"TELEVISION" FROM DISC RECORDS

# TELEVISION

THE FIRST TELEVISION JOURNAL IN THE WORLD

# and SHORT-WAVE WORLD

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JUNE, 1935

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## TELEVISION

A De Luxe Cathode-ray Viewer

The Marconi Facsimile System Explained

Drawing Patterns with Electrons

First Description of Edison Bell Receivers

A Continuous Film Transmitter

The New Cossor Cathode-ray Tube

## SHORT WAVES

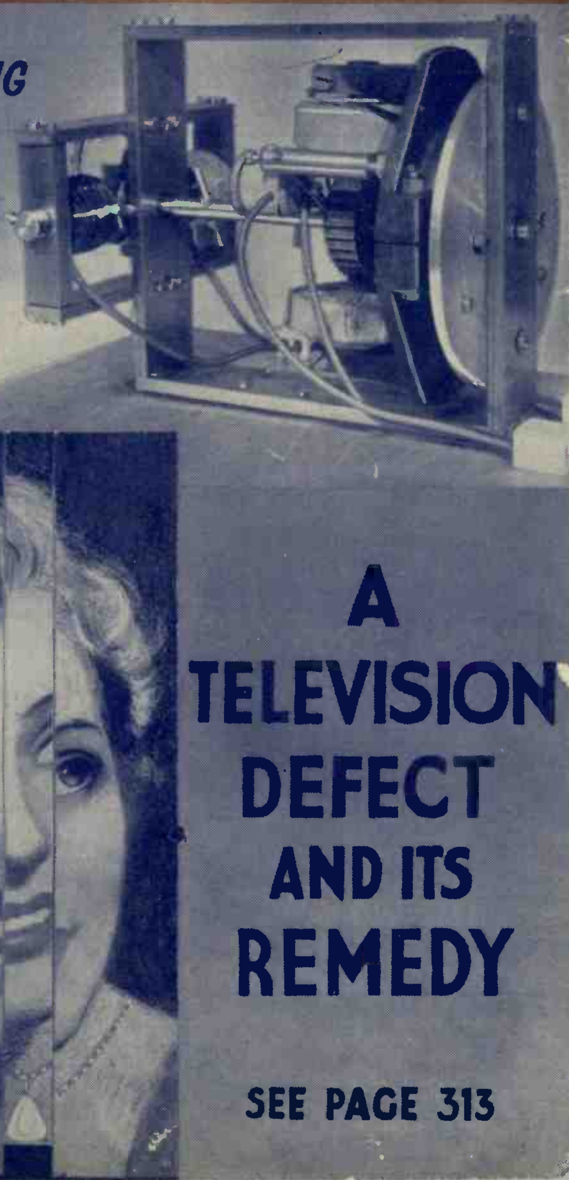
Modern Valves for Short-wave Receivers

A Short-wave Signal Booster

Short-wave Radio World Reviewed

5-metre Portable Rig

Tuned R.F. on Short Waves



SYNCHRONISING CATHODE RAYS FROM THE MAINS

A TELEVISION DEFECT AND ITS REMEDY

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# TELEVISION and SHORT-WAVE WORLD

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# *COMMENT OF THE MONTH*

## *What is the Cause of the Delay?*

ONE section of the Television Committee's Report stated that the Advisory Committee, which was set up according to a recommendation contained in the Report, should advise on: "The establishment of the essential technical data governing all television transmissions, such as the number of lines per picture, the number of pictures transmitted per second, and the nature of the synchronising signals."

Now although the Advisory Committee was formed within a few hours of the publication of the Report, four months have passed and up to the time of going to press with this issue of TELEVISION AND SHORT-WAVE WORLD, no announcement giving any information beyond that the Advisory Committee is meeting at certain times has been made. Various statements have appeared in the daily Press to the effect that the site of the first television station has been decided upon, but inquiries which we have made have proved these statements to be mere supposition or shrewd guesses No official information on the matter has been issued.

What is more important than the knowledge of the position of the first transmitter is an answer to the questions in the above reference. For want of this information the television trade is at a standstill. Immediately this information becomes available manufacturers can get right down to the problem of receiver design; under present conditions they are aware that any efforts which they might make will in all probability be labour wasted. If a high-definition service is to be available any time this year the need for this information is vitally urgent. We do not know whether the Advisory Committee proposes to make available technical data regarding the construction of receivers; we assume not, for this information doubtless is the property of the concerns which will be responsible for the transissions, but if any information of this nature is to be made public then it should be given without further delay.

There is another matter which should receive the immediate attention of the Committee, and this is the desirability of providing with as little delay as possible some test transmissions. Up to the present the only transmissions which have served any useful purpose to experimenters have been those put out from the Crystal Palace by the Baird Co., for their own research work. Arrangements should be made whereby either the companies which are to be responsible for the transmission systems, or the B.B.C., put out test transmissions at stated times. There is a definite feeling that there are retarding influences at work and that the recommendations in the Postmaser-General's Report are not being developed any too quickly.

**An Interesting Announcement appears on page 330**

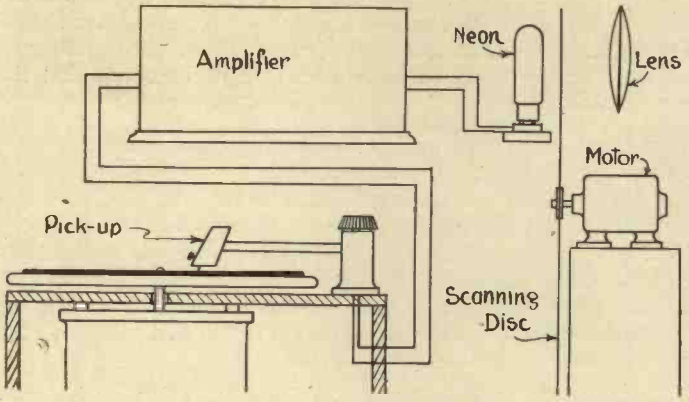
# "TELEVISION" FROM DISC RECORDS

*An article explaining the present possibilities of visual recording and its value for experimental purposes.*

THE idea of recording television pictures has always been intriguing, though it may not be apparent that the scheme has any commercial use. Actually, of course, it means turning light into mechanical vibration and then reconverting these into properly disposed light variations at any future time. Obviously the results obtained by such a process can more easily be carried out by other methods, as for instance the film in the case of moving pictures or the lantern slide in the case of "stills," and even with the most simple type of apparatus no doubt better results would be obtained.

The ability to reproduce a picture from a record by television methods may, however, be regarded as valuable from another point of view; it provides a ready means of experiment available at any time and any place. True, there are certain limitations imposed by the method of recording, but even with these a good deal of useful work could be done with some ready means of producing an artificial television signal in a simple manner.

Credit for the idea of recording television must go to J. L. Baird as he was the first to suggest its possibilities, and he also coined the word "phonovision." Records of transmissions were actually made in the Baird laboratories with the somewhat crude apparatus which was then available. Results were fair but the reproduced picture did not contain the detail that was in the original. The reason for this was that it was found impossible to record the comparatively high frequencies that are present in even a thirty-line television picture. Since that time other experimenters have worked on the idea, and in one case film has been used with a greater measure of success, for with film a much greater frequency range can be recorded. Cost, however, is one objection to this, and, in addition, there is the fact that special reproducing apparatus employing a photo-electric cell would have to be used for reconverting the recordings on the film; therefore the means employed would hardly be worth while the results obtained. Suggestions have also been made for the use of paper tape, instead of film, with the idea of cheapening the actual record. Experiments that have been made show that this is feasible, but it does not do away with the disadvantage of the necessity of using somewhat costly and intricate apparatus for reproduction.




*The scheme for reproducing the recorded picture is quite simple, merely necessitating the use of any type of scanner and an amplifier or wireless set.*

It appears then that at the present time it is only practicable to make use of the ordinary type of record in conjunction with a pick-up and be content with imperfect reproduction of a picture containing a fair amount of detail, or to make a record of a fairly simple subject with the knowledge that it will be possible to reproduce this with a very good degree of accuracy. Records of this last-mentioned type are now available, having been placed on the market by the Major Radiovision Co., 10 St. Christopher's Place, London, W.1. Up to the present lantern slide subjects have been used for the recordings and the pictures therefore are "stills." As there are no very high frequencies required in their reproduction excellent results are obtainable with ordinary television apparatus such as the disc and the mirror-drum.

A feature of these records is that a synchronising signal has been included so that synchronism can be attained by use of the usual gear, or by simple hand control; in cases where a synchronous motor is employed for the gramophone an eight-tooth wheel fitted on the shaft of the scanning motor will provide perfect synchronism.

## *Some Curious Effects*

The records are the standard 10-in. type and the recording has been done at 78 revolutions per minute. Imperfect synchronism results in the pictures slipping frame by frame rather quickly, but it is easier to correct them than in the case of an actual television transmission; as the frames slip the picture moves to one side or the other, becoming split in the usual way. It is also noticeable that it is much easier to resolve the picture in the case of the recorded image than it is when a television transmission is being received, in fact there is practically no difficulty in obtaining the picture on the television receiver screen.

Another interesting feature in connection with record reproduction is that positive or negative pictures can be obtained at will, simply by changing over the pick-up leads. Most ordinary wireless receivers or amplifiers can be used for providing the modulation when reproducing from records, and, of course, the same requirements obtain in the way of high-tension that apply to ordinary television reception. It is not claimed that record reproduction has much entertainment value, for, as was mentioned earlier, better results are obtainable more simply by other methods, but the system provides means of experiment for those who find the present transmissions inadequate, or owing to their situation have difficulty in making use of them.

# THE "DE LUXE" CATHODE-RAY TELEVISION VIEWER

*This article commences the actual construction of the cathode-ray receiver of which brief details were given last month. It has been designed so that it can be used for the present thirty-line transmissions and be adapted with very little trouble for the high-definition service when this comes into operation. The receiver is thoroughly up to date, entirely self-contained, and makes use of the new high-vacuum tube.*

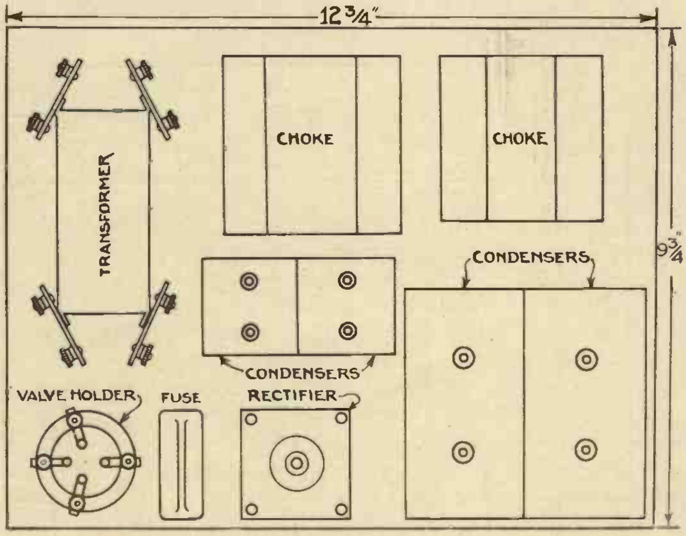
FROM the photograph which appears on this page readers will be able to judge of the neat and business-like appearance of the cabinet of the "De Luxe" viewer. The difficulty of accommodating a long tube in a cabinet of normal dimensions has been mentioned before, and it will be seen how the problem has been solved by the arrangement of the tube across the cabinet.

A hinged door at the side of the cabinet holds a mirror on its inner surface and by adjusting the angle of the mirror the image is clearly visible to observers sitting in the front. The cabinet is a standard radio-gram type supplied by Peto Scott, Ltd., altered as will be described.

If direct vision is required the cabinet can be turned through a right angle and the door swung back to expose the tube screen. The direction of scan is altered at the same time by a changeover switch so that the image will be scanned the right way.

The tube and the time-base circuit are mounted on a baseboard carried on battens inside the cabinet. Enough room is left at the end above the tube to accommodate one of the receivers, the other being mounted on the floor of the cabinet. The loudspeaker is behind the grille shown.

*The arrangement allows of the image being viewed in a mirror at the side of the cabinet or directly, as may be preferred.*




*Plan of the layout of the H.T. and L.T. unit.*

## Controls

As far as possible the controls have been arranged so that final adjustments can be carried out with the apparatus assembled in the cabinet. When the system of television is changed to 240 lines the baseboard is removed, a few alterations carried out, and the whole replaced ready for the higher definition.

Looking at the front of the cabinet the controls are:

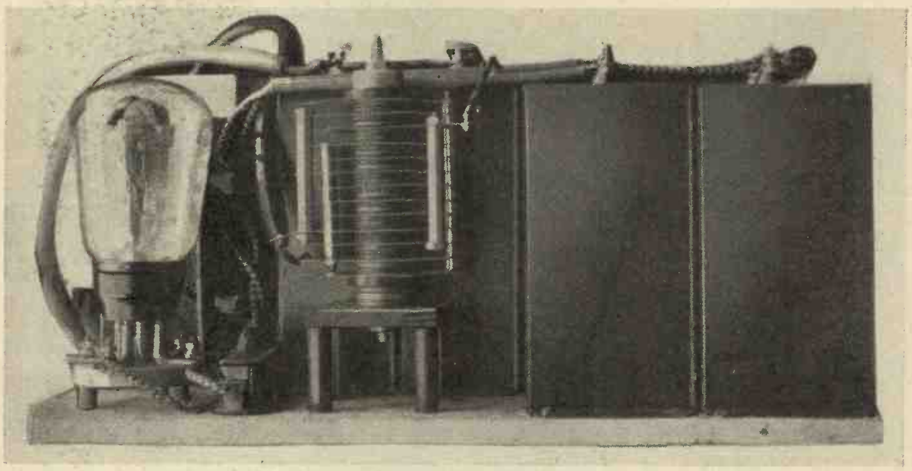
Focusing.
Modulation and synchronising (above).
Intensity (below)
Scanning speed.

The modulation and synchronising controls are two separate potentiometers ingeniously arranged on a common spindle with independent adjustment. At the back of the baseboard is mounted a bracket with length controls for the travel of the beam in both planes. The centring of the picture on the screen is done by means of the two knobs on the tube panel at the side of the cabinet. Once adjusted these need not be touched until a radical alteration is made in the circuit.

The components have been packed in as closely and neatly as possible and it is advisable to try the position of the final layout before wiring in order to make sure that nothing will interfere with the insertion of the tube or the baseboard in the cabinet. When assembly is carried out without the actual tube in position one is apt to overlook the room taken up, and a condenser may be pushed over too far.

## Baseboard

The baseboard for the tube and scanning circuit is cut from 5-ply wood to the dimensions shown. The recesses at the corners are to enable the baseboard to be fitted on the battens from the top of the cabinet without the potentiometer spindles fouling the front panel. The panel for the tube is fitted in after the baseboard is in place, and should be checked to see that it fits snugly against the uprights of the cabinet. The dimensions for the tube hole and those for the potentiometers are given in the drawing.



*This photograph shows the assembly of the H.T. and L.T. unit.*

## *H.T. Supply*

The use of a large cathode-ray tube in the viewer brings up again the question of high-voltage supply. For the best results on high-vacuum tubes at least 2,000 volts are required on the second accelerator, and the larger screen requires a correspondingly higher deflector-plate potential to produce the scan. The sensitivity of the high-vacuum tube is less than that of the gas-focused type, although its other advantages far outweigh this point. Nevertheless, this reduced sensitivity means that a high charging potential must be provided with an ample margin to take account of the reduction in sensitivity as the accelerator voltage is increased.

**COMPONENTS FOR THE EXCITER UNIT.**
"DE LUXE" CATHODE RAY VIEWER.

Ferranti Screening Box No. 1.
2000v. H.T. transformer No. T2000 (Andrew Bryce & Co.).
1 1.0-Henry choke, type T113 (Andrew Bryce & Co.).
1 100-Henry choke, type T100 (Andrew Bryce & Co.).
2 2000-mfd. type 501 condensers (T.C.C.)
2 4-mfd. type 131 condensers (T.C.C.)
1 Single fuse holder and fuse (Belling-Lee).
1 4-pin valveholder (Bulgin).
1 3 meg. resistance (Erie).

The sensitivity of the tube is inversely proportional to the accelerator potential, and this fact can be made use of at times to produce a close-up effect in the picture. If the overall H.T. voltage applied to the tube circuit is reduced the focus will not be altered, but the sensitivity will be increased. A normal size picture will thus be expanded to occupy more than the screen diameter, giving the effect of bringing the face nearer.

In the design the extra resistance for reducing the tube voltage has not been included for the sake of economy, but this point can be remembered and allowance can be made for a "stunt" if desired.

Since the high voltage has to be provided for the tube it is economical to make it serve the double purpose of supplying the scanning circuit as well, and accordingly this has been arranged.

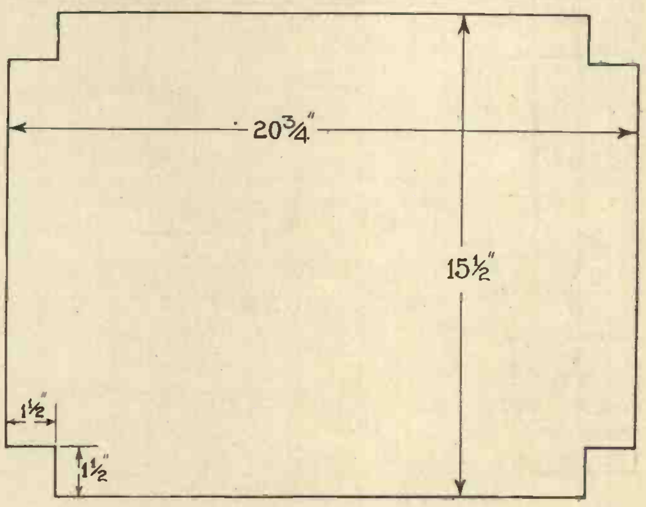
The scanning circuit is an adaptation and improvement of the resistance-condenser circuit described previously in this journal. The use of high voltage requires the best quality of components, and constructors are warned not to depart from the types and values specified unless they are experienced enough to know the variation permissible.

## *General Layout*

The criticism is often levelled at "serial" constructional articles that the constructional work is unduly prolonged and the thread of the plan is sometimes lost. With constructional work on high-voltage circuits it is of advantage to proceed gradually as it is essential thoroughly to test every part of the circuit before the final assembly. Faults in the wiring or assembly may have disastrous results in the case of cathode-ray circuits, and there is the disadvantage that one cannot explore inside the set with a finger when it is in operation.

When testing the circuits for the first time the greatest care must be taken to avoid touching any live part. Condensers in particular hold their charge for a long period after switching off, and if they are discharged by the usual expedient of holding a screwdriver across the terminals the handle should be insulated, or worse results will follow than if they were left alone to discharge.

The condensers in the H.T. circuit are fitted with a 3-megohm discharging resistance to prevent accidents as far as possible, but it must be remembered that this value of resistance takes an appreciable time to discharge the condenser, and at the expiry of 10 seconds or so the voltage is still over 1,000.




*Dimensioned details of baseboard.*

These warnings may seem unnecessarily stressed, but it is better to commence the construction with a clear idea of the possibilities of damage and shock from careless handling.

To protect everything as far as possible the H.T. unit is enclosed in a Ferranti screening box, which has a safety switch and fuses incorporated in the lid. The components are screwed on to a baseboard of 5-ply measuring 12¾ ins. by 9¾ ins., which will easily slip in the box.

A drawing shows the layout of the components and the marking out should be done carefully as there is only just enough room for all the parts on the baseboard.

## Exciter Unit

The cathode of the tube is supplied from an L.T. metal-rectifier and smoothed by a 1-henry choke and two 2,000-mfd. condensers.

The cathode is 2,000 volts " live " to the H.T. connections, so the components must be spaced carefully and the leads kept clear of the metal case and the H.T. smoothing components.

As an additional precaution the metal-rectifier itself is mounted clear of the baseboard on a paxolin or ebonite shelf. This can be cut from a piece of scrap sheet ¼ in. thick and mounted on four ebonite pillars to clear the baseboard. The sketch below shows a suitable arrangement. The rectifier is held by a nut screwed on the centre rod, which is passed through a 2 B.A. clearing hole in the paxolin. When the rectifier is mounted it should be turned so that the A.C. input terminals are nearest to the transformer.

The rectifying valve for the H.T. is an Ediswan M.U.2, which is inserted in an ordinary four-pin socket. As an additional safety device a fuse is connected between the transformer and the anode terminal of the valve socket. This is seen in the photograph, Fig. 3. The transformer itself must be screwed down with the H.T. winding nearest to the valve socket. Before screwing it down examine it carefully to see that all the terminals are tight and that no leads have become displaced in transit. Fig. 3 shows the wiring, which is quite simple and does not need a detailed print. It is advisable to solder every connection and soldering tags should therefore be clamped under the terminals of the component before they are screwed down.

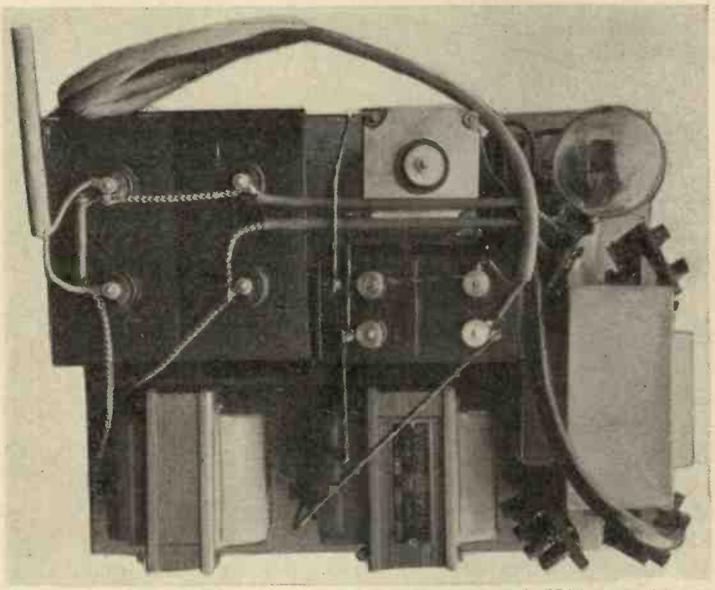
## Wire

Do not use cheap systoflex—it may catch fire! And remember that systoflex is not intended to withstand 2,000 volts, so don't let any wires cross without any air space in between. The following points in the wiring require particular care and must be inspected before the job is considered complete:

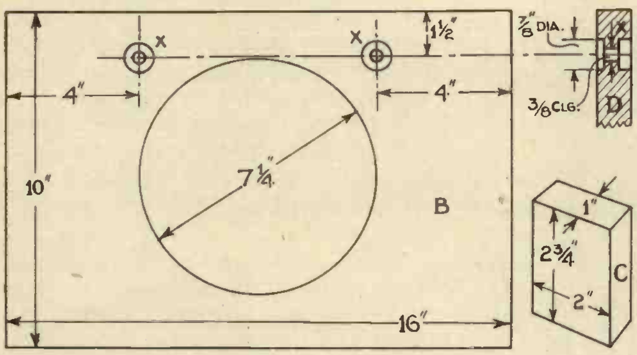
(1) The two output leads to the H.T. smoothing condensers must be quite clear of the metal rectifier and of the leads from it to its own smoothing condensers.

(2) The A.C. leads to the rectifier must be clear and well insulated from the H.T. leads to the condensers.

(3) The 3-megohm discharge-resistance, which is connected across the smoothing condenser must not touch the metal case.

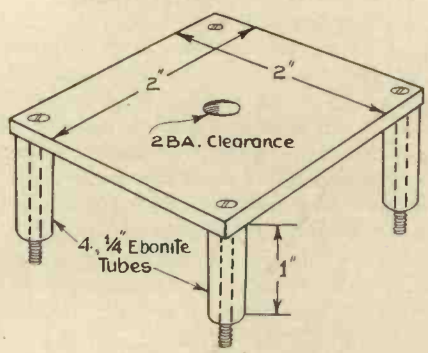


*A plan view showing the arrangement of the components of the H.T. and L.T. unit.*




*Left: Tube panel with two holes for potentiometers. The details of these holes are shown by the sketch D, and C shows the block for mounting the tube socket.*

*Right: Mount for rectifier.*




The remaining leads are in the air and are well clear of each other, so there is not much risk of a breakdown. When in doubt use two thicknesses of systoflex, one fitting over the other. No. 18 gauge wire is better than 20 gauge as it is more rigid and holds in position unsupported.

When the unit is completed, the mains leads should be connected and the rectifying valve put into the socket. Stand well clear of the unit and switch on. The rectifier should give a preliminary flash and then

(Continued on next page.)

settle down to a slight blue glow. Switch off and then cautiously short-circuit the condenser terminals on the H.T. side with an insulated screwdriver. The violence of the spark will probably alarm the experimenter who is unused to high voltages, but it will demonstrate that the H.T. is being applied to the circuit and that everything is in order.

A quieter and more certain way is to use an electrostatic voltmeter. If a milliammeter is handy it can be converted to indicate H.T. volts by adding several megohms in series. One reading from 0-1 mA. is best —a higher range meter will impose too much of a load on the transformer and give a wrong reading.

1,000 volts applied to 1 megohm will give 1 mA. so the series-resistance should be 2 megohms for a full-scale reading of 2,000.

Remove the fuseholder from the fuse on the baseboard (thus cutting off the H.T. supply to the valve) and then test the L.T. rectified supply with a low-reading voltmeter across the second smoothing condenser.

If everything is in order, leave the unit switched on for a short time with both H.T. and L.T. in order to make sure that no accidental contacts develop which may cause trouble later. Then remove the valve and fit the baseboard in the box. The board will be heavy and difficult to fit in owing to the safety switch in the front of the box, so the best plan is to lay both the box and the baseboard on their sides and fit them in that way. Or a loop of tape can be passed round the baseboard to serve as a carrying strap.

### *Connecting Leads*

Five pairs of connecting leads will be required from the unit:

Three 4-volt for the scanning circuit valves, H.T. lead for the tube and scanning circuit, L.T. lead for the cathode.

The three 4-volt leads can be ordinary flexible lighting leads cut to a length of about 2 ft. These are connected to the terminals on the transformer just before the baseboard is put in the box. At the same time a pair of leads are connected to the correct mains tappings, since they will be inaccessible when the baseboard is lowered to the bottom of the box.

The H.T. lead is left till the base is in position, and is connected to the outermost terminals of the H.T. condenser pair.

Ignition cable is the best for this purpose and can be obtained from the motor dealers. A similar length of cable is used for the L.T. connections, which are made from the terminals of the 2,000-mfd. condensers nearest the transformer. The cables are then brought out through the holes in the side of the box.

The mains leads are then connected to the safety switch and the lid closed. The unit is once more switched on to see that everything is all right and then left for the remainder of the construction to be proceeded with.

### *A New Rectifier*

Since the design of the exciter unit was completed we understand that the Ediswan Co. have modified the construction of their M.U.2 rectifier, and the anode connection is now at the top of the bulb. This will, of course, make no difference to the layout of the valveholder, but a flexible lead will be taken from one end of the 2,000-volt transformer to the cap on the valve instead of to the anode terminal on the valveholder. At the same time this removes the necessity for high insulation valve-holders and a standard 4-pin holder may be used on the baseboard.

(*To be continued.*)

## Facsimile Transmission

VERY substantial progress has been made in the last year in high-speed radio facsimile.

The ultimate possibility of transmitting entire pages of hand written or typewritten letters by radio facsimile is discussed in the 1935 report of the Radio Corporation of America.

"Progress in facsimile transmission," the R.C.A. report states definitely, "has reached a stage where communication by the square inch, instead of the traditional Morse code methods of dots and dashes on a word basis, has been achieved and demonstrated on an experimental basis. This development promises new point-to-point communication services, and new broadcast services to the home, of pictures, printed matter and other visual material."

Messages can now be transmitted by facsimile, instead of by the spelling out of words, and almost every kind of specialised communication can be flashed through the air and put in the recipient's hands in exactly the same form in which it left the transmitting office.

## Television Tests in U.S.A.

### Suggested £200,000 Scheme

ACCORDING to the New York correspondent of the *Daily Telegraph* the United States is about to start television tests on a large scale.

At the annual meeting on May 7, of the Radio Corporation, Mr. David Sarnoff, the president, told stockholders that his company had decided to spend £200,000 "to take television out of the laboratory."

A three-point programme has been determined:

(i) The construction of the first modern television plant in the United States.

(ii) The manufacture of a limited number of television sets to be place at strategic places.

(iii) The development of a programme service with the necessary studio technique to determine the most acceptable form of television programmes.

The experiments are expected to take at least 15 months, and the New York headquarters will probably be the 100th floor of the Empire State Building, where an experimental transmitter has already been in use for several years past.

Visual programmes will at first only be available in thickly-populated cities, where a single transmitter erected on some high point can serve a comparatively large number of "lookers." Ultra-short waves will be used in the tests, with a range limited to 25 miles, says this correspondent.

# SYNCHRONISING CATHODE RAYS FROM A.C. MAINS

**By R. L. Ashmore**

*This article describes the construction of an electro-mechanical piece of apparatus which will enable a cathode-ray tube to be synchronised from A.C. mains, producing the same results as are obtained when the mains are used for synchronising mechanical receivers. Tests have shown that the apparatus works perfectly.*

MANY people assume that synchronising with the cathode-ray tube is a simple matter and that with its use the trouble associated with mechanical scanners will disappear.

*Fig. 1.—This faked photograph shows how a bright object will cause a portion of the picture to shift.*

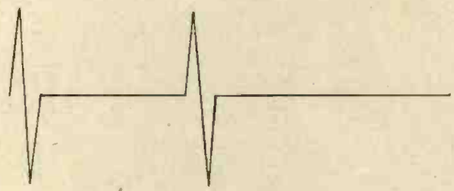
Those who have used the cathode-ray tube, however, have found, among many other things, that synchronisation is just as difficult, and with the added difficulty of synchronising in both directions, vertical and horizontal or line and picture. One also quickly realises that, as in the case of mechanical receivers, the cathode-ray tube holds best on a blank screen, and with single full-length figure a close second. In both receivers "close-ups" are the most difficult. Now the effect of different subjects on the synchronising is not the fault of either type of receivers, but in general the system of synchronising at present used on the broadcast television signal. To go into the whys and wherefores of this, however, is not the purpose of this article. Readers who are interested should refer to the article which appeared in the November, 1934, issue.

In that article it was pointed out that the picture-signal itself produced spurious synchronising pulses, which either cancelled or took control over the proper signals. This effect can often be seen on a close-up picture in which the artist makes use of the hands. If they are near the bottom of the picture, it will have the effect on a cathode-ray receiver of tripping the line time-base for too long a period, with the result that the image, above the hand, appears displaced somewhat, as shown in Fig. 1. Further distortion may develop if any strong signal is produced along the 29th, 30th, 1st and 2nd lines, which affects the picture time-base. Little can be done in the matter by those who live outside the London area who must depend on the broadcast signal to improve matters, but those who have available the same A.C. mains as those which control the B.B.C. transmitter, have a second channel, so to speak, to synchronise on.

## *Synchronising Frequency*

A frequency of 50 cycles is not convenient itself to operate the cathode-ray time-bases, and it must be changed. In the present 30-line broadcast television signal the synchronising signal is 375 cycles, and in form far from a sine wave. The synchronising signals consist of a sharp positive-negative pulse with relatively long gaps (which is filled by the picture-signal) between them, those from a blank screen being

*Fig. 2.—A graph of the synchronising impulse.*



something like Fig. 2. These pulses are generated by the light spot being extinguished between each line. They can, however, be closely imitated by driving the familiar 30-toothed synchronising wheel between its own pole-pieces, and if we drive such a wheel at 12.5 revolutions per second we shall get the necessary 375 impulses. Such a method was adopted by the writer. Figs. 3 and 4 show general views of the apparatus. It consists of a Baird synchroniser as was fitted on that company's early disc receivers, driven by a synchronous motor. This motor is made from a Mervyn eight-toothed synchronising wheel as the rotor, driven by a

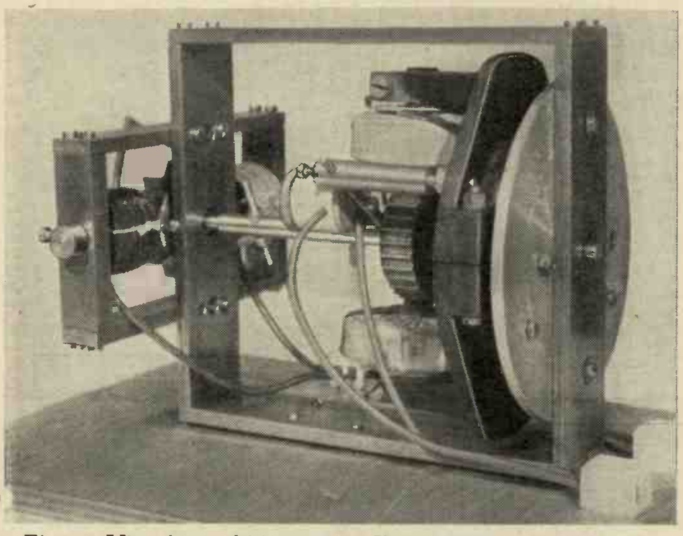


*Fig. 3.—View showing driving motor. China connectors are used instead of terminals.*

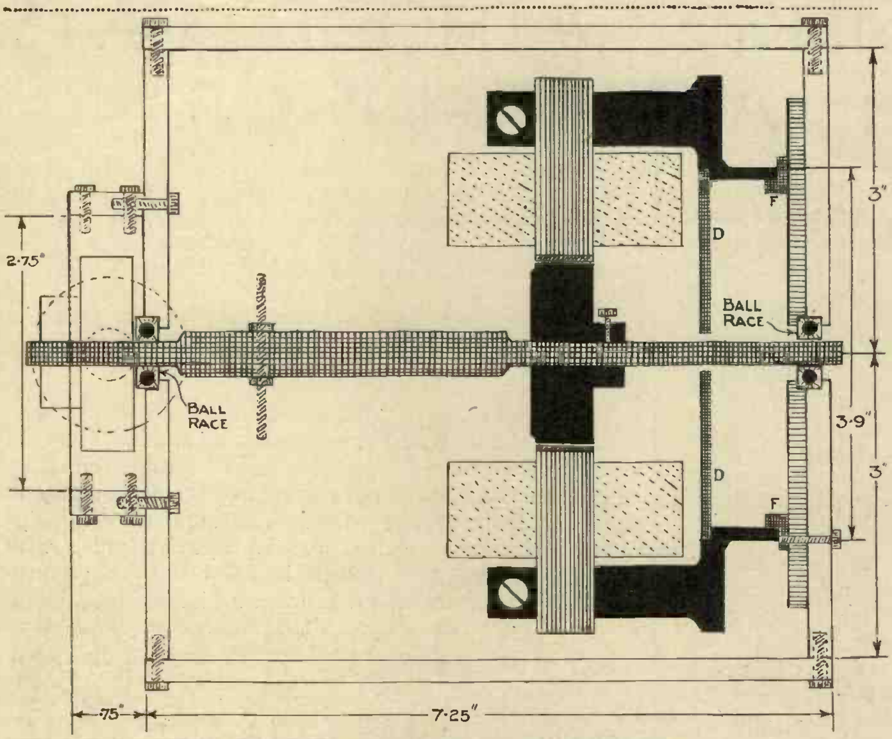



*Fig. 4.—A sectional constructional drawing of the apparatus.*

two-pole stator; it is not self-starting. There is also a 12.5 pulse generator which was added at a later date.

Fig. 4 shows a sectional constructional view. Starting with the shaft, this was turned down at each end from $\frac{1}{2}$ in. brass rod to $\frac{1}{4}$ in.; it runs in ball bearings. Mounted on this shaft just to the right of the centre is the Baird 30-toothed wheel (black); the pole-pieces and coils are shown line and dot shaded, the supports being black. These main supports rotate round a flanged disc FF, being held in position by a round disc DD through which the shaft runs with relatively wide clearance. The disc is held by two bolts parallel with the shaft and therefore not shown, though their positions can be seen in the photographs. These discs and flanges are made of brass and aluminium. The main rectangular frame is built from $1\frac{1}{2}$ in. by $\frac{1}{4}$ in. mild steel strip. In the drawings the mild steel is in all cases left unshaded. The driving section on the left is outside the main frame, the reason for this being to keep the two sets of coils as far apart as possible and so eliminate any induction of 50 cycles into the 375 coils. These coils are at right angles to each and so is the 12.5 one for the same reason (not shown in Fig. 4). Details of the driving section are best seen in Fig. 5.

As stated before, the 8-toothed wheel is a Mervyn, originally marketed so that it could be substituted for a 30-toothed one and enable those persons who are on the same A.C. mains as the transmitter to synchronise from the mains, which are fed into the usual synchroniser coils. In the instrument described the pole-pieces and supports had to be made. The poles are made out of $\frac{1}{2}$-in. round mild steel, the points of which were roughly cut by a hacksaw and then filed. They are, of course, adjustable.

The rectangular supporting frame is of .75 in. wide mild steel, the horizontal sections being $\frac{1}{4}$ in. thick, and the vertical $\frac{3}{8}$ in. The coils are wound with 30 s.w.g. wire d.c.c., about 2,500 turns being used on each pole. It will be noticed that the coils appear self-supporting except for four binding strings, this was done for no special reason except that it was simple.

