1 is a jack, into which the meter can be plugged for checking purposes, and the resistance R3 which has a value of 6,000 ohms merely employed to keep the voltage down to a reasonable level. No high-frequency choke is necessary, but the by-pass condenser C12, which has a value of .002 mfd. is most important.

Next in importance is the coupling condenser C3. During the original tests it was found most difficult to decide upon the correct value for this condenser. Too high a capacity caused pulling between circuits, while too low a capacity made the R.F. output drop off in an alarming manner. To overcome this it was finally decided well worth while to make C3 variable and to mount it on the panel complete with its own dial.

Condenser C3 has a value of 250 mmfd. and in the original model approximately half this capacity was required. However, experimenters will have to vary the checking to give maximum drive without pull.

In the early stages of design the final valve was an 801 which proved quite satisfactory, but slightly greater efficiency was obtained by substituting a T20 despite the fact that the anode lead is rather on the long side, and that the circuit could be improved by lowering the base of the valve so as to shorten the inter-connecting leads.

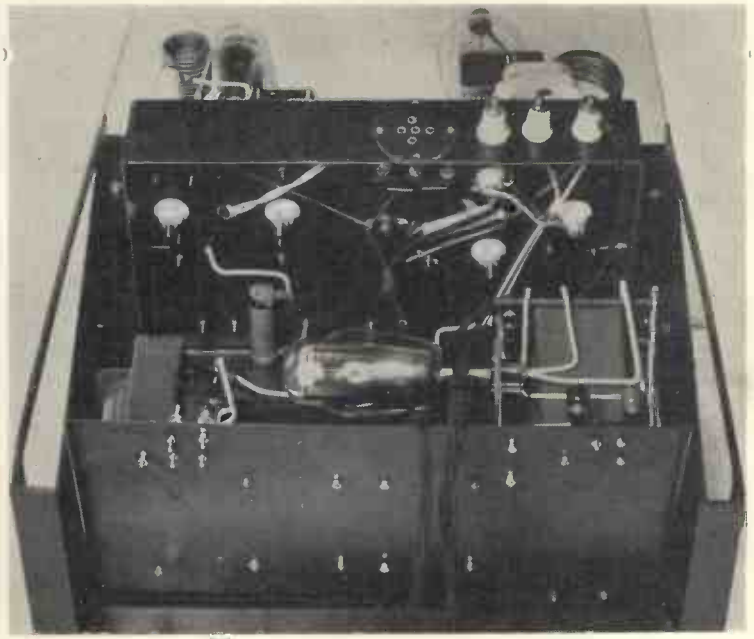
Coil L3 which is tuned by C5 having a capacity of 40 mmfd. is made up of 4 complete turns of 9-gauge wire with an internal diameter of 1¾ in. and a total winding space of 2 in. The centre tap is made with a length of heavy braided cable as is the anode lead.

The condenser shown as C10 is for neutralising and is again one of the Bulgin air-spaced pre-sets, having a value of 14 mmfd. Approximately 7 mmfd. capacity is required to neutralised the T20 as it is wired in this circuit.

It can be seen that the centre tap from L3 is taken to one side of a feed-through insulator. The other side of this insulator having connected to it C11, a condenser with a capacity of .002 mfd. and suitable for 500 volt operation.

In order to prevent modulation hum it is essential to include the condensers C7 and C8 and also the resistance R5 and these three components should be mounted as close to the valve base as possible.

The jack J2 is of the closed circuit type and is merely used for obtaining a comparative anode current check when the transmitter is being tuned. Automatic bias can also be used, in which



The under chassis components are few in number and how they are arranged can be seen from this view. Notice that no components are underneath the bottom of the second chassis.

Making the Power Unit

case R4 should have a value of 4,000 ohms and be connected directly to earth. The link connecting the mid-point of C7 and C8 to chassis should be omitted in favour of a 200 ohm 20-watt resistor. It should be remembered, however, that automatic bias can only be employed in this circuit providing the power pack is capable of supplying 600 volts for the bias voltage has to be subtracted from the available H.T. voltage.

That completes the construction of the transmitter, but on the second deck is the power unit which, however, is quite straightforward. It consists of a transformer giving 500 volts at 200 mA. with a 5-volt filament winding for the 5Z3 rectifier, a 7.5 winding for the T20 output valve and 6.3 volts for the oscillator. Smoothing consists of a single 200 mA. choke plus 8 mfd. of smoothing. Notice from the illustration how the 5Z3 valve is mounted horizontally in order that the connecting leads can be made quite short without having to be taken through the metal base-plate.

The two filament windings are taken to the top deck by means of a Bulgin 4-pin plug and socket. The H.T. negative contact is made automatically to the chassis and the H.T. positive comes up to the third of the three stand-off insulators mounted on the top chassis. The remaining two insulators are for modulation injection.

There are two switches on the front lower panel, one of the double-pole single-throw type in the mains lead, and the other a single-pole single-throw in the H.T. negative return. This switch is for stand-by operation.

With 500 volts supplied to the 6L6G C9 should be adjusted until it resonates in the centre of the 10-metre band. This can be checked by a wave meter or by picking up the over tone with a short-wave receiver on either of the 20 or 40-metre bands. Once this has been established that this C9-L1 circuit is tuned to the correct frequency, then this part of the circuit can be ignored.

Condenser C2 should then be tuned until it resonates at double the frequency of L1 in the 5-metre band.

Then remove the oscillator valve, apply voltage to the T20 and increase the bias until the anode current is reduced to zero. Re-insert the oscillator and tune C5 to the same frequency as the oscillator anode circuit after which it is merely a matter of re-adjusting C2, C3 and C5 until maximum R.F. output is obtained.

The final operation is neutralising the T20. This is done by removing the 6L6G and adjusting C10 until there is no trace of R.F. is L3 as checked by a very low reading flash lamp bulb in a looped lamp circuit. An alternative method of checking the neutralising is to connect a low-reading mA. meter in series with the grid-bias supply and adjusting C10 until there is no movement in grid current when C5 is adjusted 10 degrees or so either side of resonance. The output from the transmitter is coupled into the aerial by either a link-coupled circuit to an aerial coil or tuned line or by an 80-ohm cable terminated in a single link loosely coupled to L3.

The coupling required is very slight in order to obtain the correct input of 25 watts. By reducing the available voltage the T20 valve will run quite comfortably at 10-watts input, while a smaller and less efficient valve can be used on a lower input, for there is sufficient drive to counterbalance the effect of using a less efficient valve.

There is very little frequency drift during long periods of operation for the transmitter can be relied upon to cover long distances when used in a suitable location.

It is, however, advisable to erect a good horizontal beam aerial of the W8JK type which only occupies 8 ft. by 2 ft. so that it can be quite easily supported on a bamboo rod or other piece of light wood.

Constructors are warned that this apparatus must not be built without first obtaining a licence from the G.P.O. details of which can be obtained from The Office of the Engineer-in-Chief, Radio Division, Armour House, Aldersgate, E.C.

Components for AN ELECTRON-COUPLED 5-METRE TRANSMITTER

CHASSIS.

1 Small steel rack with panels and chassis finished black (Premier).

CONDENSERS, FIXED AND VARIABLE.

1—.0001-mfd. type 690W (C1) (Dubilier).
1—40-mmfd. type VC15X (C2) (Raymart).
1—250-mmfd. type VC250X (C3) (Raymart).
1—.001-mfd. type 690W (C4) (Dubilier).
1—40-mmfd. type VC40X (C5) (Raymart).
1—.001-mfd. type 690W (C6) (Dubilier).
1—.001-mfd. type 690W (C7) (Dubilier).
1—.001-mfd. type 690W (C8) (Dubilier).
1—101-mmfd. air spaced (Bulgin).
1—14-mmfd. type SW54 (C10) (Bulgin).
1—.002-mfd. type HVT 500 V (C11) (Dubilier).
1—.002-mfd. type HVT 500 V (C12) (Dubilier).
1—4-mfd. type LEG (C13) (Dubilier).
1—4-mfd. type LEG (C14) (Dubilier).

CHOKE, HIGH FREQUENCY.

1 Type 1022 (Eddystone).

CHOKE, LOW FREQUENCY.

1 Type WW/C1 (Sound Sales).

DIALS.

3 Indicator plates with knobs (Premier).

HOLDERS, VALVE.

1 Chassis type octal less terminals (Clix).
1—4-pin American ceramic (Clix).
1—4-pin type (V1) less terminals (Clix).

JACKS.

2—Closed circuit jacks with plugs (Bulgin).

METER.

1—Reading 0-100 mA. (Premier).

RESISTANCES, FIXED.

1—100,000 ohm type 1 watt (R1) (Erie).
1—15,000 ohm type 10 watt (R2) (Webbs Radio).
1—6,000 ohm type 10 watt (R3) (Webbs Radio).
1—2,000 ohm type 3 watt (R4) (Webbs Radio).
1—75 ohm humdinger (R5) (Premier).

SUNDRIES.

2 Large stand-off insulators (Premier).
5 Medium stand-off insulators (Premier).
6 Feed through insulators (Webbs Radio).
1 Type F11 fuse box with fuses (Bulgin).

TRANSFORMER MAINS.

1 Special type to 500-0-500 volts 120 mA.
7.5 V CT.
6.3 V CT (Premier).

VALVES.

1—6LG (Webb's Radio)
1—T20 (Webbs Radio).
1—5Z3 (Webbs Radio).
We have made arrangements for a complete kit to be obtainable from Messrs. Premier Supply Stores.

New Radio Catalogue

AMATEURS who wish to keep abreast of the times and to know all about the latest designs in components, valves, receivers, transmitters and all types of equipment associated with amateur work should make a special point of obtaining a copy of the new Webb's Radio catalogue.

This catalogue illustrates and gives a brief technical description of every popular American communication receiver so that the prices and merits of the different instruments can quickly be compared.

In the component pages items of every description are mentioned with a large number of illustrations. The component section deals with small insulators to the largest units used in amateur radio.

Several pages are devoted to test equipment of both British and American design, and we specially bring this section to the attention of radio dealers and service engineers.

Constructors who use American valves will find not only the working details of most American valves, but also pin connections.

In the hundred or so pages is a wealth of data on transformers and chokes, modulation and similar equipment, also microphones of every type from a cheap insert to the best of the crystal types.

Amateurs who contemplate buying a new receiver or any new components will be well advised to study the Webb's Radio catalogue for its shows all the items of different makes side by side with comparative prices.

This catalogue is free from Webbs Radio, Ltd., 14 Soho Street, London, W.1, upon mention of TELEVISION.

By G2NO

New Hallicrafter Designs at the Chicago Radio Fair

This type of R meter has a built-in resistance network so making it suitable for inclusion in almost any amateur set

Some interesting features of the Chicago Radio Fair are dealt with by **H. R. Adams** *who has just returned from America. Low power commercial transmitters suitable for amateur use are also discussed in this article*

JUST a quick glance around the recent Chicago Radio Fair was sufficient to indicate that the American manufacturers are rapidly changing their point of view regarding short-wave and amateur equipment in general.

This fair, which was attended by almost every important American manufacturer, was held at the Stevens Hotel in Chicago, which with its 4,000 rooms is claimed to be the largest hotel in the world. Incidentally, every room in this hotel was taken by a radio executive of some sort or other so that it will readily be appreciated that the fair was not only large but a most important one.

As in England at Radiolympia, certain manufacturers seem to be outstanding. This year, the exhibit which caused most interest was that of the Hallicrafter Company. who for many years have been producing short-wave equipment and public address amplifiers.

The name of Hallicrafter is well-known amongst English amateurs for their range of receivers of the more general coverage short-wave type have always been popular. This season Hallicrafters seem to be leading the way in this obvious change in sales policy.

Communication Receivers

It has apparently been realised in America that a time is now ripe for the manufacturer to produce two types of receiver, one a high quality two-band broadcast set, and second, a four or five channel short-wave receiver suitable for communication use.

There does not seem to be the same demand for an all-wave receiver of average efficiency. The ordinary listener is content with medium wave reception while the enthusiastic short-wave amateur needs a communication receiver of the highest possible efficiency. As the two requirements cannot be embodied in one receiver, the manufacturers have decided to produce two individual sets.

