ON THE THRESHOLD OF AMAZING DEVELOPMENTS

TELEVISION

THE FIRST TELEVISION JOURNAL IN THE WORLD

and SHORT-WAVE WORLD

MONTHLY 1/-

NOVEMBER, 1935.
No. 93. Vol. VIII.

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

BAIRD AND E.M.I.

COMING TRANSMISSIONS

Official Details
and
Simple Explanation

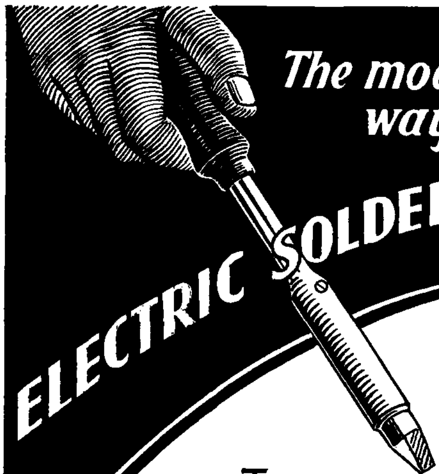
ADVANCE ALL-WAVER

Amateurs, Ships, 'Planes, World Broadcasters

16-2000 Metres all Visually-tuned. A.C./D.C.

Single Aero Dial. A.V.C.

Complete 1936 5-valve Super



The modern way
ELECTRIC SOLDERING

The Solon Electric Soldering Iron has the strongest heating element obtainable. Clamped in contact with the bit, it concentrates all heat. None is wasted. The Solon simplifies soldering. It is quicker, easier, more economical and more efficient. Plug in—solder in three minutes.

7/6
65 WATTS
125 Watts 22/6
240 Watts 37/6

Use a **SOLON** ELECTRIC SOLDERING IRON

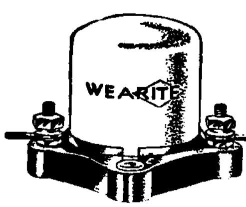
W. T. Henley's Telegraph Works Co. Ltd. Dept. 25. YAB.
Holborn Viaduct, London, E.C.1

WEARITE

POST THIS COUPON TO-DAY !

SPECIFIED for the

● ADVANCE ALL-WAVE SUPERHET



The Wearite H.F.P.J. Screened H.F. Choke.
A compact and small dimensioned fully screened choke with an effective impedance range of 100-2000 metres. Inductance 7 mmfd. D.C. resistance 770 ohms.
Price 2/-

● PRE-AMPLIFIER

The Wearite Heavy Lever Switch Type I.I.
A special low inter-contact capacity 2-way switch of sturdy construction. (also made up to 5-way). **Price 5/6**

To
WRIGHT & WEAIRE Ltd.,
740, High Rd. Tottenham, N.7.

COUPON
Please send me a copy of Catalogue T.834 together with construction details, Blue Prints, etc., of Wearite (L.P.) series of receivers, the New Universal Coils and the N E W Short-Wave Coils (with circuits).

Name ....

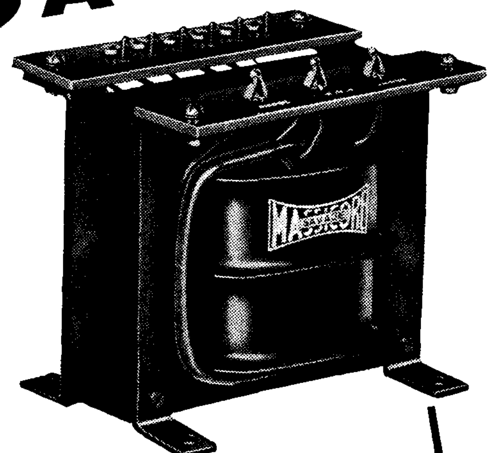
Address ....

....

T.11.35

I.I-5 7731

SPECIALLY DESIGNED BY SAVAGE-



FOR THE NEW LOW LOADING AMPLIFIER

- **Type 45/MT** *Mains transformer* **Price 85/-.**
- **Type 45/OP** *Output transformer (standard output 10, 20, 40 and 80 ohms).* **Price 45/-.** *Higher impedances.* **Price 50/-.**
- **Type 45/IV** *Intervalve transformer.* **Price 35/-.**
- **Type 45/F** *Filter choke.* **Price 19/-.**
- **Type 45/S** *Smoothing choke.* **Price 22/-.**
- **Type 45/C** *Anode Coupling choke.* **Price 19/-.**
- **Type CC38** *Secondary Smoothing choke.* **Price 11/-.**

Note.—With the exception of the last item all these components have been specially designed by W. Bryan Savage, in collaboration with Kenneth Jowers, Short Wave Editor of *Television*, for this new amplifier. The designs are critical and results cannot be guaranteed except with these components.

For the convenience of customers, building the new amplifier, limited stocks of Dubilier 10 mfd., 750 v. D.C. working, oil-filled condensers are now held. The price is 17/-.

W BRYAN SAVAGE LIMITED.
56a, CLERKENWELL ROAD, LONDON, E.C.1.
Phone—Clerkenwell 3068.

No. 93 VOL. VIII NOVEMBER, 1935.

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.

COMMENT OF THE MONTH

A Use for 30-line Gear.

An interesting suggestion is made by a correspondent on another page of this issue relating to the use of existing 30-line apparatus. The sudden decision of the B.B.C. to discontinue these transmissions left a great number of people with apparatus on their hands which apparently immediately became useless; the B.B.C. absolves itself from any responsibility in the matter by its previous repeated reiterations that the service was experimental and liable to be discontinued at any time, an attitude which certainly did prevent a large number of people purchasing apparatus and at the same time limited the use of the service.

However, as our correspondent points out, there is still a very definite use for this gear for those who wish to become *au fait* with the many problems that will present themselves when the high-definition transmissions become a fact. His suggestion is to convert existing receivers into simple transmitters and experiment in amplifier design, etc.; but there are many more sides to the matter which will occur to the ingenious experimenter. Among these are Kerr cell and light modulation experiments, and by modification of disc or drum, interlacing and other scanning variations can be considered. Also it should not be forgotten that modulation can be obtained on any sound programme and illumination intensities, etc., can be studied. Recorded programmes are also available. After all it was from this simple apparatus that the present possibilities were evolved, and so despite the fact that there are no programmes available it still has many potentialities for the keen experimenter.

The Alexandra Palace

We ask for your congratulations this month in being able to present you with what we think will prove a reasonably accurate forecast of the arrangements at Alexandra Palace. Our pictorial layout is the first of its kind published anywhere and while it lacks the endorsement of the magic word "official," we believe readers can accept our pictures as giving them a good working idea of what the Alexandra Palace transmitting station will look like when completed early next spring. A lot of hard work and the collation of details from many sources have gone to the making of our pictures.

The Official Specifications

Though manufacturers and would-be manufacturers of high-definition receivers are now in possession of the official data to allow of the design of apparatus they have no means of carrying out practical tests. It looks therefore as if when the transmissions are ready there will be practically no receivers available and that the first few months will be a period of feverish activity. It is difficult to see any way out of this impasse at the present time, but it appears to be a problem which should have been foreseen by the Advisory Committee and some plans made for test transmissions to be put out.

A DEMONSTRATION OF THE FARNSWORTH SYSTEM

20-KILOWATT, 7-METRE TRANSMITTER PLANNED

For the following information on the latest developments of the Farnsworth system we are indebted to ELECTRONICS, the journal published by the McGraw Hill Company of New York.

RECENTLY, Philo T. Farnsworth, of Farnsworth Television, Inc., of Philadelphia, demonstrated to the press the latest advances in his system of television. The demonstration consisted of a half-hour programme of film and direct pick-up subjects, consisting of Mickey Mouse cartoons, sections of musical comedy and, for the direct pick-up, an orchestra and vaudeville performance.

A photograph of the Farnsworth studio showing the latest electronic scanner in use.

Transmission was accomplished by two means: wire and radio. The wire transmission was sent over a short wire circuit having a frequency band width of approximately two megacycles, while the radio was sent from a 15-watt transmitter on approximately 40 megacycles over a distance of about 50 ft., to a standard receiver mounted in a console.

A 14-in. Cathode-ray Tube

This latter receiver contained both sound and sight equipment with a conventional 7-in. cathode-ray tube for producing the image. The receiving end of the wire line transmission consisted of a special receiver and a very large cathode-ray tube (14 ins. in diameter).

The fluorescent coating on this large tube consisted of compounds of calcium, zinc, chlorine, tungsten and silicon, and produced a brilliant image in black and white, with a very faint pinkish cast. The pictures were sent at a rate of 24 complete images per second, interlaced two-to-one, i.e., a scanning frequency of 48 per second. The picture was transmitted at 240 lines.

The result of the demonstration convinced the observers that a considerable improvement has been made during the past year by Mr. Farnsworth in his apparatus. The film pick-up, particularly, was of a very high order of excellence, and was equal to the average home-movie in detail, brilliance and contrast.

Three Stations Planned

In announcing his plans for the future, Mr. Farnsworth revealed that he has undertaken to build three television transmitters. The first, which is now under construction in San Francisco, has a power of 10 kW., which may eventually be increased to 20 kW. A 20-kW station is to be installed in the laboratory of the Farnsworth Company, in Chestnut Hill, Philadelphia, and a third transmitter will be installed later in New York City. These transmitters are of unusual design, in that they make use of the Farnsworth multipactor tube, a cold cathode electron multiplier (see TELEVISION AND SHORT-WAVE WORLD, May, 1935). According to Mr. Farnsworth, a single tube of this type is capable of delivering an output of 10 kW of useful energy in the ultra-high frequency range, and a water-cooled type of this tube is now in development for this purpose. Two tubes operating in push-pull will supply 20 kW output for the proposed transmitters.

A master-oscillator power-amplifier type of transmitter is to be used. The oscillator is a small electron multiplier tube operating at approximately 20 megacycles, which is followed by a frequency doubler stage and a final amplifier. Modulation will be applied to the final amplifier if audio frequency equipment capable of delivering 1 kW of power at television frequencies can be developed, the 1 kW being sufficient to completely modulate the 20 kW output.

Various commercial agreements have been undertaken by the Farnsworth interests in relation to patents held by the company. Philco Radio & Television Co., of Philadelphia, has been licensed under these patents for the manufacture of television receiving equipment. Heintz and Kaufmann have similarly been licensed for the manufacture of transmitting equipment, and reciprocal license agreements have been contracted with Baird Television, Ltd.

Readers interested in the formation of a wireless society in the Ealing district are requested to get into communication with H. A. Williamson, 22 Camborne Avenue, West Ealing, London, W.13.

AN IMPROVED KERR-CELL LIGHT VALVE

By T. S. Roberts

Details of an improved Kerr cell light valve suitable for experimental work and recording.

IN commercial apparatus employing the Kerr cell the source of light is usually a 12-volt 100-watt lamp. If the television experimenter is not on A.C. mains it is rather a problem to supply the necessary current, especially if one has to depend on batteries. In the usual Kerr cell system a great deal of light is lost, firstly because it is not easy to get an intense light into such a small area as the necessary aperture must be, secondly, the optical design could be improved, and this the writer has accomplished.

In the first place it was decided to draw out the optical arrangement of the commercial job. Fig. 1A is this arrangement, drawn to scale. The condenser lens was found to have a focus of 1 5/16 ins. from which the 100-watt filament was 2 15/16 ins. distant. This state of affairs produces a converging beam which has to pass through a relatively long and narrow tunnel, especially that part consisting of the Kerr cell section, which has been shown in the diagram as having 5 plates; actually it has 9.

As will be seen in the figure a considerable amount of light is lost owing to the convergence of the beam. (The light rays in the cell are shown as a dotted line so as not to cause confusion.)

Now the two obvious improvements, given the same Nicol prisms and cell would be for the light ray to be parallel, with the filament nearer the condenser so as to have a better angle of collection. To produce a parallel light beam the filament must be at the principal focus of the condenser lens; also the shorter the focal length of the condenser obviously the better will be the collection. In the 100-watt lamps the bulb is so shaped that it is impossible to get nearer than 1¼ ins. from the filament, so the original condenser is hardly suitable. When this was discovered it was decided to rebuild the apparatus completely. Fig. 1B shows the optical arrangement decided upon, both the condenser and image lens being of 1 in. focus.

As it was desirable to be able to run the lamp off batteries, a much smaller lamp was decided upon, namely, a Pathescope C lamp rated at 12 volts .5 ampere. It must be admitted that the high efficiency in the design of home-cine projectors considerably influenced the choice of lamp. As in the lamp chosen there is well under ½ in. from its filament to bulb, it would obviously be better to shorten the focal length of the condenser; this was done by the use of an additional lens so that the focal length was reduced to ½ in. Figs. 2 and 3 show the completed apparatus, while Fig. 4 gives constructional details.

The first things made were the two lens and prism mounts. These were prepared from ⅞-in. brass rod, which was drilled and bored to the required size, followed by cutting the necessary threads; these should be not less

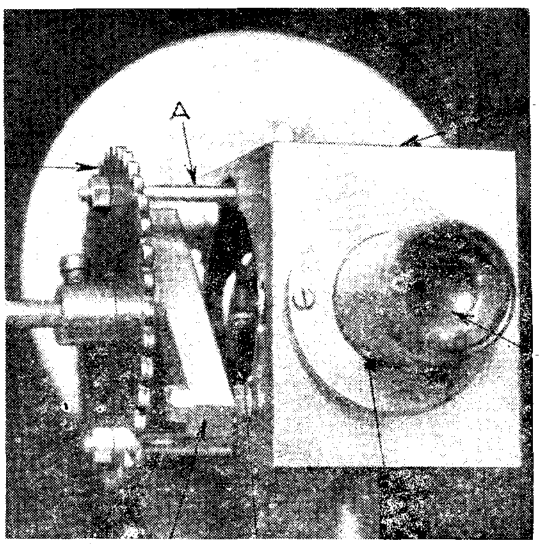


Fig. 2.—Close-up showing construction of the Kerr cell unit.

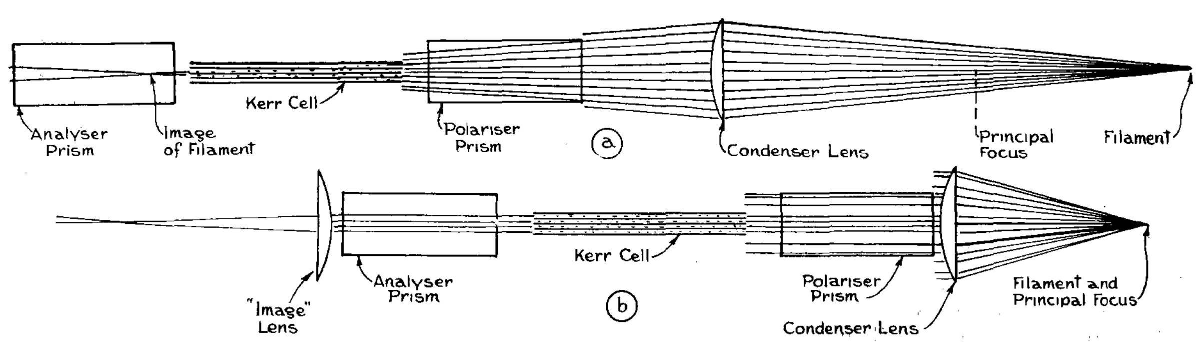


Fig. 1.—Two optical layouts showing (a) the usual commercial arrangement and (b) the method adopted in the unit described.

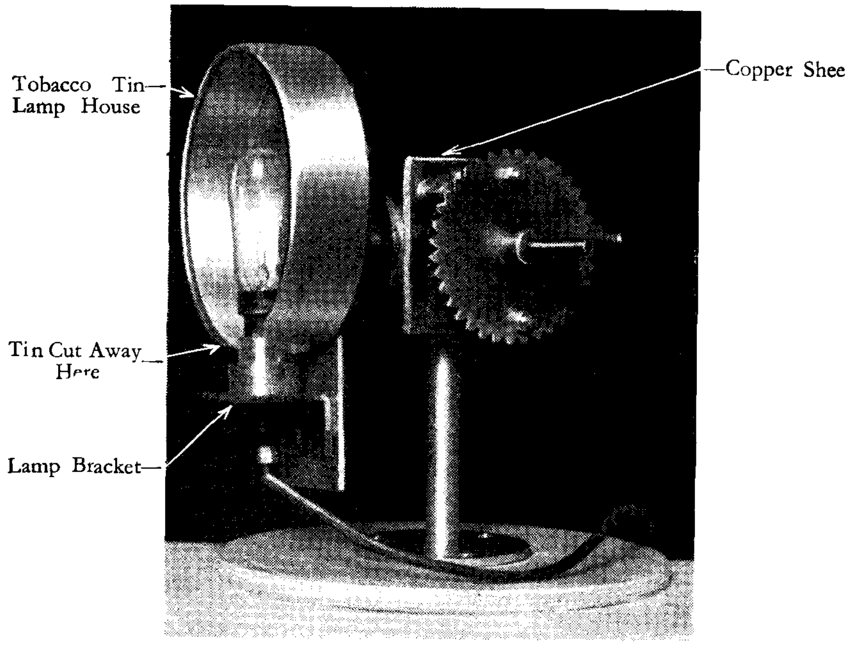


Fig. 3.—General view showing lamp house open and lamp inside.

than 30 to the inch. Thirty-two were actually used, this number being convenient on an 8-thread lead screw lathe.

The Nicol prisms are each wedged in with four thin pieces of cork, while the lenses are held with a springy wire washer, w in the diagram.

The square cell chamber was made of 1/16-in. thick brass strip 1½ ins. wide, which was considered too thin to cut a thread in, so two brass blanks 1¼ ins. diameter ⅛ in. thick, were first bolted on to the two side pieces, and after being drilled and bored, the necessary threads were cut. The four brass sides were then firmly clamped and soldered up. One side was left open, while the other was partly closed by a sheet of copper, which, however, had a round hole in it, so as to allow the Kerr cell to be fitted and be bolted in.

As this method fixed the position of the cells relative to the prisms, and therefore could not be lined up very well, it was decided to make the cell adjustable. Turning to Fig. 2, this was done by bolting two rods on to the cell mount AA which were brought out to a disc (a Meccano sprocket wheel) and bolted on. This disc can slide along or rotate on a fixed rod B, the rod being fixed to a brass cross-piece C, which in turn is fixed to the sheet copper side.

The lamp holder consists of another piece of the same strip brass similarly bushed with a brass blank and provided with a thread. The lamp bracket and lamp holder are self evident. The lamp holder can be raised or lowered by screwing it in the bracket, while a slit in the bracket allows of further adjustment. A side to side motion is obtained by swinging the lamp bracket on its locking screw. The lamp, being centre contact type contact is made by the spring pushing the centre stud up against the lamp terminal. The lamp-house was made from a tobacco tin, the design being taken from a home-cinema projector. The stand was made from ⅜ in. rod, screwed top and bottom.

To line up, first centre the lamp filament with the lens. To do this it is not necessary to have the polariser screwed into the cell chamber. When the light is centred, screw the mount in or away from the lamp until the light is parallel, then lock in this position with the lock screw. Screw the lamp and mount in the chamber, open the analiser and adjust the cell for best position by looking through the assembly at the light. When satisfied, cross the analyser, by rotating its mount, which extinguishes the light. It must not be forgotten that the polariser must be in the proper position for the polarised light to be rotated by the cell.

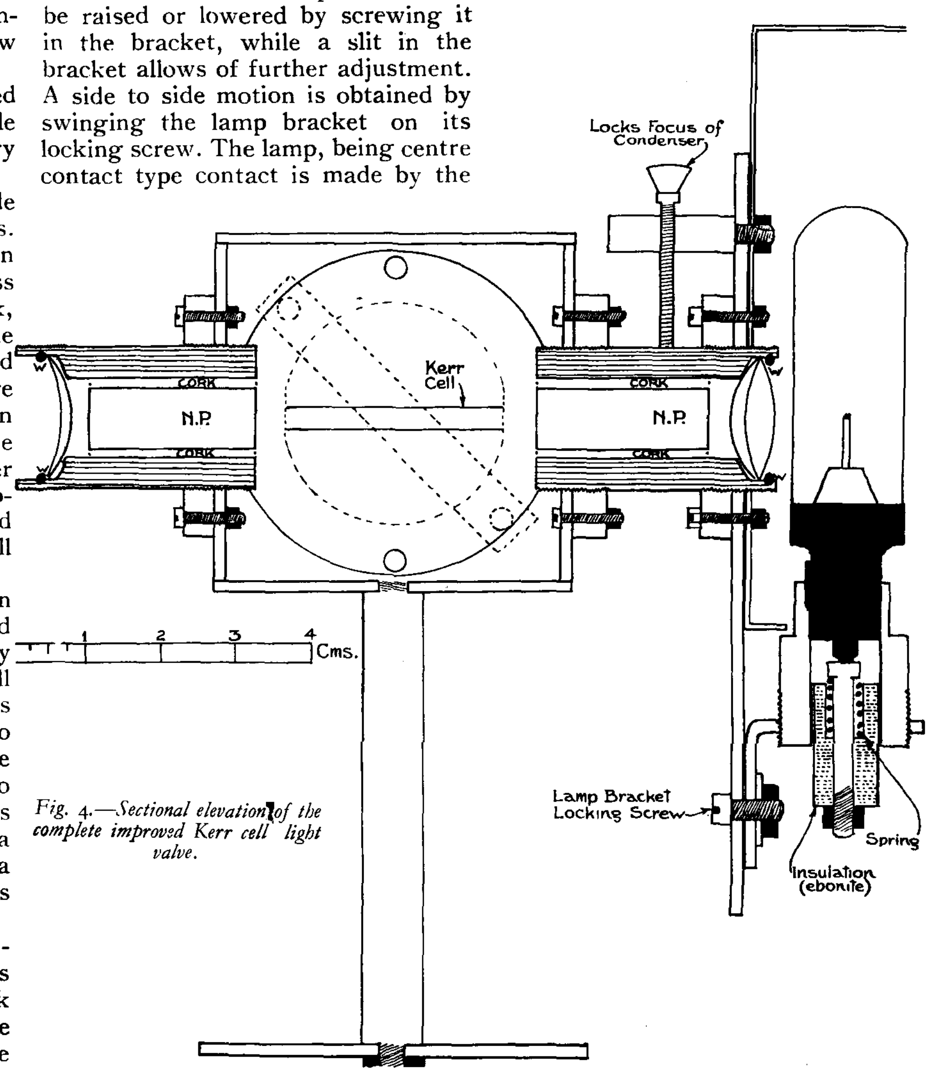


Fig. 4.—Sectional elevation of the complete improved Kerr cell light valve.

HIGH-DEFINITION TELEVISION FROM THE ALEXANDRA PALACE

DETAILS OF THE SIGNALS RADIATED BY THE BAIRD COMPANY'S APPARATUS

This information is given in accordance with the contract between the B.B.C. and Baird Television, Ltd., to enable manufacturers to design receivers suitable for receiving the high-definition television transmissions from the Alexandra Palace.

Waveform

THE accompanying drawing gives complete details of the waveform for picture modulation and synchronising impulses. From this it will be seen that, using the arbitrary aerial current units of zero to 100, the total modulation for synchronising (black) extends between the tolerance limits of zero to 5 and 37.5 to 42.5, while the picture modulation (black to white) extends between the tolerance limits of 37.5 to 42.5 and 100.

It will be noted that the high-frequency synchronising impulse is rectangular in shape and is maintained for 8 per cent. of the total time taken in tracing the line, and occurs between the *line* traversals. The low-frequency synchronising impulse, which is also rectangular in shape, is maintained during the time that 12 lines are traced, and occurs between the *frame* traversals. These traversals, as seen by an observer looking at the received image from the front, scan from left to right (line), and from top to bottom (frame).

The diagram also shows that, in addition to the above 8 per cent. of the line traversal time occupied by the high-frequency synchronising impulse, a further 2 per cent. is masked off to form a black edging. Similarly, an additional 8 lines are masked off in the case of the low-frequency synchronising impulse for the same purpose.

Additional Details

The total number of lines in the complete picture is 240, scanned sequentially and horizontally at 25 picture traversals per second and 25 complete frames per second. The line-frequency is thus 6,000 impulses per second and the frame-frequency 25 impulses per second. The dimensions of the observed picture have the ratio of 4 horizontal to 3 vertical.

Amplitude modulation is employed, which results in light intensity modulation in the observed picture, the transmitter carrier increasing towards the white. The line synchronising signals and the frame synchronising signals are in the sense opposite to increasing picture modulation. The maximum frequency band involved in the transmission is 2 megacycles and the average component of light in the picture is transmitted, a black in the picture being transmitted as black and a white transmitted as white, in accordance with the modulation percentages referred to above.

SPECIFICATION OF THE RADIATED WAVEFORM OF THE MARCONI-E.M.I. SYSTEM

The following information is also given in accordance with the conditions of contract outlined above and relates to the Marconi-E.M.I. high-definition television system.

THE Marconi-E.M.I. television system transmits 25 complete pictures per second each of 405 total lines. These lines are interlaced so that the frame and flicker frequency is 50 per second. The transmitter will radiate signals with sidebands extending to about 2 megacycles either side of the carrier-frequency. Good pictures can be received utilising only a fraction of the radiated band, but naturally the quality of the received picture will depend upon the degree to which the receiver makes use of the transmitted band width. The transmitted waveform is shown on Fig. 1.

(1) *Line Frequency.*

10,125 lines per second, scanned from left to right when looking at the received picture.

(2) *Frame Frequency.*

50 frames per second, scanned from top to bottom of the received picture.

(3) *Type of Scanning.*

The scanning is interlaced. Two frames, each of 202.5 lines, are interlaced to give a total of 405 lines with a complete picture speed of 25 per second. The line component and the frame component of scanning are regularly recurrent, the interlace being derived from the fractional relationship between line and frame frequencies. An explanation of the method of interlacing is given at the end of this specification.

(4) *Interval Between Lines.*

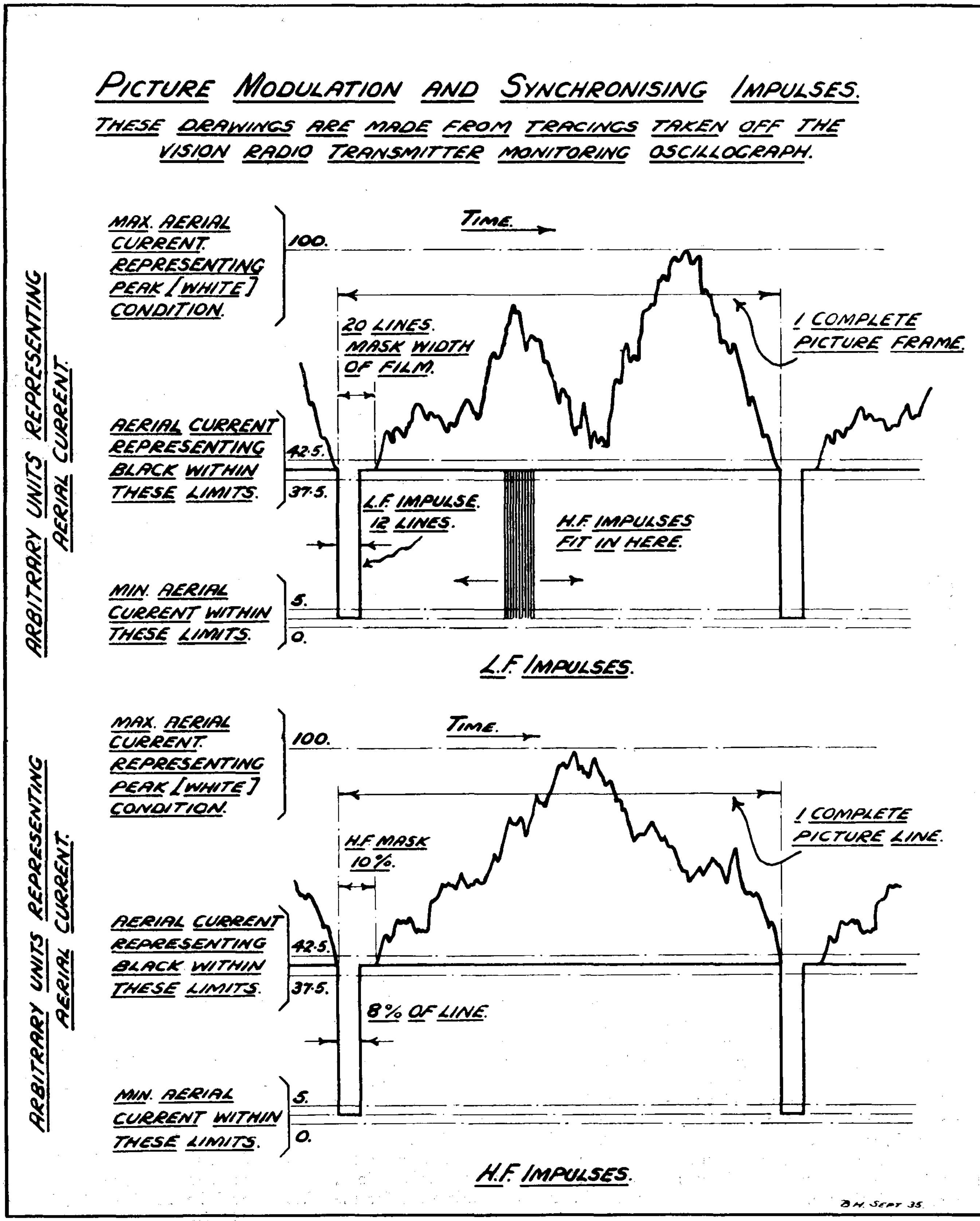
There will be intervals between the vision signals of successive lines, which intervals provide time for the transmission of a line synchronising signal and also provide time for the return of the cathode-ray beam to the beginning of the next line. The minimum interval between the vision signal of successive lines will be 15 per cent. of the total line period (1/10,125 second), the first 10 per cent. of this interval between lines being occupied by the line synchronising signal and the remaining 5 per cent. by a signal corresponding to " black " in intensity. The remaining 85 per cent. of the total line period is available for transmitting vision signals.