The method of winding was as follows. The pole-

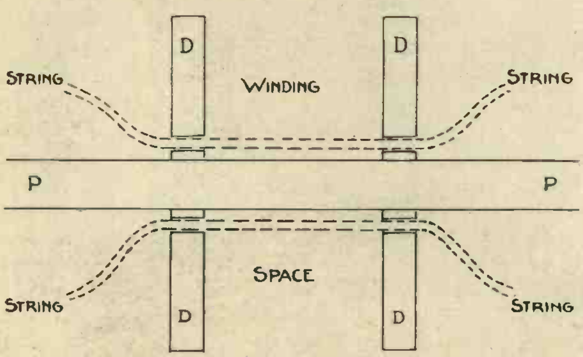



*Fig. 6.—Diagram showing the method of winding the coils.*

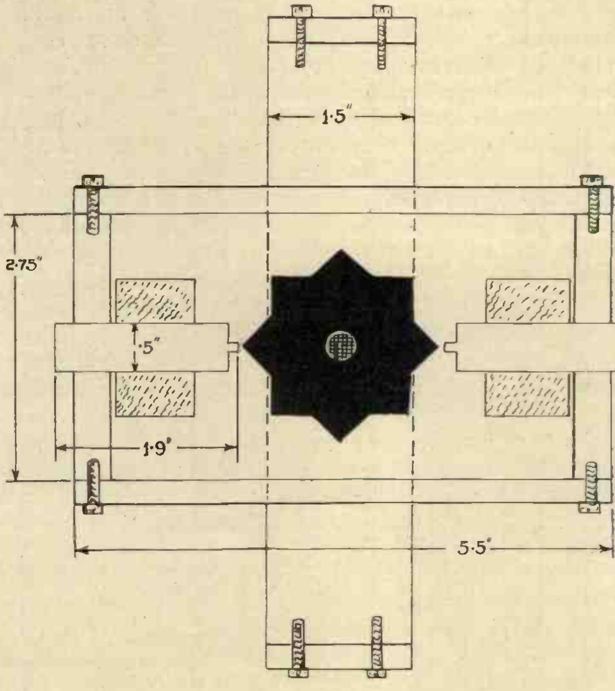



*Fig. 5.—Details of the driving section.*

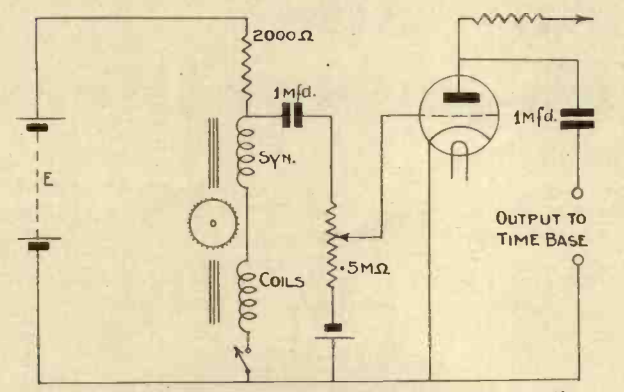



*Fig. 7.—One-valve amplifier and method of connecting to coils.*

piece PP was fitted with two wood discs DD, DD, Fig. 6. A single layer of tape was wound on first, then four strings threaded, as the two shown in the sketch, through the wooden end pieces. After the wire was wound on the two wooden ends were very carefully removed and the strings tied tight. A few dabs of "Durofix" completed the coils.

Two points of construction must be carefully noted, first everything must be true, both toothed wheels must run concentrically and without wobble. To get the final balance a short piece of threaded 4 B.A. rod with two adjusting nuts is used.

The fact that the 30-toothed wheel has three locking screws is an advantage which should be made full use of, unfortunately the 8-tooth wheel is supplied fitted with only one and it is advantageous to fit two others. The second point is use good quality ball-races, a pair of cheap ones were first fitted, which resulted in "hunting." Good ones, such as Hoffmans, cost about 2s. 4d. each.

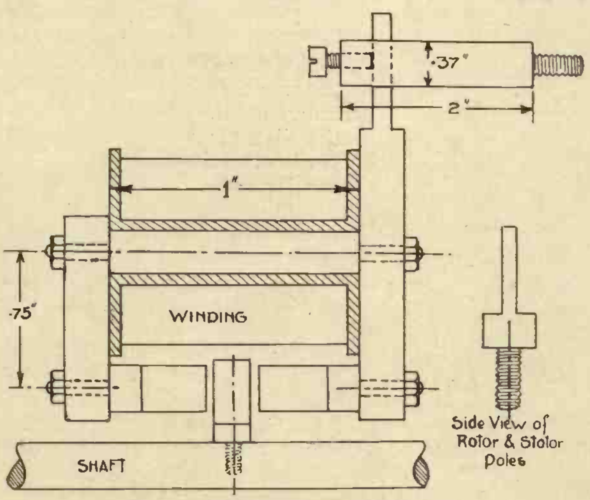



*Fig. 9.—Details of additional generator.*

## *Starting the Motor*

No provision has been made for starting the motor; though the spindle was drilled to take a piece of string to start the machine like a top it has been found better to give the driving rotor a sharp twist with the fingers. While it may not start the first time, practice quickly makes perfect. It is possible for the motor to run at half speed—6.25 r.p.s., but this is quickly realised.

The coils will stand 240 volts input, but pass more current than is desirable, the motor running best with about 110 volts across the winding. It is advisable to experiment with various lamps in series for best results, which are obtained with just sufficient power to run, though in this condition starting is not too easy. A sliding resistance, of about 400 ohm maximum would be ideal as the current can be reduced once the motor is running.

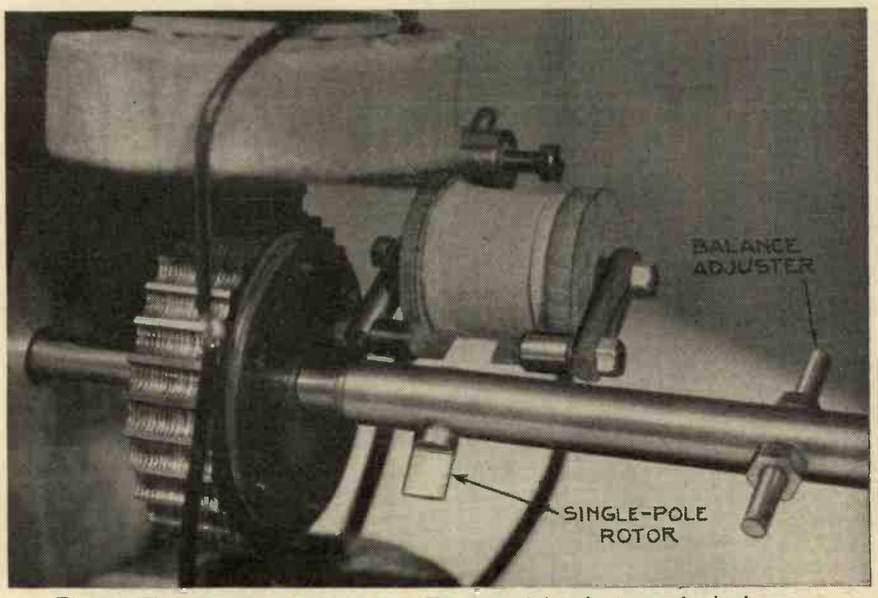



*Fig. 8.—Close-up of 12.5 cycle generator. The shape of the pole piece can be clearly seen.*

This small motor generator was first run as described, that is to say, the input 50 cycles—output 375, the output coils being connected as Fig. 7, and the signal put into the time-base input. Now, as the two time-bases for 30-line reception can only be operated from one set of impulses—375, the picture time-base is trigged by every 30th line impulse. This works fairly well, but to improve matters another generator was added, giving 1 to every 30. This addition can be seen in the general photographs, while a "close-up" is shown in Fig. 8 with sectional constructional details in Fig. 9.

The signal from this impulse generator can be either super-imposed on the first one or applied separately. If applied separately the time-base circuits will obviously have to be slightly altered. It is hardly necessary to add that both sets of impulses must be set in step by physical positioning of the single rotating pole with some definite tooth on the 30-line one.

In Fig. 7 a one-stage valve amplifier is shown, while this can be dispensed with by increasing the current through the coils, this, however, is not recommended as "hunting" may result.

# The Design of Low- and High-pass Filters

*By G5ZJ*

THERE are two important characteristics to be considered in designing a filter to combat any particular problem. First, the surge impedance and, secondly, the required cut-off frequency. By surge impedance I mean the impedance a filter would offer at the input terminals if it were particularly long, that is, if the filter were made up of several sections.

By a combination of inductance and capacity, filters can be made broadly to cut off at any given frequency, although if a sharp cut-off is required, such as for needle scratch or heterodyne filtering, a multi-section filter is required.

A high-pass filter, such as is shown

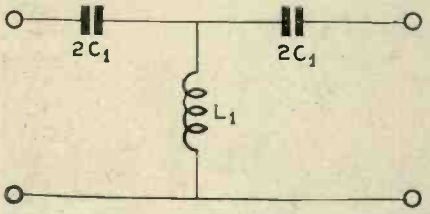



*Fig. 1.—Here is a typical section of a high-pass filter, the values of inductance and capacity determining the cut-off frequency. Several sections can be linked together to increase the sharpness of cut-off.*

in Fig. 1, with an inductance $L_1$ and capacities $2C_1$ in each section can be made up in several sections so as to increase the sharpness of the frequency cut-off. Incidentally, this arrangement is called T formation. As the two capacities $2C_1$ are connected in series, the capacity per section is only equal to $C_1$, the same as one section of the actual filter. For this section the frequency cut-off is given by

$$Fo = \frac{1}{4\pi\sqrt{L_1 C_1}}$$

while the surge impedance for an arrangement as in Fig. 1 can be obtained from $Zo = \sqrt{\frac{L^1}{C_1}}$.

By combining these two equations we obtain $C_1 = \frac{0.0796}{ZoFo}$ farad

and $L_1 = \frac{0.0796\ Zo}{Fo}$ henry.

To make a filter perform properly, the resistance of the load circuit must be the same as its surge impedance. Putting this another way the filter must be designed so that it has a surge impedance equal to the resistance of the load into which it is to work. This means that the surge impedance, in addition to being equal to the load resistance, also ensures that there will be no reflection of energy from the end of the filter.

The ratio of voltage and current of a cycle of electric energy travelling along the filter is given by Zo, the surge impedance. When this pulse meets the load resistance, R(R = Zo), all of its energy is at once absorbed by this load.

A low-pass filter, as shown in Fig. 2, can be made up of sections having the same inductance as each actual coil of the filter and two condensers, each half having as much capacity as the actual filter condenser. This type of line-up is called a $\pi$ section.

The cut-off frequency can be calculated from $Fo = \frac{1}{\pi\sqrt{L_2 C_2}}$, while the surge impedance can be obtained from the formula $Zo = \sqrt{\frac{L_2}{C_2}}$, from which we can obtain $C_2 = \frac{0.318}{Fo\ Zo}$ farad and finally $L_2 = \frac{0.318\ Zo}{Fo}$ henry.

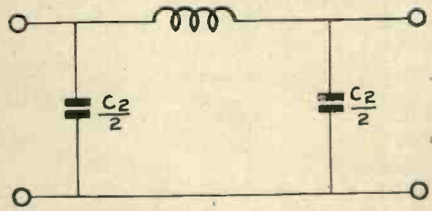



*Fig. 2.—A low-pass filter of this type is made up of sections having the same inductance as each actual coil in the filter and two condensers each having half as much capacity as the actual filter condenser.*

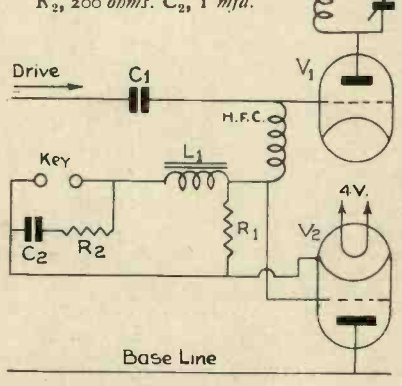
Notice that the cut-off frequency of the high-pass filter has an inductive reactance of $2\pi fL_1$, equal to half the load resistance and a capacitative reactance equal to twice the load resistance.

# Key-click Elimination

*By G2DV and G5BJ*

IN densely-populated areas the key-click problem is a very real one with the amateur transmitter. Curing the trouble by means of a trap circuit in the B.C.L. antenna lead becomes rather a nuisance after the first half-dozen have been installed, and such traps absorb a considerable amount of the radiated power. Primary keying is a very poor solution, for while the signal at the middle of a "dash" may be good strength at DX, the dots are in many cases inaudible. A good instance of this is the high-power station W6QD, whose kilowatt input a few days ago varied from R8 to R3 during keying.

*$R_1$, ½ megohm. $L_1$, 10-20 henries. $R_2$, 200 ohms. $C_2$, 1 mfd.*




After trying literally scores of so-called cures without success, the writers discovered a method which is absolutely clickless. The stage following the crystal oscillator is keyed by means of an indirectly-heated valve. Bias to a valve of this type may be obtained by means of a cathode-resistance, and it is this property that is utilised in the keying arrangement.

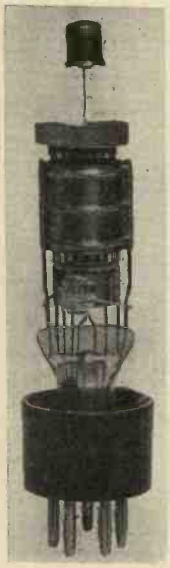
In the diagram $V_1$ is the doubler or buffer following the C.O. (parallel feed is shown here, but the system may obviously also be applied to a link-coupled arrangement).

As grid current only is being keyed, and as this is accomplished by shorting the resistance bias $R_1$ of the control valve $V_2$, it will readily be seen that the actual current keyed is exceedingly small. To remove the last trace of click the normal L, C and R arrangement ($L_1$, $C_2$, $R_2$) has been added. As $L_1$ remains as bias to the control tube when the key is closed it should obviously have as low a resistance as possible. $V_2$ may be any high-impedance triode of the AC/HL class.


*This valve, the X41, is primarily intended as a frequency changer in ultra-short wave receivers.*

# Modern Valves for Modern Receivers

By Kenneth Jowers



*The two diodes in this WD40 are screened by the circular container beneath the main lectrode assembly.*

*Here is some very important information regarding two new Marconi and Osram valves. In addition the correct operating data is given for the Mazda battery-operated triode pentode.*

In the May issue some information was given on the use of a heptode valve as a first detector, with a separate triode oscillator. This arrangement is, of course, an ideal one for ultra-short wave working. I had no idea at that time that a new valve would shortly be released that would combine the functions of a triode and a heptode, so enabling home constructors to design short-wave receivers to operate quite efficiently down to 7 metres.

This new valve, the Triode Hexode, has been designated by the Marconi and Osram Cos. as the X41. It is a multi-electrode valve specially designed to operate in the first detector or frequency-changer positions at high frequencies in super-heterodyne receivers. Actually, it is rather similar to the heptode, but it is capable of performing several functions more efficiently than can the heptode. Characteristics of the X41 are approximately as follows:

| | |
|---|---|
| Filament volts | 4.0 volts |
| Filament current | 1.2 amps. approx. |
| Control grid-anode capacity | 0.06 micro-microfarad. |
| Anode-earth capacity | 21.5 ,, ,, |
| Control grid-earth capacity | 7.0 ,, ,, |
| Oscillator grid-oscillator anode capacity | 2.6 ,, ,, |
| Oscillator anode-earth capacity | 9.25 ,, ,, |
| Oscillator grid-earth capacity | 17.0 ,, ,, |
| Oscillator grid-control grid | 0.2 ,, ,, |

One of the features of this triode hexode is that the triode section has a much steeper slope than is possible with a heptode valve. In practice, this slope is almost twice that of the triode section in the MX40. It will be realised that the triode hexode is therefore capable of giving a much greater gain and its higher anode impedance will cause less damping to the tuned circuit connected to it.

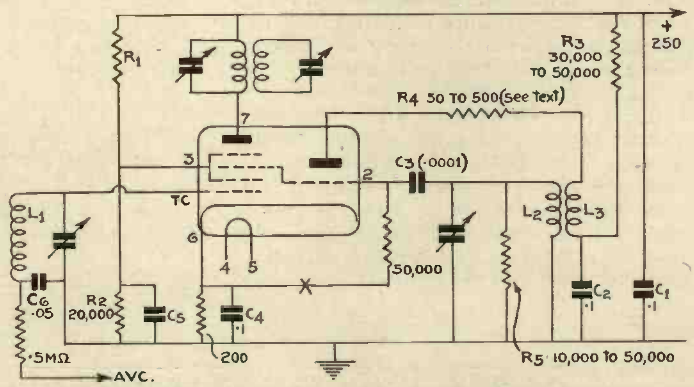



*Fig. 1.—A triode pentode is an ideal valve in a 28 mc. receiver. This is the best circuit and includes provision for A.V.C.*

A typical circuit showing application of this valve is illustrated in Fig. 1. A positive potential is fed to the screened-grid through a low-resistance potentiometer R1 and R2. Normally, 75/80 volts are required on the screen, and this comparatively low voltage gives quiet operation, low anode current, coupled with a higher impedance and practically no reduction in conversion conductance.

H.T. to the triode anode is fed through a separate resistance R3. It is not possible to give the exact value for this resistance as it depends on the design of the oscillator coil. This

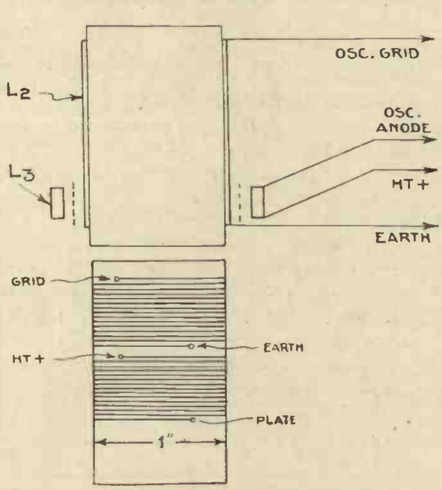



*Fig. 2.—Although the coil construction need not necessarily be on conventional lines, it is suggested that this type of former be used.*

should be so designed that the optimum oscillator voltage—15 volts peak RF—is obtained with 80/100 volts on the triode anode. As a matter of experiment, an average value for R3 is 40,000 ohms.

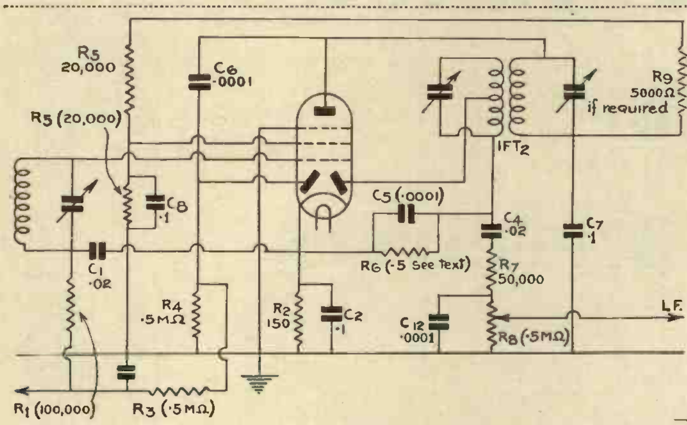



*Fig. 3.—The WD40 double-diode pentode can be used in this circuit for H.F. amplification, diode detection, and A.V.C.*

If, due to the design of the oscillator coil, conversion conductance does not remain sensibly steady, this may be overcome by using either or both the following variations.

1. A series resistance R4 to reduce the oscillator voltage; the reduction will be much greater at high frequencies than at low frequencies. A variable resistance of between 50 and 500 ohms is recommended.

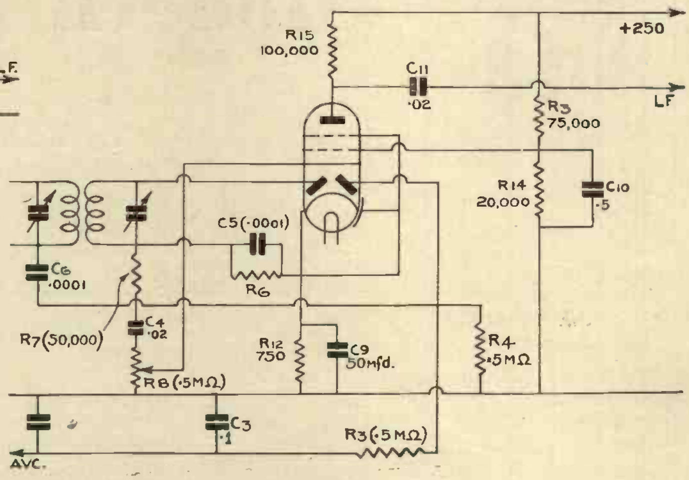
2. A shunt resistance R5 will prevent the dynamic resistance of the oscillator-tuned circuit from rising rapidly when the tuning condenser is reduced in capacity. A suitable value for this resistance is between 10,000 and 50,000 ohms, the best value being determined by experiment. It is of importance to keep the oscillator voltage at approximately 25 volts on the lower frequencies, because at this point the third harmonic of the oscillator is almost zero, so heterodyne whistles will be negligible.

In Fig. 2 is shown a suggested method of constructing the necessary coils. The formers are 1½-in. paxolin, obtainable from Wright and Weaire. The long-wave coils between 540 and 12,000 kc. are close-wound with 32-gauge S.W.G. From 10,000 kc. to 30,000 kc. space-wind 20-gauge S.W.G. half the diameter of the wire. Winding data, assuming the use of I.F. transformers having a frequency of 465 kc. and a tuning condenser of 350 microfarads, are as follows:

| Frequency. | Inductance. | | No. of Turns. 1 in. former. | | | No. of turns. 1¼ in. former. | | | Padding Condenser Semi-variable. |
|---|---|---|---|---|---|---|---|---|---|
| | R.F. | Osc. | R.F. | Osc. Grid | Plate | R.F. | Osc. Grid | Plate | |
| 540–1600 | 230 | 110 | 127 | 68 | 25 | 108 | 54 | 20 | .0003/.0005 |
| 1500–4500 | 28 | 20 | 30 | 22 | 12 | 23 | 18 | 10 | .001/.0015 |
| 4000–12000 | 4.5 | 3.3 | 16 | 12.5 | 9 | 12 | 10 | 8 | .006 |
| 10000–30000 | .72 | .53 | 4.5 | 3.75 | 5 | Not recommended | | | Not required |

This X41 appears from my experiments to be a really useful valve, but does not seem to be suitable for 5-metre working unless a separate oscillator valve is used. Certain sample valves do operate down to 46 megacycles, but this is not to be relied upon. However, with this valve in the first detector-oscillator position an all-wave super-het tuning from between 7 and 2,000 metres can easily be made.

*Fig. 4.—As an L.F. amplifier, followed by a diode detector, very high stage gain can be obtained. This is a typical circuit on those lines using a WD40.*




It is unusual for one company to produce two new valves simultaneously, but I must make reference to the new Osram WD40 double-diode screened-pentode valve. This valve operates very effectively as a diode detector, high-frequency amplifier and automatic volume-control valve. Incidentally the pentode section, although of high impedance, may be used at either radio or audio frequencies, while as the two diodes are completely screened from the pentode section they can be used for a multiplicity of purposes. They can, of course, be used separately or together.

The A.C. resistance of the pentode section of the WD40 is approximately 700,000 ohms and, as the mutual conductance is 2.6 milliamps per volt, a theoretical amplification of 1,820 is given. The pentode section has a variable grid base and with a negative voltage of 30 on the grid the mutual conductance is reduced to .3 milliamp per volt.

In Fig. 3 is given the most suitable circuit when the WD40 is to be used as a radio-frequency amplifier with diode

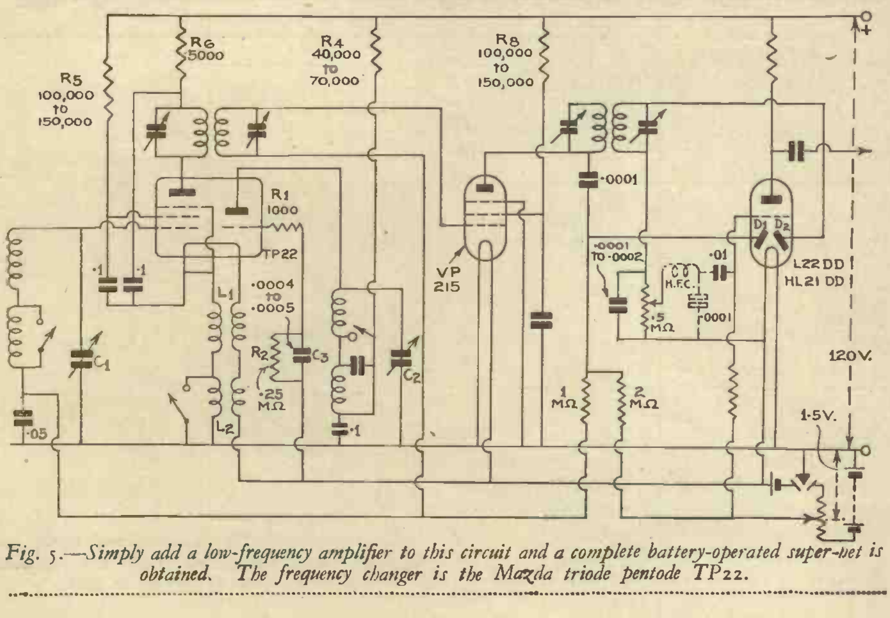



*Fig. 5.—Simply add a low-frequency amplifier to this circuit and a complete battery-operated super-het is obtained. The frequency changer is the Mazda triode pentode TP22.*

## The Latest Valves for Short-wave Receivers

detection and A.V.C. It will be noticed, however, that the A.V.C. diode is connected by means of a condenser to the anode of the pentode instead of to the secondary of the I.F. transformer. This is to obviate as much as possible "side-band screech." The resistance R2 in the cathode lead, in addition to providing negative bias to the pentode, also supplies a delay voltage for the A.V.C. diode. When maximum gain is required, the negative bias would be approximately 1 volt. Cut-off point occurs when the control grid is biased 30 volts negatively.

When it is required to extend the grid base of the pentode section, this can be done by feeding the screen from maximum H.T. through a resistance of 50,000 ohms. This causes a rise in screen voltage with increasing negative bias on the control grid and so makes the cut-off point more remote.

In receivers using two or more R.F. stages before the WD40 double-diode valve, it may be necessary to decouple the anode circuit with a resistance condenser network, shown by R9 and C7. In this case, the signal is passed to the detector diode by the I.F. transformer, where it is rectified. The varying audio potentials produced across the diode load resistance R6 are then passed on through C4 and R7 to the L.F. volume control R8. In this way, resistance R7 and condenser C12 form a filter to keep out of the L.F. amplifier any stray H.F. from the detector circuit.

For high-fidelity reception the diode load resistance R6 must be kept low. The formula $\frac{100\, R^1}{R^1 + R^{11}}$, where $R^{11}$ is the diode resistance R6, and $R^1$ is the volume control R8, gives the maximum allowable modulation percentage for no distortion.

### *Low-frequency Amplifiers*

As mentioned previously, the pentode section can also be used as a low-frequency amplifier, and in Fig. 4 the most suitable circuit is shown. Here the WD40 is used as a diode detector, delayed A.V.C. control and a high-gain low-frequency amplifier. As a low-frequency amplifier, the pentode gives a voltage step-up of 6 db. greater than the double-diode triode. The only defect is that the handling capacity is small, so that the valve has only a limited use in this position. It can be used following a low output voltage pick-up, where a double-diode triode might not fully load a wide grid base pentode.

When used as an L.F. amplifier, the most suitable anode voltage is 80 and the screened voltage 50. The cathode bias resistance will provide a negative voltage of 1.5 for the control grid and delay voltage.

Some time ago the Mazda Co. introduced an A.C. triode pentode for use as a frequency-changer. This valve has since gained considerable popularity amongst home constructors. I have now had an opportunity of conducting experiments with the TP22, which is a battery-operated pentode and so will probably have more appeal.

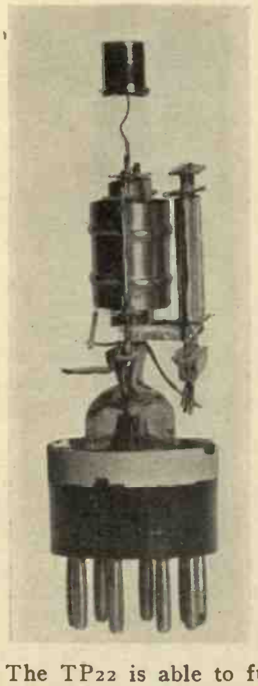
There are four features which will readily be appreciated.

1. Low H.T. consumption, plus high conversion conductance.

2. Decrease in H.T. consumption when receiving powerful stations.

3. Inability to handle large signal inputs.

4. It is very independent of wide variations in high-tension voltage, so that a battery can run to a very low voltage before it need be discarded.



*The Mazda TP22 triode pentode—an excellent short-wave frequency changer. It is for battery operation.*

The TP22 is able to function simultaneously as a frequency-changer and oscillator owing to the use of two independent electrode systems, one a triode as an oscillator, and the other a variable-mu pentode as a frequency-changer. Both sections are provided with a separate filament, but the two filaments are brought out to common pins on the valve base. Complete absence of any electronic coupling between the oscillator section and the frequency-changer section makes the oscillator frequency independent of the operating conditions of the frequency-changer sections, and, in particular, prevents frequency drift of the oscillator when bias is applied to the grid of the frequency-changer section. This point will be appreciated when the valve is to be used in a receiver embodying A.V.C.

The triode section of the TP22 requires a maximum anode voltage of 150. The amplification factor is 34, the mutual conductance 1.4 milliamps per volt. These figures have been taken with an anode voltage of 100 and zero grid voltage.

The pentode section will operate satisfactorily with 150 volts on both anode and screen, but the mutual conductance with 120 volts on the anode, 60 on the screen and zero grid volts is 1.3 milliamps per volt. Fig. 5 shows how this valve should be connected. Actually, the circuit given shows a suitable super-heterodyne for battery operation and is complete except for the low-frequency amplifier. The intermediate-frequency amplifier should have a frequency of 110 kc.

### *Cathode Injection*

Cathode injection is a recommended arrangement for the TP22, and in Fig. 5 it will be seen that the circuit uses separate coupling coils for long and medium waves. It is possible by altering the coil design to have single coupling coil operating on both wavebands, but in such circumstances it is advisable to include a second coil in series with the grid of the triode section which can be short-circuited on medium waves.

The filament coupling coils are wound with two wires in parallel in order to ensure tight coupling between the two coils in the filament limbs forming the coupling section. Both anode and screen of the pentode section are decoupled to the filament. This is essential in order to prevent any oscillator frequency voltage being produced by the pentode space current across the filament coupling coil, as this voltage is in opposite phase to the voltage produced by the triode oscillator.

A pentode anode coupling resistance of 5,000 ohms is satisfactory. The value of the screened decoupling resistance depends on the high-tension battery used and the maximum gain required for the frequency-changer stage. As a basis for experiments, a screen voltage of 60 volts is suitable. For calculating the screened resistance required, assume the screen current to be 35 per cent. of the anode current.

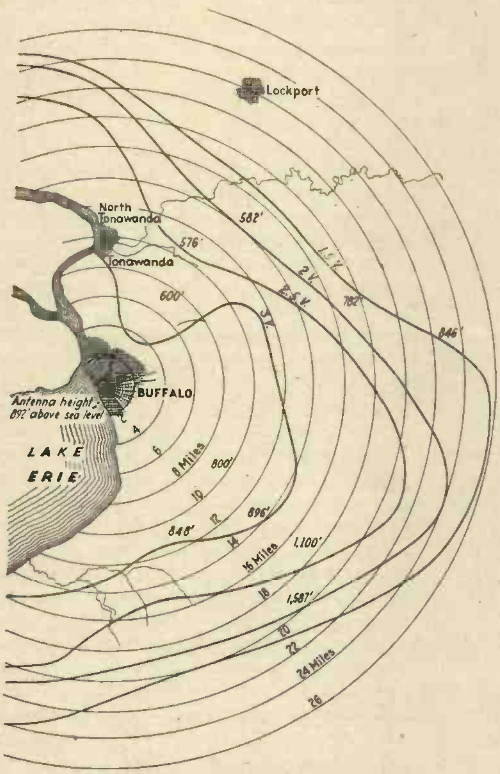
When constructing the oscillator coil it is preferable to employ the double-section cathode coupling shown in Fig. 5. It is advisable to keep the resistance of the cathode coils below two-thirds of an ohm.

There is a difference of opinion as to the minimum wavelength at which this TP22 will operate, but from my experiments with short-wave super-hets it will oscillate quite freely at 10 metres.

# TWELVE MONTHS' EXPERIENCE OF 7-METRE TRANSMISSION

*We acknowledge our indebtedness for the following information to "Electronics," it being an abstract of a report which appeared in that journal on the operation of the 7-metre station W8XH in Buffalo. It is of particular interest in view of the conflicting opinions that exist regarding the range of ultra-short wave transmissions.*

A LITTLE over a year ago broadcast station WBEN of the U.S.A. placed in operation an experimental transmitter on waves below 10 metres. Since that time it has been operating daily, collecting information regarding the transmission phenomena in the Buffalo district. At present it is on the air five hours a day on a frequency of 41 megacycles (7.3 metres) with an input of approximately 35 watts.




*This map shows the field strength obtained at various localities.*

In the intervening time much data has been collected. Field strength surveys have been made, several thousand receivers have been built by local experimenters in Buffalo, and a certain number of commercial receivers of the all-wave type which would go down to 41 mc. have been purchased by Buffalo people. To date it has been determined that a city like Buffalo could be covered with a low-powered, ultra-high-frequency transmitter effectively and cheaply with high-fidelity programmes. The only interference is from automobiles which radiate their ignition noise over 500 yards or so.

According to the report in *Electronics*, signals are free from static, free from fading, day and night ranges are equal, and good coverage of the city is obtained with an economy of power.

The only trouble is with motor cars, but the receiving aerial can be placed on the upper floors of a dwelling, where the noise is much less. Fading is non-existent. Since the transmitting aerial is in the centre of the city, its field strength is high where the noise level is highest and drops off at about the same rate as the city noise level.

Within the primary area of the transmitter little trouble has been experienced from shadow effects. Steel viaducts, it is stated, have no effect. As the outer limits of the primary area are reached (about 22 miles in this case), buildings and viaducts begin to cause trouble by shadow effects. Listeners 60 miles away report the signals to be strong and clear. At this distance the receiver must be favourably located. Up to 25 miles with the aerial on the second storey, connected to the receiver via a transmission line, loud-speaker volume is obtained with complete satisfaction.



### Importance of Aerial Height

The field-strength map shown here demonstrates the importance of the receiving and transmitting aerials being high above ground. For example, the transmitter aerial is 300 feet above the street, or 892 feet above sea level. To the north-east the equi-signal contours are pulled in quite close to the station. On the south-east, however, high signal levels stretch out to a good distance from the transmitter. In the latter case the surrounding land is considerably higher than the situation of the transmitter. Thus, the low levels are noted at elevations of 600 feet and less, while in the south-east direction good signal levels are found at elevations of 800 to 1,600 feet.

The labels on the field-strength contours are in relative and not absolute volts. They represent readings on the field-strength meter.

The actual transmitting equipment at this pioneer ultra-high-frequency broadcast station is conventional in design. It is a modulated oscillator employing two 800 valves directly coupled to the two-wire transmission line. Operating on 700 volts the power input is approximately 35 watts. The aerial proper is a vertical half-wave radiator, fed in the centre from the transmission line through a quarter-wave coupling line acting as a matching transformer.

For outside broadcasts a second ultra-high-frequency transmitter has been constructed to operate on a frequency of 37,600 kc. and on call letters of W8XD. This transmitter is completely portable, and can be operated from batteries or commercial A.C. supply.

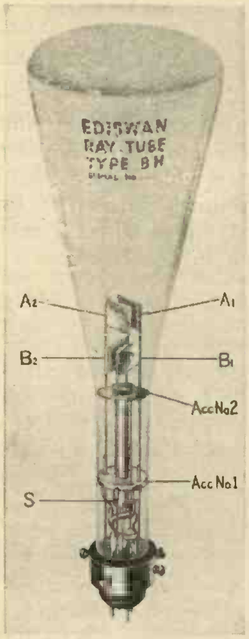



*Fig. 1. — This photograph shows the various electrodes which are used to bring the beam to a focus.*

# THE A.B.C. OF THE CATHODE-RAY TUBE—III

*By G. Parr*

# DRAWING PATTERNS WITH ELECTRONS

*This is the third article of a series explaining the action of the cathode-ray tube in a simple manner. Written in simple language they will be understandable by those who have no knowledge of the action of a cathode-ray tube. The article below explains the means adopted to focus the beam on the end of the tube.*

MOST people who see a picture on the end of a cathode-ray tube for the first time are reminded of glow-worms! It is probably the combination of greenish-white colour and the wriggling movement of the wave which gives the idea. The light given by a glow-worm is only remotely related to the light produced by the electrons in a cathode-ray tube—they certainly belong to the same family, but there the resemblance ends. The family name is *luminescence,* which is used to describe the light emitted from substances which are not heated.

Normally, in order to make a substance emit white light it is necessary to heat it nearly to its melting point, but there are cases of bodies which can emit " cold light " as the saying is. Glow-worms and fireflies are two examples. In each case the light appears to be due to the chemical changes which are going on in the body.

## How the Light is Produced

Another kind of light is that which is emitted when a substance is acted on by rays—X-rays, light rays, or cathode rays, and to this light the name *fluorescence* is given. Some beautiful light effects are obtained by the action of ultra-violet light on certain solids. But we are concerned here with the action of " cathode rays " which you will remember as being synonymous with " electron stream."

Fortunately for the whole working of the cathode-ray tube there are substances which will emit light under the impact of a stream of electrons. There are quite a number of them as a matter of fact: compounds of zinc, calcium and cadmium, to name the principal ones. So if any of these are interposed in the path of a stream of electrons they will emit light where the stream falls on them. It is the old question of the bombardment of the atom by the electron. The atoms of the fluorescent compound will lose electrons if hit hard enough, and the general upheaval and return of the electrons to the damaged atom are made visible in the form of light rays.

