TELEVISION TEST SIGNALS IN AUGUST

TELEVISION

THE FIRST TELEVISION JOURNAL IN THE WORLD

and SHORT-WAVE WORLD

MONTHLY 1/-

JULY, 1936

No. 101. Vol. ix.

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

Farnsworth Television Camera

A.P's Synchronising Signals Simply Explained

R.A.C. Television Experiments

Kinnes Television

How to Use Cathode-ray Tubes

Eiffel Tower Synchronising Signals

We See Scophony Television

Car Ignition Interference

Class A High-fidelity Amplifier

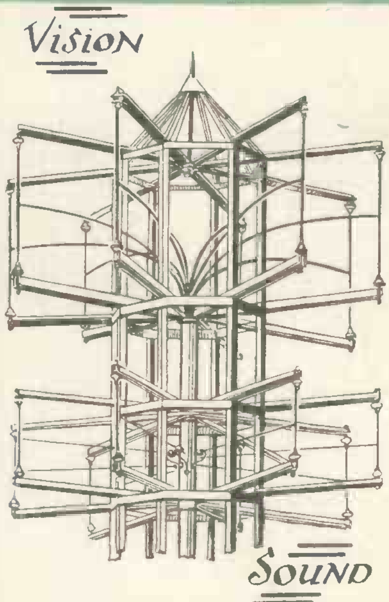
Short-wave Programme Broadcasters

Transmitting for Beginners

Simple Duplex Telephony

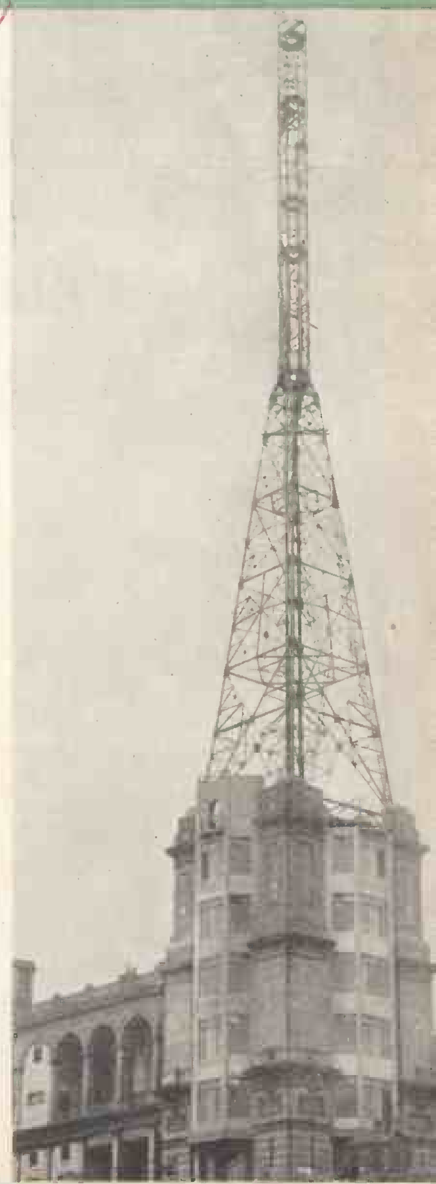
Battery Ultra Short-wave Receiver

Two Transmitters for the Constructor



MAST AND AERIAL AT ALEXANDRA PALACE

London's Television Broadcaster will be transmitting its first signals in August

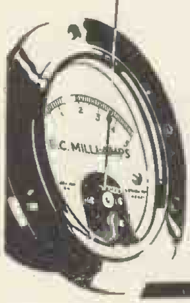


HAVE YOU

a D.C. milliammeter?

If so, you can convert it to read A.C. volts and current by the simple addition of a metal rectifier. It will then give accurate readings up to 100,000 cycles per second, and is suitable, not only for A.C. measurements, but also for use as an output meter.

WESTINGHOUSE



Full details and instructions for making a universal test set, output meter, etc., are given in brochure D.P. 11B, price 3d. post free.

instrument type metal rectifiers

COUPON

Westinghouse Brake and Signal Co. Ltd.,
82, York Road, King's Cross, London, N.1.

Please send me brochure D.P.11 B, for which I enclose 3d. in stamps.

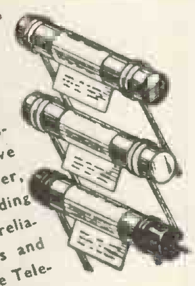
Name ....

Address..

....Tel. 7.36

SPECIFIED—

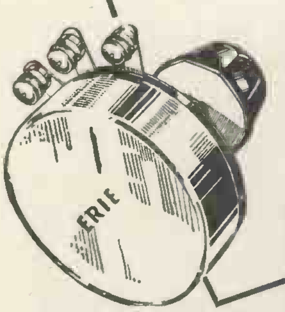
—for Dependability



ERIE Resistors are specified for the 5-metre Transmitter, the battery operated Ultra Short-Wave Receiver, and the Class A. High Fidelity Amplifier, described in this issue. Again and again leading designers express their confidence in Erie reliability. Take their tip—use Erie Resistors and Volume Control in your present and future Television or Radio circuits for trouble-free service.

Erie Impregnated Resistors
Colour-coded, labelled and guaranteed
1/- per Watt in all values

Erie Volume Control
Precision construction and bonehard resistance element give smooth and positive contact at all times. Entire freedom from hop-off noises. A lifetime's faultless service. All sizes, 5,000 ohms to 2 megohms. **3/6**
With built-in mains switch 5/-



ERIE

RESISTORS and VOLUME CONTROL

Obtainable from radio dealers everywhere. In case of difficulty, send direct. Free Colour Code Chart sent post free, on request.

The Radio Resistor Co., Ltd., 1 Golden Square, London, W.1.

MERVYN

The Popular TELEVISION and SHORTWAVE Specialists.

SPECIFIED
In May Issue. The Mervyn high voltage Cathode Ray Excitor Unit Kit. Page 299 semi assembled, output 3500v D.C. and 2 volt A.C. £3 12s. 6d.
In This Issue. The Mervyn control panel for use with above with resistances, potentiometers, condensers, semi assembled. £2 5s.

TELEVISION
Double Time Base high definition employing two gas discharge relays and balanced deflection amplifiers, less valves and supply unit, in kit form. £6 10s.
Vision Receiver. 8 valve single control, wide band frequency response, 2 megacycle, including stage for synchronising. 8 BVA valves ready for use. £16 10s.
Triode Hexode Converter for use with your present set gives you short waves and the television sound programme. In cabinet assembled and tested. £4 10s.
Choose your high voltage condensers from the Mervyn range, proved and tested. All values available up to 6,000 volts, working. 500 v 2mf., price 6/4. 4 mf., price 11/3. 4,000v 25 mf., price 9/-. 2,000v, price 5/-.

NEW
I. F. Units. Two special I.F. units for use in intermediate amplifying stages. They have a spread of over 2 megacycles with an average stage gain of 12. In shielded containers, air dielectric condensers.
Type 1. Transformer high gain unit 10/- each.
Type 2. Tuned anode coupling unit, 5/6 each.

CONFIDENTIAL, and experimental apparatus built to order—address letters to Managing Director.

GENERAL
If you are interested in variable direction short wave and ultra short wave aerials write for details.
We are prepared to accept your 30 line apparatus in part exchange for Mervyn high definition apparatus.

Radio Dealers who have not yet received terms and advanced lists should write at once.

MERVYN SOUND & VISION Co., Ltd.,

HOLBORN PLACE,
LONDON, W.C.1

Telephone : Hol. 7709.

No. 101 VOL. IX JULY, 1936.

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

Electronics and Industrial Applications.

COMPARED with America this country appears to be very much behind in taking advantage of the new field opened by recent developments in electronics. It would seem that the British engineer has not been educated up to the possibilities of the special apparatus which is now becoming available and which, were the individual requirements known, could be designed to be of inestimable value. There is, in fact, hardly any branch of industry which could not derive some benefit from it, and yet up to the present it has only made a slight incursion into quite a small section of the industries of this country. Apart from the extremely wide field for the cathode-ray oscillograph, there are many potential possibilities in photo-electric apparatus which are lying dormant for want of development.

The Price of Television Receivers.

THE price of television receivers is variously stated as being likely to range from sixty to eighty guineas. A certain amount of capital has been made out of these figures by the anti-television propagandists, who bluntly tell the "man-in-the-street" that obviously he will not be able to afford a receiver. At these prices possibly it is true, but if the average person wants a thing he seems to get it. Motor-car ownership is almost general and if television is made sufficiently attractive, the television receiver will also come to be regarded as an essential of modern life. The reduction of these prices will obviously depend upon mass production methods and obviously this cannot come until the demand warrants them.

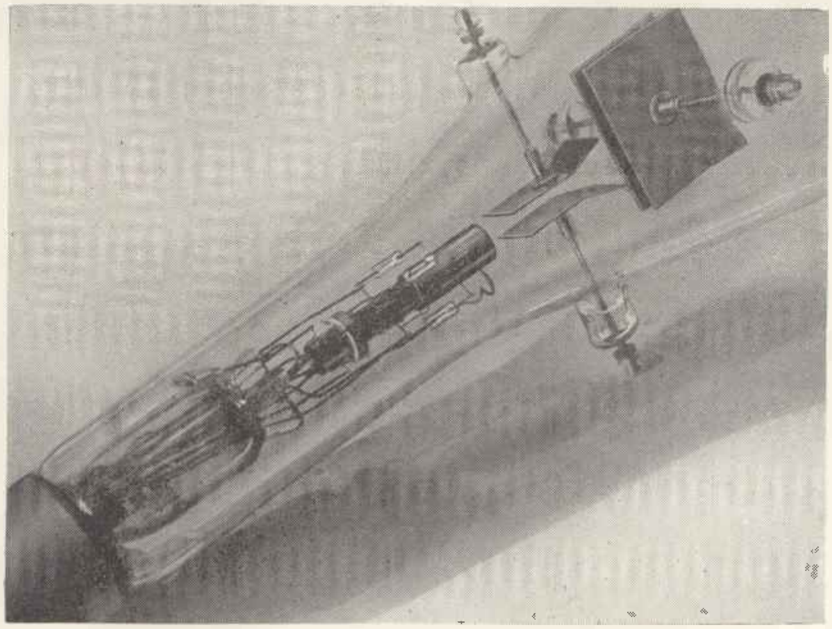
Colour Television

JUDGING from the number of patents that have been taken out it appears that there has been a great deal of misguided effort wasted in attempts to develop colour television. It is stated that five million pounds have been spent in trying to perfect a colour system for the cinema and still we are without it. What chance then has television in the colour scheme at the present time? Apart from the special troubles which will have to be met (and these have not yet been overcome in the case of the film) all the ordinary difficulties are trebled. Surely those who have visions of colour television are, at thte present juncture, pursuing a chimera.

HOW TO USE YOUR CATHODE-RAY TUBE

By A. F. Hollins

Mullard Technical Service Dept.



Although the fundamental facts upon which the principles of cathode-ray tube operation, design and application are based are understood to a greater degree by those interested in television than were the fundamentals of valve operation at a corresponding stage in the history of sound broadcasting, it is not always realised by those who enter the ranks of television enthusiasts that the quantitative factors in television tube operation are quite as important, if not more important, than the quantitative factors in broadcast receiver design.

SUCCESSFUL application of the cathode-ray tube very largely depends upon a knowledge of the characteristics of the particular tube employed, and the careful adjustment of operating conditions to suit these characteristics.

Cathode-ray tubes are susceptible to quantitative specification by means of factors and graphs in much the same way as the performance characteristics of a valve are indicated by mutual conductance, impedance and so forth and by "characteristic curves."

It is the object of this article to discuss one of the many characteristics of the cathode-ray tube, namely, the "deflection characteristics"; to indicate the significance of the facts associated with these characteristics; and to show in what ways the satisfactory performance of the tube under practical working conditions depends upon circuit adjustments which are bound up with the deflection characteristics of the tube.

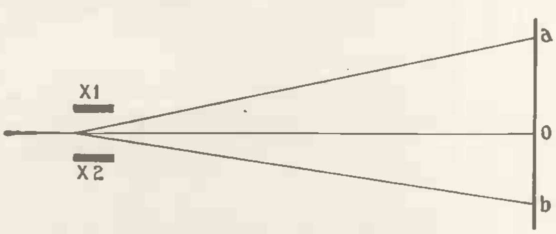


Fig. 1.—Electrostatic deflection in one plane

The principles involved apply generally to any 2- or 3-anode tube with electrostatic deflection, but in order to have a concrete example before the reader, references will be made to the photograph, which shows the electrode arrangement of the Mullard 3-anode television tube, Type 6001. The following brief technical specification is also given as it will be necessary to refer to some of the figures quoted for some of the numerical examples given later in the article.

The tube is of the high vacuum, 3-anode type, and has a screen diameter of 22 cms., permitting an image measuring approximately 170 mm. by 135 mm. The fluorescent colour is green. The indirectly-heated cathode consumes 1.0 amp. at 4 volts, and the cathode is connected internally to the heater. The maximum bias on the control electrode for beam cut-off is −80 volts, and the maximum voltages to the three high-potential electrodes are A1 250 volts; A2 1,200 volts; A3 6,000 volts. The normal working voltages on A2 and A3 are somewhat less than the maximum ratings, being 650 to 1,000 and 3,000 to 5,000 volts respectively, the ratio between the two for correct focusing being approximately 1 to 5. The inter-electrode capacity, grid to all other electrodes is 15 $\mu\mu$F, and the inter-plate capacity in the case of the plates nearer the cathode is 4 $\mu\mu$F, and for the plates nearer the screen, 5 $\mu\mu$F.

The deflection sensitivity for the plates nearer the

ANODE VOLTAGE AND TUBE SENSITIVITY

cathode is quoted as from 0.16 to 0.11 mm/V, and for the second pair of plates as 0.13 to 0.08 mm/V, for various anode voltages, and it is at this point that discussion of deflection characteristics in general commences.

The phenomenon of electrostatic deflection is, of course, very simple to comprehend, but for the complete development of the formulæ upon which the deflection characteristics of a tube are based it is as well to consider the simple case of deflection in one plane only, as indicated in Fig. 1. Here, X1 and X2 are a pair of deflector plates, and assuming that they are short-circuited and earthed, they will exert no force

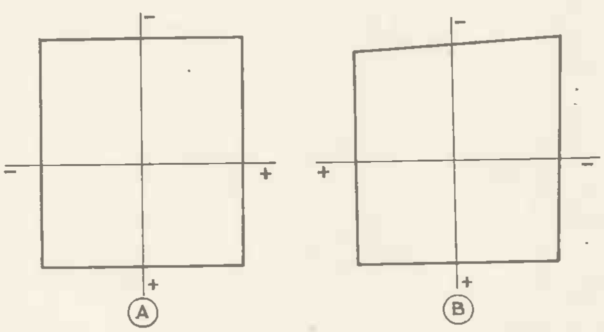


Fig. 2.—Distortion due to variations of sensitivity. A—one pair of plates. B—Two pairs of plates.

on the ray, which will therefore continue along its axial path and strike the screen at o. Now imagine a D.C. voltage applied to the two plates, X1 being the positive plate. The electrostatic field between the plates will attract the electron stream toward the positive plate, with the result that the course of the beam will be deflected and the electrons will strike the screen at the point a. If, however, X2 were made the positive plate, the deflection would be in the reverse direction, and the beam would reach the screen at the point b.

In a tube with parallel plates the total deflection, o-a for a given deflecting voltage V_p, is expressed by the formula:—

$$\text{Deflection} = \frac{L \times D \times V_P}{2 \times V_a \times d}$$

where L length of the deflecting plates,
D distance from centre of deflecting plates to screen,
V_a last anode voltage,
d distance between the plates,
V_P voltage between the plates.

It will thus be seen that the deflection is directly proportional to the deflecting voltage, so that, omitting this term in the equation above, the deflection sensitivity ratio is obtained, namely:—

$$\text{Deflection sensitivity} = \frac{L \times D}{2 \times V_a \times d}$$

Sensitivity is usually quoted in millimetres deflection at the screen per volt of deflecting voltage, and the values usually obtained in high-vacuum tubes are of the order of 0.1 to 0.5 mm/V.

Effect of Last Anode Voltage on Sensitivity.

Since in the above expression the last anode voltage occurs in the denominator, signifying that the sensitivity is inversely proportional to the last anode voltage, maximum sensitivity will be obtained when the last anode voltage is reduced to the lowest practicable value. This requirement, it will be observed, is in direct conflict with the condition for good image brightness, which demands a high value of last anode voltage, so that in practice the best compromise must be sought, and the lowest anode voltage compatible with adequate screen brightness employed.

Referring again to the expression for the deflection sensitivity of a tube, since L, D and d are constants depending upon the design of the tube, they may be combined into one figure, and the sensitivity expressed in the form:

$$\text{Deflection sensitivity} = \frac{K}{V_a}.$$

As an example, a tube for which it was stated that the sensitivity was $300/V_a$ mm/V would have a sensitivity of 300/2,000 or 0.15 mm/V when operated with a final anode voltage of 2,000 volts.

Effect of Alternating Deflecting Voltage

It was stated, when describing the arrangement shown in Fig. 1, that reversal of the deflecting voltage would cause reverse deflection to the point b on the

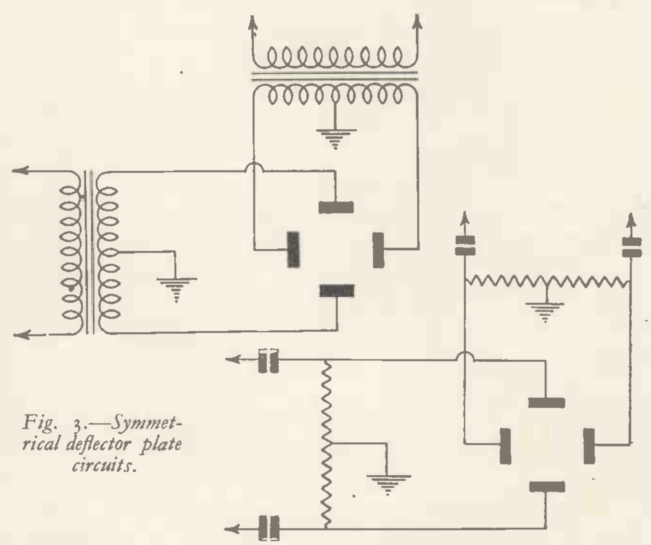


Fig. 3.—Symmetrical deflector plate circuits.

screen, and it will be clear that the full deflection with a reversing or alternating voltage will be twice that with a direct voltage equal to the peak value of the A.C. voltage.

Thus, if a direct voltage of 30 volts were applied between the plates, and the sensitivity of the tube were 0.5 mm/V, the point a would be 15 mm. above the point o; and if the battery were then reversed, the spot

VARIATION OF SENSITIVITY OF THE TUBE

would impinge on the screen at point b 15 mm. below o giving a total swing of 30 mm. But if an alternating voltage of 30 volts r.m.s. value were used instead of reversing the direct current voltage, the total swing would be $\sqrt{2} \times 30$ or approximately 42 mm., since the deflection is proportional to the peak value of the deflecting voltage and not the r.m.s. value.

Remembering that one inch equals 25.4 mm., a number of useful relationships can be obtained concerning the deflection characteristics of a tube. In these expressions the symbol S is used to denote the sensitivity of the tube in mm/V.

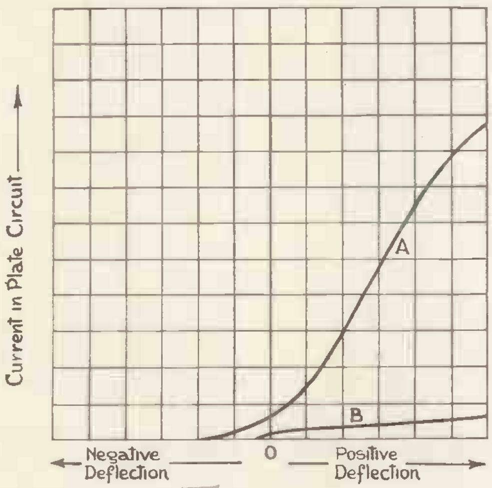


Fig. 4.—Graphs showing effect of input impendance to deflector plates.

D.C. volts required for 1 inch deflection ...... $\frac{25.4}{S}$

Peak A.C. volts required for 1 inch deflection $\frac{25.4}{2S}$

R.m.s. volts required for 1 inch deflection ... $\frac{25.4}{\sqrt{2} \times 2S}$

(or $\frac{9}{S}$ approximately)

Inches deflection per volt A.C. (Peak) ...... $\frac{2S}{25.4}$

Inches deflection per volt A.C. (r.m.s.) ... $\frac{S}{9}$

It is scarcely necessary to point out that variation of the sensitivity of the tube during operation must inevitably mean picture distortion, in that the dimensional proportions of the picture would be varied.

Now it will be remembered that the sensitivity is governed by the final anode voltage of the tube, because the susceptibility of the beam to electrostatic forces acting perpendicularly to it depends upon the velocity of the electrons comprising the beam.

Now if, as in many circuits, one plate of each pair is connected to the last anode and to earth, the normal accelerating voltage will fluctuate by plus and minus the deflecting voltage, which in itself may be from 5 to 20 per cent. of the final anode voltage. This means that the positive peaks applied to the isolated deflector plate are added to the effective accelerating voltage and the negative peaks are subtracted, with the result that the spot is deflected to a greater extent during negative half cycles than during positive half cycles. Fig. 2 shows on the left the form of distortion obtained with one pair of deflection plates, while owing to the second pair of plates being located at a different distance from the anode, the second pair introduce a further error by affecting the velocity of the beam as deflected by the first pair, the final result on the screen being as shown on the right of Fig. 2.

Distortion of this nature can be avoided if, instead of connecting one plate of each pair to the anode, symmetrical circuits of the push-pull type such as shown in Fig. 3 are used. Alternative arrangements are given for resistive and inductive circuits, and it will be seen that in each case both plates of each pair are connected to the anode through input circuits of equal impedance and that their potentials oscillate symmetrically on either side of the anode which is, of course, at earth potential.

Effect of Input Impedance.

It will be appreciated that the electrons collected by the anode of a cathode-ray tube represent a very small proportion of the total emission of the tube, and a return path must exist for the secondary emission from the screen due to the impact of the main beam upon the screen. Unless other means are provided, this return path is *via* the deflector plates, and the presence of the return beam current is indicated by a rapid rise in current in the arm of the circuit connected to the plate, which is positive for the moment, as indicated in the upper curve in Fig. 4.

Such current throws an appreciable load on the circuit providing the deflecting voltage, and in the case of oscillograph applications may seriously affect the accuracy of the investigations, and in the case of television reproduction, will obviously be another cause of distortion. There are various means for avoiding this effect, one being the inclusion of a high impedance valve to act as a " buffer " between the tube and the apparatus supplying the deflecting voltage. But the effect can also be overcome within the tube itself, and in some tubes the deflector plates are screened. In the Mullard tube described at the beginning of this article, the third anode consists of a conducting coating on the inner surface of the tube, and is carried practically up to the screen. This form of anode has two important advantages. The first is that the accelerating force is applied throughout the whole of the travel of the electrons, thus greatly improving the brightness of the image, and the second is that it acts as a collecting electrode for the return electrons from the screen and thus prevents the deleterious effect of high transconductance between the deflecting plates. The improvement in this respect is indicated in the lower graph on Fig. 4.

WE SEE SCOPHONY TELEVISION

A REMARKABLE ADVANCE

Here is an account, by the Editor, of a demonstration of the Scophony mechanical-optical system of television.

WE have consistently been of the opinion that though the standard of definition decided upon by the Television Committee had set a difficult problem to sponsors of mechanical systems, the difficulties that would have to be overcome were not insuperable. This, we are aware, was contrary to general opinion; the common idea has been that anything above 120 lines was beyond the capacity of mechanical methods. Scophony, Ltd., have now completely disproved this latter contention and have amply shown that with apparatus of a comparatively simple character results are obtainable which are equal in every way to those obtained by electronic methods.

Recently TELEVISION AND SHORT-WAVE WORLD was privileged to be accorded the first demonstration of the new Scophony apparatus given to the Press. The results and progress achieved were remarkable.

The Junior Receiver

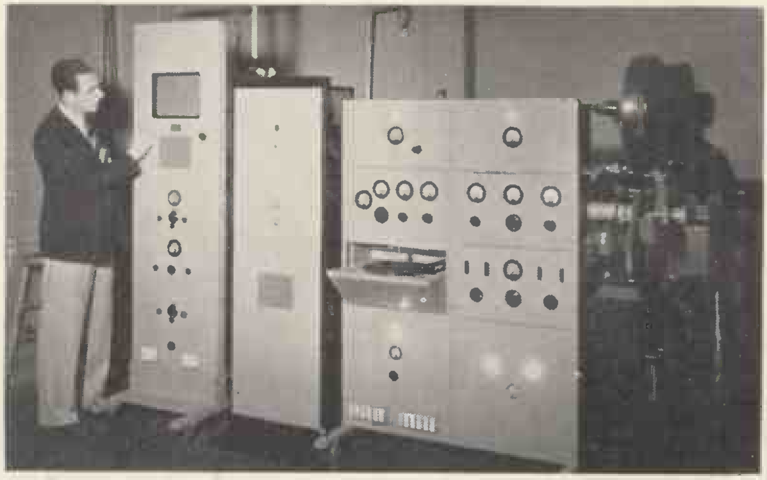
I was actually given a demonstration of a full-length reel from the Jessie Matthews' film "First A Girl," followed by a Mickey Mouse cartoon. The picture was shown to me on the so-called Junior Receiver, which is actually in the nature of a control receiver, constructed for checking up the transmitter and amplifier equipment. The size of the picture on this Junior Receiver is 10 ins. by 8 ins. The picture left nothing to be desired in quality. *There was real entertainment value in it.* The definition was remarkably good, and the lines, which are sometimes evident in the case of the cathode-ray tube, were beautifully blended one into the other on the Scophony receiver, in fact one had to be within a few inches of the screen to observe that there were any lines whatever. The standard was 240 lines, 25 pictures per second.

View of the Scophony laboratories in Kensington showing on the roof the ultra short-wave transmitting aerials.

There is no difficulty in the case of the Scophony receiver, in switching over from this standard to 405 lines interlaced, or vice versa, and actually the commercial Home Receiver has been designed to handle easily both standards. The Junior Receiver does not employ all the Scophony features, but only the so-called split-focus principles, and the light control (described in the May issue of TELEVISION AND SHORT-WAVE WORLD), It uses as light source only a filament lamp.

Medium-screen Receiver

It was even a greater and most pleasant surprise for me to be given by the Scophony engineers an opportunity of seeing the first experimental results—actually only two or three days old—of a picture on the so-called Medium-screen Receiver. The size of the picture was 5 ft. by 4 ft., again of the standard 240 lines, 25 pictures per second. The receiver was still in the process of being adjusted and tuned up, but even so the results on the screen were simply astonishing. The brilliance was more than adequate.



One of the 240-line film transmitters in operation. Mr. J. Sieger is at the controls of the control receiver. This receiver projects a picture of 240-lines definition on to a flat screen 10 in. by 8 in. using only a talkie exciter lamp as light source. The brightness is sufficient to see the picture with all the lights on in the transmitter room.

This type of receiver uses all the basic features of the Scophony sys-

PICTURES OF CINEMA SCREEN SIZE

Mr. S. Sagall, Managing Director of Scophony Ltd.

tem, evolved for dealing with the present type of transmission as adopted by the B.B.C. There are the split-focus, the beam convertor and the light control. This type of receiver is intended for demonstration in public halls, big stores, schools and the like. An arc is used as light source.

It is almost unnecessary to point out to readers of TELEVISION AND SHORT-WAVE WORLD that a picture of this size on high definition by *direct television methods* (as distinct from intermediate recording methods, involving a time delay), over one channel only, is absolutely *unique*. To the best of my knowledge, a picture of this size by direct methods has never been achieved by anybody else in the world.

Home Receiver

The Home Receiver proper is a more compact edition on a smaller scale, of the Medium-screen Receiver, and uses the same technical features. The light source used, however, is only a filament lamp, and the size of the picture on the first laboratory model is 16 ins. by 12 ins. I understood, that this is the approximate size intended to be used in the final commercial home receiver.

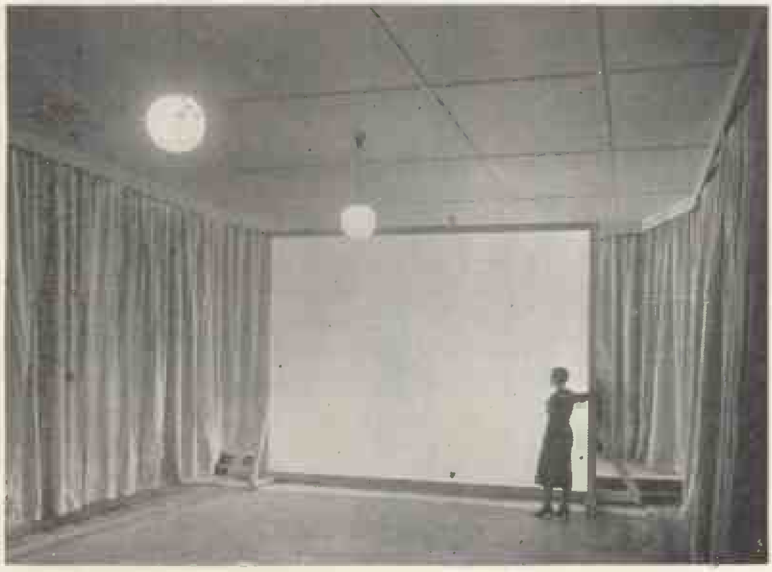
Large-screen Television

I was further given an opportunity of inspecting the apparatus for large screen television. The apparatus has just been completed, and is in the process of being tested. It uses all the features as in the case of the Medium-screen Receiver, but on a much more elaborate and magnified scale. The apparatus at present constructed in the Scophony laboratory is intended for a picture 13 ft. by 10 ft.