Hallicrafters are concentrating on the communication type receiver and for this reason their 1938 range of sets appear to be outstanding in many respects and are now without question the most popular amongst American amateurs and the American services.

The managing director of this concern, W. J. Halligan, is an active amateur with the call sign of W9WZE. He has been licensed since the very early days of before 1912, and has had the call signs of 1-AEH and 1-UL. Mr. Halligan knows just what amateurs require in the way of communication receivers and has now given up the production of ordinary short-wave receivers of a general type in favour of multi-valve superhet receivers specifically designed for amateurs.

Special Tests

His new factory just opened is claimed by American designers to be one of the best plants used for the building of short-wave equipment. The general scheme is to have one floor devoted to the production of one individual set so that a receiver starts off as raw material and, after passing through eight different testing stages, is finally ready for delivery. In this way, it is expected that there will be the minimum of trouble with Hallicrafter receivers and that all sets will be similar in performance despite the extremely high efficiency.

It is also interesting to note how the American designers of the present time are trying very hard to meet the demand for low-power transmission equipment. Their first step in this direction is

Although designed for public address work this amplifier is becoming very popular amongst amateurs. It includes two-channel input, tone correction and variable base compression.

The First Hallicrafter Transmitter

to produce transmitters more on the lines of a large receiver than of the typical rack and panel type. In this way, the equipment looks much more simple and many experimenters who would be frightened of using a rack and panel transmitter feel quite happy with similar gear in a small cabinet which can be used on the operating table. This point is rather an important one and is having a very big effect for amateurs are now buying in much larger quantities equipment which they would normally have made themselves.

A New R Meter

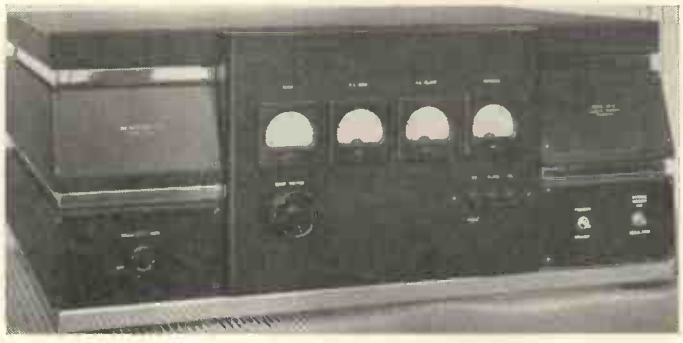
One of the most interesting items I saw at this exhibition was an R meter which can be added to practically any super-het receiver. It consists of a calibrated mA. meter all complete with a resistance net-work and an adjuster for giving a true zero level. The meter is connected into circuit with only two wires after which amateurs can read signal strength in R levels with a fair degree of accuracy. It is hoped in time that all amateur receivers will be equipped with meters of this kind so that the use of an R reference level will ultimately have some real meaning.

The Dual Diversity receiver is built to the specification of commercial companies who need the utmost reliability in point-to-point communication.

It is not generally known that there are Hallicrafter amplifiers, although these have been in production for many years. These amplifiers are of a very compact type using the latest beam power tetrodes and arranged for crystal microphones or a low-gain input circuit. Individual volume control are embodied, also tone correction and in some circuits variable bass compression. These amplifiers were designed in the first place for public address work, but they are now being extensively used by amateurs for modulating purposes.

The Dual Diversity

No receiver in recent years has created quite so much excitement as the Skyrider Dual Diversity. This equipment consists of two complete receivers embodying 23 valves and two tuning indicators. It is intended that the equipment be used with two independent aerials both erected at a considerable distance from the receiving end and at right angles to one another. It is claimed in this way fading is greatly minimised, while the general signal strength of the station is greatly increased as compared with using a single receiver.



In appearance the Hallicrafter transmitter is similar to an over-size receiver. It was one of the most outstanding exhibits at the fair.

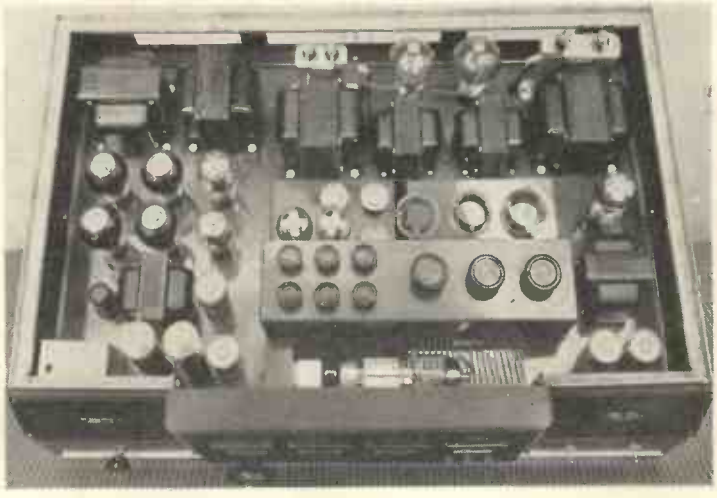
Included is the Lamb noise silencer and four of the new type 1851 high-gain low-noise level R.F. pentodes. The frequency coverage is from 545 Kc. to 62 Mc., with a sensitivity of better than 1 microvolt on all frequencies. There is an audio output of 10 watts and a current equalising meter plus an infinite adjacent channel rejector. This receiver is of the type used by commercial companies for point to point communication work and is without question one of the finest instruments available.

A New Ultra-High Receiver

Another new receiver which has not yet been seen in this country is the Skyrider 5-10. I have heard several of these sets actually in use at police and fire departments and it appears that it is an extremely reliable receiver for ultra-high frequency use. This set again indicates how the American manufacturers are concentrating on special purpose receivers rather than making one set cover many bands. The Skyrider 5-10 tunes between 27 Mc. and 68 Mc. in two wave bands. It uses 8 valves has an 1851 pentode as a pre-selector, an intermediate frequency of 1,600 Kc. and arrangements for a carrier level meter. It naturally includes all refinements such as a beat-frequency oscillator, A.V.C. and a noise silencer so that this ultra-high frequency instrument is on the lines of a communication receiver.

A second instrument which will be new to English readers is the Skyrider Marine—an eight-valve unit designed to cover all commercial frequencies. Frequency coverage is 140 Kc. to 18.5 Mc. and individual coils are used for each band so as to obtain the correct L/C ratio giving maximum efficiency.

(*Continued on page* 495)



Here is the inside of the Hallicrafter transmitter showing the R.F. section in the centre, the modulator on the left and the various power supplies at the back.

Two New British Receivers

Two new interesting receivers have just been released, one for the listener needing quality reception and press-button tuning, the other for amateur and more especially general short-wave use.

AT Radiolympia which opens on August 24, one of the main features is to be press-button tuning. Almost every manufacturer will be exhibiting a set with this refinement, while in some ranges ambitious receivers covering short, medium and long waves will also be equipped with this system of tuning. Ferranti, Limited, have produced a model number 617TB, an all-wave receiver which embodies a very satisfactory system of press-button tuning. It is a 5-valve instrument including a heptode frequency changer, R.F. pentode, I.F. amplifier, double-diode triode as second detector, A.C.V.C. control and L.F. amplifier with two output pentodes in push-pull providing no less than 6 watts of high quality audio.

The Ferranti cabinet design is particularly interesting, while the press-button tuning arrangements are rather ingenious as explained in the text.

This type of receiver will enable the user to rely upon receiving a large number of continental medium and long-wave stations with good quality, while the more powerful short-wave stations from America and other parts of the world will be available at entertainment value. The short wavelength covers from 16.5 to 51 metres, so including five commercial programme channels, two amateur channels in addition to the interesting shipping bands on about 36 metres.

With the press-button tuner incorporated six stations can be always on tap. Arrangements have been made so that inter-station noise is eliminated, while owing to special circuit design there is no frequency drift which would make it necessary for the press-button tuning arrangements to be retuned from time to time.

The receiver is supplied with the press-button tuning circuit already aligned, while the stations are chosen so that they will be receivable in the area where the set is to be used.

The controls are a five-point wave change switch, a manual tuner with two-speed drive, a continuously variable tone corrector, and a combined on-off switch with the volume control. Provision has been made for both gramophone pickup and an extension loudspeaker, while the cabinet is finished in French walnut and Macassar ebony. The price of this receiver is 17 guineas, and full information can be obtained from Ferranti, Limited, Moston, Manchester 10.

One cannot expect a multi-valve high sensitivity communication receiver for a price as low as £9, but the B.T.S. Company, Limited, have just produced a receiver which gives the best possible value for this price. It is a five valve all-wave receiver built on rather American lines in a heavy gauge steel cabinet. It includes a switchable beat-frequency oscillator for the reception of unmodulated C.W., an A.V.C. switch and a phone jack. The circuit is made up of a triode-hexode frequency changer, a triode pentode, I.F. amplifier and beat-frequency oscillator, double-diode triode, output pentode and rectifier.

The tuning dial, which can make or mar an amateur set of this kind, is of a new design with a band spreading cursor around the outside edge of the scale. We have found it impossible to locate the slightest trace of backlash with this dial which is rather surprising in view of the low cost of the receiver.

Selectivity is of a very high order not only on the broadcast bands, but also on the amateur channels. There is no difficulty in separating the commercial broadcasters on 16 metres which are all very close together. On the 40-metre amateur band a large number of stations were logged with reasonable freedom from interference, although again it must be realised that no receiver, irrespective of price, will give complete separation on this very congested amateur band. A considerable number of 20-metre amateur phone stations were received, while on C.W. transmissions from South Africa and New Zealand were logged.

The headphone jack is most useful and as it is in the output circuit gives ample volume, while in addition with the headphones in circuit the loudspeaker is automatically disconnected. All switch contacts are extremely positive as the Yaxley type of switch is embodied, while the mechanical design and construction is sufficiently good for C.W. stations to be received with the beat oscillator in circuit, while the set is actually turned upside down. This test was made owing to complaints of communication receivers drifting in tuning if the cabinets were knocked.

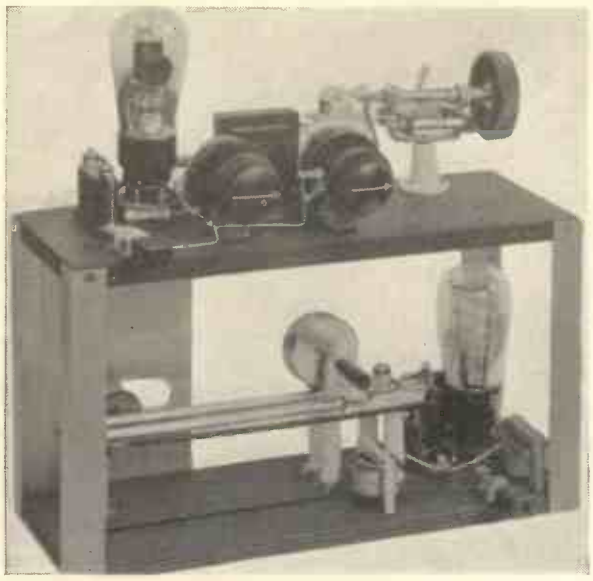
While agreeing that communication receivers should embody a high frequency stage, this added refinement would naturally increase the cost very considerably, but for those amateurs who wish to keep their expenditure to £10 or under, we consider this receiver extremely good value for money.

British valves with American characteristics are used throughout. Further information can be obtained from the B.T.S., Limited, Faraday House, 8/10 Charing Cross Road, W.C.1.

This five-valve receiver is very robustly constructed, and includes a tuning dial of new design guaranteed to be free from backlash even on the lowest wavelength of 10 metres.

An Experimental 1¼-metre Transmitter and Receiver

This equipment designed by GEOFFREY PARR is termed experimental because so little is known of the high frequencies. It has, however, been carefully checked over a comparatively short distance of two miles but it is anticipated that this range can be greatly exceeded.



The transmitter and the receiver is mounted in a small home-made rack in this manner. The transmitter is in the bottom section.

AT one time it was considered highly probable that wavelengths of between 1 and 2 metres would be set aside for emergency work. For this reason, I conducted experiments on approximately 1¼ metres, that is 224 Mc. with simple equipment that any constructor can quite easily build.