According to the nature of the substance, so is the wavelength of the emitted light varied; that is, some substances emit green light, others blue, or yellowish white. For television we choose those which emit as nearly white light as possible, since it is to form the basis of picture reproduction. Unfortunately the green fluorescent substances are the most efficient in value for money, or rather " light for electrons," but it is only a question of experimenting before the best white light emitter is found.

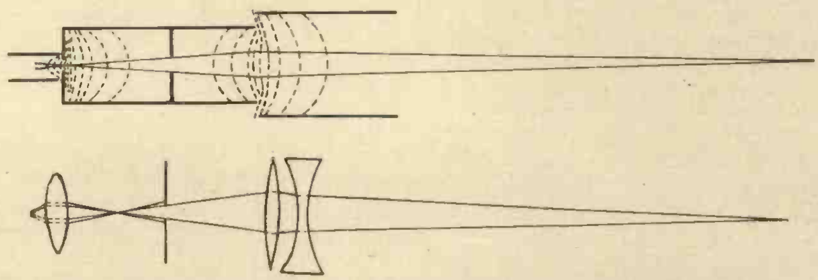


*Fig. 2.—The analogy between electronic focusing and optical focusing by lens system.*

Going back now to the electron tube, we coat the end of the glass bulb with a layer of one of the fluorescent compounds—on the *inside,* since we couldn't make the electrons pass through the glass successfully! Then, when the tube is switched on and the electrons shoot up the tube, a little patch of light appears on the end where they are hitting the " screen," as it is called. This patch of light, beyond looking pretty, isn't of much use, since it is probably as big as a threepenny

# DEFLECTING THE CATHODE RAY

bit. Before we can use it to indicate the movement of the electrons it will have to be brought down in size to a pin's head or finer.

## *Focusing the Beam*

The reason why it is so big is that the electrons on their way up the tube have spread out and, to use the water-jet analogy, are arriving more in the form of a spray. Since each electron is a negatively-charged particle it will tend to repel its neighbours and as a result the further the jet travels the further will the electrons diverge. To make the jet of use it must be kept compact—in other words, *focused* on the screen in exactly the same way that a ray of light is focused on to a screen in front of a lens.

And here we find a remarkable similarity between an electron stream and a ray of light—the stream can be focused in the same manner, but instead of lenses of glass we use electrical lenses made by applying a voltage to a series of cylinders or discs of metal. This now explains the complicated structure which you see in the tube shown in Fig. 1—the cylinder and disc are for the purpose of focusing the beam of electrons so that it appears at the screen as a tiny point of light instead of a splash.

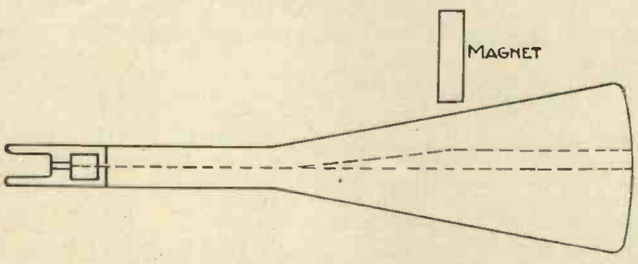



*Fig. 3.—Diagram showing how the beam can be deflected by means of a magnet.*

After the beam has passed through the hole in the first positively-charged plate it goes through a second plate separated from the first by the narrow cylinder shown. This second plate has a much higher voltage applied to it and concentrates the beam to the narrow focused point on the screen. In the same way that a pair of lenses are placed a definite distance apart to focus a light ray on a given spot, so are the discs arranged to focus the beam on a given point if a definite voltage is applied to them.

So to produce the fluorescent spot on the end of the tube the following are required:

(1) A *cathode*, which is another name for the source of electrons.

(2) A cylinder surrounding the cathode to squeeze them into a convenient form for passing through the hole in the plate above the cathode. This cylinder is variously called the *negative cylinder*, *Wehnelt cylinder* (after the man who invented it) or, perhaps more simply, the *shield*.

(3) The plate with the hole in it to send the electrons up the tube. This is called the *anode*, or more usually the *accelerator*. If there are more of them it will be the *first accelerator*. Sometimes the arrangement is called the *gun*, but this is a little vague as it might refer to the whole system for producing the electron stream or the accelerator itself. *Accelerator* is the best word, because that is exactly what it does.

(4) A second and sometimes a third plate to focus the electron stream on its way up the tube. These will then be the *second* and *third accelerators*.

## *A Light Analogy*

As an example of the arrangement, the negative cylinder may have a voltage of 10 negative, the first accelerator 500 positive and the second 2,000 positive, and if this ratio of voltage between Nos. 1 and 2 is altered the focus will be blurred. This is analogous to altering the distance between lenses when a ray of light is sharply focused. The diagram of Fig. 2 may help to explain the focusing action, although it is a little difficult to follow for those who have no knowledge at all of electric *fields*. The dotted lines represent the electric field between the two accelerators, and the electrons are guided by the contour of the lines. Below this diagram is a similar one which is more easy to understand and which shows the action of a lens system on a beam of light from a spot source. If the lenses are moved the beam will not focus at all; the same applies to alteration in the accelerator voltages.

Before going any further, there is one important point in the action of the cylinder surrounding the cathode, which we are calling the shield. Suppose it is made very negative by connecting it to a battery of about 100 volts. Then it will repel all the electrons emitted from the cathode and push them back to the surface again. The pull of the first accelerator will be nullified and we shall get no beam at all.

If the voltage on the shield is gradually reduced a few electrons will struggle through the accelerator and a feeble spot of light will show where they have managed to get up to the screen. A further reduction in the shield voltage and more come through, the spot growing brighter. Beyond this point so many will get through that there will be difficulty in focusing them sharply, and we shall get a brilliant patch of light on the screen. The negative cylinder is therefore acting rather like the tap at the end of the electron hose-pipe—by turning on the voltage applied to it we can shut off the light on the screen.

## *Making the Spot Move*

Now you see how important this is in television, because it gives a means of altering the intensity of light on the screen, and after all the building up of television pictures is by the movement of a light spot which is altered in intensity as it travels.

The next thing is how to make the spot move about the screen. All this time it has been sitting on the centre of the screen, and if we haven't been very careful it will have burnt a hole in the fluorescent material. Seriously? Yes—the impact of the electrons with 2,000 volts acceleration behind them is quite sufficient to destroy the make-up of the fluorescent compound and burn it, even if they don't go further and puncture

*(Continued at foot of next page.)*

# Canadian Amateur Radio VE3HC

*In a recent issue we advised listeners to be on the look-out for the Candian station VE3HC, Ontario. Owing to the popularity of this station we have obtained some details from the operator.*

*Canadian station VE3HC can be identified quite simply, for it terminates all transmissions with a peal of Westminster Chimes.*

ALTHOUGH Canadian stations are hardly what we term of amateur construction, the details of circuits used prove very interesting to English amateurs. Often, even though we can never aspire to the kilowatts used by VE and W stations, useful hints and tips can be picked up.

One of the most consistent Canadian stations is VE3HC, operated by Fred Hammond, of the Hammond Manufacturing Co., in Guelph, Ontario. The complete equipment is illustrated in this page. On the left is the 20-metre phone transmitter which embodies all of the latest Canadian practice. This transmitter runs with an input of 165 watts and is built up in the following way. A 2A5 operates as a crystal oscillator at 7134 kc. feeding into a 2A5 as a frequency doubler on 1468 kc. An 865 is in the third stage as the sub-amplifier driving two push-pull 800's in the P.A. stage.

The crystal or condenser microphone can be fed into a 200-ohm line through to a three-channel mixer and then into a 500-ohm feeding push-pull 56's, followed by a PP2A3 and then two push pull 800's in class B as a modulator.

This 20-metre phone transmitter has worked 18 countries in a matter of a few weeks. At the moment, the best DX on 20 metres is VK3KR and VK3KX. Incidentally, Fred Hammond would like reports from all listeners in this country and all letters are answered by QSL cards.

The three-rack transmitter shown in the photograph, at the left, is for 75 metres, in the middle for 160 metres and on the right for 40 metres. The 75-metre uses a type 2A5 CO on 3885 or 3930 kc., an 865 buffer and an 960 second buffer with a UV204 as P.A. The output is approximately 500 watts.

On 160 metres the line-up is 247 CO 210 buffer, push-pull 210's in the second sub-amplifier stage and push-pull UV2's as final amplifiers. Output 375 watts.

On 40 metres a type 247 CO on 7108 kc. drives an 865 sub-amplifier, which, in turn, feeds an 860 amplifier. A UV204 P.A. runs at 500 watts.

Power supplies vary from a 600-volt circuit in the centre panel up to a 2,500-volt supply in the right-hand rack. Incidentally the last supply uses a valve capable of giving 1,000 milliamps. The aerial systems of these three transmitters are all half-wave voltage-fed Hertz; 3.5 mc. 75 feet high; 7 mc. 60 feet high and 1.7 mc. 40 feet high. All transmitters are remotely-controlled from a receiving desk that cannot be seen from the illustration.

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"Drawing Patterns with Electrons"

(*Continued from preceding page.*)

the glass. So the moral is—don't leave the beam alone on the screen for long without turning off the tap at the back of the tube. There is no need to switch off the whole thing: just increase the negative voltage on the shield and the stream will dry up at its source.

To make the spot move over the screen we can do two things: (a) bring a magnet near the tube, (b) bring another plate near the beam and connect it to a battery. The first one is easier, and is worth trying as an experiment by any one who has a tube. If a bar magnet is brought near the side of the glass the beam will be found to draw near it or walk away from it, depending on the pole (N. or S.) which is nearest (Fig. 3). And if the magnet is moved to and fro the beam will swing to and fro in sympathy. The spot of light on the screen will then be seen to move backwards and forwards in time with the swing of the magnet.

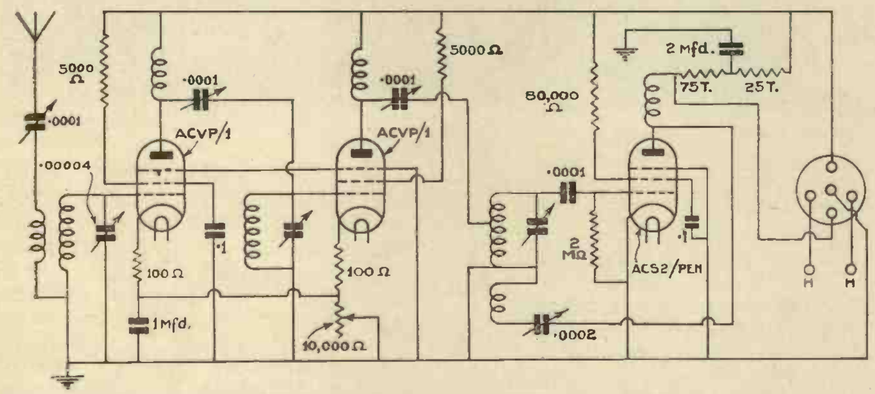
If the swings become faster and faster the spot of light will eventually move so quickly that it will appear as one continuous line. This is where our eyes are coming into the picture. Anything moved beyond a certain speed and our eyes are unable to follow its actual movement and see it as a continuous visible track instead of a series of discontinuous points. But still, you probably know all about persistence of vision already—if not, go into a dark room with a glowing cigarette and whirl it round in a small circle. There in a nut shell is the effect of persistence of vision and yet another analogy to the movement of the spot of fluorescent light!

The movement of the beam by electric fields, or plates connected to H.T. batteries is so important that we will leave it for a separate article.

# Tuned R.F. on the Short Waves

*By B.R.S. 1636*

AFTER reading so much about single-signal supers and super-hets in general on short waves, I should like to say what I think about this topic and why I use a straight receiver. Being primarily interested in reception on amateur bands, it is essential that any receiver I use has the lowest possible background level, otherwise the generally weak signals are hard to read.




*It is anticipated by B.R.S. 1636 that this type of tuned R.F. receiver will become popular on the lower frequency wavebands. It combines the advantages of the super-het, but has a very low noise level.*

In common with many other listening stations I always have a super-het receiver in use owing to its inherent selectivity. It has always been my contention that a straight set would be utterly useless except perhaps on 20 metres. When thinking of straight sets, however, I do not mean anything beyond a simple single H.F. stage, the receiver having two tuning condensers.

Just recently I have been experimenting with some new high-frequency pentodes of unusual efficiency, and found that very considerable stage gain could be obtained on all the amateur bands down to 14 megacycles. Experiments proved that with a little care the straight receiver using these pentodes could generally beat the super-het.

### *Super-het Efficiency*

Owing to stations coming in twice, high noise level, and the exceptional amount of C.W. heard, the super-het generally gives the impression of extreme efficiency. When conditions are bad, like they have been on the top band just recently, and the noise level is usually twice the strength of the average signal, then quite often I have had to close down without hearing any stations at all.

In such circumstances, although I did not know it at the time, a straight receiver would have probably brought in several stations without trouble. When I did realise this point, I built up a receiver in a very careful way, screening the coils, valves and several other components, so making sure that the receiver, even when working at optimum gain would always be completely stable. Consequently the result is a receiver that looks like an American factory-built super-het.

By paying a little attention to a few small points, the receiver was simplified very considerably. For example, the H.F. pentodes were chosen because both anode and screen required the same potential, so obviating the need for resistances and decoupling condensers. As the receiver was for amateur use, permanent band-spread could be embodied, and so on.

In the end the receiver consisted of two high-frequency stages using AC/VP/1 pentodes followed by an ACS2/Pen. pentode detector. The low-frequency section was omitted for I have a standard amplifier which can be used when necessary. The high-frequency stages are tuned-grid coupled in the conventional way except that the coupling condensers are of the Jackson baseboard preset type. The idea of using these presets throughout was to simplify the ganging of the tuning condenser. Incidentally the tuning condenser is a special three-gang unit of 40 micro-microfarads.

As the tuning spread of this condenser is very small there is no difficulty in ganging. Coils, of course, have to be wound to suit the waveband and by taking a turn off or putting a turn on, perfect ganging can be obtained, any slight variations being taken up by the presets. The coils, chokes, and valves, even if the latter are metallised, are all completely screened in metal cans. The anode connections and all other leads carrying H.F. are also screened and earthed.

### *Volume Control*

As a volume control a 10,000-ohm variable resistance is connected in the common cathode lead to the two H.F. pentodes. This is quite a simple way of varying the voltage on the variable-mu pentodes, but is only satisfactory because there is no complicated resistance network as is usual with valves of this type. The detector, although it is an H.F. pentode and R.C. coupled, is worked as a leaky-grid rectifier for this was found to give maximum volume with smooth reaction.

In use, as the tuning condensers are fitted to a wide open scale drive, the amateur bands can be calibrated on to the dial in actual frequencies and, as a matter of interest the 1.7 mc. band takes up 160 out of the 180 degrees, so that tuning is really very simple. Selectivity is of a reasonably high order, anyway ample for amateur requirements, whilst the background noise is negligible.

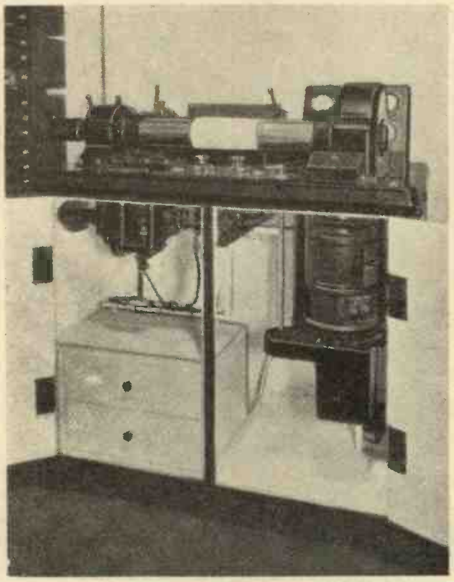
When compared with a super-het, although the volume is perhaps only 60 per cent. of that given by the super-het, the number of stations heard is usually two or three times as many. After several months' use I found that the only time the super-het was preferable to the 2 H.F. straight was when conditions were particularly good and the whole stage gain of the I.F.'s could be utilised to advantage.

## HOW PICTURES ARE TRANSMITTED ELECTRICALLY

# THE MARCONI SYSTEM OF FACSIMILE TELEGRAPHY

**By J. W. Eastman and J. F. Hatch**

*This article describes the Marconi facsimile equipment which is installed in the Central Telegraph Office of Imperial and International Communications, Ltd., Moorgate St., London. The information is given with the kind permission of the Editor of "The Marconi Review." and it is an abridgment of an article in the March-April, 1934, issue of that journal.*



*This machine combines the functions of both transmitter and receiver.*

THE equipment has been designed for the transmission and reception of printed or written matter such as letters, drawings, balance sheets, cheques, and also for reproductions of half-tone subjects, photographs, etc., the subject to be transmitted being wrapped round a cylindrical drum and scanned by an internal rotating optical system. The same machine is used for transmission or reception.

The equipment conforms with modern telephone practice as regards general layout of panels. These are mounted on 19-in. telephone racks, arranged in two pairs on each side of a bench framework. On this framework is mounted a heavy bedplate which supports the message drum, rotating optical system, also the main and auxiliary driving machines and controls.

The method of maintaining synchronism between the transmitter and receiver in the Marconi system is by the use of synchronous motors supplied with independent sources of alternating current. This current is generated by tuning forks accurately adjusted to the same frequency, and housed in thermostat chambers so that the frequency of each remains constant over a long period.

The thermostat chamber consists of a lagged copper box mounted inside an outer compartment lined with hair felt and "tentest" board. In the air space between the inner and outer chambers are heating mats for maintaining a temperature of 50° C. approximately. The temperature is regulated by means of mercury-contact thermometers; these apply bias to the grid of a valve and cause a relay in the anode circuit to control the heating supply to the chamber.

The tuning forks are kept vibrating by a resistance-coupled valve maintaining circuit and generate a fundamental frequency of 300 cycles. A minute adjustment of the tuning-fork frequency is available in the maintaining circuit of approximately ± 1 in 20,000. The

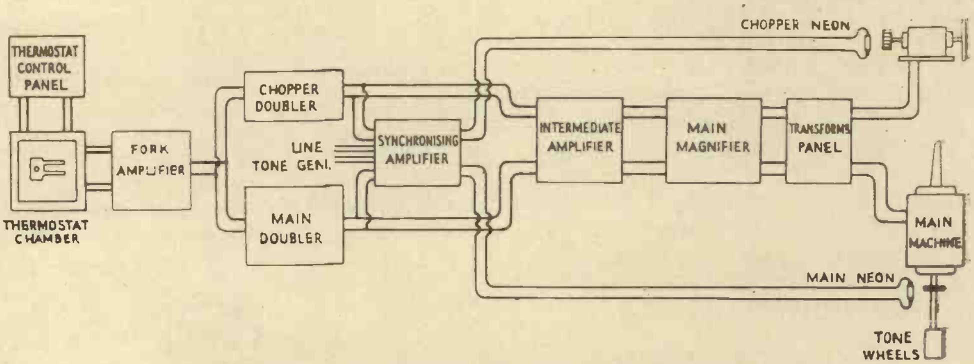



*Fig. 1.—Schematic diagram of the speed control racks.*

overall constancy of the fork drive is well within commercial requirements of ± 1 part in 100,000. The temperature coefficient of the fork is about 1 part in 160,000 per degree Centigrade.

The output of the fork is amplified and fed into a frequency-multiplier panel. This changes the synchronising frequency to 600, 900 or 1,200 cycles; this frequency change is for the purpose of varying the speed of the main driving motor in the same ratio.

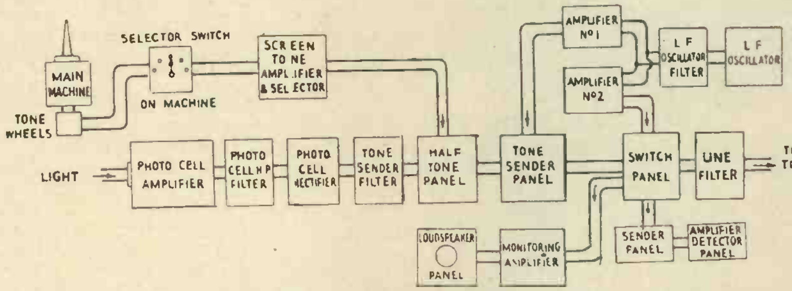



*Fig. 2.—Schematic arrangement of transmitter.*

A single handwheel control brings about change of speed and synchronises the machine at the correct frequency. An electrical gearbox is thus capable of changing the motor speed over a 4/1 range. Considerable amplification of the synchronising tone is required to produce the necessary torque to hold the driving machine in step. The output stage consists of three DA60 valves in parallel, operating with 500 volts on the anodes.

An output transformer matches the impedance of the machine synchronising winding with that of the valve circuit, and under these conditions the speed and angular hunting of the machine remains constant.

The speed control racks also contain a circuit for synchronising the chopper motor at a multiple of the fork-frequency (1,200 cycles) in order to ensure a steady carrier for the photo-cell amplifier.

The output circuit in this case consists of a single DA60 valve transformer coupled to the chopper motor.

By means of one of the panels known as the synchronising amplifier it is possible to switch the various synchronising tones either to line for comparison with distant sources, or to operate neon lamps illuminating stroboscopic discs on the shafts of the main and chopper motors for checking local synchronism and hunting. A schematic diagram of the speed control racks is given in Fig. 1.

## *Line Amplifier Racks*

The line amplifier racks contain the apparatus for converting the varying light intensities picked up by the optical scanning system from the subject under transmission into pulses of tone for passing over a telephone line to key a wireless transmitter. Also, the signal from a wireless receiving station is converted back into varying light intensities for recording on bromide paper.

## *Transmitting Circuits*

The light fluctuations from the optical system are fed into a light-tight box containing a caesium photo-cell which in turn is housed in a screened brass unit containing a four-stage resistance-coupled amplifier (Fig. 2). The path of the light is interrupted by the chopper disc and a carrier frequency is produced before the light strikes the photo-cell; in this way a straightforward low-frequency amplifier may be used.

The output of the photo-cell amplifier contains the chopper carrier-frequency on which is superimposed the picture modulation. This picture-modulated tone is then rectified and passed through a low pass filter in order to eliminate the rectified component of the carrier. The resultant, which consists of the picture-modulation only, is used to key a tone sender suitable for relaying and operating the distant wireless transmitter. If the output of the photo-cell amplifier were used to key the transmitter directly, a negative result would be obtained at the receiver, since the maximum output from the photo-cell amplifier occurs when the scanning spot is passing a white portion of the subject.

With direct scanning of the subject it is therefore necessary to reverse somewhere in the circuit.

It has been found impracticable to employ amplitude modulation of a transmitter on a long-distance radio circuit due to continuous changes in level of the received signal, and for this reason the tone sent to line to key the transmitter must always rise to a constant amplitude in order that full on and off keying is obtained.

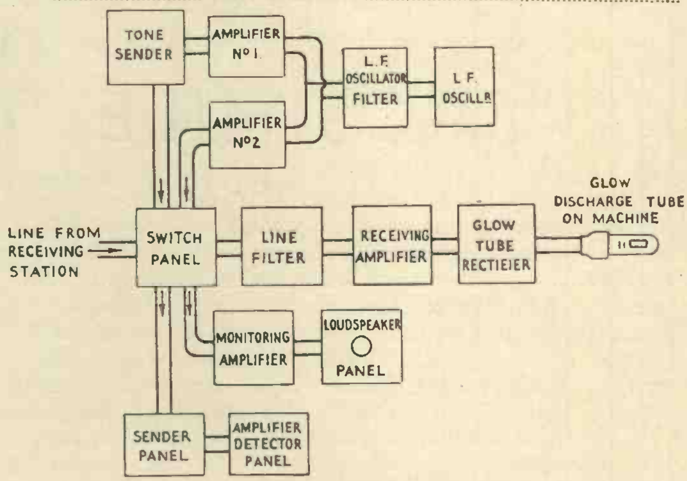



*Fig. 3.—Arrangement of receiving circuits.*

This is a simple matter to arrange when scanning black and white subjects, but in the case of half-tones such as photographs, etc., a system of keying known as the constant frequency variable dot system is employed. By this method the various intensities of the subject as recorded by the optical system and photo-cell amplifier are converted into pulses of tone of fixed amplitude but varying duration.

## *Receiving Circuits*

The receiving circuits are shown in Fig. 3. The receiving amplifier for amplifying the incoming line-tone from the wireless receiving station consists of three resistance-capacity coupled stages with an overall gain of 40 db. approximately; the tone passes through a high-pass filter before the tone is amplified.

The output from the receiving amplifier passes in to the glow tube rectifier panel where it is amplified still

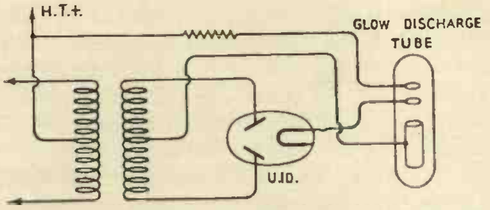



*Fig. 4.—Circuit for operating glow-discharge recording tube.*

further by a push-pull stage and rectified by a U10 full-wave rectifying valve, and finally operating the glow discharge recording tube (see Fig. 4).

This recording tube, which is a product of the Marconi vacuum research laboratory at Chelmsford, has two main electrodes, the cathode being in the form of a tube and the anode a ring. There is also a third auxiliary electrode to facilitate striking. The tube is filled with a special gas mixture of neon and argon and gives a strong actinic light when a potential of the order of 300 volts is applied to the electrodes.

The recording tube gives dense blacks on ordinary commercial bromide paper when passing a current of 10 milliamps. and at the maximum speed of rotation of the scanning device.

## *Optical Transmitter and Receiver*

The optical machine consists of a very rigid cast iron bedplate to which are attached the following unit assemblies. On the topside: An optical rotor made in two separately detachable halves, each half being almost identical and consisting of a gun metal tube 88 mm. diameter supported by a cast iron pedestal. These tubes are mounted almost central on the baseplate with their common axis coincident with the longitudinal axis of the base. The right-hand side tube carries an inner sleeve mounted on ball bearings, and has an optical head mounted at one end and a wormwheel at the other or pedestal end. The left-hand tube has no internal fittings and acts as the subject support and protection for the rotating optical parts. When in their correct positions, the tubes are separated by about one-sixteenth of an inch, leaving a slot right round their periphery. Rotating under this slot an optical head (with a fully corrected lens system) can scan the circumference of the tubes through the slot, and allows for complete exploration of suitable-sized subjects when wrapped round the tubes.

On the left-hand side of the left-hand rotor pedestal, and abutting the face is a stationary optical head which contains two prisms mounted on a quadrant. The quadrant can be swung by a ball-handled lever outside the box. The swinging of the quadrant causes the necessary change in the optical arrangements to be made for either transmission or reception.

Behind the stationary head a special housing carries a glow discharge-tube suitably mounted in a plug-in holder and attached to a removable cover. This cover has focusing and aligning arrangements to suitably position the glow tube column, and is held in place by three screws which are also the electrical connections. Immediately behind the rotor tubes and parallel to the optical axis, a special housing carries a high-precision leading screw of 5 mm. pitch. This screw is arranged to impart motion through a pair of cylindrical bush nuts to a carriage so mounted that the screw also becomes the track on which the carriage moves. A gripping device with deflector plate is fitted to the carriage, and grips the subject between two rubber-covered rollers maintained under tension by springs. A cranked handle on the left-hand end of the leadscrew housing is arranged for winding the carriage back after each run.

The screw receives its motion from the optical rotor shaft through chain, dogclutch and spiral gear train. Behind the gearguard at the back of the baseplate an instrument panel with meters and selector switches is fitted and is arranged for checking.

In front of the gearguard a small housing carries a neon tube which illuminates the stroboscope disc of the main machine through a hole in the baseplate.

Underneath and mounted on the baseplate on the right-hand side in front, a special cradle carries a synchronous motor alternator. The alternator is provided with accurately-ground trunnions co-axial with the shaft and a set of five slip rings. The machine is mounted vertically in the cradle by means of sliding bearing blocks mounted on the trunnions and sliding into horn blocks in the cradle. This leaves the carcase of the machine free to rotate about the armature. Electrical

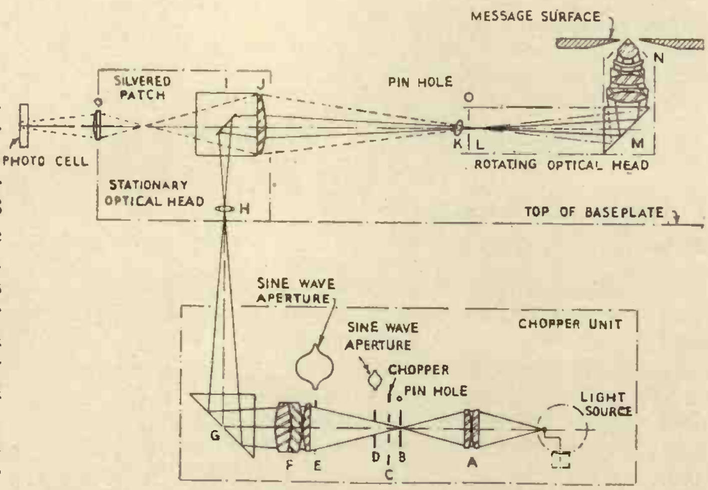



*Fig. 5.—The transmitting optical arrangements.*

connection is made to the machine windings, etc., through the slip rings and carbon brushes. On the lower trunnion is mounted a gear wheel which engages through a train with a shaft; this shaft protrudes through the baseplate and terminates in a cranked handle alongside the neon tube housing and gearguard. With this handle it is possible to rotate the motor carcase in either direction with the machine running and synchronised, and this allows for the phasing of the receiving scanning spot with the distant transmitting scanning spot. The lower spindle is extended and has mounted on it five toothed "lowmoor" iron wheels. A structure supported from the lower trunnion block carries five magnetic pick-up devices. These five separate tone generators are used to generate synchronous tone frequencies of 70, 90, 150, 210 and 270 cycles at the lowest synchronous machine speed, and provide the screen tone for half-tone work. The top spindle protrudes through the baseplate and engages the wormwheel on the optical rotor with a seven start worm. To the left of the main machine unit the Chopper unit is mounted and consists of a casting on which is mounted a small synchronous motor alternator which carries the chopper disc mounted on a special spider.

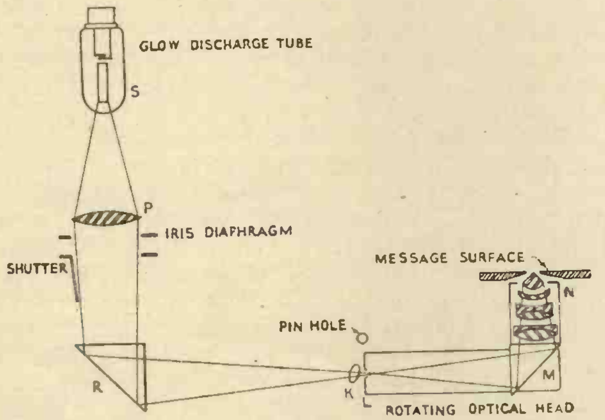



*Fig. 6.—Schematic section of the optical receiving arrangements.*

The disc and spider are totally enclosed in a housing which is made in two halves, and forms the support for optical parts of the unit. In front and mounted from the same support as the motor, a light-tight box houses a special concentrated filament lamp.

## *Transmitting Optical Arrangements*

Fig. 5 shows the transmitting optical arrangements. A is a condenser lens which collects light from a concentrated filament source, and focuses it down to give intense illumination of a pinhole B. The beam on leaving B is interrupted by a chopper disc C. This disc is $7\frac{7}{8}$ ins. diameter, made from thin sheet Monel metal, having 78 radial slots and teeth .15 in. wide at pitch line and can be synchronously run at either 1,000 or 2,000 r.p.m., giving chopped light frequencies of 1,300 or 2,400 cycles. This chopped light is collected by a condenser lens F, after it has passed through the two sine-wave apertures D and E respectively, and emerges as a converging beam, focused at H after passing the right-angled prism G. After passing the lens H, the light is projected on to a silvered patch on prism I.

The diverted beam is collected by the lens J on the prism face and focused down to fully illuminate the pinhole L after passing through ghost lens K. (The pinhole L is the one which controls the spot diameter at the scanning surface.)

The objective N is a lens which collects light passing pinhole L through prism M and focuses it down in this case to .25 mm. intense spot at the scanning surface.

This beam of incident light does not occupy the full light cone of the lenses J, K and N, and is so arranged that scattered light reflected from the subject being scanned is picked up by the objective N and focused back through prism M and pinhole L, lens J collects light passing pinhole L and passes it on through the prism I. The beam emerges from prism I with the shadow of the silvered patch in its centre. Lens O collects the scattered light beam and focuses it down as a circular spot of about 5/16 in. diameter on the active surface of the photo-electric cell. The ghost lens K is arranged so that the image of the silvered patch reflected back by prism M is diverted sufficiently from the optical axis as to fail to be within the field of lens J, and does not, therefore, get passed on to the photo-cell.

When on receive, Fig. 6 shows a schematic section view of optical parts. Lens P collects light modulated at picture-frequencies from the glow-discharge tube S and focuses it down through prism R to fully illuminate pinhole L. The objective N collects light passing through pinhole L and focuses it down to an intense spot at the message surface, and so exposes commercial bromide paper to correspond with the modulation. The iris diaphragm gives control of density of exposure to suit machine speed.

## *Operation*

The usual procedure is to run up both machines and send a synchronising signal. This can be done by placing a piece of white paper on the transmitting drum and adjusting the transmitting circuits for the normal transmission of a black and white subject. The response round the drum is uniform except at the point where the clipper bar holds the paper in position, and a short " pip " is sent to line each time the optical rotor passes this point. This signal is recorded on the receiving drum and is observed as a momentary flick of light occurring once per revolution of the optical receiver. The carcase of the receiving motor is then rotated by the phasing handle on the bedplate until the spot of light coincides with the clipper bar position on the receiver. The machines are then in phase with one another and a test transmission can commence.

## Battery Midget Valves

Constructors of short-wave receivers would be well advised to consider the use of some of the small battery-operated valves now available. The first valve of this kind was introduced by the Marconi-Osram Companies for use in deaf-aids apparatus, but as they have proved so satisfactory, particularly on ultra-short wavelengths, they have been released for general use. These valves are of the triode type and have 1-volt filaments so that two can be run in series from a 2-volt accumulator, giving maximum economy.

Hivac midget valves are also satisfactory on short waves owing to low inter-electrode capacity, and can be used down to 4 metres without difficulty. They have 2-volt .06-ampere filaments and are fitted with a special low-capacity base and supplied in either triode or heptode types.

# Scannings and Reflections

By THE LOOKER

## The Problem of Large Pictures

IN the ordinary course of events, high-speed scanning might be expected to pave the way not only to clearer but also to bigger pictures, though in practice we find that it is one thing to get a high-definition picture into the ether, and quite another to throw it in bright relief on to the viewing screen. Thanks to recent progress, we can now reproduce practically as much detail as we want, but only at an intensity of illumination which is too low to allow the picture to be magnified through lenses. In other words the problem of size really resolves itself into one of getting more light on to the screen, and this is by no means as simple as it might seem.

## More Light

In the case of rotating disc and mirror systems the Kerr cell, although a great advance on the original Neon lamp, still wastes or absorbs far more light than it passes through to the screen. On the other hand, with the cathode-ray tube, one is up against the limitations of fluorescent light, combined, of course, with the fact that the screen as a whole must be mounted inside the glass bulb.

Here it seems to me that the future of cathode-ray reception is very much at stake, because it appears that one cannot increase the brilliance of the fluorescent light produced by electronic bombardment beyond a certain point. That is so far as our knowledge goes at present, though no doubt we shall find ways and means of doing it as time goes on.

Supply usually follows demand—provided the latter is sufficiently insistent—and we can trust the television public to see to that. Anyone who can look back to the old bright-emitter valve and contrast it with the modern pentode, which does umpteen times the work on one-fifth the filament juice, need never despair of what the future may bring forth, particularly in the field of electronics.

## The Value of Research

And, in a sense, that is where fluorescence belongs, since it is produced, at least in the television receiver, by the action of electrons. Also it is closely related to what occurs in the photo-electric cell at the transmitting end. The photo-electric cell reacts to rays of light by emitting free electrons, whilst the fluorescent screen generates rays of light when bombarded by free electrons.

All this is very much in the limelight of modern physics. Research workers are at present digging into the mystery of the relation between light and the electron, and we may be sure that sooner or later they will either find out how to brighten-up the fluorescent screen, or else discover a more brilliant substitute for it.

At the same time it does not follow that the cathode-ray receiver is going to have things all its own way. In fact I have recently heard very good reports of a new type of Kerr cell, which may turn out to be a bull point for the mechanical scanner. Some people will tell you that the rotating disc or drum stands no more chance against the cathode-ray tube than the crystal did against the valve. But the electrical engineer said much the same kind of thing about the gas industry nearly fifty years ago—and in spite of that, gas shares are still a profitable investment to-day.

For that reason I prefer to keep an open mind on the respective merits of cathode-ray versus mechanical scanning. All I will say for the moment is good luck to the first who succeeds in producing the goods at a reasonable price.

## The Daily "News Reel"

Many listeners complain that the B.B.C. do not put enough "outside" broadcasts into their programmes. They would like to hear more running commentaries on sporting and other topical events than they do at present, even if it means less chamber music and nigger crooning. Of course, the programme directors know only too well that it is impossible to please everybody all the time, but I think there is a lot to be said in favour of the idea of going more frequently outside the studio for programme material.

In the States and in Germany, for instance, the "travelling microphone" is in great demand and is largely responsible for the most popular items on the programme, which are usually recorded or "bottled" so that they can be repeated at an hour when most people are free to listen to them. Once we get television in full swing here, it will open up fresh opportunities for developing a really "live" broadcast news-reel, covering all the most interesting of the day's events with the help of the film and the gramophone.

