24-INCH X 22-INCH HOME PICTURE (SEE PAGE 196)

Television and SHORT-WAVE WORLD

1/- MONTHLY

APRIL, 1937

No. 110. Vol. x.

RECEIVER OPERATING HINTS

PROGRAMME CRITICISM

SCANNING FAULTS —AND HOW TO REMEDY THEM

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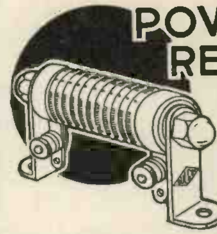

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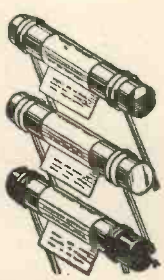

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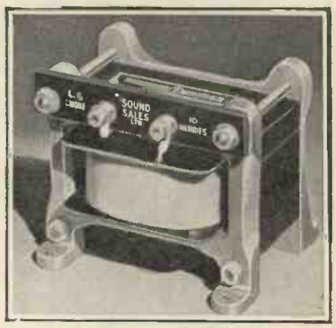

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No. 110 VOL. X APRIL, 1937.

TELEVISION and SHORT-WAVE WORLD

Special Features

TELEVISION AND SHORT-WAVE WORLD

Proprietors :
BERNARD JONES PUBLICATIONS, LTD

Editor-in-Chief :
BERNARD E. JONES.

Editor :
H. CORBISHLEY.

Editorial, Advertising and Publishing Offices :
Chansitor House, 38, Chancery Lane, London, W.C.2.

Telephones : Holborn 6158, 6159
Telegrams : Beejapee, Holb., London.

Subscription Rates : Post paid to any part of the world—3 months, 3/6; 6 months, 6/9; 12 months 13/6.

Published Monthly—1/- net.
(Last Wednesday in every month for following month).

Contributions are invited and will be promptly considered. Correspondence should be addressed according to its nature, to the Editor, the Advertisement Manager, or the Publisher, "Television and Short-wave World," Chansitor House, Chancery Lane, London, W.C.2.

IMPORTANT

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

COMMENT OF THE MONTH

Demonstrations

THAT the public are taking very full advantage of the free demonstrations of television in the various demonstration centres in and around London is evidenced by the statement of the G.E.C. that up to the 18th of March 65,000 had viewed programmes in the showrooms of the G.E.C. and their dealers since the B.B.C. television service began. For one concern this is a very large figure and if other figures were available the total number would be very considerable.

It is unfortunate in one respect that many public demonstrations have been staged as publicity stunts and that in many cases, particularly at the large stores, there is an entire lack of showmanship which is not conducive to creating a real interest in television in the public mind. The crowds are ushered into the viewing rooms and no regard is given to programme continuity, neither in many cases is sufficient time given for visitors to become accustomed to the subdued light before they are moved on. Even at the cinema a certain time is necessary before the eyes accustom themselves to the altered conditions and in television with a smaller screen and less light this is a matter of much greater importance. Demonstrations of this nature, while satisfying a certain amount of curiosity, are, in our opinion, definitely doing harm to television, though presumably they serve the purpose of attracting visitors to the stores. Those who make use of television for publicity purposes should at least take care that their patrons are seeing it under proper conditions.

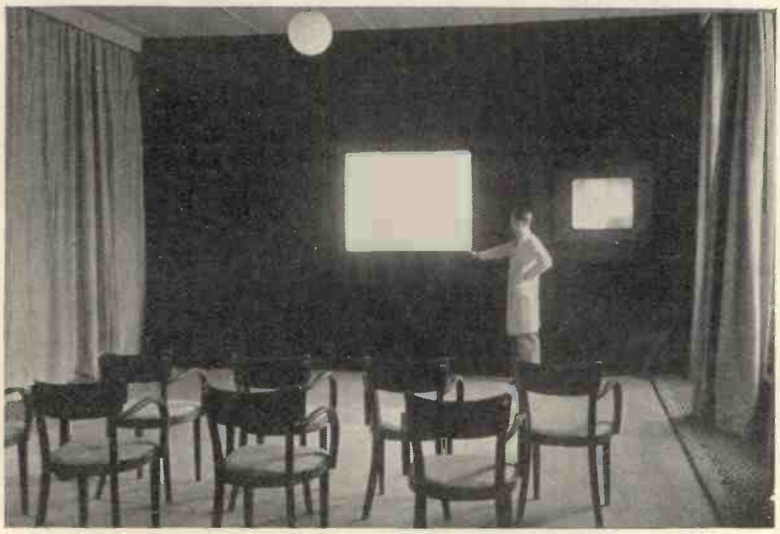
Television Experience

LAST month we mentioned that many dealers and service people have built or are building the receiver which was described in our October, November and December issues of last year, in order to obtain experience which will undoubtedly be of great value to them later. There is no better way of securing knowledge of the principles and functioning of a television receiver than can be obtained by actual construction and getting it into working order, and those that do so are bound to profit eventually. The suggestion is well worth serious consideration by all those who are engaged in the radio trade.

WE SEE SCOPHONY'S LATEST SYSTEM

LARGE BRIGHT PICTURES BY OPTICAL-MECHANICAL METHODS

AN ACCOUNT BY THE EDITOR OF A DEMONSTRATION OF THE SCOPHONY SYSTEM WHICH PROVIDES LARGE SCREEN HIGH-DEFINITION PICTURES BY OPTICAL MECHANICAL METHODS.



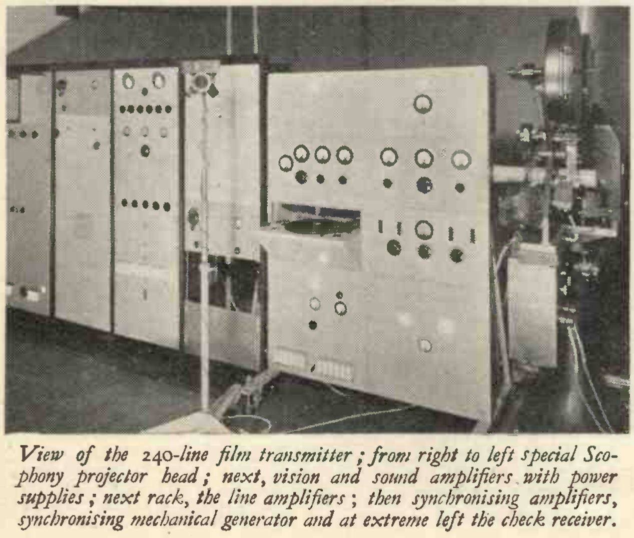
View of the Scophony Theatre showing the 5 ft. × 4 ft. screen, and next to it the 24 ins. × 22 ins. screen.

FROM time to time we have been able to provide our readers with exclusive information regarding the progress made in the development of the Scophony system of television. Originally, it will be remembered, Scophony employed a unique scanning system named the Stixograph. The particular virtue of this system of scanning was that the greatest possible advantage was taken of the modulated light available. Light modulation was by means of a double-image Kerr cell with its well-known low efficiency. Since that time, however, Scophony have developed a special type of liquid cell which was fully described in our issue for May of last year.

Plenty of Light

The introduction of this special light relay which permits of the modulation of an almost unlimited amount of light put an entirely different complexion on the possibilities of optical-mechanical systems and made possible the use of a comparatively simple scanning system and one which would readily lend itself to adoption for the standard set by the Television Committee. In fact, so efficient is this newly developed light relay that the scanning system employed is relatively of but little importance. The whole secret of the success of the Scophony system can be summed up in four words, "plenty of modulated light."

Briefly, the Scophony light relay consists of a device for passing a beam of light through a liquid in which



View of the 240-line film transmitter; from right to left special Scophony projector head; next, vision and sound amplifiers with power supplies; next rack, the line amplifiers; then synchronising amplifiers, synchronising mechanical generator and at extreme left the check receiver.

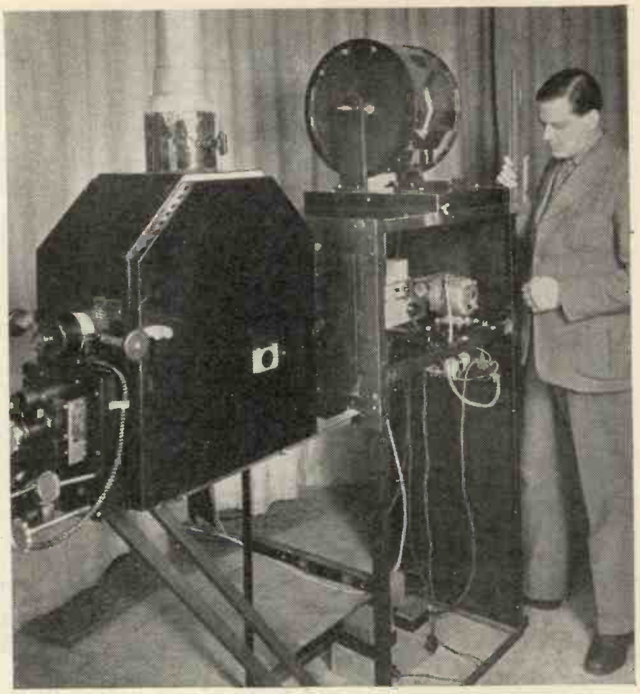
The Scophony home receiver was exhibited at last year's Radio Exhibition. The screen size was 14½ ins. × 10½ ins.

supersonic waves are propagated. Supersonic waves of wavelengths down to a fraction of a millimetre are readily produced in liquids by the agency of quartz crystals, and are propagated from a flat crystal as plane wave-fronts of compression and rarefaction.

A light beam, passing through the liquid parallel to these wave fronts, is retarded more by the compressed regions than by the rarified ones, and since the supersonic waves are regularly spaced, a regular series of diffraction spectra are obtained.

Another very important feature is that with this relay it is possible to project on the screen a number of light spots simultaneously, the number used at the present time being 77 and with the scanning device stationary these appear on the screen as a line of light instead of as a spot as in all other systems. It will be appreciated that this possibility increases the efficiency very considerably.

The relay is of very simple construction and merely consists of a cell with transparent windows in the direction of the light beam and a quartz crystal at right angles to it to which the signal voltages are applied. The liquid employed is kerosene.



5 ft. × 4 ft. projector showing high-intensity arc, slow speed mirror drum and high-speed scanner motor. This projects a picture of considerable brightness on to a rear projection screen. The size of the apparatus can be gauged from the engineer standing at the side.

Recent Progress

The last time we paid a visit to the Scophony laboratories was at the beginning of June, 1936, on which occasion we saw *home* pictures 10 ins. by 8 ins., though a promise was held out of larger home pictures, namely 16 ins. by 12 ins.; we also saw the beginnings of a medium screen picture, 5 ft. by 4 ft.

We have been aware that since that time further developments had taken place and we therefore very eagerly looked forward to some interesting developments, and at last we were given an opportunity by Mr. S. Sagall, Scophony television chief, to "look-in" on their progress.

Scophony is carrying on work in two directions: for the home and for the cinema.

As far as home television is concerned, Scophony have exceeded their own promises, and their ambition has since grown. They have decided that for the home nothing less than a picture comparable in size to the home cinema would be good enough. They have produced a picture two feet wide by 22 inches high. The picture when viewed by us last week, was of a clarity of detail, contrast and brightness equal to any we have seen, and, of course, it was larger. Indeed, at a distance of about 10 ft. one almost forgot that one was looking at a television picture. It looked so much like a home cinema. The picture is projected on to a flat screen from the rear, and the receiver is comparatively simple and should be easy to operate. This picture was 240 lines and 25 frames per second, as was also the larger picture described below. In both cases transmission was by means of a Scophony transmitter in another part of the building, the connection being by line. An arc lamp, which was entirely automatic in action was used as the light source though later we saw the same type of receiver operated with a special gas-discharge lamp which is now in process of development. Results with this were equally good and this lamp only requires 25 per cent. of the current taken by the arc.

View of experimental receiver with picture 24 ins. × 22 ins., Mr. J. Sieger of the Scophony laboratories standing at the side.

Mr. Solomon Sagall Scophony Television Chief.

The Medium-screen Receiver

A no less impressive achievement was the demonstration of the improved medium-screen receiver. We saw a quarter of an hour's demonstration on a screen 5 ft. by 4 ft., which in our opinion would be *good enough* to be introduced already at this stage for audiences of between five hundred and a thousand people.

The picture quality was astonishingly good, the amount of detail being sufficient for showing most elaborate scenes from a film, with a lot of crowd scenes with hundreds of players. The Scophony technicians seem, however, very ambitious and are working on still larger screens, approximating more the size of screens used in cinemas.

The basic principles involved in large screen reception are similar to those incorporated in the home receiver, the difference being in the size of equipment and in the nature of the light source used, thus, for instance, the Medium Screen Receiver uses a standard cinema arc.

Since our description of the Scophony system last July an alteration has been made in the scanning arrangements, though the same principle is used, viz., a high-speed and a low-speed scanner. The high-speed scanner now consists of a polygonal disc about 2 ins. in diameter and ¼ in. thick. The low-speed scanner has also been modified though it still comprises an ordinary type of mirror drum; the length of the mirrors has been increased, however. The question of synchronising did not arise with the apparatus demonstrated as both transmitter and receiver were driven from the same mains by synchronous motors. The synchronising system, which Scophony intend to employ appears to be quite practicable and there would not appear to be any difficulty in this respect. Delay in development has been caused, we understand, by the adoption of a single standard which has necessitated considerable modification.

The photographs on these pages show the Scophony apparatus, but it should be understood that these are the laboratory type.

Arrangements are now in progress for turning the first laboratory models into commercial receivers for the reception of the Alexandra Palace broadcasts. We were impressed by the fact that the adjustment and lining up of this type of receiver does not appear to demand any great accuracy; this was apparent from the nature of the adjustments provided in the optical system which in no case were anything more than a slot and thumb screw, and we understand that the optical arrangements are of a commercial standard which does not call for any great degree of accuracy

It has always been the endeavour of TELEVISION AND SHORT-WAVE WORLD to obtain first-hand information of television developments all over the world. On the strength of information to hand, we can say that to the best of our knowledge there is no other television company or experimenter in the world, who has to-day anything equivalent in size of picture for the home and larger screens to those shown by Scophony. This is, therefore, an achievement of which Britain can be very proud. At an early date we hope to be able to give a full technical description of the Scophony system.

The Pulse Generator at Alexandra Palace

THE function of the pulse generator is to produce all pulses and frequencies for synchronisation and the operation of the cameras. The pulse generator is in two bays. In the first the basic frequencies are generated by multiplying the frequency of the supply mains or of a generator which can be independent of the supply mains. The second bay further amplifies and selects the correct pulses (which are multiples of those generated in the first bay) and amplifies, corrects and diverts them to whatever part of the system requires them.

The synchronising impulses which are to be transmitted with the picture signal are added in the synchronising mixer unit. In order to prevent excessive D.C. reaching the synchronising mixer the first stage in this unit is a further diode. Signals from this diode are fed to the grid of an amplifier valve in the anode circuit of which is a second valve, the grid of which is fed with high and low synchronising pulses supplied by the pulse generator. The output therefore from the combined anode circuits of these two valves is now picture signals plus high and low synchronising pulses. This output is fed through a D.C. coupling unit to the grid of the output valve of this unit.

The complete signals to be radiated are now fed to the distribution amplifier. These duplicated amplifiers consist of an input stage and five alternative output stages, one of which—that feeding the transmitter—has two valves in parallel.

The line amplifiers consist of one stage of amplification and a low impedance output stage. Any picture signals from distant locations will enter the transmitter system through these amplifiers.

Three modulator units follow. Signals from the line amplifiers are amplified by one DA.100 feeding two DA.100's in parallel in the sub-modulator unit, between which and the sub-modulator is the black level unit which ensures that the signals are such that *at the Receiver* the degree of black is maintained constant over the picture tone range.

The sub-modulator consists of one D.E.M.3 amplifier D.C. coupled to two D.E.M.3 valves in parallel.

The final moludator stage consists of one C.A.M.3 valve D.C. coupled to a C.A.T.6 operating with an H.T. supply of 5,000 volts and handling a swing of the order of 2,000 volts peak.

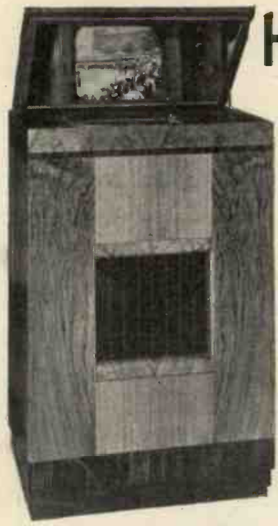
The somewhat unusual course adopted of feeding the modulator signals into the final H.F. amplifier stage is due to the band width of zero to two megacycles.

Television Exhibition at the Science Museum

As stated last month it is intended to hold a television exhibition at the Science Museum, South Kensington, which will open in the early summer. This will not be a commercial exhibition, but it will be designed to be of scientific and historical interest. The co-operation of the leading manufacturers has been secured and arrangements are now going forward. The precise opening date will be announced later, but it is expected that the exhibition will last from June to August.

An item of particular interest will be a model of Campbell Swinton's original suggestion for a cathode-ray system of television, which although at the time was not practicable, was so closely an anticipation of modern practice.

USEFUL HINTS ON OPERATING H.M.V. TELEVISION RECEIVERS



H.M.V. MODEL 901 RECEIVER.

ACCOMPANYING the instructions provided with the H.M.V. television receivers are some very useful diagrams which will enable the veriest novice to correct any fault in tuning or adjustment without the slightest difficulty. As these are of particular interest we have taken the liberty of reproducing them, and the accompanying text matter explaining how the several faults can be remedied. Actually in the H.M.V. instructions pointers are provided to a diagram of the actual controls of the receiver which still further facilitates their use.

In the H.M.V. receiver there are five main controls in addition to the on-off switch and also there are four pre-set controls; the latter, however, are not intended to be touched by the user and it is to the former to which the diagrams refer. The following are the instructions provided and the references to the diagrams will be clear. These instructions, it should be noted, are for the entire resetting of the usual controls and will not ordinarily be necessary after a picture has once been secured.

(1) Turn the brightness control fully to the left.

(2) Switch on the instrument.

(3) Turn the sensitivity control fully to the left.

(4) Turn the contrast control fully to the right.

(5) Slowly turn the brightness control to the right until a faint illumination appears on the screen. Then turn back until this just disappears.

(6) Turn the sensitivity control to the right until traces of the picture appear on the screen. Continue turning until a light and dark contrasting pattern appears on the screen.

(7) Now slowly turn the frame hold control until the pattern formed on the screen, which will be moving from top to bottom, or bottom to top of the screen, becomes stationary.

(8) Turn the line hold control until a steady recognisable picture appears.

To sum up:—

I.—To control the picture in a *horizontal plane*, i.e., from side to side, adjust the line hold control.

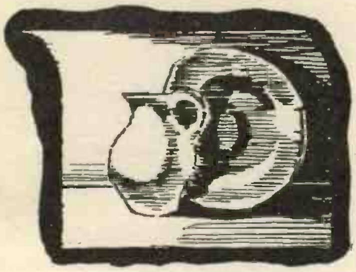
II.—To control the picture in a *vertical plane*, i.e., from top to bottom and bottom to top edges, adjust the frame hold control.

III.—If turning the line or frame hold controls slowly does not result in a steady picture, turn the control in question throughout its whole travel quickly and then recommence turning slowly.

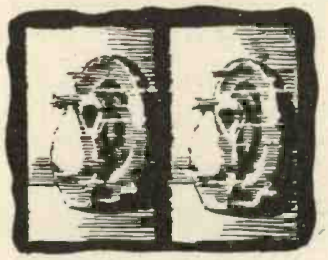
IV.—If adjustment of the line and frame hold controls fails to stabilise the picture, slightly turn the vision input control a little further in a clockwise direction.

V.—Should the picture give the impression of two pictures, one imperfectly superimposed on the other, this indicates that the line hold control is badly out of adjustment. To rectify this, turn the control as far as possible to the right, turning back slowly until the picture properly synchronises.

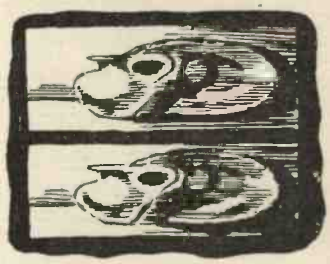
(9) Bring up the half-tones of the picture, if necessary, by manipulating the contrast control in conjunction with the brightness control.



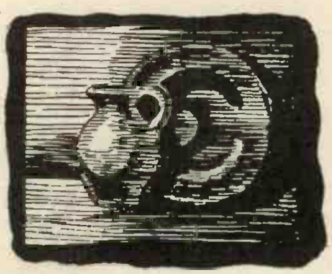
ADJUST LINE HOLD & SENSITIVITY.



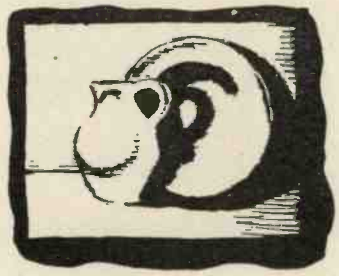
ADJUST LINE HOLD.



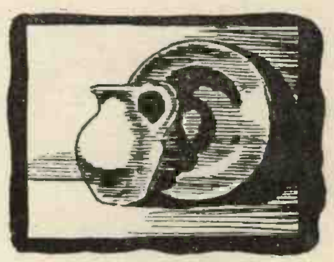
ADJUST FRAME HOLD.



ADJUST BRIGHTNESS and if necessary Contrast.



ADJUST CONTRAST and if necessary Brightness.



NORMAL.

SCANNING FAULTS —AND HOW TO REMEDY THEM

By G. Parr

The experimenter who wires up a scanning circuit for the first time may find difficulty in getting good results. The suggestions in this article will help to indicate causes of trouble.

IN checking a scanning circuit for linearity we have an invaluable aid in the cathode-ray tube itself. By making a temporary adjustment to the values of the charging condensers the wave-form of each time base can be shown on the screen in turn and the linearity checked, besides a number of the minor points which may spoil the complete picture.

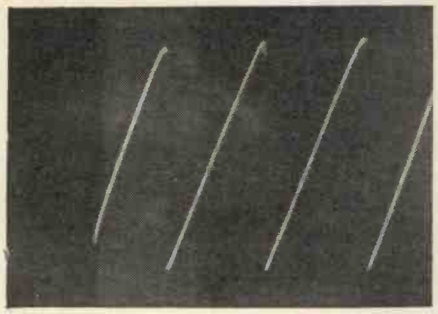


Fig. 1. The linearity of the wave-form is shown in this photograph of a correctly adjusted time base.

Although these hints can apply to all time bases whether of the thyratron or hard valve type they are principally based on the time base described in connection with the Guaranteed Receiver (original type)* as this was the one available for experiment. The photographs were taken by means of an ordinary ½-plate camera held rigidly in front of the screen with exposures of 2-10 secs. depending on the illumination and type of plate used. Fast panchromatics, although troublesome to develop, give the best results and appreciably shorten the exposure time.

Reducing Speed

The first step in experimenting is to reduce the speed of the horizontal time base to approximately that of the vertical, which is done by connecting a condenser in parallel with the charging condenser (C10 and C11 in Fig. 7)*, .05-mfd. is suitable.

On switching on, the wave-form of the vertical trace is drawn out across the screen (Fig. 1) and this should of course, be a straight line. A slight allowance should be made for the fact that the coupling condensers are designed for a high speed and will introduce distortion when a low speed is used. If sufficient condensers are available the value of C13 should be increased to equal that of C6. It is of interest to note the effect of altering the value of coupling condenser and the feed condensers to the deflector plates.

The wave-form of the vertical time base having been checked, the linearity of the horizontal can be seen in a similar manner by slightly altering the value of the resistance R18 and the charging condensers. Alternatively, to save trouble, the distance between the saw teeth of Fig. 1 can be measured with a foot rule.

It is probable that in no case is the wave-form perfectly linear and the degree of permissible departure from the straight line is about 10 per cent., i.e., the line is straight for 90 per cent. of the travel of the beam. This deviation is unnoticeable in the picture, but if it is excessive the bias of the thyratron may be too high.

Effect of Bias

The higher the bias, the further up the curve of charging voltage before discharge takes place, and in extreme cases the curved saw-tooth of Fig. 2 will be obtained. At the same time there are other factors which contribute to the curvature of the line, such as a leaky condenser or too low a value of grid leak in the paraphase valves. Occasionally the thyratron itself may contribute to the curvature owing to the slight current which flows at high anode voltage before the discharge proper takes place. This is unlikely, however, and with the normal circuit the source of trouble is usually incorrect bias on the grid of the thyratron.

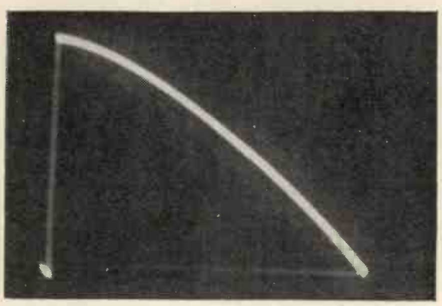


Fig. 2. Curved wave due to excessive thyratron bias or low voltage on the time base.

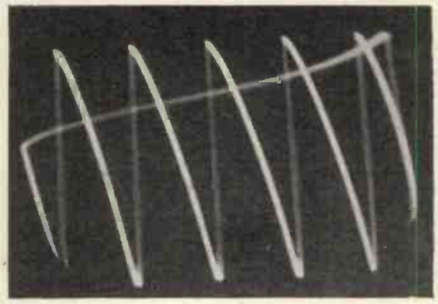


Fig. 3. Curvature due to wrong bias of the valves.

Paraphasing

In the paraphase stages the usual faults are incorrect paraphasing and too high or too low bias on the valves. The accuracy of the paraphasing is checked in the following way:

Leaving the horizontal time base running at reduced speed (about 50 cycles) the input to the vertical time base is connected to an A.C. supply instead of to the thyratron. (This involves disconnecting the grid of the first paraphase valve from the thyratron (condenser C4) and applying about 50 volts A.C. between this condenser and earth. Great care should be taken in making the necessary connection as the time base circuit is live to earth by 1,000 volts. The A.C. should be obtained from an isolating transformer to avoid risk of leakage from the mains. A wave of the 50-cycle can be adjusted on the screen and the effect of the paraphasing on the wave-form studied. A flattened top to the wave indicates over-swinging of the first valve and if a voltmeter is available the input can be checked accordingly.

A more satisfactory method than the above is to use an electrostatic

*Issue of Oct. 1936, p. 553.

TIME-BASE INTERFERENCE

voltmeter across the output from the valves and adjust the paraphasing until the voltage across each plate to earth is the same. Once set, the adjustment of the voltage in the anode circuit need not be touched, and any defect in the time base circuit will then not be due to incorrect paraphasing.

Excessive bias in the valve circuit will cause the top or bottom of the saw-tooth to be curved, as shown in the photograph of Fig. 3. This does not show the bottom curvature clearly as the fault is luckily difficult to obtain in practice. When both saw-teeth have been adjusted to the best linearity the time base can then be restored to normal and the line screen studied as a whole.

Interference

It is probable that if the circuits have not been carefully screened a certain amount of interference will take place between the two time bases, especially at the end of the scan. This is shown in Fig. 4 where the " back-kick " on one plate has shifted the last two lines of the scan. This irregularity can also be caused by excessive synchronising signal, but it will then not appear until an actual picture is received. The photograph of Fig. 5 also shows the effect coupled with a slight amount of trapezium distortion.

This distortion is difficult to avoid in some tubes even though the paraphasing is satisfactory and may be due to a slight misalignment of the plates or cross-modulation. Sometimes there is an optimum connection

Fig. 4. Interaction between time-base circuits or too much synchronising impulse, may produce tailing of the lines.

for the pairs of plates which gives the best rectangular picture and the connections to the plates can be reversed and changed over systematically until the best rectangle is obtained. The last picture shows what is again, fortunately, a rare occurrence—the effect of A.C. leakage on to one of the deflector plates or through the paraphase stage on to the plates.

This might be caused by leakage from cathode to heater in the valves, although it will not produce such a violent distortion as is shown.

The interference due to A.C. is difficult to avoid altogether and it is probable that a close examination of the line screen will show a slight ripple at the edges due to this cause. The H.T. supply may be checked for smoothness by adding an extra condenser and noting the effect.

In conclusion it must be pointed out that both the speed and amplitude of the time bases are affected by the sensitivity of the tube used and this in turn depends on the anode voltage.

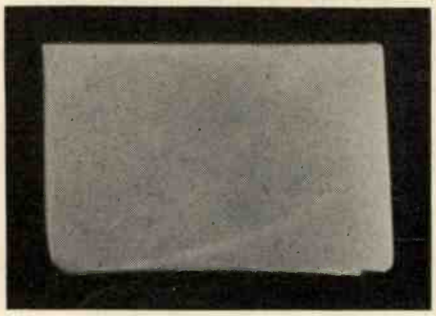


Fig. 5. Similar to Fig. 4 but showing trapezium distortion in addition.

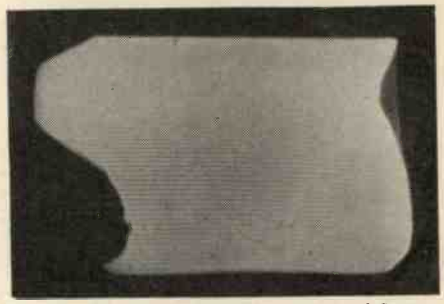
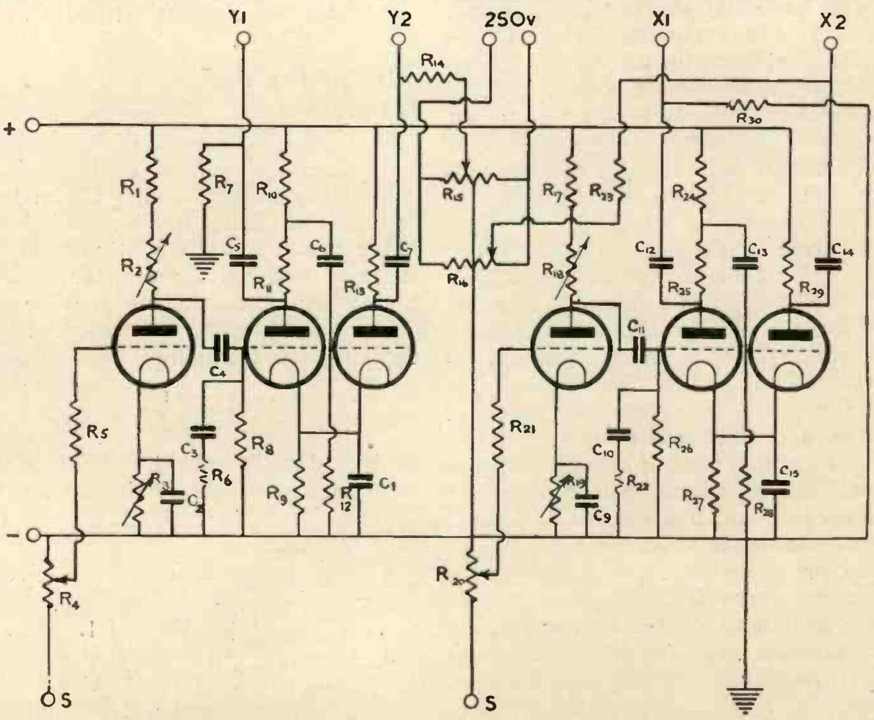


Fig. 6. Bad A.C. interference on the deflector-plate circuits due to leakage.

If the adjustment of the speed is insufficient to cover slight variation on either side of the normal it is very often a useful plan to alter the H.T. voltage of the tube by increasing the smoothing resistance in the H.T. supply and readjusting the time base to the new conditions.

It is understood that the response to the B.B.C.'s questionnaire has been most satisfactory from the point of view of numbers, though there have been few criticisms that have much constructive value. Remarks are largely confined to likes and dislikes of the present programmes and from these it is apparent that it is going to be a difficult matter to please everybody. It is probable that another questionnaire will be put out at an early date.



The theoretical circuit of the time base referred to in this article.

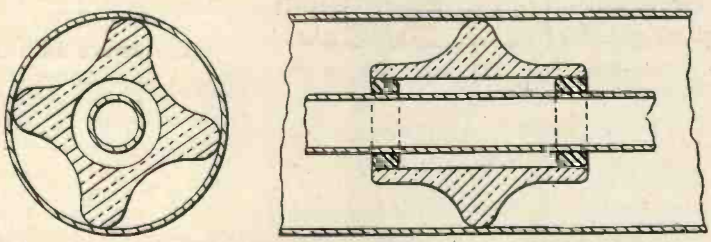
THE COAXIAL CABLE

By Kenneth Lake

A description of the construction and characteristics of the new high-frequency transmission line.

AS an inter-station link and means of relaying outdoor television, coaxial cables will play a very important part in the B.B.C.'s television broadcasts. The Post Office has connected Alexandra Park with Portland Place by means of a high-frequency cable of this type.

The construction of the air-spaced coaxial cable is very simple. Two coaxially arranged conductors, the inner of which is either a solid rod or a tube and the outer a tubular structure of conductive material concentric with the inner conductor, form the basic principle.



The original patent for a coaxial cable was applied for by C. S. Franklin on October 19, 1926. These drawings are from the complete specification filed on August 19, 1927.

The first patent taken out on this type of air-spaced cable was No. 284,005 the patentee being C. S. Franklin. In the description of his invention, he gives the ratio of inner to outer conductor as 3.7, and the sizes of conductors as:—

Outside diameter of the inner conductor $\frac{1}{2}$ in. material 24 s.w.g. copper.

Inside diameter of outer conductor $1\frac{3}{4}$ in. material 22 s.w.g. copper.

It is easily understandable that the difficulties of manufacturing this cable would be insurmountable, except in very short lengths, and the walls would collapse if any attempt was made to bend it.

Manufacturing difficulties that present themselves are the right type of spacer to use, and the material and form of construction the outside conductor will take. Regarding the spacer, there are two types in use to-day—the insulated washer and the continuous spiral of insulated material wound around the centre conductor. Of these two, the washer method is the most efficient as it enables long straight lengths of cable to be laid with just sufficient washers to keep it coaxial, thereby cutting down dielectric losses. The inner conductor presents few difficulties and here a solid copper rod is used; but for the outside conductor more flexible materials such as drawn copper or aluminium tapes or even lead are used.

In the Bell System Technical Journal of October, 1934, there is a description of an experimental cable laid in Phoœnixville, U.S.A., with a range of 100 kc. to 10,000 kc. This cable proved very successful, and to those interested, although it is highly technical, the Bell System article is well worth reading.

Measuring the Constants

The simplest method of measuring the primary constants of a coaxial cable is by loose coupling a Hartley or Colpitt oscillator to a known inductance and connecting in parallel a capacity and valve voltmeter. By tuning the capacity, it is possible to calculate the frequency generated by applying the formula

$$W^2 = \frac{1}{\sqrt{CL}}$$

By inserting the cable it is possible to measure capacity and inductance and by substituting a resistance to measure resistance.

The attentuation formula is given as:—

$$a = \frac{R}{2}\sqrt{\frac{C}{L}} + \frac{G}{2}\sqrt{\frac{L}{C}}$$

where R = resistance, L = inductance, C = capacity, G = Conductance. Experience has shown that attenuation is not seriously affected by a slight departure from ideal construction due to joints and lack of concentricity.

These larger types of coaxial cables and high-frequency air-space cables, unless as a matter of interest, are no use to the amateur experimenter, but there are now available many types of small efficiently screened lead-in and inter-connection cables. These cables are of a low-loss and low-capacity type, and useful in many ways to television, where screening is important. .

One that the writer has in mind is made by the Telegraph Construction and Maintenance Co., Ltd.., and has a 14/.0076-in. T.C. conductor encased in a gutta-percha compound which is drawn into a star shape to cut down dielectric loss. This is sheathed in an insulated tube which is in turn covered with a close braided screen. This is a very robust cable and tests in which four amps. were passed through it for four hours without a trace of dielectric softening have been made

There is still a wide field for research and improvement of this type of cable.

The A.R.R.L. Handbook, 1937 Edition

THE new "Amateur Handbook" issued by the American Radio Relay League consists of no less than 21 chapters, plus an index of miscellaneous practical information. Most of the important technical developments of the past year are embodied so that the book has been almost entirely re-written.

Special attention has been given to the development of noise silencers for short-wave receivers, the capabilities of new transmitting and receiving valves, and a wealth of constructional information.

Ultra high-frequency working has come in for a big share of the space.

Altogether there are 544 pages, including a 112 page catalogue section, plus 564 illustrations, 74 charts and 86 formulas.

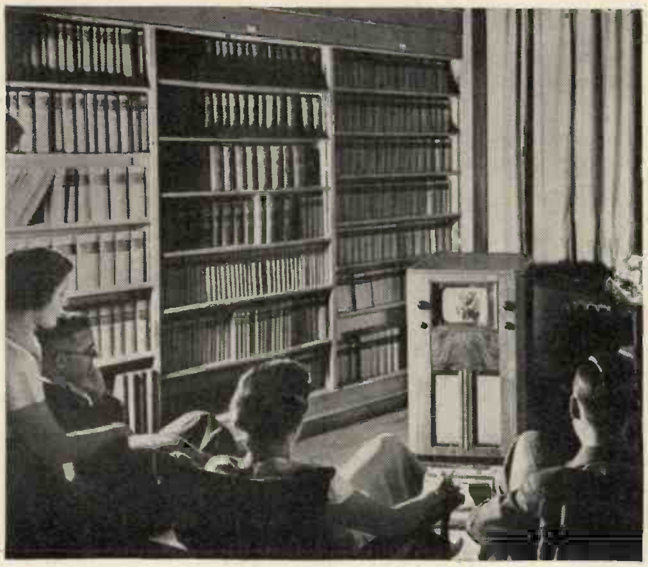
Copies of this Radio Amateur's Handbook can be obtained from F. L. Postlewaite, G5KA, 41 Kinfauns Road, Goodmayes, Ilford, Essex, post free, 5s. 6d.