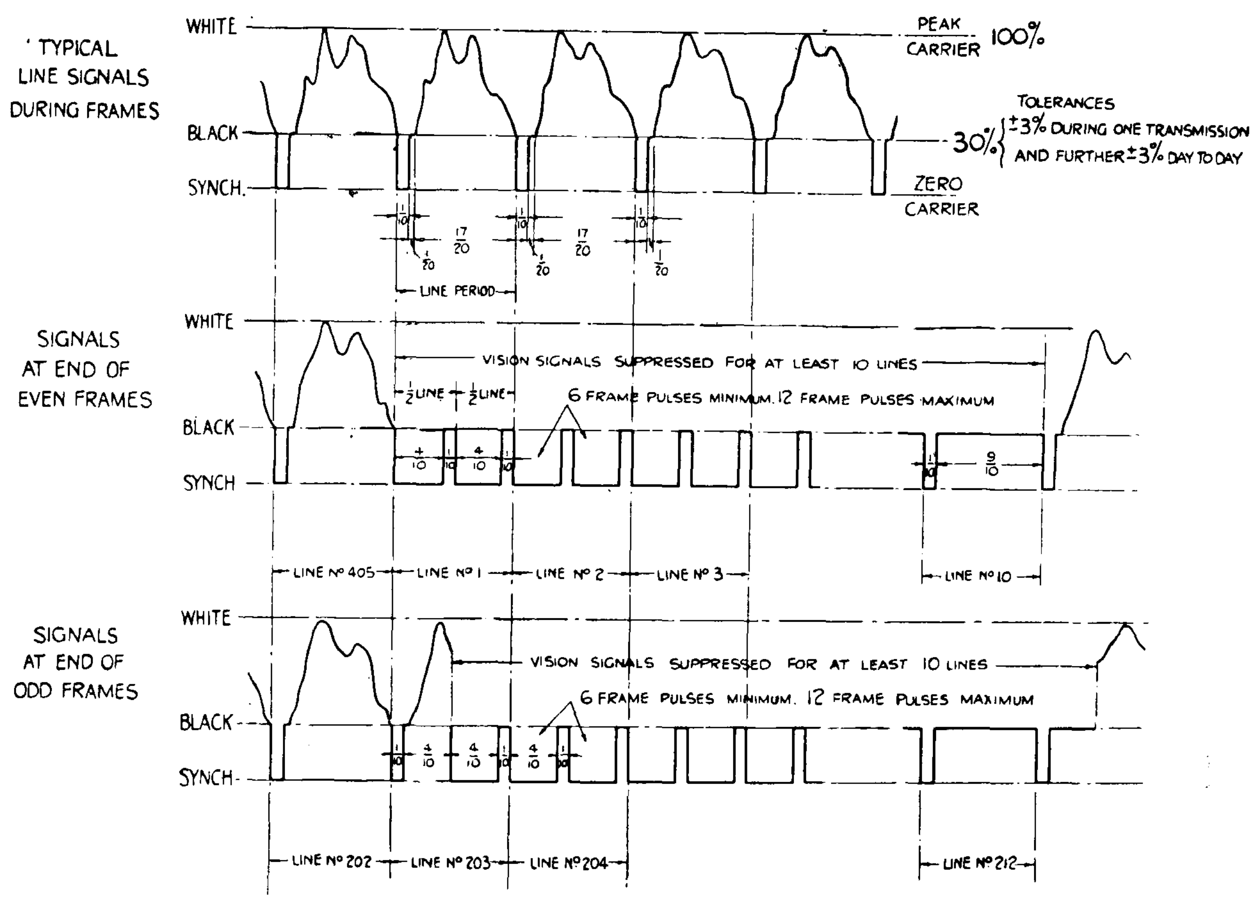
(5) *Interval Between Frames.*

There will be intervals between the vision signals of successive frames. The minimum interval between frames will be 10 lines, leaving a

(*Continued on page* 634)

THE BAIRD HIGH-DEFINITION SYSTEM





MARCONI E.M.I. TELEVISION SYSTEM
TRANSMITTED WAVE FORM.

FIG. 1.

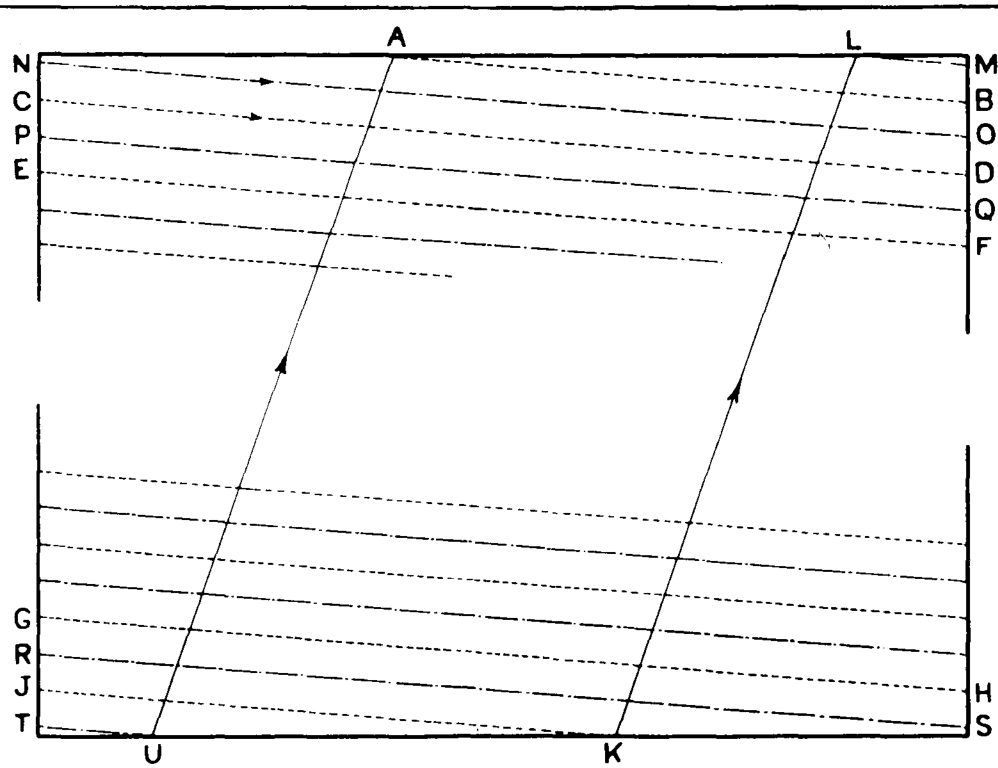


FIG. 2.

maximum of 192.5 active lines per frame, or 385 active lines per complete picture.

(6) *Picture Ratio.*

The picture ratio will be 5:4, that is to say, the distance scanned during the active 85 per cent. of the total line period will be 5/4 times the distance scanned during the 192.5 active lines of the frame.

(7) *D.C. Modulation.*

The picture brightness component (or the D.C. modulation component) is transmitted as an amplitude modulation so that a definite carrier value is associated with a definite brightness. This has been called "D.C. working," and results in there being no fixed value of average carrier, since the average carrier varies with picture brightness. The radio frequency transmitter output is specified in what follows as a percentage of the peak output. This percentage is in terms of current (or voltage) and not in terms of power.

(8) *Vision Modulation.*

The vision modulation is applied in such a direction that an increase in carrier represents an increase in picture brightness. Vision signals occupy values between 30 per cent. and 100 per cent. of peak carrier. The amount by which the transmitted carrier exceeds 30 per cent. represents the brightness of the point being scanned.

(9) *Synchronising Modulation.*

Signals below 30 per cent. of peak carrier represent synchronising signals. All synchronising signals are rectangular in shape and extend downwards from 30 per cent. peak carrier to effective zero carrier.

(10) *Line Synchronising Signals.*

The line synchronising signals are of one-tenth of a line duration, and are followed by a minimum of one-twentieth of a line of black (30 per cent. peak) signal.

(11) *Frame Synchronising Signals.*

The frame synchronising signals comprise a train of two pulses per line, each occupying four-tenths of a line and having one-tenth of a line interval of black (30 per cent. peak) signal between them. At the end of even frames, the first frame pulse starts coincident with what would have been a line signal. At the end of odd frames the first frame pulse starts half a line after the preceding line signal. At least six frame signals will be transmitted at the end of each frame, but the number may be increased to any number up to 12 pulses (6 lines). During the remainder of the intervals between frames, normal line synchronising signals will be transmitted with black (30 per cent. peak) signals during the remaining nine-tenths of the line.

It will be noted that throughout the interval between frames (as during the whole transmission) the carrier falls from 30 per cent. to zero regularly at line frequency and in phase with the beginning of the normal line synchronising pulses.

(12) *Variations in Transmitted Waveform.*

The 15 per cent. interval between vision signals of successive lines, and the 10 lines interval between successive frames are minimum intervals used at the transmitter. During the initial development of the transmitter, certain transmissions may have longer intervals between lines and between frames, which lengthened intervals correspond to the transmission of a black border round the picture.

The 30 per cent. carrier is the "black level" below which no vision signals exist and above which no synchronising signals extend. The mean black level of any transmission will be 30 per cent. ± 3 per cent. of peak carrier. The black level during any one transmission will not vary by more than 3 per cent. of peak carrier from the mean value of that transmission.

The residual carrier during the transmission of a synchronising pulse will be less than 5 per cent. of the peak carrier.

The line frequency and the frame frequency will be locked to the 50-cycle mains, and therefore will be subject to the frequency variations of the mains.

Explanation of Method of Interlacing

The method of interlacing is shown in the drawing in Fig. 2, which represents the top and bottom portions on the scanned area with the distance between the lines very much enlarged. The lines show the track of the scanning spot which moves under the influence of a regular downward motion (frame scan) with quick return and a regular left to right motion (line scan) with very quick return (not shown on drawing). The combination of these motions produce the slightly sloping scanning lines. Starting at A, not necessarily at the beginning of a line, the spot completes the line A B, returns to the left and traverses line C D, then E F and so on down the "dotted" lines on the drawing. At the bottom of the frame the spot travels along line G H and then starts at J and travels to K. At this point the return stroke of the frame motion begins and returns the spot to L at the top of the frame. A complete frame scan has now been made since leaving A, so that 202½ lines have been completed, and the point L is half a line away from A. The downward frame motion now starts again causing the spot to travel along L M completing a single line motion J K L M. The spot then returns to the left and traces out line N O, which due to L being half a line ahead of A, will lie between lines A B and C D. Similarly the next line P Q will lie halfway between C D and E F. The spot now traces down the chain dotted lines to R S and finally traces out T U, at which latter point the frame return causes the spot to rise again to the top. When the spot reaches the top it will have completed two frames, since leaving A, and, as two frames occupy the time of exactly 405 complete lines, the spot will return exactly to A, after which the cycle begins again.

From the foregoing, it will be seen that the complete picture is scanned in two frames, but as each frame contains an integer number of lines, plus a half, the two frames will interlace. The system does not rerequire the short return times shown for the line and frame scans, nor need the lines begin in the positions shown. Provided the line and frame traversals are regularly recurrent and have the correct frequency ratio (two frames = odd number of lines), an interlaced picture will be obtained.

A Simple Explanation of The Official Specifications appears on the next page.

South London and District Radio Transmitters Society.

On Wednesday, November 6, Mr. J. G. Chisholm—G2DX—is to deliver a lecture entitled the "History and Organisation of Amateur Radio." On November 15 the Society is paying a visit to the B.B.C. station at Droitwich.

Visitors and prospective members are welcomed to the Society meetings held on the first Wednesday of every month at the Brotherhood Hall, Knights Hill, West Norwood, S.E.27. The lectures commence at 8 p.m.

A SIMPLE EXPLANATION OF THE OFFICIAL SPECIFICATIONS

THE specifications given on the preceding pages may at first sight appear rather complicated and confusing to the amateur, but then no one is used to these things—indeed they may be said to be the first complete specifications of a television transmission. Neither when the old 30-line system was first broadcast in 1929 nor at any period during the six years of its life was there published by those responsible for it any such detailed particulars. Had there been we might now be more prepared for these just issued. However, let us examine and try to interpret them to the extent to which they will affect the average amateur and home-constructor. Where possible we will make appropriate comparisons with the 30-line system with which everyone is familiar.

The Marconi-E.M.I. System

Taking the Marconi-E.M.I. system first as being the more complicated, it is stated that this system transmits 25 complete pictures per second, each of 405 lines. This, of course, is perfectly straightforward and replaces the $12\frac{1}{2}$ pictures per second, 30-lines specification of the old system. "These lines are interlaced so that the frame and flicker frequency is 50 per second." Articles have already appeared in this journal explaining what is meant by interlacing and how it works,* and readers who are unaware of its nature are advised to refer to the issues in which these appeared, while there is also an extra explanation at the end of the specification. Then we are told that there will be 2 megacycle sidebands, i.e., 2,000 kilocycles. The 30-line system provided sidebands of approximately 13 kilocycles, which is about 1/150th of the new figure, but as the new wavelength to be used is 6.6 metres, the proportion is quite reasonable, and we shall soon get used to a sideband which itself is a high enough frequency to be a carrier wavelength for sound!

With a lesser maximum sideband frequency, which might easily be the case with an improperly designed receiver, it is still possible to receive good pictures. This will be evident because our experience with 30 lines has taught us that there is some entertainment value even with a maximum frequency of 13 kilocycles. The definition of the picture is directly proportional to the frequency, so, for example, a maximum receiver response of 1 megacycle would give just one-half the detail obtainable with 2 megacycles. The latter is, presumably, the frequency which gives equal definition in both directions, and is about .4 of the "zero frequency."

The line-frequency (para. 1) of 10,125 is easily derived by multiplying the total number of lines by the pictures per second—$405 \times 25 = 10{,}125$. (It used to be $30 \times 12\frac{1}{2} = 375$).

* "Interlaced Scanning," by J. McPherson, "Television and Short-Wave World" July, 1935.
"Time Bases and Interlaced Scanning," by J. McPherson, "Television and Short-Wave World," September, 1935.

The frame-frequency (para. 2) becomes double the picture-frequency by the interlacing process. Then follows in para. 3 a brief explanation of the "Type of Scanning," viz., interlacing. Obviously, each frame will have half the total number of lines, i.e., 202.5 lines.

Intervals between lines are necessary for the transmission of synchronising impulses. This was also the case in the 30-line system when about 10 per cent. of each line was cut off, forming a synchronising pulse and making a black band across the top of the image. In the present case it is stated (para. 4) that the interval will be 15 per cent., so that the "remaining 85 per cent. of the total line period is available for transmitting vision signals."

Those who are not yet "cathode-ray minded" have got to get used to the idea of two synchronising frequencies, line and frame. The old mechanical systems needed only one, the line frequency (375 cycles with the 30-line system) because, being mechanically coupled, the picture or frame could not help being in synchronism provided the lines were. The frame-frequency was determined by the rate of rotation of the mirror-drum, and so was the line-frequency which the number of mirrors on the drum automatically arranged. The worst that could be wrong when the motor was running at synchronous speed was an out-of-phase (out-of-frame) effect easily remedied by rotating the carcase of the motor. Thus it was only necessary to transmit one synchronising frequency, the line-frequency.

But we find a different state of affairs when we consider the cathode-ray tube. We have two pairs of deflector plates, one pair for making the lines and the other for the frames. But there is no mechanical or electrical coupling between them and it would be quite possible to have one pair working without the other. To make them provide a line screen we have to apply separate frequencies to each pair and in order to ensure that these two frequencies are both of exactly the correct value each has to be controlled or synchronised by special impulses sent from the transmitting end along with the image signal.

The Two Synchronising Impulses

If we tried to adhere to the old method of using only one kind of synchronising impulse we might easily find the tube scanning at the right speed with the wrong number of lines!—an impossible condition, of course, with mechanical scanners. Thus in order to ensure that televiewers with cathode-ray receivers will be able to operate them satisfactorily both systems have made provision for the two required synchronising frequencies. In the case of the line-frequency this is achieved, as already pointed out, by sacrificing a certain percentage (15) of each line.

Similarly, the frame frequency necessitates encroaching on a portion of each frame, a minimum (para. 5) of nearly 5 per cent. This corresponds to 10 lines per frame, or 20 per complete picture. In order, therefore, to ensure correct synchronisation, we have lost 20 lines out of 405, and 15 per cent. of each line; in other words, about 20 per cent. of the image size is cut.

Passing on to the other details of the specification, we find in para. 6 that the picture ratio is to be 5:4. The scanning is horizontal and the observed image will be five units in width by four in height. This contrasts with the very different shape of the 30-line image which used to be one unit wide by just over two in height.

Para. 7 is an important one and introduces another new conception compared with the old technique, viz., "D.C. working." This was foreshadowed in a previous article to which the reader is referred.* What it means, briefly, is that the average brightness of an image is transmitted, so that at the receiving end pictures having different average brightnesses at the studio end will not all appear to have the same, which used to be the case with the old 30-line system.

transmitting the sychronising impulses, and so it is arranged (para. 8) that the minimum vision carrier strength, corresponding to a black, be 30 per cent. of the maximum 100 per cent. The remainder of the carrier strength (para. 9) from zero to 30 per cent. is used for fitting in the synchronising pulses, clearly shown in the diagrams. Incidentally, this is an ideal arrangement because there is no confusion whatever between vision and synchronising pulses which was always a trouble with the 30-line system when the synchronising pulses and "black" vision strength was exactly the same, the synchronising in consequence being sadly impaired.

Paragraphs 10, 11 and 12 are more technical elaborations of paragraphs 4 and 5, and for the present the reader will probably have had enough information to digest. There follows an explanation of the method of interlacing which should be studied.

We come now to details of the Baird wave-form, which are found to be remarkably similar to the Marconi-E.M.I., and we need not go into further explanations but rather compare the one with the other. We first see that the synchronising impulses are transmitted in the same way and that approximately 40 per cent. instead of 30 per cent. of the carrier strength corresponds to no vision modulation, i.e., black.

SUMMARISED INFORMATION.

PARTICULARS.	SYSTEM.	
	BAIRD.	MARCONI—E.M.I.
Number of lines (nominal)	240	405
Number of lines (effective)	220	385
Type of Scanning	Sequential	Interlaced
Ratio—Width : height	4 : 3	5 : 4
Frame and flicker frequency	25	50
Picture frequency	25	25
Line frequency	6,000	10,125
Method of modulation	Amplitude, with carrier. value prop. to D.C. component	Amplitude, with carrier. value prop. to D.C. component
Carrier limits for vision	Approx. 40 to 100% of carrier value	Approx. 30 to 100% of carrier value
Carrier limits for synch.	Approx. 0 to 40% of carrier value	Approx. 0 to 30% of carrier value
Number of line synch. impulses	1 between each line	1 between each line
Portion of line occupied by synch. impulse...	10%	15%
Number of frame synch. impulses	1 between each frame	6-12 between each frame
Portion of frame occupied by synch. impulses	8.3%	approx. 5%
Maximum frequency band	2 megacycles	2 megacycles

A convenient way of transmitting a component proportional to the average brightness, which, of course, varies continually from picture to picture, is to make the strength of the carrier current so proportional. It is quite a new idea, because with sound or the 30-line broadcasting the carrier would still go on radiating even if no modulation at all were being applied; now when the modulation ceases the carrier drops to a low value, though not to zero as the next paragraph explains. A bright picture will send up the carrier strength more than a dull one, and if at the receiving end we make the rectified carrier current operate the biasing potential of the cathode-ray tube or other modulating device we can secure the proper contrasts.

Some of the carrier, however, has to be reserved for

Then it is stated that 10 per cent. of each line is curtailed in order to fit in the line synchronising impulses (as compared with 15 per cent. in the case of E.M.I.), while 20 lines, i.e., 8.3 per cent. of a frame, are lost while the frame synchronising takes place (as compared with 20 and 5 per cent. respectively). Therefore, 18.3 per cent. (compared with approximately 20 per cent.) of the image space is sacrificed for accommodating the synchronising pulses. The total number of lines is 240, *non*-interlaced, so that both picture and

(*Continued on page* 688)

* "There is something Lacking in Television," by J.McPherson, "Television and Short-Wave World," August, 1935.

All waves

* * *

A.C.—D.C.

* * *

110-250 *volts*

* * *

Any frequency A.C. mains

* * *

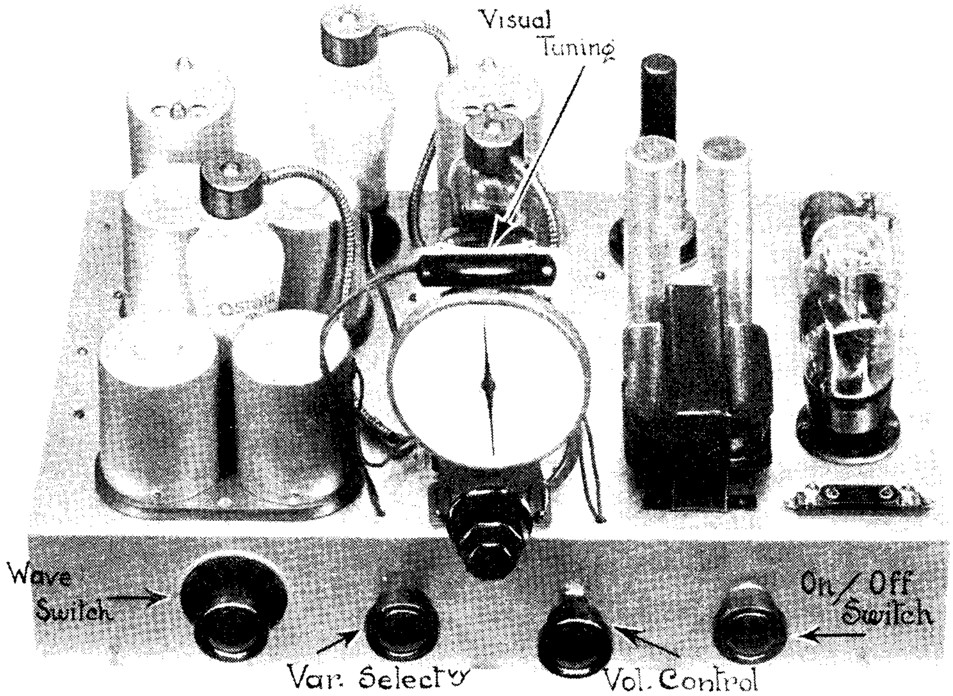
Single-dial control 16—2,000 *m.*

* * *

Four Bands

* * *

Aero Dial



Diode detector 5—9 *Kc. Selectivity*

* * *

Visual Tuning

* * *

Gramo Pick-up

* * *

No Transformers

* * *

3 *Watts Output*

* * *

R.C. Coupling

* * *

Five Valves

The Advance All-waver

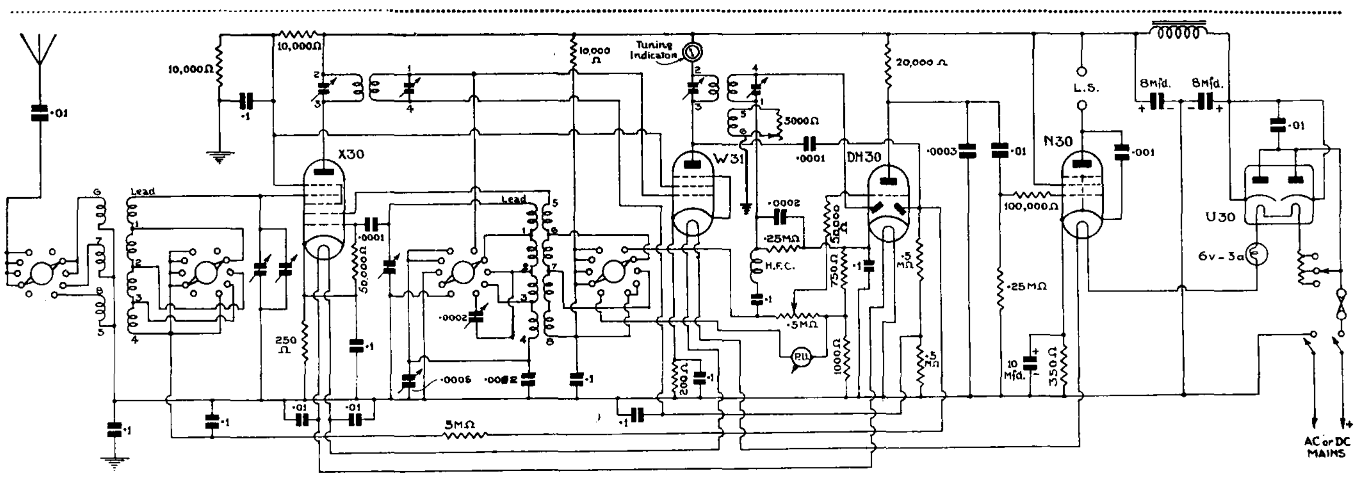
This receiver for the home-constructor has been designed on commercial lines. It has all the features to be found in advanced commercial all-wave sets and can be built quite cheaply. No special components are required.

ONE of the most important developments in commercial set design this year has been the introduction of all-wave receivers of an ambitious type. Every would-be buyer of a new set has inquired as to the possibilities of an all-waver so that American and other interesting programmes could be received.

Constructors who like to build their own receivers have complained that no set design was available to cover a receiver having all the features embodied in commercial sets.

We have been experimenting for some considerable time on a receiver on these lines which would not cause the constructor any difficulty in building. At the same time, all the very necessary features, such as variable selectivity, visual tuning, automatic volume control and so on, would have to be included. Special components make a receiver expensive to build. All of these points had to be carefully considered before the receiver was designed. Finally we evolved a circuit which has been well tried and is reasonably flexible, so that small variations in component characteristics do not upset the performance.

The Advance All-waver uses five 13-volt A.C./D.C. valves. The aerial feeds into a coupling and grid coil which are across the grid cathode circuit of an X30 heptode. This valve combines the functions of oscillator and first detector in the most efficient manner. Once and for all it completely overcomes the need of voltage adjustment in the detecctor-oscillator circuit as with other types of valve.



The circuit clearly emphasises the numerous outstanding features of this all-wave superhet.

The circuit actually is the feature of the receiver. Four coils connected across a four-section switch, each section with ten contacts, enable the receiver to be switched from 15 to 2,000 metres in four wavebands.

From the anode of the X30 the signal is fed into an I.F. transformer wound with Litz. wire, which, by virtue of its construction, is far more efficient than the ordinary type of transformer wound with solid wire. The transformer is suitable for frequencies of between 450 and 465 kc. and can be adjusted by simply balancing up the trimmers mounted in the coil can.

The second valve is a W31 high-frequency pentode, which is A.V.C. controlled with the X30. This gives automatic-volume control on two stages and accounts for the fact that as far as A.V.C. is concerned the receiver is almost 90 per cent. effective on medium and long waves, and about 75 per cent. effective on short waves. This is a very high degree of efficiency.

In the anode circuit of the I.F. amplifier is the visual tuning meter. It consists of a special type of low-reading milliamp meter, swinging from zero towards maximum as the station is tuned in. By means of this meter it is impossible wrongly to adjust the set, so that quality is always of a high order.

The second I.F. transformer calls for special attention. Normally, the receiver has a band width of 9 kilocycles, sufficient to deal with the present congested state of the ether, and enables all stations which adhere to the Lucerne Plan to be tuned in without interference.

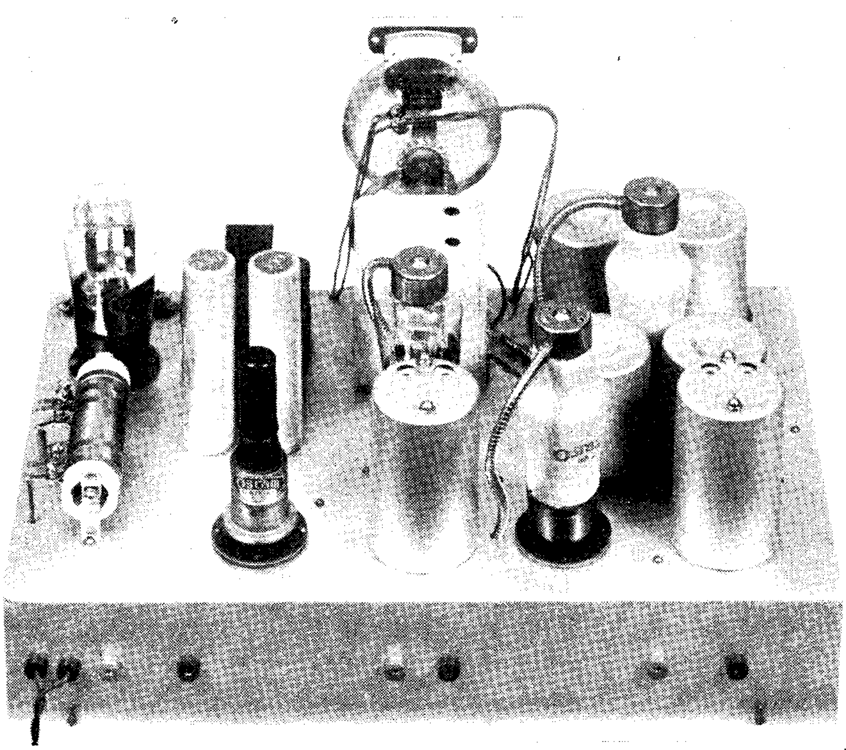
With the variable selectivity device brought into operation, the selectivity can be increased up to 5 kilocycles, so that when two stations are too close together they can be separated without much difficulty. We do not like the manual control of selectivity where a secondary coil is rotated so that the coupling between it and the primary is decreased. This only gives a very rough control. The coils we have used have a third winding which is shunted by a fairly low resistance potentiometer, and by varying this resistance the selectivity can be adjusted between 5 and 9 kc. in fine steps.

Double-diode-triode valves are rather inclined to be viewed with suspicion, but the modern valve of this type when used with the correct circuit is absolutely fool-proof, and, as it has three electrode systems in one bulb, it would be the ideal valve for the purpose.

The output from the second I.F. transformer is fed into one diode used as a speech detector. It is common knowledge that to obtain perfect rectification in a modern high-gain set, diode detection has to be used. The second diode is used to supply automatic volume control bias to the grids

Components for the Advan ce All-waver

CHASSIS.
1—aluminium 16 × 10 × 3 (Peto-Scott).
CABINET.
1—special console (Peto-Scott)
CHOKE, H.F.
1—H.F.P.J. (Wearite)
CHOKE, L.F.
1—30-henry 60-m/a. (Bryan Savage).
COILS.
1—C52 (Bulgin).
1—C53 (Bulgin).
CONDENSERS, FIXED.
2—.0002-mfd. type M (T.C.C.).
2—.0001-mfd. type M (T.C.C.C.).
1—.001-mfd. type M. (T.C.C.).
1—.0003-mfd. type M (T.C.C.).
3—.01-mfd. type tubular (T.C.C.).
1—10-mfd. type C (T.C.C.).
10—.1-mfd. type 300 (T.C.C.).
1—.01-mfd. type 300 (T.C.C.).
1—.02-mfd. type 300 (T.C.C.).
2—8-mfd. type 502 (T.C.C.).
CONDENSERS, PADDING.
1—.0002-mfd. (J.B.).
1—.0005-mfd. (J.B.).
CONDENSERS, VARIABLE.
1—.0005-mfd. 2-gang type 2121 (J.B.).
DIAL, SLOW-MOTION.
1—Aero type with trimmer (J.B.).
HOLDERS, FUSE.
1—½-amp. (Microfuse).
Holders, Valve.
5—7-pin chassis mounting type V2 (Clix).
KNOBS.
1—set of five matched knobs type K40 (Bulgin).
LOUD-SPEAKER.
1—Stentorian Baby (W.B.).
METER, TUNING.
1—magnetic tuning meter type VT50 (Bulgin).
PLUGS, TERMINALS, ETC.
8—insulated sockets type 11, and plugs type 12 (Clix).
RESISTANCES, FIXED.
3—10,000-ohm 1-watt (Erie).
3—.5-megohm 1-watt (Eric).
2—50,000-ohm 1-watt (Erie).
1—250-ohm 1-watt (Erie).
1—200-ohm 1-watt (Erie).
1—350-ohm 1-watt (Erie).
1—750-ohm 1-watt (Erie).
1—20,000-ohm 1-watt (Erie).
2—.25-megohm 1-watt (Erie).
1—100,000-ohm 1-watt (Erie).
1—500-ohm 1-watt (Erie).
RESISTANCES, VARIABLE.
1—5,000-ohm potentiometer (Varley).
1—.5-megohm (Reliance).
1—mains resistance to specification (Bulgin).
SUNDRIES.
1—insulated coupling piece (J.B.).
3—shielded anode connectors (Belling Lee).
3—coils Quickwire (Bulgin).
Quantity 6 B.A. nuts and bolts (Peto-Scott).
SWITCHES.
1—SL22 (Bulgin).
1—S88 (Bulgin).
TRANSFORMERS, I.F.
1—C50 (Bulgin).
1—C51 (Bulgin).
VALVES.
1—X30 (Osram).
1—W31 (Osram).
1—DH30 (Osram).
1—N30 (Osram).
1—U30 (Osram).



Neat construction and commercial set appearance are two of the major points in this receiver.

A full-size Blueprint of the Advance All-Waver is available, price 2/6 of the W31 and X30, while the triode section of the valve is a normal resistance-coupled low-frequenccy amplifier.