## "Sez You"

A rather belated contribution comes from a correspondent who is concerned with the vexed question of what to call those who "look-in." He argues that the earliest example of true television is the so-called "mirage" effect, of which a typical example is the distant oasis often seen by thirsty travellers in the Sahara. It may occur elsewhere, and in different circumstances, but it always represents something which is definitely beyond the range of ordinary eyesight. And it is reproduced without scanning, Kerr cells, cathode-ray tubes, or any of the other paraphernalia of its modern rival. He therefore suggests that the television enthusiast should call himself a "miragineer."

## Short-wave Therapy

Most short-wave fans are quite satisfied to use their sets in the ordinary way, and manage to get plenty of pleasure in listening to broadcast programmes outside the reach of their less fortunate brethren. But it seems that, by disconnecting the aerial and tightening-up the reaction coils, the set can also be employed in an emergency as a substitute for the family physician. One well-known hospital, for instance, is said to possess an "ultra-short-wave set" which is freely used for curing various forms of inflammation no matter how deep-seated. According to the newspaper report the treatment is particularly beneficial for carbuncles, boils, and pains in the neck.

### The Wireless Exhibition and Television

The Radio Manufacturers' Association has announced that no television receivers or television kits of parts will be allowed to be displayed at the Wireless Exhibition, which takes place at Olympia in August. It has gone a step further and prohibited the display or distribution of any advertising matter relating to television. Quite evidently the Association intends that there shall be no counter attraction to the ordinary broadcast receiver. To me this appears to be a policy which has little to commend it, and it is questionable whether it will offset the harm which it is alleged the booming of television did to the wireless trade in the early part of the year.

In direct contrast to the attitude adopted by the Radio Manufacturers' Association, the Director of German broadcasting is arranging for television to be a prominent feature at the Berlin Show to be held on August 16. There is very considerable activity in Germany, and it does seem as if manufacturers are being given every encouragement to produce inexpensive receivers.

### Ultra-short Wave Range

Incidentally, I hear that the range of the Witzleben transmitter does not appear to be restricted to the official service area of 30 miles, for a correspondent, just returned from Innsbruck, saw some excellent 180-line pictures on an Austrian-built receiver. The future of the ultra-short waves seems as yet uncertain and in official circles it has been realised that the range is not so restricted as was first thought. Proof of this can be found in the new Post Office telephone service between England and the Channel Islands, a distance of 110 miles.



### The PTT Transmissions

The inauguration of the series of test transmissions by the French PTT has created a good deal of interest among enthusiasts in this country, who had hoped that this would make another service available. I have to confess that, although I am able to receive the transmissions at good strength, so far I have been quite unsuccessful in resolving any resemblance of a picture either with a cathode-ray receiver or various expedients that I have tried with mechanical scanners of both disc and mirror-drum types. Although it is possible to adapt a 30-line scanner to some extent to suit 60-lines and 25 pictures per second, at the best any such arrangement is the poorest of makeshifts and increases the difficulty a hundredfold. A cathode-ray tube, of course, does not present any difficulty in this respect, but as I have already stated, I must confess to failure with these particular broadcasts.

### Television and Advertising

The possibility of television from the Continent being received in this country is engaging the serious attention of interests concerned with sponsored programmes, and it is quite likely that we shall see some developments. There are, of course, many difficulties and not the least is the accommodation of a scanning-frequency which will be acceptable to lookers on a wavelength which can be received in this country. It is generally considered that a 90-line picture could be broadcast upon a wavelength round about 150 metres, and if tests proved this possible some such scheme of sponsored programmes would be quite feasible. We may be sure that the potentialities from a commercial point of view are so great that no side of the matter will be neglected.

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International DX-ers Alliance

The monthly meeting of the International DX-ers Alliance (London Chapter) was held at the Chequers Restaurant, Essex Street, Strand. This month, by courtesy of the Post Office, visits have been made to the International Telephone Exchange at Faraday House and P.O. Research Station at Dollis Hill.

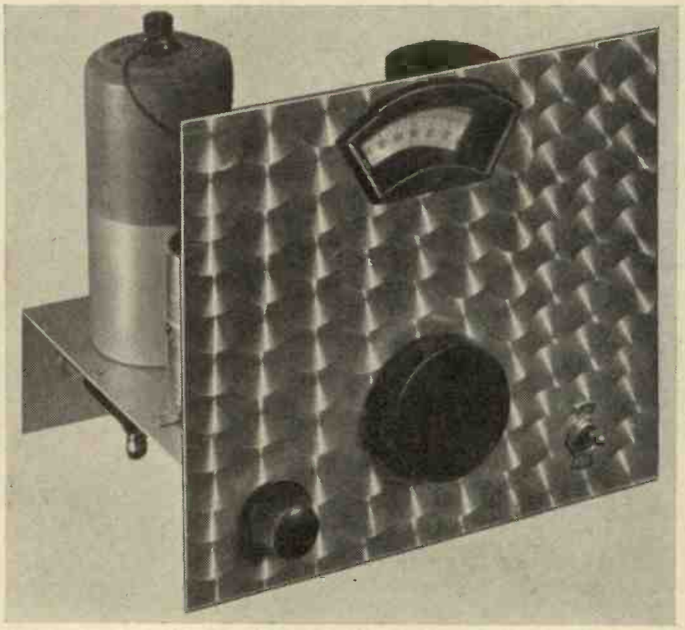
Future visits include the Battersea power station and the Post Office Research Station.

# A Short-wave Signal Booster

*Short-wave listeners interested in the elimination of harmonic interference, reduction of noise level, or the increase of signal strength will be intrigued with this simple unit. It is being used by the designer, Norman Brandon, a well-known listener, within the shadows of the aerials at Brookman's Park, and has proved very effective.*

SIMPLE short-wave receivers for use close to a powerful transmitter are inclined to be upset by harmonics which unfortunately invariably come in on one or more of the amateur or commercial wavebands. This harmonic trouble is particularly noticeable on the 160- and 80-metre amateur bands, if the receiver does not use a pre-detector H.F. stage.

From time to time I have realised the need for some unit to overcome these troubles as both my receivers—a straight two and a simple super—are troubled by harmonic interference.



*The signal booster is neat and compact.*

It is a simple matter to lash up an H.F. unit, but, unless great care is taken in the construction, it will probably be unstable or difficult to operate. As the H.F. unit is suitable for all purposes I decided to make one up to give maximum gain and at the same time to be completely stable. Naturally as this actual unit has been in use for some time all the little difficulties which generally crop up after some months of use have been removed. Improvements have been embodied as a result of personal experiments and, although perhaps they may seem unnecessary, actually perform some useful function.

A typical example is the use of a valve screen with a metallised valve; I found that the metallised valve on its own was not satisfactory on certain wavebands, as sometimes it was inclined to be unstable if the gain was pushed to the limit, and this, of course, makes the unit difficult to handle, while the results would be very uncertain. But valve screens do the trick. They remove the last trace of instability and altogether make the unit very docile to handle.

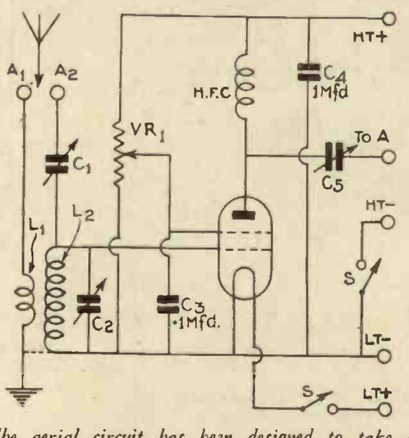
Actually this booster uses a conventional circuit, small points here and there actually accounting for the good results obtained. Notice that the coils are home-wound. Provision has been made for a doublet aerial, while the alternative aerial taps enable the selectivity to be varied as required on different wavebands.

The Jackson preset condenser is a very inexpensive component but has proved most effective, and I thoroughly recommend it for general use.

## The Circuit

First of all the circuit. The aerial is fed into the grid of the screened-grid valve through either a coupling coil or direct to the grid through a preset. Incidentally the coupling coil has been designed to give a compromise between optimum gain and maximum selectivity on all wavebands. But more about the coil design later.

When maximum gain is desired and selectivity has to take second place, the aerial can be connected to the second tapping, cutting out the coupling coil but bringing in the series aerial condenser. Slight variation in selectivity can be made by adjusting this capacity, but make these adjustments carefully, otherwise signal strength may drop off.




*The aerial circuit has been designed to take a conventional aerial or a doublet type.*

The S.G. valve is worked in a normal way except that the screened-grid voltage is continuously variable between zero and maximum. I rather like this arrangement, for with certain high-frequency pentodes, which, by the way, can be used without alteration, instability may be noticed unless very special precautions are taken. Variable screen voltage stabilises a circuit quite nicely, but, of course, no instability will be noticed with the screened-grid valve.

Actually the main function of the variable screened voltage is to provide a positive means of volume-control but, incidentally, there is no need for any reader to worry about the type of his eliminator, because any unit giving 100 volts or more will do excellently. There is no need for a special screened-grid tapping.

## Choke Impedance

The impedance in the anode circuit of the valve takes the form of a highly efficient screened choke. Several types of choke were possible in this position, but a combination of the Cossor 215SG and the Eddystone screened choke gave optimum amplification.

Before going into details about the construction, I should like to point out that the average amateur's idea that receivers can be tested very roughly when they are built on a breadboard and wired in hay-wire fashion is completely erroneous. It must be realised that the more efficient the circuit, the less efficient it will be unless it is wired in an efficient way, as intended by the designer.

In the old days with straight receivers of low stage gain any sort of layout or construction would do, in fact results were sometimes better when wired haywire than when wired correctly. It would not be fair to this circuit to try it out when built in the old way, so I strongly advise readers to construct it

*This photograph shows the rear of the signal booster which, as will be seen, is quite simple to build.*

The wiring can be seen on the reduced copy of blueprint. A full-size blueprint can be obtained from the Blueprint Department of TELEVISION AND SHORT-WAVE WORLD, Chansitor House, 37/8 Chancery Lane, London, W.C.2, price 1s.

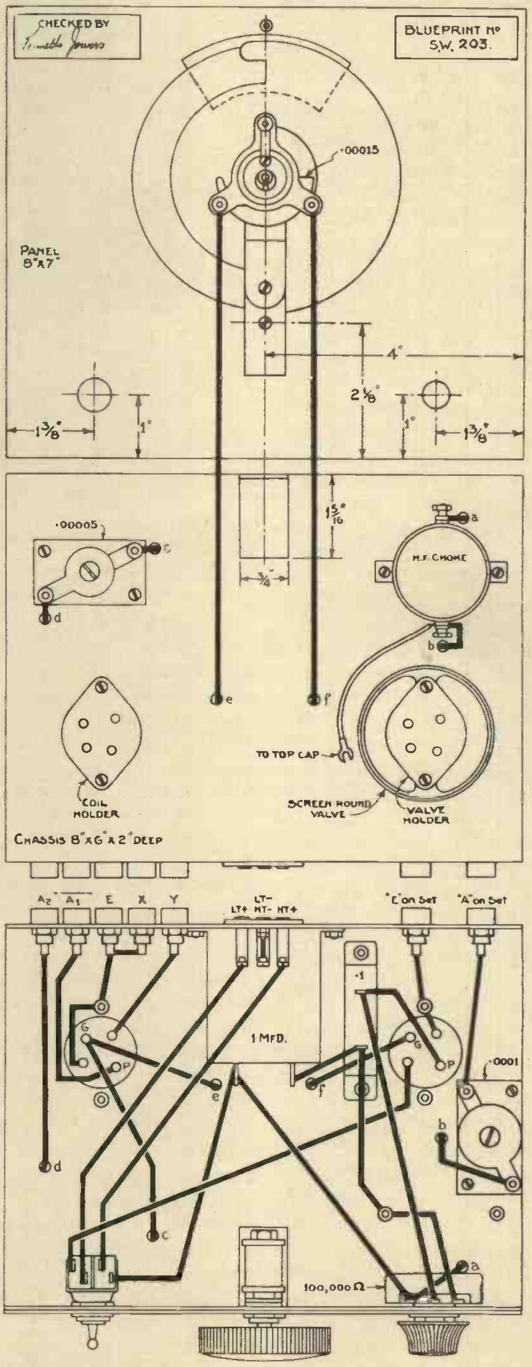
There is no need for me to elaborate the constructional details except to mention that the three-way Belling-Lee socket must be carefully fitted. Notice that one terminal is taken to H.T. positive and the other to L.T. positive, the exactly as I have done, particularly as regards screening.

All the little tuning troubles have been overcome. The circuit is completely stable, selective, will actually tune between 12 and 200 metres and even between 12 and 20 metres has a fair percentage of high-frequency gain.

## Construction

First of all the chassis can be bent out of aluminium with the minimum of trouble, but, before fixing the panel to the chassis, cut out the slot to take the Eddystone tuning drive. The two large holes, one for the valve holder and the other for the coil holder, can be cut out of the aluminium by means of a one-inch centre bit.

The actual valve holder is mounted at the same time as the Colvern valve screen, two bolts fixing both components. As the other components on the chassis are so few in number, they can be bolted on in almost any order, but it is advised to mount all components on the base plate first and on the panel afterwards, finally bolting the panel to the chassis.




*The layout and wiring diagram. A full-size blueprint is available, price 1/-.*

### COMPONENTS FOR SIGNAL BOOSTER

**CHASSIS AND PANEL**
8 in. by 6 in. by 2 in. aluminium (Peto-Scott).
Panel, 8 in by 7 in. aluminium (Peto-Scott).

**CONDENSERS, FIXED**
1—1-mfd., type 50 (T.C.C.).
1—.1-mfd., type 50 (T.C.C.).

**CONDENSERS, VARIABLE**
1—.00016-mfd., type 942 (Eddystone).
1—.00005-mfd., pre-set (Jackson).
1—.0001-mfd., pre-set (Jackson).

**COIL FORMERS**
4—4-pin (B.T.S.).

**CHOKE, HIGH-FREQUENCY**
1—Type 983 (Eddystone).

**DIALS, SLOW-MOTION**
1—Type 933B (Eddystone).

**HOLDERS, COIL**
1—4-pin (B.T.S.).

**HOLDERS, VALVE**
1—Type SW41 (Bulgin).

**PLUGS, TERMINALS, ETC.**
2 plugs, type A, marked H.T. +, H.T. — (Clix).
2—Spade terminals, type R, marked L.T. +, L.T.— (Clix).
1—3-pin plug and socket (Belling Lee).
7—Insulated plugs and sockets (Belling Lee).

**RESISTANCES, VARIABLE**
1—100,000-ohm potentiometer (Erie).

**SWITCH**
1—Two-pole make and break, type S82 (Bulgin).

**VALVE**
1—Cossor 210SPT met.

**VALVE SCREEN**
1—Colvern.

**SUNDRIES**
Connecting wire and sleeving (Goltone).
Quantity of 6BA nuts and bolts (Peto-Scott).

**A complete kit of parts is obtainable from Peto-Scott, Ltd.**

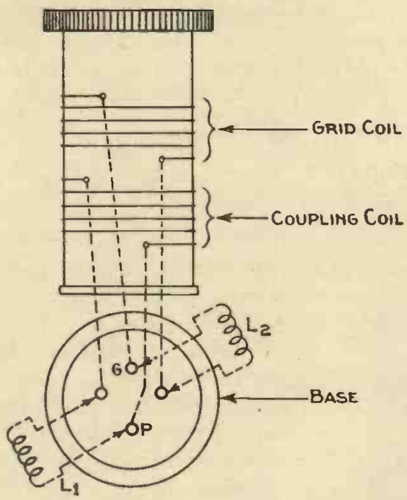
centre contact being earthed to the chassis

### The Coils

Now, as regards the coils, these are most important. Most amateurs know that, to obtain maximum volume, the L/C ratio in the grid circuit must be more or less correct. It has been arranged that the tuning coils bring the more important wavebands in at the correct position on the dial. For example a 24/48-metre coil brings in the 25-metre commercial stations at about 3 degrees on the dial. The 45/100-metre coil brings in the 50-metre commercials at 9 degrees on the dial, and so on.

The low-wavelength coil tunes between 12 and 25 metres, the formers incidentally are the same type throughout and can be obtained from B.T.S.

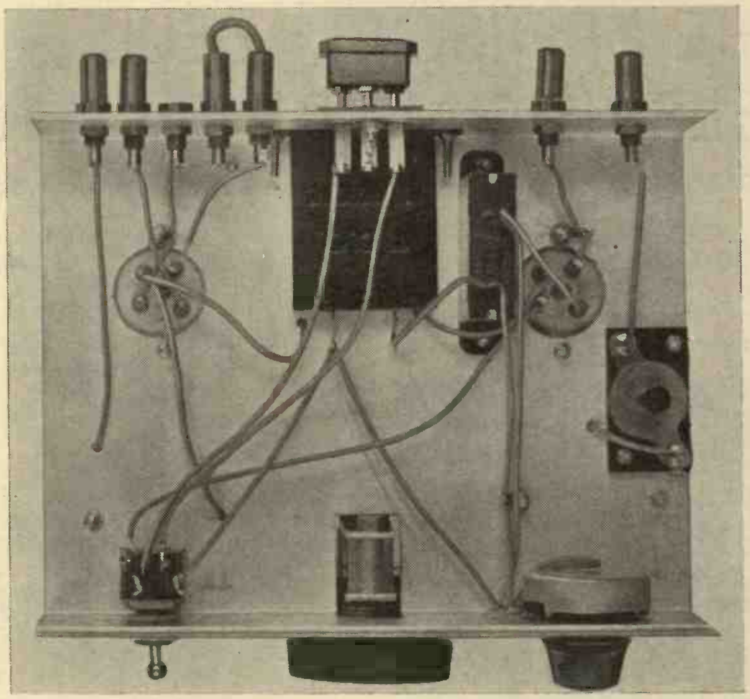
The grid coil consists of five turns of 26-gauge d.s.c. wire wound 14 turns per inch. The coupling coil consists of four turns and there is no space between the end of the grid coil and the beginning of the coupling coil. The pin connections for all of the coils can be seen from the illustrations. The second coil tuning from 24/48 metres requires eleven turns of 26-gauge d.s.c. wire also wound 14 turns per inch. The coupling coil is in this case wound with six turns and with the same spacing as for the grid coil. There is again no spacing between the coils. The 45/100- metre coil is wound with the same gauge of wire but with no spacing between turns, the grid coil requires 20 turns and the coupling coil 9 turns with a gap of 3/16ths of an inch between the end of the grid coil and the beginning of the coupling coil. For the top-band coil tuning between 90 and 200 metres the same gauge wire is used, with no spacing between turns. The grid coil has 40 turns and the coupling coil 18 with a space between coils of 3/16ths of an inch.




*Details of the grid and coupling coils.*

With regard to the final coil, the 18-turn coupling coil, this is a rather variable quantity because so much depends on the locality in which the receiver is to be used.

If additional selectivity is required, reduce the number of turns on the coupling coil, or conversely, for flatter tuning and more volume, increase the number of turns.



*This is an underneath view of the chassis, showing the wiring and layout of components.*

**COIL-WINDING DATA**

| | | Grid Coil. | Coupling Coil. |
|---|---|---|---|
| No. 1. | 12/25 metres | 6 turns | 4 turns (space 14 turns per inch). |
| No. 2. | 24/48 metres. | 11 turns | 6 turns (26 gauge d.s.c. wire wound 14 turns per inch). |

There is no gap between the grid and coupling coils in the above two coils.

| | | | |
|---|---|---|---|
| No. 3. | 45/100 metres | 20 turns | 9 turns (26 gauge d.s.c. close wound). |
| No. 4. | 90/200 metres | 40 turns | 18 turns (26 gauge d.s.c. close wound). |

There is a gap of 3/16ths of an inch between the grid and coupling coils in coils 3 and 4.

Of course, a medium-band coil can be wound and would require approximately 75 turns on the grid and 25 turns for the coupling coil, but actually the unit is not intended for medium waves.

The function of this unit is first of all to amplify signals received on a straight short-wave receiver—it can be added to any short-wave set whether it has a high-frequency stage at present or not and will distinctly improve the range of the receiver. There may not necessarily be a distinct increase in volume, but the actual range of the set is increased enormously.

As mentioned previously, if you are living close to a powerful transmitter, this additional tuned circuit will greatly help to reduce harmonic interference.

All readers who are using a super-het with a first detector oscillator not having a high-frequency stage in front of it will be well advised to use this booster, for, in addition to increasing the signal strength and reducing the number of harmonics, the bad noise level will be very greatly reduced.

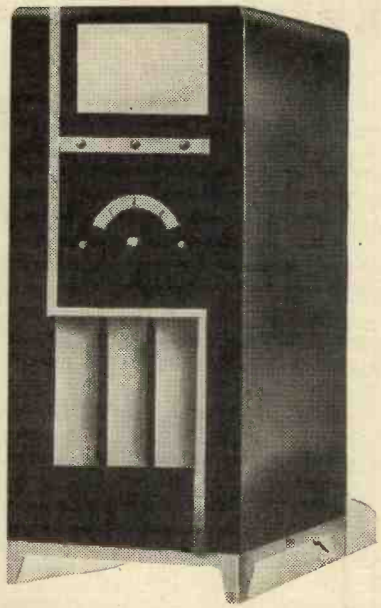
## Ten-metre Reception

Several English stations are active on ten metres, notably 2YL, from Tadworth, but some remarkable performances are being put up in Australia. We have just received details of how the VK stations are successful in contacting American and Japanese amateurs quite consistently.

Australian stations VK2LZ and 2HY have been particularly well received in America. VK2LZ has worked W9NY in Milwaukee, which is a record in Australian circles. He has also worked W2TP, the latter station being well known in this country on 20 metres, this station being eleven thousand miles distant. This, we understand, is a world record.

# THE EDISON BELL TELEVISION RECEIVERS

*First Details of the Edison Bell Sound and Vision and Vision Cathode-Ray Receivers.*



*The Edison Bell sound and vision receiver is a very handsome piece of work.*

NEARLY twelve months ago Mr. Howard Flynn, managing director of Edison Bell, Ltd., had the foresight to realise that the ultimate development of television would be

*Mr. Howard Flynn, Managing Director of Edison Bell (1933), Ltd.*

upon high-definition lines, and what was of greater importance, that the possibilities then were such that within a reasonable time some television service must be inaugurated. In these ideas he had sufficient confidence to go right ahead with the design of a receiver and for the greater part of the past year his technical staff have been engaged in research which has culminated in the two receivers which are now quite ready to go into commercial production.

We have seen the many earlier models which tell very plainly the amount of work that has been put in; these range from rough hook-ups to finished cabinet models, and incidentally it is interesting to note that throughout the policy has been adopted of entirely rebuilding instead of modifying the earlier type as possible improvements have been revealed. The outcome of this work is shown by the photographs on this page.

Two models have been designed—one a complete television and sound receiver and the other a television receiver only. In conjunction with the latter it is proposed to market a simple unit which can be used in conjunction with an ordinary broadcast receiver for the reception of the sound side of the television programmes.

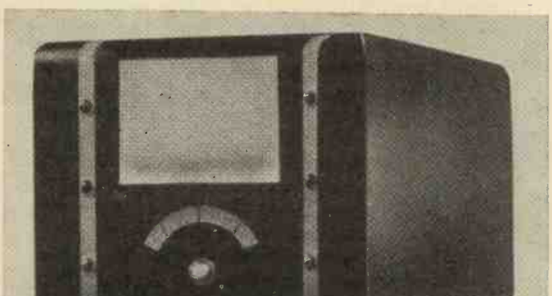
## The Vision and Sound Receiver

The cabinet of the complete receiver is approximately four feet high and the screen occupies a rectangle at the top 12 ins. by 9 ins., the tube, of course, lying horizontally. The tube is supported in a wooden cradle at the front and is held securely in position by means of a rubber strap attached by snap fasteners. An ingenious feature is the method by which the connections are brought to the tube. Towards the rear end there is an annular ring of insulating material which is fitted with terminals; the tube lies within this ring with generous clearance and permanent connections are made from it to the tube holder at the back of the cabinet.

The time-bases are accommodated at either side of the tube and as both the tube and these are mounted on a sliding tray the whole assembly can be withdrawn from the cabinet very easily.

Both vision and sound receivers are accommodated in the centre portion of the cabinet and below these are the speaker and power unit, the latter being placed right at the bottom of the cabinet. In all there are six controls which are as follows:—On-off switch, picture centring control, brilliance control, sound tuning, vision tuning and sound volume control. The controls knobs have chromium metal behind them which reflects a portion of the light from the tube and so makes them visible in semi-darkness.

The cabinet is a very handsome piece of work and as the photograph shows, of very modern design. It is of ebonised wood with bright chromium-plated metal strips in relief, and a base of the same material.



*This photograph shows the vision receiver for use with a separate receiver for the sound.*

## The Vision Receiver

The smaller model which, as mentioned before, is a vision receiver only, is built upon the same lines and has the same size of screen. This, of course, comprises the tube, time-bases and vision wireless receiver, and the chief difference is in the arrangement of the controls, of which there are five, viz., on-off switch, picture centring, brilliance control, vision tuning and vision volume. With quite a simple alteration both these receivers are adaptable for practically any number of scanning lines.

The designer, Mr. C. P.

(Continued on page 336.)

# The Tatsfield Checking Station

*Our special correspondent gives particulars of the short-wave receivers used by the B.B.C. at Tatsfield for relaying, frequency checking and monitoring purposes.*

*The Tatsfield station consists of two buildings. The one on the right is the power house and that on the left houses the checking apparatus.*

NINE HUNDRED feet above sea level, several hundred yards from a secondary road, entirely free from interference of all kinds, this B.B.C. checking station is in an ideal position for radio reception, which probably accounts for the excellent results obtained, particularly on short-waves. Some remarkable performances have been put up on 30-50 megacycles, but unfortunately the official figures cannot be published just yet.

Although the station was erected primarily for frequency-checking of British and European stations and the relaying of European programmes, its scope has been extended to checking world-wide short-wave stations, the relaying of American, Australian and other long-distance transmitters, and as a general listening post, keeping a watchful eye on the world's broadcasting.

The entire station is self-contained, except for power, which is obtained from the local supply mains, but all the equipment is operated from H.T. and L.T. accumulators, which are charged on the spot.

### Field Strength Measurements

The field strength of almost any transmitter can be measured very quickly. The apparatus used for it consists of a special super-heterodyne receiver with an intermediate-frequency of 1,500 cycles, this frequency being chosen to give the maximum selectivity. Quality, or rather, the lack of it, does not matter at all for only carrier-wave strength is measured. The intermediate-frequency currents are rectified by a logarithmic rectifier and the given D.C. recorded on a conventional milliammeter.

With this receiver is used a frame aerial, and a local screened radio-frequency oscillator is employed for calibration. The radio-frequency current produced by this oscillator, in a 1-ohm resistance at the centre of the frame aerial is measured, while the effective height of the frame aerial is known, so the effective field required to give an effective current in the meter can be calculated.

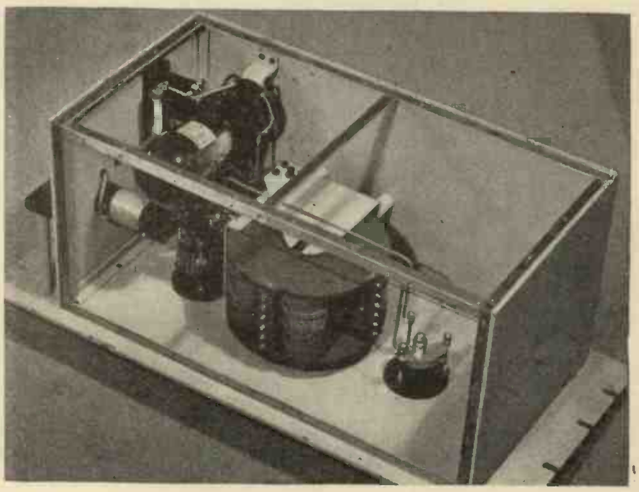
It is not proposed to delve into details of the medium- and long-wave meters used for checking purposes, except to say that the receivers cover from 200 to 2,000 metres, and work in conjunction with a Bellini-Tosi radio-goniometer. This gives an added means of cutting out interference.

The receivers for medium- and long-wave working are of the straight variety with two high-frequency stages and, of course, automatic volume control. Most amateurs will probably be more interested in the short-wave receivers, which have come into prominence recently owing to the short-wave relays from New York. Four receivers are available and it is possible to interlink two of them at any time from diversity aerials. But more about that later.

I was surprised to find that the receivers were more or less conventional. They consist of eight valves with the following sequence. Screened-grid, radio-frequency amplifier, followed by a tuned grid stage to a directly-heated triode with a separate directly-heated triode oscillator. Only two I.F. stages are used, but the intermediate-frequencies are staggered. The second detector is an I.D.H. diode with another I.D.H. triode for A.V.C. The diode can either be coupled into a triode audio-frequency amplifier or into a mixing panel for re-transmission.

### Battery Supply

Although mains valves are used throughout, the L.T. and H.T. supply are obtained from wet cells. With regard to the I.F. stages in the superhet, only one stage is A.V.C. controlled, and this is coupled to the radio-frequency amplifier. The I.F. frequency, in addition to being staggered, can also be varied between approximately 1,500 kc. and 500 kc., while the wave-range is 12-90 metres.



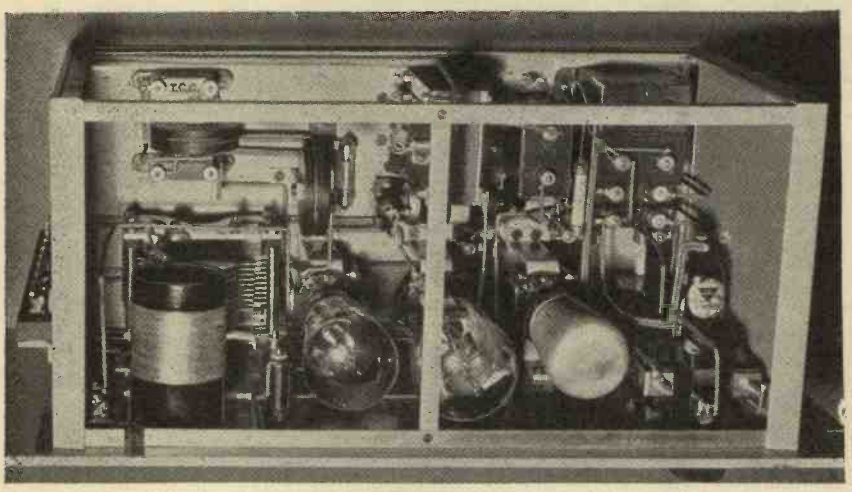
*Here is the coil switching which has a very positive action. The local oscillator is also embodied in this unit.*

The input circuit is arranged so that the receiver can operate from a simple domestic type of aerial, cross feeder, or Franklin aerial fitted with reflectors. With regard to the output circuit the engineers have discovered that by using two aerials of either different types or in different directions with two separate receivers a considerable percentage of fading could be overcome, so now it is a common practice to bring together two receivers in this way.

Outputs from the two receivers are fed into the mixing rack through a 600-ohm line. This rack contains a variable equaliser, two low-pass filters, one cutting at 3,500 cycles, and the other at 5,000 cycles, four channel fader unit, programme meter, an audio-frequency amplifier, and the necessary jack circuits to allow of connection of any receiver to the lines to Broadcasting House.

### *The Short-wave Receivers*

The short-wave receivers are all of unit construction, while wave-change switching has just been embodied. This switching is of massive construction, unlike the amateur idea of short-wave design, but it has proved to be very effective. Another feature which will appeal to listeners who have struggled with A.V.C. is that the A.V.C. control is so effective that a variation in signal strength of 66 decibels only results in an average variation at the detector circuit of four decibels.



*The second detector and A.V.C. circuits are included in this section, the entire short-wave receiver being constructed unit fashion in this way.*

Mr. Griffiths, the engineer-in-charge, told me in a most lucid way about the apparatus designed and used at Tatsfield, and one point is very hard to forget. Although the frequency-measurement is accurate to one part in one-and-a-half million, it is possible, if necessary, to increase this accuracy to *one part in ten million.*

Time-signals from Rugby on 18,000 metres are used to check frequency and these transmissions are picked up on a simple radio receiver. The quartz crystal oscillator used in the frequency-checking is, of course, temperature controlled by means of a thermostat arrangement. A Thyratron valve of the gaseous type is used in this control and has proved to be 100 per cent. efficient.

In addiption to all this apparatus, there is also a temperature-controlled tuning-fork used as a standby for the quartz crystal and other apparatus.

The average amateur cannot conceive the amount of accuracy with which tests are carried out in Tatsfield, neither is it possible that many will appreciate the results that can be obtained when conditions are favourable. If I could publish details of the short-wave stations heard, I feel sure that very few of our readers would have any doubt as to the number of entertaining programmes that can be heard with a short-wave-receiver.

## "The Edison Bell Television Receivers"

(*Continued from page* 334.)

Hall, has been particularly successful in eliminating intereference. Tests made at the Edison Bell laboratories in Rosebery Avenue, London, E.C., have proved that this is practically non-existent, although the receivers were operated within a few feet of a large amount of electrically-driven machinery. Incidentally, it is interesting to note that Edison Bell were the pioneers in this country of the original Edison phonograph which employed cylindrical records. In their works are many models and records reminiscent of the earliest days of sound recording. Once again this concern is in the forefront in the development of a new science.

## Australian Short-wave Radio from Lyndhurst

Transmissions from VK3LR, of Lyndhurst, Australia, are being well heard in this country with simple receivers. The Lyndhurst station is situated 25 miles east of Melbourne, and is at the moment carrying out experimental transmissions. Plant consists of electron-coupled oscillator followed by screened-grid radio-frequency amplifiers with low-power modulation.

The modulated amplifier is followed by two additional radio-frequency amplifiers driving the final P.A. stage to 600 watts at 9,580 kilocycles. Transmission times are approximately 08.15 to 12.30 G.M.T., programmes being taken from 3AR or 3LO. Additional experimental tests are carried out at other times, but the call sign is changed to VK3XX.

## When to Listen for Short-wave Stations during JUNE

*By 2BWP, C. J. Greenaway,*

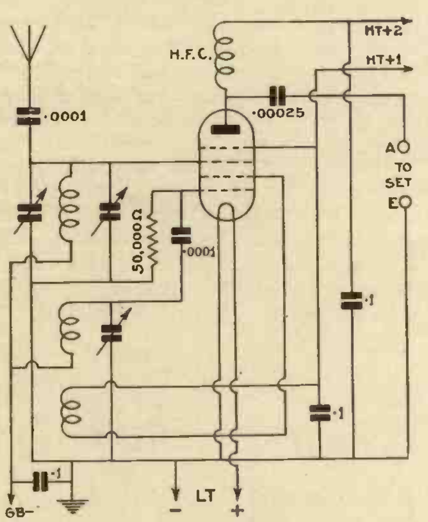
| B.S.T. | 3.5 mc. | 7 mc. | 14 mc. |
|---|---|---|---|
| 0400 | W8 | W1, 3, 9 | |
| 0500 | W1, 2, 8 | CM ; FM8 ; K5 ; LU ; TI ; W1, 2, 3, 4, 5, 8, 9 | VE5 ; W7 |
| 0600 | W8 | LU ; NY ; VE1 ; W1, 2, 3, 4, 5, 8 | VE5 ; W1, 6, 7, 8 |
| 0700 | | VK ; W1, 2, 3, 4, 8 ; ZL | HC ; VE5 ; W6, 7 ; YI |
| 0800 | | | W7 |
| 1200 | | | W1, 2 |
| 1300 | | | W1 ; FM8 |
| 1400 | | | W1 |
| 1500 | | | W1 ; FM4 |
| 1600 | | | W1, 8 |
| 1700 | | | ZC6 |
| 1800 | | | FM4, 8 ; VQ4 ; ZC6 ; ZD |
| 1900 | | | K4 |
| 2000 | | | W1, 3 |
| 2100 | | | W1, 2, 3, 8 ; LU |
| 2200 | | | FM8 ; LU ; PY ; VE1 ; W1, 2, 3, 8 |
| 2300 | | | CM ; VE1, 2 ; W1, 2, 3, 4, 8 |
| 2400 | | | W1, 2, 8 |

# The Short-wave Radio World

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

### A Battery Heptode Convertor

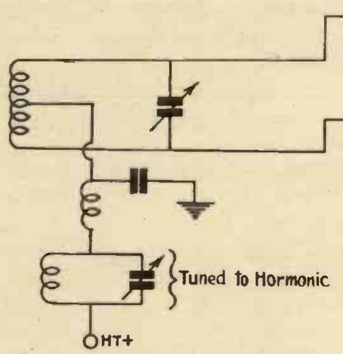
It is rather unusual to find short-wave converters still being used in Australia. We were rather under the impression that all-wave sets were the order of to-day. However, in a recent number of the Australian publication, "Wireless Weekly," we notice a very effective short-wave converter




*Single dial tuning is only one of the many features in this Australian short-wave heptode converter. English valves can be used in it.*

which, although it uses the American valve type 1C6, will be quite as efficient when used with any of the English frequency-changers, such as the Cossor 210PG or the Marconi-Osram X21.

From the illustration, one can see that the circuit is more or less conventional. Semi band-spread tuning is embodied, while a relatively large variable capacity tunes the grid coil. The tuning condenser actually is of




*Interference to stations on higher frequencies will be reduced if this filter is included in the transmitter.*

the double-gang type such as the Eddystone 967 and is used to tune both grid and oscillator. Provision has been made for the application of battery bias to the frequency changer, but, at the same time, the G.B. lead can be linked to the A.V.C. line in the broadcast receiver, used in conjunction with this unit.

With regard to coils, these are the conventional type so the Eddystone high-frequency transformers type 959 can be used in this circuit without alteration.