SOME REFLECTIONS ON FOUR MONTHS' VIEWING

By the Editor

AFTER four months of reasonably consistent viewing of the television broadcasts one begins to form fairly settled opinions of the value of this new form of entertainment. After this period the real novelty of it has gone and one begins to take a keener interest in such matters as receiver performance, programme value and the reactions of one's friends.

The receiver which has been used is a G.E.C. and from the outset it was decided to keep a record of any inconsistencies of performance. Looking back over this period I find that their were five occasions when the programmes were marred in some way or could not be received. Two of these (one sound only) were due to faults at the transmitting station, one because, owing to a high wind one side of the feeder became detached from the aerial, and fourth and fifth because of some local interference which, although it did not affect the picture to any great extent, completely drowned the sound. This same interference has been experienced on other occasions but only for periods of a few minutes and therefore it was not considered worth while to go to much trouble in tracking it down.



The pictures can be viewed in subdued light. The receiver in use in this photograph is a G.E.C.

Absolutely Reliable

Throughout the whole of this period no internal adjustment or replacement of any kind has been made to the G.E.C. receiver and this provides proof that the modern television receiver is just as reliable as the average broadcast set. It is no secret that this proof of reliability which practical experience over the past few months has provided has been one of the factors which has enabled manufacturers to reduce their prices so very considerably. In the first place provision had to be made for serviceing on a somewhat extensive scale, which is always an expensive matter, and particularly in the case of television receivers with which there had been no previous experience; but it has now become apparent to the makers that any extensive servicing with the consequent cost will not be required.

Reception conditions, during the time on which these notes are based, have varied, but in round figures it may be stated that they have been 90 per cent. good—that is for 90 per cent. of the total time of reception both vision and sound have left nothing to be desired. Naturally, when conditions are not at their best one tries what effect adjustment of the controls will have and sometimes an improvement has been effected, but generally speaking it has been found that on later transmissions and with the original settings everything has been quite satisfactory, which indicates that the transmission has been at fault or that there have been bad conditions. As a matter of fact, most of the trouble that has been experienced because of adverse conditions has been on the sound side, and it is this section of the receiver which is most affected by interference from car ignition systems.

Tuning

Tuning of the sound is far more critical than vision, in fact the picture is there within any limits of the single-knob tuning control, but the sound is critical to within a few degrees. This, of course, makes tuning as simple a matter as tuning an ordinary wireless set and it is possible for the veriest novice to receive the programmes. On the whole it has been found that in the case of the Marconi-E.M.I. transmissions the direct studio shots give better results than films and that on any of the rare occasions when there is any tendency for synchronism to be at all troublesome it is with the latter.

The results with different aerial arrangements were described in the January issue of TELEVISION AND SHORT-WAVE WORLD, but they may be summed up by saying that height is of paramount importance and that a reflector will be found beneficial at the outer limits of the range of the Alexandra Palace transmitter. Tests made with inferior aerial systems showed that a host of troubles could be introduced. I would say, therefore, erect the aerial in as high a position as possible and if on the limits of the 25 miles radius of the transmitter use a reflector. At distances of less than twenty miles a reflector should not be necessary.

Other People's Opinions

During the period that the receiver has been in use it has been interesting to observe the reactions and hear the criticisms of other people. One and all have expressed their amazement at the degree of technical perfection that has been attained. Clarity and detail have obviously exceeded their expectations, and the only technical criticism has been regarding the picture size.

It has been obvious that a large proportion of the programmes has failed to hold the interest of viewers, but it has been equally clear that when the material is good there is

THE FUTURE OF TELEVISION

plenty of entertainment value. The difference between the first-class artist and the third-rate type is very apparent on the television screen, and it is very clear how the audience reacts. The same remarks apply to productions; there have been some very amateurish attempts and some first-rate ones, and it has been observed that audiences are very quick to notice and criticise the former even to the point of ridicule. Such productions, and even poor artists, do definite harm to the progress of television and undoubtedly have been the cause of many potential buyers of receivers deciding to defer purchase until better entertainment is available.

Since the reduction in receiver prices, the previous common complaint that television is too costly is rarely heard; it appears to be appreciated that now the price represents full value, and when this has been discussed in comparison with the average broadcast set, it has been a matter of favourable comment.

The Importance of Good Programmes

It seems clear, therefore, that the popularising of television depends upon the quality and nature of the programmes and in this latter respect the consensus of opinion appears to be that it will be necessary for the B.B.C. to go outside the limitations of the Alexandra Palace for programme matter; it is too much to expect that studio programmes with 100 per cent. interest can be devised day after day. It has been noted that such outside items that it has been possible to give, as for instance the boxing match in February, have aroused more interest than the studio programmes. The extension of this branch of television broadcasting is dependent to some extent upon further technical development by the provision of suitable communication channels between various parts of London and the Alexandra Palace, a matter which is now under consideration by the B.B.C.

It has been interesting to learn the opinion of viewers who had previously witnessed demonstrations in public viewing rooms, but had not had the opportunity of seeing an entire programme through, and under ordinary home conditions. These people, it was found, were for the most part aware of the degree of technical perfection that has been attained, but had not appreciated what amount of entertainment value the programmes could carry, and it would appear therefore that these demonstrations, where viewers are only able to witness scraps for periods of about five minutes, are doing television a disservice.

Another point of interest has been the amount of ordinary room lighting which has been permissible when witnessing a transmission and it is one that is of considerable importance. Naturally, the picture is best seen in total darkness, but it has been apparent that subdued lighting, as for instance by means of a shaded table lamp, which will allow others to read, has very little detriment. It has also been found desirable to have the receiver in such a position that the programmes can be seen with as little disorganisation of ordinary seating accommodation as possible. This is not always easy for there is the light from the fire to take into consideration, and as this is likely to flicker it has a more detrimental effect on the pleasurable observance of the pictures than has a steady subdued light from an ordinary lamp. The ideal position for the television receiver screen would appear to be over the mantelpiece, a position which is not practicable at the present time but may ultimately be found possible.

These notes would be incomplete without some mention of the keenness of people to see the broadcasts. Obviously this may be because of the novelty of it all, but it indicates that the added value of sight to broadcasting has caught the public fancy and that the time will come when practically every home has a television receiver.

Book Review.

The Physics of Electron Tubes, by L. R. Koller, Ph.D. (Mc.Graw-Hill Publishing Co., Ltd., Aldwych House, London, W.C.2). This book deals with the behaviour of electrons in electron devices of all types. The objective of the author has been to describe the physical phenomena that goes on within these devices and not those which take place externally. Circuits, therefore, are not discussed and in this respect we believe the book to be unique. In this, the second edition of the book, the author has added notes on the most recent developments in electronics, including electron optics and the electron multiplier.

The contents include:—theory of thermionic emission, cathodes, secondary emission, getters and clean-up, space charge, electron tube types including the cathode-ray tube, photo-electricity, photo-conductivity and the photo-voltaic effect.

The importance of the book to the radio engineer lies in the succinct and clear explanations of the phenomena found in valve practice. The average worker does not want to extract his information from a mass of theoretical matter, however relevant, but he does want to know exactly what the "shot effect" is and how it differs from the Schottky effect. These and all the other phenomena peculiar to thermionics are described in just the right manner. The author points out the importance of grid emission in thyratrons—a point which is seldom appreciated. The note on the Geiger Müller counter conveys an accurate idea of this photo-electric device and the chapter on photovoltaic (photronic) cells is of interest in view of the increasing use of these units in measuring instruments. The book contains many references to literature dealing specifically with the items discussed and forms a valuable guide in this respect. In all it contains 234 pages; it is well illustrated and can be recommended. The price is 18s.

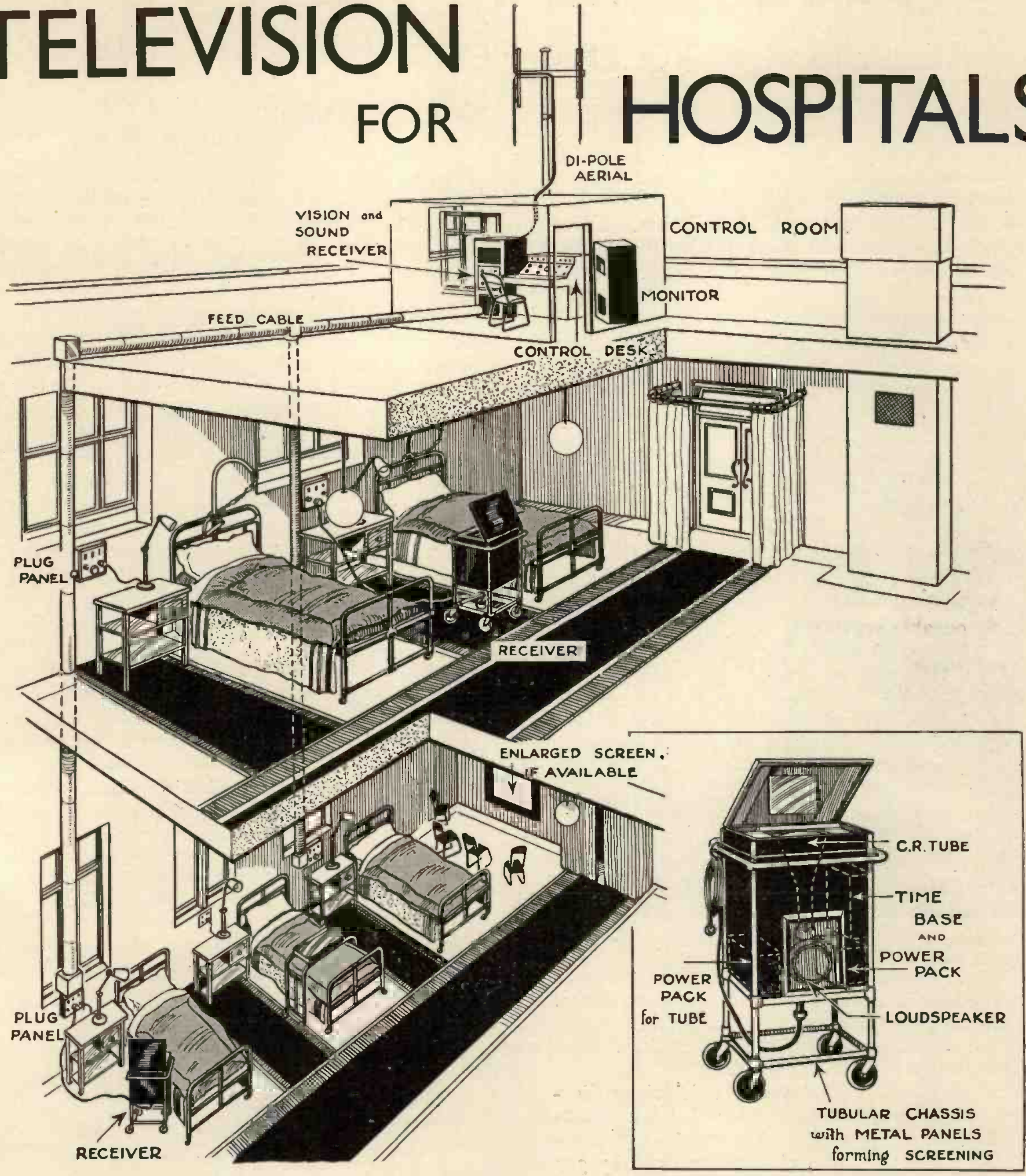
Television Lecture-Demonstrations.

Commencing on April 14, at 8 p.m., Mr. H. J. Barton-Chapple, B.Sc. (Hons., Lond.), A.C.G.I., D.I.C., A.M.I.E.E., will give the first of six lecture-demonstrations on television. The fee for the complete course is 5s., and the lecturer will cover such features as scanning methods, practical transmitting equipment, ultra-short waves, channels and filters, light modulation methods, synchronising, television receivers, installation problems, and many other points.

This course will be of interest to constructors, experimenters, and radio dealers interested in the installation and maintenance of modern television receivers.

Lectures are to be given at the Norwood Technical Institute, Knight's Hill, West Norwood, S.E.27, on April 14, 21, 28, and May 5, 19, and 26. Full details can be obtained from the Secretary, J. C. Anderson, at the above address.

TELEVISION FOR HOSPITALS



TELEVISION would appear to be an ideal form of entertainment to provide in Hospitals and the General Electric Company has already received many inquiries regarding the possibility of relay systems of television throughout a building from one central receiver.

In the case of radio installations in hospitals, one receiver is provided with relay lines to earphones at the patients' bedsides or, in some cases, (in convalescent wards) to a loud-speaker.

"Television distribution from a central point to a number of screens is quite feasible," said a G.E.C. technical expert. "It would be quite possible for a large hospital to have one screen in each ward operated from a central point. It would be necessary, however, to have a cathode-ray tube and loudspeaker for each reception point and a special mains unit to supply the necessary voltage.

"The only objection so far to the scheme is one of cost, but with the increasing demand for television it is likely that the price will shortly be within the reach of most big hospitals. Experimental work on this development is already being carried out in our laboratories

In the picture above our artist has depicted a scheme which would appear to be practicable. Owing to the size of the picture it would only be possible for one or two patients to view at the same time and on this account he has suggested a receiver mounted on a trolley which could be plugged in to points at the side of each bed. Actually this receiver would only contain the tube, time bases and power packs, the actual wireless receiver being in a central position and connected to each bedside point by means of a feeder.

PHILCO (U.S.A.) TELEVISION

RESULTS OF RECENT TESTS ON 441 LINES

BY OUR AMERICAN CORRESPONDENT

A SINGLE set of television standards for the U.S.A. has been proposed by the Television Committee of the Radio Manufacturers' Association. These standards have been endorsed by the active workers in the field of cathode-ray television, who have altered,

The Philco camera tube. P. J. Konkle, Philco television engineer, about to place the tube in the camera.

or are altering their equipment to conform to them. Among other things these standards specify an increase in the number of picture scanning lines to 441. The highest previously used was 345 lines.

Six months ago the Philco Radio and Television Corporation, at the close of a series of field tests in Philadelphia, invited the Press to witness a television demonstration at Rydal, when radio pictures scanned by 345 lines were shown. Their steadiness and clearness were commented on favourably. On this occasion it was announced that the transmitting and receiving equipment would be dismantled and rebuilt to operate as a 441-line system as recommended by the Television Committee.

First Broadcast of 441 Lines

Philco's improved 441-line system has been on the air for broadcast experiments since last December. During the first few weeks of these experiments, while initial adjustments were being carried out, picture quality steadily increased. It has now reached that stage of excellence where the effects of higher picture resolution are plainly evident to the observer. This is the system which was recently demonstrated. From the Philco visual broadcasting station, W3XE, a television programme was transmitted to invited guests gathered at the Germantown Cricket Club. A 6-megacycle radio channel was employed and the Philco engineers attribute part of their success to this wide channel.

The increase from 345 lines to 441 lines represents about a 30 per cent. increase in definition which possibly would not be noticed by the casual observer unless he was given an opportunity to compare the two pictures side by side. A test of this nature was arranged by the engineers as a part of the demonstration. By means of an electrical network, which could be switched in and out of the circuit at the transmitter, the resolution could be reduced (in one direction) so as to simulate that ordinarily secured with a 345-line system. Then, by a throw of the switch, the system could be quickly converted to 441 lines with maximum detail. The effect of thus increasing the definition was surprising. It was especially so when looking at objects on which there was small lettering, for instance, the serial number on a one dollar bill, or the second hand of a watch.

The higher definition produced a smoother, more pleasing picture, in which the line formation was not visible from the ordinary viewing distance.

A simple test chart was devised and used by the Philco engineers for this demonstration. It consisted of placing before the television camera a card on which was attached a one dollar bill, laid lengthwise. This was flanked on either end by similar bills, placed vertically, so that the width of the test chart was about 11½ ins. This area was completely scanned so that the three one dollar bills just filled the viewing frame from

A television fashion parade. Jeri La Porte shows the newest thing in bathing costumes at the Philco demonstration.

side to side. The test consisted of being able to read the serial number on the central bill and to make this legible it was found that a definition of 441 lines was necessary.

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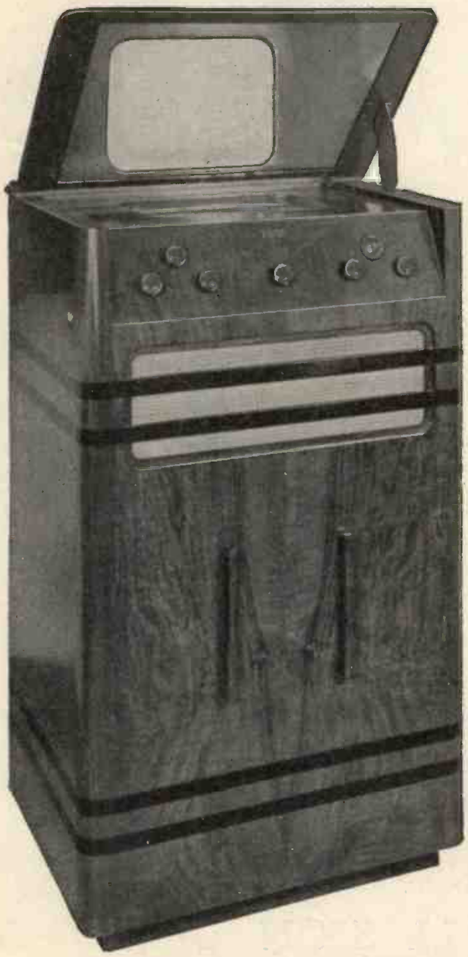

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TRANSFORMERS FOR TELEVISION SCANNING

By G. A. V. Sowter, B.Sc. (Eng.), Lond., A.M.I.E.E.

In view of the increasing use of magnetic deflection methods this article on the simple theory and practical design of transformers for handling saw-tooth waveforms is of particular interest.

RECENT articles in this Journal have clearly explained and illustrated the principles of television scanning whereby the electron beam traces out a luminous picture on the fluorescent screen of the cathode-ray tube. Whatever system of scanning is employed it invariably necessitates the control of current or voltage changing very rapidly in a particular manner with respect to time and it is proposed here to consider what must be taken into account when designing equipment handling these waveforms.

We are familiar with the normal sinusoidal waveform of the commercial A.C. supply mains, illustrated in Fig. 1, which represents, say, the variation with time of the current which passes through an ordinary electric lamp. The waveform of the voltage employed for scanning purposes in television is, in its *ideal* state, that indicated in Fig. 2 where it is seen that the voltage rises uniformly from nothing at A to a maximum value at B and falls instantly to nothing at C. This process is repeated again and again until a complete raster is evolved so that it is in effect a recurring waveform. For the Marconi-E.M.I. system of transmission the saw-tooth wave is produced approximately 10,000 times per second. This frequency will be referred to as the fundamental frequency.

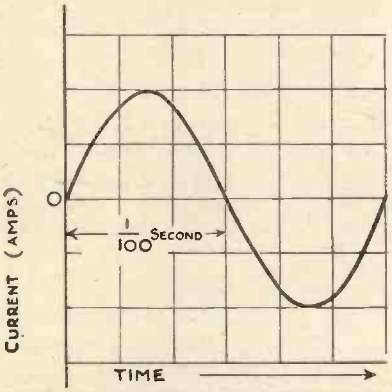


Fig. 1. Waveform of current passing through electric lamp.

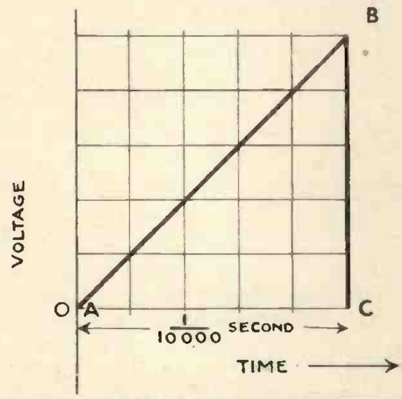


Fig. 2. Ideal waveform for television scanning.

Now it has been shown mathematically* that a single pulse of a saw-tooth waveform can be represented by an expression known as a Fourier's Series and in fact, the following denotes the voltage wave of Fig. 2.

$$y = 2(\sin x - \tfrac{1}{2}\sin 2x + \tfrac{1}{3}\sin 3x - \tfrac{1}{4}\sin 4x + \ldots\ldots\ldots\ldots)$$

The average reader will probably have decided that although this may satisfy the mathematician some further explanation of its significance is desirable. Actually the expression means that the saw-tooth waveform consists of the addition of a number of sinusoidal waveforms similar to that of the alternating current of Fig. 1,

*Fourier's Series and Spherical Harmonics, Byerly.

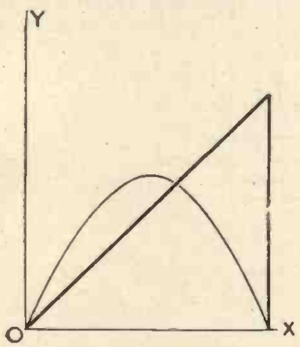


Fig. 3a. Saw-tooth wave and fundamental of Fourier's Series.

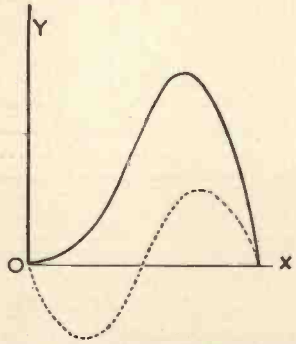


Fig. 3b. Curve resulting from addition of fundamental and second harmonic (double frequency component).

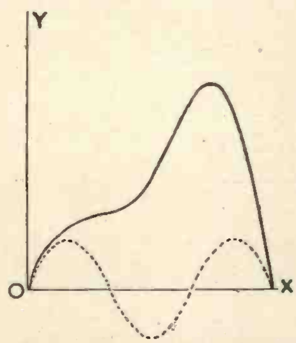


Fig. 3c. Waveform resulting from addition of third harmonic component to curve of Fig. 3b.

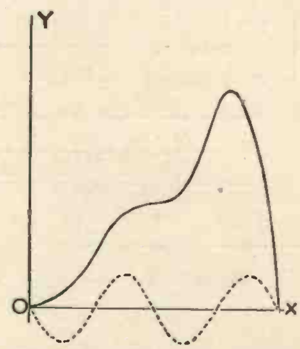


Fig. 3d. Waveform resulting from addition of fourth harmonic component to curve of Fig. 3c.

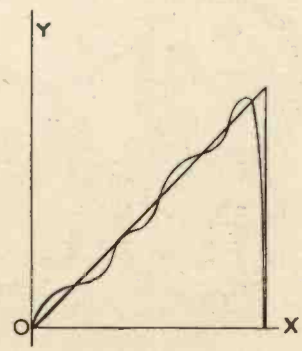


Fig. 3e. Waveform resulting when seven of the components of the series are taken into consideration. This tends to resemble the saw-tooth of Fig. 3a.

PRACTICAL DESIGN OF TRANSFORMERS

but having frequencies extending from the fundamental up to many times the frequency of the fundamental. In Fig. 3 is shown how the saw-tooth wave is produced by the addition of these various sinusoidal components.

It will be seen (Fig. 3) that if only the first and second

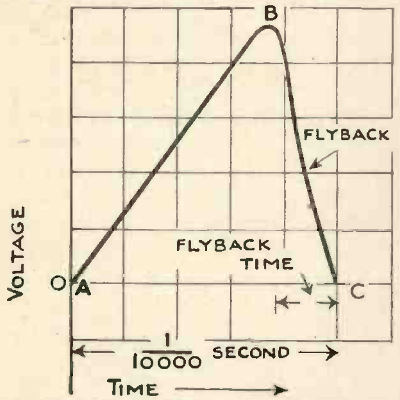


Fig. 4. Scanning waveform showing appreciable flyback time due to poor response of magnetic material of transformer at very high frequencies.

terms of the series are taken into account the thick line waveform bears but a small resemblance to the saw-tooth of Fig. 3a. When the third and fourth terms or harmonics are considered (Figs. 3c and d) the similarity becomes much more obvious and the down stroke

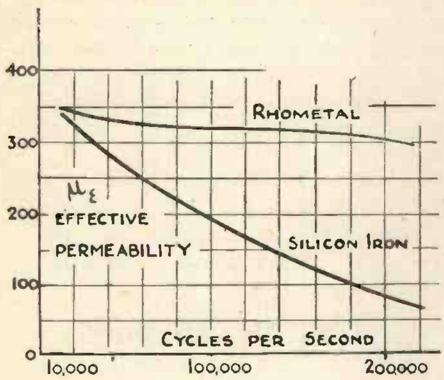


Fig. 5. Effective permeability with frequency for magnetic cores of television transformers.

much more perpendicular. In Fig. 3e the effect of including harmonics up to the seventh is illustrated and a fairly passable saw-tooth with small fly-back time results. Obviously then, as more and more harmonics are taken into account, so the waveform becomes more and more a true saw-tooth corresponding to Fig. 3a.

Although the foregoing remarks may appear to be highly theoretical they have important application in the design of transformers in television, particularly those handling currents to be carried by magnetic deflection coils or voltage transformers for electrostatic scanning.

In the case of an ordinary 50-cycle transformer the variations of the currents and voltages are more or less sinusoidal and of one frequency since the harmonics are generally unimportant and undesirable. On the other hand, it is obvious that a television transformer handling saw-tooth waveforms must carry a whole series of sinusoidal currents simultaneously and, furthermore, their frequencies will vary from, say, 10,000 cycles per second (the fundamental) up to 200,000 cycles per second (twenty times the fundamental). (Some designers are content to consider the 10th harmonic the highest one of importance.)

From the point of view of physical dimensions and reduction of winding capacity it is desirable to employ a core of magnetic material for such transformers and at the same time the output waveform must approach the ideal. In order to handle all these frequencies faithfully the magnetic material employed must not tend to lose its properties at the higher frequencies or the waveform will suffer, resulting in particular in an appreciable fly-back time (Fig. 4). To some extent magnetic penetration or skin effect will enter into the problem so that thickness of the magnetic material must be considered.

Undoubtedly a most useful alloy for this purpose is the well-known nickel iron Rhometal which has exceptionally high resistivity as well as reasonable magnetic properties. The main features of this alloy are summarised as follows:—

Electrical Resistivity (microhms per cm.³)	90
Permeability (initial)	250 to 2,000 (according to heat treatment)
Permeability (maximum)	1,200 to 5,000
Magnetising force for maximum permeability (oersteds)	0.8 to 3
Maximum flux density (gauss)	9,000
Specific gravity	8.1
Commercial thickness	down to 0.002 inch.

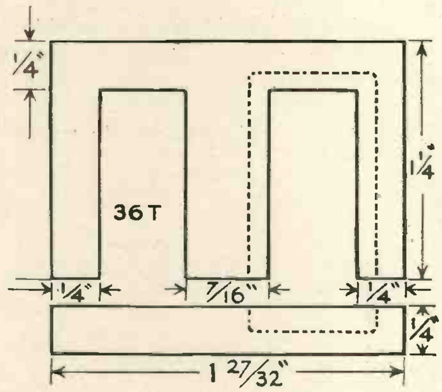


Fig. 6. Type of lamination used for experimental television transformer.

Scale: Full size.

In Fig. 5 is given a curve of the variation of per-

(*Continued on page* 213)

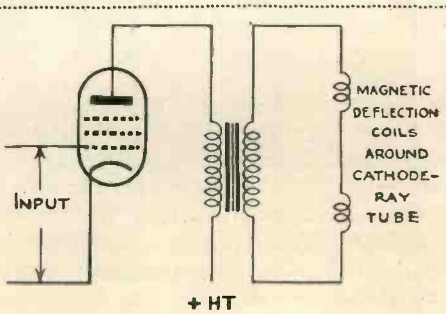


Fig. 7. Circuit of transformer, valve and deflector coils around cathode-ray tube.

Scannings and Reflections

TELEVISION AND THE HOME CONSTRUCTOR

FROM the number of letters which we have received from readers who have built the Guaranteed Cathode-ray Receiver described in our October, November and December, 1936, issues, it is abundantly clear that its construction has come well within the abilities of the average amateur who is conversant with the ordinary procedure of building a wireless set. In no case, so far as we are aware, has any real difficulty been encountered and we have received a number of letters commenting upon the excellent results that are being obtained. The actual work entailed in building this receiver is just as simple as building an ordinary wireless set and apart from the value of the finished instrument it provides an insight into television receiver construction which could not be obtained so easily in any other way. To dealers and service men who contemplate taking up the sale and servicing of television receivers this is a point which is well worth bearing in mind, for the experience gained will be a valuable asset in the future.

REAL LONG-DISTANCE TELEVISION

According to the *Sunday Graphic* radio correspondent, the Alexandra Palace vision transmissions have been received and a picture seen in New York. The statement says that "an expert of the National Broadcasting Company of America was the man who 'saw' London 3,000 miles away. This was on February 23, and the B.B.C. has received the news officially." Even though this report be true it by no means follows that transatlantic television will become a possibility in the near future, though it should be noted that the officially stated service range of the Palace transmissions (25 miles) is a very conservative one. The reliable limit at present under suitable conditions appears to be about 60 miles, though in certain instances even this has been exceeded.

INCREASED TRANSMITTING TIME

It is practically certain that the immediate future will see an extension of transmitting time. This question is now under consideration, and it is probable that at first there will be an increase of one hour each day. It is generally conceded that the one-hour sessions are sufficiently long, so the additional hour will therefore form another session, probably in the early evening. One advantage of an early evening transmission would be that dealers could demonstrate receivers to prospective customers who cannot well make it convenient to attend the afternoon demonstrations.

DEVELOPMENTS IN FRANCE

The French Government are about to institute a series of comparative tests of different television systems with the object of deciding upon the most suitable and determining an actual standard. These tests are to be made through the intermediary of the present Eiffel Tower station and it is expected that a decision will be reached about July or August of the present year. The desirability of transmitting the accompanying sound on short waves, instead of on medium as is done with the present Eiffel Tower transmissions, has been urged and that the standard adopted should be for a period of two to three years.

THE TELEVISION SOCIETY AND RESEARCH

Projects are now under discussion by the Council of the Television Society which it is hoped will result in the acquisition of premises centrally situated in London, which will form a research centre. It will then be possible to provide members with a reference library and facilities for experimental work, and in addition a demonstration receiver. It is hoped that this scheme will be possible at an early date.

Membership of the Society improved during 1936, the active membership being 354, against 354 at the end of December, 1935.

TELEVISION IN AUSTRALIA

It is reported that some Australian theatrical interests have acquired the licence rights of a German television system and intend to inaugurate a service. A privately-owned low-definition system has been experimented with during the past year or so in Australia.

SCREEN STAR AT DON LEE DEMONSTRATION

The popular screen star, Robert Montgomery, and Mrs. Montgomery were among the party of picture notables to attend a recent demonstration of television as developed by the Don Lee Broadcasting System in Los Angeles, U.S.A. Film images were broadcast from W6XAO, sound from KHJ, the two being synchronised at the receiver.

Mr. Montgomery evinced deep interest in the system employed and inquired as to the lighting and technique of making motion pictures for television purposes. "I am surprised at the results," commented the well-known star. "The present exhibition is a great advance."

NEW BRITISH CALL SIGNS

For the past few weeks a few of the GM British call signs have been heard on the air and these have caused a little confusion amongst foreign listeners who are not aware of the identity of these stations. At the request of the Radio Society of Great Britain, the Post Office have allocated to all Scottish stations the prefix of GM followed by a number and two letters. This brings Scotland into line with Northern Ireland, which has the prefix of GI. Foreign listeners should note that in future any station with the call sign of G, GM or GI is situated within the British Isles. EI is still retained by the Irish Free State; so far, no special call sign has been allocated to Wales.

RUSSIAN TELEVISION CONFERENCE

The first conference regarding the future development of television in Russia took place at Moscow on

MORE SCANNINGS . . . . . .

January 19. It has been decided to institute the first service in that city and equipment for this has already been ordered from the United States, which is expected to be delivered in April. Another station is to be provided in Leningrad and equipment for this is being made in Soviet factories. It is also planned to build a third transmitter in Kiev. Arrangements are being made in Moscow to transmit from the sports stadiums and the public squares.

BROADCASTING TELEVISION SOUND

The suitability of certain material of the television programmes for ordinary sound broadcasts is not being overlooked by the B.B.C. and the first transmission of this nature will be made on April 7. Obviously not all television programmes could be used in this way, but in many cases it is practicable to design them so that the sound transmission is suitable for the National and Regional listeners and, presumably, an economy will be effected.

BROADCASTING ON 9 METRES

Although it was considered that 13 metres was the lowest limit on which commercial broadcasters could radiate reliable programmes over a large area, the tests by the Milwaukee, Wisconcin 9-metre station have proved the contrary. This station is radiating the N.B.C. medium-wave programme and when conditions are so bad that the normal 13-, 16- and 19-metre stations are unreceivable, this 9-metre transmitter is receivable in England at great strength.

The 13-metre commercial stations are generally unreceivable after dark, but so far, Milwaukee, W9XAZ, is a steady and reliable signal at all times of the day.

REHEARSALS AT A.P.

Rehearsals of the television programmes are conducted upon almost identically the same lines as the actual transmissions. The flood lights are on and the cameras in operation, the results being observed in the monitor receivers, in fact, the only difference is that the transmitter is operated on a closed circuit so that it is not actually on the air. Apart from actual rehearsals of the artists a good deal of experimental work is carried out at all times with such matters as lighting, super-imposition, etc.

TELEVISION INQUIRY BUREAU

The reduction in prices of television receivers has aroused a great deal of public interest and, as a result, the G.E.C. has opened an information bureau at Magnet House, Kingsway, where any questions relating to television are answered either personally or by letter.

" Since the reduction in the price of television receivers, inquiries from both the trade and the public have increased," said Mr. D. Murdoch, who is in charge of the bureau. "The most frequent inquiries are from the public to know if they are in the reception area. From our experience of installing sets up to fifty miles of Alexandra Palace, we are able to give them detailed information."

" We have discovered, rather surprisingly, that many misapprehensions about television still exist. A lady rang up recently to ask what size of screen it was necessary to have in the drawing room; another inquirer thought that television provided still pictures like a magic lantern.

" We have also received many inquiries on transmission from the trade, which are dealt with by the technical staff."

Mr. Murdoch also said that the use of only one system of transmission had made the selling of television receivers an easier task. Formerly, when two systems were used in alternative weeks, the prospective buyer had to pay two visits in order to see the set working with both methods. Now one visit was sufficient.

MINE HOST AND TELEVISION

Among recent purchasers of television receivers are large numbers of owners of licensed premises who are finding them a profitable attraction. It is stated that this class are at present the largest purchasers and that the number of receivers in public houses now exceeds those in the large departmental stores.

REFLECTING ULTRA-HIGH FREQUENCY WAVES

Mr. Watson Watt, of the National Physical Laboratory, claims to have proved the existence of a third ionised layer only a few miles above the earth's surface. The reception of ultra-short wave signals in Cape Town and America is claimed to be due to the fact that these short wavelengths are being reflected by this newly-discovered layer.

No data is available as to the reliability of the reflected waves, or approximately where the ultra-short wave signals are likely to be received, but reports have come to hand which indicate that reception of 5- and 7-metre signals in distant parts of the world is quite possible and that there is no need further to foster the idea that these wavelengths are quasi-optical.

INTERNATIONAL VALVES

The introduction of a range of 6.3-volt heater valves with octal bases by the General Electric and Marconi Companies is considered as long overdue by most amateurs. Apparently, it is intended that these valves be interchangeable with American valves in the octal glass ranges.

A complete range has been introduced, all of which have a medium slope, so allowing for generous inter-electrode clearances, giving increased reliability and consistency. Owing to the 6.3-volt heaters these valves are suitable for use in A.C., D.C., A.C./D.C. and car radio receivers, for the low current makes them suitable for series heater running.

Apart from self-locating octal bases so that all valves use the same 8-pin valve-holder, there are several valves of interesting types. A double diode with separate cathode connections is ideal for noise suppression and A.V.C. circuits, while constructors will now be able to build high output amplifiers with low voltage by using the N66 tetrode, which uses the aligned grid technique generally known as " Beam " valve.

One effect of these new valves is that domestic receivers may all be rated to give 8 watts output for one of these " Beam " valves in a standard circuit with 250 volts H.T. is so rated.

O.B. TELEVISION

Arrangements for televising the Coronation procession are going ahead and a start has already been made with the laying of the co-axial cable, which will bring the television signals from various points of the route to Broadcasting House from where they will be sent over the existing cable to the Alexandra Palace. The first intention is that the cable shall tap various points in the Piccadilly and Westminster dis-

. . . . AND MORE REFLECTIONS

tricts and that later it shall embrace the whole of the West End. The Regent Street section is now in process of being laid. As with the London-Birmingham cable this is not intended entirely for television, but it is expected that it will be possible to use it for this purpose and enable various centres of entertainment in the West End to be tapped.