On these very high frequencies both the transmitter and the receiver are of an extremely simple kind so that they lend themselves to easy portability.

The experimental units were built on two small wooden base boards and as practice did for once coincide with theory there was no need to make any radical changes in order to obtain satisfactory results.

The completed transmitter and receiver was then made into a two-deck rack by means of four pieces of angle aluminium as can be seen from the illustration. In this way the two sections are kept quite compact, while, if necessary, a third deck can be incorporated to house the power supply.

The circuit of the transmitter is shown in Fig. 1 and even though the input to the first Acorn valve is extremely low, being approximately 2 watts, this is in no way detrimental and so far, no improvement has been noted by increasing the input to the maximum the valve will stand.

A triode Acorn valve is used as an oscillator and modulated by a typical mains operated LF amplifier. In order to obtain a reasonable degree of frequency stability it was found necessary to use long-line grid and anode inductances rather than to rely on the tuned coil arrangement which is used in the receiver. Fortunately owing to the short length required for the grid and anode lines, the transmitter can still remain compact while it is easily tuned by a parallel connected neutralising type condenser which enables the oscillator to be resonated to between 200 and 250 Mc.

Across the open ends of the two lines is the fixed condenser C1 which has a capacity of .0001 mfd. This condenser can be clearly seen from the plan view of the transmitter and is one of the Dubilier ceramic type. The grid side of this condenser is also connected to R1, which is of the half watt type and has a value of 5,000 ohms. In order to facilitate construction the ends of the rods are drilled and tapped and fitted with two small terminals for it is extremely difficult to solder components directly on to the rods without the excessive heat damaging the components.

The anode side of the rod goes to high tension and the modulating system. It was found that an H.F. choke in this circuit was quite unnecessary, but it is an advantage to use a screened lead which is not earthed.

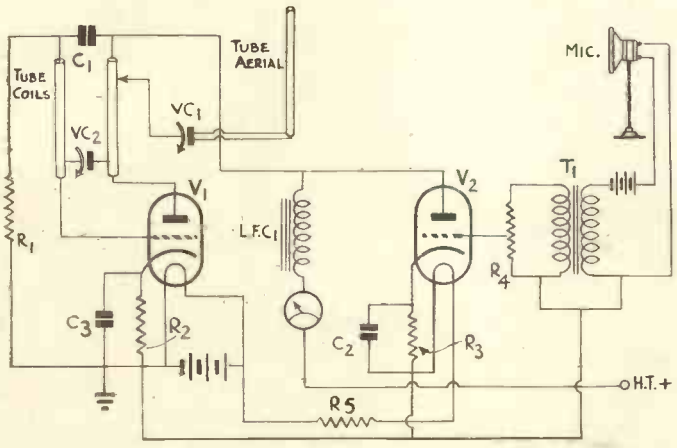


Fig. 1.—Two valves are used in the transmitter, the first being an acorn and the second a high slope triode. If an American acorn is used then there should be a resistance in series with the heater of V2. If a British acorn is used, however, both V1 and V2 can be run from the same 4 volt supply and R5 is omitted.

Construction

With apparatus of this kind it is the constructional more than the theoretical side which needs most attention for the layout has to be carefully considered so that important leads are kept as short as possible. The transmitting unit must be built around an Acorn valve holder which, fortunately, has its contacts in such positions that associated

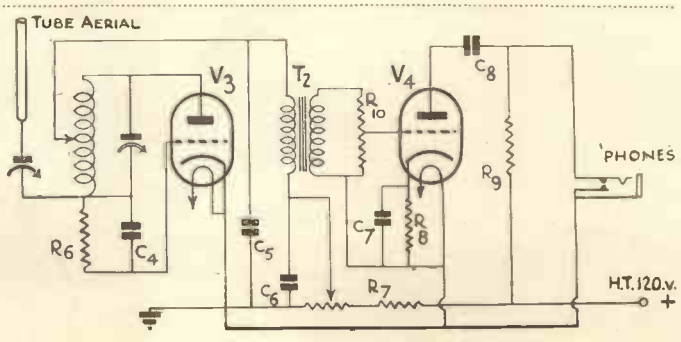


Fig. 2.—V3 in this circuit is also an acorn while V4 is the conventional L.F. amplifier which in this case is a Ferranti D4.

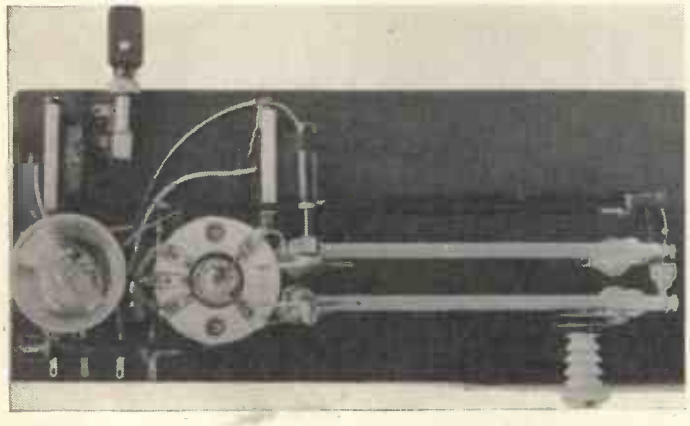
Operating the Transmitter

components are easily interconnected.

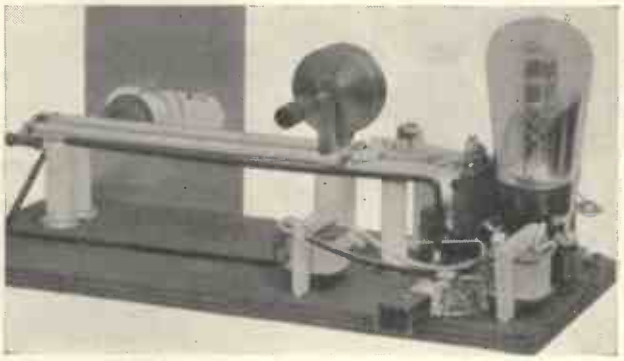
The Acorn holder is mounted off the chassis by stand-off insulators and so arranged that the grid and anode contacts, which are widely spaced, are close to and on a level with the grid and anode rods. These two rods are tapped at both ends and also mounted on insulators and spaced approximately ¾ in. In this way the connection leads are fractional in length as the tuning condenser is also automatically connected.

The tuning condenser VC1 is actually a miniature Eddystone neutralising condenser which has had its supports removed. The rods are then tapped on the top side and each plate of the condenser actually screwed into the rod.

Once this condenser has been adjusted to provide the resonate point it can be left set. Two small grub screws enable the spindle to be locked so that in normal circumstances there should be very little frequency shift.



This plan view of the transmitter shows the anode and grid lines and also the ceramic grid condenser.



Notice how the tuning condenser is actually screwed into the grid and anode lines. It is actually a converted neutralising condenser.

Modulation

Very little space is taken up by the modulator which can consist of either a 4-volt mains operated triode or if a lower consumption is required a 2-volt steep slope battery-operated pentode with a resistor in one side of the heater. A valve of the Pen-220A type will provide an audio output of approximately 800 mW. The modulator valve is mounted very close to the Acorn valve while the microphone and microphone transformer are on the left-hand edge of the chassis. The remaining iron cored component is, of course, the modulation choke.

It will be noticed that the H.T. feed both V1 and V2 has to pass through the L.F. choke. If a meter is included this should be capable of reading up to 25 mA. when the supply voltage does not exceed 150 volts. In order to obtain sufficient drive for the modulator valve the microphone must be of the high output carbon type feeding into the transformer T1 which should have a radio of 1-70. For local distance working maximum modulation is not required so for this reason the volume control R4 is included. This control has a value of 100,000 ohms and is a most important accessory as the frequency stability of the transmitter is vastly improved when the modulation level is kept down to 60-70 per cent.

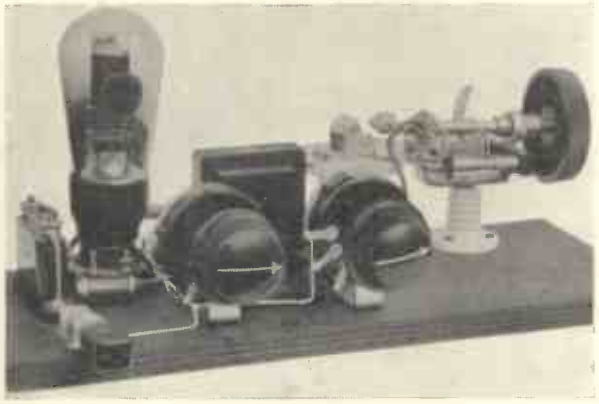
Aerial Coupling

The only difficult adjustment to the transmitter is the location of the aerial tapping. Examine very closely the plan view of the transmitter from which it can be seen that the aerial is tapped on to the anode rod via a modified stand off insulator. This insulator is mounted on a bracket and the rod to the centre is terminated in a small brass disc about the size of a halfpenny. A similar disc is screwed to the rod so that a midget condenser is made. The correct capacity has to be found by trial and error after which the plates can be locked in position.

In order to find the correct tap point a crocodile clip could be used after which the aerial lead could be soldered to the rod, but I have found that it is much more simple to tap the rod in several places and to use the tap point which gives maximum radiation. For this reason I suggest constructors make eight or nine holes down the ends of the rod, all being drilled as closely together as possible.

The power supply is taken to a four-way terminal strip which is alongside the modulator valve, but this is a matter of personal taste for a plug and socket could quite easily be used.

The rods should have a total length of 5 in. and can be ⅜ in. in diameter. With the condenser in a mid-way position the original transmitter resonated at approximately 224 Mc. When tuning, however, remove the aerial connection and adjust the anode current of V1 from its maximum of about 25 milliamps down to a resonant current of 3-4 mA. The correct aerial tap can then be located by using a position which causes maximum current flow. However, once the condenser across the rod has been adjusted to give minimum current it should never be re-set. If when the aerial is connected to the correct position it is possible to reduce the current flow by readjusting VC2, it shows that the aerial length is incorrect. If less capacity is required in VC2 the



The tuning condenser in the receiver is mounted on a stand off insulator so that it is level with the grid and anode contact of the acorn valve. A headphone jack is in the left-hand corner.

Receiver Design

aerial should be shortened, and if more capacity it should be lengthened.

When the aerial is the correct length this should not affect the setting of VC_2 and it is essential that the aerial be pruned by $\frac{1}{2}$ in. at a time to obtain correct length.

It is suggested that the aerial be slightly under $\frac{1}{8}$ wave in length which will give adequate radiation for short distance coverage. The aerial should be mounted on two stand-off insulators on the side of the chassis so that it is quite rigid and is part of the actual transmitter.

A suitable Acorn valve for this circuit is the Mazda A40, while a 955 RCA triode can be used with a 6-volt supply.

Despite the ultra-high frequency employed, it is essential that the transmitter be operated within the allocated amateur bands. The simplest way of frequency checking is to use the Lecher wire system and to measure the distance between resonant points by means of a crystal.

Receiver Design

Very little difficulty should be experienced in constructing the receiver section for this again uses but two valves in a straightforward circuit. It was not found necessary to use long line grid and anode inductances, for with a simple tuned coil arrangement providing it is rigidly made, gives sufficient stability to pick-up transmission provided by the equipment previously described. V3 is again an Acorn valve of either the A40 of 955 types. This valve as can be seen from the plan view is mounted off the base board to the same level as that of the tuning condenser. If the grid and anode pins of the holder are in the positions as shown the leads will be very short and the losses correspondingly low. The grid condenser is again of the ceramic type having a capacity of 50 mmfd. The grid leak R6 has a value of 10 megohms or higher. The coil can be parallel tuned and it is suggested that a Jackson 15 mmfd. condenser be used, but double spaced to give approximatey half the rated capacity.