### Harmonic Suppression

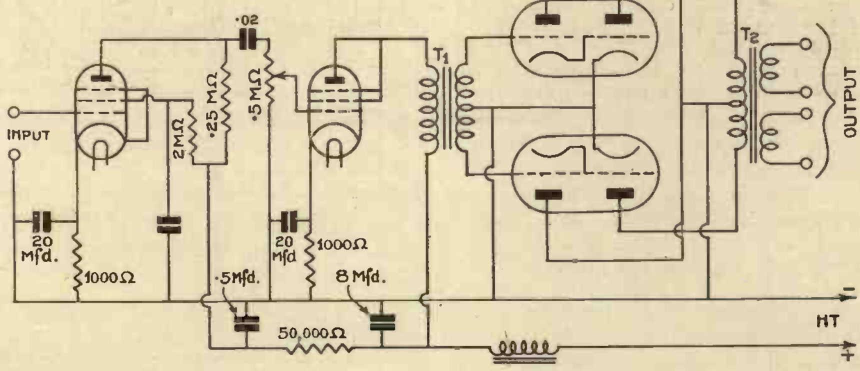
Considerable interference can be caused to short-wave listeners by unnecessarily powerful harmonics. Stations on 80 metres, for example, quite frequently generate harmonics on 40 metres which block out the entire waveband throughout the neighbourhood. Readers have probably heard amateur stations on both the fundamental frequency and on the harmonic, and very often it is difficult to distinguish any difference in R strength between the two signals. In such circumstances it is advisable for the transmitter to embody some simple method of harmonic suppression to overcome this interference.

A very simple arrangement is to connect the tuned circuit in series with the H.T. supply to the P.A. This tuned circuit should, of course, be arranged so that it will resonate at the same frequency as the harmonic to be eliminated. As a general rule the tuned circuit can be screened, when efficiency will be considerably increased. Alternatively, other methods of filtering can be adopted, such as having a coupling coil or a tapped coil in series with the H.T. supply. These variations of the original arrangement have the effect of sharpening the tuning on the harmonic to be suppressed.

Further details of this idea can be seen in the April issue of the A.R.R.L. publication, "Q.S.T."

### A High-quality Amplifier

We were interested in an amplifier design published in "R.9" which can be used to advantage in many British amateur stations. It consists of a 6C6 H.F. pentode valve used as a low-frequency amplifier. This is R.C. coupled on to a second 6C6, which has coupled grids, so converting it into a conventional triode ampliler. The two output valves are 6B5's in push-pull and these valves will, with a plate supply of 325 volts, give 18.8 watts A.C. output with 13.5 per cent. total




*13.5 watts output with less than 5 per cent. distortion are claimed for this amplifier.*

harmonic distortion. This is a very low figure and must not be confused with modulator distortion only. If the quality is improved to 5 per cent. total harmonic distortion the output is reduced to 13 watts.

The whole amplifier is built on a steel chassis, the under side of which is divided in half by a special steel partition. A.C. filament wires and other potential sources of hum are kept on one side of this partition. It is pointed out that hum is bound to be picked up unless the actual speech section of the amplifier is completely shielded. To this end, the first two valves, with their associated components, are completely screened within a metal container.

A simple input circuit is shown for a crystal microphone which, of course,

# Pre-amplifier for Crystal Microphones :: 5-metre Police Radio

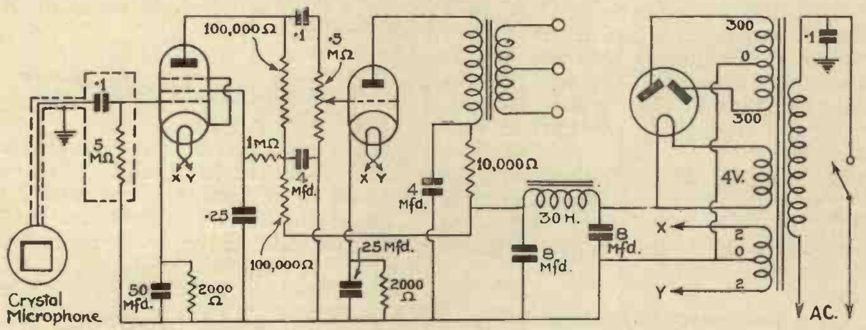
## *A Pre-amplifier for Crystal Micro hones*

Although the crystal microphone gives very fine quality, it has the big disadvantage of low output level. Rarely has an existing amplifier sufficient L.F. gain when used with this type of microphone, so it is essential, if full modulation is required, to use a simple type of head amplifier. As a general rule, these head amplifiers are battery-operated so as to prevent any increase in ripple. But we have been investigating an excellent circuit described in "Radiocraft" which is entirely A.C. operated. It consists of a high-frequency pentode which is R.C. coupled to a simple triode amplifier. Mains rectification is by means of a conventional full-wave valve. The output from the L.F. amplifier is fed into an output transformer with a 2,000-ohm primary and a tapped secondary giving an impedance of either 500 or 300 ohms.

It is essential that the high-frequency pentode be of the type having the grid connection to the top cap. The connection to this grid must be very carefully made and completely shielded. Of course, with a crystal microphone no input transformer is needed, but the microphone cable, in addition to being screened, must be of high-quality construction, otherwise there will be severe attenuation of the top notes. It has been discovered that 20 feet of the standard low-capacity cable results in a loss of approximately 10 db.

does not require any input transformer or energising battery. In the event of a more conventional microphone being used, these components, of course, will be required.

The valves and transformers specified for this amplifier can be obtained from Messrs. Claude Lyons.

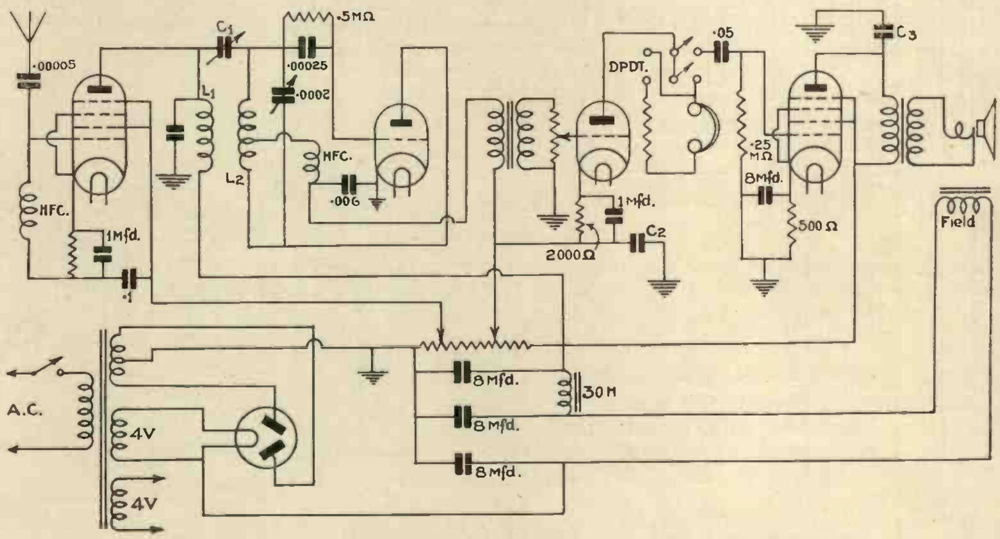



*To obtain the best quality from a crystal microphone the head amplifier has to be carefully designed.*

## *Five-metre Police Radio*

We have received an interesting circuit of a five-metre receiver used by the Chicago Police. It comprises five valves, all A.C. operated, the power supply being obtained from a rotary converter driven from the car accumulator. The first valve is a high-frequency amplifier with an untuned grid circuit which serves to give slight R.F. amplification, but more to isolate the combined detector-quencher from the varying aerial load. The combined detector-quencher is then fed into an intermediate L.F. amplifier, driving a pair of earphones or, alternatively, an output pentode. The arrangement is quite conventional, but it has been found that the noise level and sensitivity are better than a superhet. The nominal range is only 15 or 20 miles, but reliable results are obtained under the most adverse conditions.

This receiver can be made up from British components, the necessary quench coils being obtained from Eddystone or Bulgin.




*American police use this circuit on 5 metres. They find it reliable even when travelling at high speeds.*

## Useful Short-wave Books

For 6s., post free, a copy of the Radio Amateur Callbook will be sent to any address in the world. This publication is indispensable to amateur transmitting and receiving stations for it contains a complete list of amateur calls (with full addresses) of every country in the world from Alaska to Zanzibar. In addition classified lists of high-frequency commercial C.W. and telephony stations are given. For those who want to know all about the Q codes, these are given in detail, while a section entitled "Who's Who on Short Waves" is invaluable.

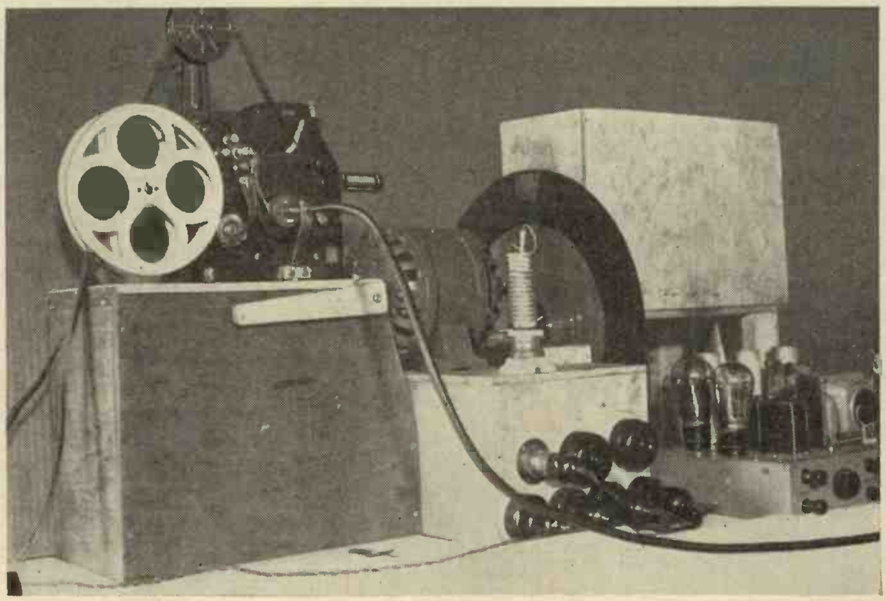
The Radio Amateur Handbook, published by the American Radio Relay League, is one of the most comprehensive handbooks it is possible to obtain. From a brief glance at the list of contents, we find that the following subjects are dealt with in a complete manner: Electrical and Radio Fundamentals, All Types of Receivers, Monitors and Frequency Meters, Planning and Building Transmitters, Radio and Telephony, Ultra-high Frequency, Aerial Systems, etc., etc. A total of nearly 300 pages for 4s. 6d.

Who's Who in Amateur Radio contains descriptions of over 3,000 American amateur stations, and is priced at 2s. 9d. These excellent books can be obtained from F. L. Postlethwaite, Radio G5KA, 41 Kinfauns Road, Goodmayes, Ilford, Essex.

TELEVISION AND SHORT-WAVE WORLD

# A CONTINUOUS-FILM 30-LINE TELEVISION TRANSMITTER

*This article is a description of a continuous-film transmitter which was designed and built for demonstration purposes. It formed a feature of the Jubilee display of Messrs. Lewis's of Liverpool and we understand that later it is to be shown at the other branches of this store. Readers in the North of England, therefore, will have an opportunity of seeing it in operation. It has been designed and built by J. H. Reyner, B.Sc., A.M.I.E.E., who here gives details of its construction.*



*This is a photograph of the complete transmitter; note the flexible drive between the projector and disc*

In order to give the general public an idea of the stage to which low-definition television has arrived, Messrs. Lewis's, of Liverpool, recently arranged a demonstration as part of their Jubilee celebrations. A description of this transmitter may be of interest.

The first problem in any television transmitter is that of the light available. Not only must this be at the right angle to throw the necessary fairly harsh contrast required, but it must also be sufficient in intensity; otherwise amplifier noise becomes troublesome and clear pictures cannot be transmitted. For this reason it was decided not to attempt any form of direct scanning but to rely on film transmsision. A modern home cine-projector is capable of an intense illumination, and it was actually found in the final transmitter that the lamp could be considerably under-run without any difficulty.

The basic lay-out is shown in Fig. 1. The image to be transmitted was projected on to a scanning disc rotated by a motor in the usual manner. Immediately behind the disc was the photo-cell, followed by the photo-cell amplifier in very close proximity. The output from this is amplified again in a mains amplifier, resulting in an output capable of modulating any of the usual forms of television receiver direct. No radio link was used as there was, of course, no necessity for the extra complication.

The early experiments were conducted on a still picture, using a scanning disc of normal type. A head and shoulders subject taken from a suitable piece of ordinary 16 mm. film was used for the purpose, and the projector was so located that the image comfortably filled the normal scanning area. At first a Baird motor was used with an 8-tooth synchronising wheel mounted on the shaft, keeping the equipment synchronised off the 50-cycle supply. It is essential that the transmitter motor should run absolutely steadily as otherwise the picture floats hopelessly and serious work is impossible.

The photo-cell used was an Oxford X41 gas-filled cell. This form of cell was used in order to obtain a high sensitivity. The measure of gas gain depends upon the H.T. voltage applied, and by using small voltages the characteristics of the cell can be made approximate to those of a vacuum cell. The disadvantage of the gas-filled cell is that when any appreciable ionisation is taking place a small time-lag occurs, which results in a restriction of the high-frequency response. This was noticeable where the cell was being used in a sensitive condition, but it was found quite practicable

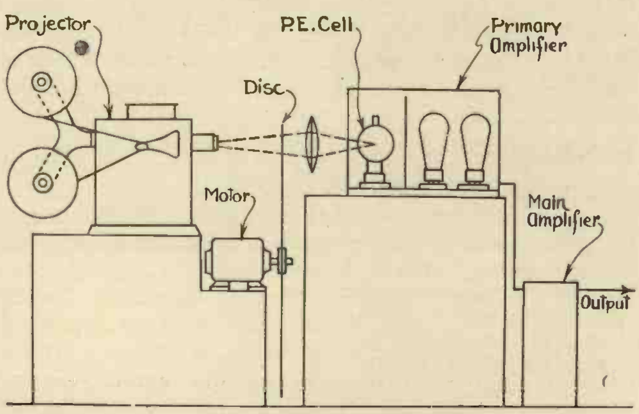



*Fig. 1.—General layout of the projector, scanner and amplifier.*

# A 30-LINE CONTINUOUS-FILM TRANSMITTER

to apply a high-tension voltage of the order of 90 volts, and to correct for the high-note loss in the subsequent amplifiers.

## *The Photo-cell Amplifier*

The photo-cell amplifier is interesting in that screened pentodes were used. Although such valves have a very high internal resistance their amplification is also large, and it was felt that two stages with such valves, with suitable correction, would probably give better results

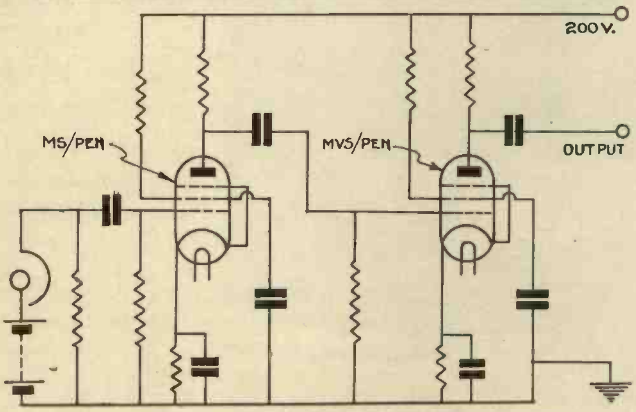



*Fig. 2.—Circuit of primary amplifier.*

than a larger number of stages of triode amplification. One advantage of the small number of stages is that no decoupling is required, whereas this additional complication would certainly be necessary with a larger number of valves.

A further advantage of the screen-grid amplifier lay in the economy of current drain. In order to avoid pick-up of hum the primary amplifier was battery-driven throughout, and since the total H.T. consumption was under 2 milliamps., ordinary single-capacity dry batteries were quite satisfactory. The heaters of the valves were supplied from a 4-volt accumulator. A.C. operation was unsuccessful here owing to the introduction of hum.

Particular care was taken, not only in the primary amplifier, but also subsequently, to ensure a satisfactory time constant. A value of at least 0.5 megohm-microfarads was arranged in each stage, and this was found to give excellent black and white. The top correction necessary was arranged by a combination of the resonant choke method in association with a capacity potentiometer.

## *Focusing*

In the initial experiments the light penetrating the scanning disc was allowed to fall direct on to the photo-cell, which was large enough to accommodate the fairly large scanning area of approximately two inches by one inch. This was satisfactory at the outset, but as the quality of the transmission improved, patterns began to appear on the receiving screen due to the slight unevenness in the sensitivity of the photo-electric surface at the back of the cell. The test, in fact, was a severe one, and it spoke well for the cell that it gave satisfactory results at all. The difficulty was minimised by focusing the rays after they passed through the scanning disc so that they fell in a more concentrated beam on to the photo-cell. Some pattern still remained, but as it was intended to progress on to actual moving film this was not deemed a serious obstacle. In any case it could be overcome by a sufficiently convergent lens.

It is a matter of interest to note that the anode, which is in the form of a loop of wire, cast a shadow which could quite clearly be seen on a white background. During the transmission of a normal picture it did not cause serious distortion, but it was present nevertheless.

## *Transmitting Moving Pictures*

The next step was to arrange the transmission of moving pictures. It is impracticable to employ an ordinary projector for this purpose because, although the picture appears continuous to the eye, the light is actually cut off for a fraction of the time while the picture is being changed, and during this period the photo-cell, of course, will receive no illumination, which will produce a vertical black band on the picture. Consequently, unless the projector and disc are synchronised, a continuous range of black bands will float across the picture, and even if the two are linked together there will be a permanent restriction of the available area.

The only satisfactory solution is to run the film continuously through the projector without any intermit-

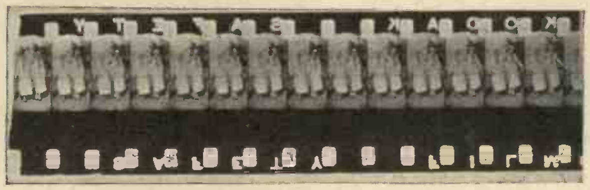


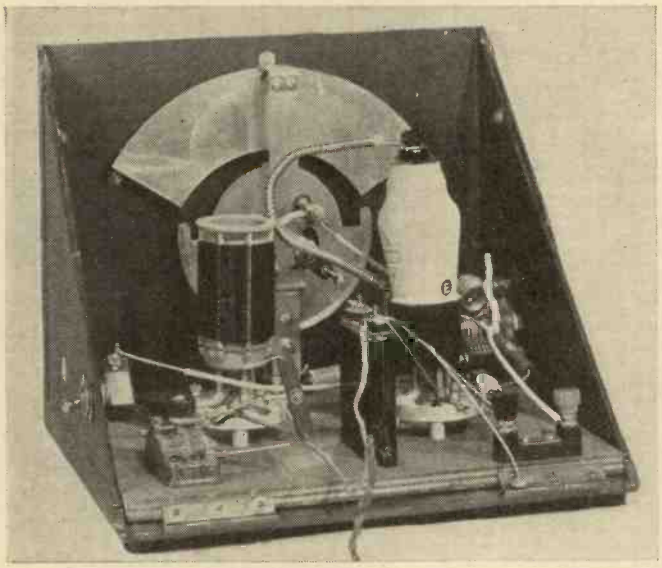
*Fig. 3.—Reproduction of a portion of the film used. This is approximately the actual size.*

tent motion. For this purpose, of course, the disc has to be arranged with all the holes at the same distance from the centre and not on a spiral as at the receiving ends. The motion at right-angles to the direction of the travel of the disc is then provided by the film itself. Attempts were made to drive the projector through a system of gears, but it was found that these had to be particularly accurate if satisfactory results were to be obtained. The slightest variation in speed will give a distorted picture. If there is any play in the gear between the disc and the projector the picture will float sideways from one side to the other, while if the disc itself does not run absolutely uniformly the top and bottom of the picture will not be straight, but will waver. In the end a flexible drive was used, coming straight off the disc shaft on to the projector, and with suitable design this was found to be very satisfactory. The projector used was a standard 16 mm. projector with the intermittent motion removed.

## *Picture Ratio*

The final difficulty on the transmitter was that of the film to be used. A normal film moves vertically, where-

(*Continued at foot of page* 342.)



*A good idea of the suggested lay-out can be gained from this illustration. Remember the whole unit must be completely screened.*

# PICKING UP HIGH-DEFINITION SIGNALS

*Now is the time for those interested in television to think about constructing an ultra-short wave receiver. This little unit is intended to be used as an introduction to television and to enable our readers to pick up the Crystal Palace and other transmissions. It should be clearly understood that it is not suitable for television but will give an indication as to how signals may be received in any given area.*

AN autodyne super-het converter is still one of the most satisfactory arrangements for both short and ultra-short wave working. It combines the virtues of simplicity of operation and efficiency. Readers who have not had any experience in super-het operation will find the autodyne circuit a simple introduction.

When this super-het unit was designed we kept in mind that it was intended to receive the 8.5-metre sound programmes which are being put out experimentally by the Baird Co. from the Crystal Palace. This meant that it would have to be suitable for use in conjunction with almost all types of broadcast receivers and would not be dependent on intermediate frequency or other minor points.

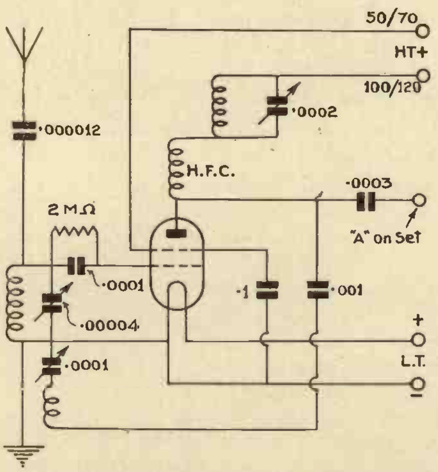
While it does not strictly conform to these requirements it is suitable for use with any receiver, whether battery or mains operated, of the super-het type or a straight set with one or more high-frequency stages.

## The Converter Circuit

The circuit may give the impression that this converter is nothing more or less than a single-valve detector circuit. That is really what it is except that it is used to generate a beat frequency of the same wavelength as the intermediate frequency coil following it, or to the wavelength to which the broadcast receiver is tuned.

Although the converter is housed in a metal case, amateurs can use breadboard construction simply screening both base-plate and tuning controls with sheet aluminium.

Tuning coils can either be home-constructed or Eddystone coils can be used. If home-constructed, a small quantity of 14-gauge copper wire will be required. This should be pulled taut in a vice and five turns wound around a round piece of wood or something similar. Actually the coils are half an inch in diameter while the spacing between each turn is equal to the size of the wire used.




*The circuit of the converter. The .000012 condenser is made of twisted flex. Several other components are also home constructed.*

From the photograph it will be seen that the coils are anchored to the respective tuning condensers so that no dielectric losses are set up by using coil formers or mounts.

For a tuning condenser only 40 micro-farads capacity is required. A suitable condenser is the .00004-mfd. Eddystone type 900. A similar condenser will do excellently for reaction, only the capacity should be .0001-mfd.

Between the high potential end of the reaction winding and the anode of the detector-oscillator valve, is a .001-mfd. condenser. This value is not critical for the condenser acts as a buffer. It is important to make quite sure there is no short circuit through the reaction condenser.

In series with the anode of the valve and the high-tension supply is a small 5-metre choke, again an Eddystone component. This choke can be home-made quite easily, and we suggest that you wind 50 turns of 30-gauge silk-covered wire on a half-inch test tube, obtainable from any chemist.

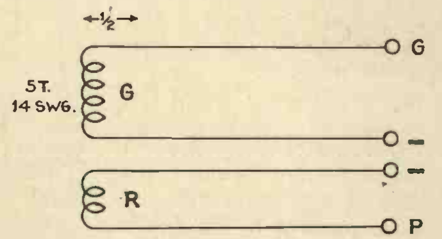
The .000012-micro-microfarad condenser in series with the aerial, must be home-made. It consists merely of two 4-inch lengths of insulated wire, twisted closely together. Either connecting wire and sleeving or twin flex will do excellently.

## Detector-anode Tuned Circuit

So as to obtain optimum efficiency, it is essential to have a tuned circuit in the anode of the detector valve. In the original hook-up this consisted of an Eddystone medium-wave plug-in coil tuned by a .0002-mfd. Formodenser.

This circuit must be tuned to 200 metres in the case of a straight receiver or to the frequency of the I.F. coils in the case of a super-het.

If, for example, the I.F. frequency is 450 kc. the coil will have to be capable of tuning to that frequency when tuned with a .0002-mfd. condenser. In extreme cases where 126 kc. I.F. coils are used (nearly 3,000 metres) it will be advisable to use an




*Both coils are constructed in the same way. Notice both the inners are at earth potential.*

I.F. transformer in this position, or a large plug-in coil of approximately 400 turns and tune it with a .001-mfd. Formodenser.

When used in conjunction with a super-het. receiver, sensitivity is of a high order for triple detection is obtained, once with the unit and twice in the super-het.

The high-frequency valve recommended, a Cossor 215SG, oscillates very freely down to below 7 metres. If any difficulty is experienced in obtaining even oscillation this can soon be overcome by varying the voltage applied to the screen. We found the normal voltage to give optimum results to be about 80 volts, but different samples of the same type of valve required only 50 volts. This, of course, is a matter for experiment.

It is not always necessary to use an earth connection, but occasionally

**COMPONENTS FOR THE HIGH-DEFINITION UNIT.**

**CABINET AND BASEBOARD.**
1—974 metal. (Eddystone.)
1—baseboard to suit. (Peto-Scott.)

**CONDENSERS, FIXED.**
1—.0001-mfd. type tubular. (T.M.C.)
1—.0003-mfd. „ „ (T.M.C.)
1—.001-mfd. „ „ (T.M.C.)
1—.1-mfd. „ „ (T.M.C.)

**CONDENSERS, VARIABLE.**
1—.00004-mfd. type 900 (Eddystone.)
1—.0001-mfd. „ „ (Eddystone.)
1—.0002-mfd. preset. (J.B.)

**DIAL, SLOW MOTION.**
1—type 970B. (Eddystone.)

**CHOKES, HIGH FREQUENCY.**
1—type 947. (Eddystone.)

**HOLDERS, VALVE.**
1—4-pin type 500. (Eddystone.)
1—5-pin „ „ (Eddystone.)

**COIL.**
1—type G.S.W. coil. (Eddystone.)

**PLUGS, TERMINALS, ETC.**
2—wander plugs marked H.T. plus 1, H.T. plus 2, (Clix.)
2—spade terminals marked L.T. plus, L.T.—. (Clix.)

**RESISTANCE, FIXED.**
1—2-megohm type 1-watt. (Erie.)

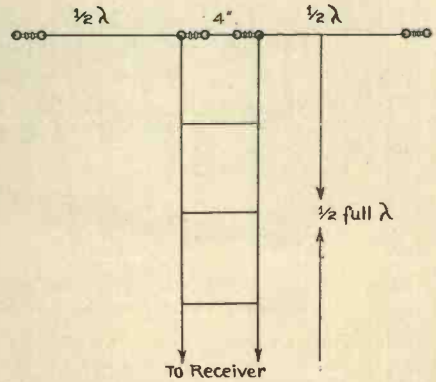
**SWITCH.**
1—type S80. (Bulgin.)

**VALVE.**
1—215SG Cossor.

**SUNDRIES.**
1—screened anode lead. (B.T.S.)
Small quantity 14-gauge copper wire (Peto-Scott.)
Quantity connecting wire and sleeving. (Goltone.)
Quantity 1-mm. flexible wire.
A complete kit of parts can be obtained from Peto-Scott, Ltd.

with a lengthy aerial the grid circuit will be too heavily damped to allow the circuit to oscillate. Incidentally, the aerial system is rather important. Our standard aerial consists of a di-pole, each section being half wavelength. The two down leads are also half wavelength. These two leads can either be connected directly to the grid and earth sides of the coil or they can be loosely coupled by means of a single-turn coil completely encircling the grid coil.

Experimenters will probably realise that an excellent aerial can be made of thin copper tube. This tube




*This is our standard di-pole aerial. Each section is ½ wavelength.*

should be just heavy enough to keep straight with only one centre support. An average length for the tube should be quarter-wavelength or round about 6 feet; that is, 6 feet for each half of the di-pole.

This unit will receive, in addition to the Crystal Palace sound transmissions, amateur broadcasts on five metres. It is not at all complicated, so that any components of similar characteristics can be used.

## "A Continuous-film Transmitter"

(*Continued from page* 340.)

as the successive scanning lines with the customary 30-line transmission move horizontally across the screen. Consequently it was necessary to take the picture on its side. The picture ratio of ordinary cine-film is about 5 to 4, whereas we require at least 2 to 1 and preferably the full 7 to 3 ratio. After some experiment a Cine-Kodak 8 mm. camera was used. This camera uses special 16 mm. film but normally the picture only extends over half the width. When the film has been run through once it is then reversed and the other side of the film is exposed. By a modification of the gate, however, it was found possible to spread the picture over the portion of the film which is normally not used, and thereby to obtain a satisfactory picture having the 7 to 3 ratio required.

A continuous film attachment was used enabling a three- to five-minute run of film to be projected over and over again and the equipment was in operation continuously throughout the day.

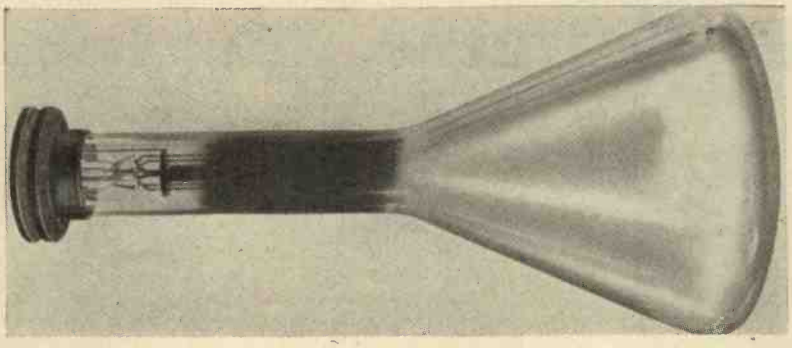
With all this additional apparatus driven from the disc it was clear that the original synchronising method would not be satisfacory. Quite a time is taken to synchronise even when running with a disc alone, and some method of running the motor up to the correct speed within a few seconds was deemed imperative. In the end, therefore, a synchronous motor was used for the purpose, and proved very satisfactory. It would run up the whole apparatus in a matter of about two seconds and stay in synchronism indefinitely.

### *Receiving Equipment*

The receiving equipment was representative of the general types available to-day. By courtesy of the Baird Company a standard mirror-drum televisor was on exhibition. Messrs. British Television Supplies provided a complete cathode-ray receiver with an 8-in. tube giving black and white pictures of surprising brilliance, and with this receiver two further cathode-ray tubes were synchronised, kindly supplied by the Ediswan Electric Co. Finally, as the baby of the piece, a B.T.S. disc-kit was running, and despite its small size, was the subject of much comment on the score of the remarkable detail which it showed.

The whole equipment was operated under licence from Messrs. Baird Television, Ltd.

*Here are details of the Cossor high-vacuum cathode-ray tube which has been developed recently for television purposes.*



*This tube has several special features in order to make it suitable for use in cathode-ray receivers.*

# THE COSSOR HIGH-VACUUM C.R. TUBE

UNTIL recently most cathode-ray tubes which have been used for television had not been primarily designed for this purpose; in fact their ordinary commercial use was for oscilloscopes. A. C. Cossor, Ltd., have now placed on the market a tube which is intended specifically for television. Features are—electrostatic deflection in both directions,

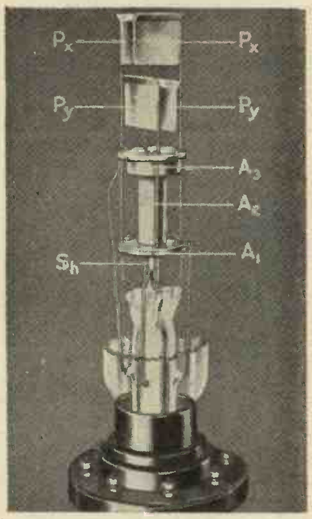



*Fig. 1.—The electrode assembly of the Cossor high-vacuum cathode-ray tube.*

electrostatic focusing which is independent of modulation, brightness, good modulation characteristic and long life. These tubes are available in three diameters, 6⅝ ins., 10 ins. and 12½ ins., and with two types of screen—one giving a light blue response which gives a picture approximating to black and white, and the other sepia.

The electrode structure of the Cossor high-vacuum cathode-ray tube, which is substantially the same for all sizes, is shown in Fig. 1. The cathode, which is joined directly to the centre of the heating filament, is located centrally behind an aperture in the first anode disc $A_1$, and is surrounded by a modulating cylinder or shield Sh. These three electrodes form a triode whose plate current subsequently forms the ray. The third anode $A_3$ is given the final accelerating voltage, whilst the second (tubular) anode $A_2$ is given an intermediate potential, usually about a quarter of the third anode potential.

Focusing is brought about by the electron lens action of the field between the second and third anodes. The second anode, which takes no current, is the focusing electrode. The modulating cylinder has no direct focusing action but functions only as an intensity control. All four deflector plates are brought out separately so that the tube has in all ten connections, i.e., filament, filament, shield, first anode, second anode, third anode and four deflecting plates.

## *Deflection Circuit*

Symmetrical electrostatic deflection is essential to maintain accurate focus over the whole screen surface, and the mean potential of each pair of plates must be kept at third anode potential. This symmetrical deflection at the same time avoids "trapezium distortion" (modulation of the sensitivity of the first pair of plates by voltage on the second pair) and also the high-tension voltage for the scanning circuit is reduced by nearly 50 per cent.

A suitable circuit for providing a balanced saw-tooth voltage is shown by Fig. 2. In this circuit the valve $V_1$ is the charging valve of a time-base, $C_1$ with $C_2$ in series is the charging condenser, $V_2$ is the discharging valve operating in conjunction with $V_3$ as trigger; this circuit is essentially a normal Cossor hard valve time-base. It is recommended that this type of circuit be used for the line scanning whilst a gas-triode

(*Continued at foot of next page.*)

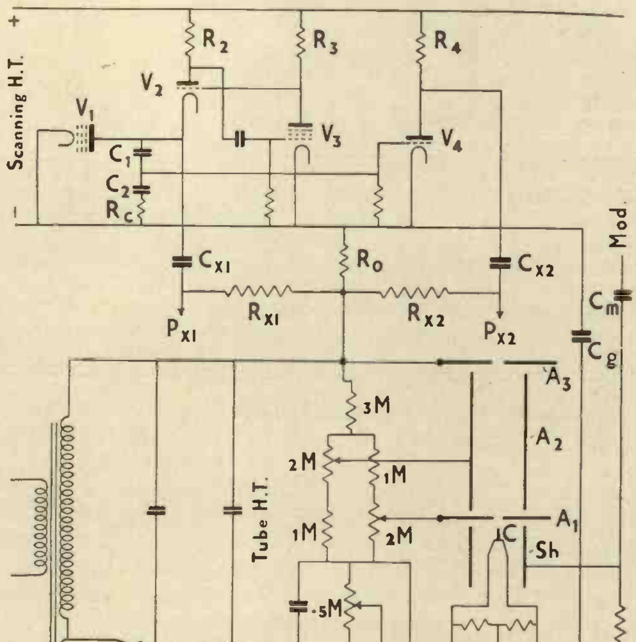



*Fig. 2.—A suitable circuit for providing the balanced saw-tooth voltage for the Cossor high-vacuum tube.*

# A QRP 5-Metre Portable Rig

*By Austin Forsythe (G6FO)*

AS the summer approaches, many transmitters will be turning their attention to the 56 mc. amateur band with the idea of carrying out experimental work using portable gear.

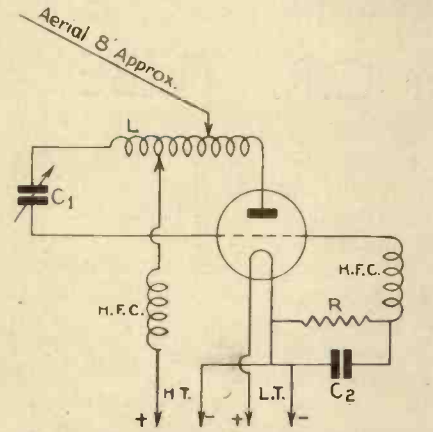



*Fig. 1.—The series-tuned ultraudion oscillator.*

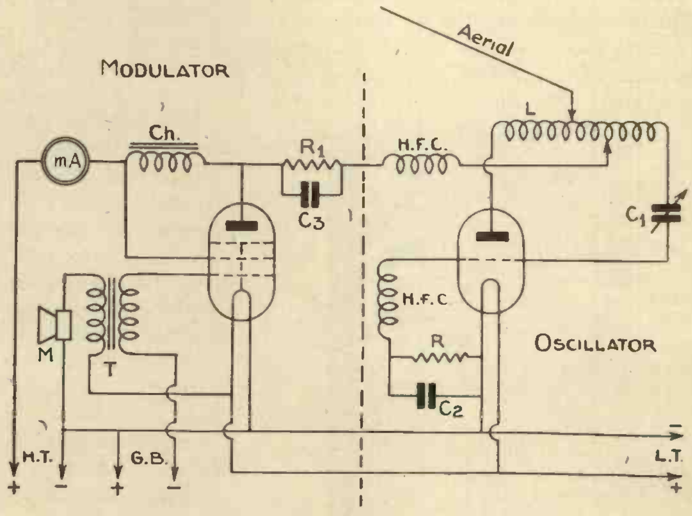
For this purpose, a circuit which deserves more notice, both on account of its efficiency and ease of operation, is the series-tuned Ultraudion.