A gramophone pick-up can be connected in the grid circuit of this DH30, while the volume control across it operates on both radio and gramophone without alteration. The anode of the DH30 is then R.C. coupled to an N30 steep slope pentode giving an output of over 3 watts.

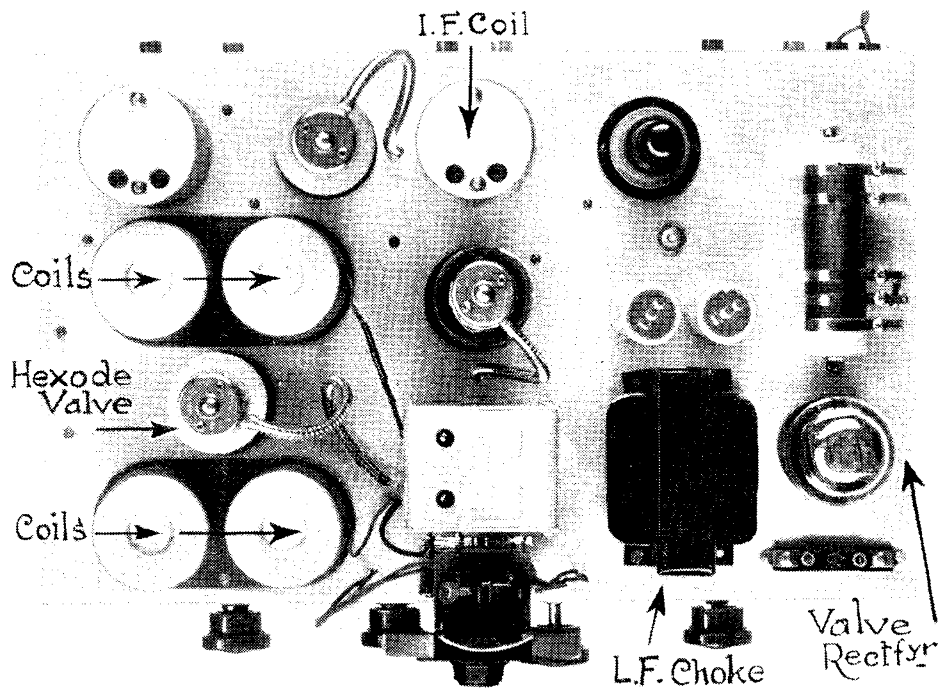
Finally, comes the full-wave U30 rectifier. This valve is so coupled that

All wave changing is accomplished by means of one calibrated switch which is also used to cut out the radio side of the receiver and link up the gramophone pick-up. Providing the pick-up has an output of more than .5 volt R.M.S. it is suflcient to load the DH30 so as to obtain over 3 watts output from the N30. If a needle armature type pick-up is used an input transformer for voltage step-up will be required.

It is most important with an A.C./

can be out of line. As the receiver is so completely flexible in every way valve or coil variations can be taken up quite easily.

A fuse is in one side of the mains supply and this must be of a special type. It is a gold leaf Microfuse which is very sensitive to overloads, so that in case of errors in construction no damage to components can result. The mains voltage dropping resistance which is mounted parallel with the chassis has to be adjusted to either 110



This plan view shows how the components are laid out and the neatness of the visible wiring.

it acts as a half-wave rectifier on A.C. mains and will provide up to 120 milliamperes of D.C. current. When on D.C. mains it is more or less a passenfer and fulfills no useful purpose.

Although only five valves are used, as the X30 is a triode and a screened grid combined, and a DH30 is three valves in one, the receiver has the performance of what would normally be a conventional eight-valve super-het.

We have already been asked how it is that with all these undoubted refinements the receiver is so much cheaper than the nearest commercial equivalent. The reason is that by the use of A.C./D.C. valves and valves of certain characteristics, we have been able to omit the use of a mains transformer—a very expensive component, a low-frequency transformer and sundry other components such as various resistances and H.F. chokes. The number of resistances has been kept down to a very low number, while only one high-frequency choke has been used in the entire receiver. The output transformer has also been omited for this is embodied in the loud-speaker we specially chose to match up with the N30 output valve.

D.C. set of this kind that both aerial and earth be isolated from the receiver, and for this reason a .01-mfd. condenser is in series with the lead-in and a .1-mfd. in series with the earth lead.

As would be expected, it is almost impossible to obtain complicated coils of the type used to match up without some difficulty. So as to make quite sure that even a non-technical constructor will not have any difficulty—for ganging is always a problem—we have embodied one or two features to counteract even this possible difficulty to the constructor. First of all, the main tuning condensers do not require ganging. A small variable trimmer is fitted to the aero tuning dial and, if at any wavelength the condensers go out of step,. they can be balanced externally by means of this small trimmer. As the trimmer knob is concentric with the master tuner the extra control is not noticeable.

In addition to this, a .0002 mfd. and a .0005 mfd. trimmer are connected in series with certain sections of the oscillater coils, so that these can be adjusted before the receiver is put permanently into use thus making absolutely sure that throughout the whole set nothing

or between 200 and 250 volts, after which it need not be touched.

We cannot see where any difficulties will be encountered in the construction. The photographs show quite clearly the layout of the components, while a full-sized wiring blueprint can be obtained from our Blueprint Department at Chansitor House, 37/8 Chancery Lane, London, W.C.2, price 2s. 6d. The number is SW206.

Construction

First of all mount the valve holders. A 1-in. centre bit will cut out the holes in the aluminium quite easily. The coil units are fixed by nuts and bolts, but small holes have to be drilled underneath so as to enable the tag contacts to go through the chassis without touching. An oblong strip, one inch long by a quarter-inch wide, has to be cut out of the chassis beneath the tuning drive so that the trimming condenser does not foul. Controls are arranged symmetrically along the front of the chassis, but the holes for these are of the normal size and can be cut with a twist drill. Neither of the potentiometers need be isolated from

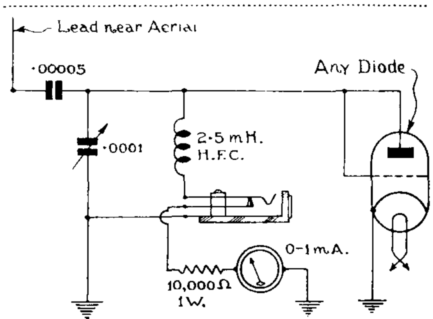
(Continued at foot of page 641)

The Short-wave Radio World

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

Over Modulation Indicator

WE were particularly interested in the linear rectifier used for determining the limit of modulation to which a phone transmitter can be operated described in *Radio* for September. In America the F.C.C. regulations call for some means of measuring the depth of modulation which must be in continual use. A well designed and adjusted phone will allow up to 100 per cent. modulation, although many amateur stations overmodulate before reaching 100 per cent.



Over modulation can be checked immediately with this simple meter.

This causes needless interference and is in the same category as bad keying.

The linear rectifier shown in Fig. 1 indicates the slightest amount of carrier shift or over-modulation. It uses a small variable condenser for adjustment of the meter deflection, while a 50-mfd. fixed condenser and 100-mfd. variable condenser form a variable attenuator for R.F. voltage. Capacity coupling is used for the aerial by simply running the lead from the unit close to the feeder.

Any type of diode or strapped grid-plate triode can be used, while the actual connections and supply are self-explanatory. The R.F. choke has an inductance of 2.5 mh. This type of over-modulation indicator must not be used with controlled carrier modulation transmitters.

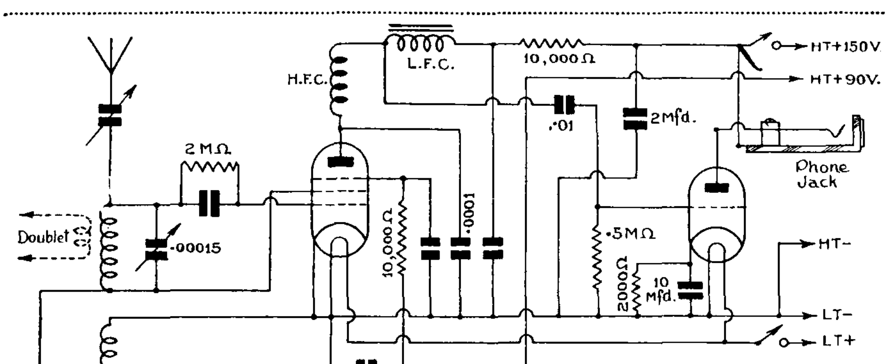
A Sensitive Receiver

The *Sydney Bulletin* (which is not actually a radio paper) published in their August 21 issue a simple two-valve receiver that can be constructed from English components.

It consists of a high-frequency pentode detector, such as a Mullard SP4, choke-capacity coupled to a triode output valve such as an AC/P. As the heaters are run from A.C. a filament transformer will be required giving 4 volts 2 amperes. High-tension can be obtained from batteries or a standard B.C.L. mains unit. The reaction coil is connected between cathode and chassis, while regeneration is controlled by means of a 50,000-ohms potentiometer which adjusts the voltage to the screen of the pentode. The L.F. choke in the anode of the detector is of the high-inductance type, such as the Varley DP16, which has an inductance of 300 henries at 10 milliamperes.

Although the coils can be purchased from Bulgin, Eddystone, or B.T.S., and are quite suitable without alteration, the following coil data should be of interest to constructors.

For wavelengths of between 15 and 32 metres, the grid coil is 5 turns, the cathode coil 4 turns, with a ⅛-in. gap between coils. 30 to 55 metres, grid coil 12 turns, cathode coil 4 turns, space between coils ¼ in. 50 to 90 metres, grid coil 24 turns, cathode coil 5 turns, with a ¼ in. gap between coils. 80 to 200 metres, grid coil 40 turns, cathode coil 7 turns, ¼-in. gap between coils. 26 gauge d.s.c. wire is used throughout, while the formers are of the standard four-pin variety. Provided that the receiver is built on a metal or metallised chassis hum will be entirely absent. We can recommend this type of receiver for the use of the beginner or for ham band use.



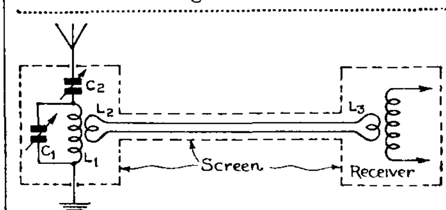
English made components can be used in this Australian two valve receiver.

Duplex Phone Working

W9CPW has a neat idea to improve duplex phone working. At the present time there seems more interest in this end of amateur radio than ever before. When listening to a long report very often details are forgotten which could not happen with duplex phone working. A shielded input tuning circuit does help very considerably to overcome grid blocking, and in view of the fact that the circuit is so simple it is well worth a trial.

Amongst the components required are two .00025 or .00035 mfd. BCL type tuning condensers, two dials and a plug-in coil former. This system is applicable to all bands and here are the details for 160 metres which is ideal for duplex working. Two turns of No. 20 rubber covered wire are used for the pick-up L2, placed 1/3rd of the way down from the aerial on L1. Connections from L2 run through a shielded two-wire cable in the aerial coil in the receiver. Naturally this aerial coil should be disconnected on its earthy side.

Good shielding of both receiver and duplex system is essential, the shielded cable connecting the common earth.

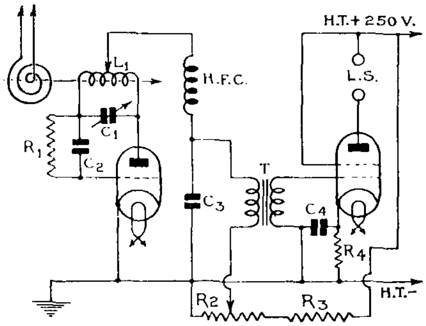


Duplex phone working is the centre of interest at the moment.

Length of aerial is more or less optional depending on the amount of grid blocking and sensitivity of the receiver. In the case of W9CPW a five-foot vertical wire is used, giving, of course, excellent selectivity with a reasonable signal level, but up to 20 feet could be used without any trace of grid blocking. The system is tuned by using a regular long receiving aerial connected directly to one side of the open aerial coil of the receiver. After a station has been tuned in, the volume control on the receiver is slightly advanced and the long aerial disconnected, so leaving the duplex system in operation. C1 across L1 is adjusted until maximum signal strength is obtained, C2 being set to about half capacity and tuned for sharpest signal after the required frequency has been obtained.

A 56-MC *Super Regen*

Five metres in America seem to be progressing very favourably, although we in this country appear to have superior receivers. Dwight Hill, W1HUV uses a very simple super-



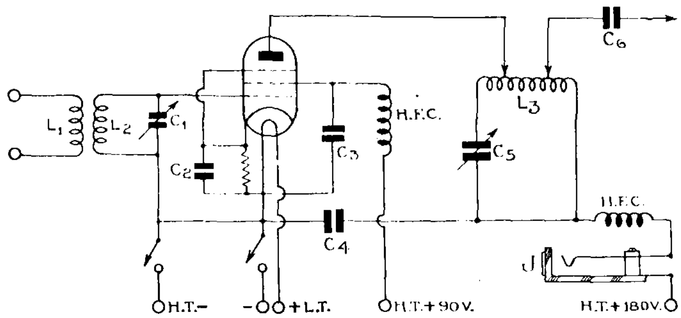
This is one of the simplest two valve 5 metre receivers we have seen so far.

regen. which is used pretty generally in Boston. The circuit is almost self-explanatory. The detector valve is a Hartley oscillator, transformer coupled to a conventional L.F. pentode. Selectivity is claimed to be higher than with a normal super-regen. but there are several points which must be remembered.

All earth connections must be brought to a single point on the chassis. The detector valve must be mounted horizontally with the anode pin soldered to the junction of the condenser and coil with just enough space between the grid pin and the other end of the coil to accommodate a midget grid condenser. The receiver should be considered unsatisfactory unless the detector operates with 25 volts or less on its anode. The aerial coil is a five-turn spiral with adjustable coupling to L1. C1 is 5-mmfd., C2 50-mmfd., C3 .002/.006 mfd., C4 10-mfd., L1 8 turns of 18-gauge wire ½-in. diameter, turns spaced the diameter of the wire. The H.F. choke consists of 45 turns, 26 gauge d.c.c. wire wound on a ¼-in. rod, after which the rod is removed. R1 as high as possible up to 10 megohms, R2 50,000 ohms potentiometer, R3 50,000 ohms fixed resistance, R4 2,000 ohms fixed resistance.

A Five-metre Pre-Selector

Radio frequency amplification on 5 metres does, at first, seem rather ridiculous, but R.F. gain at that frequency really is possible and naturally is very useful in front of either a superhet or super-regenerative receiver. W5XM, of Dallas, Texas, is using a 954 Acorn valve with which he obtains an audible increase in amplification on weak signals. The valve in use is one of the new Acorns which can be obtained from Claude Lyons, so removing any difficulty in construction.



R.F. amplification can be obtained down to 5 metres with circuit which uses an Acorn valve.

The circuit is sufficiently self-explanatory for the average amateur but construction requires a few comments. Grid and plate circuits must be carefully screened from one another otherwise the receiver will tend to oscillate due to feed-back. This screening is obtained by placing a metal " floor " or chassis half way up the cabinet and utilising the space beneath for the grid circuit and the space above for the anode circuit.

The valve is mounted on this floor with the grid terminal going down through a hole. R.F. chokes are wound on ¼-in. rods using 20 turns of 30-gauge single cotton-covered wire with slight spacing between turns. The rods are tapped at one end and screwed to the baseplate.

Under normal conditions anode current is between 1 and 2 milliamps, but if battery bias is used and the valve goes into oscillation this current rises to 20 milliamps. In the circumstances it is advisable always to include auto bias to prevent injury to the valve.

During tests with a 180-volt anode supply and 90 volt screen supply, a cathode resistance of 1,500 ohms was required. The Acorn valve has to be handled very carefully; input and output terminals must be well separated while all earth returns must be kept short and taken to a common point on the chassis.

"The Advance All-Waver"

(*Continued from page* 639)

the panels or bushed in any way, for we have taken the precaution of using components having dead spindles.

A most important component is the dial light. This is a 6-volt .3-amp. Osram bulb which is in series with the heaters of the five valves and comes between the rectifier and N30 heaters. This bulb is most reliable in use and it is folly to use a cheap bulb or one of the wrong amperage in this position.

Although none of the components are actually special types, no alternatives can be used in any position. The circuit, an intricate one, has been designed around the components used so that an unusually high degree of efficiency has been used.

Readers have asked for sets built on commercial lines, and we have obliged with this set which will be free from the usual constructor troubles providing it is built to specification. We have anticipated as far as possible the usual mistakes made by constructors and have designed the set so flexibly that the usual alterations in layout, etc., can be tolerated.

Sensitivity with 9 kilocycles separation is in the order of 1½ micro-volts per metre at 300 metres, but to obtain this sensitivity the receiver must be built exactly as the original model.

In case it has not been realised just what this receiver will do, commercial short-wave stations between 15 and 51 metres can be received on the loudspeaker, the American broadcasters on 16-, 19-, 25-, 31- and 49-metre bands can, according to our tests, and from outside tests, be received loud enough to be of entertainment value, while many amusing hours can be whiled away by listening to amateurs on the 20- and 40-metre band.

These stations are, of course, in addition to the usual run of medium- and long-wave broadcasters between 200 and 2,000 metres.

" A Guide to Amateur Radio," third edition, is now available, price 6d., from the Radio Society of Great Britain, 53 Victoria Street. It is the most comprehensive book dealing with short-wave technique published in this country, and those interested in short waves should make a point of obtaining a copy.

A very full explanation on all branches of short-wave radio is given, plus many other articles such as modern valves and their application, aerial systems, power supplies for short-wave transmitters, artificial aerials and frequency measurement. There are almost a hundred pages, all of which are of particular interest to short-wave fans.

KERR CELL DESIGN FOR 240-LINE OPERATION

By L. M. Myers

In view of the importance of the subject at the present stage we publish below the lecture given by L. M. Myers before the Television Society on April 10th, 1935, on the necessary modifications in Kerr cell design for high definition practice. This lecture is also published in the June issue of the Journal of the Television Society.

UP to the present time it has been considered most expedient to employ the Karolus multi-plate electrode cells for television pictures up to 100 lines. The limitations in the use of such Kerr cells are imposed by the internal capacity of the cell itself, and control must be possible for maximum picture frequency f_c.

This maximum picture-frequency is a product of the number of elements in the picture multiplied by the picture-frequency and divided by 2. This assumes a sinusoidal response to the transient engendered when the aperture of the transmitter passed over a sharp contour line in the picture detail. In practice it is not possible to interpret this transient in terms of fundamental frequency alone but, for the sake of convenience and in order not to introduce unnecessary complication, it will be assumed that the fundamental frequency brought about by this transient is the maximum picture-frequency.

Mertz and Gray, in the Bell System Technical Journal,* have shown that the frequency in the picture detail can be interpreted as a harmonic of the line frequency, so that the transient with which we are dealing as represented by the shift of the aperture over a sharp contour is representable by this maximum frequency, which is an upper harmonic of the line-frequency.

The capacity of the multi-electrode Kerr cell varies from 100 microfarads to 1,000 micro-micro-farads; thus the capacity reactance is too low for a frequency exceeding 100 kilocycles, which represents the maximum frequency of 100-line picture. When we come to 240-line pictures with maximum frequency in the order of 1 megacycle, the problem becomes acute.

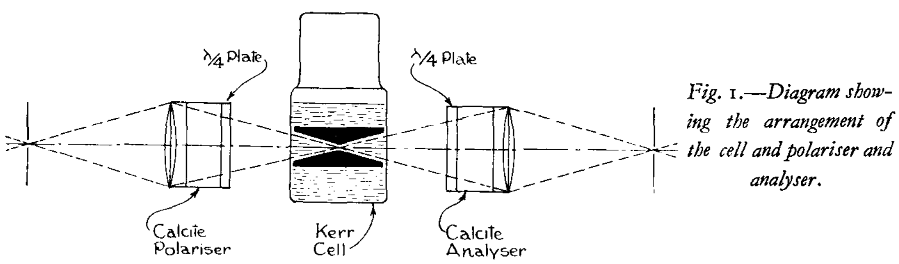


Fig. 1.—Diagram showing the arrangement of the cell and polariser and analyser.

In order to lessen the capacity of the cell, it is necessary to resort to the Wright form of electrode construction. There is only one pair of electrodes and both are shaped to follow the edge of the light cone passing through the cell. The construction is well known and described in the I.E.E. *Journal.*† In order to appreciate the various cell operating voltages when using the Wright electrodes, we give a table showing these cell operating voltages for the two cases. The first is when the cell is working on the first slope, and the second is when the cell is biased to half wave.

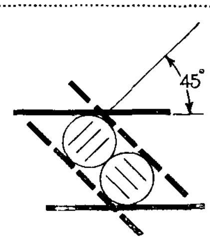


Fig. 2.—Diagram showing the vibration directions of each image.

The operation of the Kerr cell on the first slope is well known and in this case it is usual to arrange the electrical bias to give a retardation of $\phi = \frac{1}{4}$. This represents the electrical bias, the operating volts giving retardations between the range $\phi = 0$ and $\phi = \frac{1}{2}$.

Owing to the nature of the Kerr cell characteristic, the expression for which is

$$I = I_{max} \sin^2 \frac{\pi}{2}\left(\frac{V}{V_{max}}\right)^2$$

the curve becomes correspondingly steeper as the retardation increases. It is found that the maximum voltage which the Kerr cell can stand is in the order of 6 kilovolts per millimetre. This being the case, it is obvious that, providing the maximum voltage which this cell has to stand does not exceed 6,000 volts, then it would be more expedient to work higher up the curve. This can be done by raising the electrical bias on the cell and arranging that the maximum voltage should be a little below the breakdown voltage. The value of breakdown voltage is taken from the International Critical Table, but it is found in practice that this breakdown voltage is much higher when the cell is sealed and the nitro-benzene is correctly distilled. The lowest voltage imposed on the cell should naturally produce extinction, but, when the bias is much higher than $\phi = \frac{1}{4}$ extinction will not take place, hence some compensation must be effected. The com-

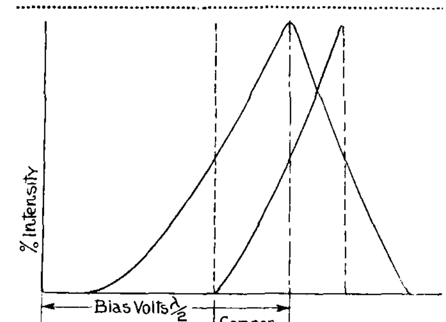


Fig. 3.—Curves showing the operating conditions of the cell.

*Vol. XIII, page 464.

†Vol. 70, page 345.

pensation resorted to is in the form of a retardation plate of mica. This material possesses roughly the same polarisation disposition as the nitrobenzene. Referring to Fig. 1, such an example is given in which the bias volts give a retardation of $\phi = \frac{1}{2}$ and the compensation is equal to $\phi = \frac{1}{4}$. This being the case, a new operating polariscope, a description of which is given by the writer in TELEVISION AND SHORT-WAVE WORLD, Vol. VIII, pp. 277-279, May, 1935.

If a circular polariscope is not used, it will be necessary to increase the distance between the electrodes as in Fig. 2, in order that the direction of the field is disposed 45° to the direction of vibration of the two beams. Such electrodes are given in full lines. On the other hand, if we use a circular polariscope, the electrodes can be arranged in accordance with the dotted line. In this case the vibration of the two beams is circular, one being left-handed and the other right-handed. Fig. 3 shows the whole layout of the circular polariscope but does not include the quarter wave plate to effect the necessary compensation essential to the operation of the cell as set out in Fig. 1. The quarter wave plates shown in Fig. 3 are introduced to produce the circular polariscope and the vibrating directions of these two plates will be mutually at right angles and disposed at 45° to the principal plane of the polariser and analyser. The compensation plate may be introduced anywhere between the two quarter wave plates and the vibration direction of this compensation plate must be disposed at 45° to either of the quarter wave plates.

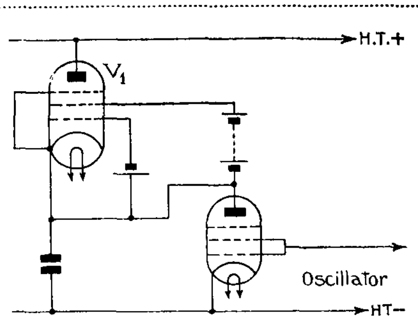
VOLTAGES FOR KERR DIVERGING ELECTRODES

No.	Electrode length in cm.	Electrode gap in mm. a	b	Peak Voltage for $\phi=\frac{1}{4}$	$\frac{1}{2}$	Control Volts for $\phi=\frac{1}{4}$	$\frac{1}{2}$	Bias Voltage for $\phi=\frac{1}{4}$	$\frac{1}{2}$	Cell capacity in m.mfds.
1	4	1	2	2,500	3,100	800	1,000	1,900	2,500	8
2	4	·75	2	2,000	2,600	750	600	1,400	2,000	9
3	4	1	3	3,300	4,150	1,000	850	2,450	3,300	7
4	4	·75	3	2,400	3,100	900	700	1,700	2,400	8
5	5	1	3	3,000	3,900	900	900	2,100	3,000	8
6	5	·75	3	2,150	2,700	650	550	1,600	2,150	9
7	5	1	4	3,400	4,400	1,020	1,000	2,400	3,400	7
8	5	·75	4	2,500	3,200	740	700	1,800	2,500	8
9	6	1	4	3,000	3,900	900	900	2,100	3,000	8
10	6	·75	4	2,300	3,000	680	700	1,600	2,300	9
11	6	1	5	3,400	4,400	1,000	1,000	2,400	3,400	7
12	6	·75	5	2,600	3,400	760	800	1,800	2,600	8

curve will be produced which is shown in the full line. This new operating curve is much steeper than the first slope curve. The second table gives roughly the operating speed and bias voltages for Kerr cells with diverging electrodes. The possibility of using double image arrangements with this cell is effected by employing a circular

A NOVEL SCANNING CIRCUIT

A NEW form of sweep circuit for cathode-ray tubes, which can be adapted for television scanning has been designed by Goldsmith and Richards.* It is well known that cir-



Scanning circuit employing hard valves.

cuits using hard valves instead of the conventional gasfilled relay for discharging the sweep circuit condenser are more stable and are not affected by temperature changes. The disadvantage of such circuits is in the multiplicity of valves required, since it is not practicable to obtain the discharge action of the relay by the use of a single valve.

In the circuit described the charging condenser is fed through a screened pentode acting as a constant-current charging device in the usual way. This is shown as V_1 in the diagram. Across the condenser is a discharge valve, V_2, which in the original circuit is a type 59 American valve. The anode of this valve is connected to the charging condenser, while the grid is directly connected to the output of an audio-frequency oscillator, which can be of the Hartley type.

The grid of the discharge valve is normally biased several volts negative by a battery inserted in the oscillator coil. By adjusting the bias of the valve, no current flows in the anode circuit until a minimum peak value of oscillatory voltage is reached. At this value the grid of the valve swings positive and a sudden release of anode current takes place which discharges the condenser. The grid must necessarily stay positive for a sufficient length of time to discharge the condenser completely. It appears from the foregoing that the waveform of the oscillation should be a single highly damped pulse of voltage, since if two peaks occur of the same amplitude the condenser will be discharged again on the start of the charging cycle.

The authors point out the necessity of shielding the driving oscillator from the output circuit. Synchronising to a given frequency is accomplished by a small coupling into the oscillator circuit.

If driven from a controlled frequency this circuit would seem to be an interesting alternative to the various types of scanning circuit developed using hard valves, and as such is worthy of note.

Reference is also made to Zworykin's paper on the "Kinescope" (Proc. I.R.E., Vol. 21, p. 1655, 1933).

* Proc. I.R.E. Vol. 23, p. 653. 1935

THE A B C OF THE CATHODE-RAY TUBE—VIII

By G. Parr

SCANNING CIRCUIT TROUBLES

This is the concluding article of a series describing the principles and operation of the cathode-ray tube in the simplest possible manner.

IN this, the concluding article of this series, we are going to deal with some of the peculiarities of cathode-ray television and what to expect from them. The reader who has followed the building up of the scanning circuits will probably be wondering whether the cathode-ray receiver of the future will not consist entirely of knobs!

This is one of the features of cathode-ray tube working which distinguish it from mechanical systems—since the circuits are purely electrical they can be varied at will in the same way that a radio receiver can be tuned at will. But once the station is obtained it is no longer necessary to twiddle the knobs. In the same way, once the correct scanning speed has been obtained for a given transmission it is not necessary to do more than tune in to the picture-signal. The knobs on the scanning circuit will therefore be in the nature of "pre-set" controls, which in the case of a commercial set will be adjusted before it leaves the factory. Of course, if a new tube is fitted during the life of the set, a re-adjustment of settings may be necessary, since no two tubes are exactly alike. A similar correction will have to be made if the relay is changed, since this will alter the timing of the condenser circuit.

What if the circuit has to receive two types of transmission, as it will probably have to do if the present policy is carried out? It will mean two "pre-set" positions in the scanning circuit, which will be brought into use by a changeover switch.

Apart from the scanning circuit the picture can be varied to a great degree by altering the intensity of the line screen and by increasing or decreasing the modulating voltage. It is helpful to remember that the modulating signal takes the place of the input to the grid of an ordinary output valve, and in a similar way we can overload the grid circuit by too strong a signal. This will produce a very harsh picture with no detail. Too weak a signal will give a faint picture like a badly-exposed photograph.

Peculiarities of the Scanning Circuit

Although the mercury vapour relays used in scanning circuits are as well made as ordinary valves they are occasionally liable to erratic performance since it is more difficult to control the behaviour of a vapour-filled bulb. Temperature is liable to upset them, for instance, and it may happen that the speed of the time-base circuit alters slightly as the set is run.

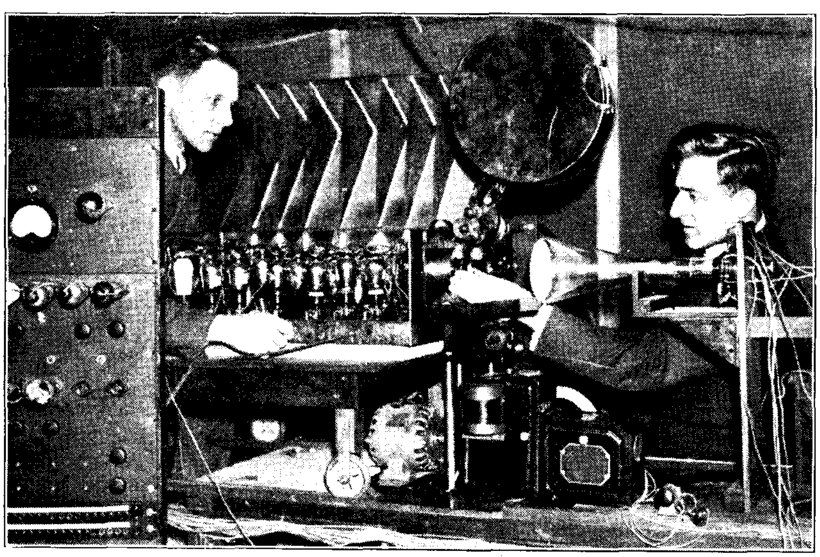
To get over this special relays have been developed with a filling of helium or argon gas instead of mercury vapour, and these are more reliable at high speeds of discharge. Even then an occasional "riccup" is met in the running of the relay which causes one or more lines to be shorter than the normal length. If the effect is only momentary the picture will flicker, but a continuation will give a displacement of part of the picture as though a slice had been shifted out of alignment.

A great deal of time and trouble has been spent in designing scanning circuits which shall be as reliable as possible, and some of these use ordinary hard valves which avoid the peculiarities of the gas-filled relay.