The big screen television projection apparatus. This apparatus is capable of projecting a 240-line picture on to the 13 ft. by 10 ft. screen, with adequate brilliance and can be focused to a still larger picture.

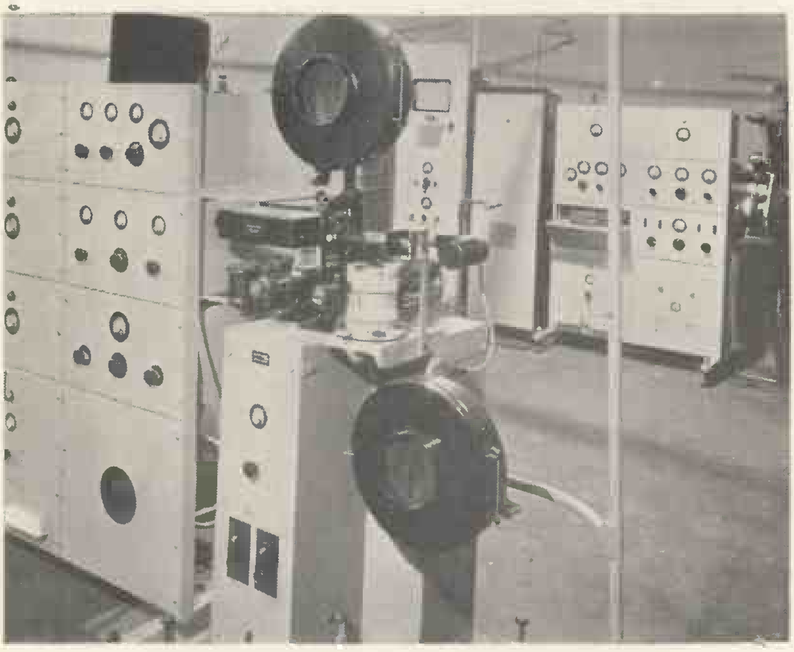
From what I was able to examine in the case of the Medium-screen Receiver, I seen no reason why a good picture, with adequate illumination, should not be achieved by Scophony in the very near future for presentation *in large cinemas*. My previous remarks about the *unique* achievement of the Medium-screen Receiver would, of course, apply with even greater force to the large screen receiver.

I hope to be in a position at some later date to provide readers of TELEVISION AND SHORT-WAVE WORLD with some more technical details of the apparatus referred to above. At this stage, however, I have to limit myself to saying that the Scophony engineers have paid the greatest possible attention to a number of very important



The Scophony big screen demonstration theatre. The screen measures 13 ft. by 10 ft. and is for cinema theatre projections.

POSSIBLE FUTURE DEVELOPMENTS



View of the Scophony Film Transmitter Room.

mechanical construction points, and the results are a credit to the ingenuity of the technicians of the Scophony laboratory.

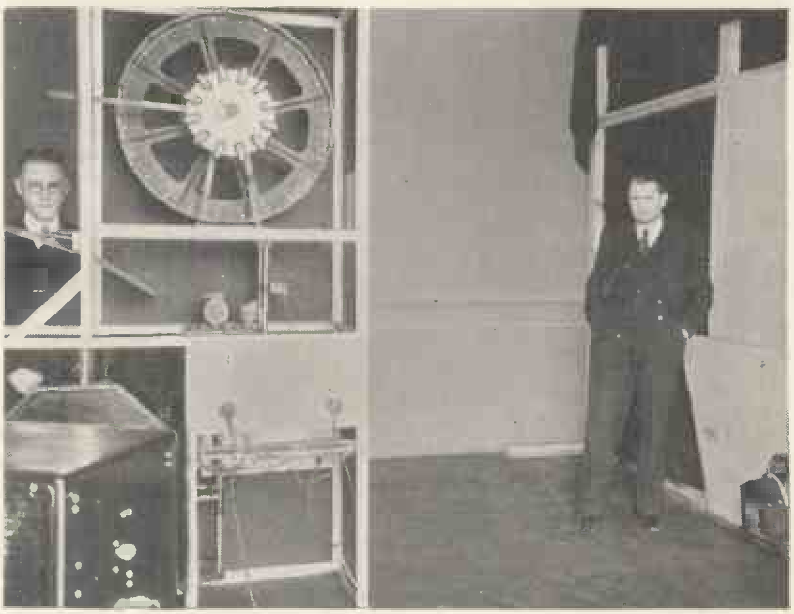
Incidentally, I ought to mention, that the transmitting equipment used is also developed and constructed by Scophony themselves and uses the Scophony optical features.

It is evident that the Scophony system is going to play a leading part in the world of commercial television. After all, we must remember that television is only emerging now from the laboratory stage, and it will probably take a few years before it will settle down to its great mission as one of the most important world industries. There will be plenty of changes and plenty of new developments, and from what I can see, the Scophony system is going to make a very effective contribution to any such new developments. The possibility of large pictures is a very important feature.

Apart from work on receivers for the intended B.B.C. transmissions from Alexandra Palace, Scophony is also engaged on the development of an entirely new transmission and reception technique which—if successful—would completely revolutionise the present-day conception of television.

On leaving the Scophony laboratory, I had to recollect the great struggles that this company had for a number of years, up to quite recently. I happen to know that at one time there was a danger of the little band of enthusiastic engineers, who formed the Scophony laboratory at the time in Dean House being disbanded altogether, and all the research work brought to an end because of lack of financial support. It did require a great deal of courage and enthusiasm on the part of the Scophony organisation at the time, to carry on with their optico-mechanical methods, to which they pinned their confidence, in spite of ridicule and derision from a large majority of technical people, who thought that the cathode-ray tube was the only possible solution for high-definition pictures. As one who belonged to the minority, that is the few who still maintained a faith in mechanical methods, I am more than happy to find to-day that the courage and confidence of Scophony has been fully justified.

I take this opportunity of congratulating most warmly Mr. S. Sagall, the managing director of Scophony Ltd., and the man who bore in all these years, the brunt of the worries and hardships that the company had to go through, and through him all the members of his organisation, on the remarkable achievements of Scophony to date.



The Medium-screen Demonstration Receiver on the left, showing the low-speed scanner. This apparatus projects a picture 5 ft. by 4 ft. on to the screen, part of which is shown on the right. Mr. G. Wikkenhauser, is standing next to the screen.

The Jersey Short-wave Club.

The new Jersey S.W. Club held their first meeting at the Savoy Hotel on June 2. The subscription has been fixed at 5s. and 2s. 6d. for senior and junior members respectively.

The club room is open on Tuesdays, Wednesdays and Thursdays, and application for membership shoud be sent to Martin G. Bourke, 2AOU, "Crediton," Samares, Jersey.

R.C.A. (AMERICA) TELEVISION EXPERIMENTS

Recently a demonstration of television was given by the R.C.A. company of America as a preliminary to an experimental service. Both studio and outdoor scenes were transmitted and the demonstration proved a complete success. We are indebted to Short-Wave Craft for the following details.

RECENTLY a demonstration of the latest experimental television receiver developed by R.C.A. was given in the R.C.A. laboratories at Camden, N.J.

Scenes televised at the transmitter, a mile away from the receiver, were clearly reproduced, although they suffered from occasional blurring. Several members of the audience appeared before the television "camera" and were clearly seen and recognised by their colleagues when the images were reproduced at the receiver which was housed in an attractive console cabinet. After this the Camden Fire Department gave a fire-fighting demonstration on a building adjacent to the studio. The television "camera" was moved to an open window and picked up the scene for the "viewers" at the receiver. This sunlit outdoor scene was reproduced with remarkable clarity. Motor cars passing over the Delaware River Bridge, several hundred feet from the "camera," could be seen as well as the activities of the fire-fighters who were about 50 feet away. To conclude the demonstration a one-reel motion picture was televised. This also came through very well.

The R.C.A. System

Cathode-ray scanning was employed in the R.C.A. equipment, two ultra-short wave transmitters being used, one for sight on 46 mc. and one for sound accompaniment on 48 mc. The television transmitter sidebands extend $1\frac{1}{2}$ mc. on each side of the carrier or a total of 3 mc. The pictures contain 343 lines and the picture repetition frequency is 30 per second. The camera has an adjustable focus and requires the presence of an operator to adjust the lens for various distances as the subjects being televised move about.

The Receiver

The receiving equipment consists of two separate receivers of the superheterodyne type, operating from a 110-volt, 60-cycle A.C. power supply. Both receivers are in one cabinet. The receivers will tune from 40-80 mc.

The cathode-ray tube is mounted vertically in the cabinet, with the end where the image appears facing upward. The television image, which has a size of 5 × 7 in., is reflected on a metal mirror placed at an angle of 45 degrees.

The receivers employ a total of 33 valves, all of which are of the standard receiving type. There are three metal valves in the set, all the rest are glass.

A total of 14 controls are employed on the set, seven on the front panel and seven under the movable top of the cabinet.

The seven front panel controls are for tuning, sound volume, high-frequency and low-frequency tone control; picture contrast, detail, and brightness. The seven upper-deck controls are for adjusting the synchronism of the picture, the focus, the horizontal and vertical size and the horizontal and vertical "framing."

Receiver Circuit

The input from the aerial and the first detector-oscillator stage is common for both the sight and sound channels. In other words, both sight and sound are tuned in by the same control. Since there is only one signal-frequency oscillator, and as this can be oscillating at only one frequency (disregarding harmonics) at a time, the 46 mc. sight carrier and the 48 mc. sound carrier must produce two entirely different beat frequencies when they are mixed with this oscillator frequency. This is just what happens and the result is that there are two different beat frequencies in the output of the first detector. These are fed to entirely separate I.F. amplifiers and thence through separate second detectors and audio systems. The I.F. employed in the picture channel is from 10-11.5 mc. while that for the sound channel is around 8.75-9 mc.

A surprising thing about the demonstration was the negligible effect automobile ignition interference had on the pictures. Frequently the interference became strong enough to render the sound channel momentarily unintelligible, but instead of blotting out the image the interference caused only slight blurring of the images for a fraction of a second.

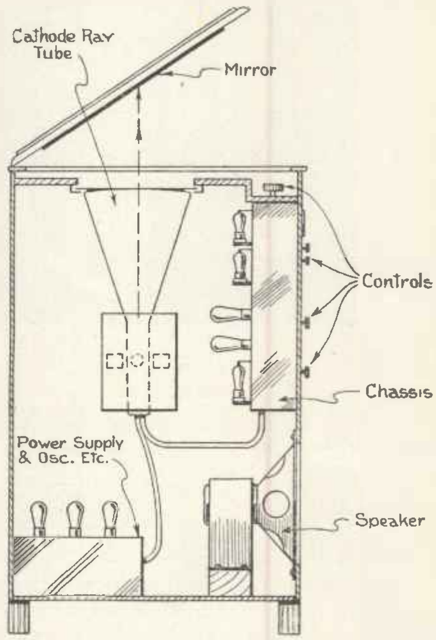


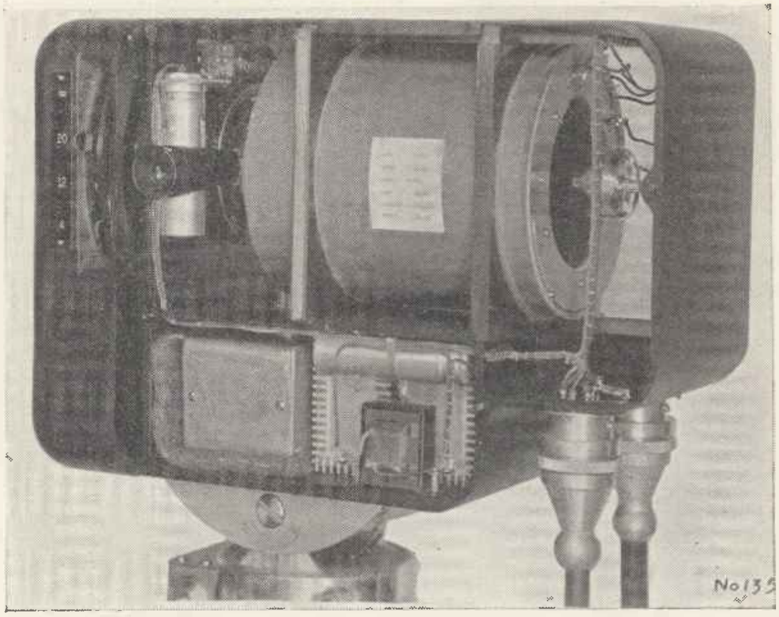
Diagram showing the general scheme of the R.C.A. receiver.

This was not serious enough to be distracting to the eye.

This demonstration was given as a preliminary to the first experimental field tests of the system to be conducted in New York City beginning about June 29. Transmission will be from the new 10 kW. ultra-short wave television transmitter now being completed on the 85th floor of the Empire State Building. The studios will be in Radio City.

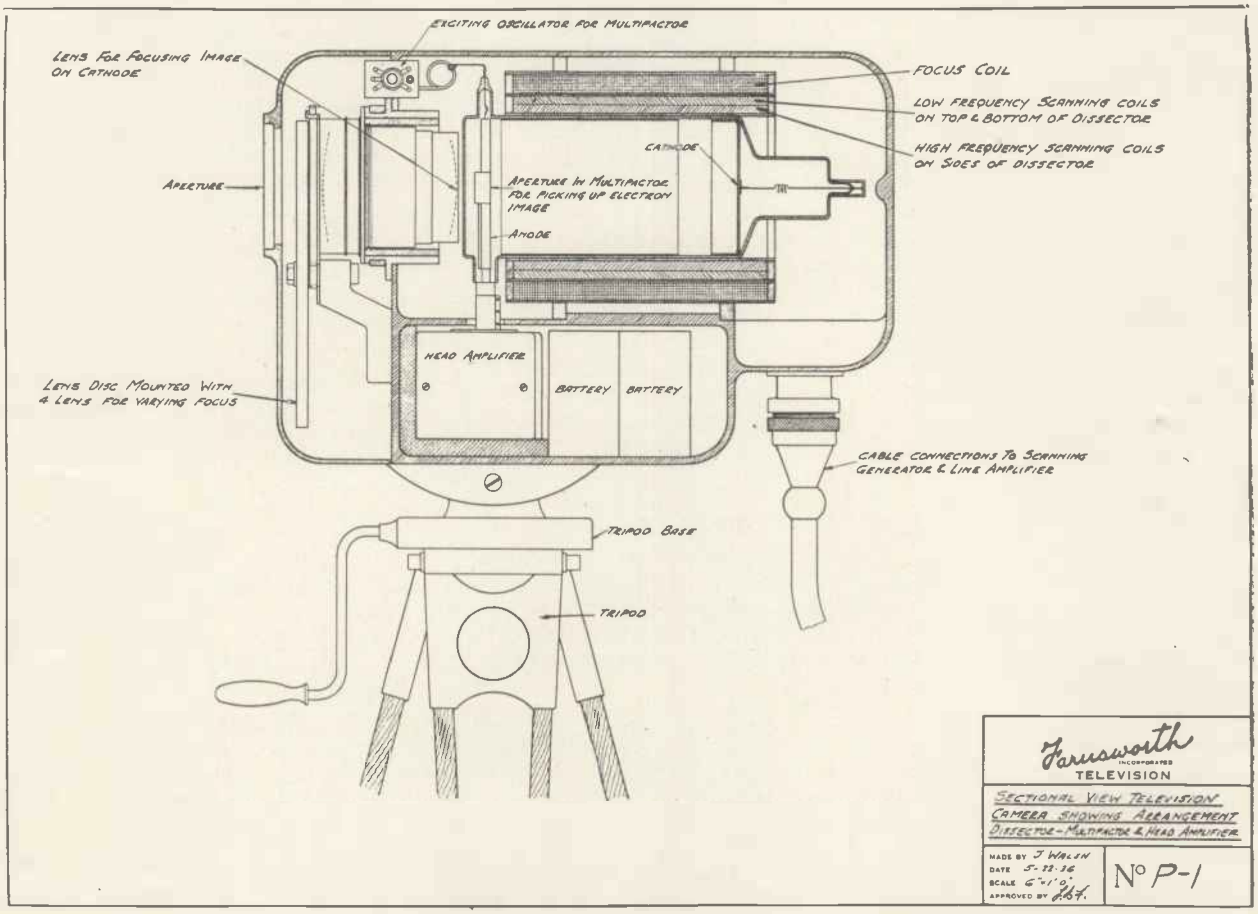
About 50 of these experimental receivers will be placed in the homes of R.C.A. engineers in and around New York for the purpose of discovering whether the system is practical outside the laboratory. If the field tests turn out successfully it is hoped to inaugurate a regular television system for the public as an adjunct to sound broadcasting. This will not occur for 18 months at the very least, however, according to statements made by R.C.A. officials at the demonstration.

FIRST DETAILS OF THE FARNSWORTH TELEVISION CAMERA



A photograph of the new Farnsworth television camera with one side removed showing the construction.

THE new television camera designed by Philo T. Farnsworth, and which will be used at the Farnsworth Television Incorporated station now nearing completion in Philadelphia, is a marvel of compactness. The camera itself is no larger than the standard motion-picture camera, in fact it is not as large. The camera is easily portable and self-contained. Operation has also been reduced to a minimum of simplicity.



This is a reproduction of the working drawing of the camera produced in the Farnsworth laboratories.

The camera is capable of highest definition—as many as 500 lines, thirty picture frames per second, interlaced.

The compactness and high performance of the camera is largely due to the ingenious use of the principle of secondary electron multiplication by Mr. Farnsworth. It will be remembered that Mr. Farnsworth was the pioneer in the field of secondary electron multiplication, and his multipactor tubes give promise of great importance not only in the field of electronic television, but it is well within the realm of possibility that his multipactor tubes will have a wide influence on the entire science of radio communication.

The Farnsworth television camera has been described before and the general design of it discussed. In this new camera, however, Mr. Farnsworth has stepped from the experimental cameras of the past, and evolved a practical camera that can be used outdoors and in studios by camera-men, and its use does not necessitate the employment of highly trained laboratory research men as operators.

Just as the advent of motion pictures presaged a new profession—that of camera-men—so it is not too early to predict that television will require highly trained men as television camera-men. No small part of the success of the motion picture and its perfection as an art has been due to the camera-men. Strangely enough, the motion picture camera-man must be a combination of artist and technician. He must know his art, and he must know his motion-picture camera, and its possibilities and limitations. So important has the motion picture camera-man become that his name is flashed on the screen with those of the author, director, and actors.

Mr. Farnsworth has realised that the resultant television pictures cannot be possibly better than the pick-up camera from which they originate, and for that reason he has expended wide research in the camera field.

The new Farnsworth camera seems to fulfil all of the requirements that might be placed upon it. And it seems to promise, from extensive laboratory tests, excellent performance. The incorporation of the multipactor tube as part of the image dissector tube solved many perplexing problems. The resultant Farnsworth camera has the great advantage, it would seem, of both simplicity of construction and design, and simplicity of operation.

TELEVISION AND CAR IGNITION INTERFERENCE

CONCERN has been expressed in some quarters regarding the effect ignition systems of cars will have on transmissions with a wavelength round about 7 metres. Experience has shown that this trouble is actually more apparent than real, but it is of interest to consider some investigations which were recently made in the States. These investigations under the joint sponsorship of the Society of Automotive Engineers and the Radio Manufacturers' Association were directed towards the determination of the magnitude of the radiations from motor car equipment and, ultimately, the establishment of the limits of tolerable radiation based, of course, jointly on the needs of the radio services and on the requirements of reliability and economical operation of car equipment.

The work of the joint committee is directed by Mr. P. J. Kent, of the Chrysler Corporation, in its purely automotive phases while the radio phases of the work are under the direction of Mr. J. T. Filgate, of the United American Bosch Corporation. Mr. L. C. E. Horle, of New York City, has been retained by the Radio Manufacturers' Association for the detailed work in the development of the measuring equipment and its subsequent use in service.

Both Mr. Kent and Mr. Horle were invited to report on the progress made in this joint automative-radio work. Mr. Kent pointed out at some length the extensive investigations that have been undertaken by the automotive manufacturers in the determination of the influence on motor performance of the various methods known to be effective for the reduction of radio interference. As a primary step in the provision of radio interference elimination it is essential that the quantitative influence of suppressors and other interference suppression means on motor economy, life, spark plug characteristics, cold starting, low and high-speed operation, etc., be determined. Already much work has been done in a number of car research laboratories along these lines and, with its completion there will be available precisely quantitative data on these influences all of which will be found important in the establishment of the most generally satisfactory means for the suppression of radiation from car equipment.

It was reported that, in general, the commonly used method of measurement of field strength fail in this field because of the unusual waveform of the disturbing radiation. While as yet no precise data on this point is available, it has been found that all types of "click" interference with radio reception have surprisingly great peak values along with durations that are surprisingly short. Thus some sorts of "click" interference, usually not of car ignition origin, are found to be of the order of hundreds of millivolts per metre in peak intensity although of durations of only a few microseconds and hence of relatively insignificant power, thus making ineffective the usual means of field strength measurement involving the measurement of the mean or r.m.s. value of the interference and, on the other hand, indicating that the measurement of the peak value of the interference is probably the most representative single measurement that can be made to evaluate the influence of this type of radiation.

The influence of such forms of radio receiving equipment is, of course, quite different to that of the usual sustained or modulated continuous waveforms and thus requires special treatment, not only in apparatus employed for picking up the radiation and for amplifying it, but in the ultimate measuring device itself.

The problem is further complicated by the fact that in the case of ignition system radiation, the unusually "steep" wave-form of the power source shocks adjacent conducting structures into natural although relatively highly damped oscillation, the radiation from which may be of the same order as that from the source of the power itself.

In general, the attack on the problem must, therefore, be made by the investigation of radiation throughout the entire useful radio spectrum.

Scannings and Reflections

By THE LOOKER

The Role of Prophet

IT is a rather unthankful task attempting to prophesy when we *really* shall have a television service actually in being. Six months ago I would have said confidently that by this time experimental transmissions would have been put out. And obviously I should have been wrong, despite the fact that the information would have been "inspired." The fact is that there is such a vast amount of unforeseen work attached to the inauguration of the television service, and so much dependance on different concerns and interests, that it is quite impossible to adhere to a schedule. However, here is the latest semi-official news of progress made and to be made. The aerial mast is completed—that is the structure as distinct from the actual aerial. The erection of the aerial is not a difficult task, but its connection by special concentric feeders to the transmitter is estimated to take about four weeks. Most of the transmitting gear is in the Palace and work of installation has been proceeding for the past five weeks, so naturally much of this is now accomplished.

Taking everything into consideration, so far as is possible, the end of July is indicated as the time when initial tests will be made, but it should be noted that these will be of the nature of running tests, and it is improbable that any signals will be put on the air until a week or so later. The entire testing is estimated to occupy four months, but for a large part of this time the station will actually be on the air. October is likely to be a "dress rehearsal" month and the real start with the service will be made sometime in November. The delay has been very disappointing, but there is comfort in the thought that progress is now such that it seems impossible that there can be any more. November seems a pretty safe estimate.

The Construction of the Mast

Last month I stated that work on the aerial mast was only possible on the calmest of days. I learn from the contractors that I was in error in making this statement and that the intervals which occurred in the process of erection were actually due to delay in the delivery of the steelwork; and curiously enough these appeared to coincide with spells of bad weather. Neither was there a flag when the first stage of the tower had been completed; there was, however, some object which in the distance appeared to be a flag.

The Television Man

The country-wide search for the male television announcer has ended in Broadcasting House! Mr. Gerald Cock, the Television Director, has decided that all the necessary qualifications for a television announcer are possessed by Mr. Leslie Mitchell, who has been a *compere* attached to the B.B.C. Variety Department. Mr. Mitchell joined the B.B.C. in 1934 though his first connection with broadcasting was in 1929 when he took part in an Armistice Day broadcast of *Journey's End.*

All those who are to be concerned with productive work at the Alexandra Palace are now undergoing an intensive course of training at Broadcasting House and according to the sphere of their future work have been allocated to special departments such as variety, drama, etc. In this way they are able to study microphone technique and, in the case of the announcers, deportment.

A Triumph for Mechanical Systems

I was privileged a few days ago to witness the first demonstration of the Scophony system since it has been adapted for high-definition. A description of this appears on other pages of this issue. I am not at liberty to disclose the actual details of this system which is now so successful, but I suppose that I am not giving a secret away when I say that it is all a matter of light. The Scophony people have discovered a way of modulating an almost unlimited amount of light and at the same time maintaining a high figure of efficiency. This means that in the case of the home receiver the illumination source can be quite small, and with the larger receivers intended for large screen projection powerful arc lamps can be used.

The scanning arrangements are ingenious and compact, in fact the high-speed scanner for producing a picture five feet by four feet is but little larger than a cigarette and the whole apparatus is practically silent in operation. Driving power is almost negligible. Other important features are that the highest voltage used is 250 volts and ordinary valves are used in the amplifier.

Sound Levels

One part of the demonstration given by Scophony consisted of the Jessie Matthews' film *First a Girl,* and I was somewhat surprised to note that although the sound was at full loudspeaker volume it did not really appear incongruous in conjunction with the pictures of tiny figures about four or five inches high. I had noted the same point with the old thirty-line transmissions and I have never heard anyone complain that the picture and sound were disproportionate, which is rather curious when you come to think about it. Later, when the sound transmissions were made from the Midland station and the sound would often fall to a low level, lack of volume was very annoying, though actually it was perhaps more in keeping with the size of the picture. This is a matter which is certain to arouse criticism and it would be interesting to have readers' impressions.

The Eiffel Tower Transmissions

According to reports, a great improvement has been effected with the transmissions from the Eiffel Tower. The power has been increased to 25 kilowatts and this has increased the range to a radius of thirty-five miles round Paris. Advantage has also been taken of the electron multiplier and a new type of mechanical scanner has been installed. A reduction

MORE SCANNINGS . . . .

has been made in the intensity of the studio lighting which artists found so trying when the first transmissions were made. France now claims to lead the world in television and according to a French Post Office official it is the developments that are taking place in this country that have influenced the French authorities who have decided that Paris must have the finest television service in the world.

More Jealousies

The British Music Industries is the latest body to adopt television as its pet bogey. At a recent convention of this body fears were expressed of the competition that will come to the music trade through television. The stocking and selling of television sets might not take place for three, four or five years, it was said, but the competition to music which it will ultimately give, cannot be overestimated. No longer will the man in the street turn on a knob and listen as much as he does now. He will turn it on to see, and what place will music take then?

Pye Radio and Television

It is well known that Pye Radio have for some considerable time been engaged in television research, but the first public statement regarding this work was made recently at the seventh ordinary general meeting by the chairman, Sir Thomas A. Polson, K.B.E., C.M.G., T.D. Sir Thomas said: "During the past year the company has spent quite large amounts in experiment and research. For example, in the field of television, I feel satisfied that your company is in a position to take every advantage of the developments which are now imminent. Before I meet you again next year looking-in will be an accomplished fact, and there is little doubt that this new industry of television will progress in the same successful manner as its parent industry, and television will, in a few years to come, be a dominant feature in the homes of the people."

Miss Alma Taylor

Lookers-in to the early Baird transmissions from Long Acre will remember Miss Alma Taylor who was frequently featured in these transmissions and, in fact, also in the later experimental transmissions made by the Baird Co. Miss Taylor was recently married to Major Leonard Avery, D.S.O., a retired surgeon, polo player and yachtsman. She will, I am sure, have the best wishes of all the early television experimenters.

German Extensions

The German Post Office authorities have installed a television transmitter on the Feldberg mountain, in addition to that which is on the Brocken. During an initial test the programme was relayed from the Brocken (160 miles away) and, according to reports, excellent results were secured in Frankfurt. Transmission was from film and it is stated that the modulation was excellent and quite free from any interference.

Television Demonstrations

It appears that the B.B.C. has given up the idea of demonstrating television to the public in London. It will be remembered that originally it was stated that the B.B.C. intended to set up a receiving centre somewhere in the West End to which the public would be admitted free. No reason is given for this change of policy and it is supposed that it is a question of finance. Encouragement is to be given to large stores to install receivers.

Viewing Stations

The B.B.C. has received inquiries from a number of large organisations asking for information on the most suitable arrangements for public viewing rooms. The information given says that the best arrangement would consist of a small hall capable of seating 30 people. There should be five rows of seats with eight seats per row, the front row being about five feet from the screen. Indoor aerials are not likely to be of any use.

Railway Television

Both the Southern and the Great Western Railway companies have approached the B.B.C. with the object of establishing viewing rooms at their main London stations and it is probable, therefore, that before the end of the year, passengers waiting at the great London railway stations will be able to spend any waiting time in a television theatre on the platform.