This is shown by Fig. 1. The tank coil L can consist of three turns of 3/16-in. copper tube, 3 ins. in diameter, though it is advisable first to make up a few rough coils to make sure of the inductance value for the particular valve used, aiming at getting the centre of the band with the condenser C1 about one-third mesh. This is a .0001-mfd. variable, while C2 is a .002-mfd. by-pass condenser. The chokes RFC should be about fifty turns of No. 32 enamelled wire, slightly spaced, on a ½ in. diameter former. R is the grid-leak.

The adjustment and operation of the oscillator is simplicity itself. With the aerial removed, the position of the H.T. clip is varied till minimum plate current is obtained at the desired setting in the band. The aerial is then tapped on towards the plate end of the coil so that reasonable transfer is obtained without loss of R.F. output, the change in frequency being taken up on the condenser C1 in the usual way. It may also be necessary to re-adjust the H.T. clip slightly to compensate for the changed load conditions.

Modulation can be applied to this oscillator, preferably by choke-control, a complete circuit being shown by Fig. 2. It will be noticed that a pentode is used as modulator; this gives very good control for a small input. A 30 : 1 transformer at T, with a carbon microphone of the solid-back variety excited from the 2-volt L.T. supply, provides sufficient grid-swing for very deep modulation, while quite a small L.F. choke is satisfactory for the speech-choke Ch. A 2,000-ohm voltage-dropping resistor is required at R1, while C3 should be not less than 2 mfd., though a good degree of modulation is obtainable with the same H.T. on the plates of both valves.

*Fig. 2.—Choke-control modulation applied to the circuit, Fig. 1. Vertical dotted line indicates screen between oscillator and modulator.*




An exactly similar portable unit has given the writer excellent results on field-day tests. For QRP work, the valves recommended are a Mazda P.220A for the oscillator, or the old Marconi P2B if available. With either of these, the grid-leak value R should be 50,000 ohms. For the modulator position, a Mazda Pen.220A is very suitable. With 180 volts from batteries and a total input of just under 5 watts, 2 watts in the oscillator and about 3 watts in the modulator, R9 phone reports have been received on 5 metres over ranges up to 30 miles, the aerial consisting simply of a direct-tap semi-vertical wire eight feet long.

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"The Cossor High-vacuum C.R. Tube"

(*Continued from preceding page*)

circuit may be used for the picture-traversing direction. The picture-traversing portion of the circuit is not shown in the diagram.

Valve $V_4$ is added to give balanced deflection. It should be a triode with a characteristic which can be effectively straightened over the necessary range by means of the high resist- $R_4$ in the anode circuit. The condenser potentiometer $C_1$, $C_2$, should divide the voltage on $V_1$ anode by the gain ratio of the valve $V_4$. Thus the anodes of $V_1$ and $V_4$ perform saw-tooth voltage excursions of equal amplitude and opposite phase. These voltages are fed to the deflector plates of the tube via condensers $C_{x1}$ and $C_{x2}$, the plates themselves being tied down to the third anode with high resistances $R_{x1}$ and $R_{x2}$ (of the order of 10 megohms).

The resistance $R_0$ placed in series with the condenser $C_2$ is a refinement which may be included if desired; its purpose is to compensate the high-frequency losses involved by the valve $V_4$ facing the high anode resistance $R_4$. Compensation is correct when the time-constant $C_2$ $R_0$ is made equal to the time-constant $C_4$ $R_4$, where $R_4$ is the plate impedance of the valve $V_4$ in parallel with the resistance $R_4$, and $C_4$ is the stray capacity on $V_4$ anode.

### The Power Circuit

The H.T. is supplied by a single-wave rectifier, preferably connected as shown. The smoothed H.T. is connected across a potentiometer network from which the D.C. voltages for the three anodes and for the modulating cylinder are derived.


## REVIEWS OF THE PROGRAMMES AND RECEPTION REPORTS

THE Alexandra Palace is almost a certain choice for the first high-definition station. The need for high ground rules out Broadcasting House and other sites in central London, and a suburb is surely indicated.

All kinds of problems arise from this inconvenient fact and it will be interesting to watch their solution.

Once a site is acquired with the necessary elevation and the transmitter is installed, adequate studio accommodation with dressing and rehearsal rooms will be the next requirement, for at first programmes will no doubt originate on the spot.

Novelty and publicity will certainly attract big artists to the suburb in the early stages, but if stars are to continue to figure on our screens and if programmes are to retain a topical interest other arrangements must quickly follow. When the novelty has worn thin stars of the stage and the film will find no time for the journey out of town for rehearsal and transmission and some alternative will have to be introduced.

A means must quickly be found of linking studios in central London with the transmitter in a suburb. Research is continuing on cables capable of transmitting the signals, but such lines cost a great deal of money. A radio link between Broadcasting House and the transmitting station is another possibility, but as with aural broadcasting, I expect that a land line will eventually provide the solution.

Alternatively, programmes might be filmed at a central studio and the reel then rushed to the station for transmission, but it is questionable whether this method would commend itself to lookers.

A film, like a sound record, removes the performer a stage further from reality, and experience has shown that recorded programmes do not satisfy the listener. Lookers may be more tolerant at first, but it is likely that they will soon insist on a really "live" programme for at least a part of the time. So I estimate the immediate requirements to be:—A site on high ground with ample accommodation for transmitter, film projection rooms, studios, dressing rooms and a special cable or radio link to connect a central studio with the station.

* * *

Of recent programmes the exhibition of sculpture by Dobson was to me by far the most interesting, both technically and artistically. In judging these pictures lookers should make allowance for the difficulty of lighting some of the groups. I had the advantage of seeing the programme in rehearsal and in the afternoon the modern romantic group made a clearer picture in the check receiver than it did on my screen at home in the evening.

Bronze portraits of Peggy Salamon and Jeanne de Casalis were seen with good definition, and the figure of a woman in Hoptonwood stone was a beautiful piece of work. Less successful was the marble torso which, owing to its length, was shown lying down. Poor dear, she was meant to be seen standing up!

In this programme televiewers had the privilege of seeing an exhibition


*A general view of the projection room at Portland Place. In the foreground is the caption machine and on the left the check receivers and amplifiers; the mirror-drum scanner can be seen on the right.*

by one of our foremost modern sculptors before his show opened at the Leicester galleries, and the sculptor himself was present to explain effects that might have been missed by the uninstructed eye—and would certainly have failed to register with me.

I enjoyed particularly his answer to critics. Any one going to see a football match for the first time would hesitate to criticise, he said, but it was not so with sculpture. As a composer strung chords together to make a melody, so did a sculptor put shapes together to produce a beautiful result. Unlike portraiture, sculpture was not a fascimile art.

Television enabled Dobson to demonstrate his point.

* * *

Twice during May transmissions have been suspended on Monday, which is important, as an indication of the B.B.C.'s feeling about these thirty-line pictures. May 6 was Accession Day and it would have been difficult to find space for the television programme. On May 20, when the third act of *Tristan and Isolde* was relayed from Covent Garden, it was wise to cancel the programme, which could not start until 11.40. But surely it might have been transferred to another night!

* * *

Eustace Robb had already celebrated the Jubilee in an earlier programme, which was notable for its careful and elaborate production. I liked particularly the drawings in the caption machine for the Golden Jubilee sequence. In 1887 industry was quick to seize an opportunity—as it is to-day—and the public was evidently twice as naïve. We saw Jubilee teeth and Jubilee fly-catchers, corn plasters, bottles and frying-pans. Then on a fleeting visit to the park we caught a glimpse of phætons and dashing tandems, with Life Guards in the pill-box caps of the day; fading to a full dress scene in the studio for the Easter Parade in the colourful costume of the time.

This show, which extended the resources of the studio to the limit, is surely an answer to critics who assert that programmes should be simple.

I should like to congratulate the producer on the juxtaposition of close-ups, which gave us facial expression and detail of bonnets and dress, and long-shots which showed us plenty of movement.

* * *

The longer I study this television technique the more conscious I become of the importance of team work in presentation. For a film, lights, camera, sound and direction must be just right, and it is the same with television. A perfect understanding between producer and engineers is essential if the best results are to be obtained. In the studio it is obvious that producer and technicians are in complete accord. Every man is a specialist in his own job, and they all work together with a common object. The programme is the thing.

Timing is one of the biggest trials. The band behind its curtain must play just long enough for the heroine to cross the studio. If the music runs short the artist is left alone in the light. If the band plays three bars too many, she is out of the picture, there is a blank screen, and the production loses its snap.

Only careful rehearsal can produce the results that we see.

*A scene during an actual 30-line television transmission. The projector (seen on the right) is mounted on rails and can be swivelled round to follow the movements of the artists.*

## Metres to Kilocycles Conversion Tables.

We have received from H. C. Van Rood Technical Publications a very useful pocket edition of metres to kilocycles conversion tables. The usefulness of this handy work will be apparent and the presentation of the matter is in a very convenient form. The tables are based upon the formula:

$$kc = \frac{3 \times 10^5}{\lambda}$$

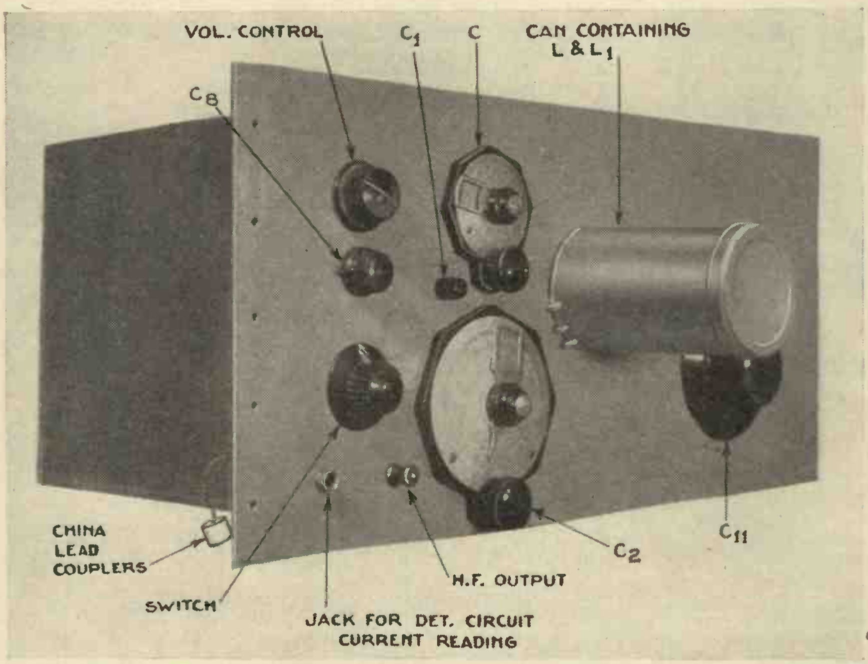
The columns of figures are interchangeable so that wavelength and frequency are reciprocal. The size of the book is 3 ins. by 4½ ins., and bound in red cloth the price is 1s. 6d., post free. It may be obtained from H. C. Van Rood Technical Publications, Berrylands, Surbiton, Surrey.

## THE AMATEUR TELEVISION EXPERIMENTER

# CALIBRATING THE OSCILLATOR TONE SOURCE

*Constructional details of this useful piece of apparatus were given in the April issue. This article describes its calibration.*

IN the April issue constructional details of a tone source were given suitable for the more advanced television experimenter. It was explained that such a tone source should have a range of from 10 to at least 1,000,000 cycles, and that to cover such a wide range it was really necessary for ease of handling and construction to have three different instruments. The writers, however, had found that two could at least be built in such a way as to be combined in one, the circuit of which is given in Fig. 1 (Fig. 3, April issue). Now we come to the operation and calibration of the instrument.




*The complete oscillator tone source, constructional details of which were given in the April issue.*

Only a mere outline of the actual physical positioning of the components has been given, as this series is intended more to suggest ideas to readers than to go into the finer constructional details.

Now assuming that we have wired up the circuit, Fig. 1, perhaps it will be just as well to check up that the L.T. and H.T. volts have reached their respective valve holder terminals. This test should preferably be done before putting the valves in position.

The next thing to do is to make sure that the valves V and V4 are oscillating. The simplest way to do this is to insert a suitable milliammeter in the H.T. circuit, say, 0 to 25, and put the valve V4 into its holder. Note the current. Now varying the capacity of C11 from maximum to minimum should slightly change the H.T. feed if the valve is oscillating.

Shorting the condenser plates of C11, to each other, should definitely bring about a drop in the current if the valve is oscillating. If the valve appears not to oscillate, check up the wiring to make sure that the inductances L3 and L4 are connected in the proper sense, as shown in the circuit diagram. It may even then be found that the valve refuses to oscillate or perhaps only does so when C11 is reduced. This probably shows that the valve is not up to standard, or perhaps the bias is excessive and, if still obstinate after lowering the bias volts put more turns on L4.

Next turn to valve V2, the rectifier, having removed V4 from its holder. Bias this valve back for anode-bend rectification, till the anode current is about .2 milliampere. Here it should be pointed out that a series jack is connected between R2 and the H.F. choke of the anode circuit of V2. This is not shown in the circuit diagram, though it can be seen in one of the photographs published in the April issue.

Next put a temporary short across R8 and replace V4. The filter condenser C14 should be set to, say, half capacity. On rotating C11 from minimum to maximum, there should be a sharply-defined point about halfway, when the rectifier current should rise to about .9 milliampere. Tuning the oscillator to filter should be tested out throughout their tuning range. It is of course possible that the maximum and minimum of the filter capacity may be just outside the oscillator's range owing to capacity effects of wiring, etc.

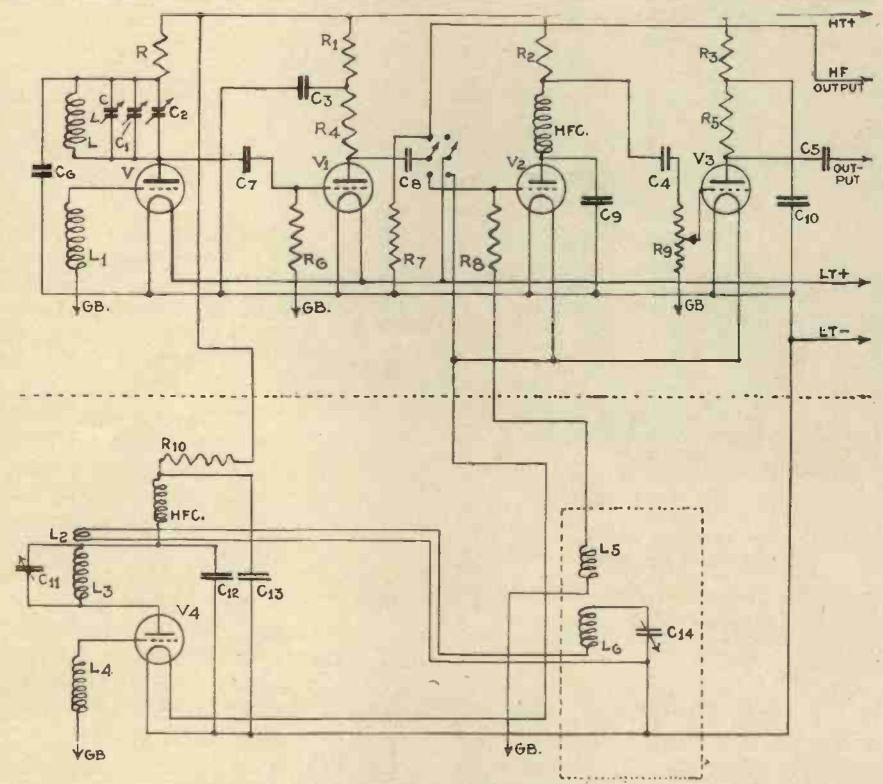
Our next test is done, again by removing V4, and inserting V and V1, and if V is oscillating the rectifier current will be well over 1 milliampere. The voltage on the rectifier grid can be reduced by decreasing the capacity of C8, which, though shown as a fixed condenser in the diagram, can with advantage be of the variable type. In the writer's apparatus this is at a minimum setting. It should be noted that the detector will indicate rectification whatever the position of the condensers C, C1 and C2, always, of course, assuming the valve is oscillating.

Having satisfied one's self that both oscillators and detector are operating satisfactorily and making sure that the V4 oscillator is in tune with the filter, switch on both oscillators, and substitute a pair of headphones for the meter in the anode circuit jack.

## THE AMATEUR TELEVISION EXPERIMENTER

On rotating C the well-known " howl," which our old sets used to produce during tuning, will be heard in the phones. Having got the "howl" try and tune it to the silent point, not too easy a job with C, but get as near as possible, making the final adjustments with $C_1$, having previously set $C_2$ to about minimum.

Having got the silent point, slowly increase the capacity of $C_2$, when first a low buzzing sound will be heard,




*The circuit of the oscillator tone source.*

which rapidly rises to the low note so familiar from A.C.-driven radio receivers, followed by the whole of the clearly audible scale to the frequencies which to many of us are above audibility. Now with our tone source working we must calibrate it.

The inductance $L_3$, also L and $L_6$, is of the order of 30 microhenries tuned by a 500 $\mu\mu$f. condenser. Assuming a minimum capacity of 80 $\mu\mu$f. such a circuit will tune from 3,000 to 1,300 kc. This can be checked by tuning an ordinary radio receiver to any available station between 230 and 200 metres, Radio Normandie is perhaps the easiest received on 206 metres, and as the tuning condenser $C_{11}$ brings the circuit into " tune " the well-known "howl" will be heard in the radio receiver output, thus indicating the actual point of similar frequency. This test should be done with the screening cans removed to be most effective. The writers have the filter condenser at maximum capacity, which, in round numbers, gives a frequency of 1,300 kc., the valve $V_4$ circuit, of course, being tuned to the filter frequency. (In " tune " being indicated by the detector anode feed, as previously described.) The use of the filter with regard to calibration will now be realised. Should anything vary in the $V_4$ circuit to alter its frequency it can always be checked against the filter, which, short of mechanical injury, will remain constant. The oscillators will vary, however, from declining emission and alteration of H.T. and L.T. volts, which must be kept within narrow limits.

Continuing, we should turn $C_2$ to, say, 20 on a 180-degree scale. Bring as before the beat note to zero by C and $C_1$. Having done this carefully increase $C_1$ till the note in the phones is the same as the 50-cycle A.C. mains. This is our starting point.

The value suggested for $C_2$ is 100 $\mu\mu$f., which means a minimum of about 25 $\mu\mu$f. The total value across L, assuming it to be 30 microhenries, to produce 1,300 kc., is 500 $\mu\mu$., increasing $C_2$ to maximum will add, say, another 66 $\mu\mu$f. with a decrease in frequency to 1,220 kc., which will produce a beat-frequency of 80,000 cycles. In practice it is advisable not to go to full capacity of $C_2$ as this avoids any chance of straining the dial against the end stops.

To calibrate in terms of frequency from 20 degrees to, say, 170 degrees, is the next step. 50 cycles has been fixed; the various notes of the piano will give us up to 4,000 cycles. A good " ear " will take us to 16,000 by identifying octaves, but from then onwards to 100,000 cycles things become more difficult. This difficulty can be overcome, however, by having $C_2$ condenser of the straight-line frequency type; in such a case it is only necessary to plot the first few thousand cycles such as a piano will give us, against dial degrees and continue the curve in a straight line.

70,000 cycles is about the practical limit of beat-note frequency range, and higher frequencies are generated direct, the oscillator $V_4$ and detector $V_2$ being switched off. To cover the range from 70,000 to 900,000 cycles two sets of inductances are required for L and $L_1$, in which L must be 400 and 5,000 microhenries, these will give with $C_1$ and $C_2$ set nearly to minimum frequencies from 900,000 to 250,000 and 250,000 to 70,000 respectively with C.

Their calibration is relatively simple. The radio receiver being tuned to the long-wave stations such as Moscow No. 1, 174 kc., Kootwijk, 160 kc., Droitwich, 200 kc., and Motala, 216 kc.; the condenser C on tuning through these station's carrier frequencies will produce a " howl " in the radio receiver, the points at which the condenser does this being plotted against frequency; as in the case of $C_2$, in the beat-note range the curve can be continued in a straight line, provided C is a straight-line frequency type.

The process is repeated with the 400 microhenry inductance; also the original 30 microhenry one, only tuning in different medium-band stations instead of the long-wave ones, to get our checking points.

The 400 microhenry inductance consists of 158 turns for L and 120.

*(Continued in 3rd col. on page 350.)*

# Correspondence

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

*The Simplest Cathode-ray Receiver :: Pentagrid Frequency Changers*
*Space Images :: An American Opinion*

## *The Simplest Cathode-ray Receiver in Dumfries*

SIR,

Having constructed the "Simplest Cathode-ray Receiver" as designed by Mr. G. Parr, I think it is only fair that I should inform you of the successful reception I have had from the B.B.C. low-definition transmissions.

No trouble has been experienced in getting the results excepting the fact that it took some time to get used to the adjustment of the various controls, but as soon as this was accomplished the picture appeared.

I am some considerable distance from the London National transmitter, and daylight reception is out of the question, so I was very pleased to note that the Saturday afternoon transmissions were to be discontinued in favour of Monday nights, as this now gives me two nights a week to experiment with the equipment and in this respect it is to be hoped that the low-definition transmissions will not be discontinued when the new high-definition station is ready to start; otherwise it will be some considerable time before Scotland will again be able to look-in.

G. PERCY (Dumfries).

* * *

## *Pentagrid Frequency Changers*

SIR.

In the first issue of the combined journals TELEVISION AND SHORT-WAVE WORLD an article appeared comparing the merits of a pentagrid S.W. frequency-changer with the older autodyne arrangement to the great disadvantage of the latter. I have been using the pentagrid with the aerial aperiodically coupled for some weeks now and have come across a disadvantage which appears to have escaped the notice of the author of the article in question.

As the aerial is aperiodically coupled there is no discrimination between the harmonics of the oscillator. The result is that on the 3.5 mc. ham band one is liable to receive the 7 mc. ham band by the action of the 2nd harmonic of the oscillator and the 10 mc. broadcasting band from the 3rd harmonic. Admittedly this difficulty is easily overcome by tuning the aerial circuit, but from experience this is liable to introduce coupling between the tuned circuits, making tuning very difficult. Moreover the aperiodic circuit is the basis of some commercial designs whose users may be puzzled by the queer effects sometimes produced. The effect is at first sight somewhat similar to the production of "sub-harmonics."

I had very great difficulty in calibrating my Rx. at first, it being a matter of difficulty even to distinguish the 3.5 and 7 mc. bands. At first I wondered why commercial stations such as PLV and JNE found it necessary to transmit simultaneously on so many channels. JNE was heard in the afternoon, apparently transmitting on about 4 mc.! A search revealed that it was actually coming over on 10 mc.

JAMES W. KNIGHT (Stoke Newington).

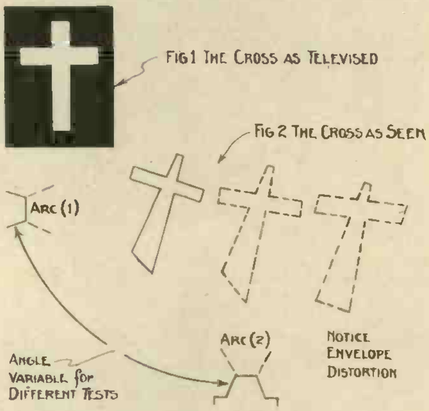
* * *

## *Space Images*

SIR,

I was very interested in the subject matter of the letter by Robert I. Rosenfelder (Frankfurt (Main)).

Whilst details were not sufficient to obtain a complete grasp of the systems quoted, there is an indication of some useful line of experiment. In connection with this I would like to say that we have recently had some uncommon experiences with this problem of "Space Projection." Using two 3 kW projectors and a series of filters we have had results which makes me at least believe in the possibility of obtaining clearer results. I have found difficulty in obtaining complete darkness, due chiefly to the leakage of light from the arcs, but this will be put right next term, when better definition may be expected. For some time a lantern slide was scanned (30-line) but, due chiefly to the lack of sufficient intensity in this slide, an aperture in the form of a cross was substituted. This is one of the phenomena that took place: With the lab. wall blackened out with black velvet (to prevent direct vision and then persistence of vision) the arcs were switched on, together with the disc, when a cross was to be expected in a vertical plane. Instead, I witnessed a cross in the *horizontal plane* which moved in jerks for a distance of about four inches and then disappeared. What is more, both arcs were being filtered to *different* parts of the spectrum, but the cross was *blood red*. The experiments continue.




*Appearance of images referred to in the accompanying letter.*

THE RADIO LABORATORY (Municipal College, Portsmouth).

* * *

## *An American Opinion*

SIR,

I take pleasure in sending my congratulations to you and the entire staff on your excellent publication. Although we have seen several abortive attempts to cover television in this country none of them has approached your magazine in the extent and presentation of articles. I hope you keep up the good work if for no other reason than to bring to a point of action the development of television in the United States.

E. L. BRAGDON, *New York Sun*.

* * *

## *A New Line of Research*

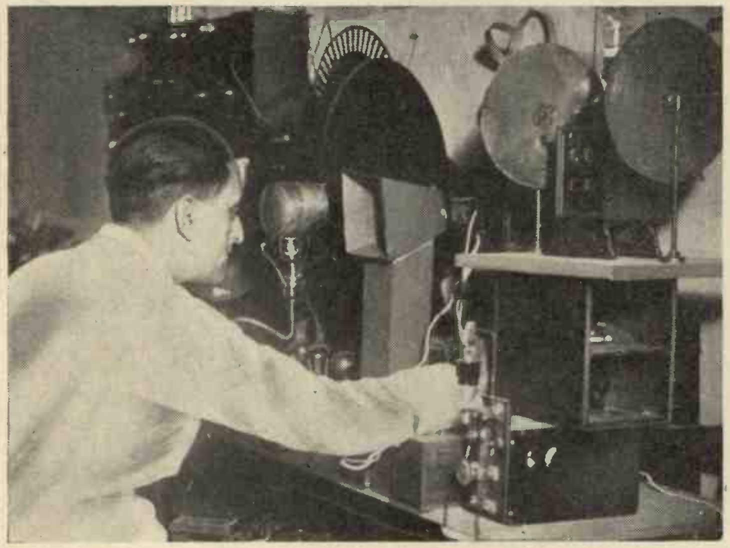
SIR,

Perhaps you might be interested to learn that experiments in television have opened new fields of research. Professor Tonna-Barthet has just constructed an instrument which enables sound vibrations up to 1,000 per second to be quite visible on the screen of an ordinary television receiver.

Herewith enclosed you will find a photograph of Professor Tonna-Barthet, director or Barthet's Laboratory, watching the lines produced by a pitched note. The thickness, quantity and position of the lines indicate exactly the quantity of vibrations per second of a given note.

(Barthet's Laboratory and Observatory, Malta).

* * *



*Prof. Barthet's apparatus for the analysis of sound referred to in the accompanying letter.*

### *Putting the House in Order.*

SIR,

I fully agree with your leading article in TELEVISION AND SHORT-WAVE WORLD, May, 1935, under Comment of the Month, "Putting the House in Order."

Regarding the anti-television scheme now in operation—I thought the enclosed newspaper cutting might be made use of in your next issue.

This appeared in one of the first editions of a Glasgow evening paper, but was immediately withdrawn and did not appear in the later editions. I looked for similar news in every paper I could lay my hands on at that time but without success.

I had a circular by post from the radio department of a large Edinburgh store also printed for the Scottish Radio Retailers' Association.

I feel certain television is not getting a square deal in many quarters.

R. B. VEITCH, J.P. (Peebles).

The statement to which our correspondent refers is reproduced below. It appeared on April 5.—(Ed.)

### *Television Stations.*

20 Operating in Britain Next Year.

***First to be ready in July***

Nice, Friday, 5/4/35.

*By the end of 1936 there will be nearly 20 television stations operating in various parts of Britain.*

*This was the prediction made here yesterday by Mr. L. W. Hayes, of the British Broadcasting Corporation, when speaking to members of the International Television Conference, which opened at the Mediterannean University centre.*

*Mr. Hayes said Britain is to make a strong bid for world leadership in television. At present Germany was leading the world in its development. By the end of July, however, the first television station in Great Britain would actually be in operation.*

***Experts at the Conference***

*Great importance is being attached to the conference, the first of its kind, which opened under the presidency of M. Louis Lumiere, whose work in connection with cinematography is world-famed.*

*Among the representatives from the many nations who are attending are Mr. Noel Ashbridge, of the B.B.C., and Mr. Baird, of the Baird Television Company, Mr. F. W. Garling, of the Radio Corporation of America, and Mr. Jordan, of the National Broadcasting Company of America. Germany has sent four of her greatest experts.*

*One of the principal items on the conference's agenda is the relations between television and the cinema and television and the radio.—Central News.*

### *Radio Transmitting Experiments.*

GENTLEMEN,

With reference to the current edition of your publication, TELEVISION AND SHORT-WAVE WORLD, in which appears a descriptive article upon the construction and working of an experimental 7-metre transmitter, it is desired to point out the possibility of some readers thereof being led, through misunderstanding, to proceed with the unauthorised installation of radio transmitting apparatus. Perhaps, therefore, you would be so good as to arrange that mention should be made, in future articles of this nature, of the Post Office licensing requirements, which are provided for under the Wireless Telegraphy Act of 1904.

This opportunity is also taken to draw your kind attention to the fact that 7 metres is not a wavelength upon which transmitting experiments are normally permitted.—I am, yours faithfully,

I. J. COHEN, for Engineer-in-Chief.
Engineer-in-Chief's Office
(Radio Section), General Post Office.

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"Synchronising Cathode Rays from the Mains" *(Continued from page 348)*

turns for L1, the 5,000 microhenry L 400 turns, and L1 300 turns, if wound on the former given last month.

The experimenter may only require to go up to, say, 25,000 cycles, the general working limit of 30-line low-definition television, which the beginner perhaps would be well advised to get experienced with before handling the larger-ranged apparatus, in which case the inductances L, L3 and L6 should be increased to about 2,100 microhenries, that is to say, about 360 turns, as compared with 45, while the other inductances are proportionally increased. Owing to rather fine wire being necessary to get the number of turns on in the space and in consequence of the increased ohmic resistance about half as many turns again will be required on L1 and L4.

So far no mention has been made of V3 and associated circuits. This valve is only an amplifier for the beat-frequencies. The output volts of the writer's instrument are from 3 to 4 on the beat-note output and 8 to 12 on the H.F. output, which is ample.

Certain experimental work, such as measuring amplitude attenuation and phase distortion with this tone source will be discussed in a future issue.

# RECENT TELEVISION DEVELOPMENTS

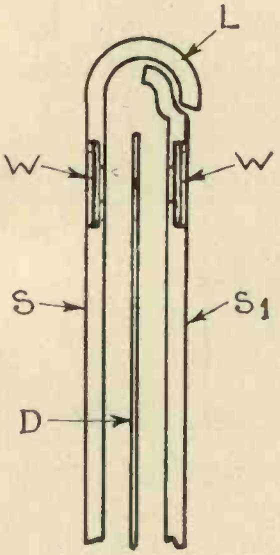
## A RECORD OF PATENTS AND PROGRESS
*Specially Compiled for this Journal*

PATENTEES :—*G. B. Banks, T. W. Collier and Baird Television, Ltd.; Fernseh Akt.; General Electric Co., Ltd. and C. R. Dunham; Marconi's Wireless Telegraph Co., Ltd., H. M. Dowsett and N. Levin; Radio Akt. D. S. Loewe and K. Schlesinger; J. L. Baird and Baird Television, Ltd.*

### Scanning Discs
(Patent No. 423,508.)

As the number of scanning lines is increased, the size of the holes in the rotating disc must necessarily be made smaller and it is found in practice that the point comes when it is necessary to screen the apertures from atmospheric dust, which would otherwise accumulate and clog them up.

It is not possible to protect the disc by mounting it inside a stationary casing, because in the first place the disc itself must be made sufficiently thin to avoid the effect of parallax, and in the second place so thin a disc is unable to withstand the eddy currents set up by the viscosity of the air in an enclosed space.



*Method of keeping disc apertures free from dust. Patent No. 423,508.*

Accordingly the disc is provided with a casing which rotates with it. As shown in the figure, the disc D is enclosed in a casing formed of two sheets, S, S1, the ends of which are spun out so as to overlap at L. Suitable windows are provided at W to allow the light to pass through the scanning apertures, and both sides of the casing.—(*G. B. Banks, T. W. Collier* and *Baird Television, Ltd.*)

### Viewing Screens
(Patent No. 423,696.)

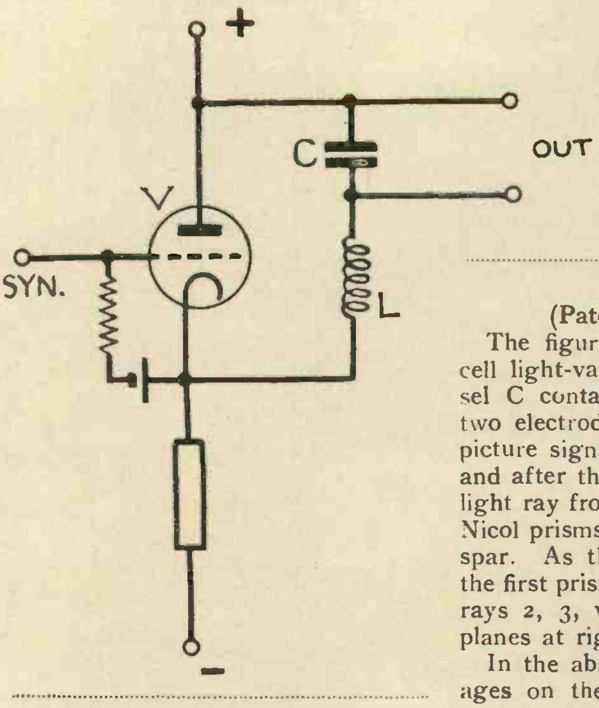
The fluorescent material forming the viewing screen is usually deposited on the inside of the flared end of the cathode-ray tube. The curvature of the glass surface is then liable to give rise to more or less distortion. On the other hand, any attempt to make the end of the tube perfectly flat necessitates the use of thicker glass, in order to withstand the reduced pressure inside the bulb, and this introduces difficulties in manufacture.

According to the invention the fluorescent material is first deposited on a foundation of thin glass foil, which is then rolled up and so inserted through the narrow neck of the tube. When it reaches the flared end its natural elasticity causes it to resume its original flat shape, where it is held in position by suitable supports. Incidentally, the preparation of the fluorescent screen is simplified since the necessary operations can be carried out in the open instead of inside the tube.—(*Fernseh Akt.*)

### Saw-toothed Oscillators
(Patent No. 423,963.)

The quick-return of the spot of light in a cathode-ray television receiver is a non-working stroke. That is to say, it adds nothing to the formation of the picture, and should, therefore, if possible, be kept off the screen.

This is ensured by inserting a choke L in series with the condenser C used to generate the scanning oscillations. The field built up across the coil, during the discharge of the condenser through the triggered valve V, is applied to the cathode-ray and sweeps it clear of the screen during the return stroke. In addition the voltage across the coil at the moment of discharge helps to increase the effective scanning voltage produced by the oscillator for a given D.C. supply.—(*General Electric Co., Ltd.*, and *C. R. Dunham.*)



*Method of keeping return traverse of cathode-ray beam off the screen. Patent No. 423,963.*

### Kerr Cells
(Patent No. 424,196.)

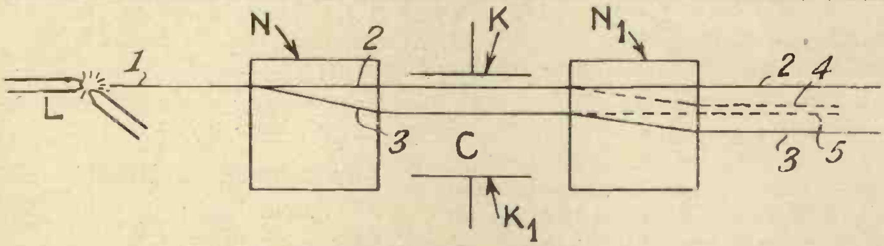
The figure shows a typical Kerr-cell light-valve, consisting of a vessel C containing nitrobenzine with two electrodes K, K1, to which the picture signals are applied. Before and after the cell, in the path of the light ray from a lamp L, are the two Nicol prisms N, N1, made of Iceland spar. As the ray of light 1 enters the first prism N it is split up into two rays 2, 3, which are polarised in planes at right-angles to each other.

In the absence of any signal voltages on the electrodes K, K1, the

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

rays 2, 3, will pass unaltered through the cell, but the presence of signals causes each ray to become elliptically-polarised, so that they are no longer vibrating in a single plane, but possess a component at right-angles to that plane.

The result is that when they reach the second Nicol prism N1, each of the rays 2, 3, is again split up into pairs, so that there are no less than four emerging rays numbered 2-5. Of these the pair numbered 4 and 5 will increase the amount of light passing with increase of signal voltage, whilst the pair 2 and 3 will diminish it.