The use of ordinary valves in a scanning circuit is more complicated than the mere substitution of the relay with, say, a triode. We have to imitate the sharp discharge action which takes place at the time when the condenser is charged, and no ordinary valve will do this. As the anode voltage rises in a valve, the anode current rises with it, and we want a valve in which the anode current starts abruptly at a given voltage and rises almost instantaneously to a high value.

To produce this action in the valve circuit it is usual to arrange some sort of "trigger" action, i.e., the current is prevented from flowing by a high bias on the grid until a kick is applied from some external circuit. This kick swings the grid of the discharge valve to a positive value and thus causes a very rapid rise in anode current. There are a number of variations of this circuit.

(*Continued on page* 646).



The Cossor variable-velocity cathode-ray transmitter. Modulation of the light is obtained by variation of the speed of travel of the beam.

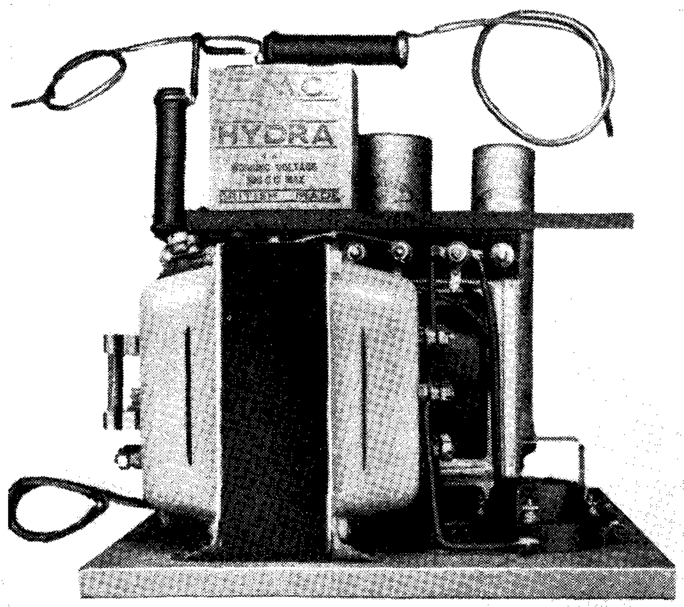


Fig. 4.—*View looking from the transformer end of the baseboard. The two decoupling resistances are seen at the top of the assembly. The second decoupling condenser fits alongside the one shown.*

A SMOOTH D.C. SUPPLY UNIT

The unit described below will provide practically smooth D.C. so essential for serious television experimental work.

FOR experimental work with amplifiers an H.T. battery is usually considered essential if absolute freedom from noise is required. The television experimenter who has A.C. mains available is naturally resentful at having to spend money on batteries in addition, but realises that the average commercial eliminator is not always up to his requirements for a smooth H.T. supply.

The unit described below is intended for all-round testing work on R.C.-coupled amplifiers and will be found a very useful accessory to the laboratory. It has the advantage that the output is considerably in excess of the large H.T. battery type, and the extra smoothing choke and condenser reduce the A.C. ripple to a minimum.

The layout has been made as compact as possible, and is designed to fit in a Ferranti No. 2 screening box, the dimensions of which are 8 in. long by 6$\frac{7}{8}$ in. wide by 7$\frac{1}{4}$ in. deep. These useful boxes are not so widely known as they deserve to be, and they will be found useful for all kinds of H.T. equipment and amplifiers. They are made in two sizes, the one quoted above, and a larger one measuring 13 in. by 10 in. Each box is fitted with a safety switch which disconnects the mains when the lid is lifted. This occupies a space at the left front of the box and allowance has to be made for it in fitting any tall object in this part of the baseboard. In the case of the unit, the valve fits well clear of the switch box, and the baseboard is easily lowered to the bottom of the box by a sideways movement.

The Circuit

The circuit diagram of Fig. 1 gives the general arrangement of the unit. The components required are as follows:

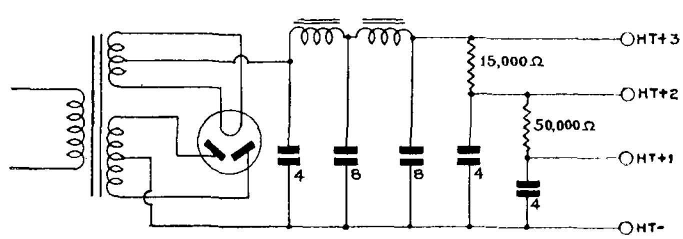


Fig. 1.—*The circuit diagram of the D.C. unit. Decoupling condensers are included on each H.T. tap.*

Transformer, 250-0-250, 2-0-2 (Sound Sales). The stock type has two extra 4-volt windings which can be disregarded or brought out to separate terminals as required.

2 Chokes, type 40 SS (Sound Sales).

2 8-mfd. electrolytic condensers (Dubilier).

1 4-mfd. ditto.

2 4-mfd. paper condensers (T.M.C. Hydra).

1 15,000-ohm 2-watt resistance (Dubilier or Erie).

1 50,000-ohm ditto.

1 4-pin valve holder (Bulgin).

4 Belling-Lee large terminals, marked H.T.–, H.T.+1, +2, +3.

Extra terminals for the L.T. A.C., if brought out.

Before screwing down the components, two extra pieces will be required as shown in Fig. 2. The electrolytic condensers are all mounted on a bracket which can be cut from 18 gauge aluminium sheet to the dimensions shown in the top of Fig. 2. After the holes have been drilled to take the condensers it is bent up to the marking shown.

At the bottom of Fig. 2 is shown an ebonite strip for mounting the decoupling condensers. These are carried on the top of the chokes, the strip being held in place by four Meccano angle-brackets.

In the photograph of Fig. 3 one of the 4-mfd. paper condensers has been omitted to show the strip in place and the method of securing it. The transformer, chokes and condensers are screwed on to a baseboard measuring 8 in. by 6$\frac{3}{4}$ in., care being taken to see that no component overlaps the edge of the board. The valve holder is also fastened down and the wiring commenced.

The connection to the negative end of the smoothing condensers is made by means of a soldering tag fastened under one of the holding-down screws of the condenser bracket. The two chokes are wired in series and a tapping is carried from the connection between them to the middle 8-mfd. condenser. The outermost choke terminal (top of Fig. 3 photograph) is the H.T. + connection, and is later connected to H.T. + 3 for maximum voltage. After the preliminary wiring is finished, the strip for the T.M.C. condensers is fastened to the angle-brackets with four 4-B.A. screws, the brackets themselves being gripped under the holding bolts of the choke castings.

If alternative makes of condenser are used in the position, the height should be checked to make sure that they fit in the screening box. The H.T. tappings are then made as follows: To the end of the choke the 15,000-ohm resistance is soldered, the other end being soldered to the tag on the fixed condenser. The photograph in the heading makes this clear, the resistance being shown upright at the edge of the board. A flexible lead is then connected to the same tag on the condenser, for joining to the H.T.+2 terminal. The

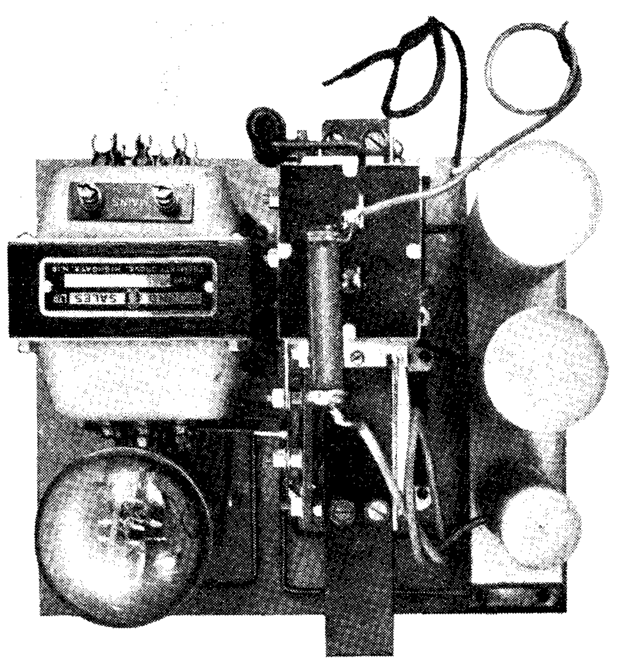


Fig. 3.—Plan of the unit showing the layout of the components. The second decoupling condenser has been removed to show the strip on which they are mounted.

50,000-ohm resistance is also connected to this point, the other end being taken to its own decoupling condenser on the strip. The remaining tags of the condensers are joined and taken to H.T. negative.

After the baseboard has been lowered into the screening box and screwed down, the Belling-Lee terminals are fitted through the ventilation holes in the front of the box, insulating bushes being used where they pass through and where the nut is secured on the inside. The flexible connections to the terminals are then made, an extra length of flex being soldered to the H.T.–, either on the condenser bracket or on the centre tap of the 250-volt winding itself. If the 4-volt windings are taken to terminals it is a good plan to bring out the centre-tap separately to allow of self-bias on directly-heated valves if needed.

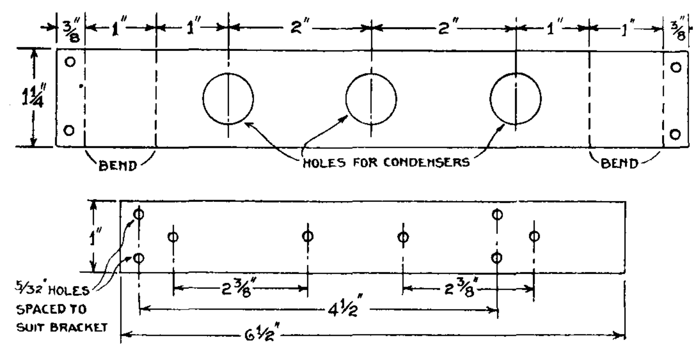


Fig. 2. — Top: Aluminium bracket for the electrolytic condensers. Bottom: Ebonite strip for the decoupling condensers to be mounted on top of the chokes.

The mains terminals on the transformer are taken to the terminals on the safety switch. The mounting of the Sound Sales transformer will render the fuses inaccessible on the terminal board, and it may be advisable to short-circuit these and rely on the twin fuses in the switch-box itself.

The following test figures show the high output voltage obtained:—

	Load.	Volts.
H.T.+2 tap.	2.5 mA	270
	5.0 mA	240
	10 mA	170
	15 mA	120
H.T.+1 tap.	1.5 mA	100
	2.5 mA	65

"Scanning Circuit Troubles"

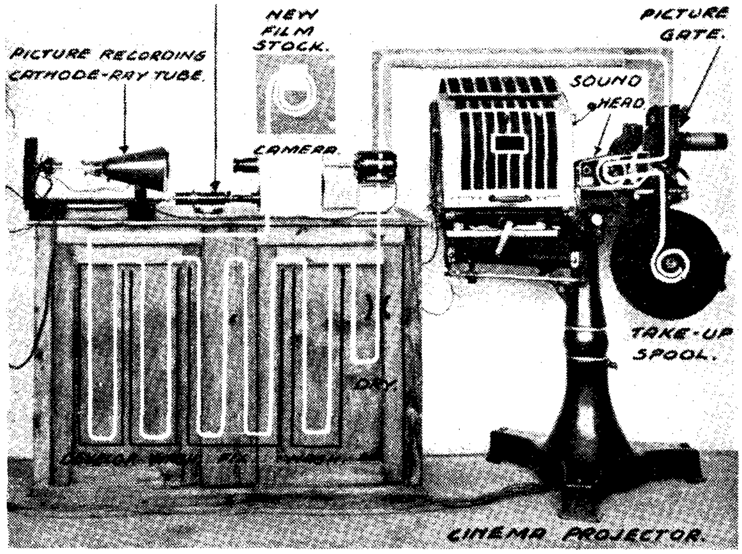
(*Continued from page 644*)

Unfortunately nearly all hard valve circuits require more than one valve for their successful operation, and when the circuit is duplicated, as it is in the case of a scanning system, the cost of the valves is a considerable item. On the other hand the hard valve scanning circuit is free from some of the defects of the gas-filled relay type and it is probable that we shall see some examples of it in commercial receivers for high-definition.

There is a system of television reproduction by a cathode-ray tube which is quite different from the conventional scanning systems which we have considered before. This is known as the " variable velocity " system and is made possible by the property of the cathode-ray itself. The action can be quite easily understood by remembering that the amount of light produced by the passage of the beam across the fluorescent screen depends on the rate at which it moves. The faster it moves, the less is the amount of illumination.

We have already met this in the passage of the beam across the screen on its return at the end of the line or picture (last month's issue, p. 589) and this principle has been applied to the reproduction of varying light and shade by altering the speed of travel of the beam as it sweeps across the screen (hence " variable velocity ").

The problem of providing large screen pictures which can be viewed by cinema audiences is one that is engaging the attention of all television research workers. The chief difficulty is an adequate amount of modulated light, and the various methods so far employed are outlined in this article which is actually compiled from two recent lectures given by Capt. A. G. D. West, B.Sc., A.M.I.E.E., Technical Director of Baird Television, Ltd.



Baird intermediate film scanner, showing the path of the film.

TELEVISION IN THE CINEMA

THERE are various methods of producing large screen pictures, the three most important methods being the mechanical, the intermediate film, and the high-power cathode-ray projection tube.

Television has been projected on to a large size screen by means of mechanical methods, using large mirror-drums rotating at high speeds. This is the way in which the televising of the Derby from Epsom was carried out and reproduced on a screen in the Metropole Cinema, Victoria, three years ago.

Mr. Baird has now developed a high-definition method of projecting large pictures, limited, however, at the moment, to close-ups only. In this mechanical method he uses an interlacing system where lines are not scanned sequentially in order, but out of turn, which has the effect of reducing flicker. Another method uses a large screen of lamps, which gives a brilliant picture, but one lacking in detail.

A Promising Scheme

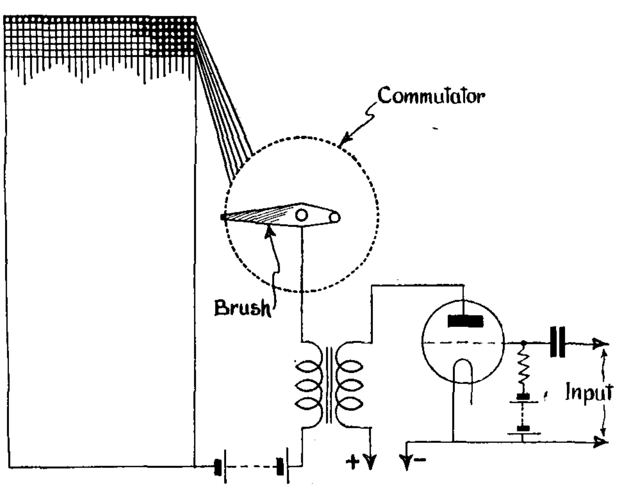
The method for which I have the most hope, at the moment, is the intermediate film method, which gets over the great difficulty, experienced with mechanical and cathode-ray systems, of insufficient light. It is possible to provide a complete equipment which projects full-size pictures on to the cinema screen having ample light and definition.

There are two forms in which it can be made:—Firstly, an arrangement which has been developed and constructed by the Baird Associated Company in Germany, Fernseh A.G., in which a continuous loop of celluloid film passes through the machine again and again. The film, with the unexposed emulsion on it, passes through a continuous motion camera, on which is projected a television image, received by radio, by means of a rotating disc, the modulation of the light from black to white being carried out by means of the Kerr cell. This film is then developed, fixed, washed and dried and is seen at this point as a finished positive print, which is then immediately projected on to the cinema screen.

After leaving the projector the film passes through tanks where the emulsion is scraped off, and the remaining clear celluloid is dried, and then it runs through a chamber where new emulsion is applied and dried, before running into the camera again.

I have seen this system working in Berlin, giving quite excellent results, but I think that the quality is not as good as that obtained by the following method.

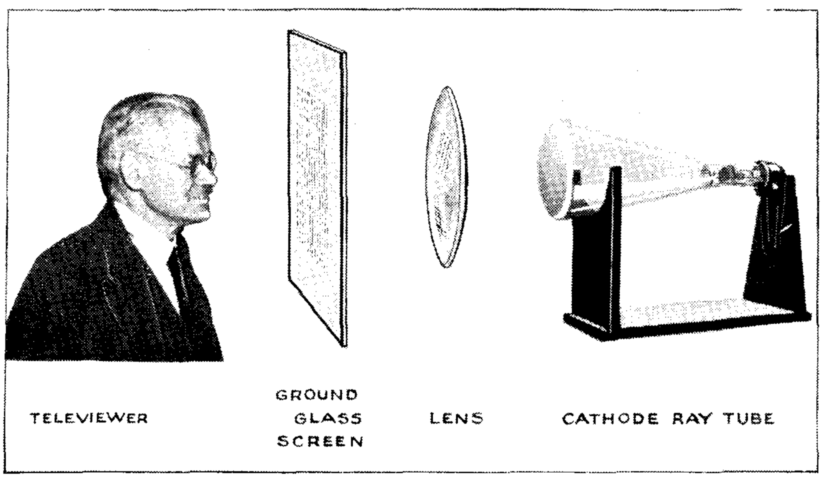
In this case, which is a development of the Baird Company, a television picture is picked up by radio and transferred to a cathode-ray tube. The picture is then photographed on to a continuously moving film using a special form of camera. The camera has two rotating drums inside it, both moving at a constant speed. One is



A schematic diagram, showing how the current is fed to the lamps in correct sequence to produce a picture. A screen of this type was recently demonstrated in Germany.

PROJECTING CATHODE-RAY IMAGES

in the position where the picture is recorded, the other is for the recording of sound. The film, after being exposed, to both vision and sound, runs straight into a developing bath, where it is developed for 20 seconds, washed for five seconds, fixed in 20 seconds, washed for a further 15 seconds and dried in less than a minute. After a total period of under two minutes it then passes immediately into the projector and after leaving the sound gate is taken up on the pick-up spool.



This is an outline of a scheme for large picture presentation employing a cathode-ray tube, the image from which is projected on to a screen by means of a lens system.

The method has one disadvantage, namely, that the cost of film is rather high. This is, of course, saved in the continuous-loop process. On the other hand, better quality is obtained and the event having been televised and reproduced, is in a recorded form, and the spool can be removed, rewound, and projected on any subsequent occasion. For instance, if the Derby were televised in this way and thrown on to the screen at 3 p.m. the same film could be used again at 4 p.m., 5 p.m. and 6 p.m. on the same day, until replaced by the standard news reels.

Cathode-ray Projection

Detail and quality with this process are very good for a moving picture which has been divided up into 80,000 parts, transmitted by radio at a rate of 25 pictures per second, put together again and impressed on a film which has been processed and dried in less than two minutes.

A third method, now in process of development, is called the projection tube. This is a special form of cathode-ray tube having an intensely brilliant picture, something between 3 ins. and 6 ins. square, so bright and well-defined, in fact, that it can be projected by means of a lens on to a screen with good brilliancy and detail.

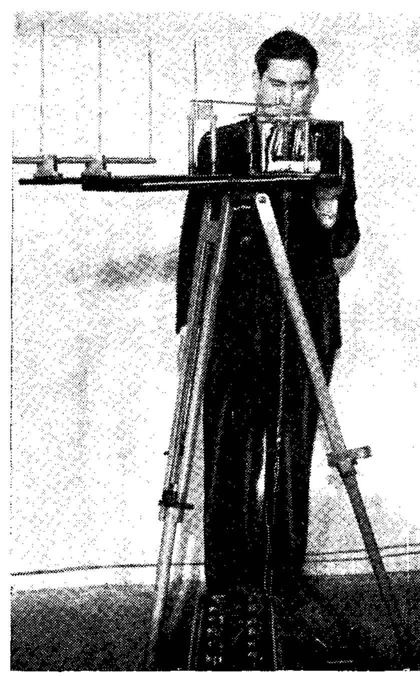
At the present moment, only small screens, about three or four feet square, can be filled in this manner. A brighter picture can be obtained on the tube, but there is then so much power put into the screen that it disintegrates. In any case, a voltage of up to 10,000 volts is necessary to produce enough brilliance to be able to project pictures of the small size mentioned, but it is a form of development which the cinema industry must certainly keep an eye on, because when it does become practicable, as it will do in the course of the next five years, it will possibly do away with the standard projector mechanism itself.

The projectionist will become the electron engineer, and, instead of cleaning his gate and spooling his films, he will be adjusting his voltages and watching his modulation meters. In this case, of course, the television is instantaneous, there is no delay whatsoever, but, on the other hand, no record whatever is made of any event which passes over its screen. Its application can well be compared with the effect of broadcasting where, like sound, it is transmitted once and for all, projected and sent out, and is never seen again, whereas the intermediate film can well be compared with sound recording, where events are shown and recorded and filed for future reference.

Linking Up Cinemas

It seems clear that the first cinemas to receive their programmes by means of television will do so by radio links, from large high-power central transmitting apparatus on ultra-short wavelengths sending out signals which cannot be resolved by any home receiver, and which will therefore be secret, picked up by radio receiver and projected on a screen.

Later on, a big central radio transmitter may, quite easily, with the future development of the concentric cable, be replaced by a central distributing exchange point, say, in the centre of London, and the same method will also be of use in connecting up a distant programme item with the central distributing radio transmitter or the central programme distributing exchange. In this latter case, however, it is possible that micro-waves, with wavelengths of the order of one metre or less, will also be used for relay purposes. A micro-wave transmitter can be built, which will operate over a distance of per-



The Baird micro-wave transmitter which will probably be suitable for linking up cinemas or transmitting from a central station.

(*Continued at foot of page 653*)

RECENT TELEVISION DEVELOPMENTS

A RECORD OF PATENTS AND PROGRESS

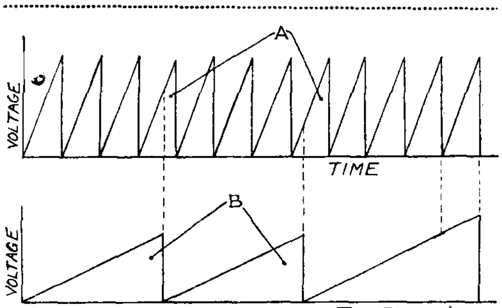
Specially Compiled for this Journal

Patentees :— J. L. Baird and Baird Television Ltd. :: Marconi's Wireless Telegraph Co. Ltd. Radio Akt. D. S. Loewe and K. Schlesinger. :: Compagnie Compteurs :: G. W. Walton, Automatic Electric Co. Ltd. and L. M. Simpson.

Interleaved Scanning

(Patent No. 431,339.)

The line scanning-impulses A are divided into three interleaved "sets" by the lower-frequency saw-toothed voltage impulses B, which are applied to deflect the electron stream of a cathode-ray receiver rhythmically but at varying periodicity. The receiver co-operates with a transmitter in which interleaving is produced by a rotating disc or mirror-drum. The synchronising impulses for A are derived by interrupting the light falling on a photo-electric cell by an obturator disc having the same number of apertures as there are mirrors on the scanning drum, whilst those for B are produced by an obturator disc with correspondingly-spaced apertures.—(*J. L. Baird* and *Baird Television, Ltd.*)



Interleaved scanning. Patent No. 431,339

Film Television

(Patent No. 431,207.)

When pictures are transmitted from a film which is scanned by means of a rotating disc, the film is fed continuously through the "gate" of the projector. But when using a cathode-ray transmitter of the " Iconoscope " type, it is usual to feed the film intermittently through the gate, as is the case in the ordinary kinema theatre. It is found, however, that the " stop " motion then leads to a loss of approximately 25 per cent. of the total scanning time. Attempts have accordingly been made to speed up the intermittent motion, so as to overcome this difficulty, but without success.

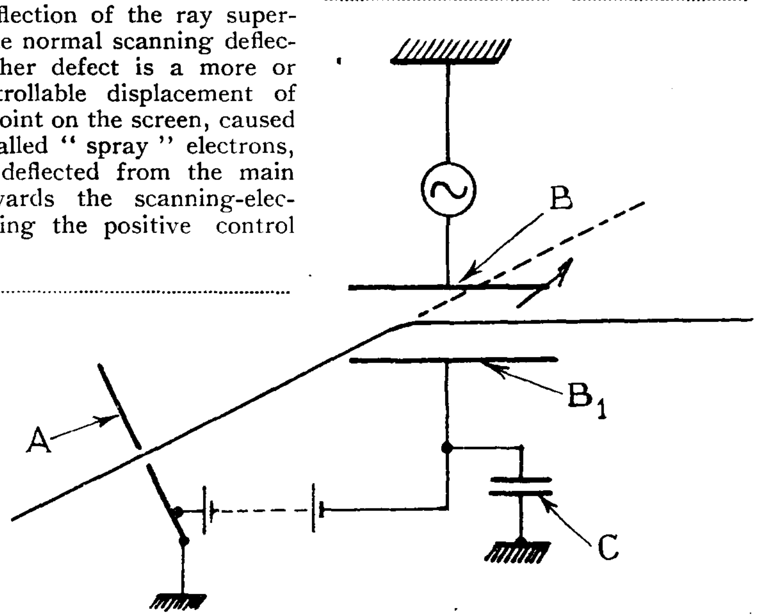
The inventors tackle the problem in another way. The film is fed through the gate intermittently and at the normal speed. As soon as the film becomes stationary, a rotating shutter flashes an image of it on to the mosaic-cell electrode of the Iconoscope tube. During this time the scanning ray is shut off. For the rest, and by far the greater part of the total scanning time, the shutter obscures the picture, whilst the electron stream through the tube is brought into play to scan and discharge the stored-up cells of the " mosaic " electrode. In this way the brilliancy of the televised picture is greatly increased.—(*Marconi's Wireless Telegraph Co., Ltd.*)

Cathode-ray Receivers

(Patent No. 431,773.)

Cathode-ray television receivers are liable to a fault known as "cross-current error " which arises from a variable deflection of the ray superposed on the normal scanning deflection. Another defect is a more or less uncontrollable displacement of the image point on the screen, caused by the so-called " spray " electrons, which are deflected from the main stream towards the scanning-electrode carrying the positive control voltage.

According to the invention the main electron stream, after leaving the anode A, is caused to enter the scanning-electrodes B, B1 at an angle, as shown in the drawing, whilst the control voltage is applied from the source O to one only of the electrodes, the other being earthed through a condenser C. The fact that the first part of the track of the electrons is at a greater distance than usual from the biased plate B corrects the undesirable effects referred to.—(*Radio-Akt. D.S. Loewe* and *K. Schlesinger.*)



Method of preventing cross-current error. Patent No. 431,773.

Scanning Systems

(Patent No. 431,827.)

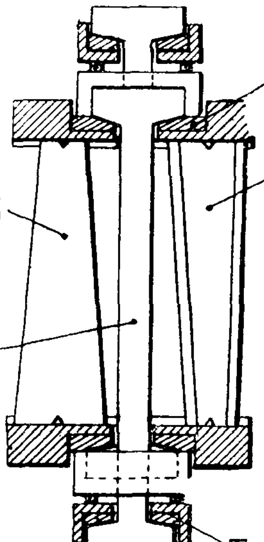
The picture is reconstituted at the receiving end by a scanning system which combines the use of a cathode-ray tube with a rotating mirror. The rapid or line-scanning component is produced in the cathode-ray tube, and is picked up and reflected by a rotating mirror-drum, which adds the slower " frame " movement. The arrangement permits of a better control of modulation, by preventing the

" spreading-out " of the darker parts of the picture, and thereby increasing the definition of the high lights.—(*Compagnie "Compteurs."*)

" Light " Valves

(Patent No. 431,958.)

In an optical valve, of the Kerr-cell type, suitable for use in television, the crossed Nicols N, N1 are wholly immersed in the refracting liquid, such as nitrobenzine. The upper ends of the stack of light-control plates P



Kerr cell construction. Patent No. 431,958.

contact with a soft-metal liner L, whilst the lower ends rest on a tension plate T which can be tightened-up by means of screws.

A second set of light-control plates is interleaved with the first and supported in similar manner. The arrangement reduces loss of light due to reflection. The cell may be mounted inside a glass bulb which is filled with the working fluid.—(*G. W. Walton.*)

" Delayed " Television

(Patent No. 432,199.)

Relates to a system of television in which a delay of an hour or more is contemplated between the actual event and the representation of it. Though not sufficient to rob it of its " topical " interest, this eliminates most of the difficulties associated with instantaneous transmission.

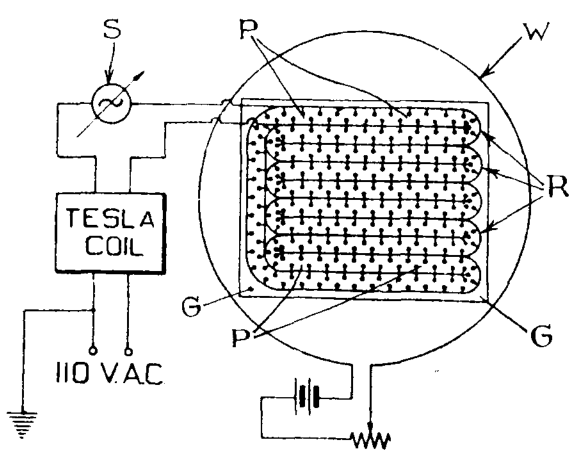
The scene is first recorded on a photographic strip as usual and an " elongated " facsimile is then prepared from which low-speed signals are transmitted, on a long carrier-wave if necessary, and received on simplified apparatus. The record, as first received, is then run at a higher speed than usual through a projecting apparatus, so as to restore the normal cinematograph effect.—(*Automatic Electric Co., Ltd.,* and *L. M. Simpson.*)

" Sparking " Screens

(Patent No. 432,455.)

Instead of using ordinary cathode-ray or rotating-disc scanning, the picture to be reproduced is divided up into small " unit areas," which form minute electrodes of the order of pin-points, so as to give a definition comparable with what is called half-tone in printing. Spark or corona discharges are produced across these points in rapid sequence, and at an intensity corresponding to the varying light-and-shade values of the picture.

As shown in the figure, the sparking-points P consist of small projections set at uniform intervals along a pair of continuous " rail " electrodes R, which are connected across a source S of alternating voltage in series with a Tesla coil. The magnetic field from a winding W, surrounding the electrodes forces the discharges to travel along the



Arc scanning. Patent No. 432,455.

" rails " from top to bottom of the screen, thereby producing a scanning effect. A plate G of glass sputtered with finely-divided metal, and backed by a second plate which is earthed, serves to facilitate the formation of the discharges.—(*Communications Patents Inc.*)

Summary of other Television Patents

(Patent No. 431,057.)

Electro-optical system for focusing the electron stream in cathode-ray tubes.—(*G. Hertz.*)

(Patent No. 431,246.)

Cathode-ray tube in which all the electrodes are carried on a separate insulating member inserted inside the glass bulb.—(*M. von Ardenne.*)

(Patent No. 431,258.)

Means for balancing-out sudden changes in the illumination of the mosaic screen in a television transmitter of the Iconoscope type.—(*Marconi's Wireless Telegraph Co., Ltd.*)

(Patent No. 431,327.)

Improvements in the control and focusing electrodes of a cathode-ray tube of the " hard " type.—(*Electric and Musical Industries, Ltd., I. Shoenberg* and *W. F. Tedham.*)

(Patent No. 431,458.)

Generating synchronising impulses for " interleaved " scanning.—(*J. L. Baird* and *Baird Television, Ltd.*)

(Patent No. 431,521.)

Generating synchronising impulses of constant form, amplitude, and frequency from a glow-discharge tube.—(*Radio-Akt. D.S. Loewe* and *K. Schlesinger.*)

(Patent No. 431,567.)

Biasing means for the saw-toother oscillators used in scanning.—(*T. M. C. Lance* and *Baird Television, Ltd.*)

(Patent No. 431,774.)

Modulating electrodes for cathode-ray tubes.—(*Radio-Akt D. S. Loewe* and *K. Schlesinger.*)

(Patent No. 431,775.)