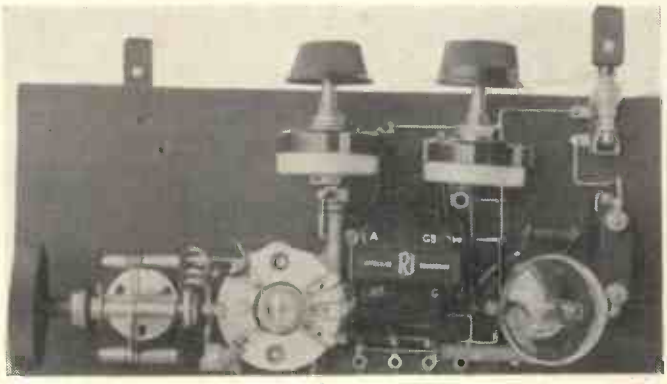
The coil is made of 14 gauge wire, consists of 4 turns, approximately $\frac{1}{4}$ in. diameter and spaced twice the gauge of the wire. It is centre tapped, but this tapping point should be made adjustable during the experimental period.

The aerial is tapped directly on to the grid end of the coil through a small condenser which should have a capacity not exceeding 10 mmfd., otherwise there will be considerable damping and the circuit may refuse to oscillate.

The aerial incidentally should be one half wavelength long for with this type of aerial there is a gain of at least one R point over the one-eighth wavelength aerial.

Following the detector circuit is a straightforward L.F. amplifier with a potentiometer across the transformer T2. Also notice how the anode voltage through the detector valve is controlled by means of the potentiometer which has a value of 50,000 ohms. The headphones in the final circuit are free from any direct current owing to the use of a buffer condenser C8 which has a capacity of .01 mfd., while the anode impedance consists of the 75,000 ohm resistor R9.

More difficulty will be experienced in obtaining satisfactory results with the receiver than with the transmitter, but the only difficult point is determining the correct anode tap which will be more a matter of patience than anything else.



The contacts to the acorn valve and to the various components can clearly be seen from this plan view. The inter valve transformer should have a ratio of at least 1—3.5.

The approximate values of the components used are :—

C1 100 mmfd.	R2 450 ohms
C2 10 mfd.	R3 500 ohms
C3 10 mfd.	R4 100,000 ohms
C4 50 mmfd.	R5 Optional—see text
C5 100 mmfd.	R6 10 megohms
C6 .01 mfd.	R7 20,000 ohms
C7 10 mfd.	R8 500 ohms
C8 .01 mfd.	R9 75,000 ohms
R1 5,000 ohms	

During some early tests two complete sets of equipment were operated about a mile and a half apart, and some excellent results were obtained. However, subsequent tests indicate that two to three miles would not be an excessive distance to cover with a half-wave radiator.

"New Hallicrafter Designs"

(*Continued from page 491*).

English amateurs will find the Hallicrafter transmitter of particular interest for it will be one of the first of the new American transmitter that will be seen in this country that illustrates the new system of construction. This transmitter is conservatively rated for a 50-watt phone carrier and 100 watts on C.W. It is suitable for 10, 20 and 40-metre crystal control operation and includes band switching by means of a single control knob. The valve line up is a 6A6 crystal oscillator and first doubler, a 6A6 second doubler and Rk47 final power amplifier. In the audio section there is a 6J7, 6J5 and four 6L6's running in class A-B with an output of 50 watts.

The transmitter is supplied complete with the exception of aerial equipment and crystal microphone. In appearance it looks like an over-size radio receiver so that it can be used alongside the radio set on the operating table.

It is rather fortunate that American police, fire and government departments all use equipment of a kind suitable for amateur use. For this reason highly efficient receivers and transmitters are being designed which normally would be far too expensive if the American manufacturers were only catering for the comparatively small amateur market.

The second instrument of a similar type but rated for 320 watts phone and 450 watts on C.W. is also available, but this is rather too large for the average English amateur.

C.W. at 69 w.p.m.

There is also a general tendency for a revival in C.W. operation and W1JYN, Ted McElroy, was giving a demonstration of receiving at 69 words per minute which was faultless for 15 minutes. It was also interesting to notice how few British amateur stations could consistently be heard in America. Despite the fact that the average American amateur uses more efficient equipment than his British counterpart. Except for a few G's such as 6SR, 5ML and 5BJ, very few others could be heard with any degree of reliability. The QRM is also unbelievably bad and if only the lower power English stations could appreciate this they would do all they could to improve their transmitting and receiving systems.

The Short-wave Radio World

A SIMPLE AUDIO SYSTEM

AMATEUR phone transmissions are steadily improving in quality and percentage of modulation. This is due in no small way to the fact that the high-slope tetrode valves, which have become so popular, are capable of providing a high audio output in quite a simple circuit and with comparatively low H.T. voltages.

Although we are accustomed to using these resistance-coupled tetrodes a circuit produced by the Kenyon Transformer Company of America has many interesting points in its favour. The circuit is shown in Fig. 1, from which it can be seen that it consists of four valves, although one, the 6C8G, is actually two complete electrode systems in one bulb. This arrangement does not require any driver or inter-valve transformers so that it can be made entirely resistance-coupled. A standard output transformer is required, of course, having the correct primary impedance of 3,900 ohms, and a secondary to match the operating impedance of the transmitting valve.

This amplifier provides high quality reproduction with a maximum output of about 32 watts. No pre-amplifier is required as there is ample gain even when the input is low as from a crystal microphone. It has been designed for crystal microphone use, and is suitable for a gain of down to a 70 db. level.

In the first stage is a 6J7G pentode valve which will provide a gain of over one hundred times. It is resistance-capacity coupled to one-half of a 6C8G amplifier which is used to drive the two 6L6G's in class-B. The second half of the 6C8G is the conventional phase invertor which has to be used with R.C. coupled push-pull circuits. Bias throughout is obtained automatically and the designers claim that considerably increased output can be obtained by using a separate bias supply for the final two valves.

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

If the amplifier is made separately from the power unit only a very small chassis is required, while the hum level is negligible even with simple smoothing in the power pack. The overall gain is slightly over 100 db. while the values are such that no stage is being run under optimum conditions which would cause tricky operation.

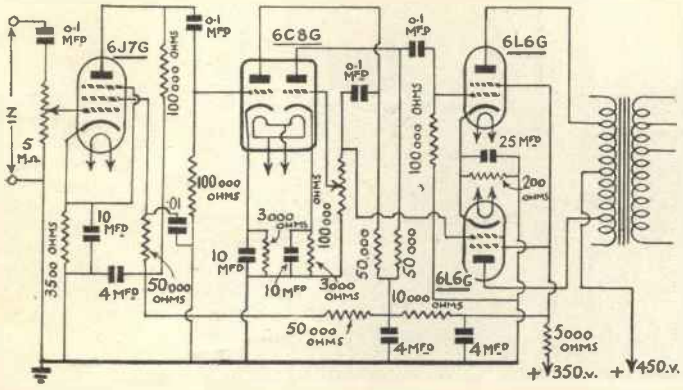


Fig. 1. This R.C. coupled 6L6 circuit provides 32 watts of high quality audio. The power supply is 450 watts.

Providing the input stage is completely screened right from the grid of the 6J7G to the contact on the crystal microphone, there should not be any additional hum pick-up. It should also be remembered that one side of each heater is directly earthed, so that there is only one lead going to the filament transformer.

All the valves are of the glass type and although this is not essential and it might be advisable to use metal glass valves for public address work, there is less likelihood of breakdown with glass valves as they do not reach quite the same heat level as the metal-glass valves.

Laboratory tests show that with the values recommended the frequency response is reasonably flat from 60 to 6,000 cycles, but should greater gain be needed then the resistor and condenser values can be modified to follow conventional practice.

The power unit should be capable of supplying 450 volts at 300 mA, while the voltage for the drive stages should be obtained from a low resistance bleeder. The total D.C. resistance of the circuit should be low so that there is very little voltage fluctuation with wide stages in anode current.

AN INTERESTING DIRECTIVE ANTENNA

A novel directive antenna has been designed by Robert S. Kruse and published in *Radio*. This arrangement bears certain resemblance in results to the scheme originated by the British designer, F. R. W. Strafford—the constructional arrangements, however, are rather different.

The aerial consists of two independent aerials with separate feeders arranged so that the aerials can be put either in or out of phase as required so as to alter the directivity.

Construction is shown in Fig. 2 from which it can be seen that the aerials are vertical and can be fed with either spaced low impedance or co-axial line. The phase of the right-hand aerial can be reversed by changing over the switch. If the two aerials are accurately cut to length so that both are absolutely symmetrical, there should not be any time lag, so there would be a very complete reversal of radiation.

The length of the feeder is immaterial providing both feeders are of exactly the same electrical characteristics. The dimensions shown are for 20-metre operation while the same arrangement holds good on 10 metres. For 40-metre operation, however, pole height would be rather a disadvantage. These two aerials are approximately one half wavelength and spaced one half wavelength, and it would not entail very much ingenuity to make them rotatable.

THE MAGIC EYE AND PHASE INVERTORS

With R.F. coupled amplifiers, which include phase inversion such as in Fig. 1, satisfactory results and high quality can only be obtained by accurately balancing both halves of the amplifier.

An interesting method of doing this,

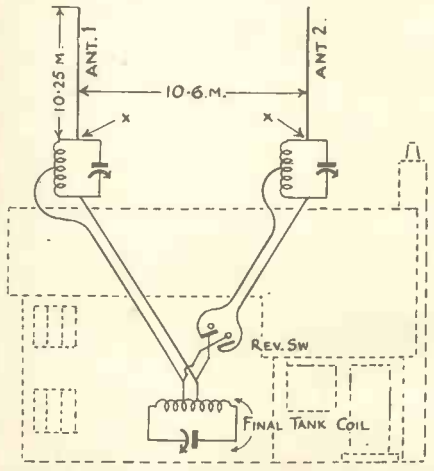


Fig. 2. With this arrangement concentrated bi-directional radiation is obtained by merely reversing one switch.

A Sensitive Valve Voltmeter

without difficulty, was shown in a recent copy of the Australian publication, *The Bulletin*. The circuit is shown in Fig. 3 from which it can be seen that a 6E5 tuning indicator is used as a built-in indicator. The system of operation is very simple and from time to time exact balance can always be checked.

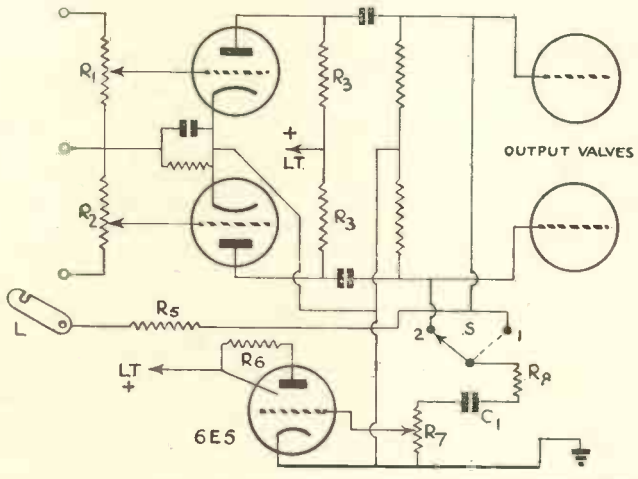


Fig. 3. Another use for the magic eye is for checking the balance of a phase invertor circuit.

An input is supplied across R1 and the 6E5 is switched into the correct half of the circuit. The amount of deflection on the indicator is carefully noticed. The input is then applied across R2 and the indicator switched to read the output from the other half of the circuit. R2 is then adjusted so that the indicator registers exactly the same deflection as when it was connected in the first half of the circuit. This then gives correct balance.

As the 6E5 is permanently in circuit, then the balance in the circuit can be checked accurately. In this way quality should always remain at a very high level. Resistance values are normal for the stage invertor circuit but C1 should be .01-mfd., R7 500,000 ohms, R6 100,000 ohms. The grid resistors in the amplifier should have a comparatively low value such as 50-100,00 ohms.

A THREE-RANGE VALVE VOLTMETER

The valve voltmeter, shown in Fig. 4, has been designed by the Phillips Company at Eindhoven. It will read up to 5 volts, 15 volts and to 50 volts in three ranges, and uses as a voltage indicator a meter having a full scale deflection of 2 mA.