*Improved Kerr cell. Patent No. 424,196.*

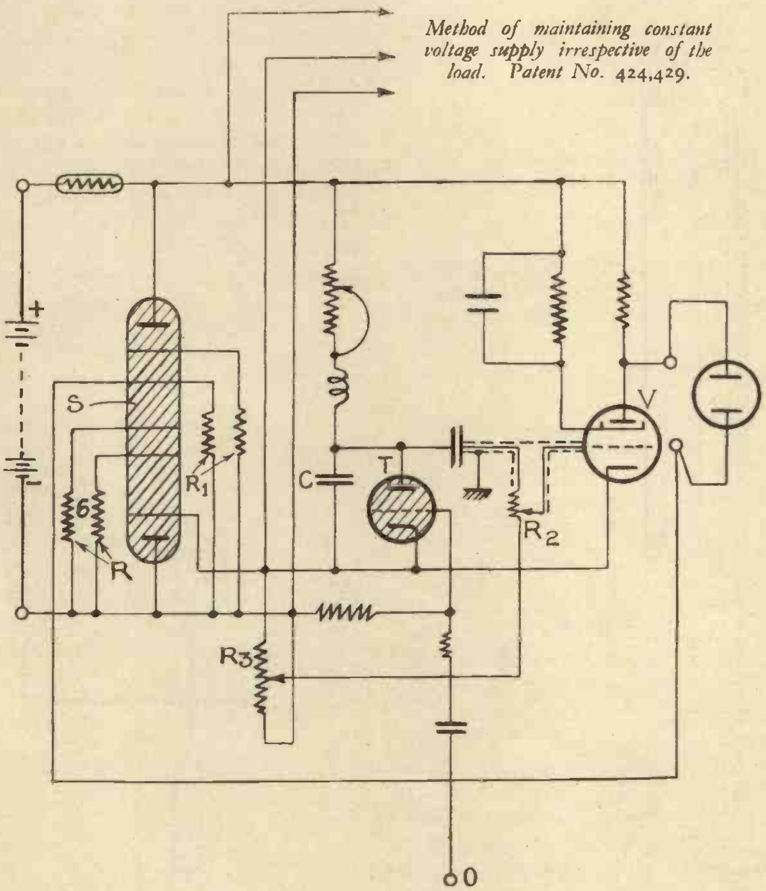
According to the invention an apertured disc and focusing lens (not shown) are arranged (just beyond the Nicol N1) so as to merge the two effective rays 4 and 5 on the viewing screen whilst cutting-out the two undesired rays 2 and 3.—(*Marconi's Wireless Telegraph Co., Ltd., H. M. Dowsett* and *N. Levin.*)

### Voltage Regulation

(Patent No. 424,429.)

One of the problems common both to broadcast and television receivers is that of maintaining the voltage supply to the electrodes of the amplifying valves at a steady value irrespective of fluctuations in the output or load. When the valves are fed from tappings on a potentiometer inserted across the mains-supply unit, variations in output current alter the voltage-gradient along the potentiometer and so affect the supply potentials.

An alternative arrangement, which is free from this defect, is the so-called glow-tube stabiliser, shown at S in the figure. It consists of a gas-filled tube, which is shunted across the H.T. supply so that it passes a constant current, and is fitted with a series of electrodes inserted at spaced intervals between the anode and cathode. According to the invention these electrodes are shunted by resistances R, which stabilise the voltage fed to the saw-toothed oscillator circuit C, T, and the subsequent amplifier V, over the whole charging curve of the condenser C. A variable resistance R in the supply line to the main condenser C enables the scanning frequency to be varied between 60, 90 and 120 lines. A variable resistance R2 controls the size of the picture and a potentiometer R3 its position on the screen. The synchronising impulses are applied to the grid of the discharge tube T from a terminal O.—(*Radio Akt., D. S. Loewe* and *K. Schlesinger.*)




*Method of maintaining constant voltage supply irrespective of the load. Patent No. 424,429.*

### Viewing Screens

(Patent No. 424,632.)

The light produced on the fluorescent screen of a cathode-ray tube is of limited intensity. As an alternative to such a screen it is proposed to coat the end of the bulb with a substance which is readily heated to incandescence, and then to produce visible effects by bombarding it with the cathode-ray stream. The incandescing material may be a layer of finely-divided metal, such as "platinum black" deposited from the volatile form on to the glass surface. Or a thin sheet of platinum may be divided into small squares so as to form a "mosaic" surface, any blurring of the picture due to heat conduction being prevented by the spacing between the squares. Cathode-ray beams of high intensity are used to produce a picture of high brilliance, which is then projected on to a second larger viewing screen through a suitable system of lenses.—(*J. L. Baird* and *Baird Television, Ltd.*)

### Summary of Other Television Patents

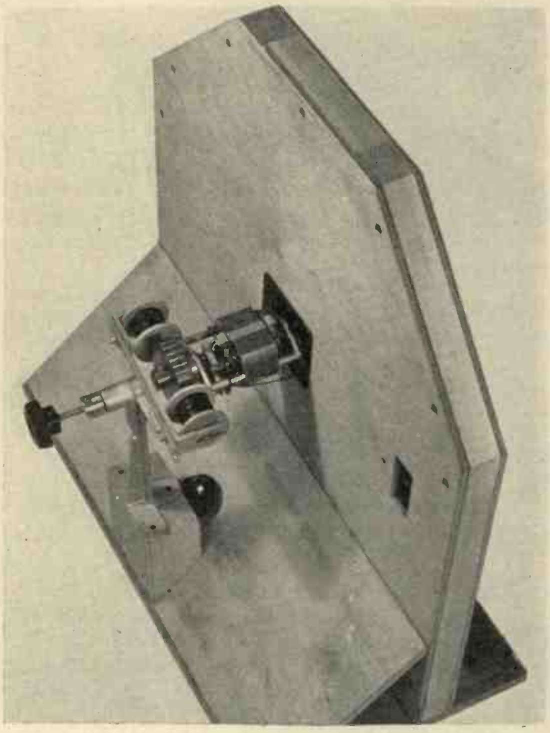
(Patent No. 423,748.)

Synchronising cathode-ray receivers by means of a servo-motor having coils in the grid and plate circuits of the control valve.—(*J. C. Wilson, T. E. Bray* and *Baird Television, Ltd.*)

(*Other television patents on page* 368.)

# REFINEMENTS FOR THE JUNIOR 30-LINE TELEVIEWER

*Last month we described a very simple thirty-line television receiver which consisted of the bare essentials. This article contains some suggestions for detail improvements which can be added without any serious modification.*



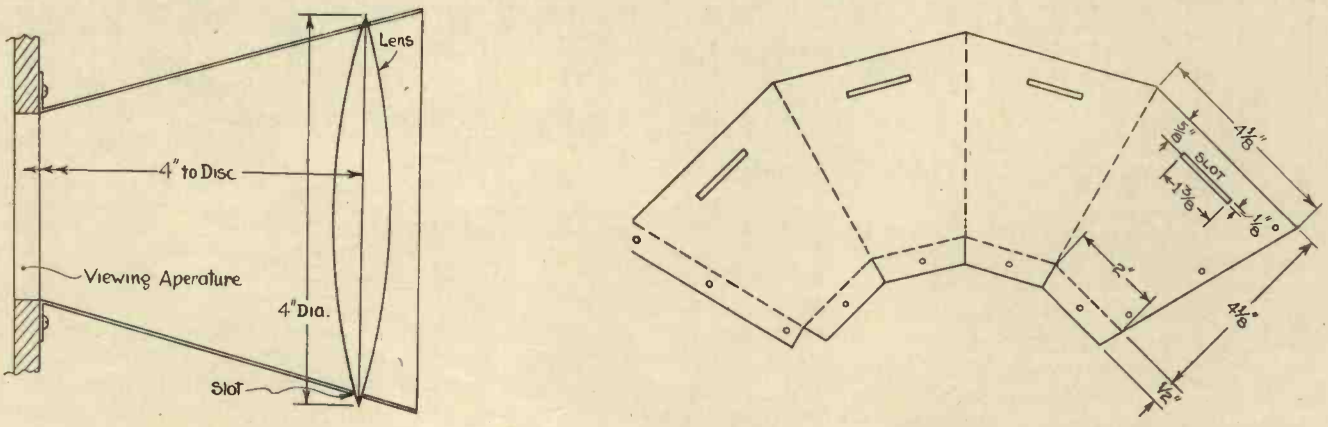
*This photogaph shows the Junior 30-line receiver fitted with the Sanders synchronising gear.*

THE object in designing the disc receiver which was described last month was to enable those who have had no experience whatever to obtain some insight into television at the minimum amount of cost and trouble. For this reason the receiver was kept to its barest essentials and it was designed so that the chassis formed the cabinet, the whole idea being to make it self-contained and simple. Following are some notes indicating how several refinements can be added without materially increasing the cost or the amount of work necessary to build the receiver.

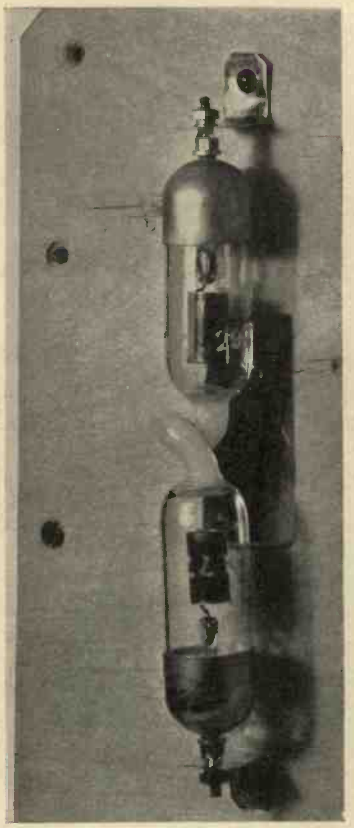
## Enlarging the Picture

As constructed, the picture seen on the screen is quite small, in fact something only a trifle over an inch high and half an inch wide. This is the normal size of a picture obtained with a disc visor and it is the usual practice to magnify it by means of a simple double-convex lens about four inches in diameter. These lenses are obtainable from advertisers, or alternatively a reading-glass from one of the sixpenny stores can be utilised, although the diameter of the latter is slightly less. The drawings show a simple method of mounting the lens. If preferred, one of the standard lens mounts, such as the Bennett, could be used.

The mount can be made of cardboard, wood or tin plate, and assuming that a 4-in. lens is to be used the dimensions of each side will be as shown below. Variation in the size of the lens will, of course, require modification of the dimensions, as also will its position according to its




*A simple light tunnel can be made up from cardboard or metal as suggested by these two diagrams.*



*The TI lamp will improve the brilliancy of the picture. A ground-glass screen should be interposed between the disc and the lamp.*

focal length. The usual distance between the lens and disc is 5 ins.

### Checking the Scanning Speed

Another very useful addition that can be incorporated quite simply is a means of checking the speed of the disc. This is accomplished by viewing eight spots or spokes marked out on the disc by the light of a neon lamp supplied from 50-cycle A.C. mains. When the disc is revolving at the correct speed of 750 revolutions per minute, these marks appear stationary, whereas variation above or below this speed will cause the marks to appear to be moving in one direction or the other according to whether the speed is fast or slow.

It is quite easy to provide a device of this kind. Small neon lamps are obtainable which are called indicator lamps and measure approximately 2 ins. long by 1¼ ins. in diameter. These can be operated direct from the mains. As the speed indicator is only used at intervals, a switch should be fitted on the sloping front panel so that the lamp can be put on or off at will. The lamp should be so mounted that the light from it is thrown on to the disc and the most convenient position is opposite the viewing aperture. A hole should therefore be cut in the front panel and the lamp mounted so that it is a little distance in front of this, sufficient, in fact, so that the disc can be viewed beyond the lamp, which should be blackened all over with the exception of a small aperture which faces the disc. In order to provide a stroboscopic device, eight radial lines should be put on the black surface of the disc with white paint.

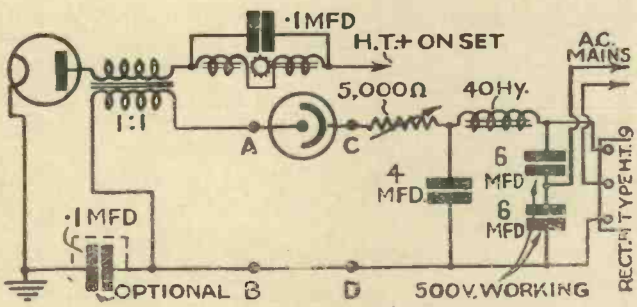
A metal screen can with advantage be placed over the lamp, and this may conveniently take the form of a piece of sheet tin bent into a semi-circle with the edges turned up for attachment to the front of the cabinet. A lamp holder can be dispensed with by soldering the leads direct to the lamp terminal points.

### Improving the Picture

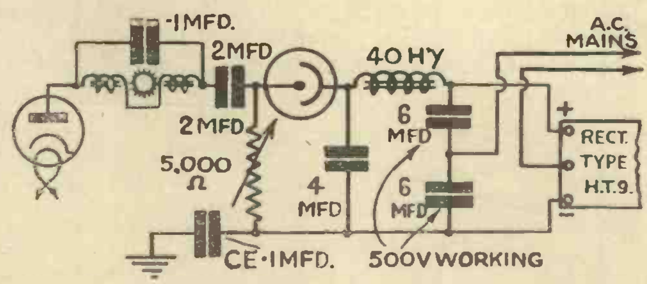
Greater picture brilliance may be secured by using one of the special neon lamps which have been made for television purposes. There are several flat-plate lamps available (the Meraco, reviewed on another page) which give a very even field of light, or there is the special T.I. lamp, in which the discharge takes place in a convolution of glass tube. Not only does this lamp provide light from the actual discharge, but the walls of the tube are coated with a fluorescent material and this also adds to the brilliancy. With this lamp it is desirable to use a screen in order to diffuse the light; a sheet of oiled paper or a slip of ground glass fitted over the lamp aperture will answer quite well for this.

### Fitting Synchronising Gear

One of the photographs shows a synchronising gear fitted to the receiver. This is easily possible with some types of gear; that shown in the photograph is the Sanders, which lends itself to the purpose without much alteration to the cabinet as it is adjustable in practically every respect. An additional two terminals will be necessary for the synchroniser and it is optional whether these are fitted at the back of the receiver or on the front panel; in the latter case it is suggested that the leads be brought through the bottom member of the frame. An on-off switch is very desirable in the synchroniser leads, for a quick flick of this will correct speed variation, should the synchroniser lose control, far quicker than can be accomplished by hand. In these circumstances it is advisable to set the motor speed control so that the tendency is for the motor to run fast. Normally it will then be kept at the proper speed by the synchronising impulses, but should anything in the picture-signals interfere with these then the motor will speed up and it can then be brought into step again quite easily as mentioned above. Schemes of connection when a synchronising gear is included are shown by the diagrams.




*Over 300 volts can be obtained from this power pack so the output is enough to feed both the neon and the output valve. The usual variable resistance is included to improve the definition from the neon lamp.*




*This is a simple arrangement in that there is no transformer and the potentiometer is across the supply instead of in series with the neon lamp. With the synchronising coils in series with the anode of the output valve the pictures are kept very steady.*

# Heard on the Short Waves

By Kenneth Jowers

*W4TJ (above) has a very businesslike station. His 20-metre phone signals are well received in England after 22.00 B.S.T. Scotia N.Y. is the location of W2DC (right) who is being so well heard in Europe at the moment. Reports are not required.*

IT seems rather a pity that with all the amateur wavebands that there are listening stations should confine themselves so much to 20 metres. This month in particular, I have noticed how almost all wavebands have been ignored with the exception of 20 metres, whilst in my mail from America there has been a pretty general groan about the number of reports from English listening stations on W 20-metre phone transmissions.

It is easy to understand that an American station which is in the habit of working English stations every night of the week does not want to be told that his signals are getting over at R4, for example. What he does want to know is what is happening to his 80- or 160-metre phone.

Listening stations seem to be rather worried because they do not obtain the required verification, that is the reason. Amateur stations want to know something fresh. If a station 2,000 or 3,000 miles away is heard on 160 metres, then by all means send a report, in fact, send a cable, and you will be very popular if you do. Going to the other extreme, I have just received a report from a listening station four miles away from my QRA asking for a card. Comments are needless.

A report covering 23 pages of foolscap has just been received from J. W. Greenshields, of Burnt Oak, Middlesex. He has had a very successful month, and on certain days has logged large numbers of stations. For example, on one sheet I noticed 46 Americans, 2 Cuban, 6 Canadian and 2 South American amateurs, while, on another day, the 20-metre band was entirely dead as regards W and VE American stations. But VP5PA and SU1CH were logged. This comprehensive report also includes a large number of commercial stations on 20, 31 and 50 metres. So it seems that conditions in Burnt Oak are very good for short waves at the moment.

Looking down the list of prefixes I noticed W4's, OK1's, PR5's, CO2's, VE2, VE4, VK2, W3, VY, LA, LU, EA, VU, HI, VO, SU, CT, W7, which pretty well covers the entire world. This is pretty good going.

## The Armstrong Super-regen.

In a letter from Sutton Coldfield, Alan Russell says that the most suitable receiver is his Armstrong super-regen. with a separate oscillator. The entire receiver is built up on low-loss lines on a metal chassis with the valve and coil holders and oscillator unit on stand-off insulators. The circuit, which is reproduced in these pages, is quite a conventional one, but is not used very much by amateurs to-day.

In view of Mr. Russell's excellent log of stations, it looks as though the Armstrong super might be worth investigating. He has heard 93 W phone stations on 20 metres from all nine districts, eight V's and several others, including BY, CO, HC, F8, F3, HAF, HI, LU, VQ4, EA, CT1, LA, SM, VP6, and so on. The total log of stations in his report is no less than 177, not counting a whole host of commercial stations from all over the world.

Incidentally, for those who are interested in the Armstrong super circuit, the super-regen. coils can be obtained ready-wound from Bulgin. That will save winding the two coils with 600 and 500 turns.

## Conditions in Yorkshire

I am glad to have had quite a number of reports from Yorkshire, which until just recently has not displayed much interest in short waves. Here are three typical examples which will provide an indication of the conditions prevailing at the moment.

First of all, Hull. John H. Hay has been doing very well. Although he says that he has not been able to spend very much time receiving just recently, he has heard 59 W phones on 20 metres, also several VE's. He has also heard J2LP, J5CE, HC1FYL, OM2RX, K6FKB, K5AF, VK2EO, K5AA, PY1DM. Either the receiver in use is a particularly hot one, or else conditions are good in Hull. In addition to these stations, 59 other W's were heard on 40 metres. Of the English amateur stations, G5TZ appears to give the best signal in Hull.

BRS 1353, S. Bradbury, Bradford, mentions that he finds conditions rather poor on 20 metres. He has logged VP6YV, when he was working a Dutch motor vessel in the Pacific, otherwise conditions regarding DX have not been too good. On the other hand, these remarks hardly agree with his report, which covers three pages and includes stations on 14 mc., 7 and 3.5 mc.

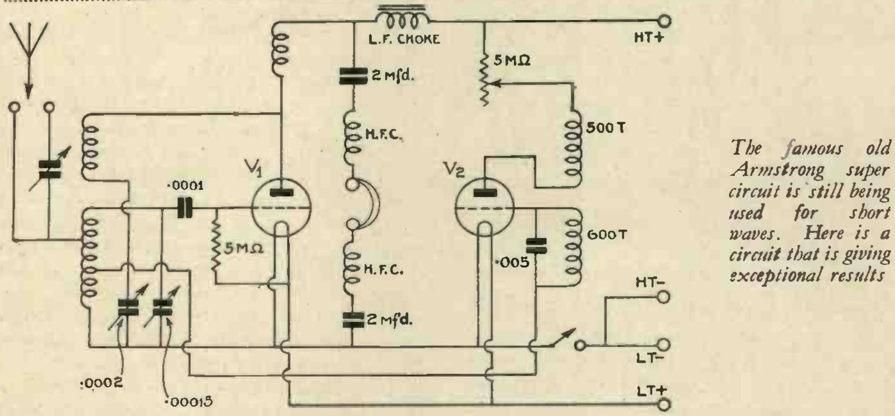
From Scarborough comes a report from BRS 1480, S. Davison, who has been listening on 20 metres. Between 19.00 and 23.30 he heard W9EEL, W9AIO, W5UM, W4AXZ, W4CRE, several VE's, VO1C, VP6YB, VP3BG and VE5HN, all good contacts. He tells me that G5ML, who at the moment is doing extraordinary well, has ordered two 80-ft. masts from Norway; I wonder what will happen when those go up. So far, BRS 1480 has heard stations from four continents and 34 countries, all using phone.

Most amateurs know W2DC, operated by E. H. Fritschel, in Scotia, N.Y. The photograph on these pages has just been received and shows his latest equipment. In the panel on the left is a complete C.W. transmitter, including all power supply. At the bottom is a high-voltage rectifier, using UX866A valves. Then comes a 500-volt rectifier, power pack for the CO anode voltage and bias for the first sub-amplifier and finally the R.F. amplifiers. One of four crystals can be switched into circuit quite simply, while an 865 screened-grid valve operates as the first sub-amplifier. The P.A. consists of two UV 211's in push-pull.

The panel on the right houses the speech amplifier modulator and all power supply. The modulator consists of condenser microphone, followed by an 864, two 864's in parallel, a type 56, R.C. coupled to another 56, then a 59, followed by a pair of 59's in class-B and, finally, a pair of FP1460's in class-B. The A.C. output is 250 watts.

According to W2DC, the star point of the transmitter is the aerial system, quite unconventional, but is apparently giving excellent results. It is of the type broken in the centre for the feeders. The two halves are 118 feet long and are at right angles to each other, but so far no directional effects have been noticed.

Most European countries have been worked on phone and all Continents on CW. W2DC wants me to thank all the English listeners who have sent him reports; he finds it financially impossible to reply to them all individually, although he appreciates the information received.




*The famous old Armstrong super circuit is still being used for short waves. Here is a circuit that is giving exceptional results*

## Some Good Logs

BRS 1374, Jack Wilson, Secretary of the Wishaw and District Radio Society, has sent me a photograph of some of the members. This Society is doing extremely well, considering it has only been in existence for quite a short time. BRS 1374 is very pleased with himself because he has logged LU6AC in Buenos Aires, at 0100 on 20 metres, using an Eddystone Ham-band Two. On the other hand, I feel that he should be very proud of receiving W3ETT on phone as early as 11.45 a.m. Conditions in Lanarkshire seem very good, for he has sent a long list of stations heard on 20 and 80 metres.

*Here are some of the members of the Wishaw and District Radio Society formed last year by B.R.S. 1374.*

As we have got as far as Scotland, here are some details from B. McDougall, of Glasgow, S.1. He has been listening on 7 mc. to G stations and has received almost all of the more prominent amateurs on that band. Amongst the stations heard were 2KT at R7, 5KG at R6, 2GG at R7, 5ML at R9, 2XO at R7, 5NA R5, and 5CW at R6. He has also heard a station calling Paris on 14,600 kc. This is apparently the Japanese station JVN in Tokio. Other stations heard include OM, PA and F's, all on 40 metres.

K. M. Spiller, writing from Sherborne, has sent me a log of stations totalling 111. The receiver is a 1-V-1 coupled to a 33-ft. doublet aerial; all stations heard used phone. Amongst some of the well-known G stations heard were 2MR at R4, 2KT R7, 2PL R4, 5UK R5, 5ML R4, 5KG R5, 5KD R5, 2IL R8, 5RD R7, 6GL R5. In addition, he has heard VE, W, HI and between 20 and 30 commercial broadcasters.

R. D. Everard points out that I omitted to give him credit for receiving 240 stations on 20 metres. I am sorry about that for it really is a very good achievement. This listening post in Standon, Hertfordshire, is probably one of the most consistent in the country and now has heard stations from almost the entire world.

A listener in Burton-on-Trent, F. V. A. Smith, says short-wave phone stations are coming in well at Burton-on-Trent, and include W1KJ, W1DRL, VE2HN.

The controversy about Icelandic stations is still going on. F. Barrett, writing from Grays, Essex, says he has heard a station with the call-sign TF3G. He has also heard OH8NF calling a TF station.

XZN2C has been heard at Exeter by BRS 1448, Eric L. Wills, verification of this will be welcomed. Conditions for reception are apparently good in Devonshire, for amongst stations heard were TY2AE, TY5AA, VS6AQ, W6KII, W6ENV, W6BCU, TF3G, TF5C, SU1RO, ES5C, W4HX, ZB1T.

CO2HY, CO2KC, CO6OM, and several other stations were heard at Woolston, Southampton, by F. H. Wingett; he is using an all-mains version of the World Beater, plus a cross-feeder aerial system. Incidentally, the use of this cross-feeder aerial has, according to Mr. Wingett, put up signal strength by 25 per cent.

To hear Bermuda on phone with an 0-V-1 is very good going. Albert Lee, of South Tottenham, logged VP9R at 22.40, in addition to a whole host of W and VE stations.

A query as to where to send EP cards is raised by BRS 1287, F. G. Sadler, of Stamford Hill. According to my latest list, EP belongs to Persia, but as far as I know there are not any active stations in that area. Using an indoor aerial and an 0-V-1 receiver, BRS 1287 logged between thirty and forty phone stations on 20 metres and a similar number on CW.

(*Continued on page* 365.)

# EFFECT OF MOVEMENT ON DEFINITION

By E. L. Gardiner, B.Sc.

*The relative movements of the image scanned and the scanning spot give rise to some curious effects. This article explains why the definition is improved when the image is moving.*

IT is a commonly accepted fact amongst television workers, that the apparent definition of an image seems better when the transmitted objects are in motion, than when the same television system is used to view stationary objects. There can be no doubt that greater detail can in fact be seen and appreciated when there is movement, but I have found that many experimenters are content to accept this fact without appreciating the cause.

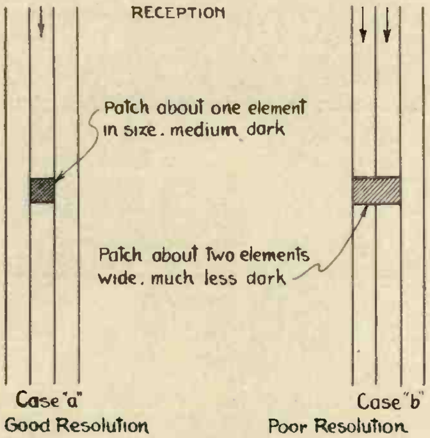



*Fig. 1.—Two typical cases of scanning in which the detail is affected.*

When considering this question of motion, we find that it is necessary to consider two conditions, namely, when the movement is slow in comparison with that of the scanning spot, and when the motion is rapid. The former results in an improvement in apparent detail, whereas the second usually results in slight loss of detail together with a certain amount of distortion.

## Gradual Motion

Consider the detail which can be seen in an absolutely stationary television image transmitted by a system in which the number of scanning lines is perhaps fairly high, but not high enough to resolve all the detail in the original.

We know that the "dot theory" of considering a television image, as if it were built up in the same way as a half-tone photographic block, is not correct, although often very convenient for explanatory purposes. In a direction perpendicular to that of the scanning lines the dot analogy is in fact rigidly true, since no detail can be obtained which is smaller on the receiving screen than the width of a scanning line.

Consider what will happen to a small detail of the original scene which is smaller than one scanning element, say, for example, one-quarter the area of the element. We will regard it as a black dot for convenience. Clearly the treatment of this small dot will vary, according to whether it happens to lie more or less centrally on a scanning strip, or whether it lies partly on one strip and partly on the next. These two typical cases are illustrated in Fig. 1, in which are shown the two positions of such a very small detail at the transmitter, and the corresponding effect on the receiving screen.

In the first case, *a*, the small detail is reproduced as a dark spot the width of one scanning strip, that is about four times its true area, and in consequence also about one-quarter its original density. Thus we *do* see the original small detail, although it is smaller than one scanning element; but we see it in a distorted form, being larger and less dense than the original.

Now take the second case, *b*, in which the original small detail falls across two scanning lines. It will now be reproduced as a darker spot on *both* scanning strips; and since its effect in reducing the light at the transmitter is only half what it was in the first case, the dark area will be proportionately less dark, or about one-eighth only of its original density.

The small detail will still be reproduced, but will be now eight times as large and one-eighth the density of the original; we may say that it is four times as badly distorted as case *a*. This means that it will be far less clearly seen, and since many television systems do not respond well to quite small changes of density, owing to imperfect methods of light modulation, it is possible that the small detail may be to faint to be appreciated at all.

## Detail and H.F. Response

These arguments can be applied somewhat similarly to the resolution of small details along the scanning strip also. To be strictly accurate, however, we should consider in this case the degree of high-frequency response which the television system possesses, since on this depends mainly the resolution of detail along the direction of motion. The investigation of this effect involves methods of calculation which are beyond the scope of this discussion, and has been very ably dealt with by J. C. Wilson (Proceedings of the Television Society, Sept., 1933), who showed that detail smaller than a scanning element can be resolved to some extent. Without going further into this, however, we can see that the ability to distinguish a small detail will partly depend upon its proximity to larger objects in the image field. Thus a detail smaller than the scanning element might be noticeable if isolated, but less so if it lies within less than the width of an element of some much larger object of similar density, or if it differs but little in density from that of its surroundings.

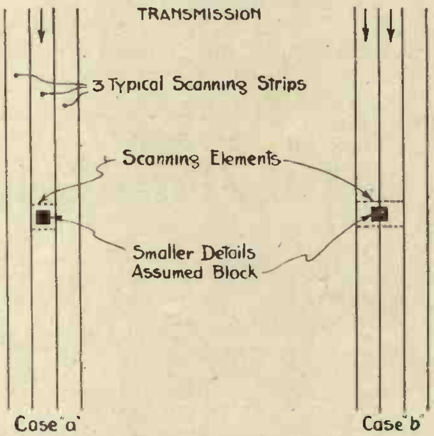



*Fig. 2.—Diagram showing the effect of overlapping scanning on a detail of the image.*

The actual position of a detail in the image may therefore also affect the chances of its being reproduced in the direction of scanning, although perhaps to a less extent than in the direction across that of the scanning strips. The presence of a certain amount of amplitude distortion in the electrical part of the television system, unfortunately nearly always present, will add still further to this effect.

From the foregoing argument it follows clearly that there are positions in a television field of view, in which small details have a better chance of being reproduced than in other positions. Once this fact is appreciated, there is no difficulty in seeing why an image in which gradual movement of the various parts is taking place, should give an apparent superior definition. In the case of a stationary scene, as, for example, a photograph held in front of the transmitter, certain details will always be in places of bad definition, and will in consequence never be noticed at all by the looker at the receiving station; whereas other equally small details in more favourable positions will be seen.

If, however, there is movement, then *every* small detail will stand an equal chance of occupying sooner or later a favourable position. In general every small detail may be expected to occupy such a position of maximum resolution at some time. The eye and the memory play a very helpful part in making television possible. An observer who has once seen a small detail in an image, such perhaps as a particular mole or wrinkle on an actor's face, will subconsciously remember its presence. Persistence of vision will also help, making appear permanent small details which in point of fact are only visible during perhaps a third of the successive scannings which make up the television image.

### *Rapid Motion*

The foregoing considerations are based upon comparatively slow movement; when motion occurs quickly in the course of a single scanning cycle a very different state of affairs exists. Definition is in fact generally reduced, because small detail may have moved into a fresh position between the time of one scanning strip and the next, and so will be reproduced as an enlarged and distorted area; this loss of sharpness is, however, not serious until very high speed of motion is reached, when it becomes apparent.

It has been suggested to me that a television image of quickly moving objects should be less clearly seen by television than in the case of the cinema. Apart from the use of an insufficient number of scanning strips, the objects will occupy a different position at the time when one part of them is transmitted than when another part is handled. This is, of course, because the successive images forming television each take a finite time to build up. Slight blurring of the individual images will no doubt occur, but this is also the case in cinematography, owing to the length of each exposure. With the cinema this slight blurring of the individual frames is of value, for due to it the motion of the film when projected appears less jerky. In television, however, this blurring may be accompanied by slight distortion, of the types very well known to experimenters, and frequently described in these columns. A horse, for example, whose tail has been scanned before its head, might appear slightly lengthened. This lengthening will, for vertical scanning, be equal to the distance moved by the horse in the time between the scanning of his tail and head. With horizontal scanning the effect will be in the vertical plane, and therefore less noticeable as movement is usually horizontal.

# International Prefixes

| | |
|---|---|
| AC | CHINA |
| AC4 | TIBET |
| AR | SYRIA |
| CE | CHILE |
| CM | CUBA |
| CO | CUBA (Phone) |
| CP | BOLIVIA |
| CR4 | CAPE VERDE |
| CR5 | PORT. GUINEA |
| CR6 | ANGOLA |
| CR7 | MOZAMBIQUE |
| CR8 | PORT. INDIA |
| CR9 | MACAO |
| CR10 | TIMOR |
| CT1 | PORTUGAL |
| CT2 | AZORES |
| CT3 | MADEIRA |
| CX | URUGUAY |
| D | GERMANY |
| EA | SPAIN |
| EI | IRISH FREE STATE |
| EL | LIBERIA |
| EP, EQ | PERSIA |
| ES | ESTONIA |
| ET | ABYSSINIA |
| EZ | SAAR |
| F3, F8 | ALGERIA, FRANCE, MARTINIQUE, MOROCCO, TAHITI |
| F4 | TUNIS |
| F8M | MOROCCO |
| FB8 | MADAGASCAR, REUNION |
| FI | FR. INDO-CHINA |
| G | GREAT BRITAIN |
| GI | NORTH IRELAND |
| HA | HUNGARY |
| HB | SWITZERLAND |
| HC | ECUADOR |
| HH | HAYTI |
| HI | DOMINICAN REP. |
| HJ, HK | COLOMBIAN REP. |
| HL | SAINT HELENA |
| HP | PANAMA |
| HR | HONDURAS |
| HS | SIAM |
| HZ | HEDJAZ |
| I | ITALY & COLONIES |
| J | JAPAN |
| K4 | PORTO RICO, VIRGIN ISLANDS |
| K5 | CANAL ZONE |
| K6 | GUAM, HAWAII, SAMOA (U.S.) |
| K7 | ALASKA |
| KA | PHILIPPINE ISLANDS |
| LA | NORWAY |
| LU | ARGENTINA |
| LX | LUXEMBOURG |
| LY | LITHUANIA |
| LZ | BULGARIA |
| MX | MANCHUKUO |
| NX | GREENLAND |
| NY | CANAL ZONE |
| OA | PERU |
| OB | SARAWAK |
| OE | AUSTRIA |
| OH | FINLAND |
| OK | CZECHOSLOVAKIA |
| OM | GUAM |
| ON | BELGIUM, BEL. CONGO |
| OZ | DENMARK |
| PA | NETHERLANDS |
| PJ | CURACAO |
| PK | NETH. INDIES |
| PY | BRAZIL |
| PZ | SURINAM |
| SM | SWEDEN |
| SP | POLAND |
| ST | SUDAN |
| SU | EGYPT |
| SV | GREECE |
| TA | TURKEY |
| TF | ICELAND |
| TG | GUATEMALA |
| TI | COSTA RICA |
| TS | SAAR |
| U, UE, UK, UX | U.S.S.R. |
| V8 | MAURITIUS |
| VE | CANADA |
| VK | AUSTRALIA |
| VO | NEWFOUNDLAND |
| VP1 | ZANZIBAR |
| VP2 | ANTIGUA, FIJI ISLANDS |
| VP3 | GILBERT & ELLICE ISLANDS |
| VP4 | BRITISH HONDURAS, TRINIDAD |
| VP5 | CAYMAN ISLANDS, JAMAICA |
| VP6 | BARBADOS |
| VP7 | BAHAMAS |
| VP9 | BERMUDA |
| VQ1 | FANNING ISLAND |
| VQ2 | NORTHERN RHODESIA |
| VQ3 | TANGANYIKA |
| VQ4 | KENYA |
| VQ5 | UGANDA |
| VQ8 | ASCENSION, ST. HELENA |
| VR | BRITISH GUIANA, MAURITIUS |
| VS2, VS3 | MALAYA |
| VS5 | SARAWAK |
| VS6 | HONG-KONG |
| VS7 | CEYLON |
| VS8 | MALAYA |
| VU | INDIA |
| W | UNITED STATES |
| X | MEXICO |
| XU | CHINA |
| YA | AFGHANISTAN |
| YI | IRAQ |
| YJ | NEW HEBRIDES |
| YL | LATVIA |
| YM | DANZIG |
| YN | NICARAGUA |
| YP | RUMANIA |
| YS | SALVADOR |
| YT, YU | JUGOSLAVIA |
| YV | VENEZUELA |
| ZA | ALBANIA |
| ZB1 | MALTA |
| ZC1 | TRANSJORDANIA |
| ZC6 | PALESTINE |
| ZD | NIGERIA |
| ZE1 | SOUTHERN RHODESIA |
| ZK1 | COOK ISLANDS |
| ZK2 | NIUE |
| ZL | NEW ZEALAND |
| ZM | SAMOA (BRITISH) |
| ZP | PARAGUAY |
| ZS, ZT, ZU | UNION OF S. AFRICA |

## DX Possibilities on 1.7 Mc.

It seems that the possibilities of DX contacts on 1.7 Mc. are still being overlooked and every day letters from correspondents show that there does not seem to be any limit to the mileage spanned on this extraordinary waveband. As already pointed out, stations such as G5NW in Dundee have been working stations in the Canary Isles, whereas G2PL in Cambridge has worked stations in Sweden, Czechoslovakia and so on.

G2II is one of the few stations in addition to 6FO who has worked America on phone, on the 1.7 band. G5ZJ has been heard by W1BES and W9DJ, and although two-way working has not been accomplished it shows that DX can be done. At the present time, in the early hours of the morning, between, say, 5 and 7 a.m., the W160-metre phone stations are being heard quite regularly even with quite simple receivers.

J. Mackintyre, of Rosyth, in a recent letter points out that on April 27, between approximately 1 and 2 a.m., he heard W1CJD, W4NCO, W2HH, W1DM, W8LIJ, W2SF, W1CJ, W1YU, W9ELL, W3EOP, VE3EE, W4NC, W3ADE, etc., etc. All of these stations were R6 to R8.

Although all these W stations can be heard a little after midnight, apparently no G station has been able to get over to America until about 5 a.m.

# THE FRENCH 60-LINE TRANSMISSIONS

As was stated in last month's issue a series of test transmissions have now commenced from the French station PTT. So far as we have been able to ascertain there is no intention of these being of a permanent character: the idea being to graduate through the lower scanning frequencies until a certain standard of high-definition is reached.