Work is also being pushed on with the outside transmitting equipment, and when this is ready it should do much to extend the scope of the programmes. The complete equipment will be contained in three vans —one for the transmitter, another for the scanning gear, and the third for power supplies, and, of course, it will be necessary for these to work in conjunction with each other.

A POST OFFICE TELEVISION TRANSMITTER

In order to test the coaxial cables which the Post Office authorities have laid, or are laying, a television film transmitter has been ordered. The first of these cables was laid between London and Birmingham and extensions of this are now being made to Leeds and Newcastle-on-Tyne. The transmitter, which has been ordered will be capable of a much higher definition than the standard employed at the Alexandra Palace; as a matter of fact, it is intended to nearly double that. It appears within the bounds of possibility that initial experiments will be conducted for the installation of a visual telephone system between certain centres.

ANOTHER COAXIAL CABLE

Most of our readers know of the existence of a special cable between Alexandra Palace and Broadcasting House specially laid for television. Well, now a second cable is being laid, this time by Messrs. Siemens, according to the name on the large drums, while the words Television Cable also appears. This second cable is, by the way, designed by the E.M.I. group and is, we understand, " the goods."

ON A SHORT-WAVE

Listeners were surprised to hear a string orchestra recently from a B.B.C. station between 9 and 10 in the morning, while a short-wave experimenter heard the same music from the Palace sound transmitter. This is not the first time the normal Regional transmitter and the short-wave sound transmitter at the Palace have radiated the same programme. We fancy it is the beginning of a short-wave Regional scheme, which has two major advantages at least—high fidelity and not easily jammed by a hostile power in time of war.

LIGHTS OUT

During one evening transmission the announcer apologised for an interval owing to all the lights failing in the dressing rooms, etc. The situation was made even more difficult, we understand, as the artists about to go on did not understand English. Failure of lights reminds us that at Broadcasting House there is an emergency supply always available from a large storage battery; also, there is a standby generating plant, should the mains fail. No such provision has been made at the Palace. Mains supply are getting so reliable that the tendency of the B.B.C. is to do away with local generators and new stations are tending to be " all mains."

"Transformers for Television Scanning"

(*Continued from page* 210)

In Fig. 5 is given a curve of the variation of permeability of this alloy with frequency up to 200,000 cycles and it will be noted that there is only a slight reduction over this range. A silicon iron sample tested having similar initial permeability at low frequencies shows very poor properties at 200,000 cycles, its permeability there being less than 100. The Rhometal curve given applies to very thin tape which is rather expensive, but in commercial television receivers laminations are generally employed having a thickness of 0.008 in. To prevent misapprehension and assist designers, the effective permeability in the above curve is given by the formula:—

$$\mu = \frac{Ll \times 10^9}{4\pi N^2 A}$$

where μ = effective permeability
L = inductance of wound sample in henries.
N = turns.
A = mean sectional area of sample. cm.^{2}.
l = mean magnetic path of sample. cm.

Example of Design.

In one case a transformer having a primary inductance of 0.8 henry was desired for a particuluar receiver and laminations of the type illustrated in Fig. .6 in Rhometal 0.008 in. thick were selected. A core consisting of 54 such laminations has a mean sectional area of 1.3 cm.^{2} and a magnetic length, indicated by dotted line in Fig. 6, of 9.8 cms. The effective permeability was assumed to be 1,000 and the primary turns were derived as follows:—

$$N^2 = \frac{Ll \times 10^9}{4\pi A\mu} = \frac{0.8 \times 9.8 \times 10^9}{4\pi \times 1.3 \times 10^3} = 4.8 \times 10^5$$

whence N (primary turns) = 690.

These turns were wound honeycomb fashion and the transformer fitted with a suitable secondary similarly wound. The laminations had previously been spray-varnished with a very thin coating to prevent eddy currents, although sometimes the usual oxide coating is considered adequate.

Where low impedance magnetic deflection coils are employed the question of coil capacity and honeycomb winding is much less acute. On a practical test this transformer proved quite effective and much superior to another with a silicon iron core and suitable windings. The circuit incorporating the transformer is given in Fig. 7.

It might here be mentioned that by varying the heat treatment of the Rhometal it is possible to obtain (at low frequencies) values of initial permeability which vary from about 250 to 2,000. In general the least variation of permeability with frequency occurs with the samples treated for low permeability, but television receiver designers have to consider costing economics and a high permeability treatment is normally specified. On test, transformers with Rhometal cores prove to have a fly-back time several micro seconds better than those employing the more common magnetic alloys and obviously this must tend towards the improvement of definition of television reception.

PROGRAMME IDEAS AND CRITICISM

In our February and March issues we asked for criticism of and suggestions for improving the television programmes. We have to confess that, while the letters we have received are interesting, our correspondents have failed as a body to put forward many ideas that are really helpful at the present time, the amount of constructive criticism being relatively small. The letter which in our opinion contains the most useful suggestions is the one printed on this page and a cheque for two guineas has been sent to the writer.

THE IDEAL PROGRAMME

Television, so far as the B.B.C. is concerned, can only be successful if it brings into the home entertainment and instruction which cannot be obtained, or only with difficulty obtained, in any other way.

There would seem to be a wealth of suitable material and some striking successes have already been put over. Choice is, however, severely limited by technical considerations, the chief of which is the small size of the viewing screen.

Generally speaking, the most successful items in the past have been those which could be presented as "close-ups" or in which a great deal of detail is not necessary for enjoyment. Amongst the latter may be cited scenes from plays, duologues, double or single dancing acts, most juggling acts and feats of bodily dexterity. It has been noticeable that Mr. Seth-Smith has been most successful when he has shown the larger animals. It may also be pointed out that the close-up or semi-close-up may be exploited to the detriment of the performance. The very beautiful balancing act of Marion and Irma is a case in point. In its last presentation it was badly spoiled because for the greater part of the time only portions of the two contortionists could be seen. In such acts it must be the whole picture or nothing.

The construction of an ideal programme is a difficult matter since each individual has his own ideas and the B.B.C. must cater for everybody. Personally, I should like to be assured of scenes from a current play at least once a week, scenes from Shakespeare's plays at least twice a month, half an hour of variety four times a week and not less than four topical or instructional lectures or demonstrations each week.

INSTRUCTIONAL

With regard to instructional matter, the programme staff has not so far been very successful. The choice of topics has been good, but the technical equipment available both in the studio and in the home is not yet equal to the showing of pictures, diagrams and very small objects. Again we are confronted with the problem of deciding how much detail is required for intelligibility and how much can be sent. This can only be determined by experiment and, obviously, adverse criticism must not be made on purely experimental items.

REPETITIONS

The repetition of programmes in the past has been due to the lack of space and time for rehearsal due primarily to the necessity for working with two entirely separate transmitting systems. Now that one system has been decided upon repetition should be reduced to the bare minimum. It does not affect the casual viewer, but it is irritating to those who have installed receiving apparatus. Doubtless, repetition will be necessary for some time to come and I suggest that if the programmes are extended to three hours a day, the items from the first hour could very well be duplicated in the other two, but that the two later hours should be as different as possible from one another.

The present programme lasts from 9.00 to 10.00, occupies a very suitable hour, and in view of the extension of daylight with summer time, it could well be made the main programme of the day. The first programme could be either in the morning or the afternoon, but it would seem to be well if there was also a transmission between 6.00 and 7.00 or 6.30 and 7.30 p.m.

DURATION

With regard to the duration of transmission, one hour seems to be long enough for a sitting. The length of time of individual items depends, of course, on their interest, but, generally speaking, no single item should occupy more than a quarter of an hour. Instrumental soloists and vocalists go down better if they do not present more than one item at a time.

Films, in my opinion, are not generally suitable for television reception. Usually, they contain far too much detail for enjoyment on the small screen and they challenge comparison with the cinema theatre, which is most undesirable. The repetition of films day after day throughout the week is boring and irritating. The news-reels are below B.B.C. standards of presentation and should be discontinued.

The question of news is a difficult one. Obviously, news pictures should form part of the television programme and they must, of course, be film shots. I suggest that the presentation of news be confined to matters of real interest and importance and chiefly to things happening in this country. The outside broadcast vans will help when they are ready.

Bearing in mind that every hour's work at the Alexandra Palace is an experiment and that it is impossible to tell the result of any item until it has gone out, the Alexandra Palace staff is to be congratulated. We shall probably never know the full history of the hectic hours of apprehension that have been passed by the programme and technical staffs during the last few months. It is obvious that Mr. Cock is aiming at the intimate item and along that line success is likely to be obtained.

E. H. Robinson (Pirbright).

More Programme Suggestions

ENTERTAINMENT THAT THE CINEMA DOES NOT GIVE

Sir,

I look at the television programmes in the same way that I regard the sound broadcasting—an entertainment to be enjoyed occasionally with due regard for what one wishes to see and hear.

When a child has a new toy he plays with it continually until he wearies from a surfeit, and I think that lookers are in danger of falling into the same error. One cannot switch on a television set day in and day out and expect to be always entertained by something new. Once the novelty has worn off the programmes will be considered in their true perspective and we shall choose our visual entertainment like we choose the film that we go to see at the cinema.

You state that it is useless to draw a comparison between the cinema and television, but how can we do otherwise? It is familiar to all of us and represents a known standard of achievement. We can only compare television with what we already know in a similar form and it is inevitable that to the lay mind the living picture suffers in comparison because it is unable to differentiate between the real thing and the photographed record.

In the writer's experience it is the most difficult thing in the world to convince an audience that they are looking at an actual scene happening in front of their eyes, so deeply is the cinema instinct ingrained in the average looker.

This being so, the B.B.C. should accept the inevitable and attempt to give entertainment and instruction of a kind that the cinema does not give or does not think it worth while giving.

EDUCATIONAL

On the entertainment side Mr. Cock has laid his plans and they cannot be well improved, subject to the limitations of time, money and personnel. On the educational side the television programme can be the means of bringing hundreds of novel features to the public. Every week in London dozens of popular and scientific lectures are being given. Let the B.B.C. reproduce them, experiments and all, and let us hear and see Sir William Bragg and Sir Oliver Lodge expounding their classical theories. How much more fascinating would Sir Walford Davies be if we could see a close-up of his hands as he picked out melodies :

To many people the museums are closed at the only time when they are at liberty to enjoy them. Take viewers round a small part of one of the famous collections —surely the museum authorities would allow their priceless exhibits to be out of their charge for one or two hours?

What about a series of "How it works," on the lines of the book that delighted our schooldays. We have not lost our interest in things mechanical and here is a chance to have them explained by men who have spent their time developing them.

There is little point in pursuing this idea in further detail—Mr. Cock has shown how willing he is to adopt suggestions, and if the above have given him a faint clue to a means of adding to our entertainment and education, the writer will feel flattered.

To other lookers—don't crab the efforts of the B.B.C. too much. It is so easy to be hypercritical at this stage, and if television had been first on the scene, think how the cinema would be despised as a poor imitation of the real thing.

C. Mack (London, N.21).

THE CINEMA COMPARISON

Sir,

While generally admitted that television production must develop its own technique, it is not possible to avoid comparison with the cinema any more than early broadcasting escaped in this way from the gramophone; that broadcasting quickly equalled and to-day is substantially better than recorded sound is a helpful augury for the future of television. In any case, the public will not follow a new idea unless it can be, in its early stages, related to some older experience; that is a hard fact all pioneers have to face.

The successful artist will soon have learnt that his appeal must be to the individual viewer—the man in the armchair comfort of his home; the pianist, figuratively, will be playing in a drawing room to his friends and not to a concert hall audience, and as symbolised by the announcer's simple, "Thank you." Unfortunately, ordinary broadcasting has led us to appreciate music as such and to forget the mechanical production of sound. To the engineer a view of the control instruments might conceivably give as much pleasure as the picture of a row of violinists. We have, in fact, become more in sympathy with the composer than the virtuoso; however, we can even at this stage, enjoy the picture of a man extracting music from an ordinary rubber balloon; the viewer has to develop his capacity to be entertained no less than the authority who attempts to amuse him. A new medium demands a new outlook, perhaps extending eventually to the derivation of pleasure from some abstract presentation of geometric forms and changing patterns. One must remember what the Chinaman thought of Wagner and what we think of "native" music. Shall we have patience to learn?—I wonder.

When it comes to picturisation of *events*—which classification applies to public performances of music or drama—we are on safer ground and have little to teach the news reel; at the moment a film is for most purposes as useful as the original, *except* the sound portion. Skilled commentators at the studio could, perhaps, replace the sound track. I am sure no one will hold a brief for the second reproduction of news reel "music."

Gerald Sayers (Ware).

A FILM LIBRARY

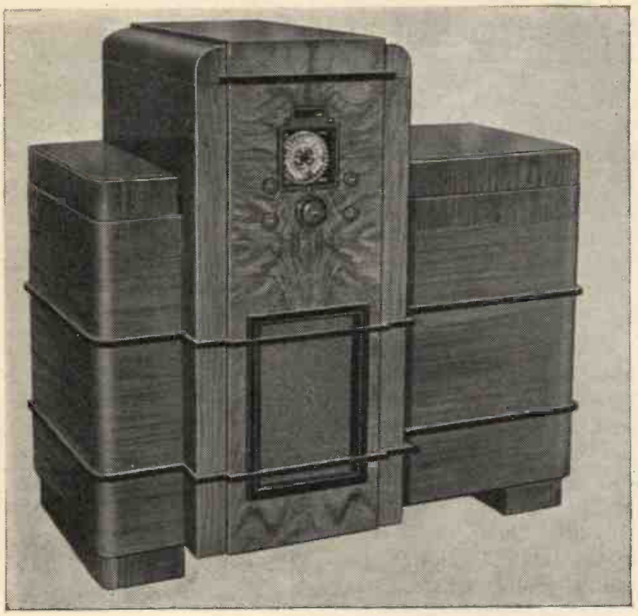
Sir,

Every year outstanding pictures are produced. After a time these pictures are of no further value to the industry.

If the B.B.C. could acquire the master negatives of such films, they would in time have a very valuable collection of film masterpieces.

C. Grossmith (London, S.W.).

If space permits we hope to publish next month some further letters which have been received.—Ed.



PYE TELECEIVERS

A technical description of the Pye range of television receivers, comprising Model 4042 television and medium and long wave sound; model 4043, television and all-wave radiogram; and model 4044, television and all-wave console.

This is a photograph of the Model 4043 television and all-wave radiogram.

PYE RADIO, LTD., have produced three types of television receiver which differ only as regards cabinet arrangements and the sound channels. An all-wave sound channel is standard to two of the models and covers the four broadcast wavebands in addition to the 7-metre sound transmission. Of these two models, one is a radiogram fitted with automatic record changer. The third model has a sound channel covering the medium and long waves only. The model numbers are 4042 for the console Teleceiver with medium- and long-wave sound channel, 4043 for all-wave radiogram model and 4044 for the all-wave console Teleceiver.

In each case four units are employed for the reception of the television programmes:—(1) Vision receiver, (2) double time base and separator stage, (3) power pack and cathode-ray tube unit, (4) 7-metre sound receiver.

The vision receiver is a super-het and comprises a radio-frequency stage employing a TSP4 valve, followed by a frequency changer type AC/TH1 and four bandpass intermediate frequency amplifiers. These operate at a frequency of 7.5 mc. and consist of three TSP4 valves and a high efficiency power pentode valve N43; all stages have an approximate band width of 4 mc. The output from the N43 is fed to two D42 single diode valves working in a voltage-doubler circuit, which passes through a 2-mc. filter, the picture modulating voltage to the shield and first anode of the cathode-ray tube together with the D.C. component which controls the average brightness of the picture. The output from the two D42 valves is also taken to the synch. separator stages.

The Time Base and Synchronising Stages

This unit is divided into three sections (a) the line scan generator, (b) the frame scan generator, (c) the synchronising stage.

The line scan generator consists of three triode valves; two (an AC2/HL and a 41MXP) comprise a relaxation oscillator which gives a linear saw-tooth waveform at 10,000 c.p.s. These are followed by a further 41MXP valve as an amplifier to give the necessary 800 volts output to the deflector plates of the cathode-ray tube—electrostatic deflection being used.

The frame scan generator gives a linear saw tooth output, again of approximately 800 volts, at 50 frames per second. A T31 Thyratron is used, and this is followed by a Pen4vA valve which is choke fed to a magnetic yoke placed round the neck of the cathode-ray tube.

Two TSP4 high-frequency pentode valves and a single diode D42 valve are used in the synchronising stage to separate the synchronising pulses from the picture signal, and pass same to their respective time bases. The two TSP4 valves are fed in parallel from the output of the vision channel unit, and their operating characteristics are so adjusted that all picture signal or noise are eliminated and only the synchronising pulses fed to the time bases. The output from one TSP4 synchronises the line scan generator, whilst that from the other, in conjunction with the D42 diode valve, synchronises the frame scan generator.

The Power Pack and Cathode-ray Tube Unit

The power unit comprises the cathode-ray tube supply and control unit, and the high tension or filament supply to the double time base and synch. separator stages and the vision channel unit.

The power supply to the cathode-ray tube consists of an indirectly-heated half-wave rectifier which delivers after smoothing approximately 4,000 volts. The voltages for shield, first and second anodes are tapped off from a potentiometer strip across this supply; each is variable within limits. The filament voltage for the cathode-ray tube, which is indirectly heated, is adjusted by a small variable resistance to the 2 volts required.

Two indirectly-heated full-wave rectifiers, each connected as half-wave, supply 420 volts at 200 ma. to the time base and vision channel units. The heater supply for these two units is from a common L.T. winding on the same transformer.

An Ediswan 12H cathode-ray tube is used in a vertical position, the picture being viewed in a mirror set at an angle of 45°, and a black and white picture is obtained 10 ins. by 8 ins.

The 7-metre Sound Unit

An ultra-short wave super-het adaptor is used for the sound and this consists of an X41 frequency changer followed by two VP4B valves as band-pass I.F. amplifiers operating at 1.45 mc. and adjusted to give an approximate band width of 150 kc. The output from the second I.F. stage is fed to a double diode valve 2D4A, which in turn feeds the L.F.

(*Continued at foot of page 219*)

PHOTO-ELECTRIC EFFECTS

A COMPLETE SUMMARY OF THE MOST IMPORTANT DEVELOPMENTS — PART I. — PHOTO-CONDUCTIVITY

By G. Windred.

This article provides an exhaustive review of the literature on photo-electric effects. It is intended primarily as a guide to published knowledge of the subject and gives particular attention to points of special importance.

THE branch of electrical theory represented by the various photo-electric effects is one of the most recent and at the same time most important additions to science. It has given rise to the sound film and television industries, and thus has a very real practical importance.

As in the case of most other scientific developments, the major facts relating to photo-electricity and its associated phenomena have resulted from purely theoretical research, carried out for the furtherance of knowledge as distinct from industrial progress. The greater part of this research has taken place in university laboratories, where the combined efforts of a very large number of investigators have gradually built up the bulk of present-day knowledge of the subject.

Classification of Photo-electric Effects

It will be desirable firstly to classify the various phenomena which may be regarded as photo-electric. Strictly speaking, the term photo-electric should be applied only to the phenomenon dealing with the emission of electrons from a substance under the action of incident light. The German term for this action is *äusserer lichtelektrische effekt* (external photo-electric effect), which describes very well the nature of the effect, and distinguishes it from the *innerer lichtempfindliche effekt* (internal photosensitive effect) relating to the change of electrical resistance of a conductor with changes of incident light. This latter phenomenon is known as photo-conductivity, and differs entirely from photo-electricity.

Another phenomenon of this class is the Becquerel effect, which relates to the production of an e.m.f. in an electrolytic cell of special form when subjected to illumination. The practical use of this effect is at present very limted.

A further and more recent development is based upon the fact that a suitably arranged copper oxide rectifier can be made to produce a current when illuminated under suitable conditions. A modification of this arrangement, developed in Germany as the *Sperrschicht Photozelle* (Barrier-plane photo-cell) forms an important addition to the range of photosensitive devices which may be used for translating variations of illumination into variations of electric current.

Photo-conductivity

The photo-conductive effect is best shown by the element selenium, which was discovered by the famous chemist Jons Jakob Berzelius as an impurity in sulphuric acid in 1817* at Gripsholm, in Sweden. The substance derives its name from the Greek Σεληνη (the moon) on account of its affinities with tellurium (Latin, *tellus*, the earth) which had been discovered a short time previously. There are three different forms† of selenium, as follows:—

1. Amorphous (*i.e.*, having no definite chemical structure), vitreous, and colloidal (*i.e.*, uncrystallisable), soluble in carbon bisulphide. These alternative types differ in appearance, but belong to the same class, sometimes referred to as liquid selenium.

Typical example of photo-electric cells. Above is a gas-filled cell and on the right is the type used for "talkies."

2. Red crystalline, occurring in two distinct forms, and soluble in carbon bisulphide.

3. Metallic, the most important from the present viewpoint, insoluble in carbon bisulphide, electrically conducting and light-sensitive; the effect of increase of incident light being to increase its electrical conductivity (*i.e.*, reduce its resistance). The last effect is best shown when a granular crystalline structure has been imparted to the substance by treatment at high temperature for some time.

The photo-conductive effect was discovered accidentally in 1872 by Willoughby Smith and his assistant May in the course of experimental work on submarine cables at Valentia Island. In connection with this work some sticks of crystalline selenium were being used as resistances, and were left lying in the sun. It was noticed that their resistance changed considerably from time to time, and that these changes coincided with

* Schweigger's Journal, 23, pp. 309, 430; Pogg, Annal., 7, 1826, p. 242; *ibid.*, 8, 1826, p. 423.

† Saunders gives a bibliography of the subject in T. Phys. Chem., 4, 1900, p. 423.

THEORY OF PHOTO-CONDUCTIVITY

changes of sunlight intensity. The observation was reported* to the Society of Telegraph Engineers (now the Institution of Electrical Engineers) and naturally gave rise to a considerable amount of research on the subject. It is, however, only during recent years that the use of selenium as a photo-sensitive substance has been at all extensive in practice.

The principal properties of selenium are as follows:—

Atomic weight, 79.2.
Melting point, 220° C., approx.
Boiling point, 690° C., approx.
Specific heat (crystalline), 0.084.
(amorphous), 0.095.
Linear expansion (crystalline), 4.9×10^{-5}.
Specific resistance (crystalline), 70,000 ohms per cm. cube.

If the last figure be compared with the specific resistance of copper, 1.7×10^{-6} ohms, it will be noted that the resistance of crystalline selenium is some 4×10^{10}, *i.e.*, forty thousand million, times as great;

An Oxford photo-cell pecially designed for television.

showing that the currents obtained are minute in relation to ordinary electrical practice.

The practical possibilities of selenium were realised as long ago as 1876 by W. Siemens, who made the first definite experiments with selenium "cells." Similar cells were also developed by Sabine (1878), Bidwell (1880), Graham Bell (1880), Mercadier (1881), Fritts (1880), Righi (1888), Liesegang (1890), Minchin (1895), Ruhmer (1902), and others.†

One of the earliest and most interesting applications of selenium cells was in connection with astronomy, where the measurement of the small luminous intensities of stars is of considerable importance. At an early date d'Albe* measured the light from distant stars, and concluded that with the use of a telescope and an ordinary selenium cell it is possible to detect stars down to the seventeenth magnitude, which are quite invisible to the naked eye. Without a telescope, it is possible to detect stars of the ninth magnitude with a selenium cell, and only the sixth magnitude with the unaided eye. It will thus be seen that the selenium cell has proved to be a valuable adjunct to astronomical observation.

The appended bibliography will serve to indicate the scope of the more mundane applications of such devices.

From the time of the discovery of the light-sensitive property of selenium in 1872 numerous investigators have attempted to formulate a satisfactory theory. Up to the present, however, there is no single theory which adequately accounts for all the various phenomena associated with the photo-conductive effect.

One of the first attempts to formulate a theory was made by W. G. Adams,* who held the view that conduction in selenium was due to electrolytic causes. It was soon pointed out that selenium is not an electrolyte, but an element, so that the hypothesis seems untenable. Considerable discussion of the possibility of photo-conductivity being due to the formation of selenides is due to S. Bidwell*. There is considerable experimental evidence for this proposal, but no complete theory has been evolved from it.

Following these developments it was suggested by Himstedt* that the increase of conductivity with illumination might be indirectly due to the action of the light itself. The suggestion has been followed up by Davis,* Chabot† and Merritt,‡, but in this case also no definite theory has resulted.

At about the same time the electron theory of photo-conductivity was being developed by numerous investigators, including Berthier,* Pfund,† Vonwiller,‡, Richardson,§ Nicholson,** Spaeth,†† and many others. This must be regarded as one of the most important theories, and is probably more nearly true than any of the previous ones. According to the electron theory the incidence of light upon selenium liberates free electrons, which can be accelerated by the application of a potential difference and are thus made manifest in the form of a current stronger than that which would flow with the same difference of potential if no light acted on the selenium.

An ingenious theory was developed in 1918 by D. Reichinstein,* who suggested that owing to polarisation effects consequent upon the application of an e.m.f. to selenium, the apparent resistance is much larger than the true resistance, and varies in proportion to the applied voltage. While there is experimental

* Journ. Soc. Telegraph Eng., 2, 1873, p. 31; Nature, Feb. 20, 1873.

† A full discussion of the various types of selenium cell is contained in Ch. II of Barnard's book, "The Selenium Cell," which also gives an extensive bibliography.

* Illum. Eng., 10, 1917, p. 115.

† Proc. R. S., 23, 1875, p. 535; Phil. Mag., 1, 1876, p. 155; Phil. Trans. R. S., 167, 1877, p. 313.

‡ Proc. Phys. Soc., 7, 1885, p. 129; Phil. Mag. 40, 1895, p. 233.

§ Ann. der Phys., 4, 1901, p. 531.

** Nature, 70, 1904, p. 506.

†† Phys. Zeits., 5, 1904, pp. 103, 168, 517, 584; *ibid.*, 6, 1905, pp. 37, 619, 620.

‡‡ Phys. Rev., 25, 1907, p. 502; Electrician, 60, 1908, p. 715.

* C'Ecl. El., 38, 1904, 441.

† Phys. Rev., 28, 1909, 324; Phys. Zeits., 10, 1909, 340.

‡ Proc. R. S. (N.S.W.), 43, 1910, p. 361.

§ Phil. Mag., 23, 1912, p. 277.

** Phys. Rev., 2nd ser., 3, 1914, p. 1.

†† Zeits. fúr Phys. 8, 1922, p. 165.

‡‡ Zeits. wissen. Phot., 17, 1918, p. 16.

** Verh. d. deutsch. Phys. Gesell., 9, 1907, p. 165.

evidence of a back-e.m.f. due to polarisation, the theory requires that the photo-sensitivity should decrease with a reduction of applied voltage, and since Greinacher* has shown this to be contrary to experimental evidence, the theory cannot be regarded as satisfactory.

A theory which has found growing acceptance was published in 1913 by d'Albe. This theory is based on the corpuscular theory of light, which assumes that a beam of light consists of minute corpuscles, called photons, and may thus be regarded as having a discontinuous structure. When a beam of light falls upon selenium there is assumed to be an interaction between the incident photons and the selenium atoms which results in the liberation of electrons from these atoms. The subsequent behaviour of the electrons ejected in this manner will depend upon the electrical potential acting upon them, and will thus be determined by the applied potential difference. The increase of the number of free electrons in this manner will be manifest as an increase of conductivity. The ejection of electrons from their atoms will produce positively charged ions (*i.e.*, atoms with one or more electrons missing) which will represent a natural attraction for any free electrons, whose success in finding an ion will obviously depend upon the number of ions present.

Since the liberation of an electron by the incident light must also result in the production of an ion, it is evident that the rate of recombination of the electrons and ions will always be proportional to the square of the number of ions, so that if C is the incident light energy, and N the number of ions which it produces, the rate of change of conductivity, i.e., the rate of increase in the number of ions can be expressed by

$$dN/dt = C - kN^2 \quad \ldots\ldots\ldots\ldots \quad (1)$$

where k is a constant. Integrating this expression to find the number of ions produced (*i.e.*, the total change of conductivity) after time t, we have

$$N = \sqrt{C/k}\,\tanh\,(t\sqrt{C}) \quad \ldots\ldots\ldots\ldots \quad (2)$$

It will be noted that this expression is of the general form $N = KC^x$, for a given value of incident light energy, and since N represents the change of conductivity $G_1 - G_0$ between the illuminated and dark conditions respectively, we may write for the total change of conductivity,

$$G = G_1 - G_0 = KC^x \quad \ldots\ldots\ldots\ldots \quad (3)$$

in which K and x are constants of the material. A curve connecting G with log C will thus represent the general characteristic of a selenium detector.

After the lapse of sufficient time under illumination there will be a condition of stability, in which the rate of recombination of the ions is equal to the rate of their production. Under these conditions the differential in equation (1) is zero, and therefore $C = kN^2$, so that

$$N = \sqrt{C/k}, \text{ or}$$
$$N = k\sqrt{C} \quad \ldots\ldots\ldots\ldots \quad (4)$$

The foregoing considerations apply also to the condition of reduced or discontinued illumination. Since the rate of recombination of ions is proportional to the square of the number present, it follows that the process commences rapidly as soon as the light is removed, proceeding at a rapidly decreasing rate until all the disturbed electrons have returned to the ions, thus neutralising them, and restoring the conditions of dark-conductivity, corresponding to the normal number of free electrons.

(The section dealing with photo-electricity will be published next month.)

"Pye Teleceivers"

(Continued from page 216)

amplifier and output stage. The high tension and filament voltages for the 7-m. sound channel and broadcast receiver are obtained from a separate mains transformer and full-wave rectifier mounted on the 7-m. sound channel chassis.

The I.F. band width of 150 kc. prevents any loss of the sound transmission due to frequency drift of the oscillator, etc.

The operation of the "Teleceiver" is very simple. In the case of Model 4042, the wave-range switch on the right-hand side of the control panel is set at "T," whilst in Model 4043 the wave-range switch on the front is set at "Gram," and the master switch on the top panel is set at "Television," each receiver is now ready for the reception of the television programmes.

In both models the television picture controls are on the left-hand side, and are four in number. They control the line frequency, frame frequency, contrast (depth of picture), and brightness.

No tuning whatsoever is carried out by the operator of the "Teleceiver" on either vision or sound, all circuits are pre-set at the factory. The large bandwidths of the bandpass I.F. amplifiers of both vision and sound channels ensure that the receiver is always in tune. Only the volume and tone controls need be adjusted for the television "sound."

Subsidiary controls to the double time base and Synch. separate unit can be operated from the back of the receiver, but are pre-set.

The aerial equipment supplied with the "Teleceiver" consists of a quarter-wave rod fed to the receiver by a weather-proofed low-loss concentric feeder.

A Chance for Inventors

A correspondent is desirous of taking up the manufacture and sale of a multi-change multi-wave switch particularly for short-wave work. We shall be pleased to put any reader who has a design for a switch of this type which is not already on the market in touch with our correspondent with a view to negotiation.

American S.W. Publications

MOST useful American radio publications are obtainable through F. L. Postlethwaite, G5KA, 41 Kinfauns Road, Goodmayes, Ilford, Essex.

The Rand, McNally's radio map of the world, is now available. This map, measuring 30 ins. by 40 ins., is printed in six colours, showing 230 countries and 180 prefixes. Time in all parts of the world is shown, while great circle measurements in miles or kilometres can be accurately measured by better than 2 per cent. This map, costing 5s., is invaluable to all receiving and transmitting amateurs.

It is said that the most important part of a station is the aerial, and nowhere more than in America, is this point more fully appreciated. The "Radio" Antenna Handbook is the last word in up-to-date information on all types of aerials, and at 2s. 6d. is good value for money.

Hints and tips which are often of great assistance to constructing amateurs, are difficult to remember. The A.R.R.L., however, have gathered together several hundreds of little time-savers, and included them in a book entitled "Hints and Kinks." This is also available through 5KA for 2s. 6d.

THE TELEVISION ENGINEER

THE DESIGN OF VISION-FREQUENCY AMPLIFIERS—II

By P. NAGY, G.I.E.E., Research Dept., International Television Corporation Ltd.

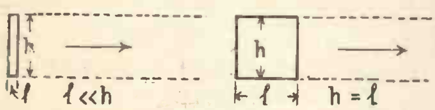
This article, the second of a short series, sums up the principles which govern the design of any picture frequency amplifier. High and low frequency correction is dealt with in detail. The correctness of the theoretical considerations has been proved by measurements in conjunction with several R.C. coupled photocell amplifiers, used for the amplification of signals generated by a television film transmitter. It was found that the push-pull resistance coupled amplifying stage has several advantages against other solutions.

THE determination of the highest frequency which is necessary for the perfect reproduction of a picture is a matter which is perhaps still open for discussion. The following is the usual way to arrive at a practical value. Consider the time T which is necessary for the scanning of a picture detail which is twice the length of the picture element, then the frequency $f_{max} = 1/T$. For instance, in the case of the Baird transmission with 25 frames per second, 240 lines, picture ratio 3/4 and with a square scanning spot

$$f_{max} = 25 . 240^2 . 4/3 . 1/2 = 960{,}000 \text{ cycles/sec.}$$

This frequency corresponds to a continuous change from black to white on the screen, i.e., an intensity change according to the sine law. (Fig. 10a). The size of the scanning spot will introduce considerable distortion of f_{max} at the transmitting and receiving end. The pattern of Fig. 10a becomes less defined and similar to Fig. 10b. This distortion is still more accentuated in the case of the pattern of Fig. 11a. Thus it will be apparent that only with a scanning element similar to a slit (Figs. 10a and 11a, $l \ll h$), with a corresponding f_{max} much higher than the above calculated value, could we reasonably approximate the pattern in Figs. 10a or 11a.

Original pattern, corresponding to two picture elements and showing an intensity change according to the sine law as required by fmax.



Scanning spot.

Light intensity change at the receiving end, corresponding to the original pattern.

Modulation of the electrical carrier.

Fig. 10a and 10b.—Showing the attenuation of fmax. caused by the finite size of the scanning spot.

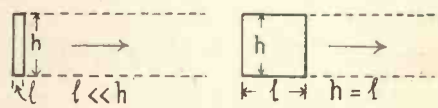
Due to this attenuation caused by the finite size of the scanning spot, practice shows that by reducing the value of the highest necessary frequency by approximately 10 per cent. there is little noticeable loss in picture detail. Or we can allow 30-degree phase shift at the calculated highest frequency. This allowance can be made apart from considerations with regard to picture size, viewing distance or resolution of the eye for picture details.

In a usual resistance-coupled amplifying stage as represented in Fig. 12a the higher frequencies are attenuated as a result of the loss-capacity C parallel to the actual load R, Fig. 12b. There are in principle two ways of correction: bias resistance and booster choke correction. The bias correction is effected by the decreasing impedance of the combination of bias resistance and bridging capacity as the frequency increases. This method actually causes a decrease of amplification at the lower frequencies.

The booster choke correction is effected by an inductance L in series with the anode load R (Fig. 13). This inductance will increase the anode load at high frequencies, thus the stage gain is much higher than in the case of the bias resistance correction. There are also other considerations which make the choice simple in favour of the latter—the simplicity of the calculations for the determination of L and, as we shall see later, the characteristics of the push-pull amplifying stage.

Many articles have been published about calculations and practical recommendations regarding choke correction.[1] The simplest result and practical correction curves are to be found in an article by G. D. Robinson. Some of the literature is misleading or unnecessarily complicated, so it seems worth while to prove the simple laws which rule this type of correction.

Original pattern.



Scanning spot.

Light intensity change at the receiving end, corresponding to the original pattern.

Modulation of the electrical carrier.

Figs. 11a and 11b.—Showing more accentuated the result of aperture distortion.

[1] G. D. Robinson, Proc. I.R.E., June, 1933.
L. E. Q. Walker, Series of articles in TELEVISION AND SHORT-WAVE WORLD
Cocking, *Wireless World*, 26 April, 1935, May 3, 1935.
C. H. Smith, *World Radio*, June 8, 1934.
O. Lurje, *Tech. Phys. of U.S.S.R.*, No. 3, Vol. 3, 1936.
E. K. Sandeman, *Wireless Engineer*, Dec., 1936.

In Fig. 13—which represents a H.F. pentode amplifying stage—all the circuit, interelectrode and wiring capacities, which actually attenuate the high frequencies, are indicated.

For the sake of clarity this "high-

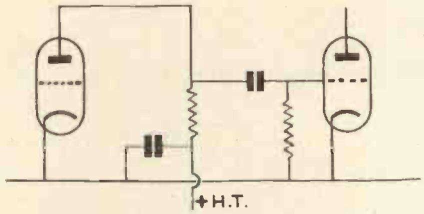


Fig. 12a.—R.C. coupled amplifying stage.

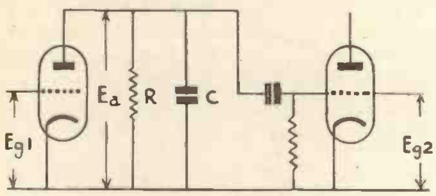


Fig. 12b.—The high frequency circuit diagram of Fig. 12a.

frequency" circuit diagram does not show the decoupling condensers between screen-grid-cathode and H.T.-cathode, and also the bias resistance-bridging capacity complex, as these components represent short circuits for high frequencies.