Screen arrangements for cathode-ray tubes.—(*Radio-Akt. D. S. Loewe* and *K. Schlesinger.*)

(Patent No. 431,904.)

Scanning system in which a cathode-ray tube is used in combination with a mirror-drum.—(*Telefunken Co.*)

(Patent No. 431,959.)

Means for renewing the light-sensitive film on a " continuous " cinema record used for transmitting television programmes.—(*Fernseh Akt.*)

(Patent No. 432,017.)

Television system utilising one-dimensional scanning, together with means for ensuring a proper phase-relation of the resulting signals.—(*G. W. Walton.*)

Scannings and Reflections

By THE LOOKER

Paying for Television

WHAT share of the broadcast licence fee will the Ullswater Committee on Broadcasting, whose Report is now anxiously awaited, recommend to be passed on to the B.B.C.? Under the existing method, which appears difficult to improve upon, the Post Office issues the licence to the public, but, of course, the Government stops a proportion of the licence money, partly as expenses of collection and partly as a contribution to imperial revenue. The question we raise is a burning one. The B.B.C. has always been discontented with the 6s. which is all it gets of the 10s. fee and at the delay in passing the moiety over; for years it has agitated for a bigger share and, let us say, a tightening up of the "terms of credit." Now comes television with its heavy but, as yet, unknown liability of cost, which certainly in the preliminary stages the B.B.C. has to shoulder, still further increasing its financial burden but adding weight to its argument for more generous treatment. Television may well be the lever that will open the Government's tight fist.

A Bigger Licence Fee?

In view of the comfortable showing made by the B.B.C.'s published accounts, the general public will not willingly pay an increased licence fee, whilst the argument that the fee should be raised to allow of the B.B.C.'s getting the wherewithal to pay for television will be most unpopular as, naturally, the proportion of licencees "looking-in" is certainly to be in a considerable minority for a long period. Nor will the looker be prepared to pay for a separate television reception licence. Why should he, in view of the ultimate identity of all broadcasting services, whether sound or vision, and of the fact that television is simply a perfectly natural and expected outcome of the sound broadcast? And in any case a television reception licence would not be a source of appreciable revenue during the first two or three years.

More Costly Programmes

The financing of television, it will therefore be obvious, is perhaps the thorniest of the business problems that have confronted the British Broadcasting authorities and will be found closely related to the difficulties inherent in providing a television programme of live and regular entertainment value. We can hear the Londonderry Air, for example, umpteen times and still take pleasure in it, but how many times can we see a "movie" without boredom? Individual programme items in a television service may easily cost more than any sound broadcasting, owing to the necessity of more lengthy periods of production before presentation, special dressing, etc., and because, as I have said, they will not stand much repetition from the same station.

The Battle of the Lines

The confustion created by the decision that Baird will operate at a scanning frequency of 205 lines and E.M.I. at 420 lines will be added to if our continental neighbours succeed in sending their television transmissions into this country. It is now expected that Germany will decide on 320 lines. What a pity the lessons taught by engineering during the last forty or fifty years are not being applied as they ought to be to television. Sooner or later we shall have one frequency.

Coverage of the New Station

What will be the coverage of the experimental television service? We believe it is one of the many things about the new high-definition service which nobody knows. Our German correspondent tells us that the German Post-Office's mobile television unit, which was placed on the summit of the Brocken mountain in July has not quite completed its tests yet, although it is rumoured that excellent results have been obtained. Further, and this is the point to which we draw particular attention, he says that reception of this transmitter has been possible even in Berlin, *a distance of over 120 miles.*

Propaganda

If progress continues in this country at the rate of the last nine months, we shall have to take a page from the book of the German Listeners' Association, which has started propaganda for television throughout Germany. Reference is made to a passage of Adolf Hitler's speech at Nurnberg, and the Association, which is the only official association of its kind in Germany, and has powerful and influential members, has decided to make Germany television-minded as soon as possible in preparation for the institution of a nation-wide service. In Great Britain the demand for a television service has not been made sufficiently articulate and the authorities have been tempted to let things slide just as long as the public will let them.

A 700-line Picture

It is quite possible to use a scanning frequency as high as 700, the effect of a picture at that extremely high definition being that of a perfect photograph, complete with every half-tone detail.

At Portsmouth

During November demonstrations of 120-line television are to be given in Portsmouth. The apparatus to be used is that which was described in our October issue and which was recently demonstrated at Messrs. Bentall's, of Kingston-on-Thames.

Plans for Next Spring

Disclosures of the B.B.C.'s plans for the coming television service have recently been made in the Press, but it is impossible to obtain any confirmation of them. Getting information on television out of the B.B.C. is very much like getting blood out of a stone.. We have reason to believe that many of the statements made, although neither confirmed nor denied, are true or very nearly so. The expectation is that the Baird and Marconi-E.M.I. systems shall be used in alternate weeks and that there shall be three separate one-hour programmes each day—one hour in the

MORE SCANNINGS . . . .

afternoon for the benefit of the trade (probably between three and four o'clock) and two separate hours during the evening. A time signal will be sent both by sound and vision. The possibility of appointing a woman announcer is being discussed. It is suggested that there will be a televiewing room open to the public, and readers will remember that during the period of the old 30-line transmission the B.B.C. had an excellent viewing room available to all who were interested. Programme items will be short and, where the item depends as much on sound as on vision, it is proposed to flash a picture on a screen for a moment or so only and then fade it out. It is suggested that this technique will apply particularly to orchestral concerts where the interest is in the music and not particularly in the personality of the orchestra itself. A hint is given that the programmes will depend to some extent on the enterprise of commercial firms which, in other words, means that in television, at all events, the B.B.C. will not frown upon the sponsored programme. To all the above the B.B.C. will say neither " yea " nor " nay."

Televiewing in Germany

The German Post Office has opened a second public televiewing room at the Schöneberg Post Office, which is within the range of the small 20-watt transmitter.

American Ideas

One of the most enthusiastic American observers of British television developments is Mr. Andrew W. Cruse, chief of the Department of Commerce Electrical Equipment Division, who spent a month during the summer in studying television in England, France, and Germany. Mr. Cruse is convinced that television is a technical reality, but he believes the problems of cost and programme technique are so great that the American industry is pursuing the better part of discretion in adopting its present policy.

" In my opinion," said Mr. Cruse, recently, " after having seen both the Baird and Electric and Music Industries' systems in operation, I feel that the future of British television depends entirely upon the ability of the British Broadcasting Corporation to present programmes which will be enthusiastically received by the public. Technically, both the transmitting and receiving equipment is adequately satisfactory to introduce this service at this time, but the unknown factors are programme material and programme presentation."

The Cinema

There will be great interest in our article on other pages in this issue entitled " Television in the Cinema." The article is the substance of lectures given by Captain West and points out that the chief trouble of large-scale television pictures is the difficulty in providing adequate light. But like most other difficulties, it will be met and overcome in due course and the cinema screen will then acquire greater importance and a new meaning.

The Farnsworth System

We reproduce this month from a well-known American journal a short article describing a demonstration of the Farnsworth system. The particular interest of the system to us in Great Britain lies in the fact that the Baird Company have entered into contracts by which the Farnsworth system will be available as a regular part of their system. The article states that Mr. Farnsworth has been entrusted with the building of three television transmitting stations in the U.S.A.—one in San Francisco, one in Philadelphia and the third in New York City.

Greek !

The official information relating to the Baird and Marconi-E.M.I. systems respectively given on other pages in this issue is issued in such highly technical form that it carries but little information to the average reader and we have therefore thought it desirable to accompany the official specifications with a simple explanation.

The Telephonoscope

This is not the name of a new marvel closely guarded within the portals of Hayes, Middlesex, or of the Crystal Palace, Sydenham. It is the name given to a purely imaginary sound-vision transmitter and receiver described by Robida in a book published in 1884.

The Hungarian Method

The Hungarian radio authorities came to the conclusion that a radio exhibition in 1935 would be entirely out of date without a good television exhibit and as they were not able to ensure such an exhibit they have decided to postpone their show until some time early in 1936. It is believed that Hungary will be one of the first of the smaller countries of Europe to start a public television service, in spite of the fact that very little money is forthcoming for the financing of experiments.

Austria and Television

The first television station in Austria has been established by Professor Friedrich Benz in the experimental Institute for Radio Technology in Vienna. The installation has cost about £2,000. This was the site of the first experimental wireless station in Austria.

From Abyssinia

The Addis Ababa station on 39 metres is now being heard quite regularly in this country. Floyd Gibbons and Bob Martin, two American journalists, broadcast on alternate evenings directly to New York. The latest events are re-broadcast throughout the whole of America at 6 p.m. American time, or 11 p.m. British time. These broadcasts are worth hearing.

10-metre Record

A world record has just been created by Miss Nellie Corry, G2YL, She has transmitted to Australia on a wavelength of 10 metres. This waveband was given to the amateurs for it had no commercial value, but it seems as if the 10-metre band will be prominent for communication over 8,000 miles. It might also affect the outlook on television for no one knows just how far the 5-metre band will travel. It may even beat the 10-metre band and provide world-wide reception.

W2XAD

W2XAD, the General Electric station in New York, is now putting out special programmes for English listeners. At 7 p.m. most evenings these transmissions can be heard at great strength, for a special aerial, beamed on Great Britain, is in use. It is suggested in trade quarters that it is just another scheme to assist in selling all-wave sets. It will be remembered that WGY had a special aerial beamed on South America while a sales push was taking place for R.C.A. receivers.

War and the Amateur

In Italy all of the amateur radio stations have been confiscated to prevent leakage of information. Germany tried the same idea, but gave it up for leakage via radio was negligible as compared with other sources. However, at the moment in Italy anybody found with a radio transmitter is liable to sentence of death.

The Amateur Helps

During the recent storms when telephone communication was suspended between London and Whitehaven, messages to the radio station there were carried on by local amateur stations. This happens fairly regularly, for only the previous week a trawler in difficulties off Northumberland, was only able to make contact with the local coastguard station by a message being picked up by a listener and carried by hand.

Car Transmitters

Pocket transmitters are now being fitted to American cars. These transmitters have a range of about 20 miles and in America link up with the nearest telephone exchange. In this way travellers can keep in touch, no matter in what part of the continent they may be. It seems possible that this idea may spread to Europe, for it would be very convenient to be able to make a 'phone call without having to hunt for the nearest box.

Quoting with Qualms

I note the Shakespearean references to television in your October "Scannings and Reflections," writes a Cambridge correspondent. It certainly appears that television was a commonplace four hundred years ago, he continues, and judging from Hamlet's "You go not till I set you up a glass," the bore of Shakespeare's time insisted on your "looking" in his home-made televisor just as the bore of to-day isn't really happy till you have listened to his new loudspeaker. And perhaps then as now it was in spite of the quality, for there is Shakespeare's own evidence on record—this "wicked and dissembling glass of mine." Our correspondent threatens more of this, but we have discouraged him.

Public Televiewing Rooms in Berlin

Following the destruction of the two ultra-short-wave transmitters by the fire at the Berlin Radio Exhibition in August, the Post-Office took a small 20-watt transmitter into service to provide for the continuance of one or two of the dozen public televiewing rooms in Berlin. At the time of writing two of these rooms are in operation and demonstrations take place daily from 8.30 to 10.00 p.m. local time. Sight is received by wireless and sound is supplied along special cables. A third public demanstration of television is arranged nightly at the Broadcasting House.

The new ultra-short-wave transmitters which were ordered to take the place of those burnt in the Berlin Radio Exhibition, will be completed before Christmas. Definition will be 180 lines and 25 frames per second as hitherto. The speed with which these transmitter have to be built, so as not to leave Berlin too long without a service, did not permit of the construction of transmitters suitable for still higher definition although it is generally supposed that Germany intends striking out for a picture in the neighbourhood of 320 lines.

Photography and Television

At the exhibition held by the Royal Photographic Society at their galleries in Russell Square, there was shown a series of films relating to television. An interesting exhibit showed the development of the intermediate film, the chief problems of which were the extremely rapid processing and development which have now been reduced to a matter of seconds only. There were also some interesting exhibits of cine films which had been produced from television signals, and one of these was the film used by Baird Television, Ltd., which was televised on the occasion of their demonstrations in June of the present year.

"Television in the Cinema"

(*Continued from page* 648.)

haps 100 miles or more, on very low power on a highly directional basis, that is to say, transmitting its power in the form of a beam or searchlight from the outside point to the distributing centre.

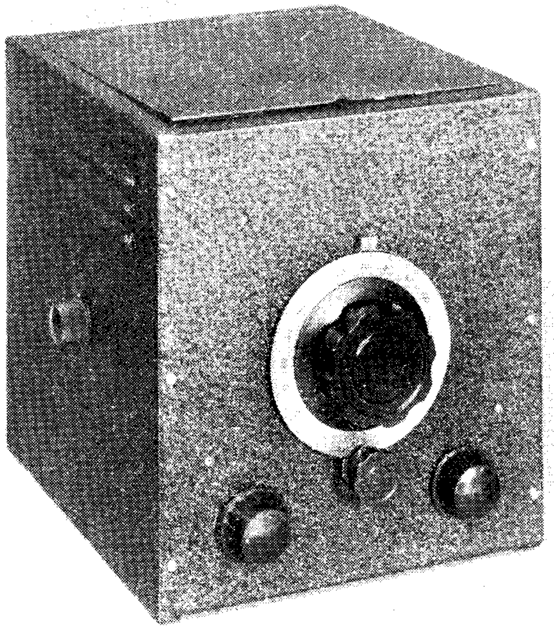
Good television pictures, in one form or another, will be shown in London cinemas before the end of the year. Not only will they show scenes specially produced at a distance, but also news items of topical value and of public interest. They will show results of fair entertainment value and should attract the public from this point of view, rather than from the point of view of novelty or from the fact that television is a matter of the moment. I think I am right in saying that in two years from now, several London cinemas will be taking regularly television items in their programmes. Perhaps within three to four years from now provincial cinemas will have their own distribution stations to cover local areas only, but it will take many years before every cinema in the country is equipped to give full screen television of programme value. This will depend entirely on the technical progress which is made with regard to cable and radio relay links.

The apparatus will not take up very much more room in the cinema than the ordinary projector; the same width and height but possibly another three or four feet more from back to front lens. It is, of course, very difficult to say at this stage what will be the cost of providing a television programme to cinemas and what will be the cost of expenditure in the rental or purchase of such apparatus. Neither can I say definitely that television will be applied only to the field now covered by news reels. With an entirely new science, new technique, art and presentation follows.

I am convinced that even if programmes for the home were made really attractive, the average member of the family will still want to go out to his local cinema or theatre, and laugh and cry and enjoy himself in common with many hundreds of others. One cannot get away from the fact of the influence of mass psychology and its unconscious attraction. Therefore, I see no reason why television in the home should have any effect on cinema box office receipts. Rather will it tend to evolve new technique in presentation and entertainment, which will develop along different lines for the home and for the cinema.

A Pre-amplifier for the Short-wave Receiver

By G. Brown (G5BJ) and E. N. Adcock (G2DV)



The special General Radio tuning dial permits of very accurate station selection.

USED on a first-class commercial super-het receiver which, in common with most designed previous to this year, possessed no H.F. stages ahead of the first detector, this pre-amplifier brought R4 signals up to consistent full loud-speaker strength, and produced R5-6 signals where otherwise none were to be heard—and with practically no increase in noise level.

The reason for this is that the self-biased anode-bend first detector in a mains-operated super-het is non-linear in action, and gives poor output for low input voltages. Very weak signals are swamped out by grid circuit losses, so that for very weak dx such a receiver without pre-conversion amplification (i.e., H.F. stages ahead of the first detector) is inferior to the much-maligned straight regenerative type of set. Efficient pre-conversion amplification, however, gives a totally different aspect to the situation, and, apart from the well-known advantages of selectivity, stability and ease of handling, such a receiver is much more sensitive than any simple straight set could possibly be. The absence of any appreciable increase in noise level is due firstly to the narrowed admittance band width (in other words, to the increased selectivity of the signal frequency tuning) occasioned by the pre-amplifier, and also to the fact that the greater proportion of what noise level is present in a well-designed super-het is due to oscillator noise, the cause of which is still only vaguely understood.

The signal frequency selectivity improvement given by the pre-amplifier *completely* removes the annoying "image interference" that is so troublesome with super-het receivers below about thirty metres.

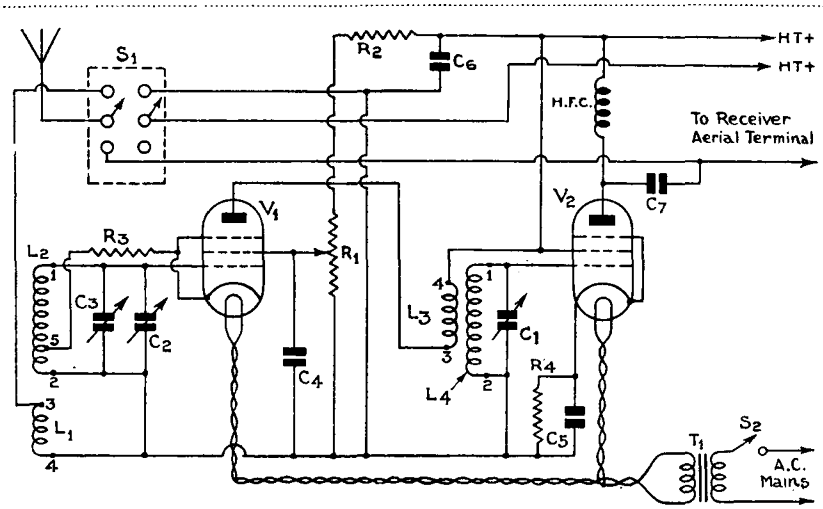
A glance at the circuit diagram will show that the pre-amplifier consists of two stages of H.F. amplification, the first of which uses electron-coupled regeneration, very smooth control of which is obtained by variation of the screening grid voltage. The reason for the employment of regeneration on the first, rather than the second stage, is that the sharpness of the tuning of its grid circuit, without regeneration, is broadened by the loading effect of the aerial. The switching arrangement connects the aerial either to the pre-amplifier or the receiver itself, without disturbing any of the connections. In addition, when the unit is not in use the H.T. supply is automatically disconnected by the same switch.

Construction

The unit is housed in an Eddystone 1033 welded steel cabinet. The chassis, a piece of .08 in. tin-plate 13⅜ ins. by 7 3/5 ins., is bent down half an inch at the front for attachment to the front panel by two 6 B.A. bolts, and also bent down 3¼ ins. at the back to form a sub-chassis space. Examination of the photographs should give a clear idea of the layout.

Above the chassis, situated centrally, is the two-gang .00016-mfd. condenser, with valve sockets and screens on either side. Metallising on valve envelopes, it should be noted, does not form an effective screen for short-wave work. Further to the rear the coil-holders are placed symetrically, with a five-inch high metal screen between the coil-holders, running from the rear of the two-gang condenser to the back of the chassis. The 40-mfd. microdenser, which must be carefully bushed, is secured to the left-hand side of the cabinet to fit close to the chassis in the space between the valve and coil sockets of the first H.F. stage. Apart from the short leads to this condenser, brought through the chassis from the coil socket, no wires, other than the valve grid leads from the two-gang condenser, appear above chassis, giving a very clean and commercial appearance to the unit.

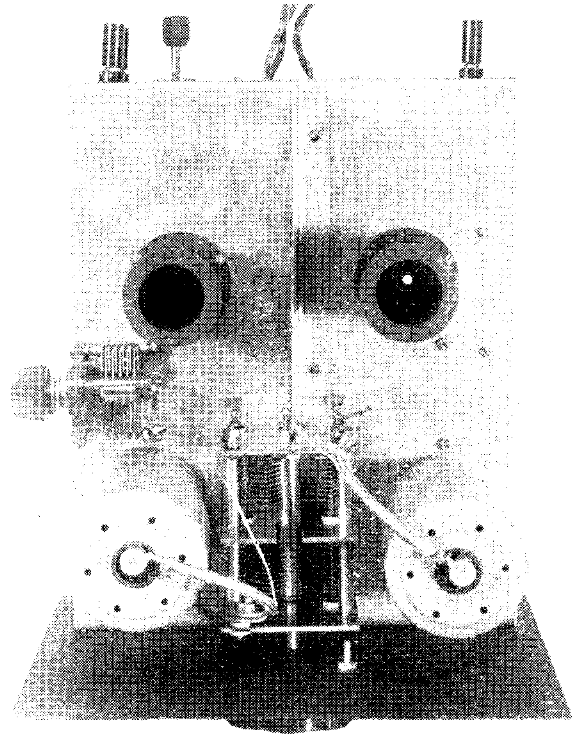
Particular stress is placed on adherence to the valves selected, on which the grid is brought out to the top cap, in contrast to the conventional construction of English valves, where the anode is connected to this position.



A filament transformer provides heater voltage for the H.F. valves. Note the tuning arrangement in the first stage.

Components for Pre-selectors

CABINET
1—Welded steel type 1033 (Eddystone).
CONDENSERS, FIXED
3—.1-type 250-tubular (T.C.C.).
1—.001-mfd. type 340 (T.C.C.).
CONDENSERS, VARIABLE
1—2-gang .00016-mfd. type 967 (Eddystone).
1—40-m.mfd. type 900 (Eddystone).
COIL FORMERS
8—5-pin plain (B.T.S.).
COIL SCREENS
2—type VS (Colvern).
CHOKE H.F.
1—screened all-wave type 982 (Eddystone).
DIAL
1—type 703 A General Radio (Claude Lyons).
HOLDER, FUSE
1—½-amp. (Microfuse).
HOLDERS, VALVE
2—7-pin type 985 (Eddystone).
1—5-pin type 954 (Eddystone).
PLUGS, TERMINALS, ETC.
2—Plugs and Sockets marked "Aerial" (Clix).
1—Socket marked "Output" (Clix)
4—Valve pins (Clix).
RESISTANCES, FIXED
2—200-ohm type 1-watt (Amplion).
1—20,000-ohm type 1-watt (Amplion).
RESISTANCE, VARIABLE
1—Potentiometer 50,000-ohms (Reliance).
SWITCHES
1—Lever type I1 (Wearite).
1—Toggle type S91 (Bulgin).
TRANSFORMER, MAINS
1—Filament with 4-volt 1.2-amp. secondary (Eddystone).
VALVES
2—VP4B met (Mullard).



A screen between the two stages is essential to preserve stability.

Employment of these valves considerably reduced the length of important leads, which, had other valves been utilised, would have necessitated considerable screening, thus reducing stage gain and (by the increase of residual capacities) the frequencies covered by each coil range. The only lead screened in the final model was that from the grid of the second H.F. stage to the corresponding section of the two-gang condenser. A little ingenuity will have to be exercised in fitting the valve screens under the coil sockets, as the screen mounting brackets turn inwards and are rather long; a little from the ends of these should be filed away, when there will be just sufficient room to secure each screen with 6B.A. nuts and bolts.

The front panel controls are three in number. The template supplied with the G.R. dial used will preclude any difficulty in mounting this. Sub-chassis, on the left of the front panel, is located the variable wire-wound potentiometer controlling the S.G. voltage to the regenerative stage, while to the right is a rotary type on-off switch controlling the mains input to the filament transformer.

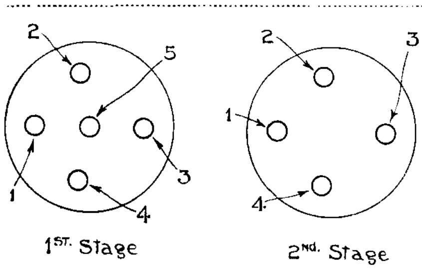
COIL TURN DETAILS.

Range in Metres.	L_1	L_2	Cathode tap, turns from ground end.	L_3	L_4
15—31	4	4	¾	4	5
29—46	6	8⅝	1½	6	9⅝
45—98	10	23⅞	3	10	24⅞

The back end of the chassis carries the filament transformer, which is located centrally; to the left of this is the anti-capacity lever switch, and further left the aerial and earth terminals. To the right of the transformer is the output terminal for connection to the aerial terminal of the receiver. The positioning of the lever switch near these terminals was essential to reduce the length of leads to it: had the switch been placed on the front panel the efficiency of the unit might easily have been reduced fifty per cent.

Sub-chassis directly behind the valve-socket of the second stage, is the all-wave H.F. choke. Inclusion of this, in preference to a short-wave type, allows the unit to be used on any wavelength, though coil details are only given up to one hundred metres. Immediately to the rear of the choke may be seen the .001 mfd. mica condenser in line with the output terminal to which it is connected. Resistances and by-pass condensers are supported from the stiff wiring, which is carried out in 16 S.W.G. wire.

A hole should be drilled in the back end of the chassis to correspond with



For those who make their own coils this method of connection will keep wiring short.

that in the back of the cabinet, and tapped 4 B.A. so that the chassis may be firmly secured to the back of the cabinet with a bolt. Alternatively, if the constructor has no taps, after the hole has been drilled a 4 B.A. nut may be soldered behind it.

Coils

Great care should be taken in positioning the coil sockets as shown in the sub-chassis photograph, and in wiring the coil formers and sockets as in the diagram. The numbers in the socket diagram correspond to those shown against the coil ends and tap in the pre-amplifier circuit.

Primary and secondary windings are wound in the same direction. All grid windings are of 22 gauge enamelled wire space-wound in the former grooves. Aerial and anode windings are of 30 gauge double-silk-covered wire. The primary windings of the 15-31 m. and 29-46 m. ranges are also space-wound, and spaced ¼ in. from the grid windings at the ground end. The primaries of the 45-98 m. coils are wound in slots at the bottom of the formers, ⅛ in. from the grid winding.

When the unit has been assembled and carefully checked over, the mains leads should be connected and the H.T. leads to the receiver H.T. supply. With the corresponding coils in position in the pre-amplifier, the lever switch should first be thrown to the up position, which connects the aerial straight through to the receiver.

A weak station having been tuned in, the lever switch should first be thrown down, bringing the pre-amplifier into circuit, and, with the regeneration control well backed off, the pre-selector dial should be rotated until the signal is again heard. The padding condenser control of the left-hand side of the cabinet should then be rotated until the signal is at maximum strength, and the regeneration control then advanced until the signal peaks sharply at greatly increased volume. If this control is advanced too far, self-oscillation will take place, and the signal will be reduced in volume. The control of regeneration, however, is particularly smooth.

THE FIRST PICTORIAL LAYOUT PUBLISHED SHOWING THE STUDIOS AND TRANS-MITTING ROOMS WITH EQUIPMENT IN APPROXIMATE POSITIONS

THE ALE
NEW HIG
TELEVISION
ST

The Alexandra Palace

as it is and as it will be.

By "The Looker"

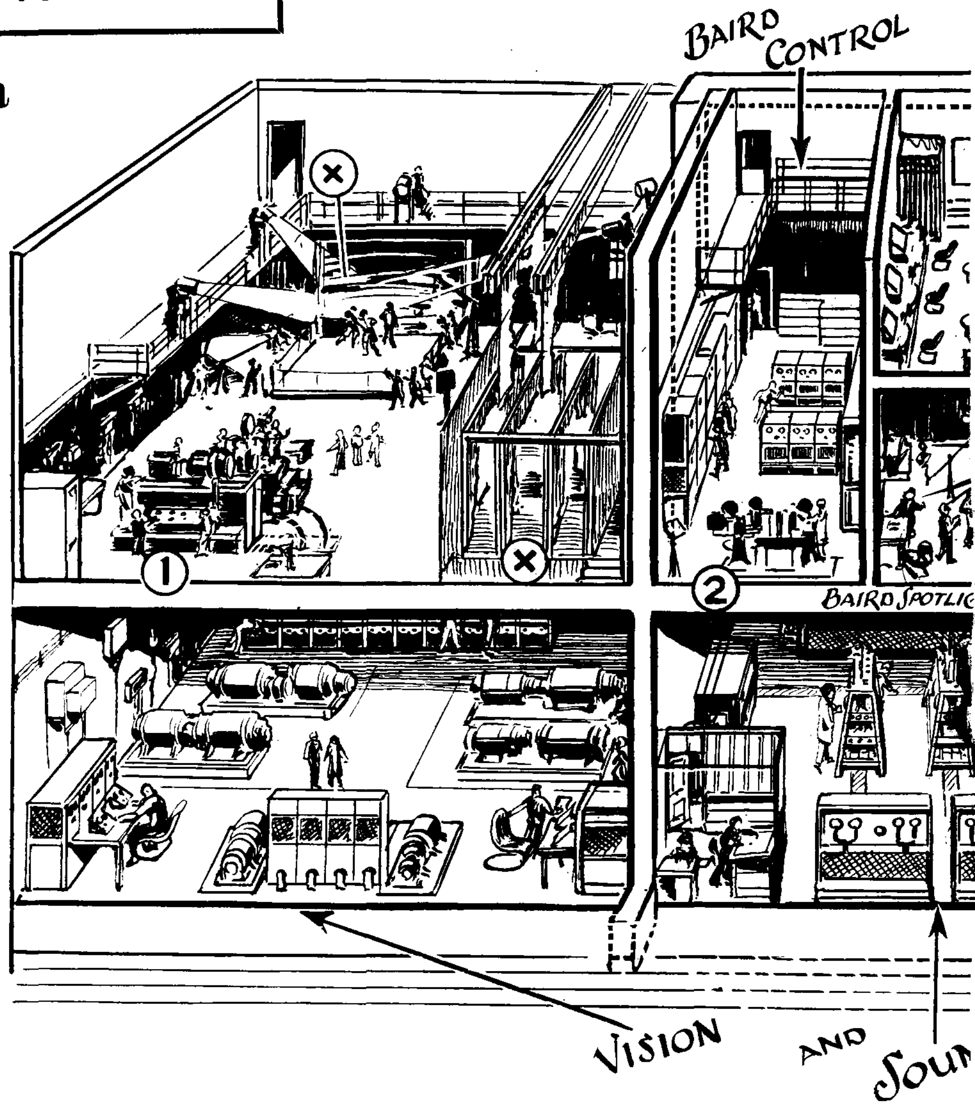
I SURVEYED Alexandra Palace with fresh interest from my carriage window as the train approached Wood Green station. The Palace lies on the left-hand side of the main L.N.E.R. line north from King's Cross; it is situated on a high piece of ground some 100 feet above the railroad and is a distinctive landmark from the south-east side. From Wood Green station a single decker tram runs up the hill, through the park and to the building, the distance being about half a mile.

One of the towers, I observed, had been decapitated. I decided to look at it from the outside. There was little to see. I walked along the great stone verandah and peered in through large and dirty windows into large low ugly looking rooms some of which I knew would be the future television studios.

I went back to the entrance. Passing the commissionaire at the door, who took no notice of me, I decided not to ask any questions as my Press instincts suggested I might learn more by wandering about on my own.

I immediately found myself in an enormous hall, in which countless workmen were hard at work. For a moment I thought they had lied, those persons responsible for the report that the B.B.C. were entirely inactive at the Palace. Unfortunately, I quickly realised that it was not so. All the activity around me were preparations for some minor exhibition.