It has a very high input circuit so that there is negligible damping to the circuit in which the meter is connected. It is entirely fed from A.C. mains and uses a high-frequency pentode connected as a triode working as an anode bend detector. To establish the optimum working point, the valve is given a fixed negative bias by means of the potentiometer R5 and R6, which is connected across the anode supply. This potentiometer has a low resistance value so as to keep the voltage steady, when the anode current of the valve increases. The fixed bias obtained in this way is about 13 volts negative.

To obtain damping by grid current the cathode voltage should rise when the voltage to be measured increases. For this reason two cathode resistors are connected to the tapping point of the potentiometer. One of these resistances may be switched into circuit on the 15-volt range, the other one being used on the 50-volt range.

In this way, besides the fixed bias an automatic bias is obtained which adjusts itself according to the voltage to be measured. The measured voltage is connected to one side of the grid of the pentode valve and the other side to bias. This bias is decoupled against the anode A.C. via a filter made up of R4 and the condenser C2.

Both the anode and screen grid supply are smoothed by means of two 16-mfd. condensers and a 10,000-ohm resistor shown as R7. The advantage of this smoothing system is that besides obviating the use of a smoothing choke, it protects the meter against overload. In the event of the input circuit being accidentally left open, that is when there is no D.C. passing between grid and cathode, the anode current is limited by R7 to a maximum of 4 mA. Such a current should not enter the meter while a further advantage is that a meter of any type may be used since the only resistance of the instrument is always small in proportion to the resistance of R7.

The screen grid is connected directly to the anode because at the value indicated the anode current alone will not reach a maximum of 2 mA. Also, the anode is connected to the cathode by a condenser of 1 mfd. so that when measuring very high frequencies there is no voltage across the impedance of the meter. The condenser must have a very low ohmic resistance.

On the 15- and 50-volt ranges this meter is practically independent of mains voltage variation. A rise in mains voltage increases the anode voltage and the anode current. The increase in anode current, however, causes a larger voltage drop in the cathode resistance so that the grid bias increases and the anode current readjusts itself to the previous value.

On the 5-volt range, however, there is no cathode resistance so that a 10 per cent. fluctuation in mains voltage causes an 8 per cent. deviation in the voltage measured.

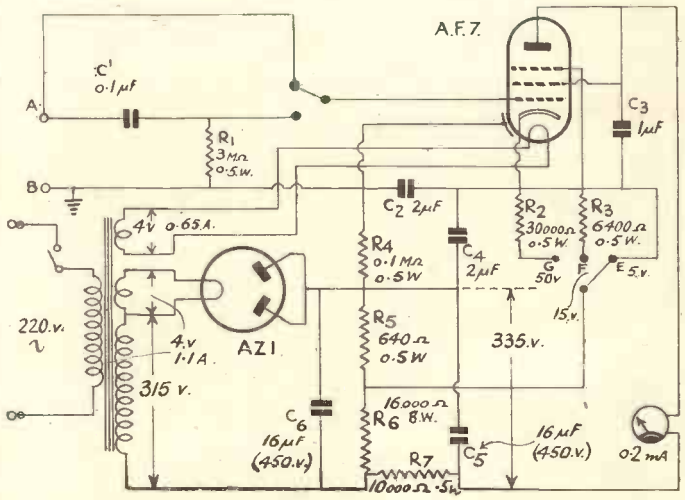


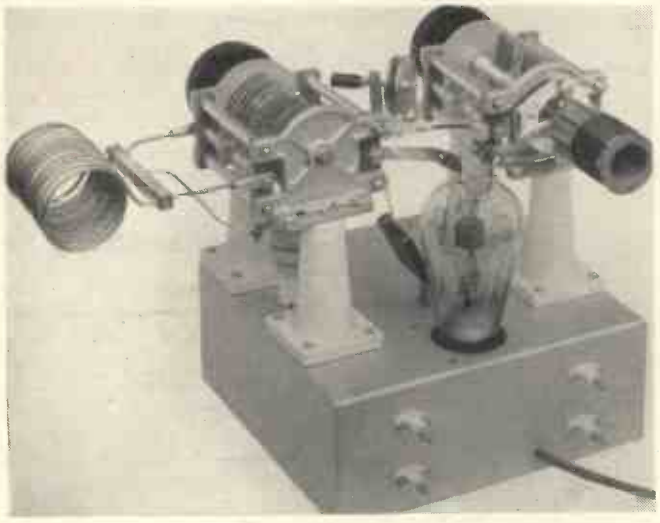
Fig. 4. Three voltages ranges can be accurately measured with this meter while owing to the high input impedance there is little damping on the circuit to which it is connected.

A TY1-50 P.A. Stage

The designer of this P.A. Stage, J. W. Paddon, G2IS, clearly shows that British equipment when properly used is superior to most of the foreign equipment more generally used.

WHEN it was decided to build a high efficiency all-British power amplifier the first problem was to choose a suitable valve. Price, needless to say, was of primary importance. A survey of the market brought to light the fact that Messrs. Mullards had recently released a suitable triode at a price comparable with its American equivalents..

The Mullard TY1/50 was specifically designed for use at frequencies above 60 Mc. This, of course, implies that the efficiency at lower frequencies will be high. The envelope is of special hard glass and the anode and grid leads are brought out in "horns" at the top of the glass envelope. This type of construction permits the shortest possible grid and anode leads as well as the advantages of negligible inter-electrode leakage and capacity.



By using a symmetrical layout the efficiency of this final stage has been raised to a very high order. Notice how the neutralising condenser is mounted in the wiring. The grid coil holder is actually fitted to the grid tuning condenser.

A spiral filament is used. At the modest demand of 7.5 volts at 3.25 amperes it provides a total emission of 1.5 amperes. The maximum anode voltage is 1,250. At an input of 1,000 volts at 100 mA. the valve is cool and produces large quantities of R.F.

For those with fifty-watt licences the TY1-50 operates cleanly with an input of 800 volts at 62 mA. This is an input of 49.6 watts. With a well-built amplifier circuit the radio frequency output at this input should be about 35 watts. A modulator delivering 25-A.F. watts will fully anode modulate the TY1-50 at this rating.

The circuit chosen is a straightforward anode neutralised one. The only unusual element is the insertion of condenser C8. This serves to provide a small amount of regeneration to make the valve easier to drive on 28 Mc. Anode neutralisation was chosen since the PA is to be used with balanced feeders.

Although the electrical specification is simple enough the mechanical layout has been carefully studied. The two Eddystone split stator variable transmitting condensers are mounted on large Raymart porcelain pillars. These pillars might be considered over large but they do allow the condensers to be anchored firmly down by means of brass strips of heavy gauge which are bolted across the feet, front and back of the condenser. These strips are drilled in the centre, bolted hard down on to the pillars with heavy gauge brass nuts and bolts. The grid bias connection is taken down through the hollow centre of the back mounting pillar of the grid tuning condenser. On frequencies above 14 Mc. a single section of the grid tuning condenser is used. On 7 Mc. the two stator sections are paralleled.

An Eddystone valve holder, type 949, is fitted to the back plate of the grid tuning condenser. Three holes are drilled and tapped and the valve holder secured by machine screws. The soft alloy of the back plate makes this operation simple. The anode pin on the valveholder is connected to the left-hand stator terminal of the variable condensed. The grid pin is taken to the earthing terminal on the condenser. These leads should be as short and direct as possible.

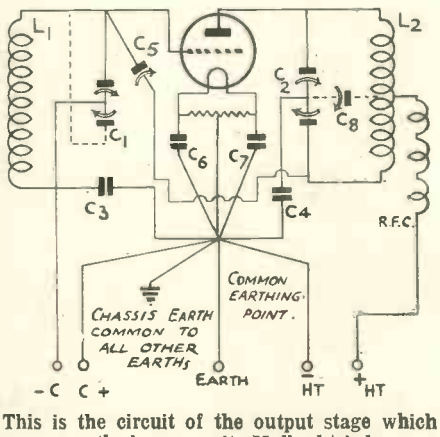
The valve holder is secured to a small paxolin panel and mounted below the deck of the chassis by means of four Eddystone pillars 1½ in. high. This serves to drop the height of the valve to the point where the horns line up with the terminals of the grid and anode condensers and hence the connections can be kept short.

Reference to the photographs will show the exact details of the layout of the components. The Eddystone neutralising condenser is deprived of its mounting pillar and swung in free air between the two tuning condensers. This is the shortest possible connection as the neutralising condenser is supported by its own heavy leads.

The Bulgin type HF22 R.F. choke is mounted on the chassis.. The small bent metal mounting bracket is removed and the porcelain supporting pillars are fastened direct. Care should be taken not to force these mounting screws as the porcelain fractures fairly easily.

A Dubilier high voltage working condenser is connected between the frame of the anode condenser and the common earthing point on the chassis. This prevents the full D.C. voltage strain being applied across the plates of the anode condenser and is a protection against flashover at full modulation. It also permits the use of the single spaced regeneration condenser. As will be seen in the photograph the regeneration condenser is supported by a long machine screw to the front mounting bar of the anode condenser. It should only be used at 28 or 56 Mc.

The back face of the chassis is drilled to take five Eddystone type 1019 standoff insulators. They serve as terminals for H.T. plus, H.T. minus, grid bias plus, grid bias minus and earth. All leads connecting to earth are terminated *at one point and one point only*. "Random" earths should always be avoided especially at UHF. If earthing connections are made at odd points on a chassis the electrical path

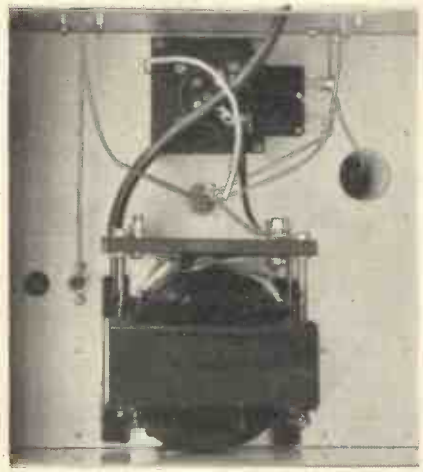


This is the circuit of the output stage which uses the low-capacity Mullard triode.

Checking the Operation

back to true earth frequently has sufficient reactance to upset the stability of the amplifier.

The grid coils are wound on standard Eddystone four pin coil formers. The same coil may be used for 14 Mc. and 7 Mc. by simply paralleling the stator plates of the grid condenser for 7 Mc. operation. The number of coupling turns used is best determined by



Underneath the chassis is mounted the filament transformer in this manner.

trial and error. The turns inter-wound at the bottom of the grid coil proved satisfactory in most cases. The link is terminated directly on to the filament terminals of the valve holder of the grid coil.

The anode coil is space wound of large gauge soft drawn copper wire. A micalex bar is used to end off the winding. Connection to the stator plates of the anode condenser is made by means of lugs which have been slotted to slide snugly over the condenser terminals.

The amplifier unit should be located in reasonably free space. There is small profit in building a high efficiency final and then operating it with the anode coil close to a metal panel or other conducting material. In this case a separate cabinet has been made carrying grid voltmeter, grid milliammeter, anode voltmeter and anode milliammeter on its front face. The meter connections are brought out to terminals on the back. Whatever final amplifier is being used is stood on top of the cabinet and connected to the instruments mentioned. This arrangement lifts the " hot " part of the final well clear of incidental wiring, etc., and allows rapid comparative experimental work to be done.

If we are to reap the benefits of the care taken in building this final amplifier it is essential that it should be perfectly neuted. It will be well to go through the procedure in detail.

(1) Completely disconnect H.T. plus lead from final.
(2) See that all connections are tight and that the final is well earthed.
(3) Light filaments and check filament voltage.
(4) Apply enough drive to show 20 mA. grid current with a bias of 200 volts.
(5) Swing anode condenser through resonance. Resonance will show up in the form of a kick on the grid millimeter.
(6) Readjust neuting condenser slightly and again swing the anode condenser through reasonance. If the kick is greater the neuting condenser is being adjusted in the wrong direction. If the kick is smaller the right direction is being followed.
(7) Keep making small adjustments of neuting condenser until the point is reached where there is no indication or only a very slight one on the grid milliammeter.