Now the simple network of Fig. 13b will be equivalent to the anode load in Fig. 13a; the resulting loss-capacity $C = C_{ac} + C_w + C_{gc2}$. The above assumption is correct if: C_c is much larger than C_{gc2}, C_{ag} very small (C_{ag} = .01 mmfd.) and R_g is at least ten times greater than R; it will always be possible to fulfil these conditions. The value of the loss-capacity C varies for different types of H.F. pentodes and constructions between 15-30 mmfd., and it should be kept as low as possible. High-frequency pentodes are especially suitable; as mentioned, their grid-anode capacity (between .002-.01 mmfd.) can be neglected. In the case of triodes the attenuating influence of C_{ag}, which is between 3-10 mmfds., is still more increased by the "Miller"[2] effect. The determination of C_{ag} using triodes or the combination of a triode followed by a pentode needs lengthy calculations, but as we shall see later, it can always be represented by a capacity parallel to RL.

It is simple to calculate the anode load impedance: (Fig. 13b)

$$\frac{1}{Z} = \frac{1}{Z_1} + \frac{1}{Z_2} = \frac{1}{R + j\omega L} + j\omega C = \frac{1 + jR\omega C - \omega^2 LC}{R + j\omega L}$$

where $j = \sqrt{-1}$; $\omega = 2\pi f$; f = frequency.

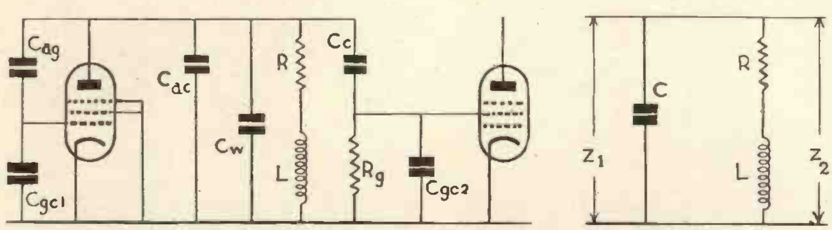
$$Z = \frac{R + j\omega L}{(1 - \omega^2 LC) + jR\omega C} \qquad (3)$$

equation 3 can be also written:

$$Z = \sqrt{\frac{R^2 + \omega^2 L^2}{(1 - \omega^2 LC)^2 + R^2\omega^2 C^2}}\, e^{j\phi} \qquad (3a)$$

$$\text{where } \phi = \tan^{-1}\frac{\omega L}{R} - \tan^{-1}\frac{\omega RC}{1 - \omega^2 LC} \qquad (3b)$$

In equation 3a the expression under the square root sign represents the absolute value of the impedance, the e term expresses the phase angle between the voltage applied to the



Figs. 13a and 13b.—High frequency diagram of an R.C. coupled H.F. pentode stage.

Cac	=	*anode-cathode capacity.*	*Cag*	=	*anode-grid capacity.*
Cgc	=	*grid-cathode capacity*	*Cw*	=	*wiring capacity*
L	=	*correction choke*	*R*	=	*anode resistance*
Cc	=	*grid coupling condenser*	*Rg*	=	*grid leak resistance*

load Z and the resulting current through Z.

We are actually interested in the variation of Z, that is in the variation of the Z/R ratio; where Z is the anode load at different frequencies and R is the anode load at a medium frequency for which the influence of L and C can be neglected. By plotting Z/R and as functions of the frequency, we obtain the frequency response curves of the amplifying stage. Further, these curves must have a general validity applicable to any amplifier. It was found that the best way of reproduction is by plotting $Z/R = y_1$ and $\phi = y_2$ as functions of $\omega CR = x$, with the parameter $L/CR^2 = Q$. From equation 3a we write:—

$$y = \frac{Z}{R} = \frac{1}{R}\sqrt{\left(\frac{R^2 + \omega^2 L^2}{(1 - \omega^2 LC)^2 + R^2\omega^2 C^2}\right)} = \sqrt{\frac{1 + Q^2x^2}{(1 - Q^2x)^2 + x^2}}$$

and from equation 3b:—

$$\phi = \tan^{-1}\frac{R\omega C}{1 - \omega^2 LC} - \tan^{-1}\frac{\omega L}{R}$$

$$= \tan^{-1}\frac{x}{1 - Qx^2} - \tan^{-1}$$

For the sake of clarity (at the present stage in our calculations) it is advantageous to consider thoroughly the conditions with regard to high-frequency phase distortion, in an amplifying stage. Which electrical vectors must be free from phase distortion? From Fig. 12b one can see that a phase displacement dependent

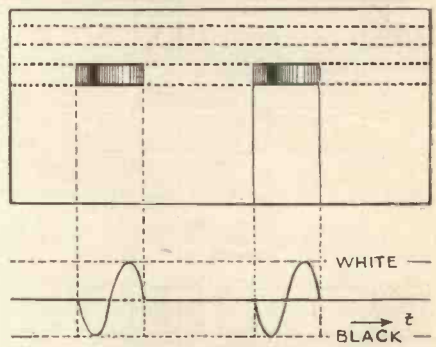


Fig. 14.—(top) Displacement of picture details caused by phase distortion.

(Bottom) Electrical impulse changes corresponding above light intensity variations.

on frequency, between the input and output voltage E_{g1} and E_{g2}, is not permissible; naturally a constant phase displacement which is independent of frequency will not result in phase distortion. If the anode load in an R C coupled stage is purely ohmic, the output voltage is displaced with 180 degrees relative to the input voltage; this displacement is independent of frequency, but there will appear an additional phase displacement, capacitive or inductive. This angle ϕ (equation 3b) is the actual phase distortion and is dependent on the frequency. ϕ can be regarded as between anode voltage and current, because the anode current is always in phase with the input voltage.

[2] Apparent capacity increase by feed-back of the anode on the grid.

These conditions expressed mathematically: the anode voltage shall have the value $|V| e^{j\theta}$ then the value of the anode current from equation 3a:

$$i_a = \frac{|V|\, e^{j\theta}}{|Z|\, e^{j\phi}} = \frac{|V|}{|Z|} e^{j(\theta - \phi)}$$

and the phase angle between anode current and voltage:

$$(\theta - \phi) - \theta = - \phi$$

As in the case of low frequency correction the phase distortion must be regarded as more important than amplitude distortion. The latter results chiefly in contrast differences, the picture elements will, however, not be shifted relatively to each other as in the case of phase distortion. For instance, a phase shift of 90 degrees in six subsequent stages will cause a displacement represented in Fig. 14.

In Fig. 15 we see plotted the equations 3a and 3b for the most characteristic Q ratios. From the curves it is apparent that the phase distortion is the smallest for $Q = L/CR^2 = 1$, the corresponding Z/R curve shows rather a strong rise and a maximum of 1.45 at x = approximately .9; this means 45 per cent. rise of amplification at the frequency $f = .9/2\pi CR$. In most of the cases—especially in the case of a photocell amplifier—the rise of amplification is advantageous at the highest frequency for correcting aperture distortion.

A practical example will explain the correct use of the curves. A six-stage amplifier must be designed with the smallest possible phase distortion and with 50 per cent. rise of amplification at the highest useful frequency. If all the six stages are similarly corrected, the Z/R ratio for every single stage is: $\sqrt[6]{1{,}5} = 1{,}07$.

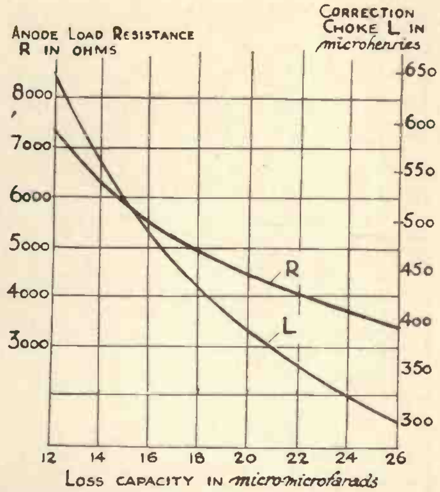


Fig. 16.—The relation between anodeload resistance R, correction choke L and loss capacity C, calculated for the following conditions :

L/CR^2 = 1, smallest possible phrase displacement.
Z/R at fmax. = 1.1.
fmax. = 540000 c/s., 180 lines definition
fmax./f1 = .3
ϕ at fmax. = 1.5 degrees.

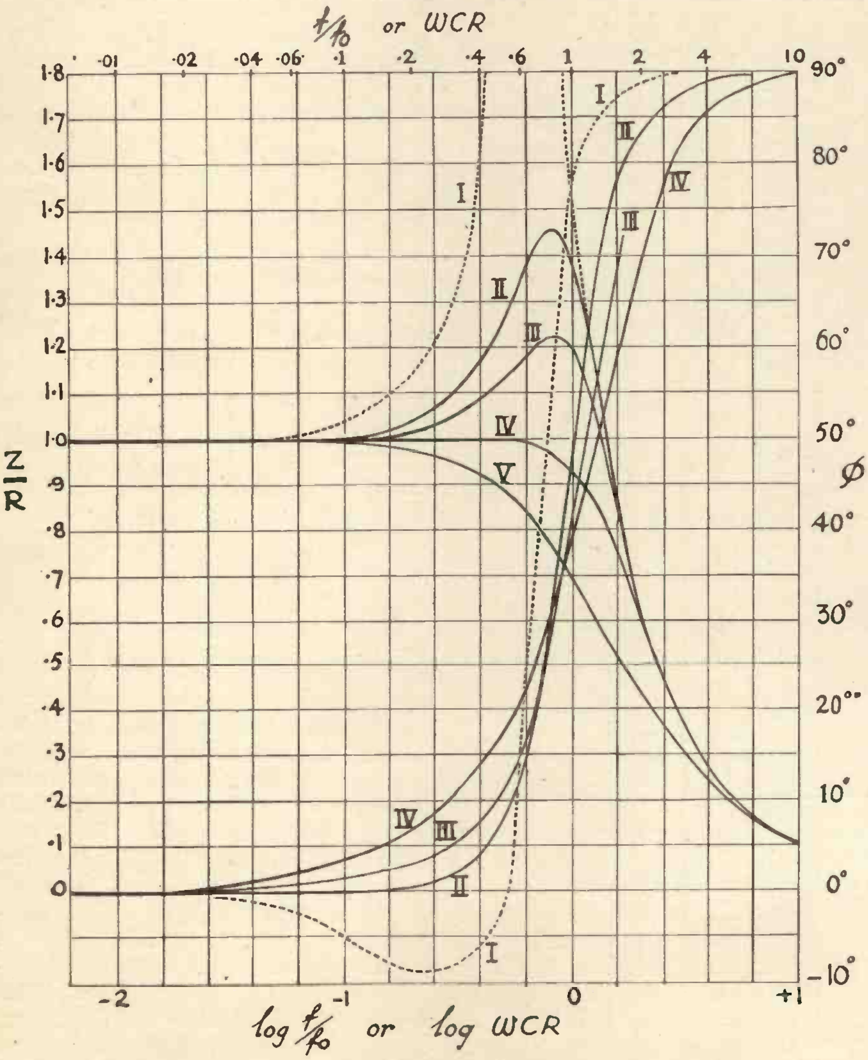


Fig. 15.—The amplification Z/R and phase displacement ϕ as functions of the frequency. The curves have general validity.
$L/RC^2 = Q$.
Curve I. : Q = 2. Curve II. : Q = 1. Curve III. : Q = .75
Curve IV. : Q = .41. Curve V. : Q = 0.

On the curve Q = 1 (smallest possible phase distortion) the corresponding ωCR value is .27. Let us take the highest necessary frequency f_{max} = 1,000,000 cycles/sec. The loss capacity C is given by the circuit, C = 20 mmfds. Now it is simple to calculate the values of the anode resistance and correction choke.

f_1 is the unit frequency for which $\omega C = 2\pi f_1 C = \frac{1}{R}$

$\frac{f}{f_1} = \omega CR = .27 \qquad R = .27/2\pi\, f_{max} \cdot C =$
$.27/2 \cdot 3{,}14 \cdot 10^6 \cdot 20 \cdot 10^{-12} = 2170$ ohms.
$L = CR^2 = 20 \cdot 10^{-12} \cdot 2170^2 = 94$ microhenries.

The determination of R and L is simplified with the aid of the curves in Fig. 16 which show the relation between R, L and C for a certain f_{max} and Z/R ratio. The phase shift for the single stage at f_{max} is given by the corresponding curve (Q = 1) = 2 degrees. The resulting phase shift of the amplifier will be six times 2 degrees = 12 degrees.

It is useful to follow up the phase shift changes with increasing L/CR^2 ratios. From Q = O to Q = 1 the phase shift is purely capacitive. With increasing Q (see Q = 2 curve) appears also in the opposite sense the phase shift, it becomes inductive. The response and phase curves will approach always more and more the

(Continued on page 254)

RECENT TELEVISION DEVELOPMENTS

A RECORD OF PATENTS AND PROGRESS

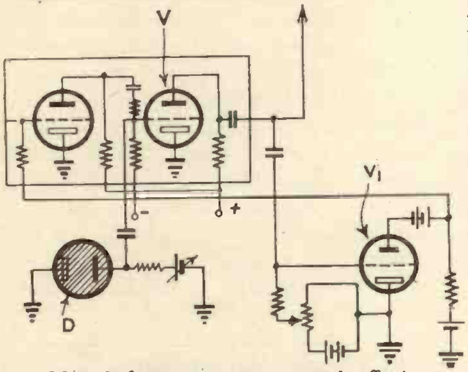
Specially Compiled for this Journal

Patentees :—Radio Akt. D. S. Loewe :: Marconi's Wireless Telegraph Co. Ltd. and G. B. Banks :: Scophony Ltd., J. D. Baynes and G. Wikkenhauser :: J. E. Keystone, F. N. Nicoll and O. Klemperes :: Marconi's Wireless Telegraph Co. Ltd. :: Baird Television Ltd. :: T. M. C. Lance and E. H. F. Pattinson

Synchronising Systems

(Patent No. 457,879.)

The picture signals and the synchronising-signals are usually separately amplified, before being mixed and fed to the transmitting aerial. Since some of the picture signals will naturally be of the same "polarity" as the synchronising impulses, it becomes necessary to ensure that they do not also reach the same amplitude, as otherwise they would tend to produce "false" synchronisation at the receiver.



Method of preventing picture signals affecting synchronisation. Patent No. 457,879

Accordingly steps are taken to prevent any picture from reaching a voltage in excess of a certain value. As shown in the figure, this is ensured by shunting the grid of the last amplifier V with a gas-filled diode D, which acts as a limiter directly the picture signals approach the level of the synchronising-impulses. The output from the valve V is rectified at V1, and the derived voltage is used to regulate the amplification of preceding valves. This automatically adjusts the amplification to compensate for the difference between a "light" and "dark" background. —*Radio Akt. D. S. Loewe.*

Magnetic Scanning

(Patent No. 457,929.)

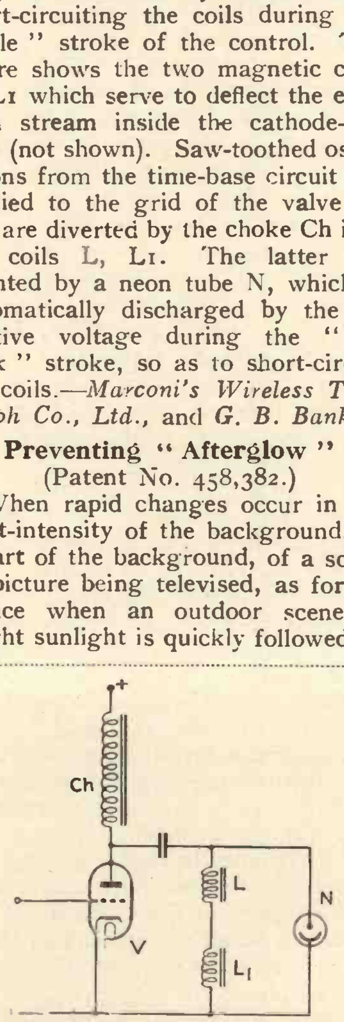
When magnetic deflecting-coils are used to control the scanning in a cathode-ray tube, the effect of their high inductance makes it difficult to preserve the saw-toothed oscillations in proper form. More particularly, the inductance tends to lengthen the "fly-back" period.

According to the invention the difficulty is overcome by automatically short-circuiting the coils during the "idle" stroke of the control. The figure shows the two magnetic coils L, L1 which serve to deflect the electron stream inside the cathode-ray tube (not shown). Saw-toothed oscillations from the time-base circuit are applied to the grid of the valve V, and are diverted by the choke Ch into the coils L, L1. The latter are shunted by a neon tube N, which is automatically discharged by the inductive voltage during the "fly-back" stroke, so as to short-circuit the coils.—*Marconi's Wireless Telegraph Co., Ltd.*, and *G. B. Banks.*

Preventing "Afterglow"

(Patent No. 458,382.)

When rapid changes occur in the light-intensity of the background, or a part of the background, of a scene or picture being televised, as for instance when an outdoor scene in bright sunlight is quickly followed by a studio scene in more subdued light, there is a tendency at the receiving end for the "high" light to persist on the fluorescent screen, due to "afterglow." This, in turn, tends to spoil the effect of the suceeding scene.



Preserving correct form of saw-tooth waveform in magnetic scanning. Patent No. 457,929

Accordingly, means are provided at the transmitter for artificially reducing the intensity of the "high light" scene just before the change-over. Where, for instance, transmission is from a cinema film, a certain number of the "frames," just before the change of scene, are deliberately treated to increase their opacity. Or, when outdoor scenes are being televised, a shutter or filter is interposed so as to intercept some of the light falling on the photo-electric cell.—*Scophony, Ltd., J. D. Baynes* and *G. Wikkenhauser.*

Focusing in Cathode-ray Tubes

(Patent No. 458,746.)

In the ordinary way, the electron beam of a cathode-ray tube is brought to a focus at a certain point, and it can only retain that sharp focus so long as it is moved over a truly spherical surface. But, in the case of a television receiver, the fluorescent screen is nearly a plane and not a spherical surface, so that parts of the picture must appear slightly out of focus.

Again, in a cathode-ray transmitter of the kind using a "mosaic" electrode of photo-sensitive cells, the latter are set in a plane surface arranged at an angle to the path of the stream, so that here again a certain amount of distortion must result, due to de-focusing.

According to the inventor these difficulties are removed by a suitable disposition of the focusing electrodes inside the tube. At the same time, special compensating voltages are applied to the two pairs of deflecting plates, so as to maintain the beam accurately in focus on all parts of a non-spherical fluorescent screen.—*J. E. Keyston, F. N. Nicoll* and *O. Klemperer.*

Television "Cameras"

(Patent No. 458,750.)

A certain part of a picture that is being televised by a camera of the Iconoscope type, is selected and shown in enlarged form at the receiver. The effect is similar to that known as a "close-up" on the cinema screen.

The result is secured by regulating

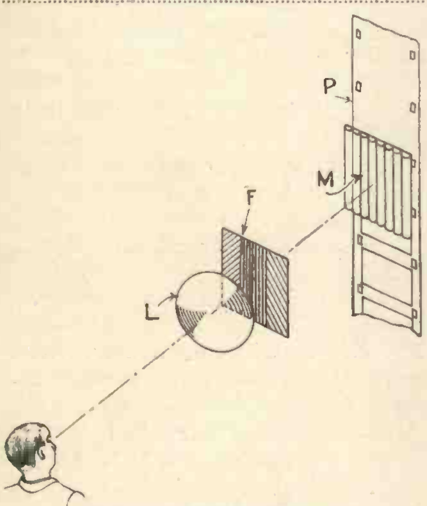
the amplitude of the deflecting voltages so that the scanning beam, instead of covering the whole picture, is restricted to a selected area. At the same time, the voltages on the auxiliary anodes are adjusted so as to "sharpen" the focus of the beam to the smaller area. The intensity-control voltage on the Wehnelt cylinder is correspondingly varied.

The selected area covers the entire screen at the receiver, giving the effect of a "close-up." The particular area to be shown enlarged is selected by regulating the current passing through a pair of auxiliary deflecting-coils.—*Marconi's Wireless Telegraph Co., Ltd.* (Assignees of *H. Iams*).

Television in Colour

(Patent No. 458,791).

Light from the object to be televised is projected through a lens L, and through a light-filter F built up of the three primary colours, red, blue and green, on to a photographic film P. Immediately in front of the film is placed a lenticular grating M, which consists of a row of cylindrical lenses placed side by side.



System for television in colours. Patent No. 458,791

The grating projects on to the film a striated image of the filter F, the image containing one, two, or three portions of light, according to the colour of the part of the object from which the light is reaching the grating.

The film is next developed and fixed, the picture then appearing as a striated monochrome. It is next scanned crosswise, and the resulting signals are transmitted to the receiving station, where they are again recorded as a film. This is finally projected in colours on to a viewing-screen, through an optical arrangement which is the reverse of that shown in the drawing.

A stereoscopic effect can also be secured by using a double lens in front of the colour filter, so that alternate strips on the grating M project left and right eye images respectively. —*Baird Television, Ltd., T. M. C. Lance*, and *E. H. F. Pattinson.*

Summary of other Television Patents

(Patent No. 456,450.)

Valve amplifier adapted to transmit a wide band of television signals, including "zero" frequency, with uniform attenuation.—*E. L. C. White.*

(Patent No. 456,564.)

Improvements in the wave-form of the synchronising-impulses used in an interlaced scanning system for television.—*Marconi's Wireless Telegraph Co., Ltd.*

(Patent No. 456,582.)

Means for changing-over from one studio to another when transmitting a television programme.—*C. F. Chapter* and *Baird Television, Ltd.*

(Patent No. 456,650.)

Method of radiating synchronising impulses between repeater trains of picture signals in television.—*E. L. C. White.*

(Patent No. 456,651.)

Synchronising means for an interlaced system of scanning in television.—*M. Bowman-Manifold.*

(Patent No. 456,666.)

Saw-toothed oscillation-generator for the time-base circuit of a television receiver.—*G. R. Tingley, D. W. Pugh*, and *Baird Television, Ltd.*

(Patent No. 457,129.)

Means for separating out the various synchronising impulses in a television receiver.—*G. R. Tingley* and *Baird Television, Ltd.*

(Patent No. 457,135.)

Time-base circuit particularly designed to prevent line "overlap" in interlaced scanning systems.—*Marconi's Wireless Telegraph Co., Ltd.*

(Patent No. 457,531.)

Providing a border of conducting material around the mosaic-cell electrode of a cathode-ray television transmitter of the Iconoscope type. —*J. D. McGee, S. P. Freeman*, and *W. S. Brown.*

(Patent No. 457,532.)

Separating or sorting-out signals of different amplitudes used for synchronising.—*Murphy Radio, Ltd., K. S. Davies*, and *H. F. W. J. Freundlich.*

(Patent No. 757,757.)

Using electrostatic focusing, and electromagnetic deflection, in a cathode-ray tube, without mutual interaction and interference.—*Radio-Akt. D. S. Loewe.*

(Patent No. 454,319.)

Superhet receiver for television utilising an intermediate frequency approximately four times the maximum modulation frequency.—*Radio-Akt D. S. Loewe.*

(Patent No. 457,773.)

Transformer coupling for a television amplifier handling a wide range of signal frequencies.—*Radio Akt. D. S. Loewe,*

(Patent No. 457,879.)

Limiting device for combining picture signals and synchronising impulses.—*Radio Akt. D. S. Loewe.*

(Patent No. 458,032.)

Photo-electric amplifier using two cells arranged so that each corrects the "fatigue" of the other.—*S. Våsilach..*

(Patent No. 458,135.)

Mains unit for supplying a cathode-ray tube receiver, and its time-base circuit, with operating voltages.—*E. Reader and L. Glass.*

(Patent No. 458,586.)

Preparing a photo-sensitive electrode, consisting of a mosaic of silver-caesium cells, for use in a cathode-ray transmitter.—*L. Klatzow.*

(Patent No. 458,618.)

Rigid anchoring of the optical elements in a scanning drum of the mirror type.—*Ferranti, Ltd.*, and *M. K. Taylor.*

(Patent No. 458,635.)

Improvements in the preparation and composition of fluorescent screens.—*N. V. Philips Gloeilampen-Fabrieken.*

(Patent No. 458,798.)

"Noise suppressor" circuit for a combined sound and television receiver.—*Marconi's Wireless Telegraph Co., Ltd.*

(Patent No. 458,878.)

Method of centring the picture, relative to the undeflected position of the electron stream, in a cathode-ray receiver.—*General Electric Co., Ltd., R. J. Dippy*, and *D. C. Espley.*

(Patent No. 458,883.)

Method of generating synchronising impulses from a rotating-disc scanner.—*General Electric Co., Ltd.*, and *D. C. Espley.*

(Patent No. 458,923.)

Mounting the mirrors on a scanning drum so as to facilitate adjustment in two directions.—*J. Bell* and *W. S. Worthington.*

STUDIO & SCREEN

A MONTHLY CAUSERIE on Television Personalities and Topics

by K. P. HUNT
Editor of "Radio Pictorial"

THE decision reported last month, that in future only one transmission system would be used by the B.B.C., already has simplified and eased the working at Alexandra Palace to a gratifying extent. Nothing like the full benefits ultimately to be derived have yet been secured, however, because there is a considerable amount of Baird apparatus yet to be removed from the Palace. At the time of writing these notes, several Baird engineers are still on the premises, and appear to be holding a sort of watching brief.

* * *

From the national point of view, keen interest continues to be shown in the possibilities of televising the forthcoming Coronation. Contradictory reports have appeared in the lay Press, but I hear it has now definitely been decided to televise the procession.

Any possibility of televising other parts of the Coronation ceremony—which, of course, hold greatest interest for the general public—has now been completely abandoned. So far as I have been able to learn, television cameras will merely be stationed at a point or points along the route, and shots will be shown of the most interesting parts of the procession as it passes by.

A few days ago I was told by a prominent television official that the B.B.C. has been fortunate in securing what might be called an absolutely ideal site along the route, but it is not proposed to tell anyone of its precise location until after the Coronation. When I asked the reason for this meticulous secrecy (now, alas, rather usual in all television matters), it was explained to me that if the site of the television cameras were known to the public, it is almost certain that huge crowds would congregate there, and in all probability something would happen to upset the arrangements.

In view of the great interest evinced by the newspapers ever since the question of televising the Coronation was first mooted, it seems rather strange that official permission to televise the most important parts of the ceremonies has been refused. The real reasons for this are known only to the Government, but after making many inquiries, it has seemed to me that a feeling is in the air, at least at the Alexandra Palace, that television might reveal too much. A television camera, as we know, can tell the brutal truth so well that perhaps in official, and particularly national matters, this virtue conceivably might become rather a disadvantage. During ordinary sound broadcast commentaries, if an important personage makes a slip, the matter can easily be slurred over and usually is, and in most cases is not even mentioned by the commentator. But this all-seeing television camera is an entirely different proposition, and it may well be that the Powers-That-Be decided that in this case its use might be attended with certain inconveniences which outweigh the advantages.

A brilliant television future is forecast for Irene Prador who is in the programme on April 6th.

The Coronation programme is expected to occupy fifteen minutes, and, of course, will show the Royal coach. It is unlikely, I am told, that the programme will be continuous, but that it probably will be punctuated with some sort of interludes.

* * *

In passing, I should point out that here is an instance of a programme in which the Baird intermediate film system, now abandoned, would have been distinctly useful. The 40 seconds of lag which takes place in this system between the event and its actual appearance on the television screen would have been extremely useful in the event of a contretemps, and it seems likely that if this system had been available all possible official objections to the televising of the Coronation ceremony itself might have been surmounted.

The camera for televising the procession will, of course, be fitted with a telephoto lens, in order to give televiewers really close-up images of Their Majesties.

Use of telephoto lenses in television is now being extended considerably, and numerous experiments in their applications have been made in the programmes. One example was in the recent boxing match. Two cameras were then used, one with the usual F/3 lens of 6½-in. focus, and the other with a telephoto lens. The first was so placed that it embraced in its field of view the entire ring, while the other was used for showing close-ups of the boxers themselves.

Telephoto lenses have also been employed for O.B.'s in the park, but their more extended use at present seems to involve certain technical problems which have not yet been fully solved. For instance, in ordinary photography one of the chief advantages of a long focus lens used at a distance from the object is that a much better perspective is obtained, while better modelling of the subject is also evident, and it is well-known that a short focus lens used at close range frequently results in distressing distortion.

The result of using telephoto lenses in television, however, does

A FORECAST OF TRANSMISSION IMPROVEMENTS

not appear to be precisely the same, for although naturally the image is rendered on the screen on a relatively larger scale, the telephoto lens in television does not seem to improve the perspective at all, but rather tends to distort it. To mention but one example, a cricket pitch seen on the television screen in this way appears to be disproportionately short, and certainly not in true perspective.

Again, in the important matter of modelling, the advantages usually associated with the telephoto lens in ordinary photography cannot be said to be fully achieved in television, because the images obtained in this way are often notably flat, instead of being improved in depth and plasticity.

In fact, it is generally realised, I think, that the whole question of television cameras is still very much in the melting pot, and it was plainly hinted to me only a few days ago that some big changes are imminent. To be more specific, I was told that the Marconi-E.M.I. people are about to introduce a new camera which will effectively remedy some of the many defects associated with the present Emitron camera.

The most notable improvement, I understand, will be in the colour response curve of the new camera. The present Emitron, as is well known, is most responsive to green and blue, resulting in a tendency for these colours to be rendered whitish. On the other hand, red makes less impression on the instrument and consequently comes out on the screen considerably darker.

In this respect the present Emitron has properties similar to the orthochromatic film used in ordinary photography, and I am told that the new camera will aim at a colour response curve which is much straighter and which will correspond roughly to the usual panchromatic film employed in ordinary photography.

If the colour response curve can be improved in this way, and a panchromatic rendering achieved, there can be no doubt that it will represent a tremendous step forward, because at the present time the tone values of pictures on the television screen are not correct, and anything which will do away with the " soot and whitewash " effect now so evident will be welcomed.

* * *

It was hinted to me that another advantage of the new camera destined to replace the present Emitron is that it will work effectively with considerably less light. Here again, it is not merely a matter of lens aperture, as in ordinary photography, because television has already been accomplished in mist and exceedingly poor light which even experts prophesied would be a complete failure, yet to everyone's astonishment good images were secured. Televiewers will remember, for instance, the sheep dog trials which were televised successfully in mist, the received images being entirely satisfactory. People on the spot who were outside in the open-air when this was done said the result could not possibly be any good, and as a matter of fact the programme was closed prematurely for this reason. Yet at the receiving end good pictures were secured.

Experiments with various types of colour filter in front of the lens are also being made continuously with a view to improving the tonal values. Another scheme that has been successfully adopted for improving the lighting of outdoor subjects is the use of spotlights. It is an unusual practice to have spotlights in daylight scenes, but it has already proved successful, a fine example of which was in the car parades recently televised.

* * *

The exact nature of this new Marconi-E.M.I. camera and its capabilities are, as usual, being kept a close secret, but as much as is publicly known gives grounds for the conjecture that we shall soon have equipment capable of televising events in almost any light, and that direct television for instance of theatrical productions is now appreciably nearer. Some support for this prophecy is given by the B.B.C.'s considerable activity in laying television cables in and around London. Last week I saw one of the cables being laid in Lower Regent Street. But here once more, as an example of the annoying mystery mongering which is going on, no information is available as to which points are being linked up in this way. It is fairly evident, however, that the B.B.C. is taking urgent steps to fling a belt of television cables all around London's theatreland, and that, in due course, there will be a network almost as extensive as the B.B.C.'s ordinary O.B. links.

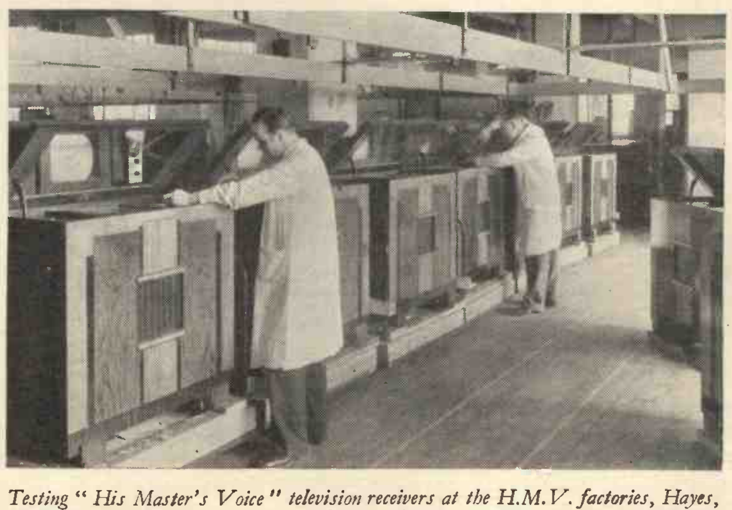
* * *

New faces are constantly being added to the Alexandra Palace staff, which is growing almost from week to week. Messrs. Crier, Smith and Bate are three new stage managers who have recently been appointed at the Palace. This now makes five stage managers in all.

Two other newcomers are Eric Crozier and G. Morley—two young men destined to become future producers. Both are about twenty years old, and have come straight from the B.B.C.'s famous Staff College. I understand that in future Mr. Morley is going to produce " Picture Page."

* * *

Mary Allan, the popular make-up expert and wardrobe mistress at the Palace, broke all records when Jack Payne and his celebrated band were televised recently. She made up 30 faces in 30 minutes! Some going.



Testing " His Master's Voice " television receivers at the H.M.V. factories, Hayes, Middlesex. H.M.V. are now producing television receivers by large production methods.

NEWS FROM THE STUDIO

Jack Payne's show, by the way, was extremely successful, and quickly resulted in numerous congratulatory telephone calls and letters. It was, I think, one of the fastest moving shows yet produced, and the boys themselves got a great kick out of it. This television broadcast must have given Jack himself a little cause for reflection, because it was he who, way back in October, 1931, gave the very first 30-line transmission under the ægis of the B.B.C. The band appeared in its usual stage act, and the performance was notably slick and peppy. It ran for half-an-hour with no intervals, and introduced the band's celebrated Russian turn, complete, of course, with Russian hats.

* * *

Talking about bands reminds me of Henry Hall's anniversary television show. This was a great effort, and the idea of the big birthday cake was a particularly happy one.

Mary Allan, by the way, now has an assistant, Pamela Hyde. I asked Pamela what made her go into television, and learned that hers was one of those delightful little romances of getting a job which do sometimes happen. She was so interested in television that she just sent in an application mentioning her qualifications and hoping that they would find her a job. That, of course, was some months ago, but there was no opening at the time and her application was put on one side. Pamela herself almost forgot all about it. Then, during the Christmas rush, an assistant was wanted at the Palace and her letter was hurriedly found. Within a few hours she was up from the South Coast where she lives and landed the job!

* * *

A big part of Mary Allan's work is now connected with the wardrobe at the Palace, and the B.B.C. already has in stock dozens of dresses for day and evening wear. All the television dresses are tested out on that most conscientious of artists—Television Tilly—who can withstand the glare of the fiercest lights without wilting and never gets tired. I should explain that Television Tilly is a dressmaker's model on which the dresses are put while they are viewed on the screen.

Tilly, by the way, does not mind being bitten by a parrot—as Elizabeth Cowell, the charming television hostess-announcer—does! I must not forget to tell you this story about Elizabeth Cowell and the parrot.

Elizabeth hates parrots because parrots, apparently, hate her. David Seth-Smith, the famous Zoo-man, brought "George" to the studio, and he (the parrot, of course), chased Elizabeth into the corner of the studio and bit her twice on the ankle. After doing the naughty deed, "George" then exclaimed in a loud voice: "I wanna get outa here." Fortunately, the bird did not draw blood, although Elizabeth seemed pretty scared and now, I hear, stands clear of all livestock in the studio.

That isn't the first time it has happened. The Rev. F. W. Turner brought the famous parrot "Cocky" to the television studio and he told all the staff that the bird would not hurt anyone, yet as soon as Elizabeth appeared he struck a threatening attitude which boded no good for her.

* * *

D. H. Munro has done quite a lot of production work during the month, one of his notable successes being that of Mr. Cochran's "Young Ladies" early in March. Cecil Madden is now programme organiser and responsible for balance, light and shade.

But from the production point of view, the man in the limelight last month was Stephen Thomas, whose new experiments in studio technique attracted considerable attention among televiewers and aroused tremendous interest at A.P. The notion of showing on the screen several different aspects of a subject at once was entirely his own idea and in the first place was, I hear, received at Alexandra Palace with a certain amount of diffidence. However, the scheme was tried out on March 2 in his programme "After Supper," in which several first-class artists were seen.

The experiment consisted in the simultaneous use of different cameras placed in such a manner that they covered different sections of the screen. A four-part fugue by Bach was utilised and the idea was first to show the figure of Maude Lloyd dancing solo. A second view of the same clever dancer then appeared by the side of the original figure, which later was triplicated, and finally four views were shown simultaneously. After this was fully demonstrated, the figures began to disappear in a similar way to which they appeared, finally leaving the single figure once more on the screen. The intermingling of these effects was attractively novel and had a kind of mystic appearance which was fascinating and admirably suited to the music. I should mention in passing that the music in this instance was specially orchestrated for the Television Orchestra by Cyril Clarke, who plays 2nd clarinet in the Television Orchestra, while Miss Lloyd deserves a special word of commendation for her excellent interpretation.