Two New Television Transmitters for Germany

It is officially announced that two new high-definition television transmitting stations have been ordered by the German Post Office for erection on the summit of the Brocken mountain in the Harz and on the Grosse Feldberg in the Taunus mountains respectively. The two transmitters will be completed by next year.

The decision to erect transmitters on high mountains in the centre of populous districts is due to an old German theory substantiated by recent tests with the Post Office's mobile television unit.

The Brocken transmitter in the Harz mountains will supply the district between Hanover, Braunschweig, Magdeburg, Halle, Erfurt, Kassel together, it is hoped, with these towns.

The Grosse Feldberg station in the Taunus will provide Frankfurt-am-Main, Mainz, Wiesbaden, Coblenz, Marburg, Mannheim, possibly even Heidelberg, with a television service. It is generally thought that the practical service range of this latter transmitter will be roughly 80 kms. to the north and 100 kms. to the south and west in the Valley of the Rhine.

Opening of Permanent Berlin to Leipzig Television-Telephone Service

The two-way high-definition television service between Berlin and Leipzig was re-opened for permanent service on May 25. At the present moment public interest is not as great as it was during the Leipzig Spring Fair. A call of three minutes' duration costs RM. 3.50. The television-telephone offices, of which there is one in Leipzig and two in Berlin, are open from 8 a.m. to 8 p.m.

New Scanning Apparatus in German Television Studio

Apparatus has now been installed in the German television studio which permits of the direct televising of scenes containing up to three and four persons. About three-quarter length is transmitted. An entirely new type of photo-electric cell is employed which is said to operate according to the "secondary emission" principle (Farnsworth).

. . . . . AND MORE REFLECTIONS

Extension of German Television Programme Staff

In the course of the last few weeks the German Broadcasting Company has made a number of important new appointments for its television staff. The number of persons occupied with the preparation of the daily Berlin television programmes is remarkably small especially compared to the staff at present engaged at the Alexandra Palace in London, but it must be remembered that the Germans only change their programme once every week, and fill a large portion of programme time with the transmission of educational films.

Micro-waves

The principal broadcasting station in New York City, WNYC, has been making good use of micro-wave link transmitters. The actual transmitter at WNYC is at Green Point, several miles from the New York studios, and it has been found that the micro-wave transmitter is more satisfactory and infinitely cheaper than the ordinary telephone land line in connecting the two together. In future programmes will be sent from the studio to the transmitter *via* the micro-waves transmitters.

Radio in a Gold Mine

Readers will remember the rescue work carried out at the Moose River gold mine in Nova Scotia a few weeks back. In order to keep in touch with the entombed men a microphone was lowered through the 2 in. pipe into the shaft beneath. An amplifier and phone were connected to it and communication was kept up for long periods. A P.A. amplifier was tried so as to permit of communication into the shaft, but the echo of the sounds sent down from the reproducers made speech unintelligible. However, the microphone did enable contact to be maintained between the men in the mine and the rescue party.

Murder of a Television Inventor

Mr. D. McFarlan Moore, the famous electrical inventor, was murdered on June 15 in the gardens of his estate at East Orange, New Jersey. Mr. Moore was famous for his researches in the production of "cold" light and many of the developments in gaseous-conduction lamps are due to him. It is supposed that the crime was the work of a demented acquaintance. At one time Mr. Moore was closely associated with the late Thomas Alva Edison.

Scophony to become a Public Company

At a shareholders' meeting of Scophony, Ltd., held on June 4, and presided over by Sir Maurice Bonham-Carter, the company's chairman, it was unanimously decided to convert Scophony, Ltd., from a private into a public company and to increase the capital from £140,000 to a nominal capital of £300,000 consisting of 1,200,000 5s. shares. The company, it is stated, holds about 117 granted patents all over the world, while 105 more are still pending. E. K. Cole, Ltd., are substantial shareholders in Scophony, Ltd.

Photographs by Telephone

Wide world photos, a subsidiary company of the *New York Times*, has completed research and development of a simple method of transmitting photos by telephone. Instead of using special wires and elaborate apparatus the new system employs portable transmitting equipment which can be set up near an ordinary telephone, and there is no actual connection to the telephone circuit.

The impulses from the portable transmitter are transferred to the lines by induction only, and are received in the same manner. Thus the system will function anywhere where there is an ordinary telephone line. The transmitters are of the portable type, and weigh about 50 lbs., packed in their carrying cases, which are about the size of a suit case.

Operation may be either from mains or batteries and an accumulator of the small car type will provide sufficient current to transmit eight pictures, the time occupied for this number being approximately two hours.

No Direct Connection to Telephone

As mentioned, no interference with the telephone circuit is necessary and the operation is simple. An ordinary glossy print is secured to the drum of the transmitter, which revolves 45 times per minute. As it turns, a spot of light from the exciter lamp is reflected from the revolving photograph to a photo-cell, the resulting current being combined with a 1,800-cycle signal. This combination signal is then amplified and applied *inductively* to the line. An ordinary call is then made over the telephone to the receiving end.

At the receiving end the operator places a drum carrying a sheet of sensitised paper upon a vertical spindle. A pick-up coil placed close to the telephone instrument is connected to the amplifying system of the receiver, and the amplifiers and synchroniser adjusted. The apparatus is so well synchronised that perfect pictures may be sent over the "carrier circuits," used quite extensively in the south western portion of the U.S. Transmission over these circuits heretofore has resulted in such distortion that the pictures were totally unusable.

The pictures obtained with this system have not the detail possible with the more elaborate types, but for newspaper work they are entirely satisfactory. A rapid expansion of the *Times'* system throughout the country, and possibly abroad, is to be expected.

The Associated Press has announced that it, too, has perfected a portable transmitter. By these new machines a 4 by 5-in. photograph is automatically enlarged to 8 by 10. With this system, also, it is stated that ordinary telephone lines may be employed.

Bennett Short-wave Guinea Kits

The Bennett Television Co., in an endeavour to provide a cheap means of obtaining short-wave reception with broadcast receivers, have now introduced a short-wave super-het converter or one-valve headphone receiver in kit form at a total cost of one guinea. It is suitable for battery or mains operation and can be assembled in 30 minutes. All components are self-connecting so there is no wiring or soldering.

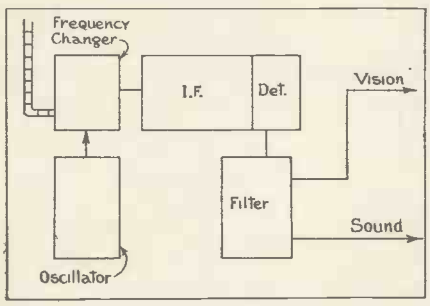
It is supplied complete, including panel, baseboard and layout diagram, all the components needed by the constructor. Even the panel is ready drilled and wood screws are provided for fixing the components to the baseplate. We can thoroughly recommend this guinea kit to all who wish to experiment and try listening on short-waves.

THE KINNES TELEVISION SYSTEM

We are indebted to Documentez-vous, a French wireless contemporary, for the following information on a proposed system for obviating the use of separate receivers for sound and vision

IT is well known that two receivers are necessary for television, one for sight and one for sound. In Germany two aerials side by side on the radio tower are used to radiate the two waves which are round about 7 metres. In France a wavelength of 8 metres is used for vision, and sound is transmitted on an ordinary broadcasting wavelength which is one solution for the experimental period.

The Kinnes system, our contemporary states, permits of sound and vision being received by one receiver, one aerial, and needs only one wavelength of medium frequency.



With this circuit the frequency changer, oscillator, I.F. amplifiers and second detectors are all used both for reception of vision and sound. The filter after the second detector splits the vision and sound signals and feeds them into separate L.F. amplifiers

In the German transmissions there is a division of 1.8 megacycles between the sound and vision frequencies. For example, let us put sound on 45.4 and sight on 43.6. If we then put the heterodyne just between the two we shall get two beats absolutely equal and a single medium wave of 1.8 on two or 900 kilocycles (about 333 metres).

However, on this same intermediate frequency channel there will be two modulations superimposed, that of sound and that of vision. The first will range from 3,000 to 4,000 cycles, while the second, in the case of German transmissions, rises to about 500,000 cycles.

The intermediate frequency channel which carries the modulation, ranges in all from 900 less 500 to 900 plus 500; that is from 400 to 1,400 kilocycles. Obviously, it is difficult to obtain amplification equally good and uniform over the entire range of 214 to 750 metres represented by the figures below. The only hope is in an amplifier of very small gain and consequently a great number of stages.

It is of course necessary to solve the problem of separating the two frequencies. As there are 180 lines and 25 pictures, there are 4,500 lines a second, each line being terminated by a synchronising impulse, so that—even if a negro fight in the middle of the night was being transmitted, one may say that the lowest frequency would be 4,500.

It is, then, sufficient to transmit a frequency range of from 4,500 to 500,000 for satisfactory vision with this definition. On the other hand, sound will be quite all right between 50 and 4,500 cycles—hence the Kinnes solution. At the end of the I.F. amplifier the signal is detected and passed to the low-frequency section through a high-note filter cutting at 4,250 cycles. This divides the signal into two parts, one going up to 4,000 cycles odd and the other beginning at 4.500 cycles. One half is fed into the L.F. power valve, the other half going to the synchronising valve and the control of the cathode-ray tube.

Advantages and Inconveniences

The advantages are obvious. In effect, in order to transmit a fight between negroes at night, it is not sufficient to employ frequencies to 4,500 periods, but right to 25, otherwise the picture would go in weakening degrees of black from left to right, or inversely, according to the direction of scanning.

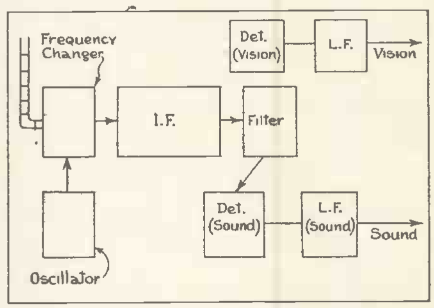
Nevertheless, when the scene to be transmitted does not consist of large uniform expanses, this fault would pass unnoticed. But, when it is known that a system has a basic fault such as this, it is certain that among the numerous imperfections which will be righted with time, this will not be altered. Thus the value of such a system is destroyed.

Our Policy
"The Development of Television."

A Recent Solution

An interesting solution to the problem which obviates this disadvantage has been established recently.

Let us take the same figures as before (45.4 for sound and 43.6 for the picture) and place the heterodyne, not in the middle, on 44.5, but a little on one side, on 44.8. Now, instead of obtaining a single wave of medium frequency of 900 kilocycles, two are obtained, one 600 and the other 1,200 kc. The I.F. range then comprises a small narrow band of 592 to 608 kc. and a very large one of 700 to 1,700 kc. It is much easier to make an amplifier more or less uniform for 700 to 1,700 kc. (that is 176 to 430 metres).



By having separate second detectors the sound and vision signals can be more accurately separated and amplified to the required amount by entirely separate L.F. amplifiers.

So that in front of the detector one would have the I.F. vision signal well amplified, and the sound I.F. signal amplified to a smaller degree, but always enough because this last is always easy to amplify in the L.F. stage. Often the detector or simple filter is inserted to cut off between 600 and 700 kilocycles.

There would then be two I.F. channels, two diodes for detection, and two power valves, one for sound and the other for vision. If it is not desired to amplify vision by the L.F. amplifier it is possible at the end of the filter to add another I.F. stage followed by a power grid detector capable of producing the 30 to 40 volts necessary to modulate the cathode-ray tube.

THE SYNCHRONISING SIGNAL FROM THE EIFFEL TOWER

By R. Barthelemy

The Eiffel Tower transmitter uses a different system of synchronising signal from the accepted practice in other countries. In this article, translated from " L'Onde Electrique ", R. Barthelemy explains the reasons for its adoption. Experimenters in this country should note the differences which preclude the use of a " universal " television receiver for French and other continental transmissions.

THE question has often been raised why in the case of the television transmissions from the Eiffel Tower the same type of synchronising system was not used as in other countries. The different conclusions to which the French engineers have come originate in the fact that they have considered in the first place the *simplicity of the receiver,* while others have been more concerned with the convenient planning of the transmitter. The French point of view now seems to receive American approval, for it is reported that, in recent tests, the R.C.A. adopted the transmission of pictures in negative form, i.e., the dark parts corresponding to the highest carrier intensity.

A first condition which was found necessary from the start in 1929, consisted in the creation of a synchronising signal the " sense " of which is that of the blacks of the picture. On observing the mean of scenes to be transmitted, it will be clear that in an amplifier constructed to cover the whole of the frequency band in use the impulses due to white surfaces can take considerable amplitudes, but that, if the low frequencies are well transmitted, the inverse amplitudes due to the dark parts do not produce such marked impulses.

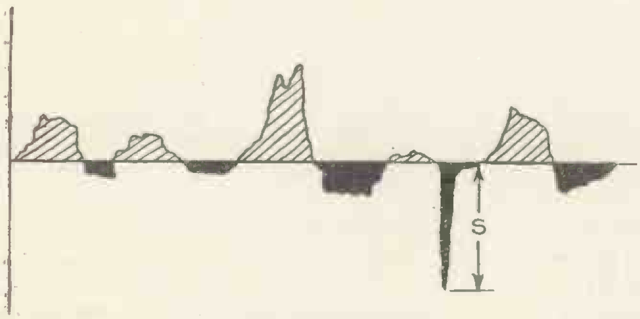


Fig. 1.—General shape of modulation curve.

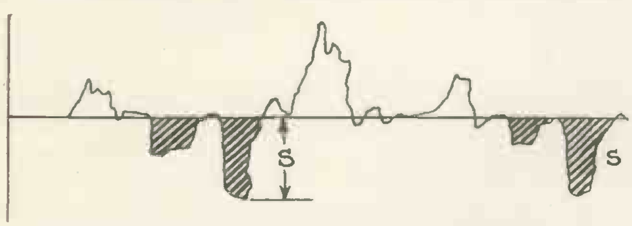


Fig. 2.—Waveform of the British and German tranmissions.

It would obviously be possible with a special scene to produce impulses towards the dark parts, but such a case does not exist in practice; as a whole, the modulation curve takes in general the shape represented in Fig. 1, where in the ordinary case of capacity couplings the total of positive parts and negative parts is nil in the interval between picture scans.

It is evident that if the synchronising signals are mingled with those of modulation the chances of spreading will be notably diminished, and subsequent filtering will be facilitated by placing the amplitudes S of the " tops " in the most uniform region, that is to say in the direction of the dark parts of the picture. Experience confirms this hypothesis.

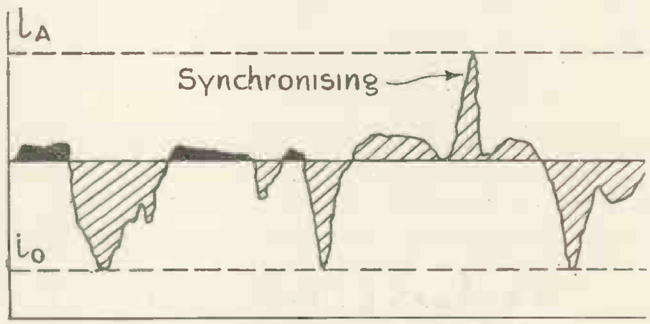


Fig. 3.—Waveform in the French transmissions.

In most transmissions the line synchronising signal is obtained by modulation of the carrier wave to 100 per cent, i.e., by the cancellation of the current in the aerial. Theoretically the wave-form of this signal is rectangular and lasts five-hundredths of the duration of the line. In practice, however, it is fairly rounded and is at a tangent to the axis of the t's.

According to what we know of the essential link in synchronisation in the receiver, the thyratron, there will be serious difficulty in obtaining an exact discharge point, which perhaps explains the fact that it is little used outside France, being replaced by a group of three or four valves.

In order to maintain the necessary exactitude a very short and pointed synchronising signal is made lasting for 1/100 of the line, and in order that this point might be perfectly transmitted with the maximum energy, the direction of increase in the current of the aerial is chosen to transmit the top; this implies that the " whites " will diminish the high-frequency intensity, while the " blacks " with the synchronising signals will increase it. Fig. 3 shows the shape of the aerial current curve (i.e., is the carrier current in the absence of modulation).

The following advantages were found in this method:
(1) *On the Reception Side.*

(a) The positive nature of the synchronising signals is superior to that of image signals, for at the moment of transmission of the " top " the energy is almost quadrupled in the aerial. In general, the picture on reception is synchronised before being visible, which would be impossible with other systems.

(b) Separation of the synchronising signals from the rest of the modulation is extremely simple and is obtained by a bias adjustment of the thyratron.

(c) The exactitude of the discharge of the thyratron is governed by the duration of the voltage impulse which is of the same order as the image point. The thyratron is therefore controlled almost rigidly and its degree of freedom cannot influence the quality of the picture.

(d) Protection against interference and the flickerings which it produces in line deviation is very much increased, as much by the raised level of energy of the " top " as by its brevity.

If to these advantages there is added that given by the time signal of the picture obtained by the suppression of a line signal it will be realised that with four valves and two thyratrons (1 octode + 1 HF + 2 LF) the construction of a complete television receiver may be achieved, and we regard this extreme simplicity as the essential basis of television development.

Another advantage of the " sense " chosen is that the control grid of the cathode-ray tube may be directly modulated from the detector and a positive picture obtained; it is thus possible to apply to this grid the D.C. component which creates the background colour, and this without any additional device.

(2) *Transmission Side.*

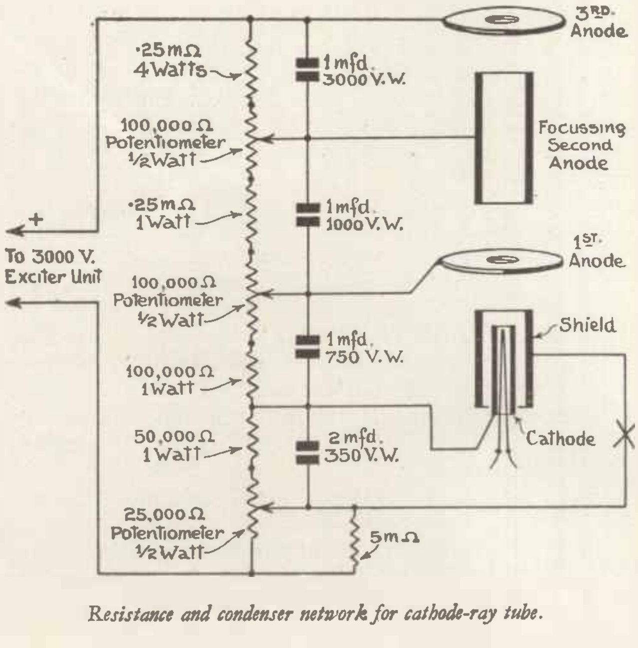
It may be objected a priori that the transmitting valves are badly utilised for it seems that they must be capable of handling the maximum strength of the synchronising signals, whereas normal modulation only uses a quarter of their capacity. In reality this objection only holds good from the point of view of insulation values and the length of the straight parts of the characteristics, for, from the energy point of view the duration of the power peak must be remembered. This duration is from 1 to 2 per cent. of the total time, so that if one admits a double overload, the average strength and in consequence the *heating* is only increased by about five per cent.

It is therefore unnecessary to choose valves of four times the normal power output and it is sufficient to see that the response and feed voltage remains correct for the large amplitudes of the synchronising signals.

To summarise: the direction and the form of the signals which has been adopted offer indisputable advantages, verified by experience as far as receivers are concerned; also it does not entail any marked additional difficulty in transmission. The only objection which might be raised is that a receiver imported from Berlin or from London cannot, without modification, function in Paris.

A CATHODE-RAY TUBE RESISTANCE NETWORK

IN the May issue an exciter unit, providing 3,500 volts to supply the D.C. potential for the operation of a cathode-ray tube, was described. This unit was complete in itself, but, of course, in conjunction with it it is necessary to provide means for applying the correct voltages to the cylinder and the various anodes of the cathode-ray tube. A resistance and condenser network of this type becomes the control panel and can be either separate from the exciter unit or the two can be combined.



Resistance and condenser network for cathode-ray tube.

The circuit diagram gives details of the resistance values and the suitable wattage ratings of these, and it is essential that these figures should be adhered to. The actual control panel is built alongside the exciter unit which was illustrated in the May issue. All tapping points are brought out to terminals mounted on a strip of insulating material at the top of the unit. This is placed above the control panel, but it may, of course, be mounted in any convenient position. The entire unit is encased in a metal cover and may so be arranged that when the cover is removed the connection to the mains is automatically broken, thus ensuring against any risk of shock. This unit may be had either as a kit of parts or completely assembled from the Mervyn Sound and Vision Co., Ltd., 4 Holborn Place, London, W.C.1.

When wiring the unit care should be taken to see that all leads are well insulated and do not touch the condenser cases or touch each other. If attention is paid to this point there will be little risk of breakdown.

Experience has shown that the potentiometers are reliable, but in order to safeguard the tube, the bias (shield control) is shunted with a high resistance so that in the event of a breakdown or intermittent contact on the bias potentiometer the full negative voltage is automatically applied.

The potentiometer values have been chosen to give a reasonable voltage variation in order not to load them to too high a wattage. The network has been calculated for the new Ediswan 3-gun tube, but it is also suitable for most other tubes and will allow the correct voltages being applied. A 1-megohm resistance is supplied which should be connected at X so that modulation may be injected in the usual way.

RECENT TELEVISION DEVELOPMENTS

A RECORD OF PATENTS AND PROGRESS

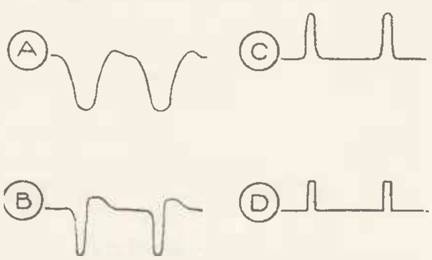
Specially Compiled for this Journal

***Patentees:* T. M. C. Lance, D. W. Pugh and Baird Television, Ltd. :: Radio Akt. D. S. Loewe. Scophony, Ltd., and J. H. Jeffree :: British Thomson-Houston Co., Ltd. :: J. D. McGee.**

Producing Synchronising Impulses

(Patent No. 443,032.)

In order to produce a clear-cut effect, the original synchronising signal, as it comes from the light-



Method of producing synchronising impulses. Patent No. 443,032.

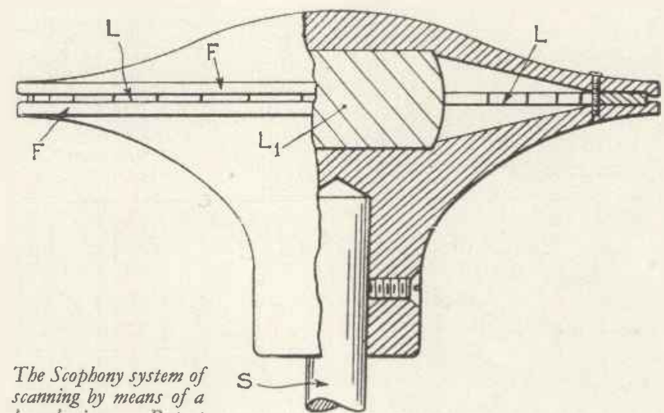
siren or other type of generator, is passed first to a valve which functions as a grid-current rectifier and then to a valve biased to operate as an anode-bend rectifier. The first valve serves to "narrow" the original impulse from the form shown at A to that shown at C, whilst the second valve changes the sign from positive to negative, as shown at B, and then converts it back to a clear-cut positive impulse with a flattened top, as shown at D. The width or duration of the final synchronising impulse is controlled by adjusting the grid-bias on the second valve.—(*T. M. C. Lance, D. W. Pugh,* and *Baird Television, Ltd.*)

Superhet Television Receivers

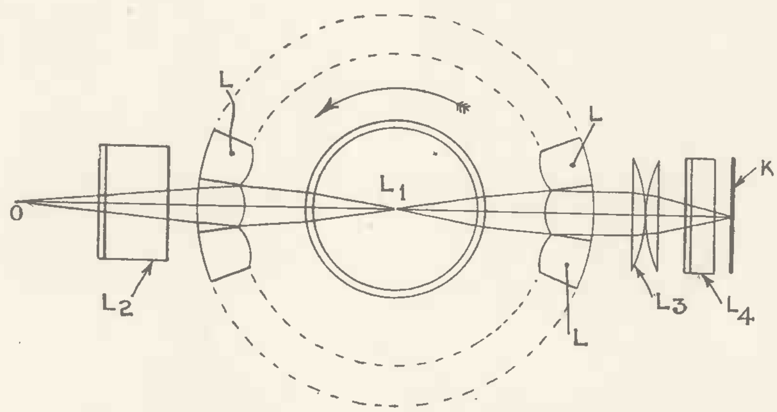
(Patent No. 443,046.)

When receiving television signals on a superhet set, it is usual to choose as low an intermediate frequency as possible. In practice this makes it difficult to separate the picture-signals from all traces of the carrier-frequency, with the result that the latter makes its presence felt in the shape of disturbing "patterns" on the viewing-screen.

In order to overcome this defect, the first set of intermediate frequencies is heterodyned with a second local oscillation. This is conveniently made twice the wavelength of the first local frequency, and is supplied from the same generator. The demodulated picture-signals are then easily separated out by passing them through a band-pass filter circuit.—(*Radio Akt. D. S. Loewe.*)



The Scophony system of scanning by means of a lensed ring. Patent No. 443,393.



Scanning by a Lens Ring

(Patent No. 443,393.)

A series of thin cylindrical lenses L, Fig. 1, is arranged in ring-formation and clamped in position between the upper and lower flanges F of a dust-proof casing. In the centre is a cylindrical lens L1 which is rotated with the outer lenses L by a shaft S.

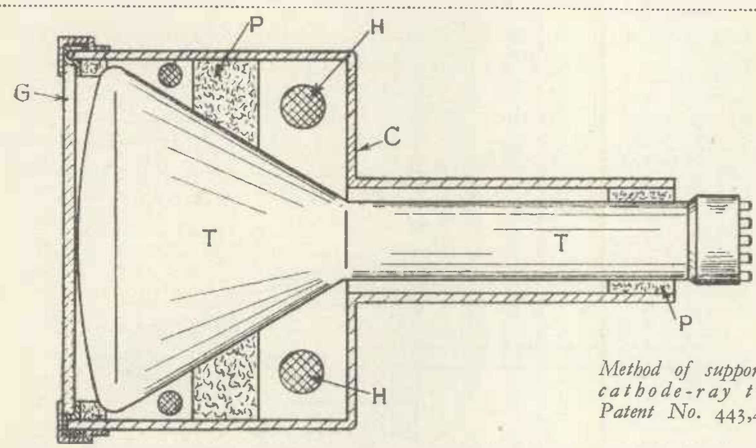
The course of the ray of light is shown in Fig. 1A. It passes from a Lamp O through a cylindrical lens L2 into the scanning-ring, and then through the centre lens L1, emerging at the opposite side. Here it passes through a condenser lens L3 and another cylindrical lens L4 on to the cinema film K or other object to be scanned. As the lens-ring rotates in the direction of the arrow, the spot of light moves from the bottom to the top of the plan-section of the film shown in the figure, or across the face of the film in actual practice. The second component of scanning is provided by moving the film in the direction of its length.—(*Scophony, Ltd.,* and *J. H. Jeffree.*)

Protecting Cathode-ray Tubes

(Patent No. 443,484.)

To prevent any possibility of damage, either to the set or the user of a television receiver, should the cathode-ray tube collapse or burst when in use, the tube T is permanently mounted inside a metallic casing C which surrounds the narrow stem as well as the flared end of the glass.

The tube and its casing are both mounted in position in the receiver cabinet, a stout sheet of glass G being provided in front of the usual viewing-screen. Pads P are fitted, as shown, to hold the tube firmly inside the casing, and the latter is provided with gauze-covered holes H to allow the entry of air for cooling.—(*Radio Akt. D. S. Loewe.*)



Method of supporting cathode-ray tube Patent No. 443,484.

Controlling the Cathode-ray Spot

(Patent No. 443,682.)

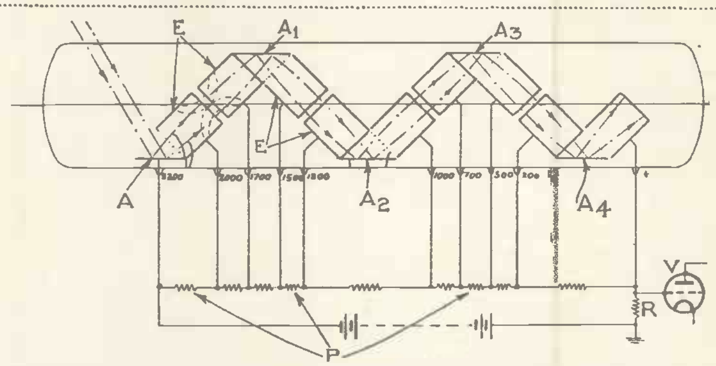
The electrode system of a cathode-ray tube is usually arranged so that the zero or "resting" position of the ray lies at the centre of the fluorescent screen when there is no applied deflecting-voltage. It is, however, sometimes useful to be able to start the spot from some point other than the centre of the screen. For this purpose a pair of C-shaped magnets are mounted so as to encircle the outside of the glass tube. The two magnets form a ring, which can be rotated bodily so that the flux from the gap between the poles will displace the electron stream to one side or other of the screen as desired. A second ring of metal, also mounted outside the tube, serves as an adjustable shunt to control the strength of the applied magnetic field.—(*British Thomson-Houston Co., Ltd.*)

Electron Multipliers

(Patent No. 443,777.)