When perfect neutralisation has been established the H.T. supply lead should be replaced. With 250 volts grid bias and a drive of 17 milliamperes the anode milliammeter should swing crisply back to about 10 milliamperes when the unloaded tank circuit is tuned to resonance. If a good clean " zero dip " cannot be obtained it usually means that the " Q " of the tank coil is not good or that too much capacity is being used. The inductance should be of a value which brings resonance on 14 Mc. with the rotor plates about half engaged. At 28 Mc. the inductance should be of a value such that very little capacity is needed. On 7 Mc. the full capacity should be used.

Components for A TY1-50 P.A. Stage.

CHASSIS.
1—Steel finished grey 11 by 8 by 4 ins. (Peto-Scot).

CONDENSERS, FIXED AND VARIABLE.
1—Type 1081 50 by 50 mmfd. (C1) (Eddystone)
1—Type 1081 50 by 50 mmfd. (C2) (Eddystone)
1—Type ceramic .001 mfd. (C3) (Eddystone)
1—Type 620. .002 mfd. (C4) (Dubilier).
1—Type 1088 (C5) (Eddystone)
1—Type 690" .002 mfd. (C6) (Dubilier).
1—Type 690W .002-mfd. (C7) (Dubilier).
1—Type 978 (C8) (Eddystone).

COIL FORM.
1—4-pin type CT4 (Raymart)

CHOKE, RADIO FREQUENCY.
1—Type HF22 (Bulgin).

HOLDERS, VALVE.
1—Type chassis ceramic less terminals (Clix).
1—Type 949 (Eddystone).

INSULATORS.
4—Stand-off insulators type SX (Clix).
5—Midget stand-off insulators type 1019 (Eddystone).

SUNDRIES.
2—Special anode connector (Webb's Radio)
½-lb. 14-gauge copper wire (Webb's Radio).

TRANSFORMER FILAMENT.
1—7.5 volt for TY1-50 (Webb's Radio).

VALVE.
1—Type TY1-50 (Mullard).

A Multi-Match Modulation Transformer

A COMPLETE range of multi-ratio transformers for amateur use have now been produced by Premier Supply Stores and can be inspected at their ham shop at Clapton. These transformers are suitable for matching any primary load, that is on the audio side, from 18,000 down to 530 ohms, and on the secondary side from 16,900 to 500 ohms.

It will be seen that any constructor who invests in one of these transformers will be able to match any audio load to any R.F. transmitting load.

Three transformers are available suitable for 50, 150 and 300-watt carriers and all are mounted in cast iron cases which are crackle finished. They are very generous in dimensions having a

This is the 50 watt multi-matched modulation transformer type MM50 which is priced at 17/6.

large iron section, and, of course, will carry maximum current from both primary and secondary.

To give some idea as to the size of the transformers, the 50-watt model which will handle 25 watts of audio is approximately 4½ in. cube, while the 300-watt model is 6 in. cube.

As each layer is individually insulated and the whole is impregnated, the manufacturers can guarantee rattle free operation even with maximum modulation.

We have actually seen these transformers built, and consider they are exceptional value for money.

The windings are on large insulated bobbins of a new design which have particularly fine insulation between the edge of the bobbin and the core. To give some idea as to the tests carried out on these transformers, the smallest model has to withstand a test of over 2,000 volts between windings and core.

These transformers are moderately priced at 17s. 6d. for the 50-watt model, 32s. for the 150-watt model and 55s. for the 300-watt model.

An Acorn Valve 5-metre Receiver

At the request of many readers we have modified the 1—10 metre receiver published in the January issue to use conventional interchangeable coils and two American valves.

IN the January issue was published a four-valve receiver designed to cover all wavelengths between 1 and 10 metres. This receiver gave an excellent performance on these bands and was particularly suitable for amateur use on 5 and 10 metres.

The receiver is entirely screened so that it does not pick up local noise or any signals other than those via the aerial feed line.

5 and 10 Only

However, a considerable number of amateur readers pointed out that they were only interested in 5 and 10-metre band reception, in which event it was rather unnecessary for them to go to the additional trouble of building the special coils which would tune down to 1 metre.

We have had many requests for a slightly modified receiver to include plug-in coils of conventional design, and also American valves in at least the first two stages. The reason for the popularity of the American acorn valve probably is due to very much lower cost for the English acorn valves are quite satisfactory in performance. Many readers have had difficulty in winding their own coils owing to the lack of reliable transmissions on which they could check the wavelength coverage, so for this reason, we have modified the design to include the special Eddystone ultra-high frequency interchangeable coil units.

The revised circuit should be carefully studied and compared with the original circuit from which it can be seen that the first two valves are American acorns, the first being type 954 and the second a type 956. These valves have 6-volt heaters as compared with 4-volt heaters of V3 and V4, so that an additional filament winding is required. The valve holders of V1 and V2 are also slightly changed as the American Acorn and British Acorn valves do not have the same fitting.

By using Eddystone coils, the circuit will cover from 4 to 10 metres, so providing coverage of both amateur bands in addition to the television sound channel. This arrangement is in a way rather more convenient than the original system of double fixed coils for the aerial coupling coil is rather a doubtful quantity and varies from one to four turns depending on the wavelength, type of aerial, and the degree of coupling.

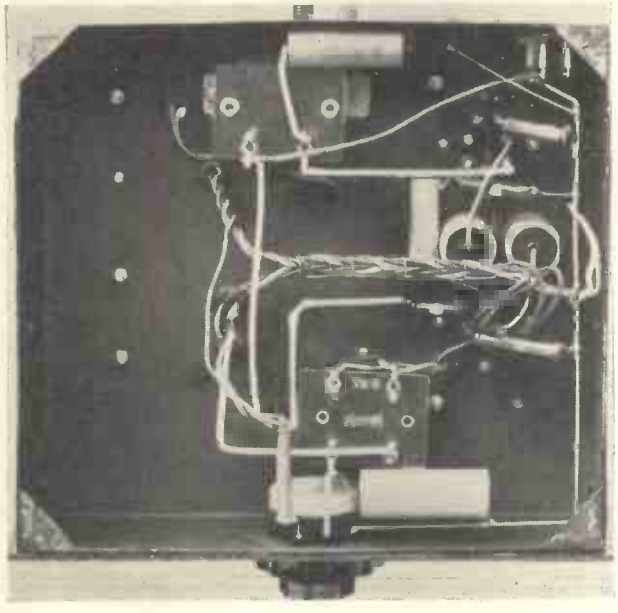
It has also been found necessary to tune the whole of L3 and to tap the grid circuit down the coil to almost mid point. This decreases damping and greatly increases the efficiency of the detector stage. Also, owing to the fact that a standard H.F. choke will work perfectly down to 4 metres there is no need to embody two high-frequency chokes, one covering 4 to 10 metres, and one from 1 to 4 metres, as was originally suggested.

Condensers VC1 and VC2 are ganged together. It has not been found necessary to use a trimmer condenser across VC1 for the first tuned circuit is very flat, while the Eddystone coils are very accurate as regards inductance. Any variations can be taken up by releasing the flexible coupler joining the two condensers and rotating VC1 on its own until it tunes the circuit to resonance. This receiver was used during the recent R.S.G.B. field day, and this method of alignment was found quite satisfactory.

Straight Receiver

It should also be noticed that the circuit now makes use of a straightforward tuned R.F. stage with a leaky grid detector. The reason for this change from a super-regenerative detector, is that with weak amateur signals it is extremely difficult to obtain a signal of sufficient intensity to completely kill the quench noise, and for this reason many signals which might have been heard with a straight set, were missed.

The noise level of this arrangement



The under-chassis construction and wiring is very straightforward as the only important components to be mounted are the cathode condensers, smoothing chokes, and the inter-valve transformer.

Coverage 4—10 metres

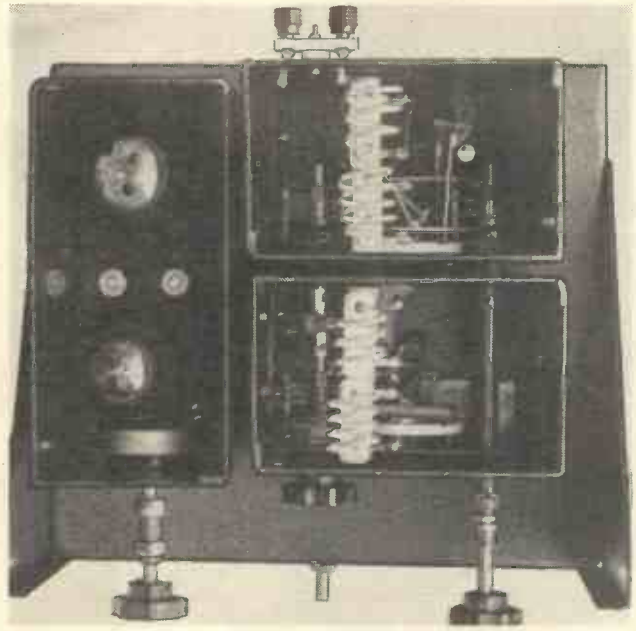
using resistance controlled reaction is extremely low, and the only stations that should be missed are those which have bad frequency control, such as with the unstabilised transmitter, or one that is both unstabilised and badly over modulated.

Coil L4, the reaction winding, is mounted underneath L3, and if this is made approximately 6 turns, it need not be changed. Reaction condenser, VC3, should have a maximum capacity of 65-mmfd. and this unit can be mounted on the bottom of the detector screening box and adjusted by means of an insulated screwdriver. The amount of reaction is then controlled by the variable resistance R10, which has a value of 50,000-ohms.

The resistance R8 is optional. It controls the voltage supplied to the anode of the detector and is generally set so as to provide maximum voltage, but if the oscillating circuit is rather rough, then a slight decrease in voltage will probably clear up this difficulty.

Audio Coupling

It is essential that the first low frequency stage be transformer-coupled.



The interchangeable coils are mounted on brackets in this way, and a complete set will cover from 4 to 10 metres. It is important that these coils be well down the side of the screening box in order that the lid will not affect the inductance.

This is rather unconventional and several constructors pointed out that they have reversed the order of these stages in order to follow conventional practice. They discovered what had been discovered in our laboratory, that it is impossible to obtain smooth reaction when the detector is followed by a resistance capacity-coupled stage.

Bias

Bias for the first valve is obtained by means of a 3-volt battery of the small flash-light type fitted to the side of the first screened box. No bias is required for V2 while for V3 and V4 it is obtained automatically by means of R4 and R7.

Frequency Stability

Frequency drift will not be noticed, providing the detector is robustly wired, and that C3, the grid condenser, is of the ceramic type. This is most important, and in no circumstances use a mica condenser in this position. Coupling between L2 and L3 should also be as loose as possible, and instead of varying the gap between the two coils, decrease the number of turns on the primary coil L2. With the interchangeable coils suggested, this is quite easily done.

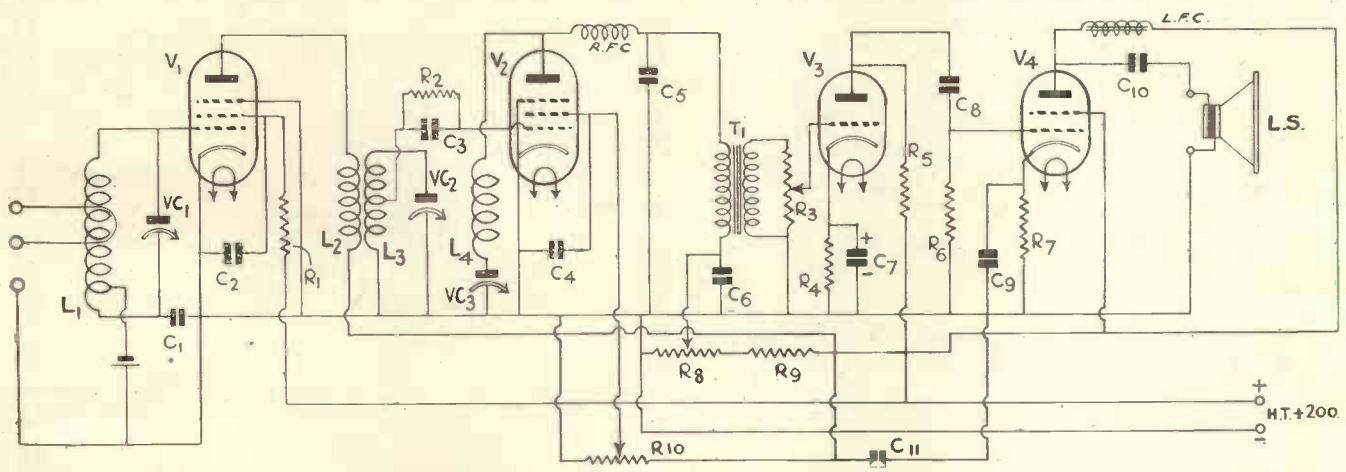
The whole of the audio section is completely separated from the R.F. section insomuch as the two valves and volume control are in their own special container, while the larger audio components are underneath the chassis. The way these components are mounted and wired can be seen in the illustration.