All this was extremely clever and gave us a foretaste of the wonderful effects which can be produced on the television screen by trick photography. It was generally supposed that this was the first time that trick photography had been used in this way, which is true so far as the present transmissions are concerned. In the old 30-line days, however, quite a number of similar things were done. I remember the extraordinary conjuring effects which I believe were done by Sutherland Felce, and so on. Even at Alexandra Palace, the staff have seen Leslie Mitchell on the screen shaking hands with himself. But this was on closed circuit and not broadcast. It makes you begin to wonder whether we shall not soon have a complete beauty chorus on the television screen consisting only of one girl. And they would all be perfectly in step!

* * *

Stephen Thomas has been devoting a lot of attention to ballet and mask dances during the month.

Dallas Bower has distinguished himself by writing the first original revue for television, called "Pasquinade," which was successfully produced a week ago. Peter Bax nowadays is concentrating mainly on scenery. The stage management work now is not so rushed as it was, owing to the appointment of the three new members of the staff.

* * *

Irene Prador, who is in the April 6 programme, undoubtedly has a brilliant television future before her, and is regarded at A.P. as the first real television star. She is an extremely versatile artist, sings in German, French and English, and, as televiewers already know, is particularly easy to look at.

The Everest Transceiver

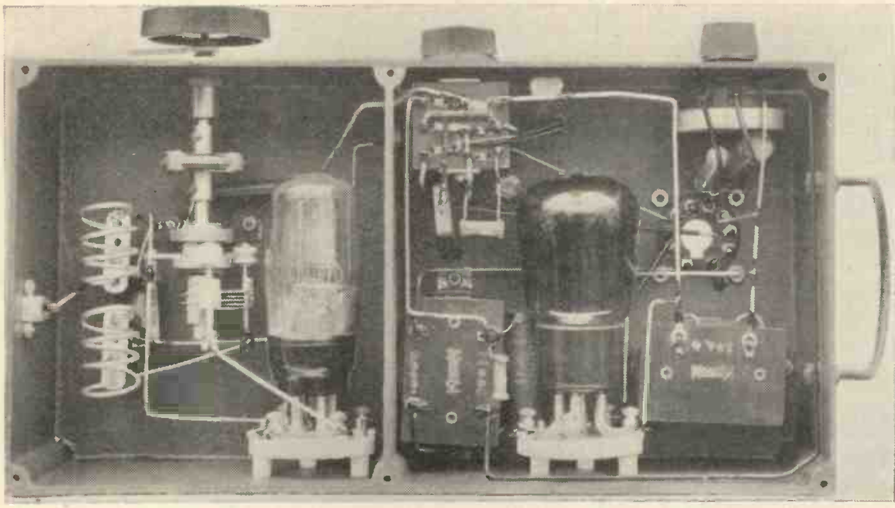
This is the first time that permission has been granted for details of the "Everest" Transceiver to be given in full. The circuit and approximate component layout is given in this article.

AFTER careful consideration the organisers of the last Mount Everest Expedition decided to make a radical change and to omit the usual field telephone sets in favour of ultra-short wave transmitting and receiving apparatus.

Apparently in previous expeditions the weight of wire for a telephone service was far too great for one man to carry in the rarified atmosphere, which led to the suggestion that a complete 5-metre transmitter and receiver could be obtained that would not weigh more than 20 lbs. This, of course, meant a very great saving in weight as there were four or five stations to be equipped.

Messrs. Eddystone designed a 2-valve transceiver type of instrument that complete with head-set, power supply and collapsible aerial, weighed approximately 15 lbs., and, with high-voltage power supply, was still under 28 lbs.

This apparatus was highly satisfactory and comparable with the domestic telephone. Some idea of how useful it was can be gauged from the fact that W. R. S. Windham in his address before the Royal Geographical Society mentioned that over 549 messages were handled in less than six weeks. We publish in this page for the first time the theoretical circuit of the Eddystone "Everest" transceiver, which although it may look reasonably simple, depends very greatly for its efficiency on the layout and complete screening.



There are two sections in which the detector and low-frequency amplifier are housed. Most of the components can be seen from this plan view.

Oscillator or Detector

A P220 battery operated valve is used as an oscillator when transmitting and as a detector for reception. The second valve, a PT2 low-consumption pentode, also performs a dual function of low-frequency amplifier and modulator for transmission. An ingenious transformer with a split-primary winding is used firstly for a microphone input transformer of high ratio, and secondly as an inter-valve coupling transformer of comparatively low ratio. The method of connection is shown in the circuit, where it can be seen that high tension for the P220, when used either as an oscillator or detector, is controlled by a 50,000-ohms variable potentiometer.

One of the main difficulties with transceivers is that component values to give optimum results are not the same for transmission as for reception. So an interesting feature is the multi-contact rotary switch which alters the value of leak in the P220 grid circuit from 10,000-ohms on transmission to 250,000-ohms on reception.

Tuning is by means of a 25-mmfd. midget type of condenser fitted with a slow-motion head, while regeneration for reception is roughly obtained by a 70 to 140 mmfd. trimmer condenser. This is shown between the anode and grid coil.

Complete By-passing

Seemingly unimportant condensers, such as the .002-mfd. by-pass after the high-frequency choke, and the .002-mfd. across the filaments of the P220 are really most important, particularly the filament condenser, for without this the apparatus is rough in operation and the high-tension voltage needed becomes very critical.

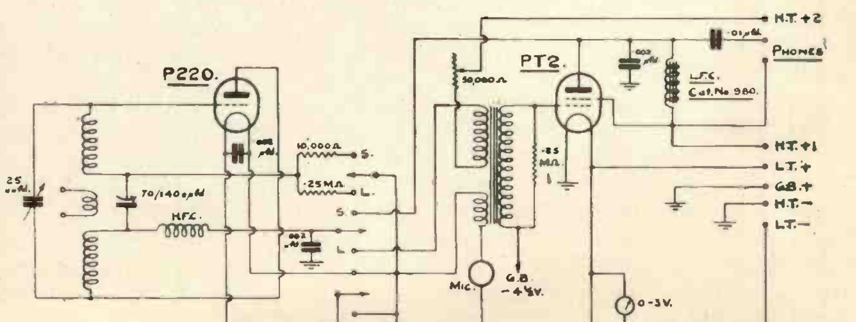
Also the .25-megohm fixed resistance across the secondary of the inter-valve cum microphone transformer acts as a damping resistance and also a top note attenuator, and, to give some idea as to the signal strength on reception, we really do feel that this resistance could have been made variable for normal amateur use, so that the strength of signal could be adjusted.

Refer a moment to the plan view of the transceiver.

In the left-hand partition is the complete detector or oscillator with its tuning coils, coupling condenser, high-frequency choke and filament by-pass condenser. Only two leads go from this partition into the low-frequency or modulator section, so that the two units are completely screened. A midget stand-off insulator has its insets reversed so that it fits a standard plug to which the aerial is connected. Actually in the model we have been testing, the aerial is tapped directly to the anode coil, but it is optional as to whether a twin-feeder is used with the conventional coupling coil.

A three-coil change-over rotary switch is mounted in the centre of the container, which incidentally is all metal,

(*Continued in 3rd column of next page*)



The circuit of the transceiver is very simple, but results are only satisfactory providing the layout is effective. The designers have spent considerable time on perfecting this transceiver, and most of the difficulties experienced with original design were in obtaining satisfactory component layout.

Our Readers' Views

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

Distant Television Reception

SIR,

I was interested in the letter from your correspondent J. Taylor, on the reception of the television transmissions in the Isle of Wight.

In it he mentions that the signals are stronger at night than during the day. I thought it might be of interest to report that this has also been observed by amateur stations in this neighbourhood working on the 56 mc. band.

During a series of tests carried out by the members of the local Radio Society here, a very definite increase in the strength of signals occurred just about twilight, i.e., from 16.30-17.00 G.M.T.

Until Mr. Taylor's letter I had not seen this effect mentioned in print. It would be interesting to hear the views of others working on the five-metre band on this point.

A. C. GEE (G2UK)
(Southend-on-Sea).

Pirates

SIR,

One of the most general topics amongst transmitting amateurs today seems to be the question of "Call sign pirating," a thing which would appear to be increasing rapidly, as in this district alone nearly all call signs have been pirated during the last few months.

On the face of it there would seem very little that can be done as if a station comes on giving what appears to be a genuine call and the transmission is within the band there is nothing to indicate that he is a pirate. I would make this suggestion to transmitting amateurs which I think will help. This is that when calling or signing they give the town or district in which they are located and also the power used—this will give listening stations a good guide as to the strength such a transmission should be received, taking general conditions into consideration. Where they suspected that it was not a genuine transmission by the station to whom the call was allocated a report would establish whether this was the case or not.

This would enable the call sign owner to report to the authorities that his sign was being pirated, and to give them an idea of the location of the pirate station.

N. J. FITZGERALD (Wanstead).

5-metre Activity

SIR,

I was amazed to read G2KT's letter on 5-metre activity in the current issue, and it is most obvious that it is his knowledge of current methods and practice that is obsolete.

The serious experimenter is well ahead of any of his suggestions, and would not dream of fitting the suggested aerial array, which is difficult and expensive to build.

There has been little reduction in activity for the past 12-18 months, and long-distance reception is an accomplished fact, be it freak or otherwise. Superhets are as common as super-regens and straights, and there are very few transmitters to-day without some form of frequency control.

Further, I would point out that no brand of frequency control will give greater range of reception, that mathematically correct systems are not always perfect and that the frequency stability of the average amateur's transmissions are as good as found on the low-frequency bands.

In conclusion, I hope G2KT is not going to suggest that because some broadcast listeners have interference from the Alexandra Palace transmissions that the B.B.C. have omitted some method of frequency control.

T. VICKERY (G5VY) (London, N.).

Contact Wanted

SIR,

I have been endeavouring to contact some British amateur who is also a constructor of limited means like myself. I build receivers of from 1 to 4 valves, and I wish to correspond and exchange items of interest regarding short-wave receivers, reception and general topics of interest.

LE ROY BLINN
(R.R. 4 London, Ontario, Canada).

On a One-valve Set

SIR,

I built the one-valve U.S.W. set designed by G2HK and described in the March issue of TELEVISION AND SHORT-WAVE WORLD. I used a 7-plate condenser instead of a 2, 5-turn coils ¾ in. diam., and a pentode instead of a triode. I connected it to an aerial of 16 gauge single bell wire in the roof.

At 8.20 p.m. I heard an amateur say, "I will call you later on." At 8.40 I picked up W9BHB talking about his diamond aerial and the effect of placing the aerial resistor in different places.

Next I got American police cars and heard a call to all cars re a coast fire, and later a short tuning note and a call to car 6X31 Park Avenue. I then took the set downstairs and, using the curtain rod for aerial, received Alexandra Palace until 10 o'clock. I found that the sound transmission could be got without an aerial.

I listened onwards till 10.30 and received many Americans, among them being W3FKK, W6IOS, W2AOE, and W2 or WT, 5BF.

The H.T. was 180 volts, no S.M. dial was used, and the whole receiver was mounted on a wooden base.

What I would like to know is what does the writer mean when he describes his set as a "local distance" set?

H.J.P. (Kingsbury).

Television at 60 miles

SIR,

We have installed at one of the highest points in Brighton, at a distance of about 60 miles from the Alexandra Palace, a standard G.E.C. television receiver, Model No. BT3701. The aerial used is a half-wave dipole with a reflector, which is on the top of a 60-ft. mast. The only interference experienced is from passing cars, the installation being on a main road.

R. LEWIS (Brignton).

"The Everest Transceiver"

(*Continued from preceding page*)

and to this most of the small components are anchored. In one position to the right the instrument operates as a complete 2-valve 5-metre receiver, and to the left as a transmitter on exactly the same frequency. The centre position cuts off all power supply.

Maximum input to this receiver is 3 watts and at 5 miles the signal strength is sufficient completely to kill the quench noise in a single valve receiver. The fact that it was used by the Everest Expedition, and very often the safety of the explorers depended on its efficiency is sufficient indication that this transceiver does all that is claimed for it. All the components and accessories are available from Messrs. Stratton & Co., Ltd., Bromsgrove Street, Birmingham.

A Four-band Ultra-short Wave Receiver

This receiver is based on the design by **Hilton J. Heffernan,** *G5BY, whose battery version appeared in the March issue. As it can be used as a straight or super-regenerative receiver it is suitable for reception of both amateur and commercial transmissions.*

There are three controls, to the left, regeneration; to the right, volume; and in the centre master tuner. The switch shown is across the quench coil.

CONSIDERABLE interest has been aroused by the simple circuit used for ultra-short wave work by G5BY described in the March issue. Several readers pointed out that by the use of slightly larger coils they were able to tune in quite a number of American stations, both amateur and commercial, on the 9 and 10 metre bands.

Other readers mentioned that the television sound programmes could be heard up to at least 50 miles, so that the receiver is far more flexible than was at first imagined. As so many constructors objected to the use of dry batteries and asked for an A.C. version, we have designed such a receiver using the basic circuit of G5BY.

2 Watts Output

This receiver is as docile to handle as the battery version, but in addition gives an output to the loud-speaker of over 2 watts. In view of this not only is it suitable for amateur use on the 5 and 10 metre bands, but many constructors will no doubt embody it with their vision receivers for the reception of the sound programmes from the Alexandra Palace.

Suitable plug-in coils are available from Eddystone that will enable the receiver to cover the 5 and 6 metre channels on one set of coils, the 7 metre sound channel on a second set, with the 9 and 10 metre bands on a third set.

Actually on test a 4-turn coil was found to tune between 4.2 and 6.3 metres, so it was pushed together and then the wavelength moved up to 4.8 to 6.8 metres.

A 6-turn coil tuned in the television sound signals at approximately half tuning capacity, while an 8-turn coil tuned from 7.8 to 11 metres. The circuit of the detector is fundamentally similar to the battery version, except that the grid-leak return is made to cathode instead of L.T. positive as with a battery valve. Two .01-mfd. condensers are connected in series across the heater supply with the centre point taken to cathode to prevent any possibility of modulation hum on strong signals.

Both H.F. chokes are of a special type wound on glass, and these have been found to be quite satisfactory between 4 and 12 metres. Constructors will have to take every care in their choice of high-frequency chokes, for many of the so-called 5- to 10-metre chokes are only suitable for the 5-metre band.

An Air-spaced Condenser

A .0001-mfd. air-spaced variable condenser couples L2 to L3, and enables the correct amount of regeneration to be obtained. This is a slight variation from the battery circuit as regards capacity, while the condenser is of the air-spaced type. The detector valve is rather tricky and it is not possible to specify merely an H.L. type of valve. The most suitable triode for this position is the Hivac AC/HL, which appears to have ideal characteristics for this type of circuit.

A commercial quench coil is recommended for unless this is accurately wound with a sufficiently high inductance it is not possible to eliminate the high-pitched whistle with a super-regenerative circuit. To make quite sure that the inductance is sufficiently high a fixed capacity of .006-mfd. is connected in parallel with the grid winding, that is, the larger coil. The switch across this winding is to enable the receiver to be converted from a super-regenerative detector to a more or less straight leaky-grid detector.

As the receiver can be used for reception of programme stations, the quality has to be improved from that usually associated with a super-regenerative

Components for
A FOUR-BAND ULTRA-SHORT WAVE RECEIVER

CABINET AND CHASSIS.
1—Cabinet type 1033 (Eddystone).
1—Steel chassis 9¼ by 7½ by 2½ ins. finished black (Peto-Scott).

CHOKES, HIGH-FREQUENCY.
2—Type HF21 (Bulgin).

CHOKE, LOW-FREQUENCY.
1—Type LF14/S (Bulgin).

COILS.
2—4-turn type 1050 (Eddystone).
1—3-turn type 1050 (Eddystone).
3—Bases type 1051 (Eddystone).
1—Quench coil type SW46 (Bulgin).

CONDENSERS, FIXED.
1—.00091-mfd. air-spaced type SW81 (Bulgin).
2—.01-mfd. type 4421/E (Dubilier).
1—.002-mfd. type 4421/E (Dubilier).
1—.1-mfd. type 4423/S (Dubilier).
1—.25-mfd. type 4426/S (Dubilier).
1—.006-mfd. type 4421/E (Dubilier).
1—2-mfd. type BB (Dubilier).
1—25-mfd. 25 volt type 3016 (Dubilier).

CONDENSERS, VARIABLE
1—Type 2140 (J.B.).
1—Type 2146 (J.B.).

DIAL.
1—Type 1027 (Eddystone).
2—2-in. black knobs (Eddystone).

HOLDERS, VALVE.
1—4-pin type SW21 (Bulgin).
1—7-pin type SW51 (Bulgin).

RESISTANCES, FIXED.
1—10,000-ohm type ½ watt (Erie).
1—165-ohm type 2 watt (Erie).
1—20,000-ohm type ½ watt (Erie).
1—2-megohm type ½ watt (Erie).

RESISTANCES, VARIABLE.
1—50,000-ohm type J with switch (Dubilier).
1—500,000-ohm type B (Dubilier).

SUNDRIES.
3—Yards 1 mm. flexible wire (Peto-Scott).
¼—lb. 14-gauge tin copper wire (Peto-Scott).
3—Dozen 4 B.A. nickel-plated round head bolts ½-in. with nuts and washers (Peto Scott).
1—Coupling unit type 1088 (Eddystone).

SWITCH.
1—S80T (Bulgin).

TERMINALS.
5—Type B marked LS+, LS—, earth and aerial (2) (Belling-Lee).

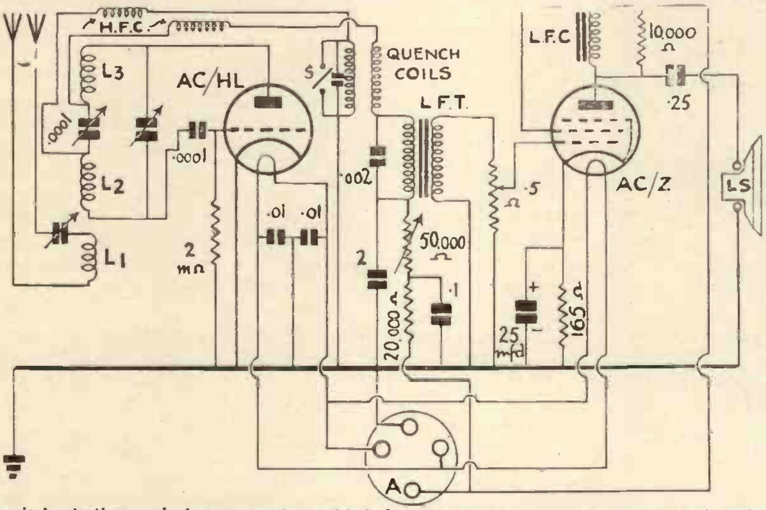
TRANSFORMER.
1—Type AF4 (Ferranti).

VALVES.
1—A.C./HL Met. (Hivac).
1—A.C./Z (Hivac).

Rigid Connections :: Ample De-coupling :: 2.5 Watts Output

circuit, so a high quality transformer has been included. Across the primary of this is a .002-mfd. condenser, the value of which is most important, for a lower value causes the detector valve to oscillate very roughly, and in fact, on the 5-metre band shows slight traces of instability.

High-tension voltage to the detector comes from an external 250-volt supply, through a decoupling resistance of 20,000 ohms, by-passed by .1 mfd., and a regeneration-cum-voltage dropping resistance. The junction of the 50,000 ohms variable regeneration control is by-passed to earth by a 2-mfd. condenser.



This circuit is similar to the battery version published in the March issue but includes indirectly heated valves, a volume control, and gives an output of over 2 watts.

L.F. Volume Control

Across the secondary of the transformer in the battery operated receiver was a ½-megohm fixed resistance. A small variation has been made at this point by the use of a ½-megohm variable resistance which gives the correct shunt effect, and at the same time, makes a most efficient volume control which is needed on the very loud television signals.

Bias for the AC/Z pentode valve is, of course, obtained automatically by virtue of the current flow across a 165-ohm cathode-bias resistance. This is shunted with a 25-volt 25-mfd. electrolytic condenser. The output valve chosen operates with 250 volts on both anode and screen, so there is no need for any screen voltage dropping resistance or decoupling condenser.

Theoretically, owing to the resistance of the output choke there will be a voltage drop on the anode circuit, so that the screen will obtain slightly higher voltage than the anode, but in practice, as the output choke has such a low D.C. resistance, the voltage drop can be ignored. A 10,000-ohm resistance is in parallel with this choke, while a .25-mfd. condenser enables one side of the loud-speaker to be at earth potential.

No H.T. supply has been built into the receiver, for the majority of constructors have a power pack available that will supply sufficient H.T. and L.T. voltage, for any well smoothed unit giving 200 volts at 35 to 40 M/a and 4 volts at 2 amperes, is suitable. The H.T. feed wires from the receiver terminate in a Bulgin 4-way plug, so if the power pack is fitted with a valve-holder instead of terminals the receiver can be plugged into the unit with a minimum amount of trouble. In this way one power pack can be used with a number of receivers.

Construction

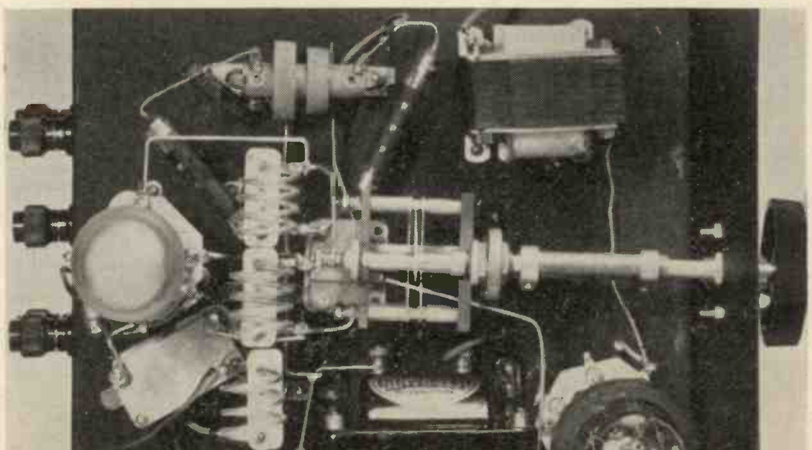
Construction should be divided into three parts. First, the steel chassis has to be bolted on to the panel of the Eddystone cabinet. This panel is, of course, free from the face of the cabinet and is merely fixed in place by 6 4BA bolts.

Five holes, approximately 2BA, have to be drilled on the rear edge of the chassis to take the two aerial, two loud-speaker, and earth terminals. The earth terminal and one side of the loud-speaker are earthed to the chassis, but the remaining three terminals must be carefully insulated.

The tuning dial is also bolted to the panel and not fixed by means of the bush and nut in the usual way. Three holes have to be drilled along the front edge of the panel and chassis to take the volume and regeneration controls and make-and-break switch. On the left-hand side is the 50,000 ohms regeneration control into which is built a two-point switch. This switch is optional, but it enables the mains lead from the power pack to be broken by a panel control without having a separate switch on an external power pack. In no circumstances should the switch be on the volume control potentiometer, for hum is introduced into the grid circuit of the output pentode.

Wiring the Detector

The second section for attention is the detector circuit. The detector valve-holder is raised off the chassis so that the leads to the grid condenser and coils are kept short and that the capacity between the wiring to the valve-holder and the metal chassis is reduced. The three coils, anode-grid and aerial coupling, are also mounted on stand-off insulators, but the coupling between these coils is automatically made correctly providing the ceramic bases on the coils

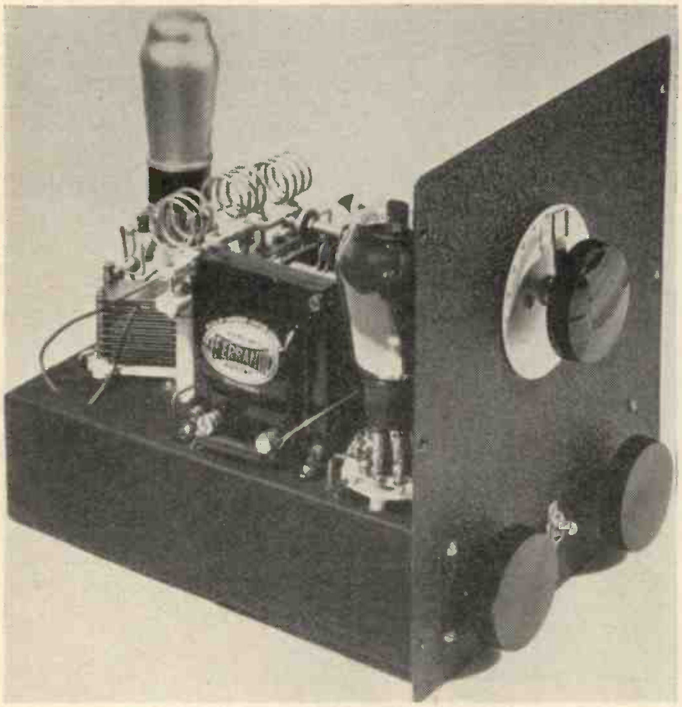


Components should be laid out in the manner suggested, for in this way leads are kept short, and the receiver will cover the wavebands given in the text.

Power Supply :: No Hum :: Straight or Super

are so arranged that there is no gap between them.

The air-spaced .0001-mfd. coupling condenser is mounted in the wiring between the coils and so arranged that the adjusting screw can be got at through the end of the tuning condenser. As can be seen from the illustration of the chassis components, the R.F. chokes are also mounted in the wiring as these are provided with long leads, while the .006-mfd. parallel grid condenser is mounted directly across the two contacts on the quench coil.



A chassis 3 ins. deep is required for the volume controls are mounted under the top plate. Most of the condensers and resistances are also under the chassis so as to keep wiring short.

A Common Earthing Bar

14-gauge tinned copper wire is used throughout and an earth bar goes between the earth terminal to the back of the chassis and the case of the 50,000 ohms variable potentiometer. All earth contacts are then made to this bar, and in this way the suspended condensers and resistances can all be anchored very tightly.

It will be noticed that all of the leads in the detector circuit plus the connections to the grid condenser and leak are kept very short. This is a most important point, otherwise the receiver may not tune down to under 5 metres, as it should, with the specified coils.

On the panel is a make-and-break toggle switch which is connected across the grid quench coil. When this is making circuit, the quench is short-circuited and the receiver functions as a conventional straight detector. It is then suitable for reception of stabilised signals on 5 metres, the television sound programmes and the crystal-controlled amateur and commercial stations on the 10-metre band.

When tuning in 5-metre signals of the unstabilised type, the switch circuit should be broken and the receiver will then function as a super-regenerative with very flat tuning, and, of course, the usual amount of background noise-level. However, checks have shown that transmitters using long-line grid and/or anode tuning can generally be received on the straight receiver, and that it is only the modulator oscillators that need the super-regenerator.

Hum Level

With the separate power pack there is, of course, no possibility of hum being picked up by the inter-valve transformer, as with a receiver having a power pack as an integral part. It should, however, be realised that if the power pack is anywhere near the receiver, or it is intended to use the power pack side-by-side with the reaction, it would be unwise to fix the inter-valve transformer in the position as suggested.

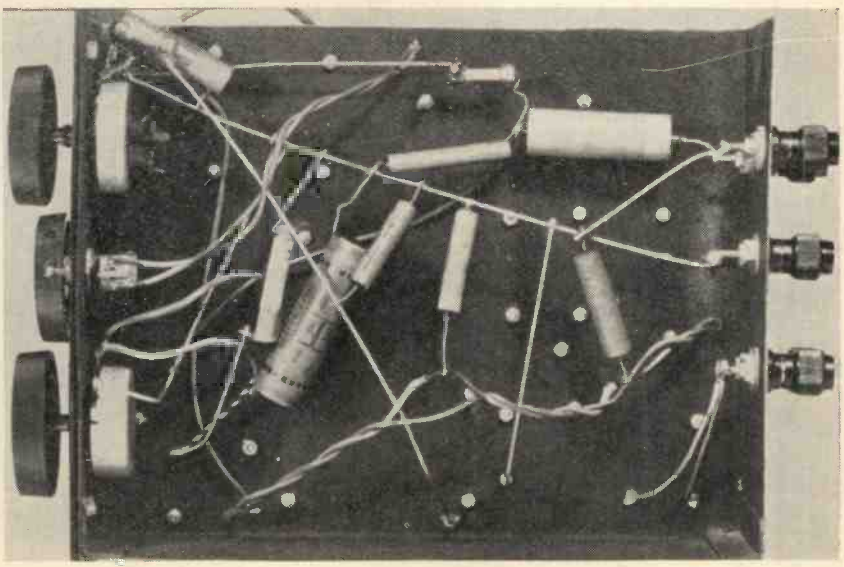
It is recommended that the transformer be left loose until all tests have been made, after which it can be rotated until a position is found where there is no hum pick-up from the power pack. After that it can be fixed to the chassis.

In cases where the receiver is to be used solely for loud-speaker working, such as on television sound programmes, then the constructor can slightly reduce the over-all cost of the receiver by omitting the output choke and .25-mfd. blocking condenser, for most loud-speakers are fitted with a matching transformer which overcomes the need for an output filter circuit. In such circumstances, however, do remember to insulate both loud-speaker terminals from the chassis, otherwise high tension will be applied to the case.

The Best Aerial

Contrary to general expectation, the type of aerial used is not particularly important. On 10 metres a horizontal dipole of the ordinary receiving type is most effective, while the television sound signals can also be received on

(Continued in 3rd column on page 241



This view shows the under-baseplate wiring. The main earth lead can be clearly seen, and to this all by-pass condensers are taken.

A Three-valve 10-metre Super

A small super-het is ideal for 10-metre reception of long-distance phone stations. Malcolm Harvey has designed this receiver which has provided reception of W6 and PK phone signals at good strength.

If a 10-metre receiver for use on amateur bands is to be effective, selectivity must be of a high order, for at the present time this band is full up with stations and is more used for real DX than the 20-metre band.

As far as gain is concerned, straight receivers of two valves or more, appear to be quite satisfactory, but congestion makes it essential that the selectivity be increased to such a degree that the amplification factor drops off to a marked extent.

I did not wish to go to the expense of building a multi-valve super-het, particularly as the gain from such a receiver was not needed. This applies to most amateurs, for the ideal 10-metre set is one having the gain level of a straight set, but with extreme sensitivity.

Super-het Circuit

A three-valve circuit gave all the sensitivity required for headphone use, and almost any station on the 10-metre band can be received reasonably free from interference. Owing to the omission of the low-frequency amplifier, hum level is negligible and the receiver sounds similar to a battery-operated straight set.

The aerial is coupled to the grid coil of the X41 by a three-turn Eddystone coil. The gap between the two coils is as small as possible, but this is governed by the size of the ceramic base provided. An eight-turn coil is needed in the grid circuit, which is tuned by a condenser having a capacity of approximately 5-mmfd. This condenser is a two-plate affair, triple spaced, and gives a reasonable band-spread on 10-metres. Actually the aerial circuit is not tuned in conjunction with the oscillator circuit, but is merely adjusted so that the aerial circuit is resonating in the middle of the 10-metre band.

A 6-turn coil of $\frac{3}{4}$ in. diameter is in the grid-anode circuit of the oscillator, being centre-tapped for H.T. supply, and tuned by a two-section 15-mmfd. condenser. Shunted across the condenser is another fixed capacity of 30-mmfd.

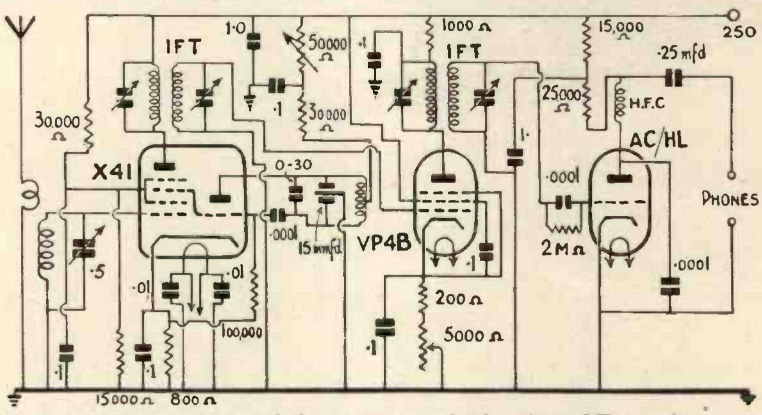
Grid condenser and leak values are important, and best results are obtained with a .0001-mfd. grid-condenser and a 100,000-ohm grid-leak with its earthly side connected to cathode instead of chassis.

To limit the number of controls, voltage to the screen of the X41 is obtained from the main supply through a resistance network of 30,000 ohms on the high side, and 15,000 ohms on the low side. The junction of these resistances is by-passed to earth by a .1-mfd. condenser.

Electron-stream Coupling

All the troubles usually associated with a super-het circuit have been overcome by the use of the X41 triode-hexode valve, which uses electron stream coupling between the oscillator-grid and detector-grid circuits. In no circumstances should the .01-mfd. heater by-pass condensers be omitted, otherwise on strong signals a type of modulation hum is introduced that cannot be removed in any other way. These condensers are mounted directly on the X41 valve-holder.

Both I.F. transformers are home-constructed and unscreened. They have a frequency of 3.5 Mc., so giving a reasonable amount of gain, but not sufficient to cause complete instability owing to the lack of screening. The primary and secondary coils in each transformer are wound on common formers of 1 in. diameter paxolin, and consist of 30 turns of 36 enamelled covered wire wound solenoid and spaced as near as possible the gauge of the wire.



A three-stage super of this kind is ideal on the 10-metre band. As the I.F. transformers are home wound, the cost of the receiver is well within the scope of the average amateur.

Grid and anode connections are at the extreme ends, so that in the centre are the H.T. and earth connections. The gap between these two connections is approximately $\frac{1}{4}$ in. Although it is possible accurately to build these transformers, the external wiring capacity upsets all calculations, so that both primary and secondary are tuned with a 30-mmfd. postage-stamp type of condenser. This is mounted across the coils but can, if they are small enough, be fixed in the top of the actual coil former.

The first transformer is mounted on top of the chassis, and the second transformer almost directly under the VP4B I.F. amplifier. This valve has the grid connection on top, so that it can be taken directly to the secondary of the first transformer. Such a layout makes for short grid and anode leads.

The I.F. Stage

Screening voltage for the VP4B should be 250 volts, so that there is no need for a resistance network, unless the maximum supply exceeds this voltage. Anode voltage on the oscillator section of the X41 is rather critical, and on the average, 100 volts will be found most satisfactory. This voltage can be obtained from the main supply through a fixed resistance of 30,000 ohms and a variable resistance of 50,000 ohms.

I suggest that the 50,000-ohm variable resistance be of dead spindle type, mounted beneath the chassis and pre-set, for there is no need for this control to be variable after the correct voltage has once been obtained. In this way there is only one variable control other than the tuners, and this is in the cathode of the single I.F. amplifier.

Maximum gain is obtained in the I.F. stage with a cathode-bias resistance of 200 ohms, so this value resistance is automatically left in circuit. Gain is controlled by increasing the bias on the valve with the 5,000-ohm variable potentiometer, which is in series with the cathode. This potentiometer need not have an isolated spindle.

C.W. Reception

With the full 250 volts on both anode and screen of the VP4B, it is essential that there be a 1,000-ohm fixed resistance in series with the anode and by-passed to earth with a .1-mfd. condenser. With such an arrangement the I.F. stage goes into oscillation at a position squal to approximately 10 o'clock on the volume control. This is

(Continued on page 250)

Programmes for Short-wave Listeners

By A. C. Weston.

As the Columbia group of stations are using beamed aerials on Europe and have also increased their power, their short-wave programmes are easy to receive. All programmes mentioned in this article are given at Greenwich Mean Time.

SPECIAL stations, new directional aerials and higher power will make the Columbia short-wave stations very simple to pick up in the future. W2XE, the C.B.S. New York station,

"Fats" Waller is featured in Bunny Berigan's Swing Time through Philadelphia.

has a special European aerial which is having the effect of increasing the signal strength by as much as two and a half times in this country. On large receivers where this gain is not so marked, the effect is to give a consistently stable signal, free from fading.

W2XE now has a special European schedule for its three short-wave stations. On 13.9 metres it radiates from 12.30 p.m. to 5 p.m. On 16.8 metres, from 5 p.m. to 6 p.m., and from 6 p.m. till 11 p.m. on 19.6 metres.

Philadelphia on 31.2 metres operates daily from 5 p.m. to 1 a.m., and on 49.5 metres, from 1 a.m. to 4 a.m. The call sign for Philadelphia is W3XAU, and this is a star station for late night Columbia programmes.

During April there are quite a lot of new listings for Philadelphia and New York stations. Below are some of the principal ones which should be worth hearing. Those during the afternoon and early evening are best heard through New York, while the later programmes should be tuned in from Philadelphia.

Major Bowes' Capitol Family, featuring Sam Herman and his Xylophone, Waldo Mayo's Orchestra, and the Dalton Brothers, is a regular Sunday afternoon transmission at 4.30. At 7 p.m. Music of the Theatre, directed by Howard Barlow is always full of surprises, for he persuades numerous guest artists to come along and support him. No one should miss Joe Penner and Gene Austin at 11 p.m. every Sunday night, actually relayed from Hollywood, but they can be picked up through Philadelphia. Not only during April, but for the next twenty-six weeks, Rubinoff, Jan Peerce, and Virginia Rea are on the air at 11.30 p.m. every Sunday. This is an outstanding transmission and is relayed by no less than 104 American stations.