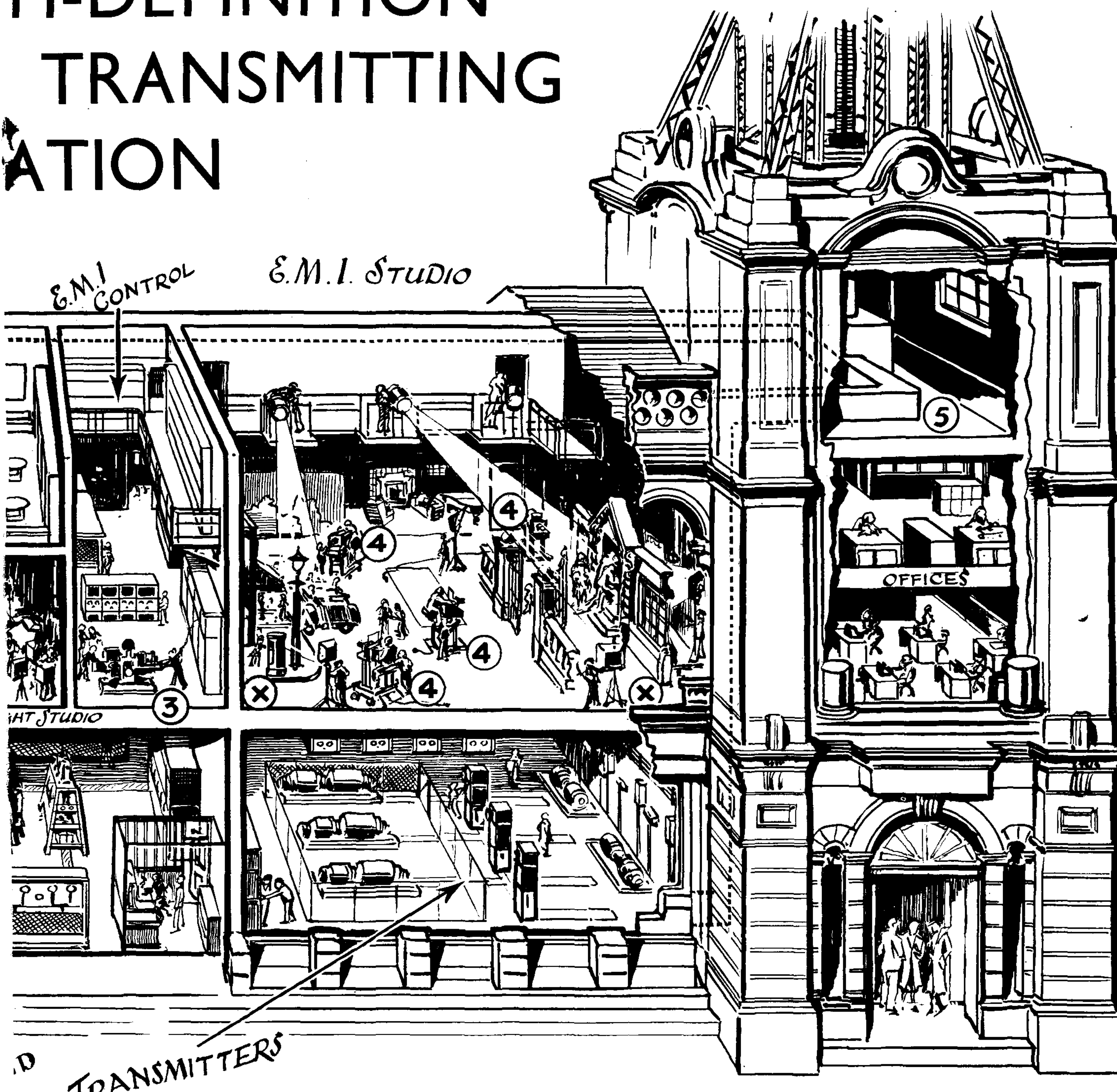
I wandered through various large



References: 1.—Baird intermediate-film scanner with self-contained developing tanks; note the boom microphone and the portable stage sets at X. 2.—Baird Control Room and ordinary film scanner.

3.—E.M. studios u

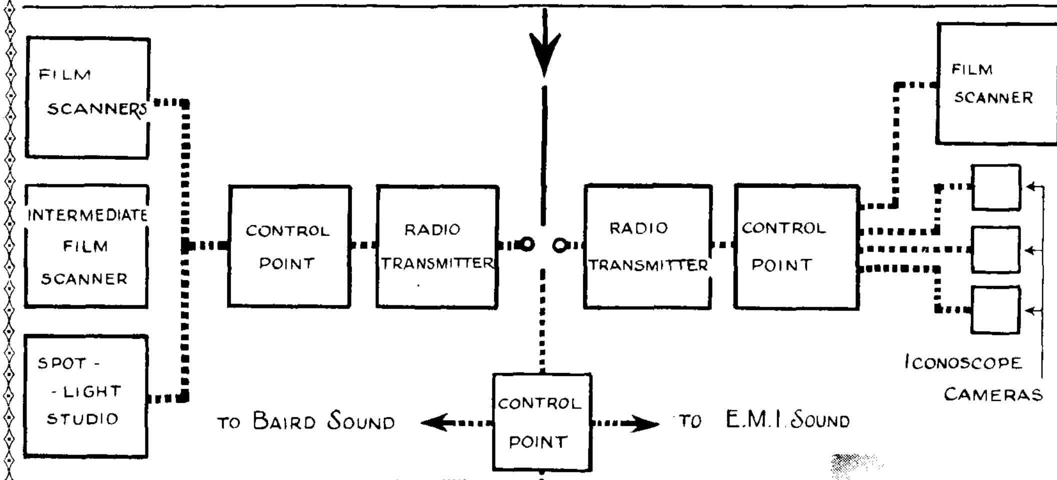
XANDRA PALACE H-DEFINITION TRANSMITTING ATION

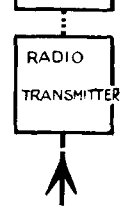


'. control room and ordinary film scanner. 4.—E.M.I. ith four Iconoscope scanners and portable stage sets.

5.—Special high-frequency cables connecting to aerials. The vision and sound transmitters and generators are on the ground floor and the Baird spotlight studio between the two control rooms.

Studio and Control Room Layout





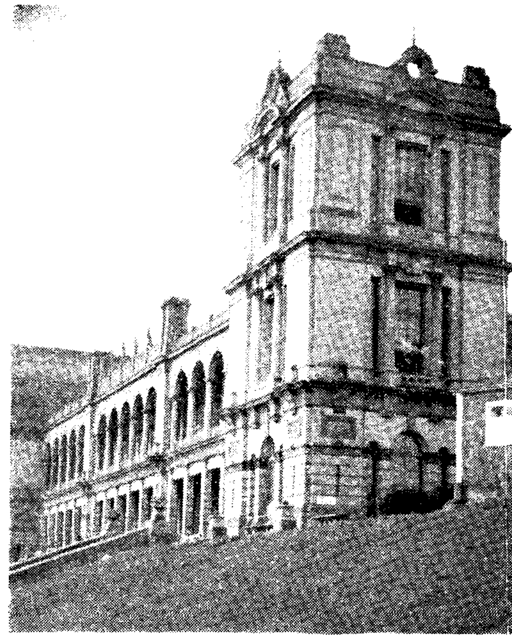
The illustrations on this page show (left) the transmission arrangements; (below) a view of the tower on which the aerial mast is to be erected and (bottom) plans of the studio and control rooms and the arrangement of the transmission gear.

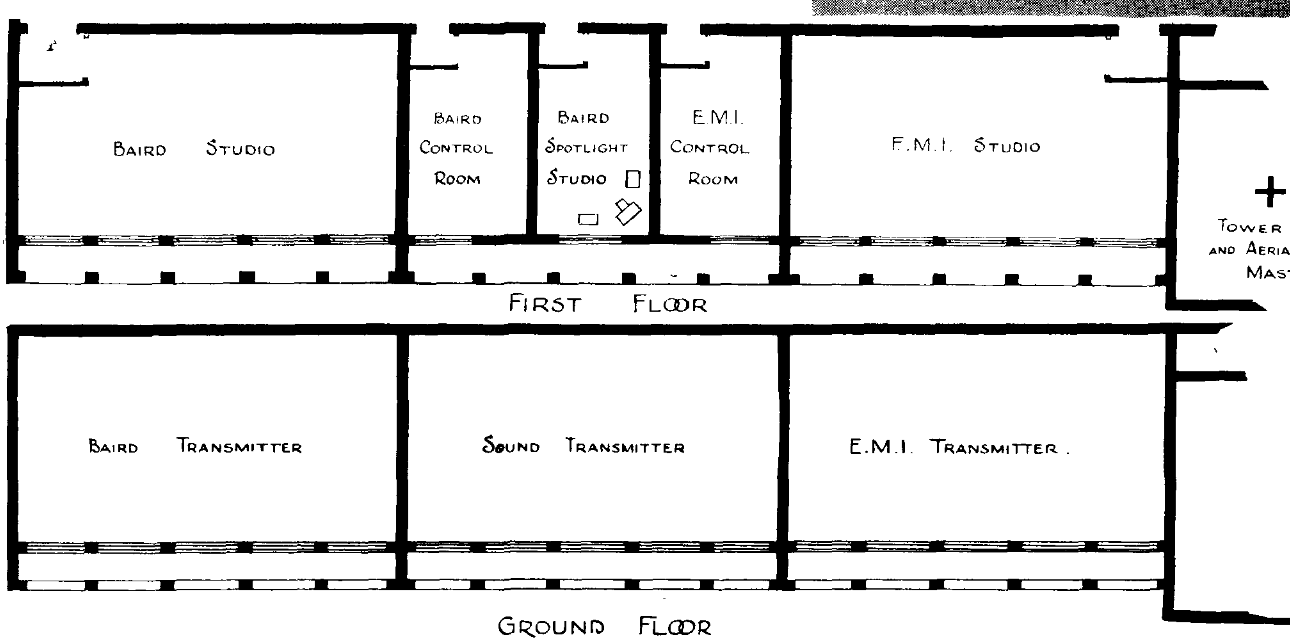
halls and courtyard gardens, all rather the worse for wear and dirty, the whole being rather depressing. I feel pretty sure that on a wet day the rain comes through the glass roof rather profusely.

Before leaving the office the Editor had given me a rough sketch of the section which the B.B.C. have leased, and this I now decided to locate. After considerable wanderings along many dark and dusty corridors I found my way, after trying various doors which refused to open, into that section where in the future B.B.C. television history will be recommenced.

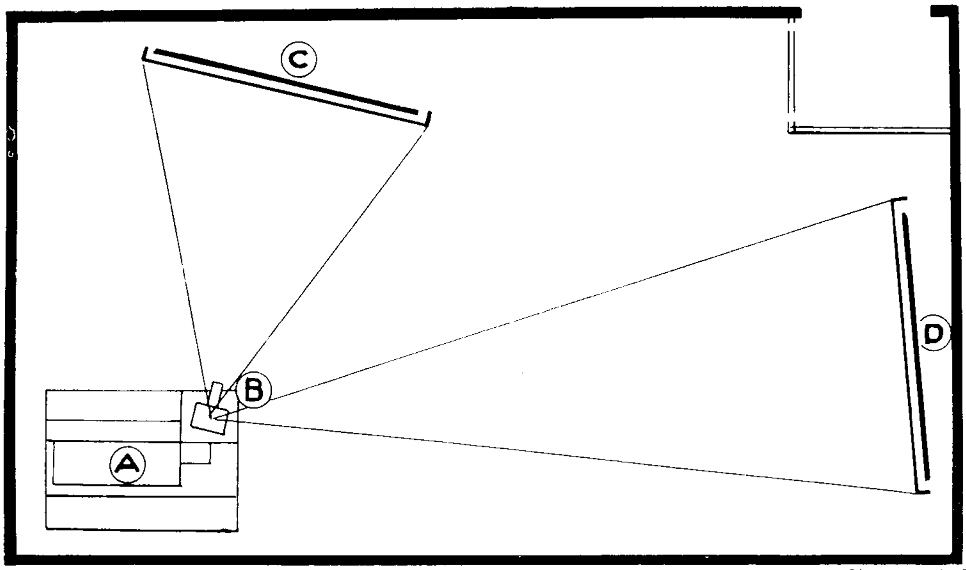
Except for footprints in the dust, there was no sign of human life. It did not require the assistance of a Sherlock Holmes' mind to observe from the footprints that at least more than one person had measured out various distances by the simple method of pacing it out. Some of the rooms were enormous. The upstair rooms had apparently been used as ballrooms. One appeared to have been a bar; advertisements of well-known drinks still ornamented the walls. I hardly imagine these will remain!

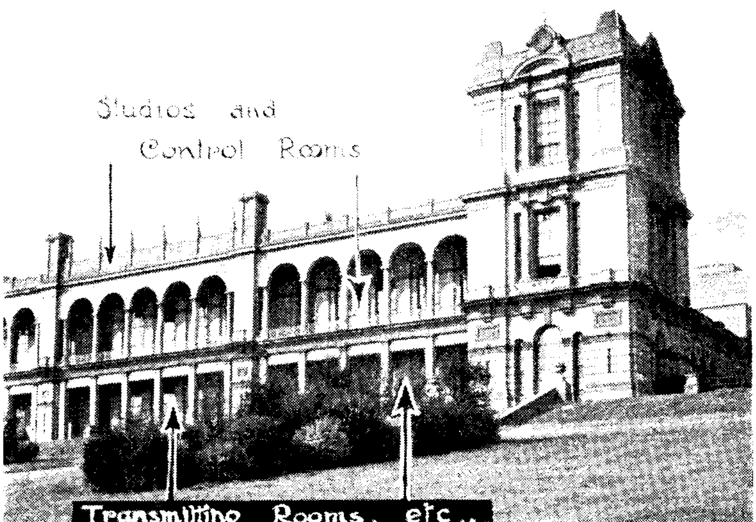
I am glad to say I was wearing rubber-soled footwear, as the echo (or should I say reverberation?) was almost

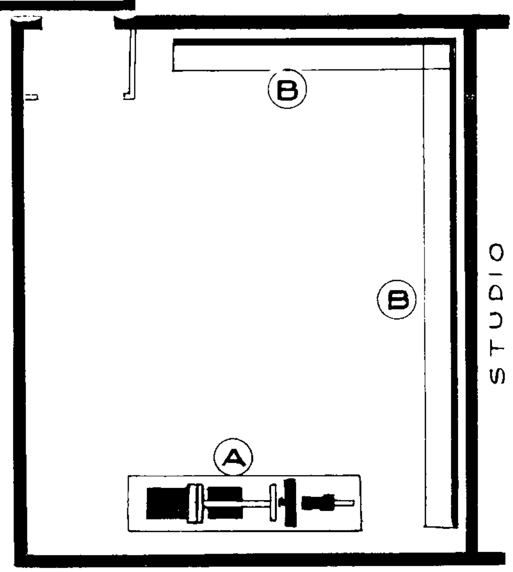




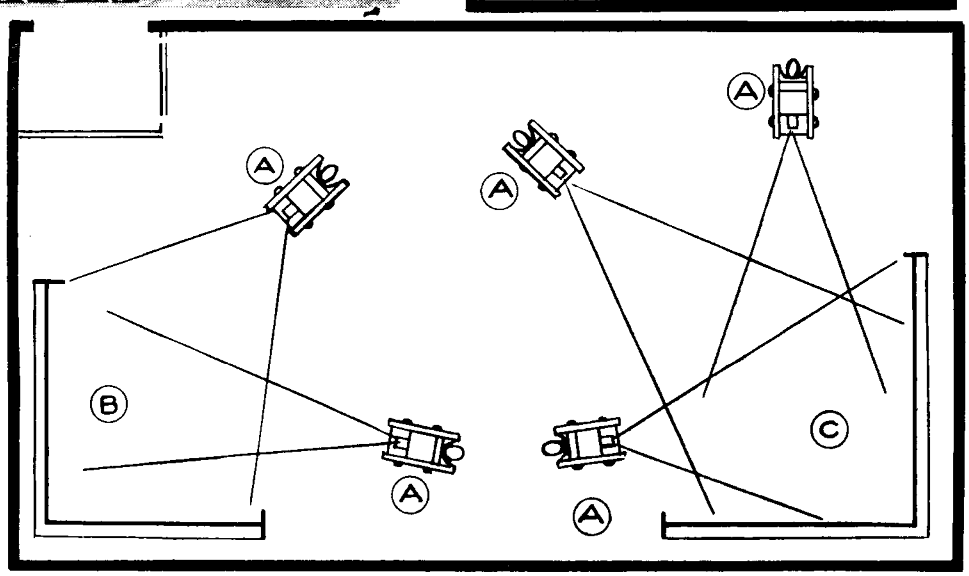
Scanning Arrangements







Here are three plans showing the layouts of the studios; at the top is the Baird main studio and at the bottom the E.M.I. studio with Iconoscope scanners. The photograph shows that part of the Alexandra Palace which has been taken over by the B.B.C.



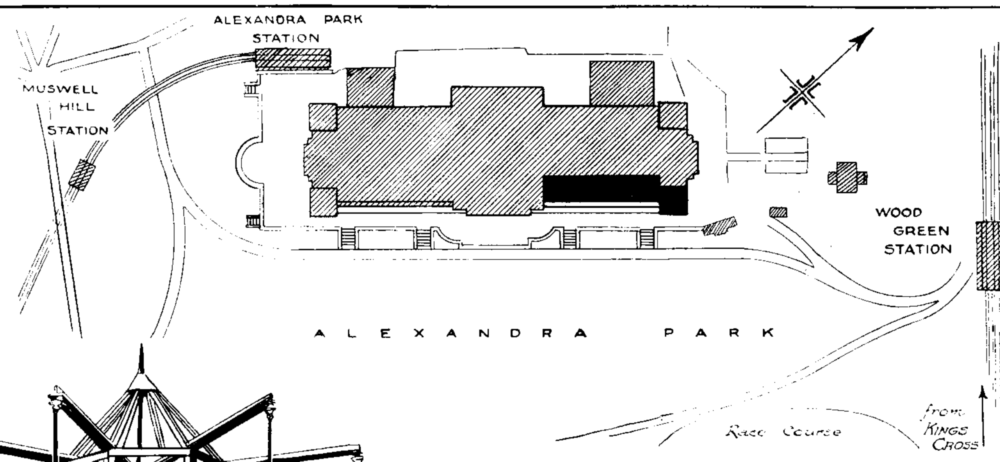
frightening. Every sound seemed to continue for many seconds after the original cause had stopped. The effects of whistling were most startling.

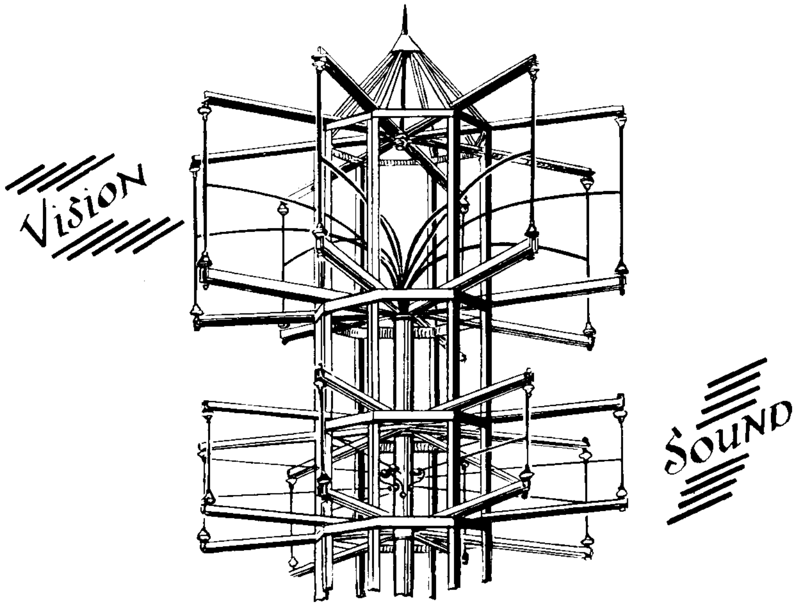
Downstairs the windows opened out into the stone verandah while upstairs one could go out on to a great stone balcony, from which a superb view of London could be obtained. East, South and West a good fourteen miles were generally visible, and if you knew where to look, no doubt landmarks could be picked up on a clear day, for perhaps thrice that distance. I could clearly see the rival Crystal Palace nearly due south some twelve miles away.

Stretching below one, as you look over the balcony, down a fairly steep slope are the gardens of the park, then the race course some 700 yards away, followed by endless roofs of houses as far as one's eye could clearly see—houses of every type and kind—I wondered how many of the inhabitants of which would be lookers-in to the fare to be provided inside the great building behind me, built as far back as 1873. This great stone balcony, with its high brick arches, will no doubt make a pleasant resting place for artist and technician alike, and as I looked over Lon-

The Aerial Tower and Aerials

These illustrations show a plan of the Alexandra Palace with the part to be used for television indicated, a general idea of the construction of the aerial tower with its two aerials and a view showing the approach to the Palace.

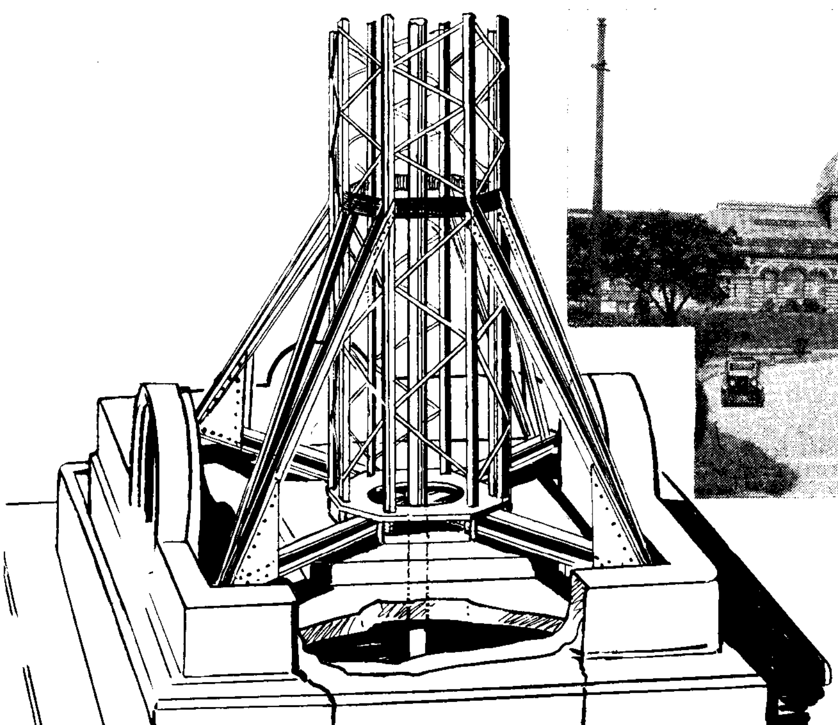


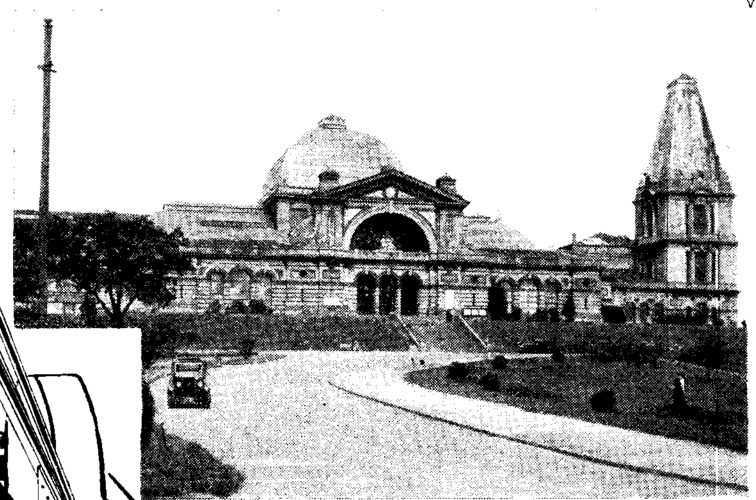


don I rather envied the future staff who will be responsible for the running of the great scheme.

Returning indoors I worked my way to the tower, the top of which, as I have already mentioned, has been removed. Here a sorry sight confronted me. The recent heavy rains had poured in, bringing large quantities of plaster from the unprotected ceiling with it, on to what was once a good parquet floor. The dampness and general dilapidated appearance made it hard to believe that within the next six months or so it will house the offices of those controlling the destiny of the latest means of communication.

Retracing my steps, I tried to visualise what the place will be like, say, six months hence, when those bright fellows





from the B.B.C. have rebuilt, decorated, sound-proofed, and installed masses of plant.

As I left the Palace I could not help thinking a lot about the magnitude of the task before the B.B.C., even in structural alteration. I felt that the infant television is officially about to leave the cradle.

THE GOLDMARK ELECTRON-OPTICAL SYSTEM

By Dr. Peter C. Goldmark

Details of a new projection system which combines mechanical principles with the cathode-ray tube in a novel manner and which it is claimed makes use of all the advantages of both systems without the disadvantages which are ordinarily associated with them.

The writer of this article and inventor of the system described is Dr. Peter C. Goldmark, Consulting Engineer, of Garden Place, Brooklyn, New York, and he is desirous of getting into touch with manufacturers with a view to the commercial development of the system which is the subject of U.S.A. patents.

ONE of the most difficult problems of television to-day is the projection of pictures to a reasonable size at smallest possible loss of brilliance.

The methods known so far for the projection of television images can be grouped into two general classes:

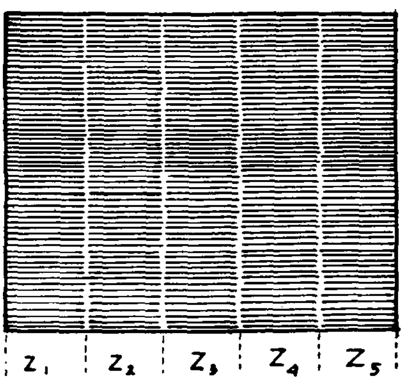


Fig. 1.—Showing how the picture is composed of five vertical zones.

A, Images directly produced on a screen by a moving light beam, the size of image being limited only by the loss of brilliance; B, optical enlargement of images of limited size—(1) by directly viewing through a lens, or lens-system, or (2) by projection through lenses on to a screen.

Class A comprises most of the so-called mechanical scanning systems, working with rotating or oscillating optical elements such as lenses, mirrors, prisms, etc. Class B includes all moving shutter systems such as Nipkow discs, drums, slotted discs and drums, etc., and especially cathode-ray images.

The brilliance and size of pictures produced under class A group, assuming constant intensity of the light source and constant area of the optical elements, depend upon the distance between the screen and the moving optical elements, and also upon the angle between those two positions of these elements which represent the maximum deflection on the screen. The inherent limitations of most mechanical systems for high-definition pictures are well known, the two most outstanding being extremely low light efficiency and complicated mechanical construction.

Class B group allows enlargement of complete television pictures almost exclusively by means of lenses. In the case of B_1 the directly enlarged and viewed image does not lose its brilliance (glass absorption and other minor losses not taken into consideration), yet with increasing enlargement the observing angle becomes rapidly restricted, and in addition the size of the enlarged image is limited by the dimensions of the lens or lens-system.

Group B_2 is optically identical with the projection of moving-picture films and makes it possible to produce pictures unlimited in size, yet the images must have great brilliance to start with in order to allow large enough projection.

How the brilliance of projected pictures in general can be mathematically defined is shown hereunder.

When a light source of g candles per cm. square is projected through an optical system of S cm. square aperture over a distance of d cm. (measured from the plane of aperture to the projection screen), the intrinsic

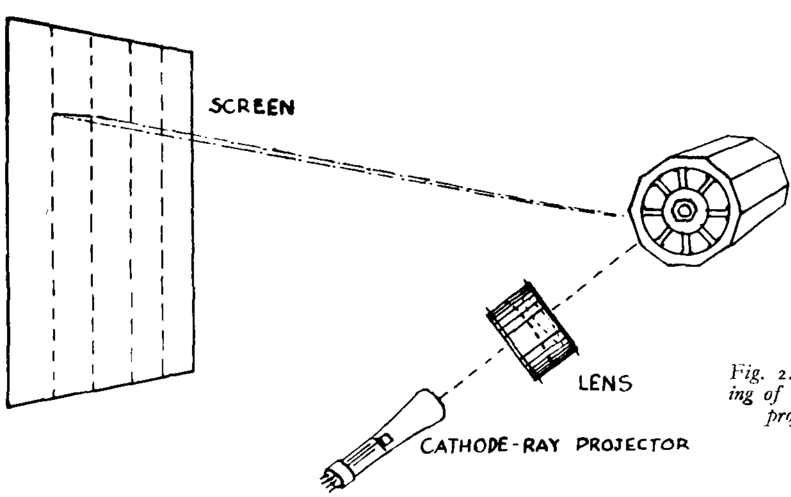


Fig. 2.—Schematic drawing of the electron-optical projection system.

EFFICIENCIES OF MECHANICAL SYSTEMS

brilliance (candles per cm^2) of the projected image G will be:

$$G = g.\frac{S}{d^2} \quad \ldots\ldots (1)$$

In order to simply further calculations it is assumed for the time being that the picture ratio (height to width) will be 1 : 1 and that Talbot's law is not taken into consideration. According to Talbot's law the intrinsic brilliance of a picture (G) produced by a scanning light spot is inversely proportional to the square of the number of picture elements (n).

$$G = k.\frac{1}{n^2} \quad \ldots\ldots (2)$$

Since this rule has to be applied to all television systems, for the following comparative calculations it can be omitted.

For the systems under class B_2 the formula 1 can be transformed as follows: If D is the useful diameter of the projecting lens or lens-system, then S is $\frac{\pi}{4}D^2$.

From the lens equation $1/q - 1/p = 1/f$ it can be found that the distance between lens and image is:

$$p = f\ (p/q + 1) \quad \ldots\ldots (3)$$

The magnification of the optical system is $\xi = p/q$ by substituting d for p $d = f\ (\ \xi + 1)$ and the intrinsic brilliance on the screen will be:

$$G = \pi/4.\ (D/f)^2.g.[1/(\ \xi + 1)^2] \quad \ldots\ldots (4)$$

When, for instance, a picture is projected on to a screen and magnified 20 times through a lens-system with $d/f = 1/2$ and the intrinsic brilliance of the light source is 100 (candles per cm^2), the resulting intrinsic brilliance of the scanning light spot on the screen will be:

$$G = \pi/4.1/4.100/21^2 = .044\ c/cm^2.$$

This value is extremely small and shows how inefficient a direct optical enlargement is. The speed of the projecting lens was purposely not chosen larger than 1 : 2, because this aperture-to-focus ratio will not make the price of the lens system prohibitive. In all further calculations the same " speed " will be used in order to obtain comparable results.

Formula 1, when applied for rotating or oscillating optical elements, is used as follows: The distance between projector and screen will be:

$$d = H/2.\tan \alpha \quad \ldots\ldots (5)$$

where H is the height of the projected picture and the angle of maximum deflection. S from formula 1, in the case of mirror-drums (to be considered here specially) is represented by the useful area of one mirror, and in oscillating mirror systems by the area of the vibrating mirror. Optically the lens and mirror-drum can be dealt with simultaneously. For class A the intrinsic brilliance on the screen is then:

$$G = (4.g.S.\ \tan^2\alpha)/H^2 \quad \ldots\ldots (6)$$

For the mirror-drum: $\alpha = 360/m$ or $2\pi/m$, where m is the number of mirrors along the circumference of the drum.

For rotating or vibrating mirrors formula 6 shows that for constant light source intensity and mirror size, the screen brilliance is proportional to the square of the ratio $(\tan\alpha)/H$ or

$$G = k_1.(\tan\alpha/H)^2 \quad \ldots\ldots (7)$$

For high-definition pictures $\tan^2$ for mirror-drums and S for vibrating mirrors will have to take such low values that those two systems have hardly any commercial merit. Combinations of stationary and rotating mirror-drums, or the latter with drum segments, show some improvement in light efficiency, yet are still far from acceptable projection standards.

A new television projection system has been created by combining groups A and B in a new principle which I claim possesses all the advantages but none of the disadvantages of the two previous classes.

The picture in this new system is scanned in two directions, from top to bottom (or vice versa) and from left to right (or vice versa). For instance, the top to bottom scanning consists of ordinary scanning lines, their length being equal to the width of one zone, while the left to right scanning is achieved by joining a sufficient number of zones next to each other in order to obtain the correct picture width.