H.T. Consumption

The total consumption of the receiver is rather more than even a large H.T. battery will stand, so for this reason, it is necessary to use a power pack giving 180 volts at 40 mA. Should there be any trace of modulation hum which is sometimes present when receiving very strong signals, then one side of the filament circuit V2 should be by-passed to earth by means of a .0005-mfd. fixed condenser. It is also a good plan to by-pass one side of the mains transformer primary by means of a .05-mfd. condenser.

For headphone use, there does not appear to be any need for the second audio stage, and it is quite satisfactory to insert a phone jack in the anode circuit of V3. If this is done, however, V4 must remain in circuit, otherwise the voltage from the power pack will rise

(*Continued on page 511*)



The circuit used is an acorn RF. amplifier, acorn detector, and two audio stages. Noise level is extremely low.

An All-band 10-watt Transmitter

It is now possible to obtain a complete transmitter suitable for the beginner at a price lower than the cost of the components bought in the normal way. This 10-watt transmitter is being marketed by Premier Supply Stores.

Three valves are used in this transmitter which is absolutely self-contained and is suitable for C.W. or telephony. Two-band switching is also employed.

ALTHOUGH amateur transmitting licences are granted for experimental use it does not follow that every licensed amateur is interested in the design and use of transmitting equipment. At the present time, more than at any other amateurs are finding that the most interesting side of amateur radio is the experimental work that can be carried out in the design of transmitting aerials.

Amateurs so employed do not wish to build their own transmitting equipment but have been forced to do so in the past owing to the lack of commercially built gear designed specifically for amateur use. There has always been a fair amount of ready-built equipment of American design and also from a few English companies, but such equipment has generally been of the high input type which is consequently fairly expensive.

We have been testing one of the first of the new transmitters built by Premier Supply Stores who are now catering extensively for the requirements of the average low-power British amateur. This transmitter is as simple as it could possibly be made bearing in mind that amateurs do need that last watt of R.F. It consists of a single 6L6G tri-tet oscillator modulated by a second 6L6G. A power unit giving 500 volts at 120 mA. is also included in the circuit and the whole equipment is mounted on one chassis and housed in a steel cabinet.

Fundamentally the circuit may seem straightforward but there are several intresting features embodied which clearly indicate that the transmitter has been built by an active amateur for amateur use.

The tri-tet circuit will stand up to 20-watts input, on both 40 and 20 metres. The tuning circuits have been arranged so that the cathode coil can be short-circuited by rotating the condenser to maximum position. A switch in the anode circuit of the valve cuts out half the tank coil so that the transmitter is then tuned to double the crystal frequency. In practice, with one crystal and two coils, the transmitter will cover 40 and 20 metres or 160 and 80 metres without coil changing.

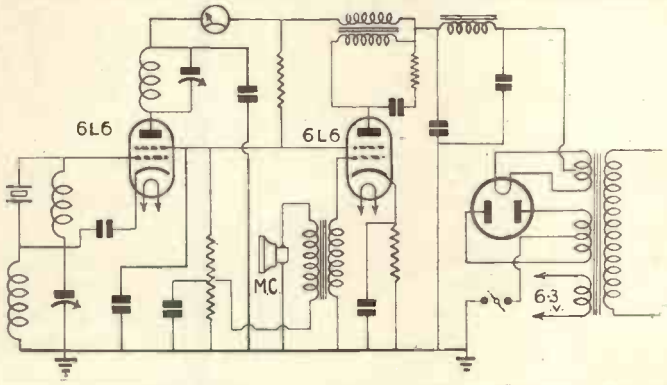
This feature is very useful for it enables an amateur to cover two bands by the flick of a switch. Despite the fact that only one valve is used for transmitting it is surprising how much R.F. can be obtained. The efficiency of the model tried was of an extremely high order and the carrier power developed was sufficient for us to work a considerable number of stations on both 40 and 20 metres.

During our tests, telephony was used and ample modulation obtained from the single 6L6G providing a high-gain carbon microphone was used. No batteries are required for the energising voltage to the microphone which is obtained automatically from the H.T. supply.

During a brief test on C.W. the reports obtained were all T9X on the 40-metre band.

The output from the oscillator is taken to the two feed-through insulators on the panel by means of a two-turn link around the tank coil. In this way, the transmitter can be placed in any convenient point and merely link coupled to the aerial tuning circuit by means of a low-impedance cable. Alternatively if the amateur intends to use a doublet aerial with untuned line or low impedance feeder then these can be coupled directly to the link coil.

The illustration on this page gives a very good idea as to the rigid construction of the transmitter. The controls can also be quite clearly seen. The left-hand tuner is across the tank circuit and the right-hand tuner in the cathode circuit. There are three switches, one on the left for wave changing, one in the centre, an H.T. break for stand-by operation with the mains switch on the right.



The fundamental circuit of the transmitter is quite straightforward consisting of a 6L6 tri-tet oscillator, a 6L6 modulator and a 5Z3 rectifier.

Above this switch can be seen an insulated jack for keying while the jack on the left-hand side is for the microphone. The transmitter is complete with two stout handles and is very robust. It is supplied ready for operation and the user merely has to furnish a microphone and suitable aerial system.

The cost of the transmitter complete with any normal frequency crystal is £10 10s. 0d., so that the amateur should have a complete station for £11 or so.

Full information on this instrument can be obtained from the manufacturers at 167 Lower Clapton Road, E.5.

The Beginner's First Receiver

This one-valve receiver is for the newcomer to short waves. In subsequent issues details will be given on how to add a second and a third valve.

By 5GZJ

A ONE valve short-wave receiver is quite inexpensive to build and for the beginner who has not had previous experience of short-wave reception, it provides an ideal starting unit. It will be appreciated that a one-valver is the heart of a multi-valve short-wave set so that the money spent on the original components is never wasted for at a later date when the receiver is enlarged into a two-valver or even a three-valver the same components can be used all over again.

The control on the left is the Eddystone band-spread condenser. The tuner is in the middle and the reaction control on the right.

Unit Construction

By proper design it is possible to add an extra valve to an existing one-valver without altering the wiring in any way. So for this reason, I have deliberately specified a chassis larger than is really required so that in a subsequent issue can be added the additional valve for those who require greater volume.

It is perfectly true that any defects a receiver might have invariably stick in the mind of constructors, whereas the advantages are soon forgotten. It was only a few years ago that short-wave sets had to be built on metal panels and chassis, and even then they were not entirely free from what is termed hand capacity.

This defect was that when a station was tuned in, directly the hand was taken away from the tuning dial there was a capacity change and the station picked up automatically vanished. This point is the first that constructors raise when they see the design of a set on a wooden chassis.

Due to improvement in design in both components and circuit, there should not be any trace of hand capacity or trickiness in operation with a modern short-wave receiver.

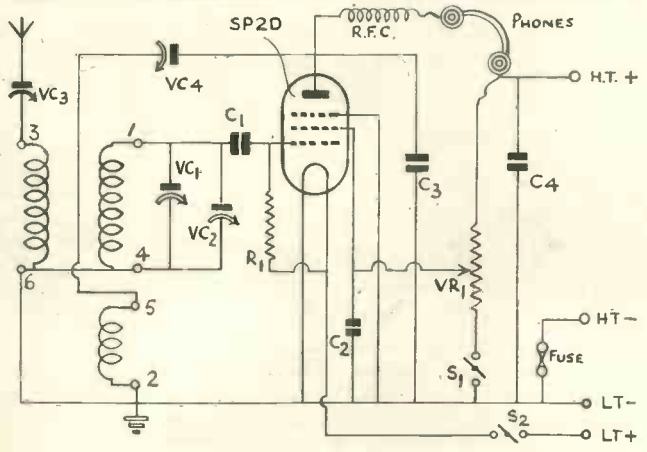
This one-valver is very easy to handle and even though when used by the beginner will pick up quite a large number of stations without difficulty. It is, of course, intended for headphone operation and is supplied from a small 60-volt H.T. battery. On 40 metres many European amateurs can be heard, while with suitable conditions, the American 19 and 16-metre broadcasters can be picked up. However, it will be realised that with a single valve there is not any reserve so that an efficient aerial must be used and very long distance reception should only be expected when conditions are favourable.

There are, however, so many sceptics about who do not feel that short-waves have anything to offer, that I have built this set to try and prove otherwise. After a few weeks of listening on short-waves they will be able to find out for themselves just what can be expected. If they are disappointed, then they have wasted very little money, while if they realise, as many thousands of amateurs all over the world have done, that short-wave reception is far more interesting than ordinary broadcast reception ever was, then they will almost certainly decide to enlarge on this receiver and to use a second or even a third valve.

The circuit is shown on this page from which it can be seen that a normal pentode valve battery operated is used as a leaky grid detector. Providing the values are correct, this valve will be very smooth in operation and will provide quite an appreciable gain. The important values are those of C1 and R1 which should be .0001 mfd. and 5 megohms respectively.

As I do not think that beginners should have the trouble of building their own coils, I have specified a standard Eddystone 6-pin coil of the plug-in type, a set of which will cover all wavelengths between 9 and 170 metres.

One of the biggest difficulties in ultra-short wave reception is that of obtaining smooth reaction and many amateurs have often found that rough reaction is part and parcel of the average short-wave receiver. However, this difficulty can quite easily be overcome by using the modern circuit combining capacity and resistance controlled reaction. In normal circumstances condenser VC4 would be a variable reaction condenser, while the screening voltage to the valve



This is the heart of the receiver being a complete tuner. Plug-in coils are used for all short wavelengths.

would be fixed. The amount of reaction obtained is then governed by the capacity of VC4, and although this is satisfactory from 20 metres upwards, under 20 metres it is extremely difficult to obtain smooth control without previous experience of this type of circuit.

The arrangement shown, however, does provide smooth control in all circumstances. The condenser VC4 is set either with the circuit slightly oscillating or nearly oscillating. The variable resistance VR1 is then adjusted so that the voltage on the screening grid is variable over a wide limit. This changes the valve impedance and the circuit can be made to go into oscillation very gently. It is an ideal arrangement and one that is free from trouble.

Only four of the terminals are used with the single valve. The fifth terminal comes into use when the second valve is added.

Condenser VC3 is also of interest. If the aerial is connected directly into the circuit, it is only satisfactory when the aerial is a lightly damped one, that is reasonably short. If, however, a normal broadcast aerial of about 100 ft. is used, the receiver will be so heavily damped that it will not oscillate. To make quite sure that the beginner cannot cause this difficulty VC3 is connected in series with the aerial and this is then adjusted to decrease the damping should the necessity arise. Theoretically, the coupling coil between pins 3 and 6 should be arranged to take care of this extra damping, but I thought it advisable to include the extra refinement, for I know many amateurs are inclined to use a long aerial rather than to go to the trouble of erecting one specially for short-wave reception.

The special coil holder recommended has, of course, six terminals, and these are all numbered to correspond with the circuit. The arrows on the variable condensers represent moving plates and the thick black lines fixed plates. As C1 is a fixed condenser, both plates are thick and it is immaterial which way round the plates are connected.

In order to make tuning simple, a band-spreading scheme has been included which is complete in itself. On

the left of the chassis is a small 140 mmfd. tuning condenser shown as VC1. The capacity of this condenser is variable in stops of ten divisions, each division being equal to 14 mmfd. The band spreading condenser VC2 has a very low capacity and the idea is to set VC1 at the appropriate stop and to spread the tuning by using VC2. In this way each division on VC1 is equal to one hundred divisions on VC2 so each coil is tuned by what is actually a condenser having a dial calibrated in 1,000 degrees.