"Betty and Bob," otherwise known as Elizabeth Reller and Lester Tremayne, are a regular feature every weekday at 3 p.m. over Columbia network. This programme is scheduled to continue for 52 weeks. At 6 p.m. on Mondays during April, Five-Star Revue, including Morton Bowe, Meri Bell, and the Hollywood Reporter, is being relayed from New York through W2XE. This is another regular feature.

"Betty and Bob" are very regular broadcasters through New York, generally at 10 a.m. every morning except Sundays.

Col. Jack Major is something of a competitor to Major Bowes, and he certainly puts on a fine variety show every Monday at 8 p.m. Again through W2XE.

The St. Louis Syncopators actually relayed from St. Louis through Columbia network is scheduled for Tuesday nights at 10.30 p.m. This programme can be well received through Philadelphia on its lower wavelength and is worth hearing.

Two good programmes for Wednesdays are the Blue Flames, a mixed quartet that comes on at 10.20, and George Hall and his Orchestra at 11.35. Again, these are both available through Philadelphia.

8 p.m. on Thursdays brings Thursday Matinee, a really hot variety programme that lasts for half-an-hour. This in itself is a good point, for very few American programmes last for more than 15 minutes unless the programme is something out of the ordinary. From Chicago at 8.30 p.m. on Thursdays comes a feature entitled "Do You Remember?" a selection of popular melodies played by a string orchestra. This is again relayed through over 100 stations. Clyde Barrie follows at 11.15, accompanied by a concert orchestra, and he is one of the most popular straight singers on the American radio.

Those who like symphony concerts

Joe Penner and Gene Austin can be heard on Sundays from New York at 11 p.m. The programme is actually relayed in the first case from Hollywood. Joe Penner is sitting at the Piano.

Crosley, N.B.C. and Columbia Programmes

should make a special point of tuning in to the Cincinnati Symphony Orchestra, which has an hour-and-a-quarter, the longest transmission allocated this month to any one item, from 8 p.m. onwards every Friday night. According to reports, this orchestra is comparable with the Chicago Symphony Orchestra, of world-wide fame.

"Time for Buddy Clark," is the unusual title of a feature relayed from New York through W2XE, and the type of programme is also unusual. The material is changed for every broadcast, so for this reason, Buddy Clark's fan mail is on the rise. This is another regular feature.

It's well worth waiting until 1 a.m. to hear "Broadway Varieties," featuring Oscar Shaw, Carmela Ponselle, Elizabeth Lennox, Victor Arden's Orchestra, plus some super guest artists. This is a half-hourly programme and it is followed by Hal Kemp's Dance Orchestra with Kay Thompson, and Hollywood Hotel, starring Fred MacMurray, Frances Langford, Igor Gorin, and Raymond Paige's Orchestra.

"The Dancepators" come on at 7 p.m. on Saturdays and "Tours in Tone" at 8.45 for 15 minutes only. "Saturday Night Swing Club," Columbia's star feature has been changed and now comes on the air at 12 midnight and will include, in addition to Bunny Berigan, "Fatz" Waller, who is to be one of the star guest artists.

All the preceding programmes are Columbia presentations, and no matter from where they are being relayed, can be picked up through either New York, W2XE, and Philadelphia, W3XAU.

The Crosley Radio station, at Cincinnati, on 49.5 metres has a call sign of W8XL. This is the short-wave relay of WLW, the most powerful American station, which uses 500,000 watts. Star presentation from this station is Ray Shannan's "Toy Band." This comes on every Thursday, Friday and Saturday at 10 p.m., and is a completely unrehearsed programme, intended primarily for children and includes in addition to the orchestral programme dramatisations of fables and fairy tales. Unlike the average radio programme, the members of the orchestra, announcer and vocalists, all take parts in these playlets.

"Magic Key of R.C.A." at 7 p.m. every Sunday is a regular programme. "Believe it Or Not Ripley," supported by Ozzie Nelson's Orchestra, is scheduled for 26 weeks, commencing April 4 at 12.30 a.m. every Sunday, and the stations from which to hear these programmes is Boundbrook, on 49.18 metres.

Agnes Moorhead with Phil Baker's Orchestra is a regular Sunday night broadcaster from Philadelphia on its higher wavelength.

The Rochester Civic Orchestra every Monday at 8 p.m., and Ann Hard at 10 p.m. in a programme entitled "Let's Talk it Over," are both receivable from Boundbrook on its lower wavelength. Jackie Coogan has now blossomed into a radio star, and supported by Louise

Joan Marsh very often broadcasts in the Hollywood Hotel hour, but she is scheduled for 10.45 on April 13th.

Massey is scheduled for 1 a.m. on Tuesday, April 20. This time seems a popular hour for star features, for Beatrice Lillie is radiating through Boundbrook on 49.18 at 1 a.m. April 22.

The Singing Lady and her musical plays are worth hearing at 10.30 p.m. on April 21 and April 23, both via Boundbrook on the higher wavelength. Vida Sutton in the "Magic of Speech" at 4.30 on April 24 is another programme for the notebook.

Jeanette MacDonald has linked up with Nelson Eddy and is heard in Vick's Open House, through Boundbrook on 49.18 metres.

Captain Diamond's Adventures make good listening at 8 p.m. through Pittsburg every Sunday. 9.30 p.m. on Mondays brings Johnny O'Brien's Orchestra, again through Pittsburgh. That popular film star, Joan Marsh, is scheduled for 10.45 on April 13 through the N.B.C. blue network, while the Easy Aces at 12 midnight on the same day is really a programme to hear. Harry Kogen's Orchestra is a new one to British listeners, so check up on this transmission at 11.15 p.m. on Wednesday nights, again through Pittsburgh. Austin Wylie is a competitor to Harry Kogen, and he is on the air at 10.15 on Thursday, April 22, and most nights from then on.

Practically all short-wave stations in the N.B.C., G.E.C., and R.C.A. groups are radiating opera from the Metropolitan Opera in New York. This relay is scheduled for 7 p.m. every Saturday in-

(*Continued on page* 250)

Vick's Open House brings Jeanette MacDonald who is singing with Nelson Eddy and supported by Ozzie Nelson and his Orchestra.

French 5-metre Activities

Owing to the lack of information regarding ultra-high frequency research in France, our special correspondent G5UK has been making some investigations to find out how they compare with the other leading countries on 5-metre transmission and reception.

IN order to increase the interest in activity of French amateurs in ultra-short wave working, so that their activities and knowledge could be put to use in time of national emergency, a "Blue Ribbon" of 56 Mc. has been instituted. Amongst the first holders are the following: F8WY, who worked G2FA at a distance of 55 kilo-metres. F8WY used a split Colpitt circuit with 120 watts input and grid modulated. The aerial was a single wire tapped on, while the receiver was the conventional three-valve super-regenerator. The second holder was F8NW, who contacted G2FA on telephony at a distance of 27 kilometres. In this case the transmitter was a push-pull tuned plate, tuned grid circuit with 28 watts input two 45's, and anode modulation. Again a super-regenerative receiver was used with a 2A6-56 and 56.

F8LO was the third holder and he received on phone F8FI and F3JH, who took a transmitter to Corsica specially for the purpose of the tests. The distance was approximately 229.6 kilometres, and F8LO was using a transceiver with 6 watts input to a vertical Zepp aerial, while the station in Corsica used a transceiver with 1 watt only.

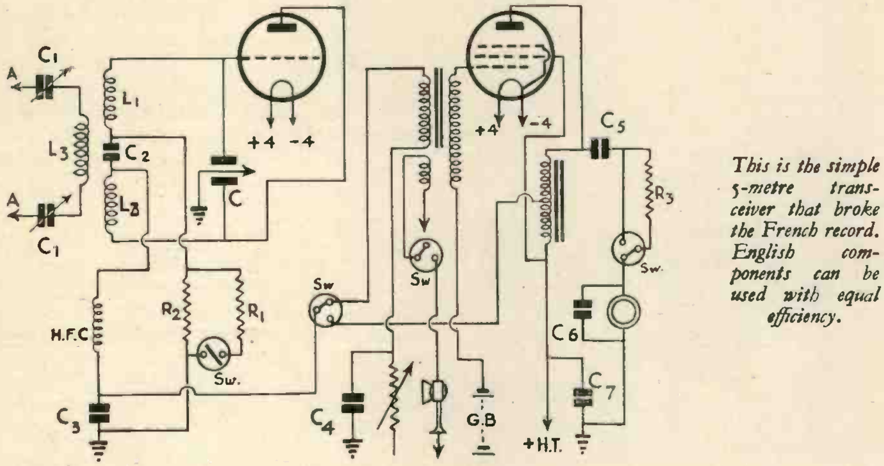
The France-Corsica contact represents a record for French 5-metre working, so that F8LO, F8FI, and F3JH are now the holders of the "Blue Ribbon." These three amateurs had been planning to link Corsica with France for many months, and it was arranged that F8LO would stop at Cannes to listen for F8FI and F3JH as they crossed over on the steamer "The General Bonaparte." Transmissions from the steamer were picked up directly it left the harbour, signal strength increasing up to 35 kilometres. A spot was chosen near Bastia at a height of 800 metres which proved to be quite satisfactory as regards reception.

It is interesting to note that neither stations were in visual range, which is shown by the sketch in this page. F8LO was at A with the second station at C. The direct line A-C goes into the sea at a depth EF equal to 268 metres. Had the stations been at sea level, that is B and D, the depth EG would have been 1,018 metres. This goes to confirm that the 5-metre signals do follow the curvature of the surounding objects and obstacles in the transmission area.

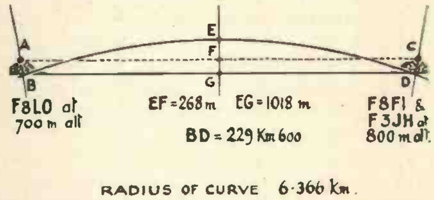
At 13.00 F8LO called on phone and modulated C.W. and was picked up by F8FX in Cannes who was not using an ultra-short wave aerial of any kind. F8LO was then called at 13.30 and his phone signals were heard at full loudspeaker strength for a period of one hour, when the transmission was terminated. The transceivers used were simple two-valvers, as shown in the circuit diagram, with vertical Zepp aerials plus quarter-wave feeders. Power supply was from high-tension accumulators, giving a maximum input of 6 watts.

Component values in this circuit are as follows: L1, L2, 5 turns ½ in. diameter; T1, L.F. transformer with primary winding for microphone; T2, low-frequency auto transformer; R, 50,000 ohms; R1, 3,000 ohms; R2, 40,000 ohms; R3, 100,000 ohms; C1, .0001 mfd.; C2, .00015 mfd.; C3, .0005 mfd.; C4, 1 mfd.; C5, 1 mfd.; C6, 2 mfd.; C7, 1 mfd.; and the tuning condenser a two-section midget of 20 mmfd. per section. Suitable valves are LP2 and a Pen220A with a high output carbon back microphone.

From these notes it appears that only the simplest apparatus is required to put up a satisfactory performance on the ultra-short wavelengths, providing attention is paid to details. Also, schedules are essential if results are to be obtained, while both transmitting and receiving aerials should be of a similar type.



This is the simple 5-metre transceiver that broke the French record. English components can be used with equal efficiency.

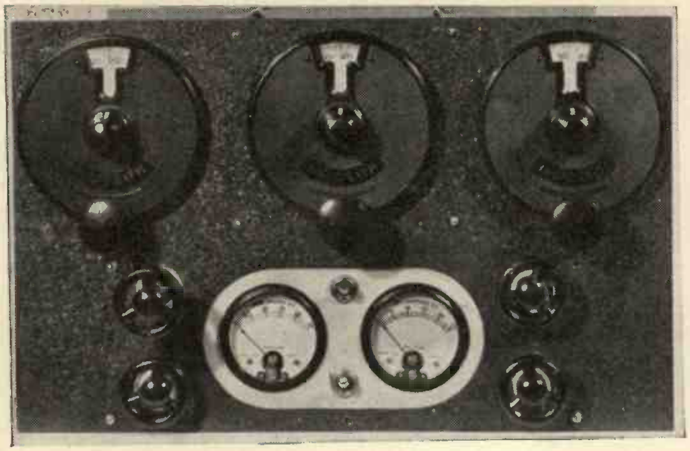


The stations, situated at Cannes and Corsica, were by no means in optical range. This plan gives some idea as to the elevation.

CALLS HEARD

L. F. Stroble, 2626 Sixth Street
Cuyahogo Falls, Ohio, W8BRS.
(14 Mc. C.W.)

4GWF, 4IJH, 4JPK, 4QET, 4VRR, 4XCG, 4YJI, EA3DL, 3EG, 4AO, 4AP, 4AY, 4BM, 5BS, 7AV, 8AB, 8AF, 8AO, EI6F, G2DP, 2MI, 2PL, 2TM, 2TO, 2ZP, 5BJ, 5KG, 5IS, 5LA, 5MP, 5PP, 5QY, 5SO, 5SR, 5YG, 5YH, 6AZ, 6BS, 6DX, 6GN, 6IR, 6JW, 6LK, 6LZ, 6NF, 6QK, 6QX, 6VP, 6VX, 6ZU, GI5QX, GI5UR, HB9J, HB9AQ, HJ3AJ, HJ3AJH, I1TKM, J2HJ, J2LU, K5AC, 5AL, 5AY, 6AJA, 6AKP, 6AUQ, 6BAZ, 6BHL, 6BUX, 6COG, 6GQF, 6FAB, 6HZI, 6IDK, 6JPD, 6LEJ, 7ELM, 7ENA, 7PQ, 7UA, LU2AX, 3DH, 4AJ, 5BZ, 6DG, 7EF, 9AX, NY1AD, NY2AB, NY2AD, ON4CC, 4DS, 4DX, 4HC 4HM, 4NC, 4UU, CA4J, OA4N, OE3FL, OE7JH, OH3NP, OH3OI, OH5NR, OH8NF, OK1BC, OK2AC, OZ2G, OK2AC, OZ2G, OZ2M, OZ4C, LA3B, PAOCE, OMQ, OPF, OQQ, OTSK, OUN, PK1BO, PY1DC, 1DW, 2BB, 2BU, 2BX, 2DC, 2ER, 2MO, 2QD, 5AB, 8QA, 9AH, PZ1AA, SM5SX, SM5WM, TI2FG, TI2AV, U1AL, 1AP, 1CN, 2NE, 3AG, 3CI, 3VC, 3QE, UE3EL, SU1SG, VK2AG, 2AN, 2AS, 2BD, 2BW, 2CP, 2DA, 2DI, 2EO, 2EX, EY, 3GR, 2HL, 2HV, 2IG, 2KR, 2LA, 2LZ, 2MT, 2QU, 2RX, 2UD, 2UU, 2VA, 2WA, 2XA, 3CP, 3CX, 3CZ, 3DD, 3DM, 3GE, 3GP, 3HK, 3HT, 3JB, 3JK, 3JZ, 3KA, 3KR, 3LA, 3MR, 3NM, 3NW, 3OC, 3OW, 3RX, 3WP, 3WW, 3WX, 3WY, 3XP, 3XQ, 3XU, 3ZB, 4GK, 4JC, 4LW, 4US, 5BY, 5FM, 5GW, 5HG, 5JC, 5KL, 5LN, 5LY, 5MD, 5OA, 5RY, 5WR, 5XA, 6AA, 6CA, 6FL, 6SA, 7JB, 7PA, VP1MR, VY1WB, VP2TG, VP2BX, VP5AD.



This receiver is flexible without being complicated, while plug-in coils can be wound to cover all amateur bands and broadcasting if required.

A Metal-valve Communication Receiver

This receiver designed by J. W. Paddon, G21S, uses metal valves with octal bases. The new British valves having similar characteristics are interchangeable with the American valves specified.

THE complete circuit, illustrations showing the component lay-out, and a full specification for the components to be used was given in the March issue. In this article, mainly constructional details are given.

It will be found necessary to adjust the unscreened caps which connect to grid caps of Det.1 and Osc.1. The "cold" end of the I.F. winding is earthed to chassis through a ½ watt 100,000 resistance. It is also by-passed direct to cathode of 6K7 *not* to earth.

A pre-set variable condenser from a Varley I.F. transformer is mounted beside the valve holder on the deck—so permitting adjustment from the top. Centred on this condenser is an untapped iron-cored inductance from the same type of transformer. The inductance is secured to the side of the chassis by a small screw which is "cast" into the hollow end of the core tube of the inductance with sealing wax.

The I.F. regeneration control variable resistance is fixed to the cross partition and driven from the lower left hand control on the front panel. An extension spindle and Eddystone flexible coupling are used.

Coil, condenser and resistance are all connected in parallel, the moving plates of the condenser, the arm of the resistance and the inner end of the inductance being earthed. The suppressor of the I.F. valve 6K7 is connected to the other side of the circuit and in order to obtain a "long" control of regeneration it may be necessary to shunt a resistance across the circuit. This value can only be found by trial and error.

The screen of the I.F. valve 6K7 is by-passed to cathode *not* earth and fed through dropping resistance R from the positive H.T. supply.

A .1-mfd. by-passes the cathode to earth, and the case of the condenser bolts to the chassis, providing an excellent earth. Since this condenser is solidly made and carries a robust top terminal, it serves to support bias resistance R and the grid and screen by-pass condensers C and C.

As in the case of Det.1, valve 6K7 the anode pin of the I.F. valve is positioned as close to the second cross partition as possible. A direct lead is taken through a hole in the partition to the "high" end of the second I.F. transformer primary. This lead is only slightly over an inch long. The "cold" end of this winding is by-passed direct to chassis through condenser C7. A 2,000-ohm feed decoupling resistance is suspended between the top of the 1½ in. Eddystone pillar terminating one of the screened H.T. main feeds.

The "high" end of the second I.F. transformer secondary is connected to the grid pin of the 6C5 det. 2 valve holder. This holder is positioned with the grid pin on the side nearest the transformer. The valve is positioned centrally on the cross dimension of the chassis and the lead from I.F. transformer to grid is screened. The "cold" end of the 2nd I.F. secondary is earthed direct to chassis.

The cathode of 2nd det. valve 6C5 is by-passed through an Eddystone .1 tubular condenser. A 100,000 ohm Dubilier variable cathode resistance is mounted on the back panel of the chassis. This permits the 6C5 to be set on its "anode bend" point. The best point will show .25 m/a on the Det.2 anode milliameter on the front panel. It seems allowable to have this control on the back as it need only be set once for a given H.T. supply.

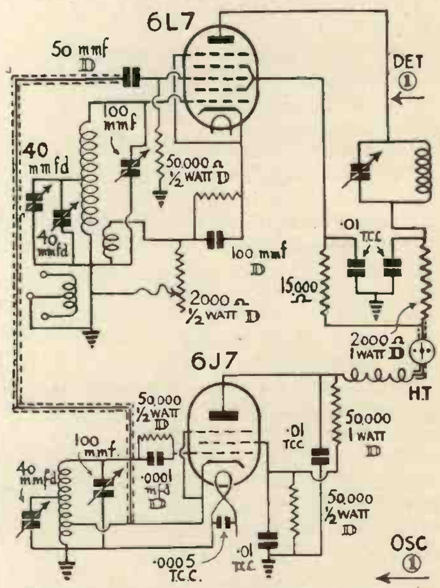
A Bulgin manufactured skeleton choke type SW69 is bolted to the back panel. The outer end of this choke is connected to Det.2 anode and by-passed direct to earth with a Dubilier .0003-mfd. tag type mica condenser. The inner end of the choke is by-passed with a second .0003-mfd. Dubilier condenser. This connection is carried by a 1½ in. Eddystone pillar screwed to the back panel of the chassis. A second Eddystone pillar—suitable spaced—permits the suspension of the 50,000 ohm Dubilier 1 watt anode coupling resistance. The screened feeder from Det. 2 milliameter is made on to the second pillar.

L.F. Stage

A Dubilier 500,000-ohm potentiometer is mounted on the second cross partition. This potentiometer is the L.F. volume control and is actuated by means of an extension shaft and Eddystone flexible coupling.

The .1 mica T.C.C. L.F. coupling condenser is soldered to the top terminal of the potentiometer and to the 1½-in. pillar to which the R.F.C. and the .0003-mfd. C10 are terminated. The bottom terminal of the potentiometer is earthed direct to chassis and the centre or slider terminal is taken direct to the grid of the 6C5 L.F. output valve.

An electrolytic cathode by-pass condenser (25UF at 25 volts) is secured to



The 6L7 valve makes a most effective first detector when used in this circuit. A separate oscillator is a big advantage particularly on the higher frequencies.

the deck by the fixing bolt on its case. This condenser is located in the corner behind the valve holder. The top terminal is the positive one and is connected to cathode of 6C5 L.F. valve, and also serves to support the 1-watt 2,000-ohm bias resistor R8.

The anode is connected direct to plus H.T. through a 50,000-ohm 1-watt resistor R9. This resistance is one of the insulated type having the element encased in a tube of insulating material.

C. W. Reception :: R. F. Gain :: Complete Screening

A B.T.S. jack provides an output position. It is mounted to the left of the Det. 2 bias resistor on the back panel. One side of the jack is taken direct to chassis and the other is taken to anode of 6C5 output valve by means of a tubular non-inductive conddenser C13—the capacity is .5 μf.

Beat-frequency Oscillator

The B.F.O. network is all located below deck in a screened partition of its own. The partition is made by the side wall of the chassis, the first cross partition, the second cross partition and a small side wall fixed between the two cross partitions.

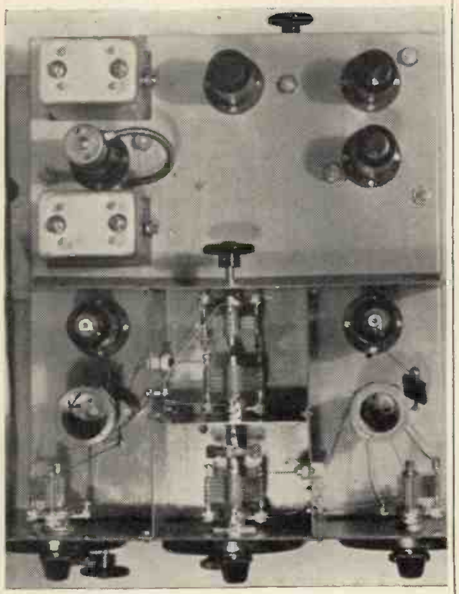
The oscillator valve is a 6C5 triode. It is possible that slightly better stability could have been obtained by using an R.F. pentode at this point, but the necessity of economy in H.T. consumption was more important and besides any " creep " can immediately be corrected by the B.F.O. band-spread condenser VC6. In practice it has been found that the beat is constant over long periods.

The valve holder is centred on the top of the partition. The coil and band set assembly, which is discussed in detail below, is mounted between the valve holder and the side wall. The Eddystone anode by-pass condenser C19 is bolted to the deck slightly behind the valve holder on the other side, with the band-spread condenser mounted on the first cross partition and driven by an extension spindle from the front panel. Due to the necessity of clearing the first oscillator valve holder—which is close to the partition in line with this spindle—it is necessary to use the original type Eddystone flexible coupling.

All parts and wiring of the B.F.O. circuit must be rigid and "positive" to prevent "wobbulation." The B.F.O. inductance is a tapped coil from the same type of Varley I.F. transformer as is used in the I.F. stages. This coil is iron cored and litz wound and is most conveniently tapped one-third of the way up. The band-set condenser is one of the ceramic-insulated air-spaced ones from the same source. A piece of $\frac{1}{8}$ in. brass is shaped into a U bracket with the top of the U drilled to take the condenser and a hole tapped in each side. The ends of the screws grip on to the core of the coil L5 and hold it rigidly in place, and the screws are locked with small nuts and tacked with solder to prevent them loosening. Close the top of the U by a small paxolin plate to which the grid and cathode terminals are fitted.

This coil and condenser unit is secured by means of the condenser bearing sleeve. This sleeve passes through the brass frame and also through a hole drilled in the deck (do not forget to scrape away the enamelling) the fixing nut is taken up tight. Thus the end of the VC5 spindle is accessible for adjustment with a screwdriver (it is slotted for this purpose) from the top of the chassis.

The grid leak assembly C17/R13 is suspended between the grid coil on the top panel of the frame and the grid terminal of the 6C5. Cathode is connected to the cathode terminal on the panel and a heavy lead is taken from this terminal to the stator plates of VC6. The anode of the 6C5 is taken to the top terminal of the by-pass condenser C19. The top of this condenser supports the decoupling resistor R14, the other end of which is terminated in the screened H.T. feed. R14 is of the 1-watt type and may be adjusted until optimum value is found. The idea is to have as little anode voltage reach the B.F.O. valve as possible commensurate with stable oscillation. If this valve oscillates too strongly it will cause trouble due to harmonic pickup.



A good idea as to the lay-out of the components can be obtained from this plan view. Note the screening in the detector-oscillator stages.

A single screened lead couples the B.F.O. to the second detector, and one end of this lead is connected to the stator plates VC6 This lead is then passed through a hole in the side partition and taken under the second cross partition through the same hole as the H.T. supply cable form. The screening of the single lead is bonded to the screening of the H.T. leads at a point close to one of the cable form earth clips.

The other end of the single screened lead is stripped of screening for about an inch, but the insulation over the conductor is left intact, while the unscreened end is bent in a single turn round the grid lead of the 6C5 second detector. This serves as a minute coupling capacity. If, on trial, it is found that the B.F.O. " rushing " noise is too high, this coupling should be reduced until a suitable point is found. When this point is established the place where the two leads are twisted together should be covered with a large drop of " Durofix " to prevent slipping or vibration.

R.F. Stages

A glance at the first part of this article in the March issue clearly shows the R.F. screening which has been made as simple as possible. There are four compartments, and viewed from the front these are: the left-hand assembly which is DET1; the centre assembly consisting of two partitions one behind the other containing the band-spread condensers, and the right-hand partition which is R.F. OSC.1.

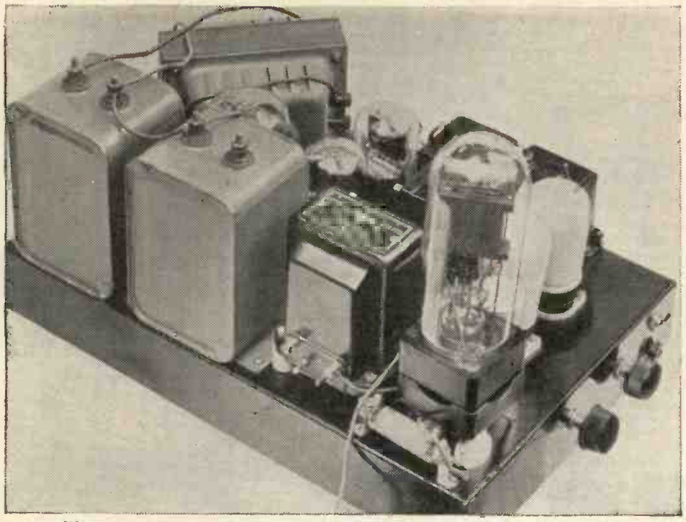
Detectors-1.—The ceramic 7-pin valve holder is supported on two Eddystone $1\frac{1}{2}$-in. pillars. The 6L7 valve holder is immediately behind it. The band-set condenser VC2 is fixed direct on to the front panel. Leads passing through the deck are covered in good sleeving and the holes through which they pass cut oversize to allow ample clearance. When the wires are put in place they are centred in these holes to reduce capacity.

*R.F. OSC.*1.—The lay-out in this partition is identical and the remarks above apply in this case.

Band-spread Condensers

The cross screen of the R.F. stages closes off the back of the R.F. compartments. VC8 is mounted on this screen and protrudes into the back partition. This condenser loads the Det-1 circuit band-spread to give the necessary frequency difference between Det-1 and R.F. Osc.-1 ganged band-spread circuits. The dividing screen of the centre partition carries VC1, which is lined up with VC3 mounted on the front panel, VC3 is driven by the centre vernier dial and is coupled to VC1 by an Eddystone flexible coupling.

An Eddystone ceramic small-size, stand-off insulator with the terminal screw removed is mounted on each side partition opposite the stator plates of the variable condenser. In each case this small inuslator serves as bushing to carry the lead from condenser to valve holder. This precaution was taken with an eye to tropical leakage paths. In most cases it would be adequate to make the lead of stiff wire and pass it through the centre of an oversized hole.



This is the complete speech amplifier and modulator for anode modulation. The variable bias resistor is in the foreground.

The Beginner's Transmitter

By Kenneth Jowers

In our November, December (1936) and January (1937) issues we published constructional details of a suppressor-grid modulated phone transmitter. In this, the concluding article, is the full circuit and also details showing how to anode modulate.

HOW the various units in this transmitter are interconnected can be seen in Fig. 1, which shows the triode crystal oscillator link coupled to two pentodes in push-pull, which are in turn indirectly coupled to the radiating aerial. This section of the transmitter has its own power pack giving 500 volts at 120 M/a., smoothed with one choke plus 8 mfd. of capacity.

The speech amplifier is in the lower half of this circuit, consisting of two HL type valves in a mixer circuit, transformer coupled to a pair of AC/P's in push-pull. The output from these two valves is fed into a 1/1 transformer, the secondary of which is in series with the suppressor grids of the RFP15 pentodes.

In series with the modulation lead are also a high-frequency choke and .002-mfd. by-pass condenser, while across the secondary of the modulation transformer is a 10,000-ohm resistance. Bias is applied mainly by a bias battery, but there is a slight bias obtained by virtue of the current drop across the 10,000-ohm shunt resistance.

High tension for the speech amplifier is obtained from an entirely separate power supply which is completely filtered. It gives 280 volts at approximately 80 M/a, and is smoothed by

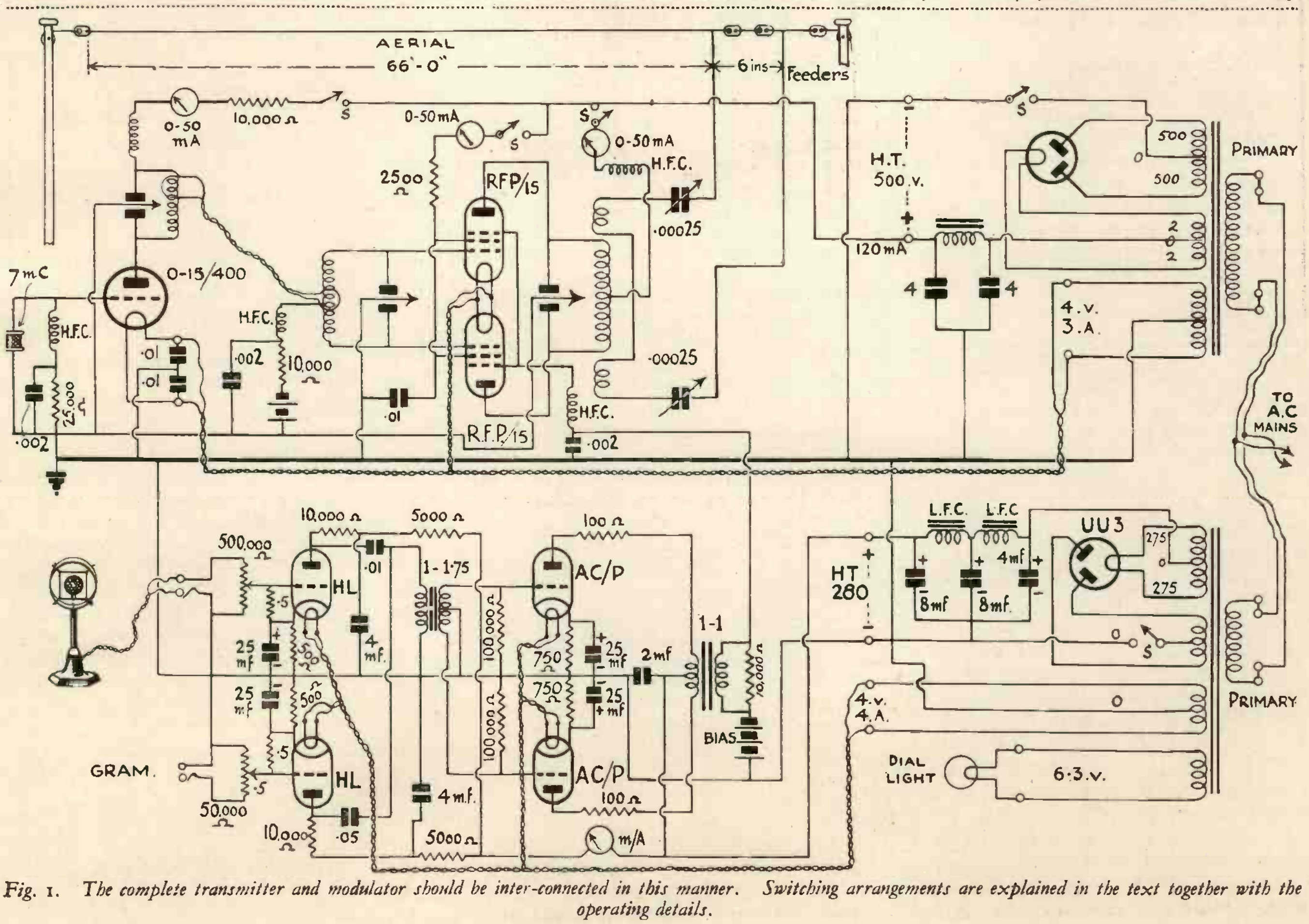


Fig. 1. The complete transmitter and modulator should be inter-connected in this manner. Switching arrangements are explained in the text together with the operating details.

All the Components for the Finished Transmitter

Components for
A BEGINNER'S TRANSMITTER
Power Amplifier Section

CHOKES, HIGH-FREQUENCY.
1—1022 type (Eddystone).
2—Type 1010 (Eddystone).
COILS.
1—7-pin form type CT7 home wound (Raymart).
2—14-turn type 514 (Eddystone).
CONDENSERS, FIXED.
1—.01 type 4421 (Dubilier).
1—.002 type 620 (Dubilier).
CONDENSERS, VARIABLE.
4—.0001-mfd. type 979 (Eddystone).
DIALS.
2—Type 1026 (Eddystone).
HOLDERS, VALVE.
1—7-pin baseboard mounting ceramic (B.T.S.).
2—5-pin baseboard mounting ceramic (B.T.S.).
METERS.
2—0-50 M/a type 2 in. flush mounting (Ferranti)
PLUGS, TERMINALS, ETC.
1—5-way terminal saddle type 997 (Eddystone).
RESISTANCES, FIXED.
2—10,000 ohm type 1 watt (Erie).
1— 2,500 ohm type 3 watt (Erie).
SUNDRIES.
2—Stand-off insulators type ST (Raymart).
2—12 in. lenths ¼ in. glass tubing (Peto Scott).
1—60 volt standard capacity H.T. battery (Vidor)
1—12 in. length 2 B.D. brass studding (Peto Scott).
SWITCHES.
2—Type S80T (Bulgin).
VALVES.
2—RFP/15 (362).

Components or a Beginner's Transmitter.
H.T. Supply Section.

CHOKE, LOW-FREQUENCY.
1—100-m/a. 30 henry (B.T.S.).
CONDENSERS, FIXED.
2—4-mfd. type 17939 (Dubilier).
HOLDER, VALVE.
1—SW21 (Bulgin).
SUNDRIES.
1—Double fuse holder with 1 amp. fuses, type F11 (Bulgin).
SWITCH.
1—S80T (Bulgin).
TRANSFORMER, MAINS.
1—To specification, giving 500-0-500 120 m/a.; 2-0-2 3 amps.; 2-0-2 2.5 amps. (Sound Sales).
VALVE.
1—R4A (Ferranti).

20 mfd. of capacity plus two chokes. Although the valves in the amplifier only need 200 volts, there is a voltage drop across the smoothing chokes, and a certain loss due to the automatic grid bias.

Modulation Percentage

The A.C. output from the two AC/P's is in the order of 2 watts, ample to suppressor-grid modulate the RFP15's up to 80 per cent. The switch in series with the centre-tap to the H.T. transformer in each power pack are linked together so that the transmitter can be switched on without high-tension being applied to the rectifying valves, the centre-tap switches being used to control the transmitter during operation.

No microphone transformer or energising battery has been shown, for this was embodied in the base of the microphone stand. A suitable transformer is the Bulgin midget type LF35 with 1½-volt bias cell in the primary to energise the microphone. This voltage will be ample with the average type of carbon instrument.

Leads both from the microphone to the transformer and from the transformer to the speech amplifier must be fully screened and earthed at both ends of the wire to prevent hum and possible instability. In addition the entire chassis should be earthed at one point.

The beginner who will be limited to an input of 10 watts to the transmitter will have to include a series voltage dropping resistance of the correct value in order to bring the total anode current of the RFP15's down to 20 M/a. It is difficult accurately to give the correct value for this depends on so many constants, so I suggest that the Bulgin resistance type PR38 be used, which is semi-adjustable, so the correct voltage can be obtained and the resistance left at the correct value.