A single tube contains a number of separate targets so arranged that electrons pass, in cascade, from one to the other, liberating at each stage a number of secondary electrons, so that a greatly-amplified current is produced at the output electrode.

As shown in the drawing, a ray of light is directed against the first photo-sensitive target or cathode A where it liberates a certain number of free electrons.. These are focused by auxiliary electrodes E towards a second target A1, which carries a higher voltage than the first, so that the original stream is reinforced by the production of secondary electrons. The process is repeated at the targets A2 and A3, the amplified output from the last target A4 being fed through a resistance R to a thermionic valve V. The increasing voltages required to bias the targets and the concentrating-electrodes are taken from tappings on a potentiometer P, as shown.—(*J. D. McGee.*)



An electron multiplier system. Patent No. 443,777.

Summary of Other Television Patents

(Patent No. 443,589.)

Method of cutting-out inductive interference from a two-wire transmission line carrying television or other high-frequency signals.—(*E. L. C. White.*)

(Patent No. 443,844.)

Electron optical system for focusing the electron stream in a cathode-ray tube.—(*C. Lorenz Akt.*, and *M. von Ardenne.*)

(Patent No. 443,952.)

Time-base circuit designed for use in scanning a mosaic-cell electrode in a cathode-ray television transmitter.—(*M. Bowman-Manifold.*)

(Patent No. 444,058.)

Amplifier having a wide frequency-response, particularly suitable for television.—(*Scophony, Ltd., G. Wikkenhauser*, and *J. Sieger.*)

(Patent No. 444,065.)

Method of synchronising in which the receiver is given a threshold value of response, in order to prevent overlap between different transmissions.—(*Telefunken Ges für Dräht-lose Telegraphie m.b.h.*)

(Patent No. 444,151.)

Scanning system for use with the Iconoscope type of cathode-ray transmitter.—(*Telefunken Ges für dräht-lose Telegraphie m.b.h.*)

(Patent No. 444,177.)

Television receiver for a carrier-wave which is modulated in opposite senses by the picture-signals and synchronising impulses respectively.—(*C. S. Agate* and *W. S. Percival.*)

(Patent No. 444,360.)

Scanning system with means for varying the frame and line frequency for different transmissions.—(*G. E. G. Graham.*)

A Mercury-vapour Lamp for Floodlighting

The Ediswan Co. have produced a mercury-vapour lamp of the Escura type with a lower wattage rating than the former 250- and 400-watt lamp. This new lamp is rated at 150 watts and is eminently suitable for small scale floodlighting. The characteristics are exactly the same as the larger types. The efficiency is 32 lumens per watt.

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

FOR THE BEGINNER

THE NEW SYNCHRONISING SYSTEM SIMPLY EXPLAINED

By G. R. ASHLEY

This article explains how synchronising with the new transmissions will be greatly facilitated compared with the old thirty-line system

IN the reception of the old 30-line television, undoubtedly the greatest problem was that of synchronisation. This difficulty was not by any means entirely due to the mechanical mass which had to be kept in step as some experimenters were inclined to think, but to the incorrect character of the radiated signals. As was pointed out in this journal at the time, spurious synchronising signals were as often as not generated in the picture part of the signal, which completely mutilated any synchronising effect the synchronising signal might convey. The engineers were, of course, aware of these defects and how they could be overcome, but, unfortunately, no authority was given to make the necessary improvements. During the last few months of the 30-line transmissions, when many experimenters used cathode-ray tubes for reception, they were disappointed to find the synchronising problem was still with them in spite of the "masslessness" of their scanning device.

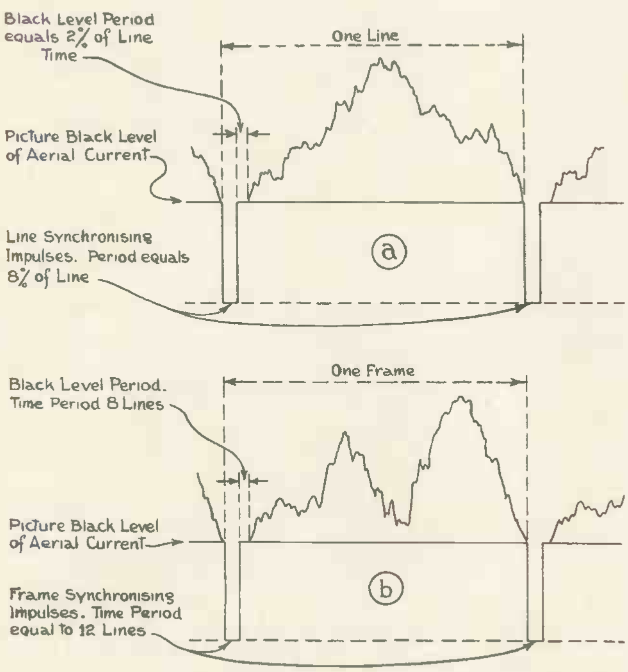


Fig. 1.—Details of waveform used in the Baird system.

Now with the high-definition systems which will be radiated from Alexandra Palace all synchronising problems should vanish, and if they do not it will be the fault of the receiving circuit. Very definite synchronising signals are radiated by both systems, which are in a different " sense " to those of the picture, this difference in " sense " being brought about by what is known as " D.C." working, which is very different from the old television transmissions, which were on the A.C. system like a sound broadcast. Incidentally one must not overlook an additional complication in that two synchronising signals are generally considered necessary to operate the cathode-ray type of receiver, which calls for a filter or selector circuits to separate the two synchronising signals. This separation is comparatively easy as the two signals are of fairly different frequency, 25 and 6,000 in one system, and 50 and 10,125 in the other.

Both firms, Baird Television, Ltd., and Marconi-E.M.I., Ltd., have published details of their transmitted waveform and as the former is undoubtedly the simpler let us begin with it.

D.C. Modulation

The Baird system transmits a sequentially scanned 240-line, 4:3 ratio picture, 25 times per second, and the waveform is shown by Fig. 1. One must not forget that this waveform is that of D.C. working and perhaps it might be well to consider the effect of applying the television carrier to the familiar anode-bend type of detector, comparing it with that of sound reception.

When receiving sound, if the receiver is detuned only a very small anode current is flowing, but on tuning-in a station the anode current rises to a given value, say, from .1 milliamp. to 1 milliamp.; this increase of current will be sensibly constant irrespective of whether the carrier has been modulated or not, or during loud or soft passages.

Now in the case of our new television carrier, supposing the transmitter is radiating but unmodulated, the anode current would rise to, say, .4; now supposing it is modulated with synchronising signals only, the anode current will drop, while when the picture comes on it will probably rise above the .4 mark (unless the scene transmitted is exceptionally dark); a sunny seaside scene would probably produce a record high anode current. It is hoped that from the brief explanation that the reader will realise what is meant by D.C. working!

Returning to Fig. 1 (a) shows what is known as the H.F. or line synchronising impulse or signal, and (b) the L.F. or frame impulse.

Taking the line impulse first, Fig. 1 (a), let us see what it has to do at the receiver—an electronic scanner in the form of the cathode-ray tube. Two self-oscillating circuits (the usual term of time base is hardly correct when the cathode-ray tube is used for television reception) are approximately producing the required number of lines and frames per second, while the electron's beam density should be adjusted to such a value as to be all but invisible on the scanning lines, and certainly invisible on any fly-back. Along comes the

THE E.M.I. SYNCHRONISING SYSTEM

television signal, say, the first line of a frame scan, but the receiver scanning spot, R1, is, say, in the middle of the 120th line while intelligence being transmitted should be at the point T_1 (Fig. 2) relative to the picture ratio frame. Assuming the receiver scanning oscillator is running about a couple or so lines less per second than is actually required (the proper setting) the spot R1 will have got to about the point $R1_2$ on line 121,

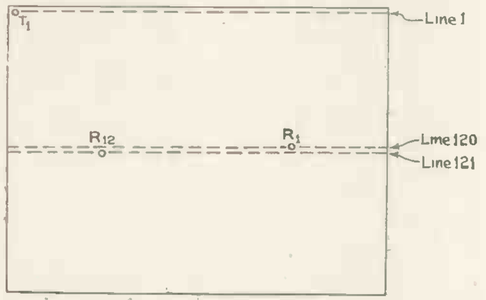


Fig. 2.—Showing the relative positions of spot and synchronising impulse.

when the transmitting synchronising pulse arrives setting R1 to the beginning of the 122nd line, when the line scan will be in step with the transmitter though displaced in the frame, the second transmitter line being received on 122 one. This displacement will carry on, the receiver's frame oscillator impulse will put the displaced scanning lines to the top of the frame till such time as the frame impulse arrives from the transmitter and sets both scanning oscillators in step with the transmitted signals, which is what we require.

The Fly-back

It will be remembered that in cathode-ray reception of 30-line television it was impossible to eliminate the fly-back stroke of the frame-scanning, and this again was chiefly due to transmitted waveform. The illumination produced from a cathode-ray tube is due to the beam intensity by time. In the line scanning the rapidity of the fly-back is almost sufficient to make it invisible, but frame fly-back which is much slower will be visible unless some method is found to reduce the electrons in the beam or move the scanning spot as rapidly as in the case of line fly-back. The new transmissions will both radiate a signal which will suppress the beam, as in both systems the aerial current is almost cut off to produce the necessary synchronising pulse which, when applied to the modulating electrode of the cathode-ray tube will all but suppress the electron beam and so make the fly-back invisible. In both systems it should be noted that the time period of a line includes the fly-back (synchronising impulses) a small section of black level and finally picture signal.

The reason for this small black level period may not at first be apparent. Its function is that which might almost be described as a " breathing space." Throughout the whole chain—studio to receiver—the violent jerk given to the system by the synchronising impulse is inclined to unsteady things generally and it has been found desirable that this short period should be allowed for everything to settle " just so " before sending a line of picture signal. Referring to Fig. 1 (b) we see a similar arrangement at the commencement of each frame scan, the synchronising and black level period occupying the time period of twenty lines.

It will be noticed in Fig. 1 that apparently no line impulses are radiated during the frame impulse and the black level period following it. Apparently it is intended that the receiver line impulse oscillator be allowed to oscillate freely during the period, and one cannot help wondering if the first line will start scanning at the correct instant. The fact that the line scanning is still operating means that the frame fly-back will not travel back across the picture as in 30-line days, but in a zig-zag path as shown in Fig. 3, which will have the added effect of increasing the speed of the electron beam and consequently reducing any illumination it might be inclined to produce. Before leaving the Baird system it should be mentioned that the one impulse between lines and the long steady impulse between frames could be used to work scanning circuits which are virtually not self-oscillating; this would have a decided advantage in reducing the number of controls in a commercial receiver.

E.M.I. Synchronising

Now let us turn to the E.M.I. system, Fig. 4, which shows the various waveforms. Here we have, at least on first inspection, a much more complicated series of synchronising signals, due mainly to interlaced scanning and also to the greater number of lines and frames per second. This system transmits an interlaced 405-line 5:4 ratio picture 25 times per second, but with a frame frequency of 50 per second.

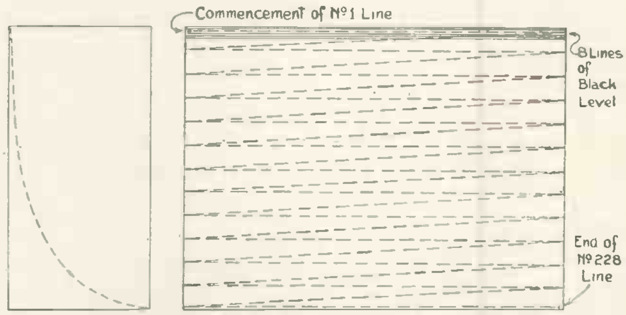


Fig. 3.—Fly-back of Baird's old 30-line system (left) compared with that of their modern 240-line system. No attempt has been made to draw any line scanning line. It must not be overlooked that the old system was designed for mechanical receivers.

On inspection of the waveforms it will appear that there are three synchronising frequencies. This does not mean that E.M.I. have some peculiar type of electronic receiver, but that they consider it necessary to keep the line oscillator locked during the frame impulse, owing to their method of interlaced scanning. The line impulse is very similar to that of bands, which is to be expected as it has to perform the same function.

Supposing one starts with line 1, ordinary line impulses take us to the commencement of the 203rd line,

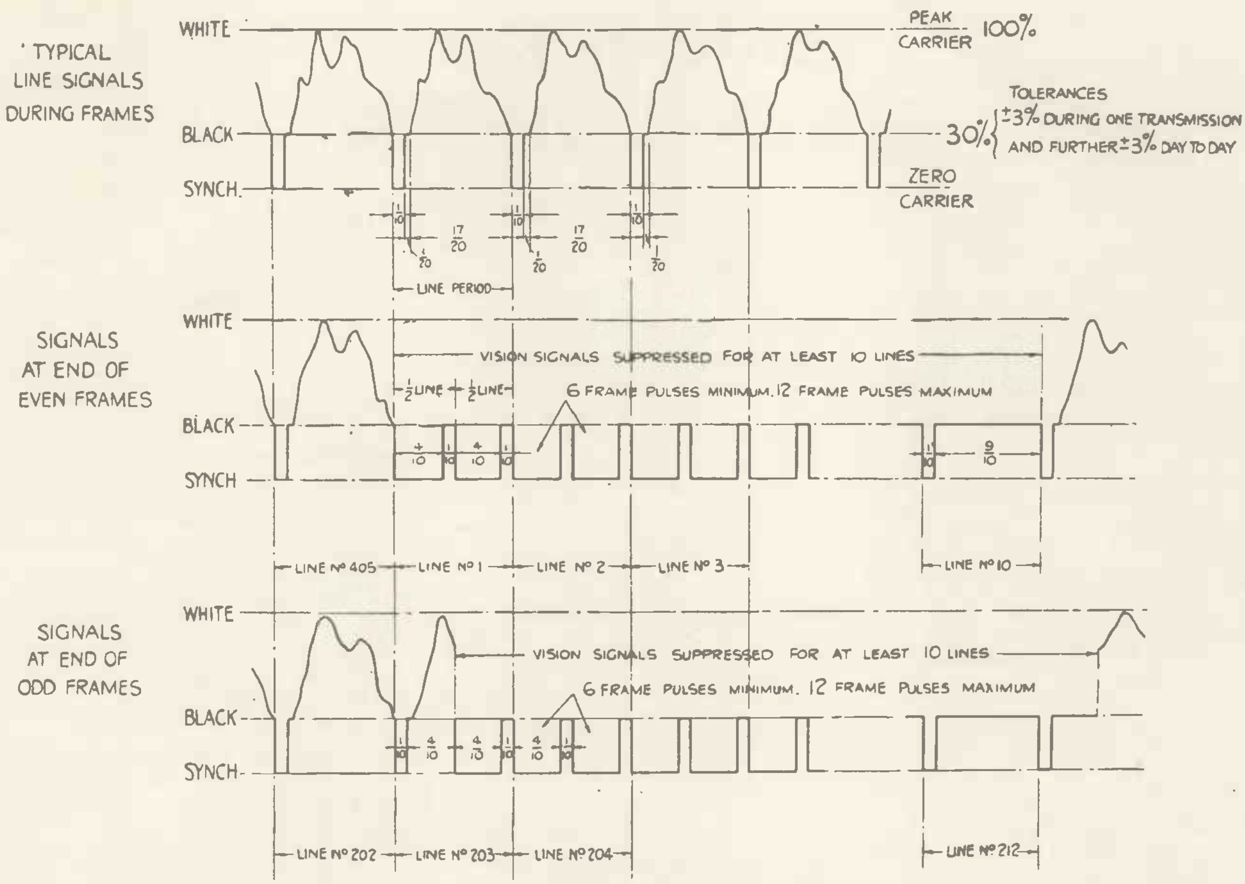


Fig. 4.—The E.M.I. waveform.

when halfway along it there comes a much broader impulse, which is the first of a series of frame impulses. This series of frame impulses has a frequency of 20,250, twice that of line. The second, fourth and all even impulses correspond to the line impulses (except that they are broadened) and so lock the line oscillator during the fly-back period. The first, third and all odd numbers have no effect as they will be too much " out of step," but on the other hand any of the broadened impulses may control the frame oscillators, supposing the first one has failed to do so. This may appear rather a " loose " way of doing things but one must not forget that there is considerably more latitude in the timing of frame oscillators compared with those of line, as much shorter times are involved in the latter.

At the end of the second frame or the 405th line, the series of broad impulses are again introduced, the only difference being that the odd numbered ones coincide with line impulses, the even ones being ineffective. As in the first systems discussed all fly-back periods are at black level and also a short black level period precedes each line and frame scan. It should be noted that the E.M.I. synchronising impulses are of smaller intensity than the Baird.

The Unit AC/DC Short-wave Converter.

The expense of a special short-wave receiver is unnecesary if a good converter is coupled up in front of the broadcast receiver.

Unit Radio, whose converters have been so widely used by our readers, have now produced a new model making use of the Octode frequency-changer which is so efficient below 100 metres.

This converter is entirely mains-operated and is suitable for either A.C. or D.C. mains of from 200 to 250 volts. It can be used with any type of receiver either super-het or straight providing the straight receiver will tune above 1,000 metres.

No alterations need be made to the broadcast receiver to hear short-wave programmes and only two connections have to be made to connect up the converter.

Once the converter has been attached an internal switch changes the instrument from short-waves to medium and long waves as required.

The wave-band range is 12.5-70 metres, so covering most of the important short-wave stations without the use of plug-in coils.

Supplied complete with valves and calibration chart the price is £4 5s. A battery version is obtainable at £3 5s., and all information can be obtained from the makers, Unit Radio, 347 City Road, London, E.C.1.

New Mazda Valves.

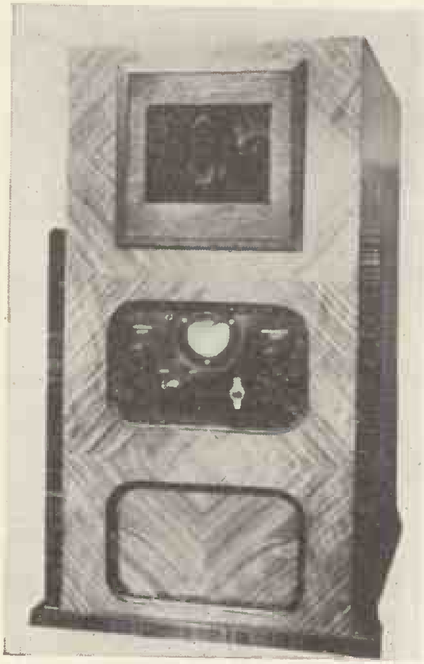
Full details are now available of the new Mazda VP210 high-frequency pentode. This valve has been designed to be free from microphony and is similar in characteristics to the present VP215. It has a mutual conductance of 1.4 mA/V at 120 volts on the anode, 50 volts on the screen and zero grid voltage.

Another new pentode is the SP210, having a fixed grid base. This also has a filament rating of .1 A and is designed to take 150 volts on both anode and screen. The mutual conductance is 1.7 mA/V.

A third new valve is the PEN231. This valve has anode current of 0.3 m/A and is designed to operate with 150 volts on both anode and screen.

Cathode-Ray Laboratory Equipment

Details of special testing gear employing the cathode-ray tube



An experimental cathode-ray receiver designed in the Furzehill Laboratories.

THE cathode-ray tube is being used to an increasing extent in modern industry. Quite apart from the ordinary applications such as waveform examination there are numerous directions in which this flexible tool may be employed to facilitate production and inspection.

In the radio industry there are, for example, such applications as the automatic plotting of resonance curves for tuned circuits, i.f. transformers, etc. Here, by the use of a horizontal deflection proportional to the frequency, the spot on the screen can be made to trace out the response curve of the circuit and the effect of altering the tuning can immediately be seen.

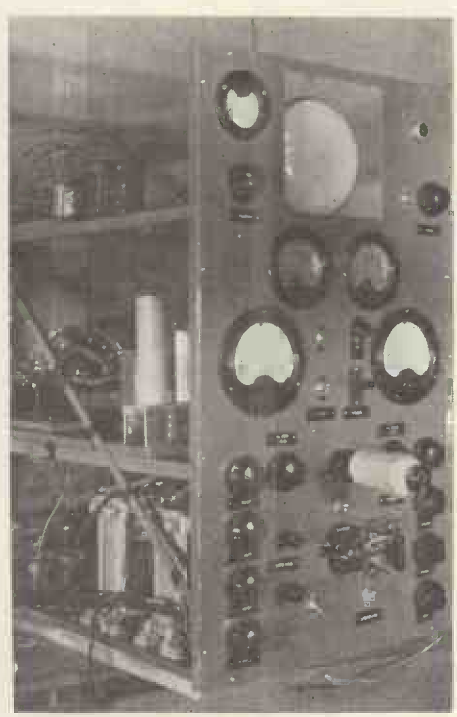
Another possibility is the application of the tube to the plotting of valve characteristics. By the use of a special commutator, three characteristics can be shown at once and the effect of varying the different operating potentials can be observed in very much more rapid time than would be possible if each characteristic had to be drawn out by the usual static method.

Our well-known contributor, Mr. J. H. Reyner, has been carrying out research of this type for the past few years and in view of the steadily increasing demand for such products he has arranged to form a special department at his laboratories for the manufacture of such apparatus, ranging from simple cathode-ray oscillographs to more elaborate applications. This department will also supply specialised accessory equipment developed to meet specific requirements, one such instrument of particular interest being an oscillator covering a frequency range of 25 cycles up to 1 megacycle, which is particularly useful for the testing of television equipment.

Many Industrial Applications

Some of the industrial applications of the cathode-ray tube on which research is proceeding are the tracing of indicator diagrams in internal combustion engines, showing the explosion pressures at each part of the cycle, the measurement of stresses and strains in building and constructional materials, the measurement of operating times to a very high order of accuracy and numerous other specialised adaptations.

The selling organisation for this new development is in the hands of Mr. C. H. Keeling, who is well known to the radio trade, while specific details and prices regarding the apparatus available may be obtained on application to the Furzehill Laboratories, Boreham Wood, Herts.



Cathode-ray equipment for plotting the characteristics of valves.

The Coaxial Cable for German Television

The following are details of the coaxial television cable installed between Berlin and Leipzig. The inner copper wire is 5 millimetres in diameter, and is kept in place by a spiral of insulating material known as "styroflex" which is a transparent flexible material of paper thickness. The spiral is surrounded by a "styroflex" sleeve on top of which is a sleeve of spiral-wound flat copper bands held together with copper foil, over which is a linen sleeve and finally a lead covering.

The frequency band capable of being handled by the cable is 4,000 kilocycles, of which only 500 kilocycles are at present being used for television for a 180-line, 25-frame picture. Later it is believed that a 2,000-kilocycle band suitable for 400-line, 25-frame pictures will be used. A new type of cable called "symmetrische" has been designed by Siemens and Halske, and it is claimed to be equivalent if not superior to the coaxial type of cable. The "symmetrische" cable contains two wires in one core, one of which handles the return circuit instead of using the spiral wound copper sleeve as is done in the coaxial system.

Baird Television

Change of Address

The head office of Baird Television, Ltd., has now been removed to:—Greener House, 66 Haymarket, London, S.W.1. Telephone: Whitehall 5454. Telegraphic address: "Televisor, Lesquare, London," to which address all correspondence should be sent.

SHORT-WAVE SECTION

All of the small components in the amplifier are mounted within the valve rack. In this way connections are kept short and hum pick-up reduced to a minimum.

A Class A High-fidelity Amplifier

We have received a number of requests for a high output amplifier using a single valve. This Class A amplifier is capable of giving a continuous output of 30 watts while maintaining a level frequency response.

This amplifier is based on a design by G2HK.

HIGH-OUTPUT amplifiers need not make use of complicated circuits and multi-electrode valves when undistorted outputs of up to 30 watts are required. Class AB and class B amplification have been very widely used, but in certain quarters are unpopular owing to the fact that special low-resistance power packs are required and that there is always a tendency for valve breakdown.

Public-address engineers realise that the main essential of an amplifier is complete reliability in all circumstances. For that reason we have received quite a number of requests for a single-ended amplifier giving a high output and at the same time free from any possibility of breakdown. Naturally such a circuit would have to be run very much below maximum conditions and to have a wide margin of safety with the valves in use.

This class A high-fidelity amplifier gives an output of at least 30 watts with less than 5 per cent. second harmonic distortion, while up to 40 watts have been obtained with slightly increased drive.

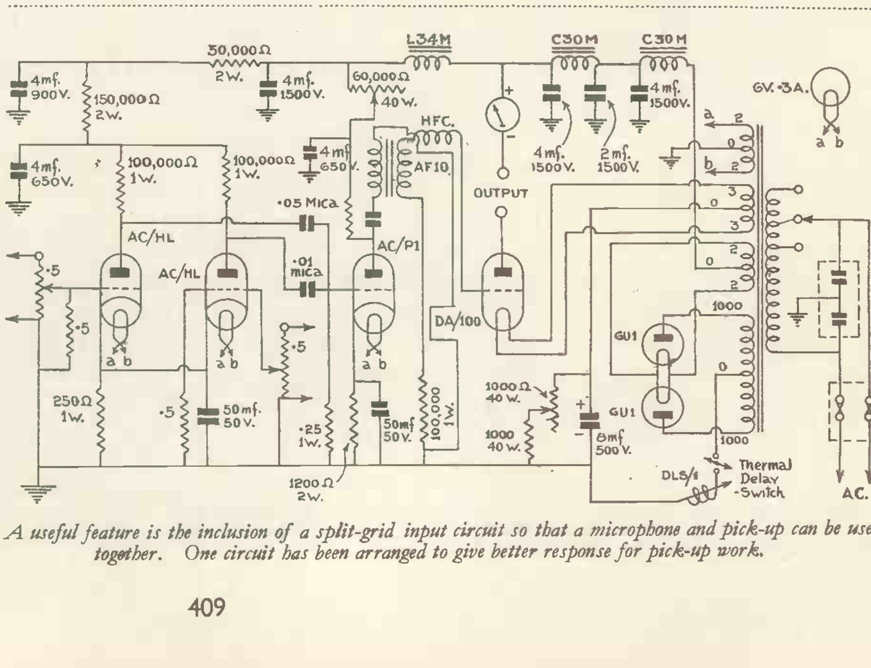
A feature that should be of interest to the public-address man and the amateur transmitter is the use of a split-input circuit. The idea is to have two similar valves with a common cathode bias resistance, but separate grid returns and volume controls. In this way a microphone and gramophone can be run simultaneously giving perfect mixing. The outputs from the mixer valves are fed into separate impedances linking up with a common voltage dropping and second decoupling resistance. We have arranged the circuit so that there is a slight bass boost to one circuit and it is intended that this circuit be used for record reproduction. This slight boosting is obtained by using an .01-mfd. mica coupling condenser for one circuit and a .05-mfd. in the second circuit.

Both anode resistances in the first stages are 100,000 ohms with a common voltage dropping resistance of 150,000 ohms and a common second decoupling resistance of 50,000 ohms. This complete resistance network ensures absolute stability in all circumstances.

The grids of the first two HL valves are tied down to earth by .5-megohm resistances while a 50-mfd. condenser shunts the cathode bias resistance so maintaining adequate bass response.

In the second stage is used an AC/P1 triode amplifier which gives but a low gain, which is sufficient fully to load the output valve to give maximum volume.

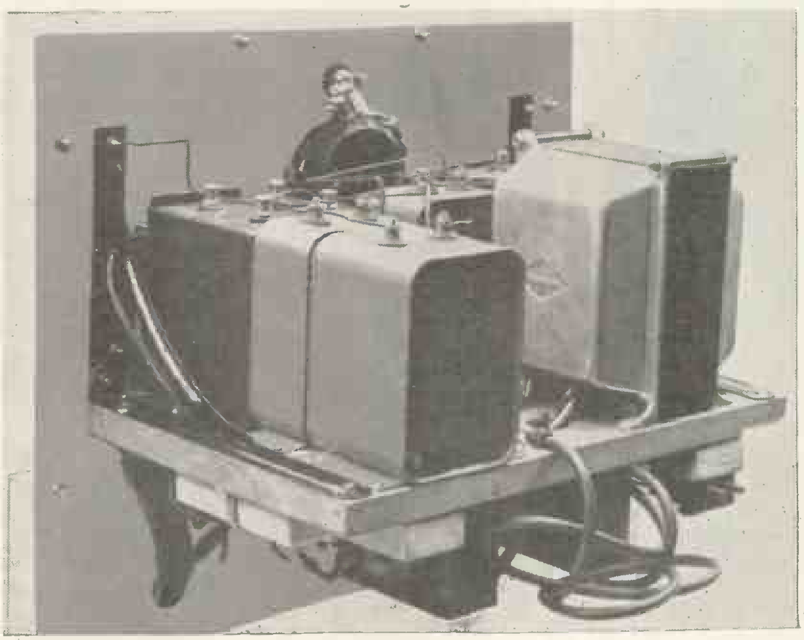
Small variations in anode current, which can be due to variations in valve characteristics or variations in cathode bias resistance will make a very big difference to the voltage applied to the anode of the AC/P1, so it is almost impossible to give a value of resistance to suit all valves and circuits. In the original amplifier the anode resistance was 20,000 ohms, while the voltage-dropping resistance was 8,500 ohms. The resistance chosen is one of the



A useful feature is the inclusion of a split-grid input circuit so that a microphone and pick-up can be used together. One circuit has been arranged to give better response for pick-up work.