The number of lines and zones are independent from each other, and the picture can be broken up into vertical lines and horizontal zones instead of vertical zones and horizontal lines. Fig. 1 shows how a picture scanned in 5 vertical zones actually consists of 5 separate narrow pictures each of which is scanned by the same amount of lines. The number of picture elements of such a picture is, of course, the same as that of an ordinary television picture, with the same number of lines as in one zone, since the length of one line is as many times smaller as there are zones.

The horizontal lines in the zones are produced by an extremely small cathode-ray tube where the fluorescent spot is deflected only in one direction, as indicated on Fig. 1. The intensity of the fluorescent spot is modulated in the usual way. A lens projects the moving spot (for instance, horizontally deflected) through a rotating mirror-drum on to a screen. The mirror-drum has at least as many mirrors as there are zones in the picture. Each mirror is tilted differently so that the rotating drum spreads the moving spot into zones joining each other, thereby forming the picture shown in Fig. 1. Fig. 2 shows the schematic drawing of the projection.

A 5-zone picture can be produced by a drum with 15 mirrors so that three complete pictures result from one revolution of the drum. At a rate of 24 complete pictures per second the drum, therefore, has to make eight revolutions per second or 480 r.p.m. With mirrors 20 centimetres square in area, the drum will have a diameter of about 5½ ins. The physical dimensions and speed of rotation of the moving part of this system are, therefore, very small. The cathode-ray projector tube is extremely small in size producing a light spot of reasonable size. For a picture composed of 250 lines, built up of five zones, 1,250 deflections are necessary to complete one frame. At 24 frames per second, 30,000 deflections per second are needed in order to produce a continuous effect on the screen. The cathode-ray tube being practically inertialess, easily provides such a scanning frequency while the projecting drum enlarges the images to any desirable size at comparatively small loss of light, as shown in the fol-

PROJECTED PICTURES WITH A CATHODE-RAY TUBE

lowing: The equation 6 will be used here, yet instead of α it is necessary to write:

$$\alpha = 2\pi/\omega.p \quad \text{(8)}$$

where ω is the number of zones and p the number of complete pictures scanned during one revolution of the drum. For the new system the intrinsic brilliance of the light spot on the screen will be:

$$G_3 = 4.g.S\ (\tan^2 2\pi/\omega.p)/H^2 \quad \text{(9)}$$

At constant picture size H, light source brilliance g, the brilliance of the projected picture is:

$$G3 = k_4.S.\tan^2(2\pi/\omega.p) \quad \text{(10)}$$

Formula 10 is the typical mathematical representation of the new zone projection system; the system acts as a cylindrical lens. It enlarges more in one direction than at right angles to that direction. The enlargement in the direction $\alpha = 2\pi/\omega.p$ is ω times greater than in the horizontal direction (referring to Figure 1). Since the enlargement in the α or vertical direction is a spreading of the lines, the light spot on the fluorescent

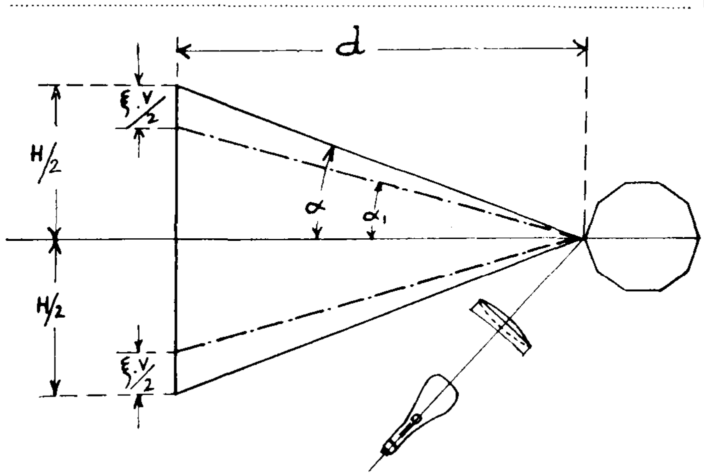


Fig. 3.—Diagram showing how the spreading is applied to reduce the necessary deflection angle.

screen is only enlarged as many times as permitted by the projection lens. The picture in horizontal direction, on the other hand, is a result of multiplying the vertical zone by ω, so that the light spot on the cathode-ray tube screen is many times larger than it would be if a picture of the same size were produced by ordinary scanning. The fluorescent spot for the zone projector system is exactly ω times larger.

The brilliance of the projected picture can be increased in several ways. From formula 10 it can be seen that the surface of the mirrors, when enlarged, will proportionally raise the amount of light projected on to the screen. On the other hand, $\tan^2 \alpha$ will increase with decreasing number of pictures per revolution of the drum: (p). When, for instance, the mirror surface in the example cited before is increased to double (40 cm^2), the number of mirrors at 5 zones can be reduced to 10, the diameter of the mirror drum would be even smaller than before, namely, 5 inches.

A numerical comparison between the light efficiency of the direct projection of cathode-ray pictures (formula 4) and the zone-projector system (the latter varied for two different values of ω and p) is shown here.

In both systems pictures with 250 lines at 24 frames per second 50 cm. by 50 cm. (about 20 ins. by 20 ins.) in size, using a cathode-ray tube of 25 mm. (1 in.) diameter and maximum deflection with an intrinsic brilliance of 100 candles per cm^2 are produced. The lenses used will have d/f = 1 : 2 in both cases.

Direct Enlargement.	*Zone Projector System.*	
Formula 4.	*Formula* 9.	
$G_1 = \pi/4.(d/f)^2.g/(+1)^2$;	$G_2 = 4.g.S.\tan^2(360/\omega.p)/H^2$;	
d/f : ½; g : 100; : 20;	g : 100, H : 50 cm.	
G_1 = .044c/m^2	S : 20	S : 40
	ω : 5	ω : 5
	p : 3	p : 2
	G_2 = .64 c/cm^2	G_2 = 3.4 c/cm^2

It can be seen that the intrinsic screen brilliance of the new zone projector system when using 15 mirrors of 20 cm^2 area each is 14.5 times greater, and when using 10 mirrors of 40 cm^2 area each is 77.3 times larger than with the ordinary direct projection of cathode-ray pictures under equivalent conditions of tube size, intrinsic brilliance, picture size, and lenses. (The same ratio in brilliance is obtained when comparing tubes of larger size.) Of course, a complete 250-line picture cannot be produced on a cathode-ray tube screen of 1 in. in diameter, since the light spot has to be slightly over .1 mm. in diameter. Yet the new zone projector does use a small tube of 1 in. diameter, since the screen deflection does not have to be any larger, using a light spot of slightly under .5 mm., a size which is easily achievable in modern cathode-ray tubes.

The cost of a small tube of only 1 in. diameter is, of course, extremely low; as a matter of fact, like the new all-metal radio tubes, these projector tubes can be made out of metal with only a narrow glass or quartz window in front.

The picture ratio was assumed so far to be 1 : 1. The more customary size also used in motion picture films is 5 : 6 (height to width). In order to obtain this ratio it is either possible to tilt the mirrors of the rotating drum in such a fashion that the desired ratio results or, as appears to be more satisfactory, to introduce the so-called "spreading," which means that the deflections on the screen of the projector tube are spread in a direction at right angles to the original deflections

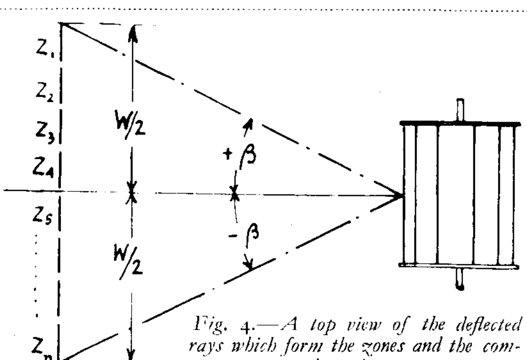


Fig. 4.—A top view of the deflected rays which form the zones and the complete picture.

by means of an additional pair of electrodes or rather deflecting plates. The necessary deflecting potential is obtained from saw-tooth shape oscillators, the same way as generated for the line-frequency deflections.

OPTICAL ENLARGEMENT

The amount of spreading depends upon the required picture ratio primarily, and is controlled by the amplitude of the deflecting potential as well as by the magnification of the optical projection system. The frequency of the deflecting voltage, producing "spreading," is equal to zone frequency which is equal to the number of complete frames per second divided by the number of zones. How the line frequency and zone

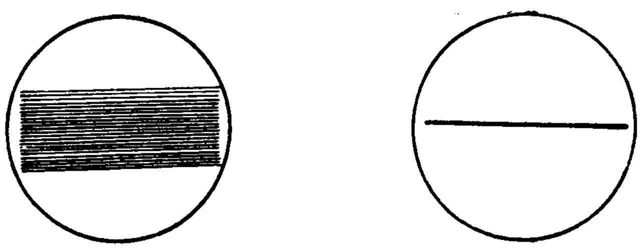


Fig. 5.—Actual shape of a spread scanning pattern and (5a) scanning along one line only.

frequency are kept in step with each other will be shown later under Synchronisation.

The angle between adjacent mirrors on the drum according to formula 8 was:

$$= 2\pi/\omega.p.$$

In order to compensate for the necessary spreading, angle α has to be reduced to α_1. The amount of spreading on the fluorescent screen is v; this means the original beam trace is deflected at right angles to its length, the amount of this deflection being v times the width of the original trace. Fig. 3 shows a schematic diagram of how the "spreading" is applied to reduce the necessary deflection angle; it correspondingly increases the existing one.

It is $(H - \varepsilon.v)/2d = \tan \alpha_1$; and $H/2d = \tan \alpha$; therefore $(H - \alpha.v)/H = \tan \alpha_1/\tan \alpha$; and $\tan \alpha_1 = [\tan(2\pi/\omega.p)].(H - \varepsilon.v)/H$ 11

Instead of compensating the increase of $2\pi/\omega.p$ by increasing the number of mirrors, the light efficiency can still be raised by obtaining the adequate picture width (according to the correct ratio) through increasing the tilting angle β of the mirrors. The tilting angle (producing the zones) without considering "spreading" effect is derived in the following way: Fig. 4 gives the top view of the deflected rays, forming the zones and the complete picture. The number of zones was ω and z is their width. From Fig. 4 it can be seen that the maximum deflection to each side from the centre line is:

$$W/2 = (z.\omega - 1)/2 \quad \text{.........................} \quad (12)$$

Accordingly, the maximum deflecting angles $+\beta$ and $-\beta$ are calculated as follows:

$$\tan(\pm\beta) = (z.\omega - 1)/2d \quad \text{......................} \quad (13)$$

The total width of the picture is W = z. and the height was H. The picture ratio u is therefore:

$$u = H/z.\omega \quad \text{....................................} \quad (14)$$

Now if spreading of the trace on the fluorescent screen is introduced, v being the amount of spreading, the angle β has to be increased, if $2\pi/\omega.p$ should remain unchanged; the latter is desirable as explained before, in order to obtain a larger image without loss of brilliance, compared with the size and brilliance of the picture before spreading. The increased height of the picture will be:

$$H_1 = H + \varepsilon.v \quad \text{...............................} \quad (15)$$

Since the picture ratio was $u = H/z.\omega$ according to formula (14) and should remain unchanged, it is also $u = H_1 z_1.\omega$, where z_1 is the increased width of the zones.

It follows that $H/z.\omega = H_1/z_1.$; therefore $z_1 = z.H_1/H$ and combining it with formula (15) the new width of the zones will be:

$$z_1 = z(1 + \varepsilon.v/H) \quad \text{............................} \quad (16)$$

In formula (16) $(1+\varepsilon.v/H)$ is called q and is the spreading coefficient. It remains to find the new deflection angle β_1, which will produce the increased width when vertical spreading is introduced.

Formula (13) was $\tan(\pm\beta) = (z.\omega - 1)/2d$; according to formula (5) : $d = H/2.\tan\alpha$; therefore: $\tan(\pm\beta) = [(z.\omega - 1)/H\ .\tan(2\pi/\omega.p.$ When introducing $\beta 1$:

$$\tan(\pm\beta 1) = [(z.\omega.q - 1)/H]\ .\tan(2\pi/\omega.p) \ldots (17)$$

Obviously the diameter of the fluorescent spot on the screen of the projector tube has to be increased according to the amount of spreading.

The increased height of the projected picture was according to formula (15) $H_1 = H + \varepsilon.v$. When using k number of lines the original spot diameter was (overlapping omitted):

$$X = H/k.\varepsilon \quad \text{..................................} \quad (18)$$

After spreading, the increased spot diameter will be:

$$X_1 = (H + \varepsilon.v)/k. \quad \text{.....................+...} \quad (19)$$

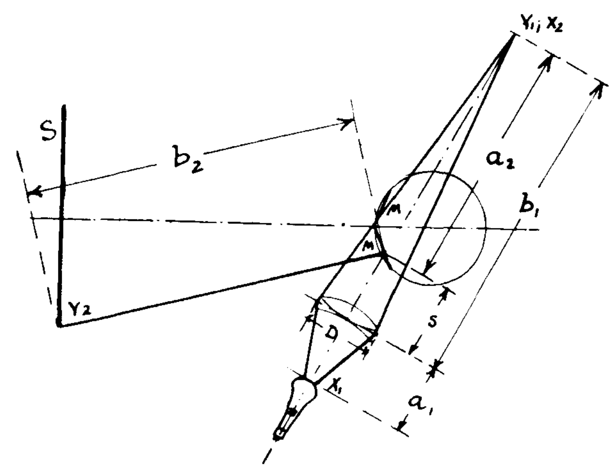


Fig. 6.—Schematic drawing of optical enlargement and projection.

From 18 and 19 the new spot diameter, expressed with q from the spreading coefficient, will be:

$$X_1 = X(1 + \varepsilon.v/H) \text{ or } X_1 = q.X \quad \text{........} \quad (20)$$

In practice the great advantage of "spreading" is that the fluorescent spot is not produced across one single line only, but is distributed on a larger area of the screen. Thereby the life of the fluorescent screen is greatly increased and undue overheating of the tube by electron bombardment on a relatively small space is prevented. Fig. 5 shows the actual size and shape of a spread scanning pattern, while 5a shows scanning along one line only.

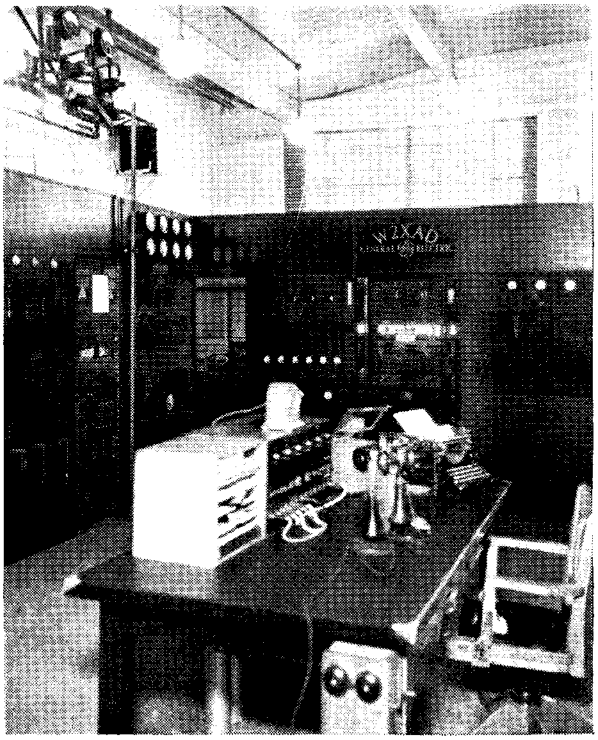
Fig. 5 pattern produces a 5-zone picture at 250 lines, the spot diameter on the fluorescent screen being

(*Continued on page 675*).

Short Waves for the Beginner

Short-wave Entertainment

This article gives an outline of the wonderful amount of light entertainment that can be obtained by short-wave listening. There are now over two hundred stations which provide really excellent programmes.



W2XAD on 19·56 metres uses an aerial directed on Europe. It is a particularly easy station to hear.

TWO or three years ago a short-wave receiver would only bring in commercial stations, amateurs, and occasionally two or three erratic programme broadcasters, so the beginner could well be excused for becoming sceptical about the value of a short-wave receiver. The fact that manufacturers are now building all-wave receivers is, in itself, proof that the short-wave end is of use, for manufacturers are not philanthropists and never do they build a special receiver until there is a definite demand.

There are several comprehensive lists available showing the wavelengths of some 400 active short-wave stations. Although programme sheets are available, these are not much use to the man in the street who has just bought a short- or all-wave receiver, and who wants to hear the best programmes.

Out of these 400 stations not all are of interest to the beginner, though after a time when the art of tuning a short-wave set has been mastered there are many out-of-the-way stations that can be heard from time to time.

We can assume that readers wish to listen between the hours of six and midnight, so for that reason we are devoting much more space to the stations receivable during those hours, but for those short-wave readers who can listen during the afternoon here is a list of the stations most likely to be heard.

Wavelength.	Time.	Station.	Location.
15.93	2.40 p.m. (onwards)	Bandoeng	Java
16.87	2 p.m. until 4 p.m.	W3XAL	New Jersey
16.89	1-7 p.m.	Zeesen	Berlin
19.52	1-4 p.m.	HAS3	Budapest
19.56	6-9 p.m.	W2XAD	Schenectady N.Y.
19.63	2-8 p.m.	DJQ	Berlin

The periods for which these stations transmit may vary, but they are never less than mentioned above. Bandoeng, in Java, is a most reliable station. Actually it was erected about ten years ago and is a commercial station, but at the moment excellent records are sent out during the afternoon. It really is great fun listening to a station like this from the other side of the world.

All short-wave fans when they want to demonstrate the efficiency of their receiver invite friends to listen to W3XAL, in Boundbrook, New Jersey. During the week-day afternoons it relays the normal N.B.C. programmes. When you hear this station on the loudspeaker of a simple set, do not for a moment imagine that the set is anything extraordinary. This station is so loud and so reliable that almost any receiver will bring it in during the times quoted. There is a whole host of stations in Berlin, all on different wavelengths, of course, but during daytime, the 16.89 wavelength is most reliable. Programmes may not be anything out of the ordinary. They are usually relayed from a medium-wave German station, but very few receivers will bring in, say, Hamburg, during the afternoon without a fair amount of noise level.

W2XAD is in the same building as W2XAF, in Schenectady, New York. It relays programmes from WGY a station often relayed by the B.B.C. a few years back. This, perhaps, is the most popular of the American short-wavers, for it is available in the evening as well as during the late afternoon. W2XAD usually radiates from 6 p.m., but sometimes it is a little earlier than this.

Next time the B.B.C. start their "Five-hours Back" series, listen to the broadcast direct from W2XAD and don't be surprised if your results are almost as good as that obtained by the B.B.C. This station is easy to get, particularly as their aerial is directed to Europe.

There are far too many stations broadcasting during the evening for us to give a complete list, but make a note of these specially selected stations which anyone can hear under reasonable conditions.

Wavelength.	Time.	Station.	Location.
23.39	12.30-3 p.m. Sundays only	CNR	Rabat, Morocco
25.00	7-10 p.m.	RNE	Moscow
25.25	8-midnight onwards.	FYA	Paris
25.26	9 p.m.-4 a.m.	W8XK	Pittsburgh
25.4	5 p.m.	I2RO	Rome
30.43	10.30 p.m. onwards.	EAQ	Madrid
30.67	5 p.m. onwards.	I2RO	Rome
31.25	9.30 p.m. onwards.	CT1AA	Lisbon
31.28	6-9 a.m. and 3-6 p.m. Sundays	VK2ME	Sydney
31.36	4 p.m.-5.30 p.m.	VUB	Bombay
31.48	11.15 p.m.-4 a.m.	W2XAF	New York

All of these stations are being heard regularly on small and large sets with equal ease. The two-valve receiver in the October issue received all of the above stations with the exception of

Bombay, in two days, so expense is not really an important item.

Some readers query the use of hearing these international stations. International is the correct term, for the programmes radiated are picked up throughout almost the entire world. A good example is W8XK. This station is permanently linked with KDKA, a station known all over the world. The programmes are the same as those heard by Americans every evening. The thousands of people who listen to Radio Luxembourg will appreciate these programmes. Contrary to general belief, more advertising matter is broadcast from the European commercial stations than from the better-class American transmitters. The only way to eliminate the idea that an American broadcast is like an Eddie Pola burlesque is to listen to America during one of the normal transmissions.

I2RO in Rome is of special interest at the moment. An English announcer broadcasts news bulletins for our special benefit so that we get quite a different angle on present affairs. VK2ME, Sydney, has no programme value as it only broadcasts on Sundays at awkward times and then only English records. Very few, however, can resist the thrill of listening to an Australian station. The best American station for late night reception is W2XAF, which is linked to W2XAD. Try this station some time.

When the B.B.C. have closed down listen to New York via W2XAF on 31.48 metres. It relays WGY.

After midnight there are also some 30 or 40 stations radiating continuously. For example, Johannesburg, on 49 metres. W2XE, Atlantic City, 49.02 metres, W9XF, 49.18 metres, VE9DW, in Ontario, 49.26 metres, and so on. When tuning the short-wave receiver remember that it is quite a waste of time going from one end of the tuning dial to the other. Listen for some particular station or on a certain waveband, then programmes will be heard.

Typical American Programmes

TO give readers an idea of what entertainment can be heard from America from W2XAD and W2XAF, here are some actual programmes. Times are Eastern Standard, but to convert to Greenwich time simply add five hours.

W2XAD, 19.56 metres, 15,330 kc.
Schenectady, New York.

Wednesday, October 30. (E.S.T.)
2.00 p.m.—Helene Mae, soprano.
2.15 p.m.—Household Chats.
2.30 p.m.—NBC Music Guild.
3.00 p.m.—Sign off.

Thursday, October 31. (E.S.T.)
2.00 p.m.—Household Musical Revue.
2.30 p.m.—Louise Florea, soprano.
2.45 p.m.—Pete Mack's Moosikers.
3.00 p.m.—Sign Off.

Friday, November 1. (E.S.T.)
2.00 p.m.—Helen Hathaway, soprano.
2.15 p.m.—Household Chats.
2.30 p.m.—Musical Program.
2.45 p.m.—Musical Program.
3.00 p.m.—Sign Off.

Saturday, November 2. (E.S.T.)
Saturdays during October and November, W2XAD and W2XAF will carry intercollegiate football games, starting generally at 1 p.m.

W2XAF, 31.48 metres. 9,530 kc.
Schenectady, New York.

Wednesday, October 30. (E.S.T.)
4.00 p.m.—Betty and Bob, sketch.
4.15 p.m.—Woman's Radio Review.
4.30 p.m.—Stock Market Quotations.
4.45 p.m.—Musical Program.
5.00 p.m.—Al Pearce and his Gang.
5.30 p.m.—Adventures of Tom Mix.
5.45 p.m.—Clara Lu 'n 'Em.
6.00 p.m.—Flying Time.
6.15 p.m.—Joe LaTour, comedy sketch.
6.30 p.m.—News Items—English.
6.35 p.m.—Talk by Stanley High.
6.45 p.m.—News Reports.
6.50 p.m.—Musical Program.
6.55 p.m.—Marty McDonagh, sports comments.
7.00 p.m.—Amos 'n' Andy.
7.15 p.m.—Uncle Ezra's Radio Station E-Z-R-A.
7.30 p.m.—Stock Market Reports.
7.50 p.m.—News Items—Spanish.
8.00 p.m.—LATIN AMERICAN CONCERT—Ortiz Ensemble.

Thursday, October 31. (E.S.T.)
4.00 p.m.—Betty and Bob, sketch.
4.15 p.m.—Women's Radio Review.
4.30 p.m.—Book News, Levere Fuller.
4.45 p.m.—Stock Market Quotations.
5.00 p.m.—Musical Program.
5.30 p.m.—Matinee Musicale.
5.45 p.m.—Clara Lu 'n' Em.
6.00 p.m.—Flying Time.
6.15 p.m.—Bart Dunn & Studio Orchestra
6.30 p.m.—News Items—English.
6.35 p.m.—Talk by Stanley High.
6.45 p.m.—News Reports.
6.50 p.m.—Musical Program.
6.55 p.m.—Marty McDonagh, sports comments.
7.00 p.m.—Amos 'n' Andy.
7.15 p.m.—Popeye the Sailor.
7.30 p.m.—Stock Market Reports.
7.50 p.m.—News Items—Spanish.
8.00 p.m.—Variety Hour, Rudy Vallee & his Orchestra.
9.00 p.m.—Capt. Henry's Maxwell House Show Boat.
10.00 p.m.—Paul Whiteman's Music Hall.

Friday, November 1. (E.S.T.)
4.00 p.m.—Betty and Bob, sketch.
4.15 p.m.—Woman's Radio Review.
4.30 p.m.—Stock Market Reports.
4.45 p.m.—Musical Program.
5.00 p.m.—Al Pearce and his Gang.
5.30 p.m.—Adventures of Tom Mix.
5.45 p.m.—Clara Lu 'n' Em.
6.00 p.m.—Flying Time.
6.15 p.m.—Joe LaTour, comedy sketch.
6.30 p.m.—News Items—English.
6.35 p.m.—Talk by Stanley High.
6.45 p.m.—News Reports.
6.50 p.m.—Musical Program.
6.55 p.m.—Marty McDonagh, sports comments.
7.00 p.m.—Spanish Home Program.
7.30 p.m.—Stock Market Reports.
7.50 p.m.—News Items—Spanish.
8.00 p.m.—Cities Service Concert—Jessica Dragonette, soprano.
8.30 p.m.—Farm Forum.
9.00 p.m.—Waltz Time—Concert.
11.30 p.m.—Glen Lee & his Orchestra.
11.45 p.m.—Jesse Crawford, organist.
12.00 mid.—Program Resume.

Optimum Performance from the Transmitting Antenna

By Rienzi B. Parker, Ph.D., W1AJZ, Harwichport, Cape Cod, Massachusetts

THE object of experiments made at the writer's station was to obtain the best performance possible from an antenna operated in the 14 mc. amateur band. Careful study had convinced me that for my particular location the antenna best suited to this band of frequencies was a horizontal wire of such length as to be operated at a harmonic rather than at the fundamental wavelength. Accordingly, as a practical compromise with the limitations imposed by available space and expense of the supports, a wire was put up which, in terms of 14 mc., was two wavelengths long and 0.9 wavelength above ground.

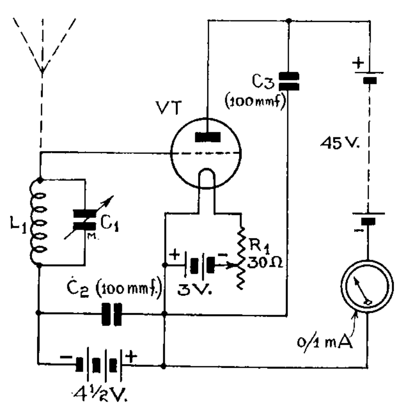


Fig. 1.—This field meter embodies quite a conventional circuit which is self-explanatory.

Certain other practical considerations made it desirable to use a single-wire feeder. This feed system, like other non-resonant lines, should be terminated at both transmitter and antenna so that standing wave on the line is reduced to a minimum. Termination at the transmitter was accomplished through a conventional antenna matching network.

In order to effect proper termination at the antenna, two r.f. ammeters were placed in the feeder at points one-quarter wavelength apart. Then, starting at the point on the antenna which calculation had shown to be the proper place of attachment, the feeder was moved along the antenna until the two ammeters read alike thus indicating reduction of the standing wave.

As a check upon this method of adjustment, the field meter shown by Fig. 1 was used. This was set up at some distance from the antenna and as remote from the feeder as possible. With constant input it was found that maximum reading on the field meter coincided with equal readings of the r.f. ammeters in the feeder. Therefore, it was concluded that the feeder termination at the antenna had been properly made.

For an antenna two wavelengths long, calculations based on 14.2 mc. show the point of feeder attachment to be 18 ft. 9 ins. one side of the centre. With the particular antenna studied, it was found that the proper point for feeder attachment was 22 ft. one side of the centre. While the divergence is interesting, the value of 22 ft. certainly should not be considered to hold true for other two-wavelength antennas because, among many other factors, physical configuration of the feeder and height of the antenna above ground tend to alter the point of attachment considerably.

The usual amateur practice had been followed in cutting the antenna to a length calculated by the following formula:

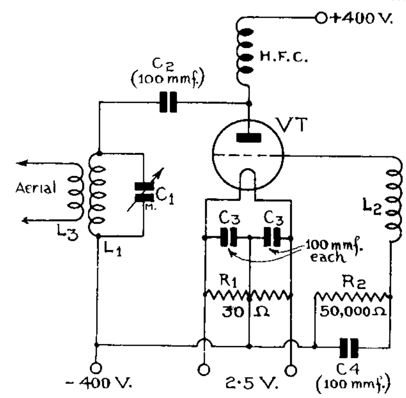


Fig. 2.—An oscillator of this kind can be constructed from standard components as indicated. The valve, although of American design, can be an AC HL with a 4-volt heater.

$$\text{Length (feet)} = \frac{468{,}000}{\text{Freq. (kc.)}}$$

In order to determine if the calculated length were correct for the antenna selected for 14 mc. the following

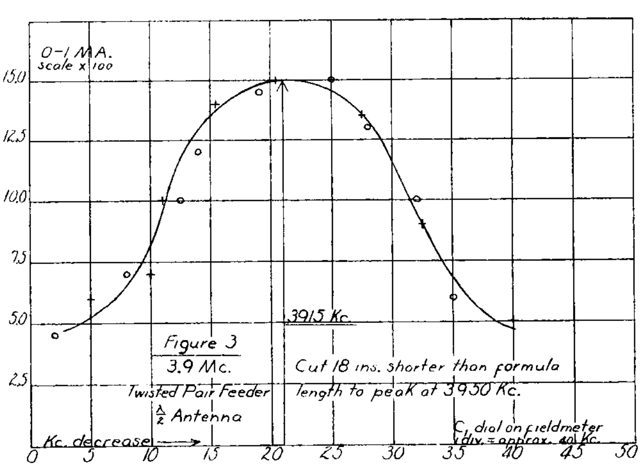


Fig. 3.—This is the resonant curve of an aerial designed for 3.9 megacycles on the 80-metre band.

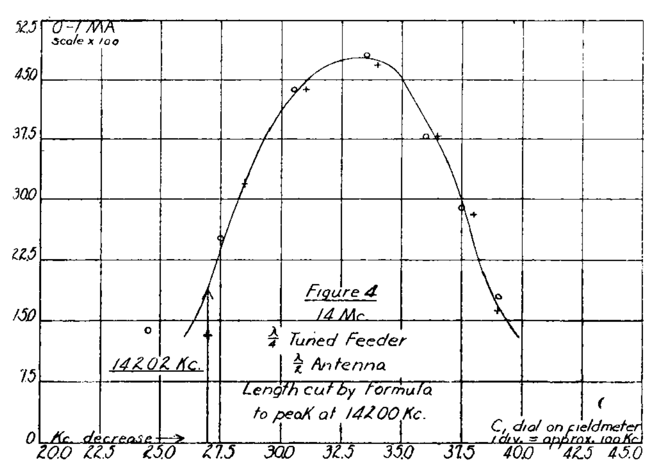


Fig. 4.—The constants are given for this 14-mc aerial. The length is exactly to formula.

method was employed. A small oscillator was constructed with the constants shown in Fig. 2. This was coupled to the antenna under test. The field meter was placed near the antenna and the frequency of the oscillator, or driver, was varied. For each setting of the driver two readings were taken on the field meter, the milliammeter and the dial of C_1, and thus a series of values were obtained which were plotted to give a curve showing the resonance of the antenna.