Components for
A PUSH-PULL SPEECH AMPLIFIER

CONDENSERS, FIXED.
1—.01-mfd. mica type B775 (Dubilier).
1—.05-mfd. mica type B775 (Dubilier).
2—4-mfd. type LCA (Dubilier).
1—2-mfd. type LCA (Dubilier).
2—25-mfd. 25 volt type EC4 (Bulgin).
2—25-mfd. 50 volt type EC17 (Bulgin).
HOLDERS, VALVE.
4—5-pin chassis type ceramic less terminals (Clix).
RESISTANCES, FIXED.
2—.5-megohm ½ watt type HW31 (Bulgin).
2—500-ohm. type 1 watt WE10 (Bulgin).
2—10,000-ohm type WE2 (Bulgin).
2—5,000-ohm type WE1 (Bulgin).
2—100,000-ohm type HW25 (Bulgin).
2—750-ohm type 1 watt (Dubilier).
2—100-ohm type 1 watt (Erie).
RESISTANCES, VARIABLE.
1—50,000-ohm type B (Dubilier).
1—500,000-ohm type B (Dubilier).
SUNDRIES.
24—6BA ½-in. bolts with nuts and washers (Peto-Scott).
2—Coils of quickwyre (Bulgin).
1—Dial light type D35 (Bulgin).
2—Type J2 jacks (Bulgin).
SWITCH.
1—S123 (Bulgin).
TRANSFORMERS, L.F.
1—1·1.75 type AF7CS (Ferranti).
1—OPM1c (Ferranti) or
1—DP17 (Varley).
VALVES.
2—AC/HL Met. (Mazda).
2—AC/P (Mazda).

The Completed Transmitter

That is the completion of the transmitter for suppressor-grid modulation, but as the average efficiency with this method is rarely more than 30 per cent., an additional unit to provide enough audio for anode modulation has been designed. Anode modulation will enable the constructor to obtain around 80 per cent. efficiency without much difficulty, but despite this, many amateurs still use suppressor-grid modulation owing to the small speech amplifier required. However, as circuits for both systems are given, either can be used as required.

Components for
THE PUSH-PULL SPEECH AMPLIFIER POWER PACK.

CONDENSERS, FIXED.
2—8-mfd. type 802 (T.C.C.).
1—4-mfd. type 812 (T.C.C.).
CHOKES, LOW-FREQUENCY.
2—60-m/a (Bryan Savage).
TRANSFORMER, MAINS.
1—Special to specification giving 275-0-275 volts 60 m/a; 2-0-2 volts 2 amps.; 2-0-2 volts 4 amps.; 3.15-0-3.15 volts .3 amps. (Bryan Savage).
VALVE.
1—UU3 (Ediswan).

The circuit for anode modulation is shown in Fig. 2. Starting from the beginning, it will be seen that the 1/1 output transformer in the speech amplifier stage has to be exchanged for one having a ratio of 1/1.75 to give a slight voltage step-up. For a modulator valve an Ediswan ES60 is recommended, which runs with 500 volts H.T., and an input of 60 watts. It gives an audio output of approximately 12 watts, just sufficient to give 100 per cent. modulation with 25 watts input to the RFP15's.

A separate power pack supplies the

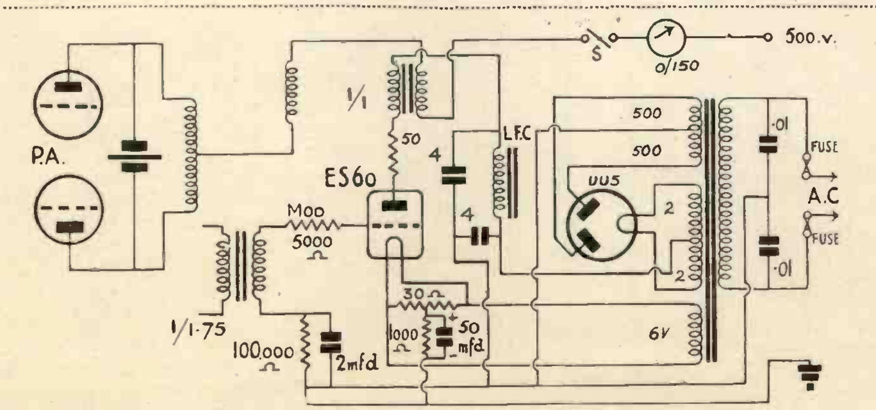
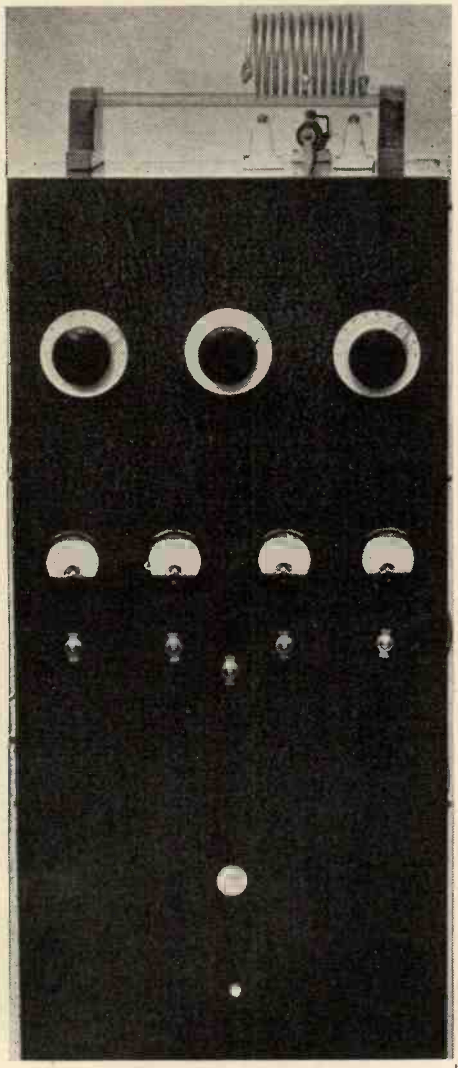


Fig. 2. For those who wish to anode modulate, this is the additional low-frequency stage required.

Tuning Up .·. Cutting The Aerial

500 volts, and this is smoothed by means of one choke plus two 4-mfd. condensers. The output transformer originally in the speech amplifier is now connected in the anode circuit of the



If the specified Eddystone rack is used, the transmitter has a most professional appearance.

ES60. The primary of this transformer feeds into the H.T. supply, while the secondary couples the H.T. to the tank circuit of the two transmitting valves. To prevent oscillation in the modulator stage, a 5,000-ohm resistance is connected in series with the grid, 50 ohms in series with the anode, while the grid is also decoupled with 100,000 ohms and a 2-mfd. condenser.

Bias is obtained automatically. Across the heater of the ES60 is a 30-ohm humdinger which in addition to providing an exact electrical centre tap to the filament transformer, so neutralising hum, is also used as a centre tap of the filament so that the cathode-bias resistance is virtually between filament centre and chassis. This resistance had a value of 1,000 ohms, and to preserve bass response, is shunted with a 50-mfd. condenser.

Tuning Up

After the transmitter has been constructed, wiring checked and the correct voltages applied, the crystal oscillator and power amplifier sections should be tuned up.

With the H.T. switched off to the output stage, the crystal oscillator should be tuned until the current read in the milliameter drops to the lowest possible figure. A single turn loop is then wound around the H.T. end of the coil, also round the centre of the following grid coil. This will completely upset the crystal oscillator tuning, and it should then be returned for minimum current.

Next, tune the grid of the two output valves, still without H.T. being applied to them, until the current in the crystal oscillator stage is drawn to maximum reading. These two stages can then be retuned until the highest minimum current is obtained in the crystal oscillator stage. H.T. can then be switched on to the two pentode valves, and the anode circuit tuned to give maximum aerial current, or to give minimum anode current as read on the 0/50 milliameter in series with the H.T. supply. On 40 metres a 6-turn coupling coil split so that 3 turns are coupled to each end of the anode coil is used. In series with this coupling coil are two 250-mmfd. condensers which should terminate in two stand-off insulators.

Cutting the Aerial

The correct length of aerial is most important, and this can be obtained from a very simple formula. The frequency of the crystal, which is supplied by the makers, should be divided into a fixed constant of 300,000. The answer is multiplied by 1.56, which gives the length of the aerial between the two insulators. The feeders are an odd multiple of the aerial length and for 40 metres are around 49 ft., and spaced approximately 6 ins. apart. Radiation meters are connected in series with the twin feeder as close to the series tuning condensers as possible. All the controls are then readjusted to give maximum current reading in the radiation meters, while H.T. and bias voltages should also be experimented with in an endeavour to increase the efficiency of the transmitter as gauged by increases in radiation.

Modulation must be checked, for the maximum percentage allowable is 100. Assuming the aerial current to be 1 amp, 100 per cent. modulation is obtained when the current can be increased by a little over 20 per cent., when the operator is speaking into the microphone. The theoretically correct value is 22.6 per cent. rise in aerial current.

Aerial current should always rise when the transmitter is being modulated. A downward kick in current indicates incorrect tuning, wrong bias values, or occasionally over-drive due to too many turns or too tight a link coupling.

With the voltages and valves suggested, the transmitter is ideal for the beginner, for it can be used with a low input of 10 watts by the inclusion of a voltage dropping resistance. After six months, when the Post Office generally grant an increase in power to 25 watts, the resistance can be altered to allow for the higher input.

Additional Components for the

ANODE MODULATOR

CHOKE, LOW-FREQUENCY.
1—Type WWC1 (Sound Sales).

CONDENSERS, FIXED.
1—2-mfd. type BB (Dubilier).
2—4-mfd. type LEG (Dubilier).
2—.01-mfd. type 691 (Dubilier).
1—50-mfd. type 3004 (Dubilier).

HOLDER, VALVE.
1—Special type RAF (Premier Supply Stores).

METER.
1—0/150 M/a type flush 2 ins. (Ferranti).

RESISTANCES, FIXED.
1—100,000-ohm type ½-watt (Erie).
1—5,000-ohm type 1-watt (Erie).
1—50-ohm type 2-watt (Erie).
1—30-ohm humdinger (Claude Lyons).
1—1,000-ohm type 10-watt (Bulgin).

TRANSFORMER, MAINS.
1—Type 21C (Wearite).

VALVE.
1—ES60 (Ediswan).

"A Four-band Ultra-short Wave Receiver"

(*Continued from page* 232)

the same aerial. It was, however, noticed that a vertical di-pole cut to approximately 7 metres increases the signal strength on the 7-metre band and is the only satisfactory aerial on 5 metres. All kinds of aerials worked, but the di-pole gives a little more input, which is so necessary on the ultra-high frequency bands.

However, while the receiver is being tested, any length of wire in any direction will provide signals unless the receiver is in a bad position. The input coupling coil is designed for a doublet aerial using the normal 2-in. feeders, which can be of any length, but it is suggested that experiments be made with a doublet aerial fed with Belling-Lee 72-ohm cable.

The only alteration that need be made to the receiver is to omit the series feeder condenser, or to bend the final rotor plate so that it shorts on to a stator plate at maximum capacity. A single turn coil should then be fixed in between the turns of the grid coupling coil and connected to the 72-ohm cable.

It will be noticed that the series aerial condenser is not fitted to the receiver chassis. This condenser is mounted on a bracket close to the feeder and left set.

The Short-wave Radio World

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

A Twin-Triode Mixer

A TWIN-INPUT circuit so that microphone or gramophone can be used independently and the two circuits mixed as required, is a great asset to the experimenter using public-address equipment. Amateurs who transmit quality programmes on the lower-frequency bands will also have need of a duplex input circuit of some kind or other.

The 53 valve or its 6-volt counterpart,

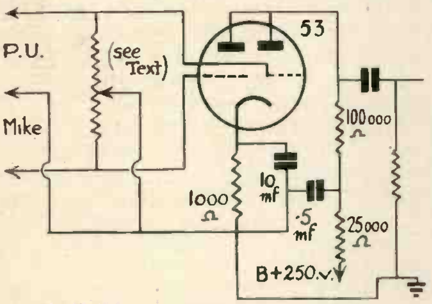


Fig. 1.
Either a 53 or 6A6 valve can be used in this circuit. It is intended that the mixer be added to an existing amplifier in place of the input valve.

the 6A6, seems to have numerous applications, and one of the most important is the fact that it can be used in an amplifying circuit as a split grid strapped anode valve. It is one of the most flexible valves of its kind, and when used as a voltage amplifier has an amplification factor of 35, so that it is possible to realise an effective gain of 25.

The circuit shown in Fig. 1 has been developed by the New Zealand station, ZL3KR, and was published in the "Sydney Bulletin." The potentiometer, which is used as the mixing fader, has a fairly low value of 50,000 ohms. Larger values than this are not suitable because rotation of the control causes volume to increase or decrease too rapidly. This gives an uneven mixing characteristic, full volume being obtained with both input sections at one time with the fader only partly advanced.

Separate volume controls can be used on the two sources of audio input, but although this gives perfect balance there is not the real need for two separate controls. It must be emphasised that the input control must be noiseless, for the slightest rustle is amplified up to quite a high noise-level.

Referring again to the circuit in Fig. 1, it will be noticed that anode decoupling is embodied, consisting of a 25,000-ohm decoupler and a .5-mfd. condenser. To obtain adequate bass response the cathode is shunted with a rather high capacity of 10-mfd. This arrangement can be added to any existing amplifier, providing the following valve has a sufficiently wide grid base to handle the input.

A Valve Modulation Meter

A most interesting circuit for the direct measurement of modulation percentage is described in detail in the January issue of "Electronics." It consists of a valve volt meter which gives a modulation percentage reading by noting the ratio between a D.C. and an A.C. meter.

The principle of operation of the modulation meter can easily be followed by referring to the circuit in Fig. 2, in which D is a diode rectifier of the VD14 type with a 100,000-ohm resistance load to ensure a high degree of linearity in the demodulation of the carrier supplied to the blocking condenser. The rectified current in the load resistance is directly proportional to the high-frequency carrier envelope.

The D.C. component of this current is proportional to the average carrier amplitude and is measured by the D.C. milliameter. Measurement of the A.C. component of the load current is proportional to the carrier modulation and is measured by the A.C. meter in the secondary of the transformer, T.

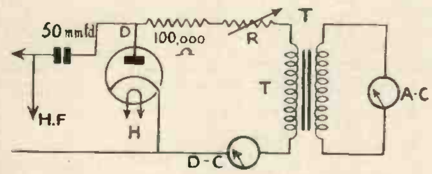


Fig. 2.
Direct reading of modulation percentage can be obtained with this valve voltmeter. The transformer T has a ratio of 1-1.41.

Modulation of a carrier signal applied to the diode rectifier is equal to the ratio of the A.C.-D.C. milliameter readings. The A.C. milliameter is calibrated in R.M.S. values and as modulation is essentially a ratio of peak values, the modulation, M, of a carrier applied to the diode is $\%M = \frac{A\text{-}C}{D\text{-}C} \times 1.41 \times 100$, where A-C is the milliameter reading, and D-C is the D.C. milliameter reading. To save calculation, the 1.41 constant can be omitted by using a transformer, T, with a ratio of 1/1.41, although this transformer was originally intended merely to isolate the copper oxide A.C. meter.

Assuming the correct ratio meter transformer be used, equal readings on both meters indicate 100 per cent. modulation, and other readings equal to the ratio of A.C.-D.C. meter readings.

By adjusting the input carrier until the D.C. meter reads 1 M/a, the modulation factor can be read directly on the A.C. meter. This current adjustment is made by varying the value of the resistance, R.

A Low-cost Oscilloscope

By the introduction of the 913 cathode-ray tube which can be obtained in this country for well under £2, the experimenter is able to construct an effective oscilloscope that is suitable for serious test work. A most effective, but simple circuit, is described in the March issue of the American publication, "Short Wave and Television."

All the components for this circuit are readily obtainable, and it is suitable as it stands for use as a transmitter modulation meter, intermediate-frequency transformer line-up checker, for frequency response measurement, etc.

This type of oscilloscope can also be embodied in a transmitter for constant monitoring, so that improper operating

(*Continued on page 256*)

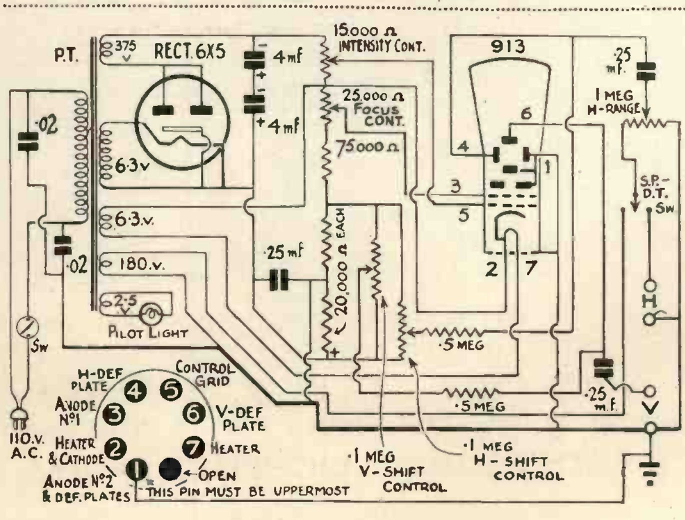
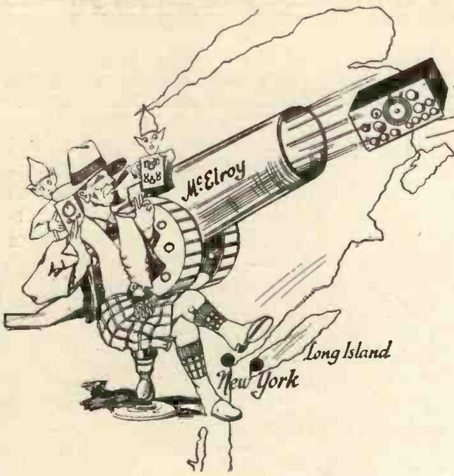
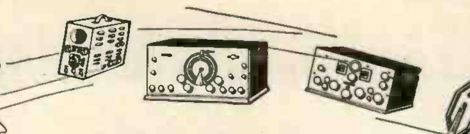


Fig. 3.
Most of the advantages of the larger cathode ray tube are available to the amateur with this 1-in. R.C.A. tube. This is the complete circuit for an oscilloscope.





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Designed by Kenneth Jowers

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VERY few amateurs, service-men or radio dealers, are prepared to go to the expense of building a high-output quality amplifier which invariably needs 1,000 volts or upwards on the final valve. In the past any output of more than 20 watts of audio automatically meant the use of high-power push-pull triodes, or occasionally a single 1,000-volt triode. In either case cost is prohibitive owing to 1,000-volt transformers, similar smoothing condensers and generally mercury vapour rectifying valves, plus a thermal delay switch.

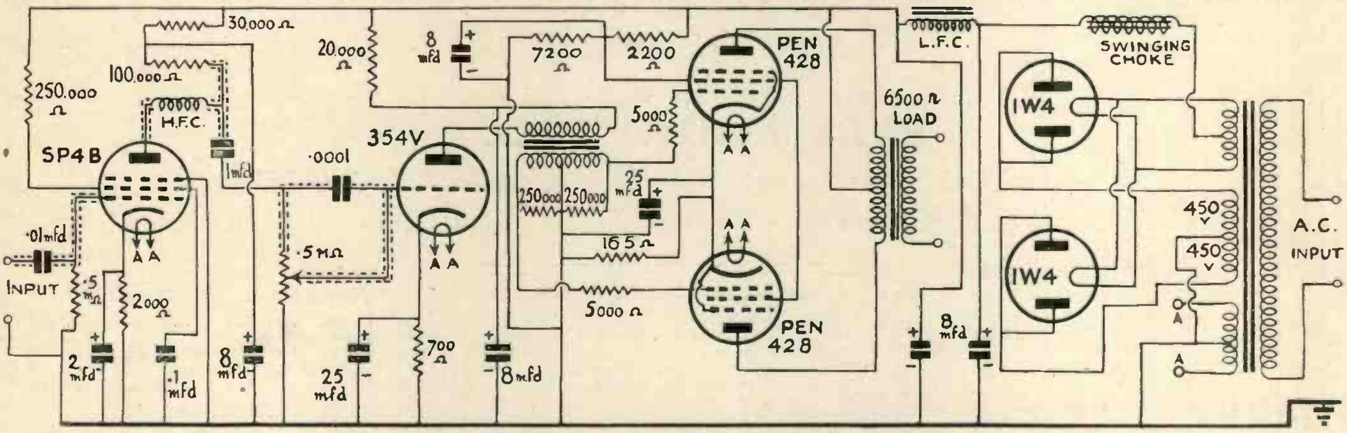
American circuits have for some time been of the low-voltage high-current Class B type which gives almost equal output to the British 1,000-volt triodes with only a feed of 350 to 450 volts. Previously British valves have not been altogether satisfactory in this respect.

Class B

There are, however, at the present time several valves in each maker's range which are suitable for high audio, low-voltage work, and this enables an amplifier to be constructed that is more than enough for large outdoor functions or for modulating transmitting apparatus.

I have already described in preceding issues a Class AB amplifier using triode valves giving an output of 45 watts, but even this was inclined to be expensive for the small service man who wants to make as much money as possible from his public address equipment.

The Mullard Wireless Service Company have recently issued a pentode valve designated the Pen-428 which tests have shown is ideal for low-voltage Class B operation. A pair of these valves working well within their limits are capable of giving an undistorted output of 28-watts with approximately 3 per cent. total distortion.



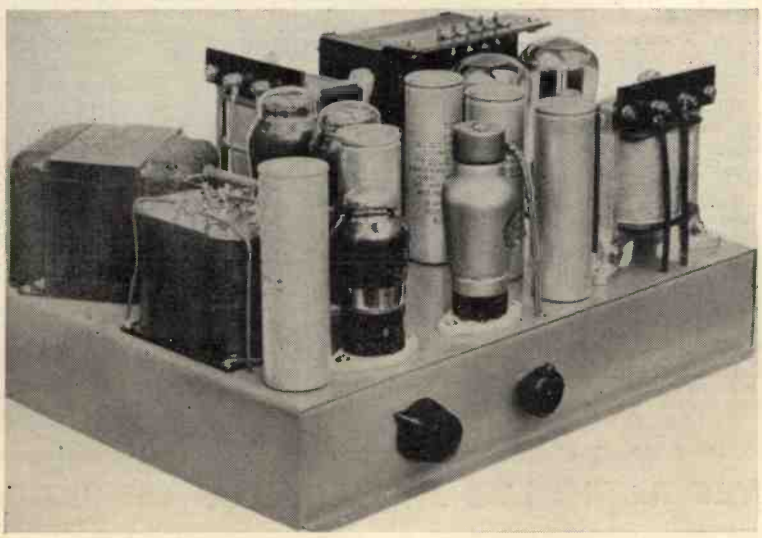
The complete amplifier follows conventional practice although there are many points that have to be considered. These are dealt with in the text, together with information on all component values.

Operating characteristics for a pair of these valves in Class B are as follows:—
Max. anode voltage, 375 volts.
Max. aux. grid voltage, 275 volts.
Normal anode voltage, 375 volts.
Normal aux. grid voltage, 275 volts.
Zero signal anode current, 96 M/a.
Zero signal aug. grid current, 10 M/a.
Max. signal anode current, 124 M/a.
Max. signal aux. grid current, 18 M/a.
Cathode bias resistance, 165 ohms.
Optimum A-A load, 6,500 ohms.
Audio output, 28 watts.

These figures should be compared with the normal operating characteristics of a single valve in Class A to give some idea as to variation in voltage and current. Class A characteristics are as follows:—
Max. anode voltage, 250 volts.
Max. aux. grid voltage, 250 volts.
Cathode bias resistance, 150 ohms.
Anode current, 72 M/a.
Optimum load, 3,200 ohms.
Max. anode dissipation, 18 watts.
Audio output, 8 watts.
Total distortion, 10 per cent.

It will be seen that a pair of these valves in Class A will give approximately 16 watts, so that it is highly advantageous to use the Class B system giving the higher audio.

Refer to the theoretical circuit of the complete amplifier. The first point that may appear at variance with the previous details is the voltage supply from the mains transformer. This special



In the left-hand corner can be seen the anode by-pass condenser, first and second L.F. amplifiers, and the special 2-1 ratio push-pull transformer for giving high-fidelity response.

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AMERICAN VALVES

HIGH-GRADE TRIAD for which we are sole British Distributors. The following types all 5/6 each: 2E5, 6E5, 2G5, 6G5, 6D7, 6E7, 6B6, 1A6, 1C6, 2A3, 2A5, 2A6, 2A7, 2B7, 6A4, 6A7, 6B7, 6C6, 6D6, 6F7 00A, 01A, 11 12, 15, 18, 19, 20, 22, 24A, 26, 27, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39/44, 40, 41, 42, 43, 45, 46, 47, 51, 53, 55, 56, 57, 58, 59, 71A, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 89, V99, X99, 112A, 1VO, 5Z3, 12Z3, 25Y5, 25Z5, 6A6, 185R.

Also **6B5**, High Gain Triode, will give 15 watts per pair in Push-Pull with only 300 anode volts, 5/6 each.

All the new Metal-Glass Octal Base tubes: 6N7, 6L7, 6N6, 6A8, 6K7, 6J7, 6C5, 6Q7, 6F5, 524, 6D5, 6B6, 6H6, 6Z6 (at 6/6 each) 210 and 250, 8/6 each. 4-, 5-, 6- and 7-pin U.S.A. chassis mounting valveholders, 6d. each. Octal Bases, 9d. each.

All the valves specified for the Metal-Valve Communication Receiver in this issue can be supplied from stock.

EUROPA MAINS VALVES

Famous Europa 4 v. A.C. types, H.L., L., S.G., Var.-Mu-S.G., H.F.-Pens., Var.-Mu-H.F. Pens., 1, 3 and 4-watt A.C. directly-heated output Pentodes. Full-wave rectifiers, 250 v. 60 m.a. A.C./D.C. types. 20-volt .18 amp. S.G., Var.-Mu-S.G., H., HL., Power, and Pentode. All 4/6 each. **Following Types.** Full-wave rectifiers, 350 v. 120 m.a. and 500 v. 120 m.a. 2½ watt indirectly-heated Pentodes. Frequency Changers (Octode).

Double Diode Triodes, all 5/6 each.

2½ watt Directly Heated Triodes, 6/6 each.

BATTERY VALVES. 2 volts, H.F., L.F., 2/3. Power, Super-Power, 2/9. S.G. Var.-Mu-S.G., 4- or 5-pin Pentodes, H.F. Pens., Var.-Mu-H.F. Pens., 5/-. Class B, 3/6.

PREMIER'S FAMOUS MAINS TRANSFORMERS

PREMIER wire-end type with screened primaries, tapped 200-250 v. Centre-tapped Filaments. Guaranteed one year. **H.T. 8 & 9** or **H.T. 10** with 4 v. 4 a. C.T. and 4 v. 1 a. C.T., **8/6. 250-250 v. 60 m.a.** or **300-300 v.**, 4 v. 1 a., 4 v. 2 a. and 4v. 4 a., all C.T., **8/6. 350-350 v. 120 m.a.**, 4 v. 1 a., 4 v. 2 a. and 4 v. 4 a., all C.T. **10/6.** Any of these transformers with engraved panel and N.P. terminals, **1/6 extra. 500-500 v. 150 m.a.**, 4 v. 2-3 a., 4 v. 2-3 a., 4 v. 2-3 a., 4 v. 3-4 a., all C.T., **17/6.**

Super-shrouded model, **21/-.** 500-500 v. 200 m.a., 5 v. 3 a., 4 v. 2 a., 4 v. 2 a., 4 v. 3-5 a., all C.T., **25/-** (for use with 83 or 523 rectifier, cost only 5/6 to obtain 500 v. 200 m.a. 500-500 v. 150 m.a., no L.T.'s, **12/6.** 1,000-1,000 v. 150 m.a.) no L.T.'s, **19/6.**

SPECIAL OFFER. 350-350 v. 120 m.a. wire-end transformers with 4 v. 2 a. 4 v. 3-5 a., all C.T., **9/6** each.

AUTO TRANSFORMERS, step up or down, 60 watts, **7/6**; 100 watts **10/-.**

SPECIAL OFFER PHILLIPS MAINS TRANSFORMERS. 250-250 v. or 300-300 v. at 80 m.a 4 v. 5 a., C.T.: 4 v. 1 a. Tapped Primary 100-250 volts, **6/11.** 450-450 v. at 150 m.a. or 500-500 v. 100 m.a. 4 v. 4, a. C.T.: 4 v. 4 a. and 4 v. 3 a. Screened Primary. Tapped input 100-250 v. **12/6.**

FILAMENT TRANSFORMERS, Tapped Primaries, 200-250 v. All secondaries C.T. 4 v. 3 a., **7/6**; 4 v. 5 a., **8/6**; 7.5 v. 3 a., **7/6**; 6 v. 3 a., **7/6**; 2.5 v. 8 a., **7/6**; 6.3 v. 3 a., **7/6**; 5 v. 3 a., **7/6.**

SMOOTHING CHOKES, 25 m.a. **2/9**; 40 m.a., **4/-**; 60 m.a., **5/6**; 150 m.a., **10/6.** 2 500 ohms, 60 m.a. Speaker Replacement Chokes, **5/6.** 250 m.a. Chokes, **21/-.**

GIANT MULTI-RATIO OUTPUT TRANSFORMERS. 5 ratios—1 : 1, 1.5 : 1, 2 : 1, 2.5 : 1 and 3 : 1, **5/6** each.

COSSOR NEON TUNING INDICATORS, 3/6 each.

.05 MICA CONDENSERS, 500 v. working **1/-** each.

PREMIER L.T. CHARGER KITS for A.C. mains, including Westinghouse Rectifiers and Tapped Mains Transformers. 8 volts at ½ amp., **14/6**; 8 volts 1 a. **17/6**; 15 volts 1 a., **19/-**; 15 + 15 volts 1 a., **37/6**; 15 + 15 + 15 volts 1 a., **50/-**; 8 volts 2 a., **29/6.**

TELSEN iron-cored screened coils, W.349, **4/-** each.

Electric **SOLDERING IRONS**, 200-250 v. A.C./D.C., **2/3.**

LOTUS JACKS (and Jack-switches), all types, **1/-** each. Lotus Plugs, **1/-** each.

U.S.A. MIDGET 2-GANG (2 × .0005) **CONDENSER** with trimmers 3½ in. wide, 2¼ in. long, ¼ in. spindle, ⅜ in. long. **3/6** each.

SHORT-WAVE KITS

NEW 1937 1-VALVE SHORT-WAVE RECEIVER OR ADAPTOR KIT 13 to 86 metres without coil changing. Complete Kit and Circuit, **12/6. VALVE GIVEN FREE!**

DE LUXE MODEL 14 to 150 metres, complete Kit with Chassis, 4 Coils and all parts, **17/6. VALVE GIVEN FREE!**

SUPERHET CONVERTER KIT, 13/6.

DE LUXE MODEL, 18/6.

S.W. SUPERHET CONVERTER, for A.C. Mains Receivers, **20/-.** A.C. Valve given **FREE!**

A.C./D.C. S.W. SUPER-HET CONVERTER, 14-50 metres. Completely self-energised. Will operate with any Receiver, **30/-. VALVE GIVEN FREE**

NEW 1937 2-VALVE S.W. KIT, 13 to 86 metres without coil changing. Complete Kit and Circuit, **19/6. VALVES GIVEN FREE! DE LUXE MODEL**, 14 to 150 metres, complete Kit and Chassis, 4 Coils and all parts, **25/-. VALVES GIVEN FREE!**

3-VALVE S.W. KIT, S.G., Det. and Pen., **42/-. VALVES GIVEN FREE!**

BAND-PASS TUNING PACK, comprising set of Telsen 3-gang iron-cored coils with switching, mounted on steel chassis with 3-gang condenser, illuminated disc-drive and 4 valve holders. **25/- the lot.** All Mains or Battery circuit. **FREE!**

3-VALVE BAND-PASS KIT, 200-2,000 metres. Complete kit of parts, including chassis, all components, valves, M.C. speaker and wiring diagram. Battery Model, **50/-.** A.C. Mains Model, **70/-.**

LISSEN ALL-WAVE COILS, 12-2,000 metres, complete with switching and wiring diagram. **Special Offer, 6/11.**

1936 TELSEN 3-gang iron-cored Band-Pass coils with integral switching. 200-2,000 metres, **12/6** set.

HIGH-GRADE Litz-wound I.F. Transformers with dual ceramic trimmers, 465 kc., **5/6** each.

PREMIER HIGH-FIDELITY P.A. AMPLIFIER KITS

3-WATT A.C 2-stage **AMPLIFIER** for Mike or Pick-up. Complete Kit of Parts with 3 valves, **40/-.**

7-WATT A.C./D.C. 3-stage **AMPLIFIER.** High-Gain, Push-Pull output. Complete Kit of Parts with 5 matched valves, **£4 4s.**

10-WATT A.C. 3-stage **AMPLIFIER** incorporating Phase-Inversion and Push-Pull Triodes. Enormous gain and straight line reproduction. Complete Kit of Parts, including 5 matched valves, **£5 5s.**

20-WATT A.C. 3-stage **AMPLIFIER**, suitable for largest dance hall. Employs new Giant Speech Transformer to ensure perfect reproduction. Complete Kit of Parts with 5 matched valves, **£8 8s.**

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Reisz pattern. Large output, exceptionally fine frequency response with low hiss level. Frequency range, 45-7,500 cycles, plus or minus 2DB, 30/-. Transformer, 5/-; Table Stand, 7/6; Adjustable Floor Stand, 22/6.

ELECTROLYTICS. U.S.A., 4 or 8 mfd. 530 v. peak, **1/9** each. **Dubilier**, 4 or 8 mfd. 500 v., **3/-**; 50 mfd. 50 v., **1/9**; 10 mfd. 50 v., **6d.**; 25 mfd. 25 v., **1/-.** T.C.C. 8 mfd. 650 v., **4/-**; 15 mfd. 50 or 100 v., **1/-**; 50 mfd. 12 v., **1/-. Paper Condensers.** W. E.,250 v. working 4 mf., **2/-**; 2 mf., **1/-**; 1 mf., **6d.**; 350 v. working 4 mf., **2/6**; 2 mf., **1/6.** Dubilier 500 v. working 4 mf., **4/-**; 800 v. 4 mf, **6/-.**

Wego 450 v. working, 2 mf., **1/9**, 4 mf., **3/-**; 700 v. working 2 mf., **2/-**, 4 mf., **3/6.**

Dubilier Oil-filled Condensers. Complete range in stock up to 3,000 volts working.

DIALS.—Clarion Illuminated S.W. slow-motion Dial with 2-in. knob, **2/-. Premier** All-Wave 2-speed Dial, full vision straight-line, dual ratios 10-1 and 150-1, **6/6**, with escutcheon.

Potentiometers by well-known makers. All values up to 1 meg., **2/-**; with switch **2/6.**

TRANSFORMERS, latest type Telsen R.G.4 (list 12/6) **2/9.** Lissen Hypernik Q.P.P. (list 12/6), **3/6.**

OUTPUT TRANSFORMERS for Power or Pentode, **2/6**; Multi-Ratio, **4/6.**

ELIMINATOR KITS for A.C. mains. 120 v. 20 m.a., or 150 v. 25 m.a., **15/-**, tapped S.G. det. and output. Complete kit with long-life valve rectifier (replacement cost only 2/-).

PREMIER H.T. KITS, all with Westinghouse rectifiers; tapped transformers and adequate smoothing. All Kits absolutely complete. 120 v. 20 m.a., **20/-**; with ½ a. L.T. Charger, **28/-.** 150 v. 30 m.a., **25/-**; with ½ a. L.T. Charger, **31/6.** 250 v. 60 m.a., with 4 v. 3 a. C.T., **30/-.**

SHORT-WAVE COMPONENTS

SHORT-WAVE COILS, 4- and 6-pin types, 13-26, 22-47, 41-94, 78-170 metres, **1/9** each, with circuit. Special set of 3 4-pin S.W. Coils, 14-150 metres, **4/-** set, with circuit. Premier 3-band S.W. Coil, 11-25, 19-43, 38-86 metres. Simplifies S.W. receiver construction, suitable any type circuit, **2/6.**

COIL FORMERS, in finest plastic material, 1½ in. low-loss ribbed, 4- or 6-pin, **1/-** each.

SUPER CERAMIC CONDENSERS, S.L.F. .00016, .0001, **2/9** each; double-spaced, .00005, .000025 .000015, **3/-** each. All brass with integral slow motion, .00015 tuning, **3/9**; .00015 reaction, **2/9.** British Radiophone 2-gang .00016, **5/6.**

H.F. CHOKES. S.W. 10-200 metres, **9d.**; S.W. screened, **1/6**; standard screened 180-2,000 metres, **1/6.**

CERAMIC S.W. VALVE HOLDERS, 4-, 5- or 7-pin. Chassis type, **6d.**; B.B. type, **8d.**

GLASS AERIAL INSULATORS, 4d. each.

BEEHIVE STAND-OFF, 6d. each.

SCREENED FLEX, single, **3d.** yd. Twin, **4d.** yd.

METERS

MOVING-IRON flush type milliamp meters in 2¼-in. Bakelite Case, to read A.C. or D.C. **Ranges**, 10, 20, 30, 50, 100, 150, 250 and 500 m.a., also 1, 3, 5 and 10 amps., 6, 16 volts all **5/9** each. 0-250 v., **8/6.**

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VOLTAGE MULTIPLIERS, any value, **1/-** each. Tapped milliamp shunts for 10, 50, 100 and 200 m.a., **4/-** each.

TELSEN MULTIMETERS. An extremely useful multi-range meter reading A.C. and D.C. Ranges, 8 v., 16 v., 240 v., 30 m.a. and 300 m.a., **8/6** each.