The three controls are to the left band setting condenser, to the centre band-spreading control and on the right the variable resistance VR1 into which is built the two pole on-off switch. On the back of the chassis are the aerial and earth terminals of the ceramic type so that there are no losses caused by using a wooden chassis. In the centre is a 5-terminal strip, but with one valve only 4 of these terminals are used. These are for H.T. positive and negative and L.T. positive and negative. The fifth terminal is only used when a second valve is added at a later date.

The SP2D valve has a seven-pin base and the grid which connects to C1 and R1 is brought out to top cap, so as to reduce the inter-electrode capacity of the valve making it more suitable for use on the very short waves.

Condensers C2, C3 and C4 are all of the tubular type mounted in the wiring so that it will be seen very few of the components need actually fixing. If the constructor does not intend to use more than one valve at any time then the chassis size can be reduced, but the existing chassis which is 6 in. square will take up to three valves, and it is intended to add these valves in subsequent issues. It must be remembered that the circuit as shown is only suitable for headphone reception and if a loudspeaker is to be used, a second valve must be added.

Coils should be obtained of the Eddystone type 959, and although five coils are needed to cover all wavelengths from 9 to 170 metres, these can be purchased singly if required. The two most important coils are the 6LB and the 6Y which tune from 12 to 47 metres, so covering most of the commercial and some of the amateur channels.

Power Supply

The total H.T. consumption of the receiver is about 3 mA., so that the smallest type of 60-volt battery will be suitable. Similarly the lowest capacity accumulator will have quite a long life owing to the low filament consumption of the recommended valve.

In order to obtain maximum efficiency use the heaviest convenient connecting wire, and a pair of high resistance headphones such as the Ericsson.

Components for The Beginner's First Receiver.

CHASSIS.
1 Wooden chassis 6 × 6 × 3 ins.

COILS.
1 Set 6-pin coils to cover 9-170 metres type 959 (Eddystone).

COIL HOLDER.
1 Type 6-pin socket type 964 (Eddystone).

CONDENSERS, FIXED.
1—.0001-mfd. type 690W (C1) (Dubilier).
1—.001-type 690W (C2) (Dubilier).
1—.001-mfd. type 690W (C3) (Dubilier).
1—.01-mfd. type 691 (C4) (Dubilier).

CONDENSERS, VARIABLE.
1 Tank condenser type 1042 (VC1) (Eddystone)
1 Bandspread type 1043 with dial (VC2) (Eddystone).
1—.0003-mfd. trimmer type 2150 (VC3) (Jackson Bros.).
1—.0003-mfd. trimmer type 2150 (VC4) (Jackson Bros.).

CHOKE, R.F.
1 Type S.W. 68 (Bulgin).

HOLDER, VALVE.
1 Type 7-pin chassis less terminals (Clix).

HEADPHONES.
1 Pair super sensitive (Ericsson).

RESISTANCE, FIXED.
1—5-meg-ohm ½-watt type (R1) (Erie).

RESISTANCE, VARIABLE.
1—100,000 ohm potentiometer (VR1) (Erie).

SWITCH.
1 Double-pole single-throw type S88 (Bulgin).

SUNDRIES.
1 Coil Quickwire (Bulgin).
1 Top cap anode connector (Bulgin).
1 Jack type J2 (Bulgin).
1 Plug type P2 (Bulgin).
1 Single fuse holder with fuse (Bulgin).

VALVE.
1 Type SP2D met. (Tungsram).

"An Acorn Valve 5-metre Receiver"

(*Continued from page 504*)

very considerably. Constructors who do not intend to use the receiver with a loudspeaker, can omit V4, merely connecting their headphones in place of R6, but a bleeder resistance will have to be connected across the total output of the power unit in order to keep the voltage steady at 180 volts, because the current flow will not be more than 8-10 mA. For field day use, this light load could easily be taken care of by means of a dry battery, so dispensing with a power pack. In such circumstances, a 6-volt accumulator will be needed for the filaments of V1 and V2, which can be tapped off at 4-volts for V3.

Constructional Points

There are several points in the construction which must be borne in mind. Firstly, owing to the greater increased diameter of the coils as compared with the original design, the coils will have to be mounted well down the screening boxes in order that they should not be effected by the metal lid when this is placed in position. The distance between the top of the coil and the bottom of the lid should be as great as conveniently possible.

By mounting the inter-valve transformer underneath the chassis the leads from the secondary to the volume control and from the volume control to the grid of V3, are kept very short. If this part of the circuit is carelessly wired, there is every possibility of L.F. instability being noticed. In the succeeding stage the components are mounted in the wiring so that they have to be short and rigid. Both condensers, C7 and C9, are of the tubular type, with one hole fixing, and they are mounted vertically as can be seen from the sub-chassis illustration.

Components for AN ACORN VALUE 5-METRE RECEIVER

CABINET.
1—Steel 11 by 8 9½ in. cabinet with lid finished black (Premier).

CHASSIS AND PANEL.
1—Steel chassis with brackets 10 by 9½ by 2 ins. finished (Premier).
1—Steel panel 11 by 7½ ins. finished black (Premier).

COILS.
1—Type 3-turn 1050 (Eddystone).
3—Type 4-turn 1050 (Eddystone).

COIL HOLDERS.
3—Coil holders ceramic type 1051 (Eddystone
3—Coil holders ceramic type 1051 (Eddystone).

CONDENSERS, FIXED.
1—.01-mfd, type 691 (C1) (Dubilier).
1—.01-mfd. type 691 (C2) (Dubilier).
1—.01-mfd. type 691 (C3) (Dubilier).
1—50-mmfd. type ceramic CDS1 (C4) (Dubilier).
1—.01-mfd. type 691 (C5) (Dublier).
1—.01-mfd. type 691 (C6) (Dubilier).
1—.5-mfd. type 4608/S (C7) (Dubilier)
1—.10-mfd. type 401 50 volt working (C8) (Dubilier).
1—.10-mfd. type 401 50 volt working (C9) (Dubilier).
1—.1-mfd. type 4603/S (C10) (Dubilier)
1—2-mfd. type BB (C11) (Dubilier).

CONDENSERS, VARIABLE
1—20-mmfd. type Apex (VC1) (Webb's Radio)
1—20-mfdm. type 978 (VC3) (Eddystone).

CHOKE- HIGH FREQUENCY.
1—Type 1011 (RC1) (Eddystone).
1—Type 20-henry to specification (LFC1) (Keston Manufacturing Co.,)

DIAL, SLOW-MOTION.
1—Type 1085 (Eddystone).

HOLDERS, VALVE.
2—Type ceramic acorn for American valves (Clix).
1—Type 5-pin chassis less terminals V1 (Clix).
1—Type V1 7-pin chassis less terminals (Clix).

PLUGS, TERMINALS, ETC.
1—Ceramic terminal block type 1046 (Eddystone).
1—5-awy plug and socket type 1260 (Belling-Lee).
1—2-way terminal strip type P54 (Bulgin).

RESISTANCES, FIXED AND VARIABLE
1—5-megohm type ½ watt (R1) (Erie)
1—50,000 ohm type potentiometer (R2) (Reliance)
1—20,000 ohm type 1 watt (R3) (Erie).
1—700 ohm type 1 watt (R4) (Erie).
1—100,000 ohm type ½ watt (R5) (Erie)
1—.5 megohm type ½ awt (R6) (Erie)
1—420 ohm type 1 watt (R7) (Erie)
1—500,000 ohm potentiometer (R8) (Reliance
1—500,000 ohm potentiometer (R8) (Reliance)
1—100,000 ohm potentiometer (R9) (Reliance)
1—50.000 ohm type 1 watt (R10) (Erie).

SUNDRIES.
2—Extension outfits (Eddystone)
3—knobs type 1089 (Eddystone).

TRANSFORMER, LOW FREQUENCY.
1—Special type 1/4 ration (Keston).

VALVES.
1—MH4 (Osram)
1—KT42 (Osram).
1—954 (Webb's Radio).
1—956 (Webb's Radio).

"Building a Stable Signal Generator"

(*Continued from page* 486)

higher frequencies, as will each successive coupling winding, and this difficulty is overcome by connecting fixed condensers in parallel with each winding to by-pass the higher frequency. No condenser is required for the 20-metre oscillator, there being no higher frequency to by-pass. The 40-metre oscillator has a small condenser and as wavelength increases the condensers become progressively larger in order to provide a low impedance for the frequency to be passed. The skeleton theoretical circuit illustrates the scheme applied to six valves. The output voltage is fixed by the value of R which is in series with 50 ohms, the output connection being taken from the junction of the two resistances.

The audio-frequency circuit consists of a triode oscillator feeding a triode providing choke modulation of all the R.F. valves. The audio oscillator is fed to the grid of the modulator via a condenser and potentiometer permitting adjustment of modulation. The power supply is drawn from the A.C. mains, a full wave rectifier supplying 250 volts at 60 m.a. for H.T. and a separate transformer employed for the heaters.

The battery operated audio oscillator has been retained for reasons already stated, the battery requirements being so small no great inconvenience is caused.

The complete generator has been in constant use for eighteen months and has so far been quite reliable.

An Open-Air Television Demonstration

AN interesting side-light on the modern receiver is shown up by the fact that an open-air television demonstration is being given at a Boy Scout Jamboree to be held at Letchworth Garden City on Friday, September 2, and Saturday, September 3. As television receivers are now so reliable and give an intensely bright and well-defined picture it has been found quite possible to give an open-air demonstration providing the face of the tube is slightly screened from direct light. The organisers of this Jamboree are going to use a standard H.M.V. receiver and contemplate having between 30 and 40 viewers at a time. This demonstration is to be entirely free and it is expected that it will be a great attraction as this is probably the first time that a television receiver has been used in the open-air at a charitable function of this kind. Although the receiver will be at least 32 miles from the television transmitter a simple aerial is to be used.

OPPORTUNITIES SECTION

BUSINESS :: EQUIPMENT :: EMPLOYMENT :: MISCELLANEOUS

The charge for miscellaneous advertisements on this page is 12 words or less 2/-, and 2d. for every additional word. Single-column inch rate displayed, 12/6. All advertisements must be accompanied by remittance. Cheques and Postal Orders should be made payable to Bernard Jones Publications Ltd., and crossed, and should reach this office not later than the 15th of the month previous to date of issue.

INDEX TO ADVERTISERS

Peto Scott broaden Sales Policy

In common with other radio firms now seeking fresh markets for new lines, the Peto Scott Co., Ltd., is in the process of broadening its sales interests to a considerable extent. A range of general merchandise of every description is being catalogued, and already includes bicycles, sports equipment, travel goods, the "Petovac" Vacuum cleaner, electric irons, electric safety shavers, electric clocks, cameras and household ware.

Established in 1919, and well known as leading suppliers of radio sets and components by mail, the company intends to develop its postal sales by intensified mail order methods coupled with national press advertising. In this connection, Mr. Graham Lomas has just been appointed sales and advertising manager. Mr. Lomas was associated for some years with the publicity department of Odhams Press Ltd., and recently resigned his position as chief copywriter of G. Street & Co., Ltd. (Serle Street). Street's will continue to place the Peto Scott advertising.

MISCELLANEOUS

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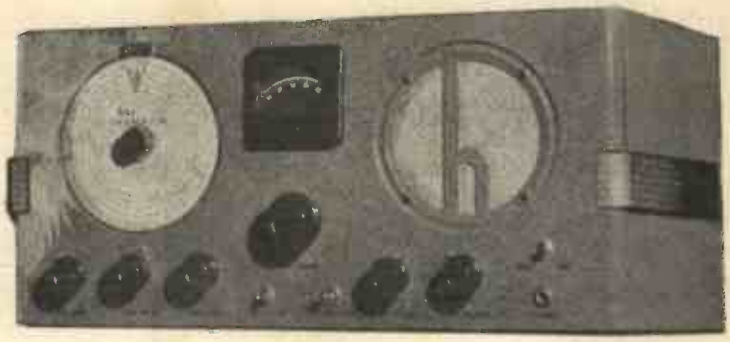

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