No A.C. Ripple :: 30 Watts Output :: Delayed Switching

Bulgin high-power type having a total resistance of 60,000 ohms. This component is so arranged that a contact can be made with almost any part of the resistance element by means of an adjustable clip. It is recommended that this resistance be adjusted to give 200 volts to the anode of the AC/P1. It should, of course, be borne in mind that there will be a certain error due to the current consumed by the meter unless this is taken into consideration.



The large condensers and mains transformer are mounted on a solid wooden baseboard. Under the baseboard are the smoothing chokes, power resistances and fuse plug.

Although the H.T. supply is common to all valves an additional smoothing circuit consisting of a C30 low-frequency choke and 4-mfd. condenser are included in the high-tension supply to the first three valves. In this way almost entire freedom from A.C. ripple is assured.

A transformer is used to couple the AC/P1 to the DA/100 in a parallel feed circuit. This arrangement enables a small transformer to be used as no D.C. current passes through the primary, so keeping up the inductance to a high value. The Ferranti transformer chosen is an inexpensive type but gives very level output with the constants chosen.

The DA/100

This is the first amplifier for the constructor to make use of what is acknowledged as one of the finest output valves available. It is the Marconi or Osram DA/100, a triode valve suitable for 100 watts dissipation, with an input of 1,000 volts. It has a 6-volt heater and requires 146 volts grid bias. When operated under such conditions the undistorted output is no less than 30 watts, while this output can be increased to 40 watts with a slight rise in distortion.

The complete smoothing circuit is made up of two large Savage smoothing chokes and 10 mfds. of capacity. Notice from the circuit how this capacity is used. No condenser is required before the first choke. This reduces the maximum high-tension voltage but noticeably improves voltage regulation, which is more important when the voltage has to be reduced to a low value in other parts of the circuit.

In between the first and second chokes are two condensers in parallel, a 4-mfd. and a 2-mfd. It is, of course, quite in order to use a 6-mfd. condenser, but this takes up more space on the baseboard.

After the second smoothing choke is another 4-mfd. condenser which completes the smoothing circuit. No one will ever want to use this type of amplifier in a confined space so quite a lot of hum could be tolerated, but when tested in our laboratory the hum was less than 3 volts r.m.s. For public-address work this is quite unnoticeable, while even when used as a modulator no hum is observable. The percentage of hum as compared with the total output is particularly small.

Delayed Switching

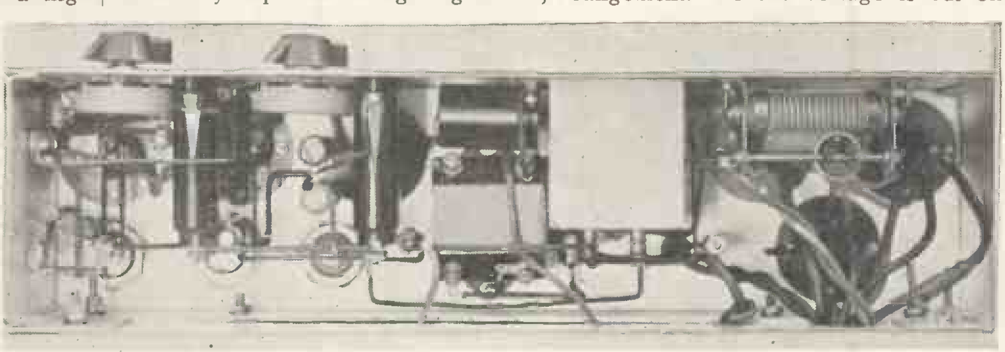
There are several points to be remembered in connection with the power pack. First mercury-vapour valves, which have low-voltage high-current heaters, are used in the rectifier circuit. These valves must be heated for at least 60 seconds before the H.T. voltage is applied otherwise the emission will be impaired.

A thermal delay valve takes care of this switching once it has been adjusted. There is usually a variation in delay action with valves of a similar type so that the heater voltage must be regulated to give the proper delay time. Those who only have one valve available should connect a resistance in series with the heater of the DLS/1 and reduce the heater voltage until the contacts close at the proper time.

Amateur transmitters who wish to use this amplifier for modulation purposes will appreciate the switch in the H.T. return lead. In this way the power amplifier valve in the transmitter can be tapped into the modulator anode circuit, so making the one power pack do for both transmitter and amplifier.

The switch in the H.T. return cuts off voltage to both sections at once, thus making a simple change-over arrangement. As the voltage is cut off

An idea as to how the components are mounted can be obtained from this illustration. All of the small resistances are connected in the wiring while de-coupling condensers are bolted directly to the top of the chassis. Notice the variable bias resistance which can be adjusted after the amplifier has been mounted in a rack.



New Constructional System

from the modulator there can be no possibility of feed back from the microphone circuit. In this way the switching is almost as good as primary switching without the bother of separate filament transformers.

Metal chassis and high voltage do not go hand in hand, but dearly bought experience has enabled us to design an amplifier which will be quite free from trouble. Almost the entire amplifier is mounted in the small chassis on which the valves are mounted. We consider this to be the only way of amplifier construction. All leads from components are as short as possible while owing to double screening hum that might be introduced by induction is wiped out.

able bias resistor to the DA/100 is mounted on the lip of the chassis so this can be adjusted after the entire amplifier has been mounted in a frame.

The valve line-up can be more appreciated if the illustration is examined. The first two valves are of the AC/HL type and are used in the split grid circuit. After these come the AC/P1 then the DA/100, and the GU1's with the thermal delay valve between them.

On the left of the panel is the mains switch connected in the primary of the mains transformer. The H.T. switch is mounted externally on the operating table, but the leads from the amplifier are brought out to two terminals to be seen on the right of the meter.

Components for Class A High-fidelity Amplifier.

CHASSIS AND PANEL.
1—Wooden chassis to specification (Peto Scott).
1—Aluminium panel sprayed grey to specification (Peto Scott).
1—Amplifier container sprayed grey to specification (Peto Scott).

CHOKE, HIGH-FREQUENCY.
1—Type SW69 (Bulgin).

CHOKES, LOW-FREQUENCY.
1—L34M (Bryan Savage).
2—C30M (Bryan Savage).

CONDENSERS, FIXED.
2—50-mfd. 50 volt electrolytic (Dubilier).
1—8-mfd. type 0281 (Dubilier).
2—4.mfd. type LEG (Dubilier).
1—4.mfd. type LSG (Dubilier).
3—4.mfd. type 951, 1,500 volt (Dubilier).
1—2-mfd. type 951, 1,500 volt (Dubilier).
1—.05-mfd. Mica type B770 (Dubilier).
2—.01-mfd. Mica type B770 (Dubilier).

DIALS.
2—Type IP7 (Bulgin).
2—Type K58 knobs (Bulgin).

HOLDER, FUSE.
1—F18 with 3 amp fuses (Bulgin).

HOLDERS, VALVE.
3—5-pin chassis mounting (Clix).
3—4-pin chassis mounting (Clix).

INTERFERENCE SUPPRESSOR
1—Type 1118 (Belling Lee).

METER.
1—Flush mounting 0/150 M/a (Ferranti).

PLUGS, TERMINALS, ETC.
2—Type J2 jacks (Bulgin).
2—Type P15 plugs (Bulgin).

RECTIFIERS.
2—Type GU1 (Osram).

RESISTANCES, FIXED.
1—250-ohm 1 watt (Erie).
1—1,000-ohm type PR29 (Bulgin).
1—1,000-ohm type MV4 (Bulgin).
1—1,200-ohm 2 watt (Erie).
1—10,000-ohm 20 watt (Bulgin).
1—50,000-ohm 2 watt (Erie).
1—60,000-ohm type PR42 (Bulgin).
3—100,000-ohm 1 watt (Erie).
1—150,000-ohm 2 watt (Erie).
1—250,000-ohm 1 watt (Erie).
2—500,000-ohm 1 watt (Erie).

RESISTANCES, VARIABLE.
2—.5-megohm (Reliance).

SUNDRIES.
4—Coils quickwire (Bulgin).
6 yards 3 mm. insulated flexible wire (Peto Scott).
3 yards twin flexible wire (Peto Scott).
2 yards 3 mm. sleeving 1,000 volt test.
2 dozen 4BA countersunk steel bolts with nuts and washers (Peto Scott).
½ grosss 6BA countersunk nickel-plated bolts and nuts (Peto Scott).
1—dial light type D 7 with B620 bulb (Bulgin).
6—⅜ bushing washers (Bulgin).
1—Strip ebonite 4 by 2½ by 3/16 in. bevelled and polished (Peto Scott).

SWITCH.
1—Bakelite tumbler switch.

THERMAL DELAY SWITCH.
1—DLS/1 (Ediswan).

TRANSFORMER LOW-FREQUENCY.
1—AF10 (Ferranti).

TRANSFORMER, MAINS.
1—Type T125 (Vortexion).

VALVES.
2—AC/HL (Mazda).
1—ACP/1 (Mazda).
1—DA/100 (Marconiphone).

Construction

The actual construction is also simplified for, instead of handling a large heavy chassis, almost all the connections can be made before the small chassis is bolted to the main panel. Just how neat the arrangement is can be seen from the illustration of the component wiring.

As a guide the small components are mounted in the following order. Looking from left to right: 2 input jacks, 2 volume controls, the first coupling condenser, second coupling condenser and small grid and anode resistors. Then comes the parallel feed condenser in the anode circuit of the AC/P1 over the inter-valve transformer. The vari-

The milliammeter is in the main H.T. feed to the output valve and does not read the total current consumption of the whole amplifier. In this way a careful check can be made on distortion. This meter should not in any circumstances read more than 100 ma.

Component Mounting

Some idea as to how the heavy components are mounted can be gained from the third photograph. A 1-in. wooden baseplate is fixed to the panel by strong brackets. All condensers of the high-voltage type and the mains transformer are mounted on the top of the baseplate. Underneath are mounted the smoothing chokes and the power resistances. Notice how the baseplate is mounted about 4 ins. from the bottom of the front panel. The idea of this is that when the amplifier is mounted in a rack all components that require adjustment can be seen to without difficulty.

Large holes must be drilled in the wooden baseplate to take all leads from the transformer and smoothing condensers. The few leads that go through the metal panel must be bushed if they carry high voltage. Particular care must be taken over the two leads that go to the anodes of the GU1's and to the anode of DA/100.

The valve-holder holes for the rectifier valves must be cut to allow maximum clearance and all holes must be smoothed off. Any rough edges increase the possibility of arc over. Another point is that the Clix valve holders must be mounted from under the base and not bolted through the top. We have mounted the DA/100 valveholder on rubber bushes. This allows a little movement and is a distinct advantage. No provision has been made for an output circuit, as most loudspeakers will be supplied with the correct ratio output transformer.

When used as a modulator it is important that the power amplifier be correctly matched to the modulator. If this is not done the correct percentage of modulation will never be obtained.

Alternative Valves for the High-fidelity Amplifier

We have just had an opportunity of testing the first samples of the 362 PX100, a triode valve with an anode dissipation of 100 watts with an anode voltage of 1,000.

The working conditions for class A are as follows: Filament 6 V 3 A, anode voltage 1,000, anode current 100 ma, grid bias 170 volts, optimum load 8,000 ohms.

The maximum undistorted output is 34 watts with low percentage of distortion, a very high figure even for a valve of this type. The bias resistance should have a value of 1,700 ohms and be of the 20-watt rating type. The makers are the 362 Radio Valve Co., Ltd., and the price £5.

The Ediswan ES100 is also a power triode of 100 watts rating but is constructed with a carbon anode and hard glass bulb. The characteristics are as follows: Filament voltage 6, filament current 3 A, maximum anode voltage 1,000, impedance 1,750 ohms, amplification factor 5.5, optimum load 7,000 ohms. The power output is 30 watts and the price 10 gns.

Both of the above valves are suitable for use in the High-fidelity Amplifier without change in circuit. The bias resistance must, of course, be readjusted to suit the valve used.

Short-wave Programme Broadcasters

Many of the regular commercial stations have altered their schedules for July. In this article Malcolm Harvey points out which stations will be best heard during the normal listening hours.

DURING July the short-wave band of between 13 and 50 metres can be split up into three distinct groups, the first group covering wavelengths of between 15.00 metres and 20.00 metres, the second group 25 metres to 26.00 metres, and the third group from 30 metres up to 32.00 metres. For all intents and purposes the other wavebands not covered can be ignored.

Day-time Listening

The first group is mainly for day-time listening and covers stations such as Bandoeng, Java, on 15.93 metres, Boundbrook, W3XAL, New Jersey, on 16.87 metres, Huizen, the Dutch station, on 16.88 metres, Wayne, New Jersey, W2XE, 16.89 metres, Budapest, HAS2, 19.52 metres, Schenectady, W2XAD, New York, 19.56 metres, Zeesen, DJO Berlin, 19.63 metres, and Pittsburg, W8XK, 19.72 metres. All these stations can be heard during the early afternoon and evening and have arranged fixed schedules for the period of July.

Boundbrook

Bandoeng operates every Tuesday, Thursday and Saturday from 4 o'clock until 4.30 p.m. These transmissions are reliable and have been reported from all parts of Europe. Boundbrook starts radiating at 2 p.m. and carries on until 10 p.m. Those with sensitive receivers will be able to hear transmissions for the whole of this period, but the average receiver should only be tuned to Boundbrook from 3 p.m. until 7 or 8 p.m. Of course, on a hot summer day it may be possible to hold this station until 9 p.m.

The Dutch station Huizen has rather a complicated schedule, but it is a good station to which to listen, particularly if the weather is not too good. The July schedule is Sundays, 1.30 to 3.30 p.m. and 7 p.m. to 9 p.m. Mondays, Thursdays, Fridays, and Saturdays, 1.30 to 4. Wayne, W2XE, is in some parts of the country a stronger signal than Boundbrook, but every listener should be able to hear programmes broadcast seven days a week from 5 till 8 p.m.

For the past few Sundays the Budapest station has been so loud that on simple receivers it has been causing interference to other stations. It only operates on Sunday afternoons from 3 to 4 p.m., but the programmes are certainly worth hearing.

A special schedule has been arranged for Schenectady, W2XAD, which will be on the air between 3 p.m. and 7 p.m. The whole of this transmission should be received without difficulty.

Some of the foreign programmes broadcast by Zeesen, DJB, from 2 p.m. until 5.30 p.m. and 6.30 onwards are compiled for colonial reception. The programmes are split, being for North America, South America, Asia, etc. These programmes are all of a national character and suitable for the peoples in those areas. There is nothing quite like them broadcast from any other station.

Although W8XK in Pittsburg is on the air from 2 p.m. until midnight, very few listeners will be able to hear very much until 6 or 7 p.m. Reports have been received of continuous reception over the whole period, but this is not general.

Evening Listening

Those who are restricted to listening during the evening should concentrate more on the 25-metre channels covering such stations as Moscow, Lisbon, Rome, Boston, Zeesen and, of course, the British Empire stations. These Empire stations can often be of great use for news bulletins are radiated at odd times of the day, while important programmes are re-broadcast by means of gramophone records. It often happens that events taking place in the afternoon can be heard again during the evening.

The Moscow station on 25 metres is now operating on a regular schedule from 9 to 11 p.m. As a rule, signal strength is good. Boston, W1XAL, working on a wavelength of 25.45 metres is perhaps the best heard American station on this channel. The July schedule is Sundays, 3.45 to 8 p.m., and 8.30 to 10 p.m. Mondays, Tuesdays, Thursdays and Fridays, 8.30 until 11 p.m.; on Wednesdays only, 8 until 11 p.m. This station relays normal American medium-wave programmes *via* the National Broadcasting Co.

The 31-metre channel is most satisfactory for late evening reception. It covers such stations as Madrid, Lisbon, Rome, Philadepphia, Schenectady and Millis, all of which radiate on high power towards the end of the evening. It will probably have been noticed that some stations radiate on three or more channels. The idea of this is to provide world-wide reception.

EAQ, Madrid, on 30 metres, is scheduled to radiate between 11.15 p.m. and 1.30 a.m., but as a general rule a commercial news bulletin in English can be heard a little after 10 p.m. Lisbon CT1AA is only on on Tuesdays and Thursday from 10 p.m. until midnight, but the transmissions are very strong and can be heard on the simplest of equipment. Philadelphia, W3XAU, on 31.32 metres, is perhaps the most interesting station on this band for it relays medium-wave American programmes. The schedule is 5 p.m. till 1 a.m., but generally it can only be received at entertainment volume from 10 p.m.

South American Programmes

Very few listeners are prepared to stop up after 11.30 or so although there are quite a number of stations radiating about this time. Most of the South American broadcasters between 45 and 48 metres are well heard in this country, but it is a difficult matter to identify them. Valencia, YV6RV, on 46 metres, radiates from 6 until 7 p.m., and for July only from 11 p.m. until 4 a.m. The 11 p.m. transmission is well heard and owing to its interference free wavelength can be identified reasonably well. YV4RC, in Caracas, using one of the new high-power Collins' transmitters, is very well heard. The first broadcast starts at 10 a.m.

Except for local stations the 50-metre band can be ignored, although if listeners are prepared to wait up until after midnight a really fine bag of long-distance stations is assured. On the other hand the few who are up early in the morning can rely on hearing American broadcasters until about 6.30 or 7 a.m. on this band.

New Westinghouse Units

A new type of rectifier has just been introduced by the Westinghouse, Brake & Signal Co., Ltd. This new type J rectifier is designed for high voltage work at low currents and is rated for a continuous output of 2 m/a. when using either the half-wave or voltage doubler circuit. The small rectifier type J10 weighs 1¼ ozs., and with a 10-mfd. reservoir condenser, gives an output of 80 volts with an A.C. input of 74 to 80 volts r.m.s. Various units are available giving output of 80, 200, 400, 600, 800, 1,000, 1,200, 1,400 volts in the half-wave circuit, and 170, 425, 850, 1,270, 1,700, 2,120, 2,550 and 3,000 volts in the doubler circuit.

THE WORLD-WIDE SHORT-WAVE RECEPTION CONTEST

All those readers who have entered for our reception contest should now be busy filling in their entry forms and obtaining verification cards. We should like to reiterate that the contest, as far as reception is concerned, closed at midnight on June 21st, but that a further period until July 14th is still available to enable readers to obtain the necessary verification cards. Those who are concerned about the return of the QSL cards should make a special note that every card received by us will be returned immediately the report concerned has been verified. It will also assist us if all competitors mark their envelope "Reception Contest" in addition to the address.

PRIZES

FIRST PRIZE.—A "Burndept All-Wave Super-Het" type 233 six valves and covering three wave-bands. It is fitted with special short-wave slow motion tuning dial with all bands calibrated in stations' names and wave-lengths. The value of this fine receiver is 17 gns.

SECOND PRIZE.—The "Eddystone All-World Two" a special receiver for amateur use. Good features are band-spreading, resistance controlled reaction, and it is suitable for wavelengths from 10 to 200 metres.

THIRD PRIZE.—A fine 10 in. Terrestrial Globe, by "Geographia," mounted on a polished wooden pedestal. This globe is coloured and gives a good relative idea of the positions of the world's chief cities and towns. A most useful asset to the short-wave operator.

FOURTH PRIZE.—A short-wave tuning condenser by Jackson Bros., Ltd., with an insulated rotor, brass vanes and low minimum capacity. It is fitted with the new Jackson short-wave tuning dial having ratios of 8-1 and 150-1.

RULES

1. The subject of the contest to be the reception by our readers of amateur and commercial short-wave stations situated outside Great Britain, Northern Ireland and Irish Free State.

2. The contest is open to all readers of *Television and Short-wave World* using a commercial or a home-built receiver.

3. The listening period was between May 31st and June 21st inclusive. Competitors being allowed a further period of about 3 weeks for the purpose of completing their reports (obtaining QSL cards, etc.), the competition finally closing on Tuesday, July 14th, 1936.

4. The winners of the contest are the competitors who send in the fullest and most useful reports duly accompanied by verification (QSL) cards.

5. The names of the winners will be published in the August issue of *Television and Short-wave World* on sale on Wednesday, July 29th, and we shall give instructions for the prizes to be forwarded without delay.

6. All reports to be of phone stations—not of morse stations.

7. Obviously, reception is best restricted to countries from which cards are receivable within the time limit. (Note: every report must be authenticated by a QSL card.)

8. Competitors should model their entries upon the style or form set out in the sample at the foot of the page.

9. Successful competitors to be prepared to furnish full details of their receivers for publication in *Television and Short-wave World* if so requested.

10. All entries must be received by Tuesday, July 14th, 1936, when the competition finally closes They should be addressed to the Short-wave Editor, *Television and Short-wave World*, Chansitor House, 37-38, Chancery Lane, London, W.C.2.

11. The Editor's decision is final and legally binding. All competitors in entering this competition give their particular assent to this rule.

CONTEST NOTES

It appears from our observations that the period set aside for the reception contest has been a poor one owing to abnormally bad conditions. Atmospherics have been troublesome on all wavebands so that long distance stations have been difficult to hear. Although this does not concern entrants to any great extent owing to the fact that all will be similarly affected it will mean that there will be more than the average number of local or European stations received.

The few fine days have enabled many readers to take advantage of the 10-metre band to obtain some really good DX reception, but these favourable periods have been very much restricted.

Several readers have enquired as to whether we can accept QSL cards received before the contest period to verify stations heard during the period May 31st and June 31st. It must be clearly understood that all the cards received must refer to stations logged during the stipulated dates.

At the foot of this page is the suggested method of reporting on stations heard. This report sheet can be made out on foolscap paper and it is hoped that all competittors will keep to the form suggested as this will greatly assist us in checking.

The rule regarding the value of useful data and weather reports seems to have caused a little confusion. While we do require all the useful information available so as to give the reception contest added value, readers concentrating on the data angle would not gain any advantage over the entrant with a large number of stations but little accompanying data.

Assuming two readers to have heard an equal number of stations, the one giving maximum accompanying data will, of course, provide the most useful report. The information required need only be of a simple nature such as amount of static, if possible the temperature and whether it is fine or wet. If all readers give simple data of this kind we shall be able to obtain some valuable data when they are all put together.

Those readers who remembered National Field Day and took advantage of al long distance stations who were on the air should be able to obtain quite a large log of unusual stations. Very often during these Field Days foreign stations come on for an hour or so merely to help make the contest a success. It is these stations who make rare appearances that help to swell the station reception logs.

We hope that most of our readers interested in short-wave listening will complete and send in their logs by July 14th and endeavour to win one of the four valuable prizes. The names of the prize winners and other information will be published in the August issue of *Television and Short-wave World* on sale July 29th.

Suggested Type of Report for World-wide Short-Wave Reception Contest

Call Sign.	Date.	Time B.S.T.	Wave-length.	Programme or call heard.	Weather conditions.	Notes on reception.
W2XAD	May 30th.	9 p.m.	19 m.	Dance band.	Fine.	Bad Static.
LAIG	June 1st.	11 p.m.	20 m.	Calling W9BHT	Wet.	Good conditions.

Total number of verifications: 127.
Type of receiver and number of valves: home built super 5 valves.
Type of aerial: inverted L in loft.

NAME..

ADDRESS..

The Diamond Aerial

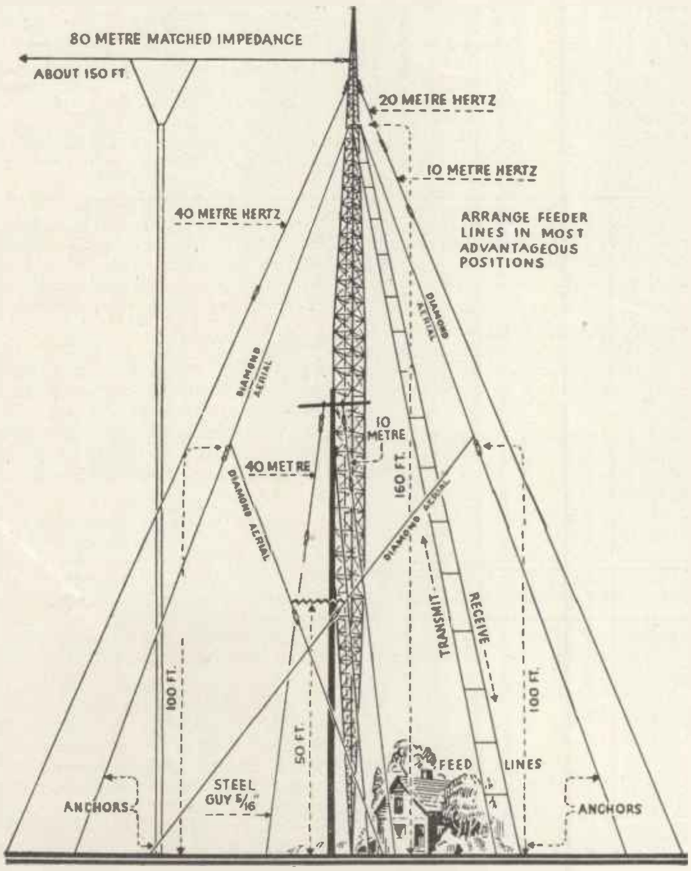
By Don. C. Wallace, Long Beach, California.

Transmitting readers will appreciate these constructional details of the Diamond aerial as used by W6AM. Although but few English amateurs will be able to use such a system the idea can be adapted to more suitable dimensions.

THE Diamond aerial is a fairly simple one to put up and instal. Height is not important, although the same rule applies as in other aerials, the higher the better. It may require four poles although often one pole will be sufficient if the supporting wires are in the right direction and have sufficient pull to hold the other three corners.

Easy Construction

Although it is desirable that the proper angles be maintained, it will work even if a slight error is made or is necessary due to the nature of the supports. The dimensions are given on the diagram which is self-explanatory.



The total height of this mast is 171 ft.; rather too high for the average G amateur.

A switch or relay may be inserted in the corner where the resistor is connected so that the resistor may be cut in or out of circuit as required. It will be found that when the resistor is connected the aerial will be directional for transmission, as shown by the arrow on the diagram.

When the relay or switch is left open it will be bi-directonal. i.e., it will receive and transmit from both directions along a line as shown by the feeders in the illustration. This makes it particularly useful when one has both morning and evening schedules so as to work East in the morning and West in the afternoon.

In the case of an East Coast amateur the diamond must be directional towards Southern Europe. When the resistor is open, Southern California, New Zealand, and South Australia will be in line.

Wire and Insulation

The size of wire is unimportant and the insulation at the corners is not vitally important. The great voltage potentials are not built up as in the case of the usual amateur transmitting aerials. The feed line can be any length and can be made up of 14-gauge wire placed on a 6-in. feeder bar. A slight increase can be made by making the feed line an odd number of quarter wavelengths such as would be done in an ordinary Zepp aerial. In this case it can be tuned somewhat to improve the impedance match to the system.

The exact ohms of the resistor (within limits) does not seem to be particularly critical. Various ohmages have been used—such as 500, 600, 625, 700, 750, 800, and all seemed satisfacfactory. In order to handle the full power, resistors are placed in series, but if a high-power resistor is available this can be used.

Checking

A feature of the whole system is that all results can be checked on the receiver and then one throws a double-pole, double-throw switch or a similar relay to switch from send to receive the transmitter performs with exactly the same volume and direction percentages as the receiver.

Aerials of various designs can be added by connection from the tower to other points of anchorage *via* the cables acting as supports to the tower. All these are possible in addition to the Diamond aerial. In this way experiments can easily be conducted provided the tower is so constructed that it can easily be climbed to make semi-permanent installations possible.

Some idea as to the height of the tower can be gained from the fact that at the base of the tower can be seen a two-story house in which are located two radio rooms, one being used as a workshop and the other as the radio operating room.

The aerial the writer uses at Long Beach points east towards the east coast, with an average height of 110 feet, and it is used on the 40-metre band. It works as a bi-directional aerial and after the east coast fades out it works well for Australia and other countries in that direction.

The Diamond aerial has proved to be one of the only permanent features of this station where aerials undergo frequent changes. It can be recommended for use on all frequencies and with any type of transmitter or receiver.

The 40-metre Phone Transmitter Adding a Doubler Stage

Constructors of the 40-metre Phone Transmitter described in the May and June issues should consider the addition of a frequency multiplier so that the transmitter can be used on 20 metres

MANY readers who have constructed the 40-metre transmitter have approached us regarding the use of this transmitter on the 20-metre band. We pointed out in the first article that by simply substituting 20-metre coils for the original 40-metre coils and keeping the grid circuit of the crystal oscillator at 40 metres a reasonable output could be obtained on 20 metres.