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All fitted with Output Transformers

MAGNAVOX. Mains energised. "154," 7-in. cone, 2,500 ohms 4 watts, **12/6**; "152," 9-in. cone, 2,500 ohms, **17/6**; "152 Magna," 9-in. cone, 2,500 ohms 6 watts, **37/6. Magnavox** P.M.'s—"254," 7-in. cone, **16/6**; "252," 9-in. cone, **22/6.**

ROLA latest type P.M.'s, **15/-. GOODMANS'** 8-in. mains energised, 1,000 ohms field, **10/6** each.

JENSEN P.M. Speakers, **10/6. R. and A.** energised Speaker, 7½-in. diameter, 2,500 Ω field. Pentode Transformer, strongly recommended, **11/6.**

ENERGISING UNIT for any above energised speakers, **10/-.**

MAGNAVOX "33," "33 Duodes" and "66" Speakers can always be supplied from stock.

SPECIAL OFFER of large B.T.H. energised Moving Coils. 10½ in. diam., 1650 Ω field. Power or Pentode Transformer (state which required), **14/6.**

GRAMOPHONE MOTORS

COLLARO Gramophone Unit, consisting of A.C. motor, 100-250 v. high-quality pick-up and volume control, **45/-**; Collaro motor only, **30/-**; Collaro Universal Gramophone Motor, 100-250 v. A.C./D.C., with high quality pick-up and volume control, **67/6**; Collaro Universal Motor only, **49/6**; **EDISON BELL** double-spring motors including turntable and all fittings, **15/-**; **COSMOCORD** Gramo. unit, comprising A.C. motor pick-up and volume control (list 55/-), **35/9.**

COSMOCORD PICK-UPS, with tonearm and volume control, **10/6** each.

PICK-UP HEADS only, **4/6** each.

TUBULAR CONDENSERS, non-inductive, all values up to .5 mfd., **6d.** each.

Wire-end **RESISTORS**, any value, 1 watt, **6d.**; 4 watts, **1/-**; 8 watts, **1/6**; 15 watts, **2/-**; 25 watts, **2/6** each.

Reliable **MORSE KEYS** with Morse Code engraved on bakelite base, **2/-** each.

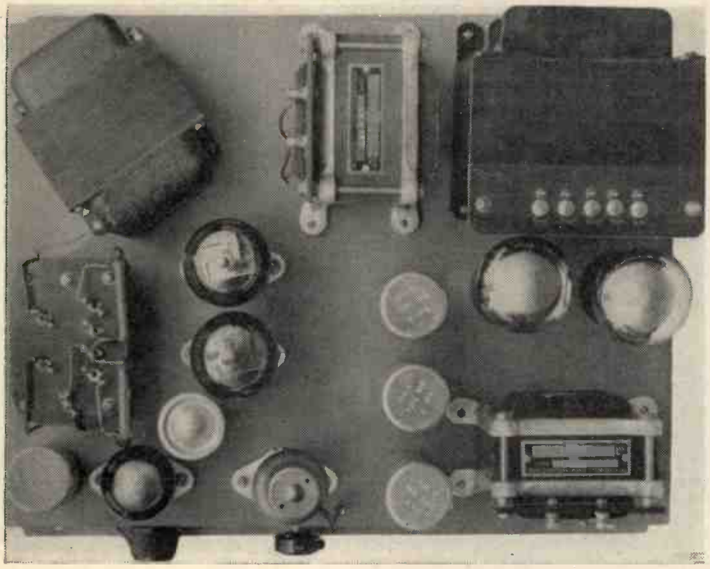
Bakelite case **BUZZERS, 1/6**; Walnut case "Loud-tone," **2/6** each.

Super Quality lightweight **HEADPHONES, 3/9 pair.**

TELSEN BINOCULAR H.F. CHOKES, Bakelite case, 200-2,000 metres, **1/3** each.

Screened Heater Leads :: 3 Pentodes :: Low Hum Level

transformer has a secondary giving 450-0-450 volts into a pair of strapped IW4 rectifiers. As the maximum anode voltage on the Pen.-428's must not exceed 375, it is obvious that the excess voltage of 75 volts must be dissipated. This is done quite simply by the fact that automatic bias is employed taking up the bulk of the excess voltage, while the balance is lost across the swinging and smoothing chokes even though these are of a special type of low D.C. resistance.



A plan view gives a comprehensive idea as to the lay-out of the components. It is important that the chokes, inter-valve and output transformers be arranged as indicated, as otherwise there is a possibility of hum pick-up.

Special H.T. Pack

It is important that the voltage applied to the Pen.-428's be as steady as possible despite the fact that there is a variation in total anode current. This immediately cuts out the possibility of using a capacity input circuit which gives a higher voltage but poor regulation. For this reason the swinging choke precedes the normal filter circuit and as the total resistance of the supply unit is of a low order, the total variation in anode voltage is only approximately 15 volts between minimum and maximum current flow.

I cannot stress too strongly the fact that a standard 450-volt power pack with a resistance of up to 500 or 600 ohms is absolutely unsuited for Class B operation, not only in this particular amplifier, but in every circuit of a similar type where there is fluctuating current. In addition, when the current flow changes beyond certain limits automatic bias is also impossible.

However, in this circuit as the current change is not particularly great, the use of automatic bias is permissible, so for this reason the cathodes of the Pen.-428 valves have been joined together and connected to earth through a 165-ohm bias resistor shunted by a 25-mfd. capacity.

Consider the applications of the circuit as a whole. It has been designed so that the overall gain permits the use of a low output microphone without the need for an intermediate head amplifier. A microphone of the Reisz type fed into the grid circuit of the SP4B through approximately a 1-20 step-up transformer will load the input valve so that the overall gain will result in a final output of 28 watts.

Input Required

Consequently a pick-up giving an output of .5 volt can be fed directly into the grid without step-up transformer, and in certain circumstances will need an additional volume control to prevent overloading of the SP4B. This valve, if operated under optimum conditions, gives an extremely high stage gain, but the resistance values are critical.

The control grid is tied down to earth through a .5-megohm resistor, while bias is obtained automatically by virtue of the current flow across a 2,000-ohm resistor. Those values are more or less conventional, but to obtain the correct screen voltage, the maximum supply is stepped down by a 250,000-ohm resistor of the conventional potentiometer network.

The nearest one can get to matching the external load to the A.C. resistance of the valve is 100,000 ohms. This is by no means correct theoretically, but too high a value causes a voltage drop which counter-balances any possible increase in gain there might be due to correct load matching. Tests have shown that 100,000 ohms is the best compromise value.

Decoupling in the anode circuit is essential and 30,000 ohms plus an 8-mfd. condenser is most satisfactory. An H.F. choke is included in the anode circuit of the SP4B and this is essential when the amplifier is used with a microphone. It seems unnecessary with the pick-up input so this point should be borne in mind.

A high-value coupling condenser of 1-mfd. gives a slight bass boost, whilst the .0001-mfd. between the grid and top end of the potentiometer in the 354V grid circuit gives considerable top note boost. This grid potentiometer acts as a volume control to prevent overloading of the 354V, for with a gramophone

Components for
A PEN-428 HIGH-QUALITY AMPLIFIER

CHASSIS.
1—Steel 15½ by 11½ by 2½ ins. finished grey with baseplate (Burne-Jones).

CHOKE, HIGH-FREQUENCY.
1—SW69 (Bulgin).

CHOKE, LOW-FREQUENCY.
1—25-henry type 25/180 (Sound Sales).
1—Swinging choke type 74/S (Sound Sales).

CONDENSERS, FIXED.
1—.0001-mfd. type M (T.C C.).
1—.01-mfd. type tubular (T.C.C.).
1—2-mfd. type FT (T.C.C.).
1—.1-mfd. type 50 (T.C.C.).
4—8-mfd. type 805 (T.C.C.).
2—25-mfd. type FT (T.C.C.).
1—1-mfd. type 250 (T.C.C.).

HOLDERS, VALVE.
3—7-pin type chassis less terminals (Clix).
2—4-pin type chassis less terminals (Clix).
1—5-pin type chassis less terminals (Clix).

PLUGS, TERMINALS, ETC.
2—Terminals type B marked output (Belling-Lee).
1—Single circuit jack type J2 (Bulgin).
1—Plug type P15 (Bulgin).

RESISTANCES, FIXED.
1—.5-megohm ½-watt (Erie).
1—250,000-ohm 1-watt (Erie).
1—2,000-ohm 1-watt (Erie).
1—100,000-ohm 1-watt (Erie).
1—30,000-ohm 1-watt (Erie).
1—700-ohm 1-watt (Erie).
1—20,000-ohm 1-watt (Erie).
2—250,000-ohm ½-watt (Erie).
2—5,000-ohm ½-watt (Erie).
1—165-ohm 3-watt (Erie).
1—3,000-ohm type PR8 (Bulgin).
1—7,500-ohm type PR10 (Bulgin).

RESISTANCE, VARIABLE.
1—500,000-ohm type B (Dubilier).

SUNDRIES.
1—Coil screened connecting wire type WS2 (Bulgin).
2—Coils Quickwyre (Bulgin).
1—Screened anode connector type 1234 (Belling-Lee).
3—Dozen ½-in. nickel-plated round head 4 B.A. bolts with nuts and washers (Peto-Scott).

SWITCH.
1—S126 (Bulgin).

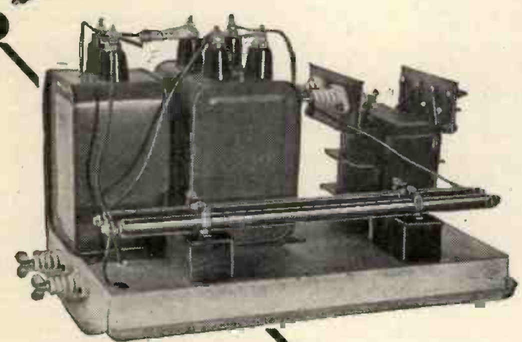
TRANSFORMER, LOW-FREQUENCY.
1—Special 1/2 ratio type PP2/1 (Bryan Savage).

TRANSFORMER, OUTPUT.
1—Special for 6,500-ohm load type 28/OP (Bryan Savage).

TRANSFORMER, MAINS.
1—Special, giving 450-0-450 volts 180 m/A.
2-0-2 volts 5 A.
2-0-2 volts 6 A.
type 28/MT (Bryan Savage)

VALVES.
1—SP4B Met. (Tungsram).
1—354V Met. (Mullard).
2—Pen-428 (Mullard).
2—IW4 (Mullard).

3,000 VOLTS for television tubes



Typical power pack for cathode-ray tube. Output 3,000 volts 2mA.

The "J" type Westinghouse Metal Rectifiers have a current output of 2mA and have been specially designed for use in television power packs.

They should be used in series, and two J.176 units will give an output of 3,000 volts. They enable the unit to be made very compact, and have the advantage that they will need no renewal. Full details are given in "THE ALL METAL WAY, 1937." The attached coupon and 3d. in stamps will bring you a copy.

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Microphone or Pick-up Input :: Checking The Voltages

pick-up fully loading the SP4B, the gain is more than sufficient to cause overloading of the 354V without the intermediate volume control. Full gain, however, is needed with the average microphone.

Screening

Notice how the anode circuit in the first stage and the succeeding grid circuit are completely shielded. This is a most important point, for owing to the closeness of the two circuits and the A.C. heater wiring, hum may be introduced. At this point it would be well to mention that all heaters are interconnected by twin shielded wires earthed at both ends, and though to some, this may seem unnecessary, it accounts for the complete absence of hum even with full gain.

Bias for the 354V is again obtained automatically by a 700-ohm resistor in the cathode circuit shunted by 25-mfd. A special inter-valve transformer has been designed by Bryan Savage for coupling the 354V to the Pen.-428's. This maintains the frequency response and enables the primary to be coupled directly into the anode circuit of the 354V and to maintain its rated inductance despite the fairly high current flow. Decoupling in this stage is again complete by means of a 20,000-ohm resistor and 8-mfd. by-pass condenser.

The secondary of this transformer is in two halves, so that if necessary separate bias could be applied to the output pentodes. As I discovered that these valves were very accurately matched so that individual bias was necessary. The secondaries were then coupled together in the centre and taken directly to earth, but having resistors of 250,000 ohms shunted across each half. Also in series with the contrmicd grids are 5,000-ohm resistors for normal H.F. blocking.

In order to obtain maximum audio output it is essential that the screen voltage on the Pen.-428's be exact. Incorrect voltage, within reason, will cause up to 25 per cent. decrease in audio output, so for that reason a preset potential divider enables the correct voltage of 275 to be obtained.

As no commercial resistors of the required values are available they are 2,200-ohms and 7,200-ohms, plus a 10-watt rating for the low value resistance and 15-watt rating for the high value resistance, 3,000-ohm and 7,500-ohm preset 20 watt resistors were included. These resistors were then adjusted to give 275 volts actually to the screen of the pentodes. By-passing at this point is most important, and for that reason, both screens are tied down to chassis by means of an 8-mfd. condenser.

The special swinging choke is shown in the foreground of this illustration and at the left-hand side of it the smoothing condensers and Pen.-428 cathode condenser.

The Correct A-A Load

One of the most important components in the amplifier is the output transformer which has been designed to operate into an anode-to-anode load of 6,500 ohms with an appropriate secondary suited to the loadspeakers to be used.

A special steel chassis already cut and drilled with every hole has been made specially by Messrs. Burne-Jones. This chassis will stand the weight of the transformers and chokes, which are towards the centre, without any trace of bending, so that the amplifier is rigid and quite suitable for rough handling and outdoor use.

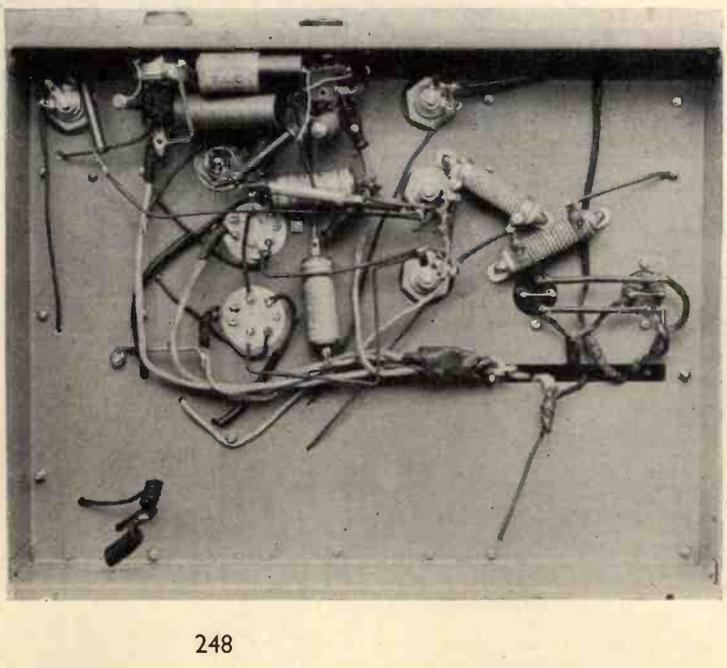
To give some idea of how simple it is to build, all the fixed components can be bolted to the chassis in under half-an-hour, while the average amateur or service man used to such work, can wire the amplifier in two hours.

Layout is such that all of the components are easily wired, while as the fixed resistors and condensers are interconnected in the wiring, construction is simplified.

There are several points which should be borne in mind as the amplifier is being built. With the exception of the electrolytic condensers, the cases of which make automatic negative contact to the chassis, all negative connections are actually wired without relying on automatic contact to the chassis. I refer in particular to the input jack and volume control. Clean the chassis so that the electrolytic condensers make good contact.

The laminations in the push-pull input transformer are also earthed to a tag which is connected through the chassis to the main earth circuit. I found it a great help to have screened heater leads, for the metal coating makes a convenient earthing point and to this all

(*Continued on page* 256)



All heater leads are screened and earthed at both ends. The metal casing is then used as an earth return for the condensers and resistors.

"A Three-valve 10-metre Super"

(*Continued from page* 233)

done deliberately to obtain a regeneration effect and to make the receiver suitable for C.W. reception.

If this regeneration is not needed it can be overcome by screening the second I.F. transformer and using a screened anode lead. The screen for the transformer should have a diameter of approximately 2½ in., otherwise it will have a damping effect on the coils and will effect the winding data previously given.

A leaky-grid triode second detector gave best results with minimum amount of trouble. Headphones are isolated by a .25-mfd. condenser, so that a plug and jack circuit is suitable, having the frame of the jack in contact with the chassis.

Operation should not cause any trouble. The oscillator circuit is tuned to approximately 10 metres, after which the grid circuit is roughly tuned to resonance. The coils recommended are suitable for the 10-metre band, but it may be necessary, according to the manner in which the receiver is wired, to make slight modifications to them. A doublet aerial also works well, particularly if it is cut to length, although the original receiver is working most effectively off a 7-metre television di-pole. The di-pole is linked to the coupling coil in the receiver by 72-ohm cable, the only alteration necessary being the disconnection of the aerial coupling coil on the earthy side.

Additional selectivity, if required, can be obtained by tapping the grid of the X41 down the aerial coil. The whole coil is still tuned, but damping is reduced when the grid is tapped on to a position about two turns from the top end of the coil. The correct point has to be determined by experiment.

If a power pack is not already available, a unit is needed that will give 250 volts for the H.T. supply and 4 volts for the heaters. Only the very simplest smoothing will be necessary owing to the omission of any low-frequency amplifiers. Total H.T. consumption is 22.5 M/a and the heater current 2.85 amperes.

This receiver can be adapted to use the Eddystone ultra-short wave plug-in coil and tunes quite nicely between 4½ and a little over 10 metres. On occasions, home-built plug-in coils have been hooked into circuit and the 16, 19 and 20-metre stations tuned in quite easily. It is not intended, however, that the receiver be used on the normal amateur bands.

"Programmes for Short-wave Listeners"

(*Continued from page* 235)

definitely. It lasts for approximately 3 hours, and is the only complete opera relay of its kind. The nearest transmission of a similar type is through Rome on 31.13 metres, relayed from La Scala, Milan.

Philips have what they call a Happy Programme, which they are relaying through Eindhoven between 1 and 4 o'clock on March 31, April 6, April 7, April 8, on a wavelength of 16.88 metres. They also have these programmes on 19.7 metres, and there are no less than six of them scheduled for April.

Broadcasts from Moscow seem to be shrouded in mystery, for very few of their programmes are listed in advance. However, programmes for April and May are already available, together with the transmission times. It appears that the best period for reception in England is from midnight onwards through Moscow, RAN, on 31.25 metres. This time brings Answers by Radio to Listeners' Letters, a political talk on current world affairs in which the Soviet opinion is given, and also a survey of Who's Who in the Soviet. Operatic relays are scheduled for the 5th, 11th, 17th, 23rd and 29th April, at 4.25 p.m., and it will be interesting to see just how these broadcasts compare with the American and Italian counterparts.

The French Government station, Radio-Colonial, broadcasts programmes from outside concert halls and also relays from cinemas and theatres. The programmes are broadcast on either 19.68, 25.24 or 25.60 metres. There is a relay on the intermediate wavelength at 8.30 on the 2nd April, also on the 4th, 5th, 7th and almost every day after that to the end of the month. There is also an operatic relay scheduled for 4.45 on April 9, but this appears as if it might be on gramophone records, but as these are done so well, nobody will be any the wiser.

At 2 p.m. every day on 31.34 metres, the Australian station Lyndhurst, broadcasts a programme for English listeners. This station, at this time only, has an aerial directed on Europe.

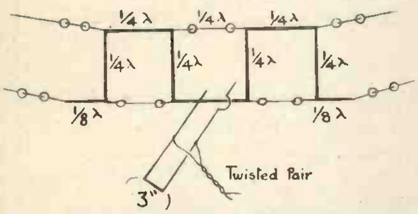
All Zeesen short-wave stations are well received in this country, so tune in at 9.15 on April 6 for a solo concert, and to a relay of *Parsifal* at 9.15 on April 11. Scenes from *Don Carlos* are featured for April 16 at 6 p.m., and a popular concert at the same time on the 25th. These programmes are intended for reception in North America, but as England is in the beam of this transmission, we get the benefit of the directional aerial.

Almost every evening from 7 until 10.30 p.m. Rome on 25.4 or 31.13 metres, relay a varied programme from Italian medium-wave stations, which is a general mix-up, but is well worth hearing. Also most nights at 12 midnight a programme is broadcast for North America.

A Bi-directional 5-metre Aerial

*The information contained in this article is the result of experiments conducted by the Australian amateur, **Don. B. Knock**, VK2NO. This Bruce directive aerial is very popular in America.*

WHATEVER the frequency used it appears that all long-distance contact makers employ some special type of directive aerial so that the radiation is localised in one particular area. Low-power stations are able by means of beam aerials to obtain results equal to those obtained by stations with five and six times the power input but coupled to an omni-directional aerial.



This array is suitable for 72-ohm twisted pair or 600-ohm feeder.

After the exceptional results obtained last summer on the 10-metre band it was only to be expected that experimenters would turn their attention to the DX possibilities of the 5-metre band.

On this wavelength more than on any other the beam aerial is essential if signals are to be regularly transmitted over distances greater than 50 miles or so. Readers should bear in mind the results already obtained by G5BY, whose 5-metre signals have been heard in America. The aerial in this instance played a most important part and consisted of a diamond with 34-foot sides.

This aerial cannot be erected in the average garden so the more simple folded type is of greater general interest. The beam effect of this aerial is most marked, for many stations that are unworkable with a doublet or Zepp have been contacted quite easily.

The construction of this folded aerial is shown by the diagram and it will be seen that it consists of four half-waves in phase. A length of wire equal to four half-waves for a given frequency is folded in the manner suggested with quarter-wave sections, beginning and ending with a single eight-wave section.

A J system coupler is used in which a quarter-wave stub-line is closed at the bottom with one side connected to the aerial at the centre. This type of coupling is most effective when fed by a 72-ohm cable of the Belling-Lee type, but the correct tapping point for this feeder is where the stub is connected to the aerial.

If 600-ohm cable is used the tap point is more towards the closed end, the correct point being found by experiment.

The transmitter is loaded to the aerial with the trombone and feeder positions adjusted until a current indicating device, at the centre of one of the vertical quarter-wave section, shows maximum light or current. An absorption wavemeter with a flash-lamp bulb will do quite well to indicate maximum current or a small R.F. meter, if available, can be clipped across the section when a more accurate reading is needed.

Contrary to expectations, although this aerial is erected horizontally, it gives vertical polarisation. The space taken up is about 17 ft. by 4 ft., and the aerial should be slung between two poles.

Directivity is broadside and the angle of beam is around 10 degrees at 56 mc. For general work the quarter-wave sections should be 4 ft. and the eight-waves 2 ft., but for optimum results the sections should be cut to transmitter frequency, adding five per cent. to the calculated length owing to the fact that the sections are folded. This gives a length of about 4 ft. 3 ins. for 57 mc.

If directivity is needed only in one direction a considerable gain can be obtained by fitting a reflector behind the aerial. This reflector should take the form of a curtain and be cut to the same dimensions as the aerial, less, of course, the stub line and feeders.

Such an aerial will give the 10-watt ultra-short wave stations a good chance of long-distance transmission without building complicated apparatus.

Wireless as a Career

A SERIOUS shortage of trained wireless engineers and operators has been brought to light recently as the Services are unable to obtain anything like the correct quota of men needed. There are apparently far too few operators, both in the navy and merchant service, while the R.A.F. are now training their own radio operatives after finding it impossible to obtain properly trained radio men in civil life.

It seems that at the present time, more than at any other, radio as a profession should be seriously considered by youths who have not yet settled upon a career. As an expanding profession radio has no equal, and for that reason offers more than the usual amount of scope for advancement. Even so, the higher executive posts are only offered to those who have been properly trained and are able to undertake the responsibility.

As radio is very rarely part of the school training, very few boys are able to gain a good technical grounding unless they are prepared to undertake a course at a proper school where all branches of the industry are fully covered.

One such college is the Wireless College at Colwyn Bay, North Wales, which is situated on the sea-front and stands in its own grounds. Another is the Wireless College, Calmore, Southampton, which is of a similar type, for both are fitted with all the latest radio equipment needed for instruction in transmission, reception, servicing and television.

In both colleges there is accommodation for resident students, while if required, fees can be paid to the College after the student has qualified and obtained an appointment to a suitable position. These fees are then paid in reasonable instalments from the salary obtained.

At the Southampton College accommodation has been increased so that between 150 and 200 resident students can be taken at a time.

The training period depends mainly on the branch in which the student is to enter, but as the fundamental principles of radio remain the same for all branches, the question of specialising for any one particular section does not arise until the student has been in residence for the customary period of six months.

An indication as to the demand for wireless operators which is only a small section of the radio trade, can be gauged from the fact that Messrs. Marconi Wireless Telegraphs have immediate vacancies for 100 marine operators, and will require a further 250 during 1937.

Training for the second-class certificate, which all marine operators must have, generally takes eight months, while a first certificate needs about twelve months' training. Any student with a first-class certificate is then entitled to apply for a position as Wireless Operator-in-Charge on any British vessel.

Special training courses are now being prepared for students wishing to obtain a sound knowledge of television technique, both from the design and servicing angles. This branch of the industry offers ample scope for the well educated and trained student.

Full information on these courses can be obtained from The Principal, Wireless College, Colwyn Bay, North Wales; The Wireless College, Calmore, Southampton, or the London representative for both Colleges at 4 Winton Avenue, N.11.

Our Policy
"The Development of Television."

"The Design of Vision-frequency Amplifiers"

(*Continued from page* 222)

characteristics of a typical resonant circuit, having at the resonance frequency zero phase shift and right and left from this point of symmetry, capacitive respectively inductive phase. Note, that, for instance, with the aid of the $Q = 2$ curve it will be possible to construct in several stages an amplifier practically free from phase distortion. There are many other points of interest in connection with this type of high-frequency correction, and the curves of Fig. 15 will give full information; to avoid lengthy explanations we must leave readers to follow the necessary considerations and calculations in constructing amplifiers with different characteristics.

Practice shows that there is a certain danger of high-frequency oscillation when the response of the amplifier is greatest, at the approximate frequency $f_1 = 1/2\pi CR$, that is when $\omega C = 1/R$. This trouble can be eliminated by using valves with small grid-anode capacity, by reducing the mutual conductance of the valves or by decreasing the L/CR^2 ratio.

Several amplifiers have been constructed based on the above theory and the frequency response measurements were in very good agreement with the calculations.

Regarding the design of the correction choke there is no necessity for special precautions; the resistance of the choke is unimportant because it can be regarded as a fraction of R. As a matter of fact the choke could be designed in such a way that its resistance will be equal to the anode load R. The self capacity of the correction choke is also of minor importance, because generally it represents only a fraction of the loss capacity C; naturally it should be kept as low as possible. The correction choke should be placed always after the load resistance to reduce the attenuating effect of this self-capacity.

As some of the latest television receivers show, the attenuating effect of a R.C. coupled stage is not fully appreciated by the constructors. Taking, for instance, the values of the output pentode stage in a well-known commercial receiver and calculating the amplification attenuation and phase displacement at the highest frequencies, the result is as follows:

$R = 5{,}000$ ohms; $C = 50$ mmfarads; $f_{max} = 2$ megac/s.

the corresponding ωCR value is:

$\omega CR = 2\pi . 2 . 10^6 . 50 . 10^{-12} . 5{,}000 = 3{,}14$

the corresponding Z/R value can be easily determined in Fig. 15 from curve No. V, for which $Q = L/CR^2 = 0$; it is approximately $Z/R = .3$. The amplification of a high-frequency pentode is almost directly proportional to the load; this means that the loss of amplification at the highest frequencies is 70 per cent.

The phase distortion is approximately 90 degrees at 2 megacycles, but it is already 20 degrees at .5 megacycles.

As we see from the above it is advisable to use, even in a single stage, some sort of high-frequency correction if we wish to achieve a reasonably sharp picture.

(*To be continued.*)

Modern Amateur Communication Receivers

(Continued from the February issue)

THE NC-100X has five amateur bands with a tuning range of .54 mc. to 30 mc., so taking in the now lively 10-metre band. The valve combination is one radio-frequency stage and two intermediate frequency stages, with a total of 11 valves. A crystal filter is employed in this model, but the NC-100 is identical but without the crystal. It includes, of course, a beat-frequency oscillator, band spreading, a signal indicator, and has an audio output of no less than 10 watts.

This receiver is amongst the higher priced instruments, but as can be seen from the illustration of the chassis, it is a well designed receiver that will more than hold its own with any of a similar type. Another creation of the National Co. is the One-Ten, an ultra short-wave receiver which is the only one of its type. It uses Acorn valves with the now familiar National U.H.F. tuning unit and covers from 30 mc. to 300 mc. A special super-regenerative circuit is employed in which four valves are used in such a way that the noise level is really low and an appreciable gain is obtained right down to 1 metre.

Although this type of receiver is not at the moment in great demand, the growing interest in ultra short-wave working will shortly call for an outstanding receiver of this kind.

The most popular kit set of the year is undoubtedly the Tobe 7, which by virtue of its extremely efficient band-spreading and accurate calibration, is ideal for amateur use. The total cost is ridiculously low, but the performance comes up to many of the larger receivers. Without question it is the best value for money available for the amateur in this country. The tuning range is 1.8 mc. to 14.5 mc. and with the standard amateur tuner merely covers the four amateur bands and adjacent channels.

An excellent scheme in this receiver is the use of an alternative tuner covering from 22 mc. to .54 mc., for those who require all-wave coverage. By the addition of a separate tuning scale which is supplied with the tuner effective band-spreading is still possible. This kit makes use of one radio-frequency and one intermediate-frequency stage, switchable A.V.C., a B.F.O., and standby switch.

A receiver with more than the usual number of refinements is the SX11 Super Skyrider, which covers five amateur bands, has one radio frequency stage, a crystal filter and has an audio output of no less than 14 watts. Nine out of the ten valves employed are of the metal variety, the tenth valve being the 6G5 Magic Eye.

Pilot All-wave Radios

IT appears that the objective of Pilot Radio is all-world reception for every listener.

One of their most popular models is the U355, a 3-band superhet receiver tuning from 16 metres upwards and giving an output of 3 watts. It is priced at 12 guineas, suitable for A.C. mains of the standard voltages, and is of the horizontal type, that is, with the receiver and loudspeaker side by side.

A more ambitious instrument is the U225 which is a 6-valve 3-band receiver for A.C. or D.C. mains. Despite this latter feature, performance is equally as good on D.C. as on A.C. It is fitted with a 5½ in. flood-lit tuning dial so that the non-technical user should have little trouble in receiving out-of-the-way short wave stations.

Console cabinets are certainly coming into favour, which is not surprising when one examines the finish on the Pilot CU355, or CU225 models. The first is a 5-valve all-waver at 17 guineas fitted in a cabinet 39 in. high and arranged to give superb quality owing to the greater baffling effect of the cabinet, and the inclusion of a 10 in. loudspeaker. The second model is for A.C. or D.C. mains and is a 6-valver covering three wavebands.

Further information can be obtained from Pilot Radio, Ltd., 87 Park Royal Road, N.W.10.

"The Short-wave Radio World"

(*Continued from page* 242)

conditions are immediately noted. All component values have been given and with the exception of the mains transformer, are of the conventional type.

The mains transformer, however, has to be made specially. It has the conventional primary plus five secondaries; two for high-voltage, and three for filaments. First high-voltage gives 375 volts, which actually has an output of 450 volts owing to the use of condenser input. This is followed by a 6.3-volt heater for the rectifier, 6.3-volt heater for the tube, 180-volt winding to give a 60-cycle sweep votage, and 2.5-volt winding for a dial lamp.

The high-voltage winding has its output split up by a potentiometer of which the two 20,000-ohm sections allow the spot or pattern to be shifted up or down, or from side to side. Two other potentiometers control focus and intensity. As regards the sweep voltage, when the double-pole switch is in one position, the H plate is connected through a potentiometer to the terminal marked H. The designer makes a special point that all leads to the deflector plates and associated circuits must be completely screened, in order to prevent stray pick-up.

When the wiring has been checked there should be approximately -50 volts on the intensity control, and about + 80 volts on the focus control, reading being taken from the cathode of the 913 tube.

The beam shift controls should have a range of about 10 volts each side of centre position, as read from the potentiometer arm to chassis. If voltages are found to be in the above ratio with about 450 volts across the shunt resistance, the 913 tube can then be connected into circuit.

"A Pen-428 High-Quality Amplifier"

(*Continued from page* 248)

the earthy sides of the fixed condensers are taken.

When the amplifier is being checked, the following voltages and currents should be obtained; on the anode of the SP4B approximately 200 volts, which is the equivalent very roughly to the current flow of 1.5 M/a across 130,000 ohms. There should also be a .25 M/a current flow in the screen circuit of the SP4B. The 354V is very slightly overrun and has an anode current flow of approximately 6 M/a with an anode voltage of 200.

In the combined feed to the primary of the output transformer there should be a zero signal current flow of 96 M/a, rising to 124 M/a with maximum audio output. This figure should not be exceeded and if it is found that the current rises above this value, then the amount of drive should be decreased.

Screen current can only be given roughly. The average value is approximately 36 to 40 M/a through the potential divider with an 18 M/a actual screen current with maximum audio and a standing screen current of 10 M/a. As the total amplifier current with maximum audio output is slightly over 170 M/a, two IW4 rectifiers are needed to avoid overloading one valve.

The original design of this amplifier was to meet the requirements of service men and radio dealers needing public address equipment during the Coronation period and for subsequent local events. The apparatus will fulfil the general demand, for it is the first of its kind to give such a high output with low voltage and comparatively small type of valves. Replacement costs on valves are also small as compared with the 8 and 10 guineas of large triodes giving a similar audio output.

Leeds Radio Society

The new quarters of this society are at the Y.W.C.A., Cookridge Street, Leeds, where lectures are held and instruction is given in morse code, while demonstrations are held of new apparatus. The society has arranged a trip for members to the North Regional station, and readers interested should write to the Hon. Secretary, Mr. J. Kavanagh, 63 Dawlish Avenue, Leeds, 9.

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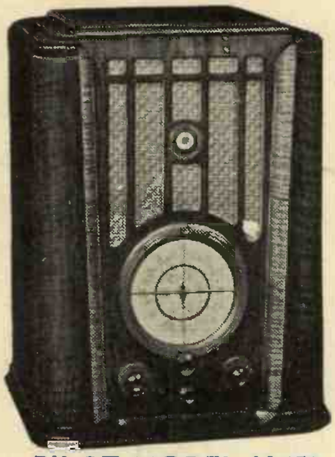

PILOT MODEL U.650

★ ★ ★

Note.—The Editor of "Television and Short-Wave World" has read the original letter from which we quote below.

THERE IS NO TERRESTRIAL LIMIT TO THE RECEPTIVE RANGE OF PILOT RECEIVERS, EUROPE IS ONLY ONE OF THE CONTINENTS THEY CAN SPAN.

For proof, read the extracts from published "test" reports :—

"THE WIRELESS WORLD" said : "Before one has traversed more than a few degrees of the dial on the 16-52-metre band it becomes apparent that the performance on short waves is something quite out of the ordinary. The crisp response and excellent signal-to-noise ratio are only two of the qualities which mark this set as a thoroughbred !" (Model U.650.)

The wonderful Pilot tuning Beacon enables anyone to tune in stations without sound. It is much easier to tune by the eye than by the ear. You get dead accurate tuning and then get all the volume you want by just turning the volume control knob. Simplicity itself. Fitted to Table Model U.650 and Console Model CU.650.

MODEL U.650, 6-Valve Super-het, as Illustrated above, 4 Wavebands, 16-52, 48-150, 175-550 and 750-2,100 metres. Tuning Beacon for silent accurate tuning. 3 watts undistorted output.

For A.C. Mains 200/250. **16 Gns.**

Model U.650

There is a **D.C. Model U.690 at 17 Gns.**
Console Model CU.650 for A.C. Mains **23 Gns.**
Console Model CU.690 for D.C. Mains **24 Gns.**

THE "STAR" writing about the PILOT U.225 Universal A.C./D.C. Model said :—"The distinction of this set is its clear reception of short-wave stations. It has the quietest background of any set of its size that I have tested. Amos 'n' Andy have been followed night after night from New York . . . a remarkable product, one of the few that makes short-wave listening tolerable for people who judge the music by what it sounds like and not by where it comes from."

MODEL U.225, this 6-Valve Universal Receiver for A.C./D.C. mains, covers three separate wavebands, 16-2,140 metres. 5½-in. Compass Dial, sectionally illuminated. High and Low Ratio Tuning Dial.
8-in. Speaker. 2½ watts undistorted output. Model U.225. **14 Gns.**
Console A.C./D.C. Model CU.225, **19 Gns.**

PILOT MODEL U.225

"THE DAILY HERALD" said of Pilot Model U.355:—"Its performance is out of all proportion to its size, and I was frankly astonished at the results. On the short waves my first station was Pittsburg W8XK on the 19-metres band, at full strength. Later on, Caracas, Java, Barranguilla, New York, Tokio and a host of other stations were received. In my opinion, this Pilot Model U.355 is an excellent all-wave superhet."

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* * *

A PILOT OWNER SAYS:

"I was very excited listening to the S.O.S. from the Trawler on the Yorkshire coast the other night, on a wavelength of 135 metres (this band is not on many of the sets), also the cross talks from the Fishermen at sea and the Police messages, Australia, S. America, Iceland . . . I have listened to London National via New York, 6,000 miles, what a wonderful performance."—R. Murphy, Horsforth, nr. Leeds.

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