The first 60-line transmission was made on Friday, April 26, when representatives of the Press were invited to attend. From reports it appears that 60-line definition was not considered satisfactory so it is probable that within a very short time the scanning frequency will be increased to 90 lines when, after some experience is gained, the institution of an 180-line service is contemplated.

***First Television Transmission in France.***
*Mademoiselle Bretty, of "La Comédie Française," during the transmission.*

A studio has been specially equipped for television and the arrangements are apparently on much the same lines as those at Portland Place, the projector being placed in a room adjoining the studio. Scanning is horizontal and the picture-frequency is 25 frames per second. Ratio is about 3-4 and the wavelength is 175 metres.

We have had reports from several readers that the transmissions are well received in the South of England, but apparently there is some difficulty in resolving a picture even with cathode-ray receivers. As the transmissions with this scanning-frequency are only for an uncertain period it is improbable that any receivers will be developed for use by the general public. It does not appear that any definite transmission times have been arranged, but they usually take place between 9 and 10 p.m.

## The Berlin High-definition Television

On May 13 the German Post Office opened the first public televiewing post outside Berlin in the Post Office Administration Building at Potsdam. The distance from the Berlin television transmitters is just 13 miles, as the crow flies. A few weeks ago a similar viewing post was inaugurated in Berlin. As many as 3,000 people pass the receiving set during demonstration time, which is limited to the hour and a half of the broadcasters' programmes. One-hundred-and-eighty-line scanning is employed.

On May 13 the Post Office had arranged for Mr. Otto Gebühr, the film star, to appear in front of the televisor in his well-known role as Frederic the Great of Prussia, who during his life-time was so closely linked with Potsdam. Picture-quality was good and the direct television transmissions seemed better than the broadcast of films.

The Broadcasting Company provides Berlin with a regular evening television programme three times a week, whereas the Post Office supply programmes in the mornings and afternoons and on alternate evenings.

At the present moment there is a certain amount of friendly rivalry between Post Office and Broadcasting Company in all questions relating to television. The attendance of the Press was very large, over a hundred and twenty representatives being driven out to the station.

## Radio Society of Great Britain

At a meeting of the Society held in the building of the Institution of Electrical Engineers on Wednesday, April 24, Mr. G. Parr, of the Edison Swan Electric Co., gave a lecture on "Recent Improvements in Cathode-ray Tubes." Mr. A. Watts was in the chair.

In introducing the lecturer, Mr. Watts regretted that the audience would not have an opportunity of seeing a demonstration of the latest type of tube, but Mr. Parr had promised to arrange a full demonstration at the time of the Convention in the autumn.

Mr. Parr then traced the development of the gas-focused tube and summarised its advantages and disadvantages. The more recent requirements of television had led to the development of a tube in which the focusing of the beam was by purely electrostatic means, the tube itself being evacuated to a degree comparable with that of a thermionic valve. In this tube the intensity of the fluorescent spot is dependent on the shield potential and the shield does not affect the focus of the beam within wide limits.

## New Bennett Television Lines

New lines are announced by the Bennett Television Co., of Redhill, Surrey. A new complete disc receiver without optical unit is 55s., including baseboard fitted with terminals and component mount. This disc receiver includes the latest NuGlo lamp, which has already proved very popular. An optical unit specially designed for this inexpensive disc receiver costs 10s. extra and is of special patented design.

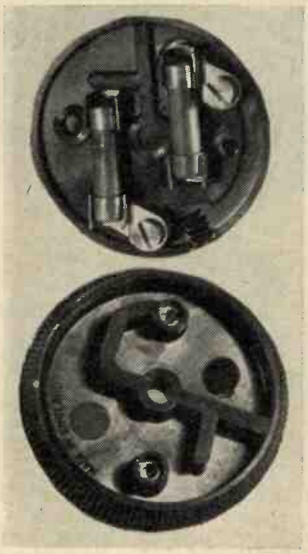
A short-wave converter of unusual efficiency is also available and a report giving details of its capabilities will be published in an early issue.

# Trade Notes of the Month

## Reports on Apparatus Tested

### Combined Mains Plug and Fuse

READERS will be interested in the new D.P. fuse plug manufactured by Ward and Goldstone, of Pendleton, Manchester. This plug has been designed for standard 5-amp. sockets and the moulding is approximately 1¾ ins. wide by less than ½ in. in depth.



*The Goltone combined mains plug and fuse.*

From personal experience we know that when making alteration to experimental receivers it is a very simple matter to burn out a fuse. When the fuses are in some inaccessible position, which they usually are, considerable time is wasted in replacing the burnt-out fuse.

This Goltone combined fuse and plug once and for all overcomes that trouble and also prevents interference with house lighting when the main fuse burns out. Also this two-pin plug has twin tubular fuses mounted internally. In the event of a short-circuit all one has to do is to pull the plug out of its socket, unscrew the top cap, put in two new fuses and the whole job is finished. Wherever experimental work is being carried out and the mains are in use it is of great advantage to know that in case of accident only one source of supply can be affected.

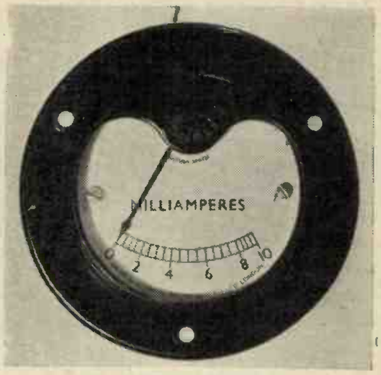
Supplies of this ingenious component can be obtained from all electrical suppliers, or from Ward and Goldstone, Pendleton, Manchester. The price is 1s. 4d.

### Inexpensive Meters for the Amateur

A PROBLEM confronting the amateur is how to meter a receiver or transmitter without going to great expense. A low-power transmitter requires about eight meters if every circuit is to be continually checked.

The Sifam Electrical Instrument Co. have introduced a new cheap range of meters very suitable for amateur use. For example, the milliamp. range consists of nine instruments, reading 0-6, 0-10, 0-30, 0-60, 0-100, 0-150, 0-200, 0-300 and 0-500 milliamps. With the exception of the first meter, which costs 12s. 6d., the remainder are all priced at 10s. These meters are guaranteed to an accuracy of 5 per cent., which is near enough for normal use. They are 2¾ ins. over-all and mounted in black moulded casing.

Low-reading voltmeters and ammeters with a centre zero and reading 1-0-1 up to 20-0-20, only cost 7s. 6d. A useful meter for connecting in the anode circuit of the detector valve is the type




*The Sifam milliammeter.*

E66, reading 0-20 milliamps. The model we tested had a D.C. resistance of 1,699 ohms and was reasonably dead beat in action.

Portable moving-coil instruments and hot-wire meters for measuring radiation are also available, and are correspondingly cheap. We can recommend these Sifam units for all amateur use with the utmost confidence.

### A New Flat-plate Neon Lamp

THE Mervyn Sound and Vision Co., Ltd., have just produced a new flat-plate neon lamp constructed on the same principles as their well-known Nu-Glo. This, it will be remembered, has a polished metal plate for one electrode and a flat sheet of wire gauze for the other, the object of this arrangement being the reflection of the light through the meshes of the wire grid and its even distribution. Although the striking voltage of the new lamp is below normal, the makers recommend between 180 and 200 volts with a maximum current of 25 milliamps. The particular sample submitted has been run at figures in excess of these and the lamp does not appear to have been harmed in any way. The coverage current required is extremely small—6 milliamps.—though naturally there is not much brightness at this figure. An extremely good field of light was obtained with a current of 15 to 17 milliamps., which obviously make the lamp very suitable for the battery

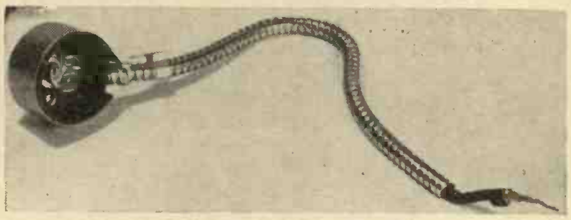
*The Meraco flat-plate neon lamp.*

user. The name of the lamp is the Meraco and it retails at 7s. 6d.; it can be obtained from the Mervyn Sound & Vision Co., Ltd., 4 Holborn Place, London, W.C.1.

### Screened Anode Connector

WITH the introduction of steep-slope high-frequency amplifiers, it is essential that all anode connections be completely screened. The new Belling-Lee flexible anode connector which has been designed for plug-top valves is ideal for this purpose, as in addition to being a completely screened wire, the connector terminates in a shroud which covers the top of the average H.F. pentode.

The actual connecting wire, a flexible one, is insulated from the casing by porcelain beads. The first bead is movable so that the length of cable can be adjusted. Incidentally, inside the hood is a circular insulated ring to prevent accidental contact between the metal coating on the valve and the metal hood. It will be realised that it is possible with connectors not having this ring to short-circuit the cathode bias resistance.



*Belling-Lee screened anode connector.*

Several new features embodied in the construction have overcome the disadvantages noticed in certain types of anode connector. For example, it is impossible for the metal casing to move along the connecting wire and earth the anode lead with dire results. Very often we have seen amateurs using the old-fashioned type of connector, which has been covered in insulation tape. This connector can be recommended for use in any stage of the receiver where instability would occur if a plain anode wire were used. The makers are Belling and Lee, Ltd., and the price of the connector, type 1224, is 1s. 6d.

## Two Marconi-Osram Valves for Short Waves

SUPPLIES are now available of the two new M/O valves for which television and ultra-short wave experimenters have been waiting. They have been designated the X41 and X31, and have similar characteristics except that the X41 has a 4-volt heater while the X31 has been designed for AC/DC operation and has a 13-volt heater.

The rated constants are as follows:

Filament volts, 4.0 volts.
Filament current, 1.2 amps.
Anode voltage, 250 volts.
Screen voltage, 70 volts.
Osc. anode voltage, 100 volts.
Control grid voltage, −1.5 volts.
Conversion conductance, 550 micro-amps/volts.
Conversion impedance, 2 megohms.

The X41 and X31 triode-hexodes have been specially designed for use as frequency-changers in super-het receivers. They offer certain advantages over previous valves made for that purpose, particularly when used on the short-waves. They are eminently suitable down to 7 metres owing to the very efficient oscillator section and reduction in "pulling." The price of each is 20s.

## Reliance Potentiometers

ONE of the most important components in a modern television or short-wave radio receiver is the potentiometer for volume or voltage regulation. We have experienced the utmost difficulty in obtaining resistances for this purpose, but we have at last found a range of these components that have solved our difficulties.

They are manufactured by the Reliance Manufacturing Company, of Walthamstow, and are of the wire-wound type with the winding carried on a thin strip of paxolin. This strip is fixed to a metal case and connections are made through the side of the case and brought out to terminals or soldering connections.

The contact consists of a light-flexible

(Continued on page 362.)

"Trade Notes"

(Continued from page 361.)

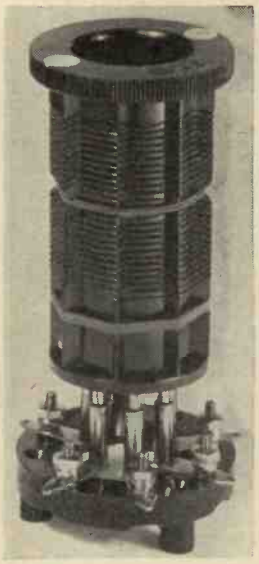
arm of phosphor bronze travelling along the edge of the paxolin strip so making contact with the slight flat on the wire.

Variations to a vry small degree can be made quite easily, while owing to the lightness of the arm there is no undue wear. One of the samples tested having a nominal value of 50,000 ohms was found to have an actual value of 49,300 ohms, a very creditable figure. This potentiometer has an excellent feel, being smooth and free from rough spots, but at the same time the phosphor bronze arm makes a very definite contact. As an example, the 50,oco-ohm model is priced at 4s. 6d.

## B.T.S. Short-wave Coils and Holders

HIGH-FREQUENCY transformers are being used very generally in amateur receivers at the moment. This type of coupling, in addition to doing away with an H.F. choke and blocking condenser, appears to give greater stage-gain with a modern valve. In view of this the B.T.S. Co. have introduced a range of high-frequency transformers, mounted on 6-pin formers, which are to be listed in addition to the 4-pin coils already so well-known.

An important feature is that the coils are wound on high-grade moulded formers which are slotted so that the windings cannot possibly become loose. Another point is that at the top of the former there is a ring with a milled edge so that the coils can be pulled out of the holder without damage to winding. Also around this ring is marked the actual tuning range of the coil with a given condenser capacity.



*B.T.S. short-wave coil.*

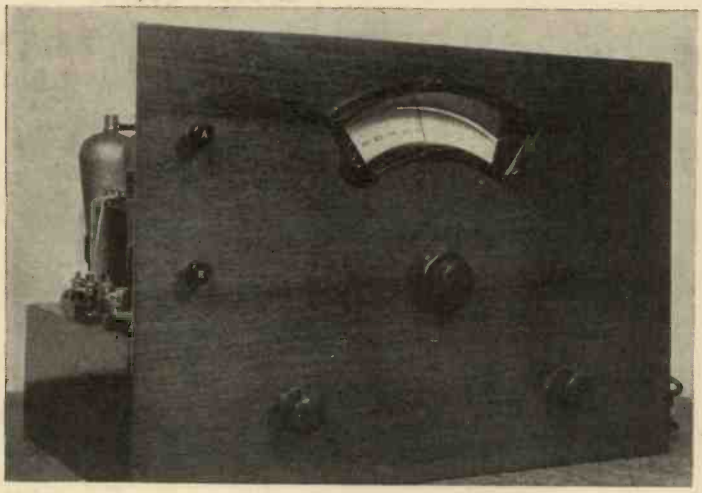
There are three windings, first the primary or coupling coil, second the grid or secondary coil, and finally a re-action wound in between the turns of the grid coil. Coal SPA tunes between 13 and 26 metres, SPC 24-52 metres, SPD 41-94 metres, and the prices are 4s. 6d. for the SPA and SPC, and 5s. for the SPD.

For those who are not familiar with the 4-pin range of coils, let us point out that these are suitable for the tuned grid or aerial circuit, and that a set of five coils covers all wavelengths between 13 and 190 metres. Prices vary between 4s. and 4s. 6d. A 6-pin holder is also available at 2s. and a 4-pin holder at 1s. 6d.

On test the coils in both ranges were found to be wound very accurately and completely covered the rated wavebands. The losses were extremely low even at 13 metres, so we can recommend them with every confidence.

These coils can be used in almost every short-wave circuit of conventional design, but, as the windings are entirely separate they can be used in an experimental arrangement or in super-het receivers.

## Commercial Receivers for the Short-waves: No. 5.



This receiver has been designed to cover the 3.5 mc. band in addition to the other higher frequency amateur bands.

# The Ferranti A.C. S.W. Super-het Five

WE are pleased to be able to give details of a Ferranti Kit receiver for the home constructor short-wave enthusiast. The receiver reviewed below has been in use at our laboratories for the past three months, so we have now gained a very complete idea as to its possibilities.

The receiver has been designed to tune between 15 and 85 metres, but this range is rather conservative for we have received stations down to 14.2 metres and up to 91 metres. But first of all let us explain the working of the unusual circuit adopted.

### *The Circuit*

Actually the receiver uses five valves, a VHT4 heptode as a combined oscillator-modulator, which is band-pass coupled to a VPT4 H.F. pentode in the single I.F. stage. A three-in-one double-diode-triode, type H4D, combines the functions of diode-detector, intermediate low-frequency amplifier and A.V.C. control valve. A parallel-fed transformer couples the triode portion of the H4D to an LP4 triode output valve which gives about 2½ watts.

An interesting detector oscillator circuit has been employed. The control grid of the heptode is anchored down to earth via an H.F. choke. The grid section of the oscillator, instead of being coupled to the anode by means of the conventional grid and anode coils, has a single coil going between the grid and anode of the oscillator which is tuned by a .00015-mfd. condenser. Of course the oscillator has a grid condenser and leak which also prevents H.T. reaching the grid. Instead of the usual coil in the anode of the oscillator through which is applied high tension, an H.F. choke has been used, so the entire combined detector-oscillator circuit uses only one simple tuned circuit, automatically overcoming ganging and coupling troubles.

The I.F. transformers operate at a frequency of 125 kc. and are adjustable to give optimum gain. In practice, the adjustment allows a variation of approximately 3 kc., sufficient to line up the most obstinate I.F. coils.

The receiver is supplied complete with every possible component, including valves, wire, sleeving and copper foil. The majority of the smaller components are mounted beneath the baseboard allowing for easy construction. The constructional leaflet is profusely illustrated and a full-scale blueprint is also provided. We are of the opinion that it is almost impossible to construct this receiver incorrectly or not to obtain satisfactory results immediately the receiver is built.

There are four controls, which, reading from left to right, are: Wave-change switch, tuning control, combined volume control and on-off switch and tone control. Aerial and earth terminals are also mounted on the panel.

A feature of interest is that the oscillator coils and first I.F. band-pass coil are mounted on the same chassis, so that a considerable portion, in fact, the most important portion, of the wiring is already done. Providing the components are mounted as shown on the blueprint, any variations that might possibly occur are completely prevented.

In operation, the first point of interest is that the background noise level is of a very low order. Also from our tests it seems as if the length of aerial used is immaterial. We used different systems from 40 to 132 feet and it had no effect on oscillation or very much effect on signal strength. On the longer aerial the 80-metre band was affected a little, for harmonics became more noticeable.

While the actual band tuning width for the amateur frequencies is not wide, owing to the excellent tuning drive, there is no difficulty in bringing in stations on 20 metres, which is, of course, the most congested band. On 40 metres, although there are more stations, the actual tuning width is greater, while Ferranti deliberately extended the range of the receiver so as to cover the 3.5 mc. amateur band. And for actual signal strength this is one of the most successful bands on the receiver.

A.V.C. action is very satisfactory down to approximately 18 metres, although quick fades are not always taken up. On commercial broadcasters, where the volume level is usually high, the A.V.C. action is particularly good. With stations such as W2XAD the noise level can be heard rising and falling quite regularly as the A.V.C. comes into operation. Of course the signal level remains sensibly constant.

### *Wide Range*

During our tests we heard amateur stations on all bands, including Americans on 3.5 mc. Quite a number of ships were heard around 70 metres, while real DX stations were logged on 40 metres.

We understand that the components used are suitable for tropical use, so Colonial listeners will now have an opportunity of building a short-wave receiver backed by the Ferranti guarantee. The price of the kit, including every component and accessory, is £15 12s. 6d. and full details can be obtained from the makers. Messrs. Ferranti, Ltd., Radio Works, Moston, Manchester, 10.

## With the Amateur Societies

### Anglo-American Radio and Television Society

The Anglo-American Radio and Television Society is open to all who are interested in radio or television. There are no entrance fees or charges, and all one has to do is to send a card to the President, Leslie W. Ordton, Kingsthorpe, Willowbank, Uxbridge. A ladies' section has been organised by Miss Carol Bush, and enrolment to this section should be addressed to the British representative, Miss Eileen G. Harris, Brampton, Victoria Avenue, Porthcawl. A junior section is being organised by Mr. Arthur Jones, of 27 Ringham Road, St. Johns, Ipswich.

### *Amateur Radio in Essex*

Radio G5UK, of Westcliff-on-Sea, has sent me the following details of the last meeting held at Rayleigh, QRA of G2KT. The following are details as received :—

" We were glad to welcome G2ZJ, and our visitors G6LL and G2JO at our monthly meeting. An interesting exhibit was a very portable 56-megacycle receiver constructed by 2BNR, whose QRA, by the way, was offered for the next meeting, held at 15 Nelson Street, Southend-on-Sea. G6DH is now on 1.7 mc. and we wish them success on this band. What about phone DX on 1.7? W's are coming through very well at 5 a.m., B.S.T. G5ZJ has got through, so let us see something done on this band. Will all 1.7 enthusiasts note that F8NU worked good phone on 170.14 metres at 23.00, B.S.T. There is no need to be a linguist, F8NU knows English quite well. His QRA is Orleans.

" Another foreign item of interest. ON4VC, the amateur station representing the Reseau Belge at the Brussels Exhibition, has two operators in charge, both speak English well and are heard on 7 mc. R99.

" Has any G station worked an Italian? If so, please communicate with G5UK."

## " Heard on the Short Waves "

(*Continued from page 356.*)

E. B. Chapman, of Sidcup, logged approximately 40 stations using phone on 3.5 mc. These include PA, W3, W4, W9, VE1, ON and F8. On 20 metres, his log of stations is far too great for me to reproduce. It goes to show what most amateurs already know, that South London is very good for radio.

A report has been received from a station very close to my own QRA, from G. Lindsey, of Hitchin, Herts. The receiver used is a straight four, coupled to an L-type aerial with transposition feeder blocks of home construction. Next month, I hope to give details of how these blocks are made. Mr. Lindsey has heard almost 100 stations, including W1, 2, 3, 4, 5, 7, 8 and 9, HA, HI, CO, VE, and several G's, all on 20 metres. A similar number of stations was heard on 40 metres, while, on 160, 5VT, 5HO, 6KV, 5PB, 2JU, 5WW and 2PL have all been logged.

Verification from J2GX has been received by 2BMP, Henry Leishman, of Old Polmont, Stirlingshire. In addition, the following calls have been heard : W1, 2, 3, 4, 5, 6, 7 and 8, VE1, 2 and 4, K4, K6, TM, TU, OA, LU, VK, ZM, PY, PK, VU, VS, VQ3 and 4, ZU, ZE, ZC, SU, ST, ZB, VQ8, VP5, XZM. This is one of the most imposing logs I have had for a long time, and all the stations were heard on an H.F. detector and pentode receiver, using an aerial 66 ft. long and 16 ft. at the highest point.

It is easy to see that conditions for short-wave reception are good on all bands in all parts of the country, with, perhaps, the exception of Bradford. With the better weather coming along there will be a migration from the more popular bands down to five metres. Amazing performances are being put up in America and there is no telling just what distances will be covered this summer.

### *Codes*

Listening stations have expressed doubt as to the codes used by amateur stations, so, to clear up any doubts, here are the official codes in use at the moment.

#### *Scale to Express Strength of Signals*

QSA 1 Hardly perceptible; unreadable.
QSA 2 Weak; readable now and then.
QSA 3 Fairly good; readable, but with difficulty.
QSA 4 Good; readable.
QSA 5 Very good; perfectly readable.

#### *Scale to Express Audibility of Signals*

R1 Faint signals; just readable.
R2 Weak signals; barely readable.
R3 Weak signals; but can be copied.
R4 Fair signals; easily readable.
R5 Moderately strong signals.
R6 Good signals.
R7 Good strong signals.
R8 Very strong signals.
R9 Extremely strong signals.

#### *Scale to Express Tone of Signals*

T1 Poor 25-, 50- or 60-cycle A.C. tone.
T2 Rough A.C. tone.
T3 Poor rectified A.C. tone. (No filter.)
T4 Fair rectified A.C. tone. (Small filter.)
T5 Nearly D.C. tone. (Good filter, but key thumps or back wave noticeable.)
T6 Nearly D.C. (Very good filter.)
T7 Pure D.C. (but key thumps and back wave noticeable).
T8 Pure D.C. tone.
T9 Pure crystal-controlled D.C. tone.

# Calls Heard

IN view of the extraordinary amount of interest in short-wave listening and the volume of correspondence received, we are collating all the reports and publishing the calls heard for the benefit of receiving and transmitting stations all over the world.

*John A. Hay, 1, Stafford Street, Hull.*

(*14-mc. phone.*)

154 W's, including W6BBY, W6CXW, W5UL, W9NKZ, W9ADN. 13 VE's, including VE3KP, VE2EE, VE2BB, and VO1P, VO2J, VQ4CRL, VQ7MA, VS6GJ, VS8BT, KA1CS, K5AF, K5AG, LU8PV, LU6JV, CM3DO, U9MA, U9MB, HI4P, G5GC, G5BP, G6OY, G2QO, G2KM.

(*7-mc. phone.*)

ZL2LB, ZL2BL, ZL4BQ, ZL4AP, ZL1GZ, ZL2BH, VK3LK, HR1ZU.

2*AKA, Malcolm Geddes,* 44, *Lindisfarne Avenue, Leigh-on-Sea, Essex.*

(*14-mc. phone.*)

VP6YB, VP9R, W4AH, W1AS, W3EHY, W2CLA, W2FFD, W4CRE, W2AU, W3BFH, W4AXZ.

*B.R.S.* 1,703, *Frank J. Forbes,* 78, *West Hill, East Grinstead, Sussex.*

(*14-mc. phone.*)

*Receiver* 0-*V*1.

W8AKU, 3ACX, 3XE, 2FG, 1AMG, 2VC, 3PC, 2AMB, 3DOX, 2BOF, 5BX, 8LAU, 1AB, 2XAU, 1AF, 9EGL, 2HFS, CO2HY, VE1BE, W2ZC, 2EYY, 3EBC, 3BFH, 5GSH, 3XG, 2VP, 4AGQ, 3EHY, 2ZA, 1AHI, 1AJZ, 9BHT, VE3H2. VE3KW, VE1GE, CO2HY, HI7G, W8WA, 1CAA, 8KLK, 8AED, 9EPH, 2ZP, 8HGX, 2HFS, 1AJD, 1IMG, 2GOQ, 2AZZ, 1AMG, 8JNU, 4CRE, 9CSS, 8NE, VE3HF.

*B.R.S.* 1,374, *Jack Wilson, Newmains, Lanarkshire, Scotland.*

(*14-mc. phone.*)

VP6YB, LU6AP, PY2BN, EA2BA, LU8DR, VE3HC, LU1JA, LU1JA, W3FLO, W1AJZ, W5BNN, VE2BG, VE3HE, W5FF, W3BFH, W1BES, W8GLY, W3CRG, VP9R, CO2HY, W9CPP, W1AHI, W3ZX, W2GEW, K4SA, W3MD, W1DRL, W1KJ, VE2EE, W8CTC, LU6AC, LU1JA, VP5IS. VP6YB, VE4KW, VE2EE, VE2DB, VE2DE, VE2BG, VE1JH.

*B.R.S.* 1,353, *S. Bradbury,* 15, *Hollingwood Mount, Bradford.*

(*14-mc. phone.*)

HP1A, TI3AZ, CO6OM, CO2HY, CO2WW, CO2WZ, K4SA, HI7G, VP6YB, VE1DR, VE1DC, VE2BG, VE2EE, VE2CA. In addition W's from W1, W2, W3, W4, W5, W8, and W9.

2*ANT, D. A. G. Edwards, Chester Road, Sutton Coldfield.*

(*14-mc. phone.*)

W5BDS, W5BEE, W5BMM, W5ZS, BO1P, VP5IS, VP5PA, VP6YB, VP9R, LU1DA, LU8DR, HC1FG, HI7G, HH5PA, TI2SG, CO2HY, CO2LL, CO2SG, CO2WW, CO2WZ, and CO6OM. In addition to approximately 100 W's and VE's.

2*BSF, S. Geoffrey Wood, Sunnymead, Bawtry Road, Rotherham.*

(*7-mc. phone.*)

Approximately 50 W stations in addition toW3DQ, W1IGZ, W4DHM, VY3FFA, W2BOM, W8OM, W3WG, W2HJH, W1BHC, W8KDX, W8BCG, W2AZO, W2FPL, W1JDB, W1GIM, W1IOZ, VE3ET, PAODK, PAOWJ, G2IL, G2LU, G5NQ, G5PP, OH1JE.

(*7-mc. C.W.*)

OZ5K, W8FHX, OK2KO, PAODB, PAOAX, PAOMG, F8QL, F8ZK, G5TU, G2HT, G6BL, G6BB, G6BU, U3DM.

*A. G. Dunn,* 10, *Clifton Gardens, St. George's Road, Hull.*

(*14-mc. phone.*)

W1DUK, W1HQN, W1CF, W1QZ, W1LZ, W1QV, W1HXW, W1HIP, W1CNU, W1AAO, W1HUO, W1BEQ, W1GFF, W1DGC, W1WE, W1IJZ, W1AJZ, W1CD, W2BHZ, W2DTB, W2GOX, W2BHZ, W2MB, W2GAH, W2GIA, W25XZ, W2CZS, W3CDO, W3EHH, W3CWG, W3AIZ, W3BZB, W3AFW, W3EAQ, FF8MQ, HP1TA, VQ4CRL, SU1SG, VO1P, PY2VK, VE2FQ, VE2AX, XZM2C, SX2A, TF3G.

(*7-mc. phone.*)

G5GC, G6CF, G5CW, G6BF, G2RF, G2IL, G2MI, G5MM, K4BRN, HR1ZU, VK2HF, D4BQO, HB9B.

(*1.7-mc. phone.*)

G5NW, G2YI, G6VQ, G5PB, G6GO, G2XS, G2IN, G5ZJ.

2*BDN, John Lucas,* 44, *Eldefield, Letchworth.*

(*1.7-mc. phone.*)

G2KT, G6KV, G5UK, G6CT, G5PB, G6GO, G2XC, G5JU, G6OM, G6UU, G6SR, G5NW, G5RD, G5WW, G6FM, G6SG, G5VT, G2PL, W9AAR.

*B.R.S.* 1,295, *John Preston, Muirkirk, Ayrshire, Scotland.*

(*1.7-mc. phone.*)

G5RD, G5ZJ, G6SR, G5MM, G6KV, G6GO, G6FM, G6BO, G6HD, G5VT, G5NW, G6UU, F8DR, G5VK, G5XG.

(*14-mc. phone.*)

W9BIF, W4AH, LU6AP, W2FLO, VE2BG, W3BSY, G5NI, W3BSH, W4AH, CO6OM, VP6YB, CT1BY, VP9R.

*J. F. Treagust,* 20, *North Street, Emsworth, Hampshire.*

*Receiver—Short-wave Two.*

(*14-mc. phone.*)

VE9GW, PRF5, W2XAF, W1AXK, W3XAU, EAQ, VK2ME, W1XAL, W3XAL, HJ4ABB, YV4RC, W9XF.

# S.W. Programmes for English Listeners

The broadcast stations from which programmes originate are shown in the first column. The short-wave transmitters are shown in second column, frequencies in the third, wavelengths in the fourth and power in the fifth. Time is B.S.T.

| | | | | | |
|---|---|---|---|---|---|
| WJZ | W3XAL | 17,780 | 16.873 | 12-35 kW. | Daily (except Sundays) 2-3 p.m.; also Tuesdays, Thursdays and Fridays, 8-9 p.m. |
| WJZ | W3XL | 6,100 | 49.18 | 15-35 kW. | Mondays, Wednesdays, Saturdays, 10-11 p.m.; also Saturdays, 5-6 a.m. |
| WGY | W2XAF | 9,530 | 31.48 | 40 kW. | Daily, 11.30-4 a.m.; also outstanding events from time to time. |
| WGY | W2XAD | 15,330 | 19.56 | 20 kW. | Daily, 7.30-8.30 p.m.; also outstanding events from time to time. |
| KDKA | W8XK | 6,140 | 48.86 | 40 kW. | Daily, 9.30 p.m.-6 a.m. |
| | | 11,870 | 25.27 | 40 kW. | Daily, 9.30 p.m.-4 a.m. |
| | | 15,210 | 19.72 | 40 kW. | Daily, noon-9.15 p.m. |
| | | 21,540 | 13.93 | 40 kW. | Daily, noon-7 p.m. |
| WENR | W9XF | 6,100 | 49.18 | 10 kW. | Mondays-Fridays, inclusive 6-7 a.m. and 2-3 a.m. Saturdays, 6-7 a.m., Sundays, 6-7.30 a.m. and 2-3 a.m. |
| WLW | W8XAL | 6,060 | 49.5 | 10 kW. | Daily (except Saturdays and Sundays), 11.30 a.m. to 1 p.m. and 4-7 a.m.; Saturdays, 11.30 a.m.-1 p.m., and 4-8 a.m.; Sundays, 1 p.m.-1 a.m., and 4-7 a.m. |
| WBZ | W1XAZ | 9,570 | 31.33 | 10 kW. | Daily, noon-6 a.m.; Sundays, 1 p.m.-6 a.m. |
| WCFL | W9XAA | 6,080 | 49.34 | .5 kW. | Daily (except Sundays), 2.30 p.m.-11 p.m.; Sundays, 4.30 p.m.-2 a.m. |
| | | 11,830 | 25.35 | .5 kW. | Used only occasionally. |
| | | 17,780 | 16.57 | .5 kW. | Used only occasionally. |
| WIOD | W4XB | 6,040 | 49.67 | 2.5 kW. | Temporarily discontinued. |
| CFCF | VE9DR | 6,005 | 49.96 | .05 kW. | Dismantled, temporarily. |
| CRCT | VE9GW | 6,095 | 49.2 | .5 kW. | Mondays, Tuesdays, Wednesdays, 8 p.m.-5 a.m., Thursdays, Fridays, Saturdays, 12 noon-5 a.m. Sundays, 6 p.m.-2 a.m. |

## "Other Television Patents"

(*Continued from page 352*)

(Patent No. 423,765.)

Method of radiating picture signals in combination with "zero current" synchronising impulses.—(*Telefunken Co.*)

(Patent No. 422,914.)

Television system in which direct and low-frequency components are utilised for controlling the average brightnes of reproduction.—(*Electric and Musical Industries, Ltd., C. O. Browne* and *A. D. Blumlein.*)

(Patent No. 422,963.)

Mains-driven unit for generating saw-toothed scanning oscillations.—(*Radio Akt. D. S. Loewe* and *K. Schlesinger.*)

(Patent No. 423,036.)

Cathode-ray tube having an auxiliary concentrating electrode in the form of a conductive coating on the wall of the tube.—(*Radio Akt. D. S. Loewe* and *K. Schlesinger.*)

(Patent No. 423,311.)

Cathode-ray tube for producing a line source of light on a fluorescent screen, varying in intensity with the signal voltages.—(*Ferranti, Ltd.*)

(Patent No. 423,546.)

Improvements in the construction of mirror-screws for high-definition work.—(*Suddeutsche "Tekade" Co.*)

(Patent No. 423,583.)

Means for preventing undesirable "shifting" of the extinction potential in a saw-toothed scanning system.—(*Radio Akt. D. S. Loewe* and *K. Schlesinger.*)

(Patent No. 423,599.)

Improvements in "trigger" circuits used for saw-toothed scanning.—(*Radio Akt. D. S. Loewe* and *K. Schlesinger.*)

Patent No. 423,685.)

Separating the line and picture impulses fed to a television receiver and preventing interaction between the respective oscillation-generators.—(*M. Bowman-Manifold* and *W. S. Percival.*)

(Patent No. 423,793.)

Improvements in the magnetic control of the electron-stream through a cathode-ray tube.—(*M. von Ardenne.*)

(Patent No. 424,093.)

Cathode-ray tube in which a plurality of oscillators are used for deflecting the beam.—(*General Electric Co., Ltd.*, and *L. C. Jesty.*)

(Patent No. 424,221.)

Saw-toothed oscillation-generator with negative feedback for controlling the beam in a cathode-ray tube.—(*Electric and Musical Industries, Ltd., M. Bowman-Manifold* and *W. S. Spencer.*)

(Patent No. 424,490.)

Preventing the effect of secondary emission in screen-grid valves used for generating saw-toothed scanning voltages.—(*Radio Akt., D. S. Loewe* and *K. Schlesinger.*)

(Patent No. 424,633.)

"Intermediate" television system utilising a photo-chemical film which can be re-sensitised as often as required.—(*J. L. Baird* and *Baird Television, Ltd.*)

(Patent No. 424,657.)

Improved scanning system for televising from photographic films.—(*W. W. Jacomb* and *Baird Television, Ltd.*)

(Patent No. 424,690.)

Improvements in the construction and assembly of the electrodes of a cathode-ray tube.—(*Fernseh Akt.*)

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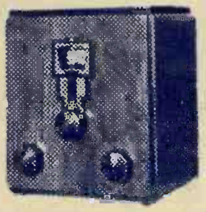

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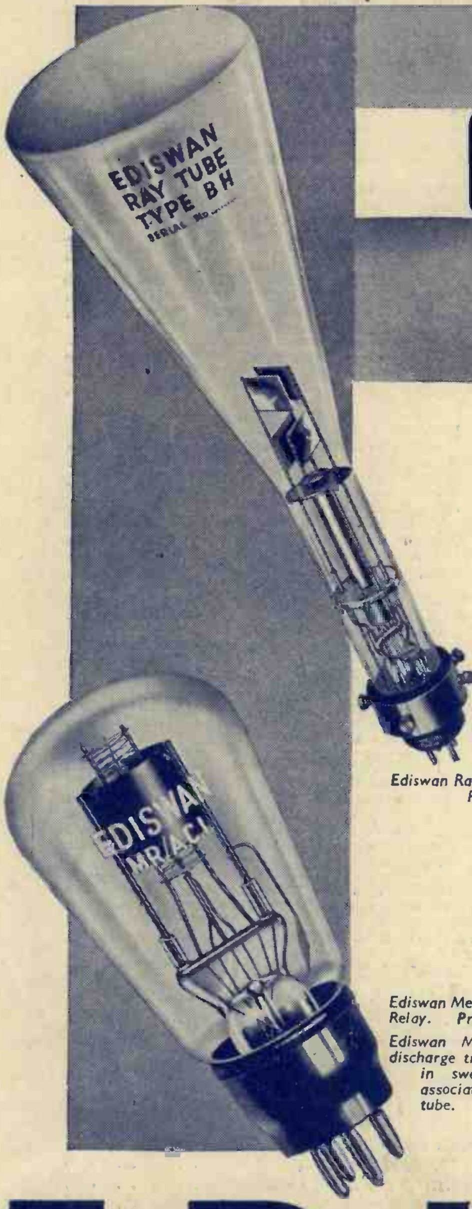


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