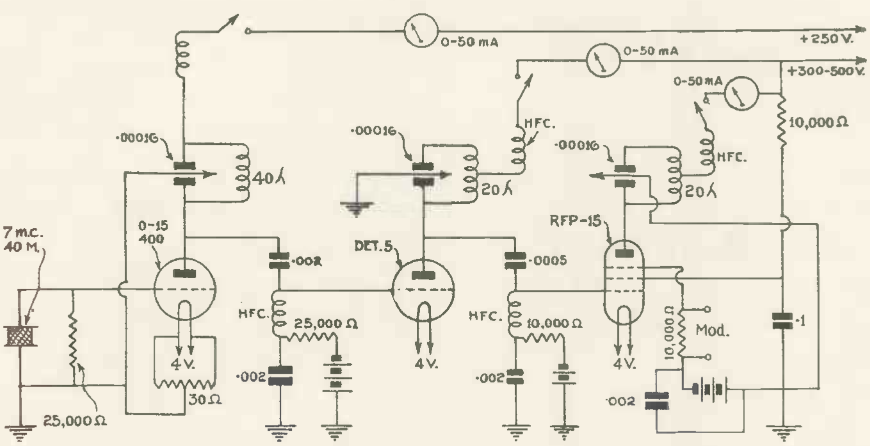
These remarks still hold good, but those who wish for a 20-metre R.F. output comparable with the output on 40 metres would be well advised to include a frequency-multiplier or doubler stage. The modifications necessary are quite straightforward and providing the adjustments are carried out very carefully no trouble will be experienced.

A modified circuit of the original transmitter is shown above. If this is split into three sections it will be seen that, the first and third sections that is the crystal oscillator and power amplifier are unchanged.

The Doubler

The frequency-doubling stage is connected in circuit between the C.O. and P.A. and fundamentally the circuit is the same as that of the P.A. stage. Referring back to the original circuit, it will be remembered that in the grid of the oscillator is a 40-metre crystal. The anode circuit of the C.O. stage is tuned to 40 metres as is the anode circuit of the power amplifier stage. When the power amplifier stage is to operate on 20 metres the tuned circuit has to be modified in the following way. The 40-metre crystal remains unchanged, as does the 40-metre coil in the anode of the oscillator valve, but the output from the crystal oscillator is fed into the grid of a DET5 triode valve.

This valve operates as a frequency multiplier so the coil in the anode circuit is tuned to twice the frequency of the C.O. coil. In practice this is a very simple operation for it only means winding a coil of approximately half the number of turns used in the C.O. stage.



The modifications required to convert the 40-metre phone transmitter to 20-metre operation are quite simple as can be seen from this circuit.

The R.F. output from the DET5 should be coupled to the grid of the RFP15. This valve works in exactly the same way as it did as a 40-metre amplifier with the exception that the anode coil has half the number of turns and tunes to 20 metres.

Correct Bias

The most important points to watch are the bias voltages. The crystal oscillator stage is biased automatically by means of grid-current flowing across the 25,000-ohm grid leak. With the H.T. switched off to the C.O. and P.A. stages, but connected to the frequency-multiplier, grid bias from a high-tension battery should be applied until the anode current drops to zero. Assuming 50 volts are needed to bring about this condition, the bias voltage is fixed at 100 volts.

The H.T. to the crystal oscillator should then be switched on and the tuning condenser adjusted until the current flow, measured by the milliammeter, drops to the minimum value. It will be noticed that as the crystal stage is tuned, the current flowing in the anode circuit will vary between about 40 and 5 ma.

In the initial stages of tuning the circuit should be left so that the crystal oscillator stage is consuming approximately 10 ma. It will then be noticed that although the doubler stage is over-biased to double cut-off, directly the condenser in the anode circuit is adjusted to the correct position an anode current of about 30 ma. will flow in the doubler stage. This indicates that this circuit is tuned to a harmonic of the crystal oscillator stage.

With the high-tension switched off to the first two stages, but switched on to the RFP15, the final grid bias is adjusted until the anode current of the RFP15 drops to zero. H.T. is then switched on to all valves and the tuning condenser adjusted in the output stage until a reading of about 10 ma. is obtained.

Checking R.F.

Readers who do not intend to use milliammeters in each stage will be able to check the resonant point by means of a loosely coupled looped lamp. As has been previously mentioned a small flashlamp bulb connected in series with a single turn of wire of about 2½ ins. diameter can be held over the tuning coil. When the stage is oscillating and, or is, tuned to resonance the bulb will light by induction.

When using the looped lamp method simply adjust each stage to give the maximum light from the bulb. An alternative method of obtaining evidence of R.F. output is to connect a small milliammeter reading from 0/15 or 0/30 ma. in series with the grid bias lead. Then with H.T. to the valve switched off, the preceding stage should be tuned to give maximum grid current reading.

The Dummy Aerial

After the transmitter has been adjusted to give maximum light in all stages some provision for a radiating or dummy aerial should be made. Those who have only been granted an A.A. licence should make up a dummy aerial consisting of inductance, capacity and resistance so as to measure the relative

40-metre Transmitter

amount of radiation. A coil, an exact counterpart of the P.A. tank coil, should be obtained and coupled by means of stand-off insulators about 1 in. away from the P.A. coil. It should be coupled against the free end and not to the end connected to the anode of the output pentode. In series with the coupling coil a tuning condenser of any capacity between .0001 and .00035-mfd. a non-inductive resistance having a resistance of between 20 and 100 ohms and a hot-wire R.F. meter having a maximum reading of .5 ampere should be connected. All these components are in series with the hot-wire meter connected to the other end of the coupling coil.

Those who are unable to arrange for a hot-wire meter can use a small car bulb of approximately 10 watts rating. This will give good indication of the amount of R.F. in the dummy aerial circuit.

Radiating

A single wire aerial having a length of between 65 and 67 ft., the exact length to be determined by the frequency of the crystal, can be tapped on to the P.A. tank coil. The lead-in should be terminated in a large crocodile clip similar to those used in accumulator charging. The exact position of this clip must be determined by experiment. With an aerial of the length suggested no indication of radiation can be obtained if a hot-wire meter is connected in series with the tapping so that the only indication of resonance is obtained by watching the current flow in the P.A. stage.

Assuming the standing anode current of the RFP15 to be 10 ma., directly the aerial is tapped on to the tank coil this current will rise by a ma. or so. A start should be made by connecting the aerial to the end of the coil opposite to the anode connection and then the parallel condenser be retuned. This should bring the current reading back to normal. Then the aerial should be clipped on one turn nearer to the anode end and the condenser again be returned. This may or may not have effected the anode current reading. The tapping is adjusted until a point is found where the anode current rises to about 20 or 25 ma. This tapping point will be sharply defined and may be critical up to half a turn. The tapping point giving maximum anode current is the correct one to use.

The transmitter is then ready for use on the 20-metre band, the frequency being double that of the crystal. Assuming the crystal to be 7,140 kc., that is almost in the centre of the 40-metre band the P.A. stage will be tuned to a frequency of 14,280 in the 20-metre band.

A Three-stage Transmitter

After these adjustments have been made the transmitter can be changed back to 40-metre operation by simply replacing the 20-metre coils with 40-metre coils. By keeping the frequency-doubler stage in circuit greater R.F. output is obtained, but it will mean the addition of another control for neutralising. An alternative arrangement is to make the grid connection to the DET5 flexible so that it can be joined to the frequency-doubler or P.A. stage at will. In this way the transmitter can be two-stage on 40 metres or three-stage on 20 metres.

The neutralising condenser in the intermediate stage should be connected between the free end of the anode coil and the grid of the DET5. Correct neutralising is indicated by a complete absence of light in the looped lamp when held over the P.A. tank coil when the C.O. and buffer are operating at full efficiency and high-tension has been switched off the RFP15.

A Morse Key for the Beginner

By 2BZN

AMATEURS who are learning the Morse code in preparation for the time when the full ticket comes along want a good key for practice work. The ex-army keys are still available, but even 15s. or so is a lot of money when components for the transmitter are wanted at the same time.

I have made a key which feels like the R.A.F. type and costs only a few shillings to make. This is probably an exaggeration for most amateurs will have the few pieces wanted without having to buy anything.

First cut a piece of ebonite 5 × 3 × 3/16 in. and mount it on two ebonite blocks 1 × ½ × ¼ in. to form a baseplate. The main rocker arm consists of another ebonite strip 2⅞ × ½ × ⅛ in. backed with a piece of phosphor bronze 3⅞ × ½ × 1/32 in. to give the correct amount of spring.

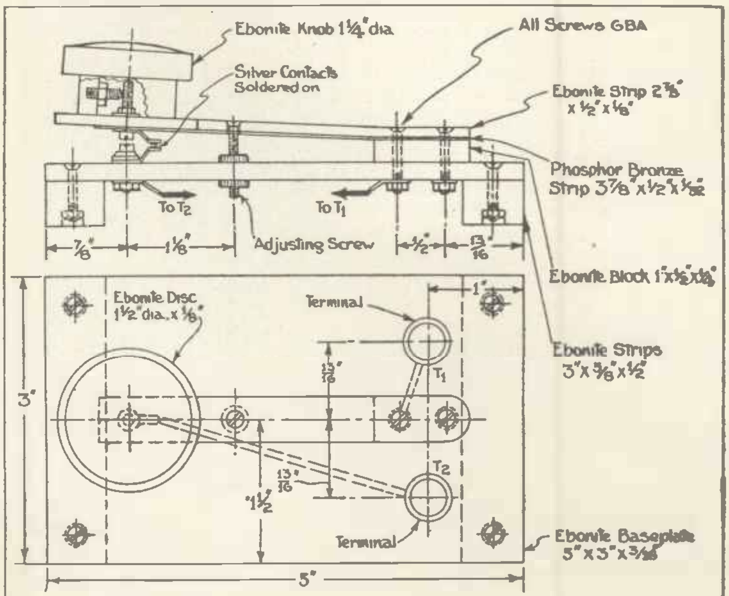
Two 6B.A. cheese-head bolts have then to be fitted as shown in the sketch. The top one is used to hold the knob in position, while the top and bottom bolts act as buffers to the actual silver contacts.

A small length of 6B.A. screwed rod plus two bolts are used to vary the gap and the amount of movement of the rocker arm. This is fixed in position at a point 2 ins. from the end of the baseplate, nearest to the knob.

Two connections have to be made and brought out to the terminals at the end of the baseplate. The first contact comes from the bottom bolt under the knob and the second from one of the fixing bolts for the rocker arm. Actually the bolts contacts with the phosphor-bronze facing piece, so make sure the connection is a firm one.

This type of key has been tried by several active stations and has been received very favourably, so it can be commended to the beginner with every confidence.

This sketch gives a clear idea how the morse key is built up. There are no expensive parts to buy while a fret saw and a brace and bit are the only tools strictly required.



Transmitting for the Beginner

The Crystal-oscillator

This article for the beginner by Basil Wardman, G5GQ, will be of special use to those about to construct a transmitter. Many points not generally known are fully explained.

IT is now time to consider the crystal oscillator circuit. Most crystal circuits of to-day are developed from that of Fig. 1, which is easily recognisable as the Armstrong, or tuned-grid, tuned-plate circuit. In this circuit, if L_1C_1 and L_2C_2 are tuned to almost the same frequency, oscillation will take place due to the circuits being coupled

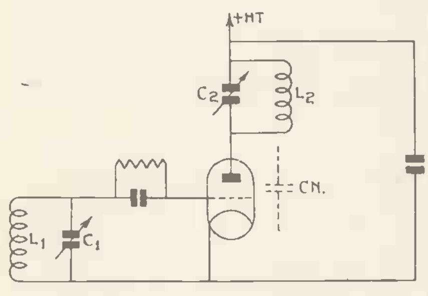


Fig. 1.—The tuned-grid tuned plate circuit.

together by the natural plate-grid capacity of the valve.

A crystal for practical purposes can be treated as a circuit tuned to a very definite and fixed frequency, so that if a crystal is substituted for L_1C_1 the circuit will oscillate at the frequency of the crystal, and so we come to the most usual crystal circuit, that of Fig. 2, or, if a pentode is preferred, that of Fig. 3.

Power Output

It is obvious that a certain amount of R.F. current must flow through the crystal. This is the factor which limits the amount of power which may be taken from a crystal oscillator, because if too much power is taken from this circuit the R.F. current through the crystal will increase to such a value that the crystal will heat and finally crack. In general, with a triode it is advisable to limit the H.T. volts to about 500 maximum, with an input of 10 to 15 watts.

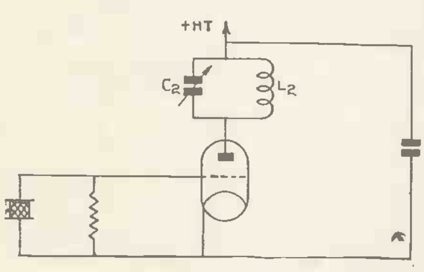


Fig. 2.—A simple crystal control circuit.

I am frequently asked: "Which is the better, C.O. triode or pentode?" The answer is that they are both equally efficient as oscillators, but with the pentode the crystal R.F. current is considerably smaller, and so, much more power may be taken from it than from the triode oscillator. In fact, with some R.F. pentodes it is possible to use up to 1,000 volts on the anode with 50 watts input without damaging the crystal. It should be borne in mind, however, that if the crystal heats its frequency may drift. It is advisable to use as heavy a bottom plate as possible so that any heat developed may be carried away quickly. For the top plate, one about the size of a sixpenny piece is approximately correct.

Quartz crystals are available in frequencies up to 14 mc. and even at that frequency are perfectly tractable. It is best, however, to obtain 14 mc. crystals ready mounted, as it is very difficult for the amateur to clean a crystal of this frequency, and cleanliness is the whole secret of success.

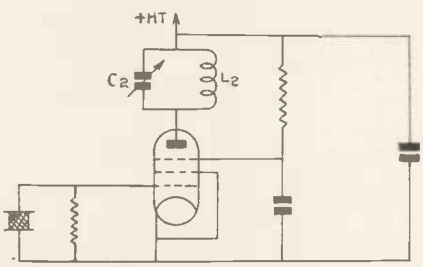


Fig. 3.—A pentode oscillator gives greater output.

Grid Choke

It will be noticed that in these circuits no R.F. choke has been drawn in series with the grid leak. It is usually shown in diagrams, but I personally never use one because there is quite a big chance of the choke, or part of it, becoming resonant with the output circuit. In such circumstances the valve would become a self-oscillator instead of a crystal oscillator.

Doublers

Doublers, or frequency multipliers as they are often called, do not really double, i.e., the anode circuit does not have a fundamental frequency twice that of the grid.

In the audio-frequency amplifier, if the bias is not correct, severe distortion occurs; this distortion usually taking the form of harmonics.

In the R.F. doubler, advantage of this is taken deliberately to produce harmonics so that if plenty of power is required from a doubler everything should be tried on it that would cause distortion in an audio amplifier. Apply plenty of H.T. volts, plenty of negative bias, and tune the anode circuit to the frequency (harmonic) required. Triodes, screen grids and pentodes all produce good harmonics, but if strong second

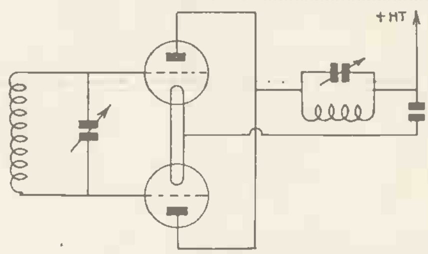


Fig. 4.—Push-pull oscillators have the anodes strapped in this way.

harmonic (double frequency) is required, valves should not be connected in push-pull, for, as in audio circuits, the second harmonic will be suppressed. Instead, the grids only should be push-pull and the anodes connected in parallel (Fig. 4).

It is impossible to lay down hard and fast rules for the type of valve to use in a doubler—trial and error is the best test, but with triodes the high-impedance ones are generally the best. Recently circuits have been designed in which the valve actually does double, but they are still in the laboratory stage.

Oscillator Doublers

With the advent of multi-grid valves, circuits were developed in which part of the valve was used as crystal oscillator, and part as doubler. The first of these, called the Tritet, was designed around the American 59 valve. This valve is an indirectly-heated triple-grid power amplifier, or, in plain English, a pentode with all the grids brought out

(*Continued at foot of next page*).

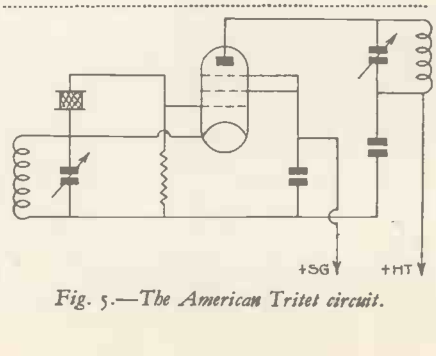


Fig. 5.—The American Tritet circuit.

Simple Duplex Telephony

By G. H. Eckles G5GC

It is not often that amateur transmitting stations are heard working duplex telephony. This is probably due to the fact that the transmitter and the receiver have to be specially designed for duplex working if the results are to be at all satisfactory. Some stations are able to obtain a fair degree of efficiency by duplex working from one band to another where the frequency difference between the receiver and the transmitter is high.

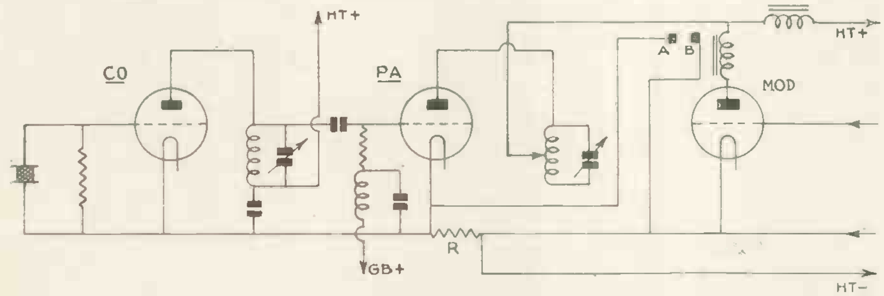


Fig. 1.—This is a typical transmitter showing just how the relay is connected as described by the author. We can recommend this arrangement for all types of transmitters up to 10 watts input.

Duplex telephony can be used by means of the quiescent carrier method when grid modulation is used, but in any case grid modulation is comparatively inefficient. I have found quite an efficient system whereby duplex-telephony can be used with either choke or any other method of modulation.

After considerable experimental work had been carried out a sensitive relay was constructed and connected in the anode H.T. lead to the final valve in the speech amplifier. The keying system in the transmitter was modified so that the H.T.-supply could be utilised to key both the crystal oscillator and P.A. stages.

To accomplish this a high resistance was placed in the H.T. lead so allowing the crystal oscillator stage to oscillate quite feebly. The relay contacts were connected up to this resistance R as shown in Fig. 1, and the H.T. supply switched on to the L.F. amplifier, the H.T. wiring having been altered as illustrated.

After careful adjustment of the relay it was found that when words were spoken into the microphone the speech currents had an immediate effect on the relay, so closing contacts A and B and shorting out the resistance and keying the transmitter. In this way the transmitter was only switched on during the period when the microphone was actually in use.

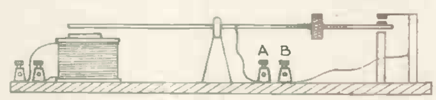


Fig. 2.—The relay may be home constructed on these lines.

The illustrated position of the relay in the low frequency amplifier and the particular system of keying may not appeal to every reader, but the basis of the idea can be adapted to suit any transmitter. In this short article it has been my endeavour to point out the basis of the system in the hope that it may be improved and adapted to suit the various types of transmitters and keying systems.

In my opinion, the only disadvantage of using the method already described is that another station cannot be worked duplex if its frequency is the same as the transmitting frequency due to interference caused by the crystal stage, which oscillates continuously to overcome any sign of key lag.

It should also be remembered that a 10-watt transmitter was used during these duplex tests so that the described system may have to be modified when used with a high input.

A feature of the system is that all key click and lag circuits in the keying system must be cut out when working duplex, due to the time lag which would cut out a word or two in the actual transmission.

The Relay

A relay to operate in this system is quite simple to construct. In the original model an old telephone headpiece was brought into use. The magnets were mounted on a solid base and a balanced arm with an adjustable balancing nut being the main features of the relay. These points can be seen in Fig 2.

To operate the relay the mains are switched on and the balancing nut adjusted until the arm falls lightly on to the rest. On speaking into the microphone the arm will jump, making immediate connection with the contact point, so keying the transmitter. A low-resistance telephone has been used with success, but a high-resistance unit is much more sensitive in operation.

The only trouble likely to be experienced when using a relay is that the contact points are very sluggish, due to the light pressure, but this can be overcome if care is exercised in adjusting.

"Transmitting for the Beginner"

(Continued from preceding page)

separately instead of one being earthed. This circuit is shown in Fig. 5.

There are two versions of this circuit, one in which it is used as oscillator with a crystal, and the other in which it is used as an electron-coupled oscillator. From this it gets its name, one part of the valve being used as a *tet*rode electron-coupled oscillator, and the other part as a *tri*ode doubler—hence "Tritet." Only the crystal version is shown because the use of E.C. oscillators demands the use of highly accurate wavemeters, and so is rather complex for a beginner.

Recently, another American valve has been manufactured, a class B mains valve, in which are an indirectly-heated cathode and two separate triodes. One of these is used as a crystal oscillator and the other as a doubler (Fig. 6). This is called the "Jones Exciter," after the designer, and gives considerably more output than the Tritet. The type 53 valve is used with a 2.5 volt filament supply, and the type 6A6 with a 6.3 volt supply. Coil values are quite conventional and can be as suggested in the first article of this series.

Details of our SHORT-WAVE RECEPTION CONTEST are given on Page 413

A New Vidor Short-wave Converter

Messrs. Vidor are about to release a new short-wave converter employing a heptode frequency changer and suitable for wavelengths of between 13 and 50 metres. The tuning dial is calibrated in both metres and megacycles accompanied by a list of the more regularly heard stations.

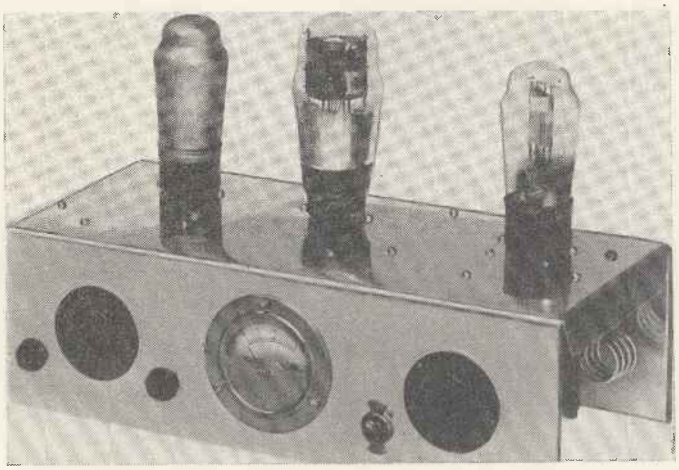
This unit is for battery operation and it has been arranged so that an internal switch changes over the aerial from the converter to the main receiver. The converter should be used in conjunction with receivers of the super-set type or straight type that will tune to 2,000 metres. The model number is 250 and the price £2 7s. 6d.

A Battery-operated 5-metre Phone Transmitter

In the April issue we described a 5-metre transmitter for operation from A.C. mains. Here are the constructional details of a battery-operated transmitter of a similar type for those who are without mains of any kind.

OUR experiments with 5-metre apparatus during the past six months have proved that with the new valves and components designed for ultra high-frequency working most of the troubles usually experienced have disappeared. Many of our readers who have built up 5-metre equipment have had considerable difficulty in obtaining any reliable results.

In particular the 5-metre transmitter has been most erratic, and although it has been well known that distances of up to 200 miles can be covered, 5-10 miles has been the average amateur's experience of "DX" work. The A.C. operated transmitter described in the April issue gave particularly good results and sufficient radiation was obtained to burn out our small supply of 6-volt bulbs used to indicate resonance.



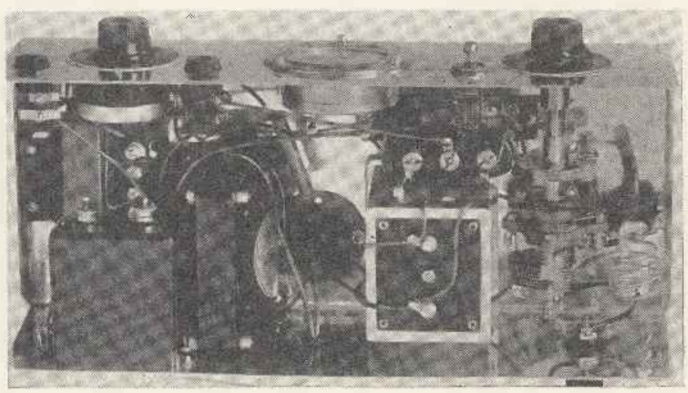
This design lends itself to rack construction with the transmitter and modulator in one section, the receiver in another with power supply on the bottom.

30-mile Range

Our tests over an area of about 30 miles showed that a reliable service range could be guaranteed except where the receiving point was situated in a very bad locality. As most reports even up to the maximum distance of 30 miles gave QSA5 R8 to 9 with simple sets and a half-wave vertical aerial, it is safe to assume that with a more efficient receiver and a good aerial the maximum range would be greatly increased.

If 5-metre transmitters are to become more widely used for local working so as to give the 160-metre band a rest it is obvious that cost must be a primary consideration. This immediately rules out an A.C. operated transmitter except for those who already have gear on hand.

Tests of a battery-operated transmitter similar to the A.C. model in the April issue showed that the efficiency was of a high order and that the maximum range was again well over 30 miles. The transmitter was left running with the carrier modulated by the ticking of a large clock. The receiver described elsewhere in this issue was taken out in a car and with only a 4-ft. vertical aerial the transmission could be heard consistently all over North London up to a distance of 30 miles. Only in bad hollows or in obviously bad localities was the signal strength reduced or lost.



All of the components are mounted within the chassis. In this way the transmitter can be used for portable work.

Local Working

Such tests indicate the value of such a simple transmitter which can be used for normal U.H.F. experimental work or for local contacts. A large number of the components will be already on hand so that the total outlay is very small indeed. For example, the intervalve transformer, output choke, grid leak and condensers are all of conventional type, and few amateurs are without a Ferranti transformer or a good stock of Erie resistors.

Reference to the theoretical circuit of the transmitter and modulator will show that we have again used the old familiar ultra-audion circuit, which in our opinion is one of the most simple for the beginner, or those inexperienced on 5 metres, to get going. Also in view of the scarcity of stable transmitters it is really not worth spending a lot of money on the construction of a crystal-controlled or multi-stage transmitter.

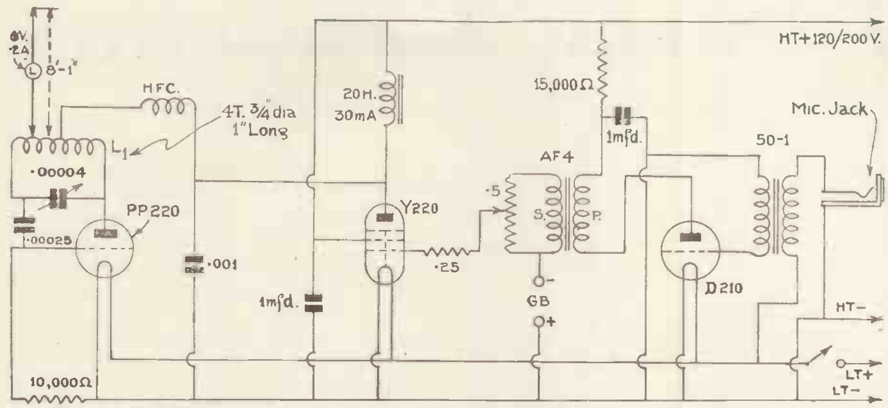
The oscillator valve is a Hivac PP220 operated to handle a maximum input of 4 watts. The coil is home constructed and consists of four turns of 16-gauge wire ¾ in. diameter, spaced to occupy a total length of 1 in. Both Eddystone and B.T.S. can supply a ready-wound coil mounted on a ceramic base, but owing to the difference in diameter and spacing a 5-turn coil is necessary.

A 40-mmfd. condenser is used for tuning, while a .00025-mfd. grid condenser with 10,000-ohm grid leak gives the most satisfactory output. The 10,000-ohm grid is a good average value, but if high tension is increased up to 200 volts this resistance should be increased to 15,000 ohms. However, it is advisable that readers experiment with all values of grid resistance between 5,000 and 20,000 ohms. It must be remembered that this resistance governs the amount of bias applied to the PP220 valve.

Anode By-pass

H.T. is applied to the anode of the valve through a high-frequency choke tapped on to the approximate electrical centre of the coil. It is essential that the cold side of this choke be by-passed

The Modulator :: Tuning :: Current Supply



Only three valves are used, two in the modulator-speech amplifier section and one as an ultra audion oscillator.

to earth by a .001-mfd. condenser. This value is not important. The radio-frequency choke is of the Raymart CHP type, but can be made from 50 turns of 28-gauge D.S.C. wire on a ½-in former, each turn spaced as little as possible.

The speech amplifier and modulator are quite conventional. A microphone, preferably carbon, is connected in the primary of a high-ratio microphone transformer. As can be seen from the circuit this is arranged so that the filament voltage is used to energise the microphone. The secondary of this transformer feeds into the grid of a D210 triode valve.

Transformer coupling is employed and the first valve is de-coupled by means of a 15,000-ohm resistance and 1-mfd. condenser. Across the secondary of this transformer is ½-megohm volume control with a ¼-megohm resistance in series with the grid of the Y220 pentode used as a modulator. The modulation choke need be only a small one capable of withstanding 20 to 30 m/a.

In our original instrument we left permanently connected in circuit an 0-30 m/a. Sifam meter, which was used to read the total consumption. However, it is quite satisfactory to connect this meter externally if one meter is going to be used for several purposes.

Tuning

The length of aerial is most important. We have found 8 ft. 1 in. with a 6-volt 2-amp. bulb connected in the exact centre to be approximately correct. Resonance in the 5-metre band is indicated by maximum illumination from the bulb. After the correct tuning point has been found it is a good plan to try tapping the aerial up and down the coil with, of course, a readjustment of tuning every time a different tapping point is selected. In this way maximum radiation will be obtained.

Although we found that the high tension could be connected to the exact centre of the coil, it is also a good plan to vary this tapping a turn or so either side of centre. It must be remembered that any adjustments made in connection with the coal make a readjustment of the tuning condenser.

Power Supply

A 175-volt high-tension battery gives more than enough high tension, but by increasing the bias on the modulator and increasing the value of the decoupling resistance in the D210 anode circuit the maximum H.T. can be increased to 200 volts on the PP220. In this way the radiation is very considerably increased.

Constructors of other ultra high-frequency apparatus have queried the fact whether a Post Office licence is required for the short wavelengths. We should like to point out that no apparatus capable of generating oscillation or signals can be constructed without first obtaining permission from the Post Office.

Components for 5-METRE TRANSMITTER

CHASSIS.
1—Cadium-plated 12 by 6 by 3½ in. 18 gauge (B.T.S.).
CHOKE, HIGH FREQUENCY.
1—5-metre type CHP (Raymart).
CHOKE, LOW-FREQUENCY.
1—20 H, 20 M/a, type " WW " C1 (Sound Sales).
COIL.
1—5 turn type 1020 (Eddystone).
CONDENSERS, FIXED.
2—1 by 1-mfd. type 250-volt working (Dubilier).
1—.001-mfd. type M (T.C.C.).
1—.00025-mfd. type M (T.C.C.).
CONDENSERS, VARIABLE.
1—40-mmfd. type 900/40 (Eddystone).
DIALS.
2—IP7 plates (Bulgin).
2—K58 knobs (Bulgin).
HOLDER, FUSE.
1—Type F5 with 6-volt .2 amp bulb, type B620 (Bulgin).
HOLDERS, VALVE.
3—4-pin ceramic chassis (Clix).
1—5-pin ceramic chassis (Clix).
METER.
1—0/30 M/a type E66M (Sifam).
MICROPHONE.
1—Carbon type M (B.T.S.).
PLUGS, TERMINALS, ETC.
1—5-pin cable plug type P36 (Bulgin).
1—4-way cable type BC2 (Bulgin).
1—Terminal type B marked Aerial (Belling Lee).
2—Wander plugs marked H.T.+, H.T.– (Clix).
2—Wander plugs marked G.B.+, G.B.– (Clix).
2—Spade terminals marked L.T.+, L.T.– (Clix).
1—Jack type J2 (Bulgin).
1—Plug type P38 (Bulgin).
RESISTANCES, FIXED.
1—10,000-ohm type 2-watt (Erie).
1—15,000-ohm type 1-watt (Erie).
1—.25-megohm type 1-watt (Erie).
RESISTANCE, VARIABLE.
1—.5-megohm potentiometer (Reliance).
SUNDRIES.
Two coils quickwire (Bulgin).
Quantity of 1 mm. flexible wire for battery leads (Peto-Scott).
SWITCH.
1—S80 toggle (Bulgin).
TRANSFORMER, LOW-FREQUENCY.
1—Type AF4 (Ferranti).
TRANSFORMER, MICROPHONE.
1—Midget type L35 (Bulgin).

ACCESSORIES

ACCUMULATOR.
1—2 volt 45 AH type GS45 (Ever Ready).
BATTERY, GRID BIAS.
1—9 volt (Ever Ready).
BATTERY, HIGH TENSION.
1—175 volt type Port 32 (Ever Ready).
VALVES.
1—PP220 (Hivac).
1—Y220 (Hivac).
1—D210 (Hivac).

DO NOT FORGET
that the
CLOSING DATE OF THE RECEPTION CONTEST
is
JULY 14

Half-wave Doublet Aerials

Length-frequency Relation

IN recent years the twisted-pair form of doublet aerial has achieved great popularity, both for general short-wave listening and amateur transmission. The following table of lengths of wire for frequencies within the most-used amateur bands is compiled by W6AAR. The lengths given are quite accurate for wire sizes between Nos. 8 and 14. If the aerial is less than a quarter-wave above earth the length may have to be reduced as much as 3 per cent.

Kc.	Length. Ft.	In.	Kc.	Length. Ft.	In.
3,500	133	8	14,000	33	5
3,550	131	10	14,050	33	3
3,600	130	0	14,100	33	2
3,650	128	2	14,150	33	1
3,700	126	5	14,200	32	11
3,750	124	9	14,250	32	10
3,800	123	1	14,300	32	9
3,850	122	0	14,350	32	7
3,900	120	5	14,400	32	6
3,950	118	5	28,000	16	8½
4,000	117	0	28,250	16	6¾
7,000	66	10	28,500	16	5
7,050	66	4	28,750	16	3¼
7,100	65	11	29,000	16	1½
7,150	65	5	29,250	16	0
7,200	65	0	29,500	15	10½
7,250	64	6	29,750	15	8¾
7,300	64	1	30,000	15	7½

A Battery Operated Ultra Short-wave Receiver

This two-valve super regenerative receiver designed by Norman Brandon, 2BZN, has a very low noise level so making it suitable for those who wish to participate in the July 5-metre tests.

DURING July several radio societies are arranging 5-metre tests in various parts of the country. In 1935 the usual range obtained by these 5-metre stations was between 50 and 200 miles, so that instead of being restricted to a few ardent experimenters receiving stations in all parts of the country can now participate.

5-metre Tests

EI4J has organised a number of tests on 56,616 kc. to take place on July 4 and 5, the transmitter being situated on a hill a few miles south of Dublin. The input is 150 watts and the call sign EI9G. Transmitting times are as follows: Saturday, July 4, with an aerial directed northwards from 5 p.m.-7 p.m.; with a north-easterly aerial from 7 p.m.-8 p.m.; with an easterly aerial 8 p.m.-9 p.m.; from an aerial directed south-east from 9 until 11 p.m.

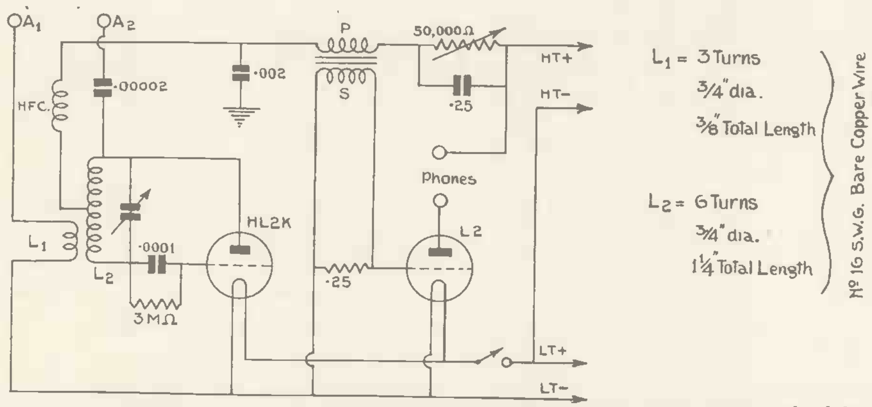
Those who are unable to listen during this period should tune in again on Sunday, July 5, from 6 a.m. until 9 a.m. when an aerial directed northwards will be used; from 9 a.m. until 12 mid-day with an easterly aerial; from mid-day until 3 p.m. with a south-easterly aerial; and from 3 p.m. until 6 p.m. with a north-easterly aerial. It may be possible for a large number of English amateurs to receive these transmissions.

BRS2036 and 2138 will be on top of Sea Fell Pike in Cumberland all day on Sunday, July 5, listening for C.W. and phone transmissions on the 5-metre band. This means that a number of stations will be radiating in this area.

If readers are to take advantage of these 5-metre transmissions it is essential that a simple noise-free high-gain receiver be used. The average super-regenerative receiver, while being simple to operate and broadly tuned, normally requires an R6 signal in order to overcome quench noise. The receiver to be described has been designed mainly to give low noise level without having to use complicated apparatus and a separate quench valve.

30 Miles and R9

Tests during the past few months have proved highly satisfactory, and when used in conjunction with a 5-metre transmitter described elsewhere in this issue reliable signals of between R7 and R9 have been received over a radius of 30 miles. This does not by any means mean that the maximum range is 30 miles for this depends mainly on location.



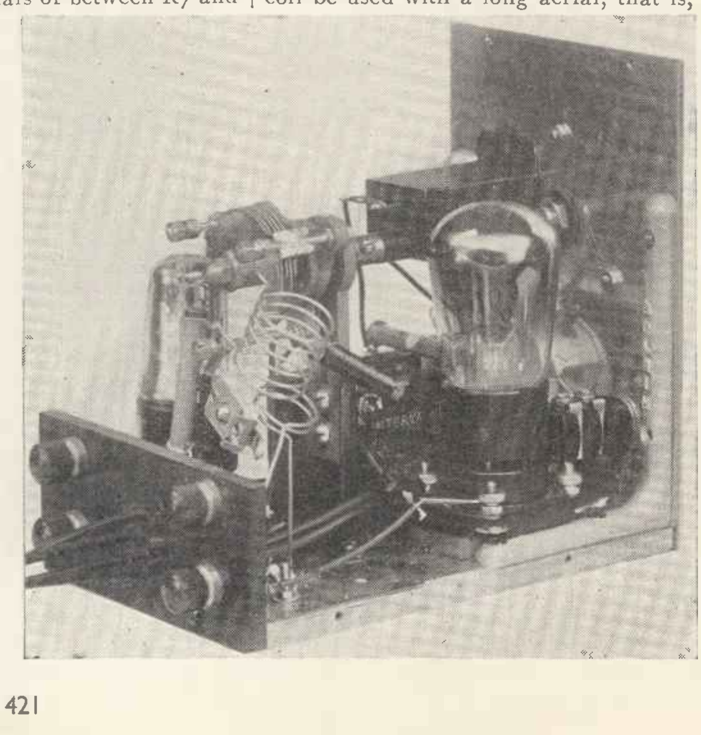
By connecting the grid return to a point at high potential the efficiency is increased and noise reduced by at least 25 per cent.

We are firmly convinced that a two-valve receiver of this kind is quite capable of receiving 5-metre signals up to 200 miles.

The circuit fully explains the way in which the detector-quench valve is operated. The main tuning coil is between anode and grid of the HL2K Catkin triode, a .0001-mfd. grid condenser and 3-megohm grid leak being in series with the grid end of the coil. In addition to completing the detector circuit it also acts as a blocking condenser to the high-tension voltage which is applied to the centre of the coil. This coil is made up of six turns 18-gauge tinned copper wire of ¾ in. diameter. Spacing is arranged that the whole coil takes up 1¼ in. in length. The aerial coupling coil is made up of three turns of a similar gauge wire ¾ in. diameter with a total length of ⅜ in. The illustration of the layout shows how the tuning coil is connected directly across the tuning condenser, with the coupling coil at one end and fixed to the aerial terminal and chassis. Correct coupling can be obtained by bending the support wires to the coupling coil.

Aerial Length

It is recommended that the coupling coil be used with a long aerial, that is,



So as to reduce losses the coils are mounted in the wiring. Commercial coils with low-loss bases can of course be mounted on the base-board. Read the text concerning the use of commercial coils for more windings are needed.

Low Quench Noise :: Simple Construction :: Grid Loading

The controls are; left, phone jack; centre, on/off switch; right, volume control. The tuning dial in the receiver is one of the original Burndept type which can still be obtained but any dial with a good smooth drive can be used.

anything over 20 ft., while A2 be used with the aerial of the correct length of either 4, 8 or 16 ft.

Oscillation is controlled by means of a 50,000-ohm variable potentiometer shunted with .25-mfd. condenser. It is advisable that the voltage applied to the HL2K be kept as low as possible as this noticeably reduces quench noise.

In series with the tuning coil and primary of the inter-valve transformer is an ultra-short wave high-frequency choke. This can be purchased ready wound from Eddystone and is the type 1011. But those who wish to make their own choke should go about it in the following way. Wind 50 turns of 28-gauge D.S.C. wire on a ¼ in. former. If the wiring is arranged so that the distance between the transformer primary and the centre of the tuning coil is approximately the length of the choke, then the former can be slipped out and the choke suspended in air. If, however, there is any possibility of the choke not being perfectly rigid it is recommended that a former be used and the choke wired up directly to the coil and transformer. Glass tubing makes an excellent choke former and costs only a penny or so.

The detector-quench valve is transformer coupled to an L2 triode amplifier. The L2 valve is normally of the amplifying type and only gives a very small output, but in such a receiver as this it is preferable to either a power or pentode valve. Another point in its favour is that the total anode current of the receiver is under 3 m/a. It will be noticed from the illustration that the base is lined with copper foil. The idea of this is to reduce the number of wires by taking all negative connections directly to the copper foil.

Construction

In the centre of the baseplate is mounted the Eddystone extension bracket and the 20 mmfd. tuning condenser. On the panel are mounted the variable resistance, on-off switch and phone jack. If the components are mounted as suggested, the leads in the detector circuit are kept very short and the receiver will tune to the 5-metre band with the coils as suggested. If the spacing between components is increased it would probably be necessary for the reader to reduce the number of turns on the tuning coil to make up for the additional capacity. Meanwhile we refer readers to page 701 of the December, 1935, issue to the description of a 5-metre absorption wavemeter. With this instrument the exact frequency covered by this receiver can carefully be checked.

As previously mentioned we have found that the 3-megohm grid leak should be connected across the grid condenser so that it is between the grid and a point connecting to the positive high-tension supply, for this results in improved selectivity and smoother operation than when the resistance is connected to cathode in the conventional manner.

Layout

In this receiver, as in all other ultra high-frequency receivers, much depends on the layout. As no two layouts can be identical it will be advisable to experiment with the grid leak value and the point to where it is connected. Also experiment with the tap point of the high-frequency choke and the size of the by-pass condensers. It is also good practice to run earth leads to a single point on the copper chassis of the receiver. Attention to this will prevent any likelihood of instability.

The circuit shown, although designed for 56 mc. operation, is quite suitable for use on 112 mc. On the higher frequency, however, the valve and coil connections must be kept very short, so to this end the valve should be mounted upside down. If in operation, threshold howl is experienced before the detector goes into super regeneration connect a resistance of 250,000 ohms across the secondary of the inter-valve transformer.

Grid Loading

Another important point is that the detector grid circuit should be loaded very heavily, so it is advisable to provide variable coupling between the aerial coil and the grid coil, or to provide some means of series tuning the aerial. The simplest way of varying the grid load is by adjusting the gap between the coupling coil and the grid coil.

During the time the receiver was being tested an aerial having a total length of 8 ft. was used. This gave ample pick-up without causing too much damping.

Components for
BATTERY-OPERATED ULTRA SHORT-WAVE RECEIVER

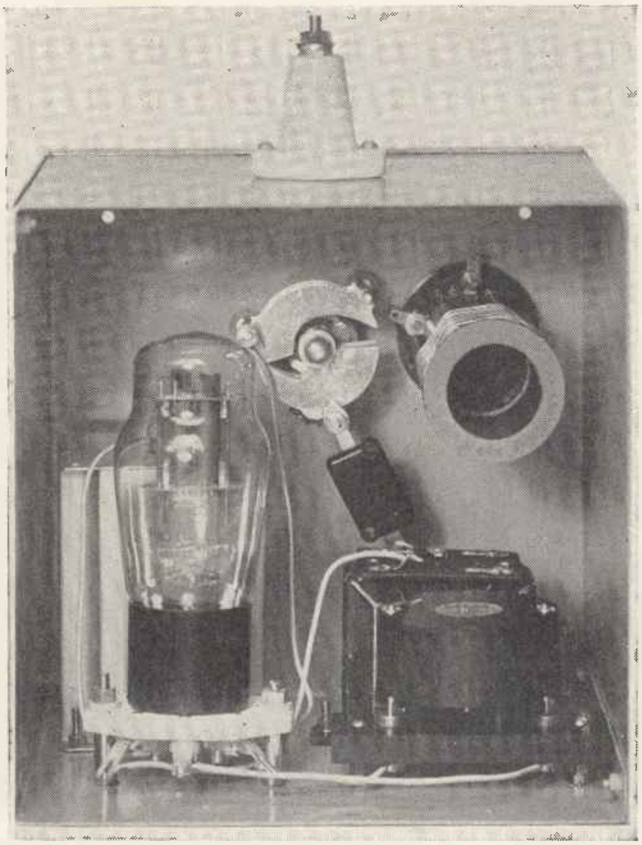
CHASSIS AND PANEL.
1—Cadmium-plated panel 7 by 4½ by ⅛ in. (B.T.S.).
1—3-ply baseplate 7 by 4½ by ½ in. copper foil covered (B.T.S.).
CHOKE, HIGH-FREQUENCY.
1—5-metre type 1011 (Eddystone).
COILS.
1—3 turn type 1020 (Eddystone).
1—6 turn type 1020 (Eddystone).
CONDENSERS, FIXED.
1—.0001-mfd. type M (T.C.C.).
1—.002-mfd. type M (T.C.C.).
1—.25-mfd. type tubular (T.C.C.).
1—.00002 mmfd. air-spaced (B.T.S.).
CONDENSERS, VARIABLE.
1—.00002-mfd. type 900/20 (Eddystone).
1—.00002-mfd. trimmer air spaced (B.T.S.).
HOLDERS, VALVE.
2—4-pin ceramic baseboard type (B.T.S.).
PLUGS, TERMINALS, ETC.
2—Wander plugs marked H.T.+, H.T.– (Clix).
2—Spade terminals marked L.T.+, L.T.– (Clix).
1—Phone jack type J2 (Bulgin).
3—Terminals TL/AE1, TL/AE2 and TL (Bulgin).
RESISTANCES, FIXED.
1—3 megohm type 1-watt (Erie).
1—250,000-ohm type 1-watt (Erie).
RESISTANCES, VARIABLE.
1—50,000-ohm potentiometer (Reliance).
SUNDRIES.
2—Brackets type PB4 (Bulgin).
1—Piece of ebonite 4 by 2 by ¼ in. (Peto-Scott).
Small quantity 16 gauge copper wire.
1—bracket type 1007 (Eddystone).
1—extension type 1008 (Eddystone).
SWITCH.
1—S80 (Bulgin).
TRANSFORMER, L. F.
1—LF33 (Bulgin).

ACCESSORIES.

ACCUMULATOR.
1—type DTG (Exide).
BATTERY, HIGH TENSION.
1—108 volt (Vidor).
PHONES.
1—Pair Super-sensitive (Ericcson).
VALVES.
1—HL2K (Osram).
1—L2 (Mazda).

The 6A6 Transmitter

Readers who have not attempted to construct a transmitter owing to lack of experience or cost will be interested in this single-valve arrangement which is capable of giving excellent results over several thousand miles.



The lay-out of this transmitter can be seen from this illustration. In the foreground is the special Brookes 20 metre crystal. Insulate the tuning condenser from the metal case by means of a large square section of ebonite.

DURING the past few weeks many of our readers have heard the phone and C.W. transmissions sent out by G5GQ from Norbury. The phone on 40 metres has been heard all over Europe at strengths up to R7 with heavy modulation and good quality. On 20 metres W's have been worked on C.W. and reports so far have been QSA5.

No listener having heard these transmissions could have realised from the strength and quality of the transmission that the entire outfit uses only one valve.

Single-valver

G5GQ has for some time been experimenting with a simple transmitter for emergency use, and his final design as indicated in these pages is causing considerable interest in amateur circles. The entire transmitter and modulator is shown in the theoretical circuit, from which it can be seen that no more simple arrangement could be possible. The valve used is of the twin-triode type such as a 6A6 or 53. These valves are almost identical with the exception that the 6A6 has a 6 volt .3 ampere heater and the 53 a 2.5 volt heater. Constructors will readily appreciate that these valves are of the class B type, so that those unfortunately restricted to the use of batteries for power supply could use a battery-operated class B valve such as the Cossor 240B. With such a valve the total cost of the transmitter would be only a few shillings including microphone.

In the original instrument a 6A6 valve is used with the filament heated from a filament transformer. A 40-metre crystal is connected in the grid circuit of one-half of the valve, bias being applied by means of a 100,000-ohm leak in parallel with the crystal. This, of course, is the conventional method by which bias is automatically obtained in proportion to the grid current passed by the valve.

Later experiments have shown that a slight increase in efficiency can be obtained by automatically obtaining bias through a 400-ohm resistance in series with the cathode. This, however, is a matter for experiment.

A 2-in-1 Valve

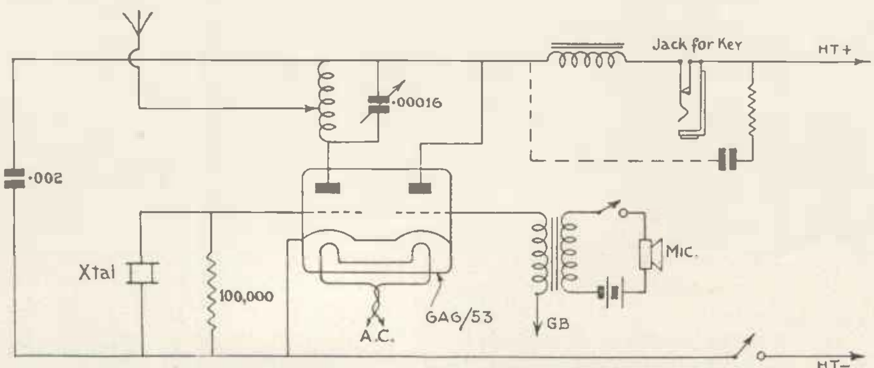
The 6A6 valve has a common heater and cathode so that wiring is greatly simplified. The anode of the first triode is connected to a tuned circuit consisting of a 40-metre plug-in coil tuned by an Eddystone type 900 condenser. This condenser can be of any capacity between .0001 mfd. and .00025 mfd. if the transmitter is to be worked solely on the 40-metre band.

The cold end of the coil is connected to H.T. via a small output choke and key jack. It will be seen from the illustration that a key click filter has been connected in circuit. This filter makes use of the output choke so that the only two additional components required are .01-mfd. condenser and a small fixed resistance of about 25 ohms.

The junction of the tuning coil and output choke is by-passed to earth through a .002-mfd. condenser of a type suitable to withstand maximum high tension. The anode of the second triode is also connected to the output choke, for this acts as the external impedance to the modulator valve. The second grid is connected to the secondary of a high ratio microphone transformer which is wired up as indicated having a switch and energising battery in series with the primary winding. A suitable microphone transformer is the Bulgin LF35.

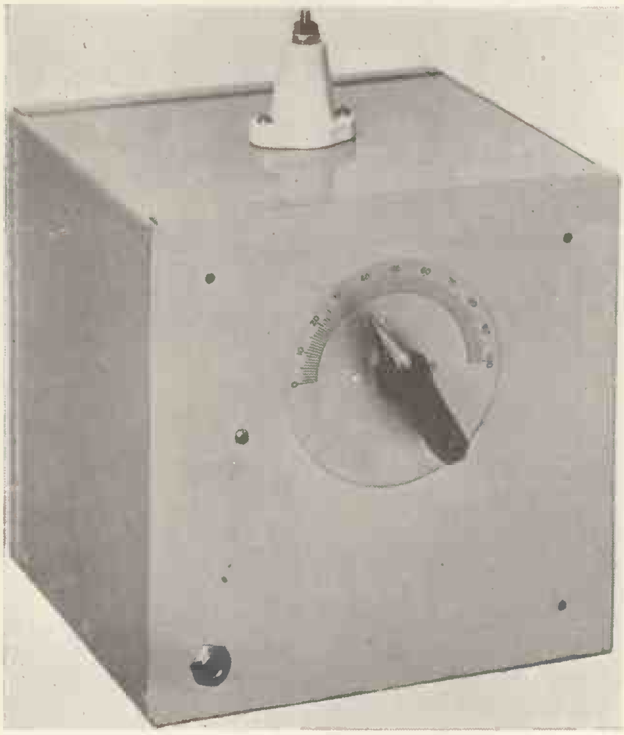
Simple Aerial

Important features for the beginner are the extremely simple aerial circuit and the fact that no adjustments are necessary. Tappings must be made to the anode coil so that the aerial can be connected directly to the correct point.



Either a 6A6 or a 53 type valve can be used. Full modulation cannot be obtained unless the microphone is of the carbon type giving a high output. There must be at least 4 volts across the secondary of the microphone transformer.

The 6A6 on 20 Metres



The plug in the left-hand corner is for the microphone while the stand-off insulator is connected to the coil in anode circuit of the 6A6. Unless the correct tapping point on the coil is obtained efficiency will be greatly decreased.

High tension should be applied to the transmitter, and while tuning a milliameter should be connected in the jack reserved for the key. The tuning condenser must be adjusted until the minimum current is obtained on the meter.

For those who cannot obtain a meter a suitable substitute is a looped lamp. Simply loop a single turn of wire and connect it across a 6-volt bulb. The loop should be about $1\frac{3}{4}$ ins. in diameter and fastened at the extreme end of the tuning coil former, after which the tuning condenser is adjusted until maximum light is obtained. A flexible wire is connected to the stand-off insulator on the side of the case, the other end of this flexible wire being terminated in a crocodile clip. If a meter is being used, try clipping the aerial on to different points on the coil until maximum anode current is obtained. Of course every time a different tap is tried the tuning condenser must be re-adjusted to give minimum current. For those who again are going to use the looped lamp the correct condenser position is indicated by the minimum light point after the aerial has been connected.

Aerial Length

The aerial is of the simple single-wire receiving type having a total length, including lead-in, of either 33 or 66 ft. The exact length depends entirely on the frequency of the crystal and this can be determined by the usual aerial formula:

$$\text{This is } L(\text{ft.}) = \frac{492{,}000}{F} \times K$$

where L is the length in feet for the frequency F, and K is a constant depending on the frequency. For wavelengths between 80 and 10 metres K is equal to 0.95.

20 Metres

When operating on 20 metres it is not advisable to use a 53 valve as a combined oscillator-doubler, so we have obtained from Brookes Measuring Tool Co. a 20-metre crystal which gives a remarkable output. This means that to work on 20 metres a new crystal plus a 20-metre coil are necessary.

The illustrations show how we constructed the original transmitter. The internal view illustrates the 53 valve mounted on a B.T.S. ceramic valve holder behind which is a Bulgin screened smoothing choke type LF14. To the right of the smoothing choke is the Bulgin microphone transformer type LF35, in front of which is the 20 or 40-metre crystal. The Eddystone tuning condenser is mounted almost centrally in the middle of the cabinet, close to the anode coil. No switching has been provided, but if this is required a toggle switch can be included in the L.T.-H.T. negative leads.

Low Cost

We can thoroughly recommend this transmitter for all those who wish to experiment with short-wave speech propagation, for it is absolutely fool-proof in operation. Valves of the type suggested can be obtained for as little as 3s. 9d., while a cheap carbon type microphone is essential to obtain full modulation. The transmitter is on the air quite frequently under the call sign G5GQ, and we suggest readers listen on 40 metres, particularly over the week-ends.

The Surrey Radio Contact Club

At the last meeting of the above society held at the Railway Bell Hotel, West Croydon, on Tuesday, June 9, over 50 members and friends attended to hear a lecture by Norman Brandon on the new Tobe amateur super-het. The receiver aroused considerable interest as it embodies nearly every ham refinement. Many questions were asked particularly about the second model to use a crystal gate.

Basil Wardman also gave a talk on his new single-valve transmitter with which he has worked all parts of Europe and certain American stations. A Super Sky-Rider receiver loaned by G2NO was also on view, but this could not be demonstated to advantage owing to bad local interference. At this meeting for the first time members of the Thornton Heath Society were present and arrangements were made for a 5-metre field day to take place on June 28.

All interested in this society should write to the secretary, E. Taylor, G5XW, 35 Grant Road, Addiscombe, Croydon.

An International Amateur Radio Society

It will no doubt interest amateurs to know that through the effort of W 9DQD, Mr. Magill, Grand Junction, Colorado, U.S.A., a Society known as the "World Friendship Society of Radio Amateurs" has been formed. Amateurs throughout the world have been asked to join and in this country Mr. A. H. Bird, Radio G6AQ is acting as secretary with the assistance of G5XW.

Eighteen members of the Surrey Radio Contact Club have sent in their applications for membership, which is entirely free.

Special Short-wave Transmissions

Information as to the wavelengths used by the *Queen Mary* has so far been difficult to obtain as many channels have been used experimentally. However, for the time being, the call sign GBTT and the following wavelengths are in use: 74.6, 66.08, 36.5, 33.9, 24.3, 22.5, 18.8 and 16.8 metres.

The Zeppelin "Hindenburgh," with the call sign DEKKA, will be using wavelengths of 74.2, 51.03, 29.10, 22.70 metres.

Selected and Specified for the

BATTERY OPERATED ULTRA SHORT-WAVE RECEIVER

Three Resistances—one price: 120, 2,000 and 4,000 ohms
12/6

Ericsson SUPER SENSITIVE TELEPHONES

No wonder the designer of the Battery Operated Ultra Short-wave Receiver featured in this issue chose Ericsson Telephones as indispensable. They are simply perfect for the 100 per cent. functioning of this set.

Wonderfully sensitive, comfortable in wear, and very pure in tone, they have come to be regarded as standard for the keen short-wave enthusiast's equipment.

Hook them up to your Battery Operated Ultra Short-wave Receiver.

At all good radio dealers. If you have any difficulty in procuring, write direct to :

ERICSSON TELEPHONES, LTD., 67-73, Kingsway, London, W.C.4, Eng.

Telephones : 3271/3 Holborn

PRACTICAL RADIO COMMUNICATION

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

By **ARTHUR R. NILSON**
Lieutenant (Technicist) (Communications) U.S.N.R. (Retired)
and **J. L. HORNUNG**
Formerly Radio Instructor, Guggenheim School of Aeronautics, New York University.

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

Features of this book :

—covers the entire spectrum of radio waves; ultra-short-, short-, medium-, and long-wave radio transmission and reception
—gives special attention to alternating current engineering principles and their application in radio transmission and reception
—covers transmitting, receiving, and power generating apparatus for all types of stations
—includes marine, aeronautical, police, and amateur radio, with especial attention to broadcasting, and studio and control-room equipment and operation.
—written in simple, concise style, with many illustrations and diagrams

CHAPTER HEADINGS

1. Direct-current Electricity and Magnetism
2. Alternating-current Electricity.
3. Introduction to Vacuum Tubes.
4. Transmitting-circuit Principles.
5. Receiving Circuit Principle
6. Antennas and Wave Propagation.
7. Studio Acoustics and Apparatus.
8. Control-room Equipment and Operation
9. Broadcast Transmitters.
10. Communication Transmitters.
11. Radio Receivers.
12. Radio Aids to Navigation.
13. Rectifier Units.
14. Dynamo-electric Machinery and Meters.
15. Storage Batteries.

McGRAW-HILL PUBLISHING CO., LTD., ALDWYCH HOUSE, LONDON, W.C.2

A Powerful 2-valve Short Wave Receiver with Bandspread Tuning

STAR FEATURES

- Calibrated Band Setting
- High Sensitivity — Low Noise Level
- Diecast Aluminium Chassis
- No Grid Bias Battery Continuous Bandspread Tuning
- Pre-Set Reaction—Potentiometer Gain Control
- Low Current Consumption
- Simplicity of Construction

WAVE RANGE— 15.5/52 Metres.
(Extra Coils to 200 metres)
Adaptable to A.C. for Low Tension.
PRICE OF ASSEMBLY 67/6, complete with Instruction Book and Service Manual containing theoretical and practical circuits, point to point wiring plan, wave-range charts and full building data.

EDDYSTONE ALL WORLD TWO

STRATTON & Co Ltd
Eddystone Works, Birmingham.
London Service: **Webb's Radio, 14, Soho St., Oxford St, W.I.**

The Short-wave Radio World

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

2½-10-Metre Receiver

W2DHN and W2CQI have published in the April issue of *Short-wave Craft* quite an ingenious ultra high-frequency receiver, which should interest English amateurs. It consists of a super-regenerative circuit, of quite an unorthodox nature. A 6C5 metal valve is used as a detector, and a 42 glass pentode as an amplifier. The aerial is coupled to the receiver through a "Pie" winding, but this must be experimented with for certain amateurs have discovered that the ordinary coupling coil gives better results. On the other hand if a single wire vertical aerial is used it must be coupled by means of a very small fixed condenser. It is also an advantage to use a semi-variable grid condenser, particularly if it is air-spaced. The grid leak is important, insomuch as it must have a value exceeding 10 megohms. For an intervalve transformer use the highest ratio possible within reason, while the volume control must be of the dead spindle type if a metal panel is to be used.

English valves of the A.C./H.L. and A.C.2/Pen types can be used in this circuit, but the bias resistance must be varied to suit. The complete circuit is shown in Fig. 1.

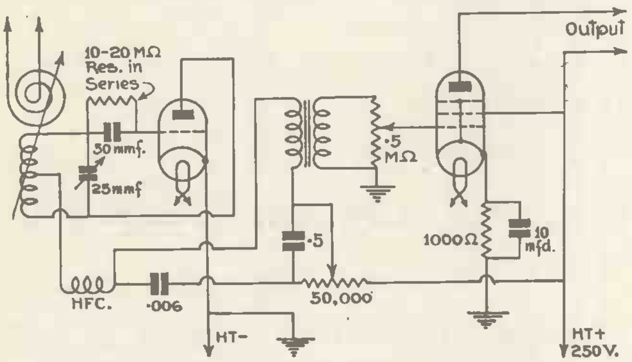


Fig. 1.—A super-regenerative type of receiver of this kind is claimed to be very free from background noise.

A Twin Valve Frequency Meter

A frequency meter using a Class B valve is fully described in the February 12 issue of the *Sydney Bulletin.* This interesting piece of apparatus is very useful to amateurs and particularly to listening stations, while at the same time the transmitter will be glad of a monitor with which he can check radiation.

The two functions are combined by using a two-in-one Class B battery valve. As monitoring is to be carried out there must be no external leads to batteries, so the whole unit should be housed in a metal box. The original unit was in a box 10 ins. by 10 ins. by 7 ins. with a tight fitting lid.

A 100-mmfd. midget condenser is used for band setting, with a 35-mmfd. midget as a tuner. Both these must be of sturdy construction, such as the Jackson midgets. No knob is provided for the band setter as this must be fixed to preserve calibration. A filament type headphone jack is used with its chassis insulated from the panel so the unit is switched on as the headphones are plugged into circuit.

To enable an accurate reading to be made, a reading glass from Woolworths was obtained. This was fitted to the drive with a hairline pointer fastened to it. The meter works on harmonics so that one coil serves for all amateur bands. The actual construction is very simple, as can be seen from Fig. 2.

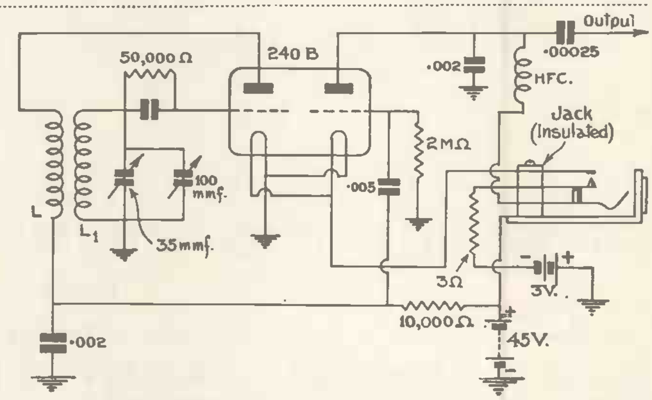


Fig. 2.—The Cossor type 240B valve is most suitable for this circuit as it oscillates very freely.

Improving Detector Stability

W5TR has put forward a good suggestion for freeing the regenerative detector from frequency variation with regeneration control settings and variations in input voltage. The sketch in Fig. 3 shows an improved electron-coupled detector arrangement. The oscillating portion of the circuit using an MS4B type of valve is orthodox; the improvement lies in the regeneration control.

A voltage divider consisting of two fixed resistors was chosen to meet the following requirements. First, to divide the H.T. voltage so as to provide proper screen voltage. Second, to draw sufficient current from the H.T. supply to cause appreciable voltage drop across the variable resistor R3, which is used to control regeneration.

The voltage divider circuit is incorporated in the detector wiring and is entirely separate from other voltage-dividing equipment.

It will be seen that this is a true electron-coupled oscillating circuit and inasmuch as oscillation starts each time with the same voltage across R1-R2 calibration is more or less constant. The generation control has a negligible effect on tuning, and an increase of 20 or 30 volts in the H.T. supply only causes the slightest frequency shift. A decrease, of course, takes the detector out of oscillation, while reducing R3 oscillation comes back in on the same frequency.

If the variable resistor R3 is 50,000-ohms the total resistance of R1 and R2 should not exceed 50,000 ohms and preferably less for most effective control. Some experimenting with resistor values may be needed for maximum sensitivity and smoothest control. An average starting point would be to make R1 about ¼ the resistance of R2.

A Low-power Transmitter

QST have introduced a simple transmitter for very low-power working. It consists of three indirectly-heated cathode screen-grid valves which in this country could be of the receiving type provided the H.T. supply is reduced to a maximum of 200 volts.

The crystal oscillator circuit feeds in to an MS4 type of tetrode with the conventional anode coupling coil. The C.O. stage is coupled to the P.A. by means of a variable condenser of 100 mmfd. This condenser is quite important, particularly on the higher frequency bands. So as to increase R.F. output, two screen-grids are used in parallel in the final stage, having the cathodes joined together and broken with a key. It will be seen from the circuit, Fig. 4, that the screens are not taken to a positive potential but are

(*Continued on page 428*).

CALLS HEARD

2AOU M. G. Bourke, Jersey, C.I.
(*20 metre phone*)
VK2BW, 3MR, 2BQ, 2AP, 3AC, 2BK, 3JA, VO1J, VO1I, FA3JY, FT4AH, VP2CD, VP9R, NY2AE, PY2BA, 2AK, 2ET, 2CK, H15X, 4F, 7G, T12RC, 2AV, SU8N8, 1CH, 1RK, SV1KE, CO2RA, 6OM, 8YB, 2HY, 2WZ, W6BGH, 6GAT, 6CME, 6AH, W5CEE, 5DQ, 5EWD, W7ALZ, K4DDH, VP6YB, VP5AC, YV4AC, OA4AA, HK1Z, URAV, PK4AU, VU2AM, 2CQ, PK4DQ, KA1HA.
VK2, 3, 4, 5, ZL2, 3, 4, CX1FB, 1BG.

(*20 metre C.W.*)
2AK VU2PL, ZB1C, 1H, 1J, TF3V, SV1KE, SU1RO, 1XX, 1TM, 1SG, 1KG, 1FS, 1RH, 1TW, 1RK, HH1P, 5PA, VQ4SNB, 4KSL, PK1RL, ON4CJJ, ZE1JS, K5AA, AG, CN8M1, 8AD, 8MQ, U9M1, 9MF, 9AV, OX7ESK, VP6MR, ZD8A, VO3HM, VO1N, VP2TG, J2JJ, 2CL, XE1Q, 2O.

(*10 metre C.W.*)
SU1JT, ZE1JU, ZS1H, VK4EI, K4DDH, CP1AC, ZT6Y, SU1SG, OA4J.

B. McDougall, Stornoway, Lewis.
(*40 metre phone.*)
G2LU, 2UU, 2IU, 2OC, 2FC, 2WD, 2LD, 2UY, 5JO, 5HB, 5TS, 5CJ, 5HL, 5IS, 5CP, 5QM, GI5MZ, 6US, 6VS, 6SR, 6YU, 6CW, 6WR, 6UU, PAOFB.

K. Gray, Swansea. (*160 metre phone.*)
G2WO, 2JM, 5KJ, 5ZJ, 6GO.

(*40 metre phone.*)
G2AV, 2AO, 2DF, 2TM, 2IP, 5XG, 5ZJ, 5CJ, 5GL, 5CW, 5LC, 5CY, 5BK, 6DL, 6FH, 6LZ, 6SR, 6US, 6AX, F3AC, 3FA, 8WZ, 8AL, 8VL, CT1CV, EA1BT, 1AS, EI7G, 8G, 2J, GI5MZ, PAOWJ, WD, IDW, EO, FB, RP, DK, ON4KD, 4BR, 4MJ, 4RA, 4MD, 4UB, 4VC, 4ARD.

(*20 metre phone.*)
CT1BY, 1CB, LA1G, LA4N, HB9B, LY1J, EA2BT, 3ER, 8AF, 3CP, F3IM, 8DC, 8NH, 8NR, 8WK, HI5X, VE2HY, VO1I, W1BFN, 1CMD, 1CPD, 1IMG, 1ADE, 1AS, 1KJ, 1AGW, 1HCM, 1FHY, 1HHQ, 1HYJ, 1AJZ, 2BZR, 2GLO, 2UK, 2GDU, 2BSD, 2IXY, 2JOA, 2GFH, 2AN, 2CLX, 2OJ, 2BSD, 3AIB, 4AHH, 4OC, 8IV, 9CLH.

W9DXX, Alice R. Bourke, Chicago, U.S.A. (*20 metre C.W.*)
CM2AI, CX2AK, K7ELM, LU9BV, ON4CC, VE3CA, VE4OC, VK2TG, 2XU, 3CP, 5HM, XE2N.

(*28 Mc. C.W.*)
D4ARR, 4CSA, 4GWF, 4QET, EA3EG, 4AO, 4BM, F8CT, 8EO, 8EX, G2NH, 2PL, 5VP, 5KG, 5RS, 6CJ, 6CL, 6DH, 6LK, 6NF, 6RH, 6RV, 6RX, 6TT, HJ3AJ, LU9AX, OA4B, 4J, OH5NG, OK1AW, 1BC, 2HX, ON4AU, 4JB, 4NC, OZ2M, OZ7KG, PAOAZ, OFX, OUN, SM6WL, VE1FW, 4HT, 4UY, 4DK, 5EO, 5HC, 5QP, VK3YH, VP5PZ, ZS1H, 2A, ZU1C.

A Transmitter with Receiving-type Valves

coupled to the control grid, so converting the valve into a low impedance triode. Neutralising is carried out in the usual way, C3 being connected between grid and the high potential end of the tank coil.

This simple transmitter is quite effective in operation and we can recommend it to any beginners who wish to knock up low-power equipment.

Changing to 10 Metres

In the June issue of *Radio,* W6JD puts forward a simple arrangement so that a 20-metre transmitter can be converted to 10-metre operation without too much circuit changing.

His transmitter is designed for 40 and 20 metres only and during the last contest he found that most of the long-

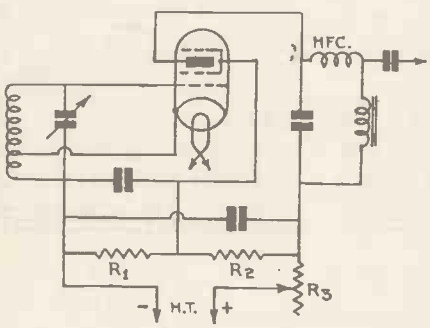


Fig. 3.—Regeneration is very important in straight receivers. Try this arrangement for it is smooth and does not introduce modulation hum.

distance stations were using the 10-metre band. For contest work it is hardly the most suitable arrangement to have a rig that takes an hour or so to change from one band to another, so to overcome this difficulty an add-on unit was designed.

An HF300 was used as a P.A., was driven by a 50T, and by reducing the excitation an output of 200 watts was obtained without the HF300 showing any signs of stress.

The circuit used is shown in Fig. 5 and is fairly straightforward. To change the 20-metre transmitter for higher frequency working the aerial coupling circuit has to be removed and the link coil from the grid of the HF300 coupled to the 20-metre tank coil. The change-over can be made in about two minutes without having to make any circuit alteration to the standard transmitter.

Those operators who have not taken advantage of the DX possibilities on the 10-metre band, owing to the troubles in modifying the transmitter, should go right ahead with the simple unit.

The idea can be adapted to suit any type of valve although it is advised that the valve chosen be of the low inter-electrode capacity type. A low input capacity is essential.

Component values for the HF300 are as follows:

C1—.000035-mfd.
C2—.00005-mfd.
C3—.000035-mfd.
C4—.002-mfd. mica.
C5—.002-mfd. mica.
R—50,000 ohms, 75 watts.
L1—9 turns No. 10 wire, 1½ ins. dia.
L2—7 turns No. 10 wire, 2½ ins. dia., tapped at centre.

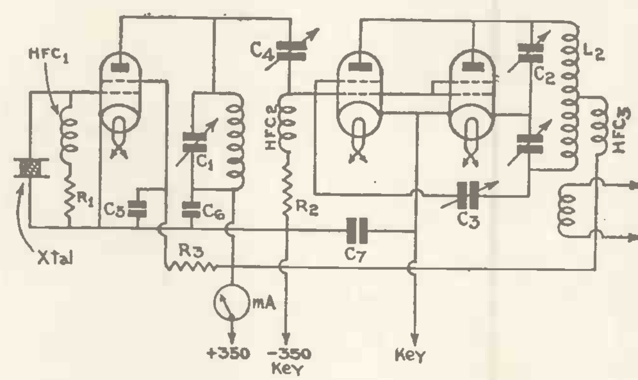


Fig. 4.—Any low impedance type of screen-grid valve can be used in this circuit. The H.T. must be kept down to below 200 volts.

Adjustments should be made in the following manner. Tune C2 for minimum plate current after first adjusting C1 for maximum grid current with the anode voltage off. Then couple the aerial inductively to L2 and load up as much as possible without the HF300 showing any suggestion of colour during keying. Primary keying was used

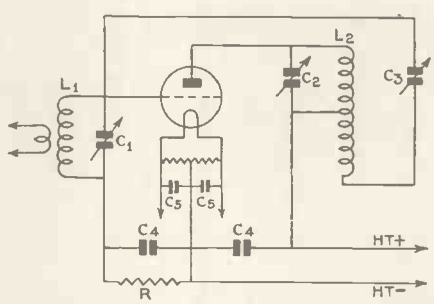


Fig. 5.—This power doubler uses the H.F. 300 but it can be adapted to use other valves of lower wattage if the input capacity is low. We suggest the Ediswan E.S.W.501.

on the HF300 unit as this was found to be most satisfactory. As can be seen from the circuit the stage then acts as a power doubler.

Our Policy
"The Development of Television."

Pilot All-wave Receivers.

The Pilot Radio Co., Ltd., have now introduced a new range of receivers for two and three band reception. Amongst the new sets listed are the following:—A 4-valve plus rectifier A.C. Super-het priced at 12 guineas, and an A.C./D.C. version at 14 guineas. Both of these receivers are of the three band all-wave type. At 17 guineas there is a 5-valve plus rectifier A.C. model and a 5-valve

D.C. Receiver with 2 Wave-bands.

Two console models price 18 and 24 guineas will incorporate the 12 and 14 guinea chassis. The all-wave models of these receivers should be of particular interest to our readers wishing to hear short-wave stations in addition to the normal long- and short-wave programmes.

The Superheterodyne Receiver.

Alfred T. Witts, A.M.I.E.E., has now revised his excellent book "The Superheterodyne Receiver," which is published by Pitmans at 3s. 6d. net.

It takes 157 pages fully to cover all phases of super-het theory and practice while the various chapters are so lucidly explained that the novice will find much of interest. All information required completely to understand the modern super-het and the past researches upon which the present receiver is based are fully given.

Chapters include such headings as "Post-War Developments," "The General Principles of Super-het Construction," "Single-valve Frequency Changers," "Automatic Volume Control," etc. The chapter devoted to maintenance is also very comprehensive for it deals with servicing problems of several commercial receivers.

Luminescent Materials

Research on luminescent materials during the last 2 or 3 years has resulted in the production of luminous sulphides suitable for cathode-ray tubes, the efficiency of which is about three times as great as the highest value previously obtainable. The maximum amount of light now obtainable amounts to 4 or 5 per cent. of the energy input. It is impossible to say whether this figure can be materially increased in the future, but there is still ample scope for development. The production of luminescent substances which are specially sensitive to low-speed electrons should lead to further improvement, as high voltages entail greater expense in the manufacture of television apparatus.

Our Readers' Views

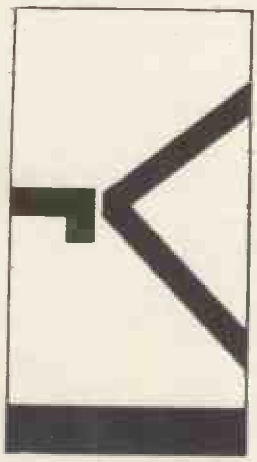
Correspondence is invited. The Editor does not necessarily agree with views expressed by readers which are published on this page.

Television on 40 Metres

SIR,

Last night, May 26, at 22.30 B.S.T., I heard a 30-line television transmission on the 40-metre amateur band, the approximate frequency being 7015 kc.

On applying the signals to a disc visor it was seen that a still geometric pattern was being transmitted. Rough sketch of this is given below.



Picture ratio and frequency were identical with the former B.B.C. transmissions, and a synchronising band was observable. Apart from occasional heterodyne patterns from adjacent amateur telephony and c.w. transmissions, the image was very clear, but double and triple images were seen every few minutes or so.

The receiver was an A.C. mains 2-v-1 broadcast set fitted with A.V.C. preceded by a 2-valve convertor.

The transmission continued without a break until 02.15 B.S.T. this morning, the 27th, the same pattern being transmitted throughout. No announcement of any sort was made during the whole time.

It would be interesting to know whether any other readers heard this transmission, and to hear their reports on the same.

SYDNEY CATTELL (Glamorgan).

Ultra-short Wave Developments

SIR,

I was interested to read Mr. Microwave's recent letter in answer to the second part of my letter published in your May issue.

Before going further I might point it out to him that had he read my letter he would not have written this note of his. It may interest him to note that I asked no questions or rather put up no objections to anything he wrote except to this spirit of fixing a definite mechanical mien on a problem on a matter as yet so undecided. In fact I went to the extent of describing (and that I repeat very rightly) his analogies as "very instructive and straightforward."

My objections started with such remarks of his as "This is an almost exact analogue of the B-K cycle" (see your March issue, p. 169). As a matter of fact we don't yet know what the B-K cycle really is. It is strange coming from him that I shall be more precise and less sensational in my objections in order that Mr. Microwave will condescend to very kindly explain them. With due thanks to Mr. Microwave may I inform him that, as to what I intended to convey to him, I cannot be more precise. It may perhaps be better if he kindly read through the letter again and kindly demarcate the region where the letter leaves precision and enters the realm of sensationalism. It may be difficult.

On the other hand, if he wants me to show why I think his already fixed notions may be detrimental, I may point out one or two points which may be of interest. Here I depart from his article No. II, which was my objective in the last letter, and I intend to cover both the articles in a superficial manner, as the explanations might lead up to some mathematical dialogue (which I have already been made to understand by the Editor is an item he has found "necessary to curtail when possible" before this).

In his first article he covers only the two claimants "Medicine and Communication" though I am pretty certain that Mr. Microwave must know of other claimants in the field. Then he writes at the end of the first paragraph "For medical purposes . . . . nice technical problem at the very short wavelengths (below one metre)." Unfortunately in many of his works where he is specially in need of high power the "medico" likes to work over a range of 8.5 metres to 1 metre.

In dealing with safety margins, frequency limits and reduced sizes, he has talked of "transit time"—that favourite password of an ultra-short wave research worker or rather reviewer—and talks of heating of the seals due to the excessive resistance produced by the high-frequency current.

Does the whole envelope near these contact point not get a heating through the loss in the dielectric. What precautions one needs in producing the glass envelopes, to avoid the other radiations from the ordinary "lead glass" due to forcible impact of electrons on them. These may perhaps be included in the valve technique story he mentions and are important. Moreover, as to using considerable sizes of valves necessarily with tremendous cooling arrangements or for that matter using the "acorn" type, he forgets one uses sometimes a cathode-ray tube if one wishes to produce the very high frequency oscillations. It has been done—has it not?

I have great respect for Philips' Magnetron valves, but why adorn your "Recent developments" with

OUR POLICY
The Development of TELEVISION

that alone? there has been lots of work done on magnetrons alone in the Marconi-Osram research department, in America and notably in Japan and U.S.S.R. Where are they? It would have been more precise work if Mr. Microwave had put forward all of them and then after singing his songs had left us poor readers to choose what we felt most sensible to use.

Coming to his second article. One does not necessarily have to go below 10 metres for a fall of output and efficiency with ordinary negative grid oscillations. A sudden drop in these values start beyond 20 or 30 metres. Regarding his "exact analogue" of the B.K. cycle, it might interest him to note that as early as January, 1935, people realised that there was a great drift of opinion from that "swinging electron conception" of the oscillation produced in a retarded field triode, towards an explanation depending mainly on the phase difference between electron current and voltage brought about by electron inertia. Of course, one must allow for the existence of a proportion of electrons which must, as universally agreed, swing to and fro on either side of the grid. Moreover, his second paragraph under the subheading "An analogy of the B.K. cycle" is rather difficult to understand. What is he driving at there?

Regarding the magnetron valve, he is not at all fair in its capabilities, not its efficiency and output. It is, I believe, one of the greatest creations of the wireless engineer. I am sorry I cannot spend more time on this letter, but I am glad to state that I still hold the view expressed in my last letter.

Mechanical models went to the extent of making Lord Kelvin disbelieve the electro-magnetic phenomena as developed by Maxwell.

What chance has the scientist-physicist or engineer if he falls into that trap.—P.K.C. (London, N.5).

Microwave's Reply

SIR,

One had hoped to obtain from P.K.C. an orderly and concise catalogue of his objections to my article. Instead he states that though they are "very instructive and straightforward" he personally has a great aversion to mechanical analogies. He is fully entitled to this opinion, and also to express it in any manner he pleases, but the manner in which he has chosen to express it seems to have occupied an unnecessary amount of the Editor's valuable space, and must, one feels, impress the discerning reader as a rather good example of that "spectacular obstructionism" about which he (P.K.C.) complains in the first letter.

The whole point is, of course, that his letters revolve about a matter of *opinion* and not of *fact*. As for the merits or otherwise of analogies equally weighty and authoritative opinions can be brought to bear on either side. In my article (about which P.K.C. complains) I merely chose to use this method of expression. The question of a "fixed idea" does not enter into the matter. I am quite willing to discuss psychology with P.K.C., but the Editor would then have real cause to be annoyed and to issue a reminder that there *is* a limit to the space and scope of his excellent journal.

Having made the point to which I have replied above at some length, P.K.C. proceeds to write an article under the guise of a letter, in which he descends from things of the "spirit" to matters of mundane "fact."

The technique of the use of ultra-high frequencies in the medical field is still in its early infancy, so it is rather hard to see where P.K.C. derives authority to state the precise frequency limits which he mentions—this rather savours of the "fixed idea" about which he has complained.

To save space, let us deal with his other "facts" as follows:—

Valve Envelopes.

Some trouble was caused in the early days due to dielectric loss and electron impact, but this proved to be due to *metallic* impurities in the glass. It never occurs nowadays.

The only "radiations" produced are X-rays, which at the voltages concerned are so "soft" (*i.e.*, lacking in penetration) as to have given rise to no effects of practical importance.

"Lead glass" was *sometimes* used, years ago (prior to the introduction of the present-day apparatus) in the construction of X-ray equipment, since this glass is opaque to even moderately "hard" X-rays. It is not, and never has been, to the writer's knowledge employed for any other purpose, and certainly not for the manufacture of radio valves.

Cathode-ray Tubes as H.F. Generators.

The razor has been used for cutting firewood, but the process is of mainly

(*Continued on page iii of cover.*)

(*Continued from previous page*).

academic interest. It *has* been done. If is of course too early to say positively that special razors may *not* be developed for cutting firewood, and whether in that event they would still be referred to as razors.

Illustrations.

Take this up with the Editor, P.K.C.

Transit Time Effects

Have, as P.K.C. sagely remarks, been noticed at frequencies as low as 10 megacycles, but in normal circumstances are not of practical importance at frequencies below 100 megacycles.

The "B.K. Cycle."

As in the case of his remarks re transit time and "radiations." P.K.C. has again made use of the red herring device. The *details* of the B.K. action are, as he says, still a matter of controversy. This controversy centres around the question concerning the manner in which the potentials due to electron motion interact with the electrode potentials.

One of the simplest and most satisfactory mathematical methods of attacking the problem of electron oscillations involves the use of equations of motions of the simple pendulum. In these equations the phase relationships between force (= voltage) and velocity (= current) are implicit. These equations fit both the main features of the B.K. action and my mechanical analogies. Is it possible that in writing of "phase difference between electron current and voltage brought about by electron inertia" P.K.C. is unaware of, or had forgotten the equations which I have mentioned?

The Magnetron.

I am not aware of having had anything derogatory to say about this excellent device. Having regard to Lord Kelvin's contributions to physical science I think P.K.C. ought to forgive his lapse. Many men, even as great as he (Kelvin), have made errors as grievous. Anyway, there is no danger of the modern physicist or engineer falling into that error whilst P.K.C. is around.

Pray accept my apologies for having occupied so much of your space. If P.K.C. now wants the last word, he is welcome to it. I certainly cannot bring myself to inflict any more of this mainly pointless correspondence upon your long-suffering readers.

"MICROWAVE."

MISCELLANEOUS ADVERTISEMENTS

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

INDEX TO ADVERTISERS

Printed in Great Britain for the Proprietors and Publishers, BERNARD JONES PUBLICATIONS, LTD., Chansitor House, Chancery Lane, London, W.C.2, by THE PRESS AT COOMBELANDS LTD., Addlestone, Surrey. Sole Agents for South Africa: CENTRAL NEWS AGENCY, LTD. Sole Agents for Australia and New Zealand: GORDON AND GOTCH (AUSTRALASIA), LTD.