Unfortunately, such procedure requires a driver of good regulation, and this was not available. In order to minimise the false results arising from that the reference point of 3,915 kc. indicated in Fig. 3 and similarly shown in the other curves, was obtained by using the regular transmitter. After measurements were completed on an antenna, the transmitter was coupled to it under reduced input. Resonance was found on the field meter and the reading of the condenser dial noted. This gave one reference point in terms of kc. as indicated by the maker's calibration of the transmitting crystal, a point sufficitly accurate for measurements of this nature.

Also by using the main transmitter, it was possible to determine the difference in field meter indication, as between 10 and 15 in Fig. 3, represented in terms of r.f. power output. The transmitter input was first reduced until the indicator read 15 and then reduced further until a reading of 10 was obtained. For both cases the feeder currents were noted, and by comparing their squares it was found that a decrease in field meter reading from 15 to 10 represented a decrease of 85 per cent. r.f. power output. While it was not possible to conclude positively from this data that the doublet antenna of Fig. 3, if operated at such frequency either above or below its resonance peak as to correspond with indicator values of 10 on the curve, would cause a loss of 85 per cent. of the r.f. output power, it appeared that the evidence was sufficient to believe the loss would be considerable.

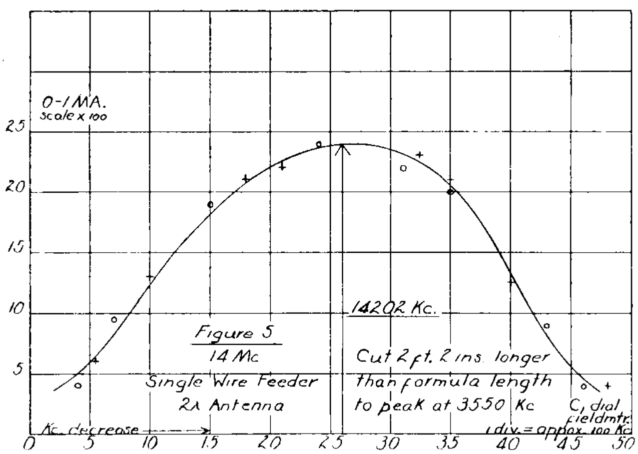


Fig. 5.—A double wavelength 14-Mc. antenna gives this curve.

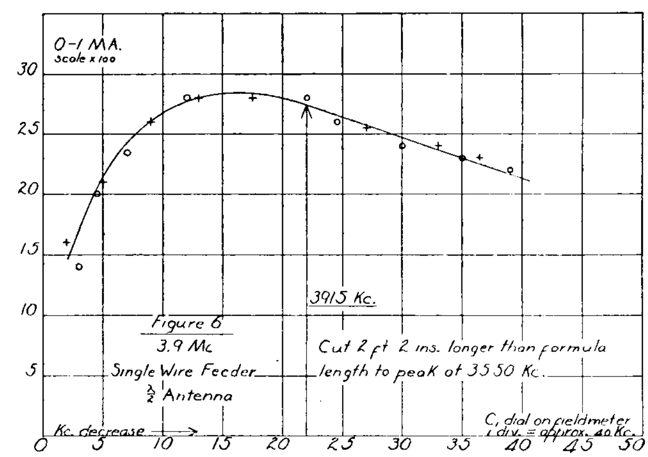


Fig. 6.—A two-wavelength 3.9-Mc. aerial gives this unsymmetrical curve.

poor regulation the following precautions were taken. First, the grid coil L_2 was adjusted carefully to secure as nearly uniform performance of the driver as possible. For these coils No. 26 d.c.c. wire was used wound on a 1-in. former and adjusted by half turns if necessary. Second, coupling between antenna and driver was made very loose. Third, two sets of readings were taken in each series of measurements, approaching antenna resonance first from the low-frequency and then from the high-frequency side. As a result of this last step each curve shown for antenna resonance has two sets of reference points, circles and crosses, according to whether resonance was approached and passed through from one side or the other.

Three different antennas were measured by this method, one antenna at both 14 and 3.9 mc., thus obtaining four resonance curves. These are reproduced herewith.

In Fig. 3 is shown the resonance curve of an antenna designed for the 3.9 mc. phone band. The antenna was cut 18 ins. shorter than the length calculated by formula for 3,950 kc., and it is evident from the curve that agreement between formula length and proper frequency response is close.

At this point it should be mentioned

Fig. 4 shows the resonance curve of a 14 mc. antenna, constants as noted, and here it is evident that resonance is far removed from the desired point of 14.2 mc. if the antenna is to be used in the 14 mc. amateur band. The length was cut exactly according to formula.

The resonance curve of the two wavelength 14 mc. antenna is shown in Fig. 5. As noted, the antenna is cut slightly longer than calculated by formula. This curve showed the antenna did peak over the desired range of operating frequencies on 14 mc. The considerably broader response, as compared to the fundamental antennas shown in Figs. 3 and 4, is a characteristic of harmonic operation.

The resonance curve of the same antenna for the 3.9 mc. band is shown in Fig. 6. This curve is not symmetrical like the others. The asymmetry, it is believed, is due partly to the offset position of the feeder which, having been adjusted for 14 mc. operation, is far removed from the proper point for operation on 3.9 mc.; and partly to the fact that the antenna is cut much too long for 3.9 mc. The fact remains that the desired range of phone frequencies, 3.9 to 4.0 mc., falls quite high on the curve.

With particular reference to 14 mc., it would appear that the study given the antenna system has been well worth while. With such limited means as were available it was possible to determine with reasonable certainty that the feeder was properly terminated and the system properly resonant. The results obtained with the antenna operated in this band have been excellent.

The Yorkshire Television Association

An association which is affiliated to the Television Society has been formed in Leeds.

The objects of the Association are the study of television and allied subjects by lectures, discussions, demonstrations and experimental work in the Association's club room or elsewhere. Application for membership is invited, the entrance fee being 5s. and the subscription 2s. per month, or in the case of country members 10s. per annum. Full particulars may be had on application to the Hon. Sec., A. Buckley, 52 Vicarage Avenue, Gildersome, Leeds.

What Amateurs are Doing

During his visits to amateur short-wave stations our Short-Wave Editor comes across numerous ideas that should be of interest.

A Super-het Conversion

MOST amateurs who have not been able to afford a real full-sized single-signal super-het envy all those stations who are using crystal-gate supers. One idea that I thought rather ingenious was being used in conjunction with a very antiquated super-het constructed in breadboard fashion, which on its own was comparatively flatly tuned. The idea has been tried and it appears that any short-wave super-het can be arranged in a simple way so that regeneration can be added to the I.F. amplifier. A small B.C.L. coil and variable resistance in the I.F. circuit are all that are required. The addition of this regeneration circuit, if sufficient regeneration is used, gives the receiver a single signal effect approaching that of a quartz crystal super. The arrangement is shown in Fig. 1.

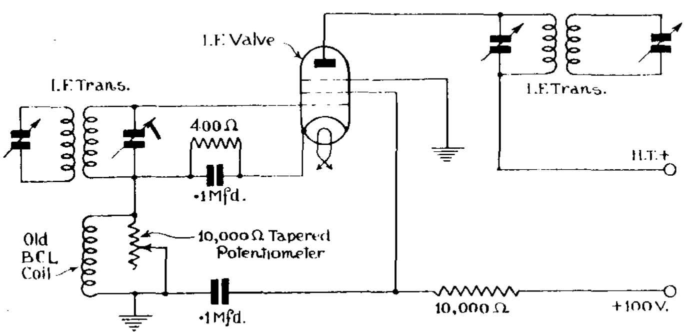


Fig. 1.—A simple idea that can be added to almost any super-het.

It requires the minimum amount of effort and knowledge to effect the alterations. A coil taken from an old B.C.L. receiver is used for cathode reaction and controlled by a tapered 10,000-ohms potentiometer or volume control. The isolating resistance and by-pass condenser in the screen-grid circuit are not always required, but this is a matter for experiment. The suppressor grid of the intermediate frequency pentode should be earthed as this enables it to act as an internal H.F. screen.

Too fierce oscillation can be cured by removing some of the turns from the B.C.L. coil. The interesting feature of this arrangement is that the cathode coil does not have to be inductively coupled to the transformer winding, while the coil can be wound very simply if a B.C.L. coil is not available. Generally, a 100 turns of 32-gauge enamel-covered wire on a standard coil former will do excellently.

Break-in

Break-in is occupying the thoughts of many at the moment. It is customary to use a black contact on a relay in order automatically to cut off the receiver while transmitting. This black contact usually causes a bad click in the phones or loud-speaker. The circuit of Fig. 2 uses 100 volts negative bias from a grid leak in the transmitter in order to lock up the A.V.C. system in the receiver. The slight lag introduced by the filtering action of the 0.1 condenser and the .1 megohm isolating resistance eliminates the clicks and prevents the transmitter from loading the A.V.C. circuit of the receiver.

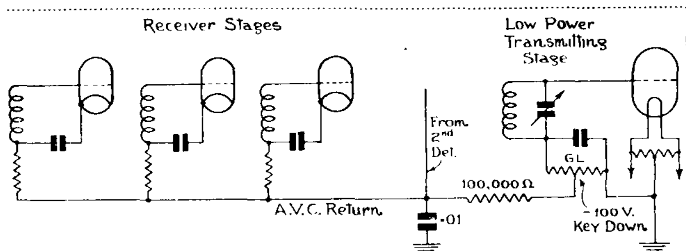


Fig. 2.—A lightning change-over can be made if this arrangement is used. It can be used with a straight set as well as in the I.F. stage of a super-het.

The circuit operates whenever a stage in the transmitter receives enough R.F. grid drive to make it draw grid current. The resultant negative bias is applied to the grids of the receiving valves preventing them from amplifying.

In a receiver in which no A.V.C. is used, 100 volts negative bias can be used to block out the R.C. coupled L.F. amplifying stage or even a transformer coupled stage if the D.C. grid return to earth is made through the transmitter grid leak, by-passed by a 1-mfd. in order to complete the L.F. to earth.

A convenient way to introduce the blocking bias into a receiver is to use a closed circuit jack, mounted at the rear of the receiver by the circuit in which the blocking bias is to be applied.

Universal Couplers

All the controversy about universal aerial couplers does not seem to have produced any concrete evidence. For my point of view I would not operate any transmitter on the 20-, 40-, 80- and 160-metre bands without my Collins couplers. On 20 and 40 metres there is a decided increase in QRK, while on

(*Continued on page* 671)

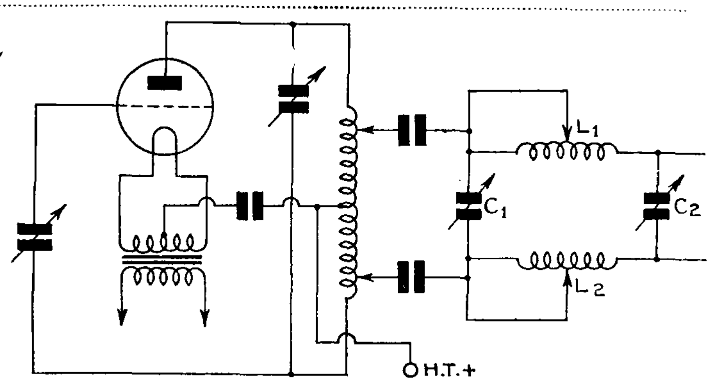


Fig. 3.—This is the well-known Collins coupler so popular in the States.

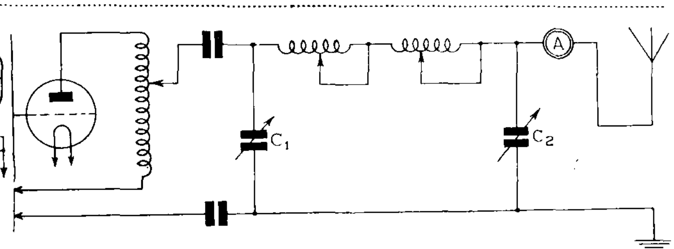


Fig. 4.—With a single feeder the Collins coupler has to be adapted in this way.

Heard on the Short Waves

By Kenneth Jowers.

F3AC is one of the most prominent 40-metre French stations on the band. Phone quality is very fine.

AMONG the bright spots of the month are the results of the A.R.R.L.'s 1935 DX Contest held during March of this year. It is getting quite a habit for G5BY to put up a good showing in these contests and this year he obtained 14,860 points and worked 12 countries on four wavebands. The next best G was 6NJ with a total of 10,097 points from 11 countries on two wavebands. The best GI was 6TK with 4,650 points from 10 countries on three wavebands.

Other European stations were ON4AU 24,030 points, EA4AO 23,504, D4BAR 18,870, F8FC 18,080, CT2BK 17,236, OK2AK 7,044, HB9J 6,220, PAOUV 6,080, LA1G 4,058, SM6SS 576. The station with the highest number of points was W3SI with 40,808 points from 56 countries on three wavebands. A large number of other W's went over 35,000 points.

Irish Competitions

At the time of writing, the Radio Society of Northern Ireland are competing for the Leonard Trophy. The contest started on October 26 at midnight and carried on until October 27 at midnight. The second half of the contest is from Saturday, November 2, at midnight, to Sunday, November 3, at midnight. The contest is open to all amateurs in Ireland. In conjunction with this contest will be held a further competition for British and foreign stations working Irish stations, for which a gold and silver medal is being awarded.

G6QI wants to arrange schedules for 56-mc. working. He is using ten watts phone on Tuesdays between 20.00 and 22.30 G.M.T., but is open to operate at other times for the purpose of tests. A multi-wave A.O.G. aerial is used with a single-ended Colpitts of special design. The oscillator is a PV625X. The QRA of G6QI is Potters Lane, New Barnet.

For those in South London, G5ZB is putting out a good signal on 56.72 mc. The QRA of 5ZB is 45 Moniven Road, Beckenham, Kent. His usual working hours are 22.30 to 23.30 on weekdays, and 11.30 to 13.30, 14.00 to 15.45 on Sundays. Reports will be welcomed. To make these reports of interest, please give details as to the aerial, receiver, strength of signals, carrier stability, and modulation.

The transmitter in use is a three-valve four-stage rig, with 7,090 kc. crystal oscillator with harmonic output on 14,180 kc. driving the first frequency doubler, which, in turn, drives the final valve for doubling down to 56.72 mc. During these test transmissions the radiator is a 70-foot multi-wave arrangement directly coupled to the transmitter.

Short-wave Broadcasters

Conditions on short waves for commercial broadcasters have been extraordinarily good during October. I have not been able to spend very much time in listening before 6 p.m., but at that hour W8XK and W2XAD have been varying between R7 and R9 plus. One evening in particular I was able to put four American transmitters on the loud-speaker at 7 p.m. using only a two-valve receiver. W2XAF on 31.48 metres and W2XAD on 19.56 now issue programmes in advance, which are really worth obtaining. Some of the American programmes have been shuffled round a little so that it is now possible to hear what we would consider to be evening programmes that are actually being broadcast during the afternoon in America.

As a good example, on Sunday evenings I have been listening to Jesse Crawford's Musical Diary which is broadcast at 4.15 Eastern Standard Time. It has been coming over at 9.15 p.m. G.M.T. regularly and makes a distinct change from the normal afternoon programmes, such as how to bake cakes and other domestic talks. The Lang Sisters, who are now almost as famous as the Boswell Sisters, broadcast at 6.45 most evenings, that is, a quarter-to-twelve British time.

Those who buy gramophone records will be well acquainted with the Dorsey Brothers and their Orchestra. They broadcast about three times a week, usually at 7.30 p.m. G.M.T. or half an hour after midnight. On October 21 Grace Moore broadcast from W2XAF, while during the last two weeks in October other prominent items included Amos 'n Andy, Wayne King's Orchestra, Ben Bernie and his Orchestra, Eddie Duchin, and a programme conducted by the American Agricultural Board. It may not sound very interesting, but actually it consisted of genuine hill-billy singers and came over very well indeed.

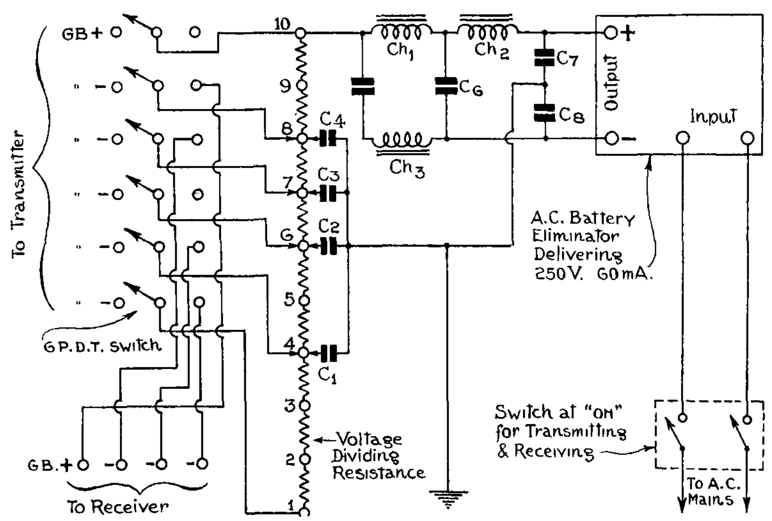
B.R.S. 1295 sends me some interesting information about doings in Scotland. J. Wyllie, G5YG, who for the last eleven years has been Scottish Manager for the R.S.G.B., has just resigned, but before doing so has organised a very comprehensive Scottish Society, divided into four districts. All the information can be obtained from James Hunter, G6ZV.

G6CT worked an LU on 40 metres and got an R6 report which is pretty good going. Talking about 40 metres, I managed to get R7 on phone from

Bombay which also pleased me. District 14 is still very active. The monthly meeting was held at G6CT, where a lot of interesting information came to light. 2BNR is working on 112 mc. while 2BWP is now rebuilding. He hopes to be in time for the VK-ZL contest for which G5VQ, G6CT and G6IF entered. G6NW, now on A.C., will be able to exceed his present input of 3 watts, and, finally, 2KT has received R8/R9 from New York.

F3AC, in Nantes, is putting out a fine signal on 40-metre phone. He is contacting very regularly with G's who comment on the exceedingly fine quality. His station is a business-like affair as the illustration shows.

F8DR is getting good R9 reports on phone from America and, according to many reports I have received, is one of the best European stations heard over the other side. K. M. Spiller, of Wimborne, sent me some information on W3CZE which is being well heard at the moment. The Tx. consists of 47 C.O., 802 doubler, 802 buffer, 860 buffer, and a pair of 832's in push-pull with 2,100 volts H.T. The speech amplifier modulator consists of the following line-up, 56, 59, two 46's driving a pair of 203B's with 1,250 volts H.T. The aerial is half-way 20-metre doublet with an EO1 transmitter line of 72 ohms.



Where cost is important this circuit used by GI5MZ should be used. One pack does the work of two.

GI5MZ has an interesting station and, as far as I am concerned, is the only Irish amateur who is doing very much on 40 metres. He has sent me the circuit of his power pack which delivers H.T. from his receiver, and by means of a multi-contact switch can be converted to supply bias for the transmitter. This is a fine way of saving money and is certainly more reliable than bias batteries.

Many readers have asked about FA and FT prefixes. FA is the new call for Algeria and FT for Tunis. QSL cards should be sent to Reseau des Emitteurs Francais, 17 Rue Mayet, Paris, 6e.

Birmingham amateurs are starting a radio society of their own and have already obtained the support of 50 active transmitters. As the Birmingham Society is one of the most go-ahead in the country I strongly advise anybody in that area interested in short waves to write to G2DV or 5BJ for further information. Another big Society is being formed in Croydon, but information will not be available for a week or so. If any South London readers wish to know more about this society, please drop me a card and I will forward it to the proper quarter.

When to Listen for Short-wave Stations during NOVEMBER

By C. J. Greenaway,—2BWP.

G.M.T.	3.5 m.c.	7 m.c.	14 m.c.
0400	VE1 ; W1, 2	W4, 5	
0500	VE1 ; W1, 2	W4, 5	
0600	VE1 ; W1, 2, 8	LU ; PY ; ZL	
0700	W1, 2, 3, 8	VK ; W3, 4, 5 ; ZL	
0800		W1, 3, 4, 5 ; ZL	
0900		W1, 3	LU ; SU ; YI
1000			CX ; SU ; ZL
1100			FA8 ; VK
1200			FA8 ; VK
1300			FA8 ; VK ; W1, 2, 3
1400			SU ; VE1 ; W8
1500			J ; SU ; VE1, 3 ; W1, 2, 8, 9
1600		SU	VE1, 2, 3 ; W1, 2, 3, 5, 6, 8, 9
1700		PK ; XU ; YI	CN ; W1, 2, 3, 6, 8
1800		SU ; FA8	W1, 2, 3, 8
1900		FA8 ; SU ; VK	VE1 ; W1, 3, 8
2000		CN ; FA8 ; VK ; W1, 2 ; YI	VE1 ; W1, 2, 3, 8, 9
2100		CN ; VK	W3, 9
2200		CT3 ; K5	
2300		K5 ; LU ; NY ; W3	
2400	W1, 2	CM ; W4	

"What Amateurs are Doing"

(Continued from page 669)

all bands the BCL's report less interference. This, in itself, merits the use of a coupler.

In the case of two-wire feed systems Fig. 3 should be used. The tank circuit of the P.A. is tuned for minimum feed with the coupler disconnected. The transmitter should then be switched and the coupler tacked on at either end of the plate coil. The parallel condenser at the aerial end of the coupler should be set to midway position, and then with the transmitter running normally C1 is adjusted for minimum feed. If the input is low, or high, alter C2 and readjust C1.

C1 and C2 can be .0003 or .0005 mfd., while coils L1 and L2 are 10 turns for 7 Mc., 5 turns for 14 Mc. A small point—always use minimum capacity and maximum number of turns.

Fig. 4 should only be used with a Marconi aerial, so is limited more or less to 1.7 working. The circuit is itself explanatory, while the coil values are 30 turns for L1 and L2 on a 2½-in. former. The fixed condensers in each case are merely for H.T. blocking and should be of high test value.

THE TELEVISION ENGINEER

THE DESIGN OF HIGH-DEFINITION AMPLIFIERS

By L. E. Q. Walker

This article is the third of a short series on the theoretical considerations of the design of high-definition television amplifiers. The articles are of special importance at the present time in view of the attention that is being devoted to the subject. The first two articles appeared in the August and September issues.

IN the preceding parts of this article we have investigated the nature of transient signals of the type generated in television systems and we have seen that, under certain ideal conditions, amplifiers could theoretically be designed which would cope with such signals and produce amplified and undistorted outputs. We must next see what limitations are imposed on amplifier design by practical considerations and in what ways these limitations react on the performance of the amplifiers.

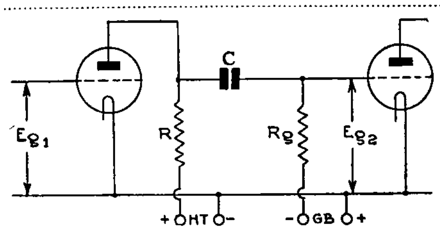


Fig. 16. — Typical stage of resistance-capacity amplification.

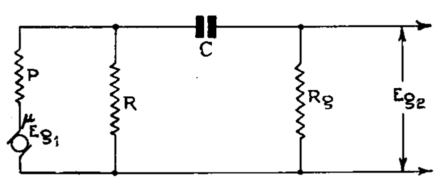


Fig. 16a.—Equivalent circuit of Fig. 16.

Let us first recapitulate briefly the general principles underlying amplifier design. We shall confine ourselves to the consideration of amplifiers of the resistance-capacity type as it is in modifications of this type that we shall find the best conditions for television signal amplification. The transformer-coupled amplifier, the choke-coupled amplifier, and the more involved types of amplifier which employ reactance elements between stages are not suitable as it is found that phase and amplitude response cannot be made satisfactory.

Indeed, as we shall see later, theoretically perfect amplification can be obtained without correction only if the elements between stages are purely resistive and entirely devoid of reactance.

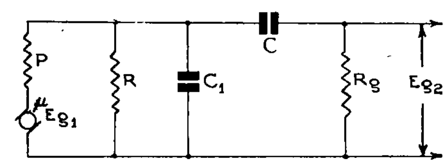


Fig. 17.—Equivalent circuit of Fig. 16 with by-pass capacity represented by C.

A single resistance-capacity coupled stage can be represented most simply as in Fig. 16, or by the equivalent Fig. 16A. In these figures ρ represents the internal plate-cathode resistance of the valve, which generates a signal voltage μE_{g1} (E_{g1} being the voltage applied to its grid), R the external anode resistance, C the coupling condenser to the grid of the second valve, and R_g the grid leak of the second valve.

Such a circuit as shown in Fig. 16a can easily be

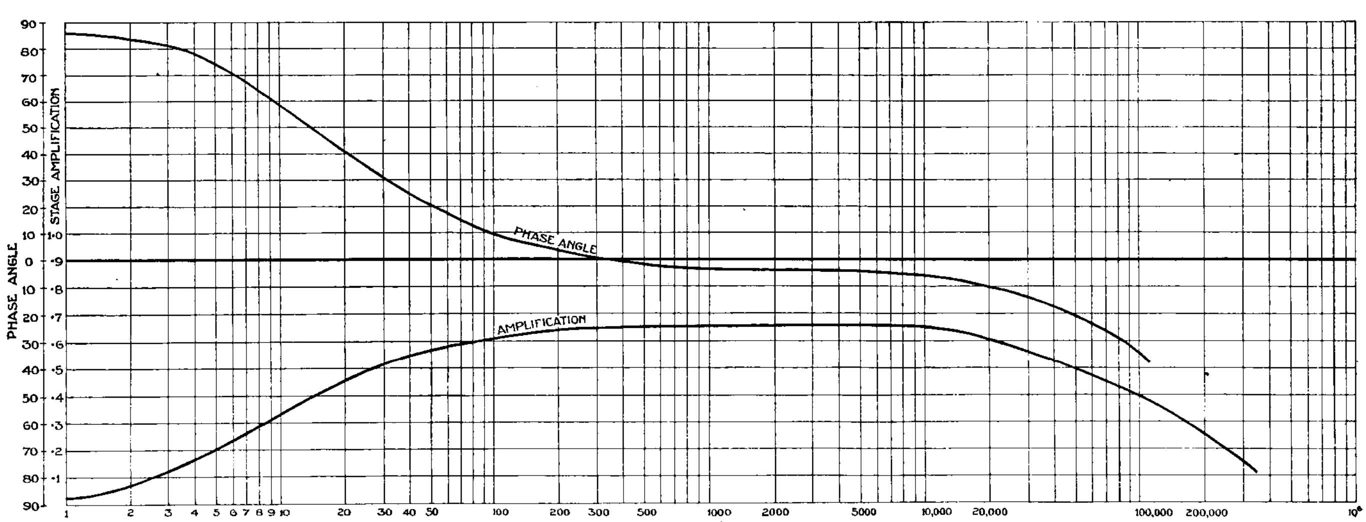


Fig. 18.—Curve showing how stage amplification and phase angle vary with frequency.

analysed from the point of view of determining the ratio $\frac{E_{g2}}{\mu E_{g1}}$ or the stage gain and the angle of E_{g2} relative to E_{g1} or the phase angle change per stage. As we shall see later, it exhibits a frequency characteristic which shows a drop in stage amplification at the low frequencies due to the capacity of the condenser C. The circuit, however, does not correspond to the practical case as it does not allow for the distributed capacity existing between the various components (i.e., valve, resistances, condensers) to earth. To allow for this we must add a capacity C_1 in parallel with R and obtain such a circuit as is shown in Fig. 17.

This circuit corresponds as nearly as possible to a practical stage in a resistance-capacity amplifier. We can easily obtain an expression for E_{g2} in terms of E_{g1}. It is

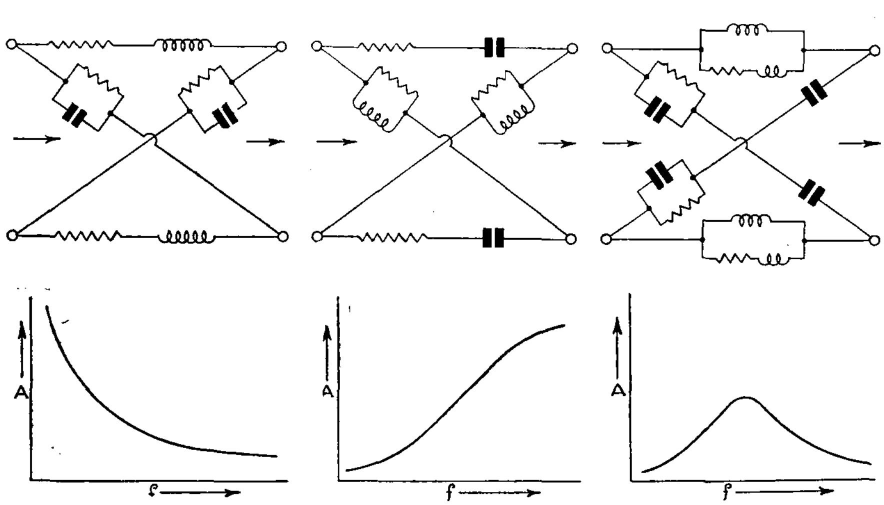


Fig. 20.—Three types of constant resistance lattice equalisers with their approximate attenuation characteristics.

$$\frac{\mu E_g}{1 + \frac{\rho}{R} + \frac{\rho}{R_g} + \frac{C_1}{CR} + j\left(\omega C_1 \rho - \frac{1}{\omega C R_g} - \frac{\rho}{\omega C R R_g}\right)} \qquad (9)$$

where j represents the usual imaginary operator.

It must be remembered that both E_{g2} and E_{g1} are vectors, i.e., they possess directions as well as magnitudes.

Fig. 21.—The form of impedance arm which should be substituted for R in Fig. 16a to provide correction at low frequencies.

We may consider (9) under two headings:

(a) When the frequency is low and ω is small.

(b) When the frequency is high and ω is large.

(a) When ω is small, the effect of C_1 on the result will be negligible. Thus C_1 may be written equal to zero and we have

$$|E_{g2}| = \frac{\mu E_{g1}}{\left(1 + \frac{\rho}{R}\right) - j\left(\frac{1}{\omega C R_g} + \frac{\rho}{\omega C R R_g}\right)}$$

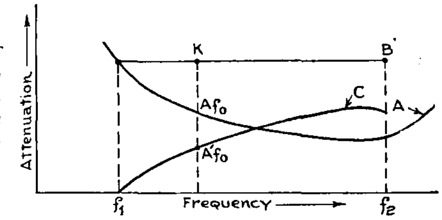


Fig. 19.—Method of determining necessary form of equaliser attenuation curve for a given amplifier characteristic.

$$= \frac{\mu E_{g1}}{\left(1 + \frac{\rho}{R}\right)\left(1 - \frac{1}{\omega C R_g}\right)} \qquad (10)$$

Hence, the absolute magnitude of E_{g2} can be written

$$|E_{g2}| = \frac{\mu E_{g1}}{\left(1 + \frac{\rho}{R}\right)\sqrt{1 + \frac{1}{\omega^2 C^2 R^2_g}}} \qquad (10a)$$

the phase angle E_{g2} being positive with respect to E_{g1} and given by Θ where

$$\Theta = \tan^{-1} \frac{1}{\omega C R_g} \qquad (10b)$$

(b) When ω is large, the effect of C may be neglected, i.e., C may be put equal to infinity. Hence, for high frequencies

$$E_{g2} = \frac{E_{g1}}{1 + \frac{\rho}{R} + j\omega C_1 \rho} \qquad (11)$$

and the absolute magnitude of E_{g2} is clearly

$$|E_{g2}| = \frac{\mu E_{g1}}{\sqrt{\left(1 + \frac{\rho}{R}\right)^2 + \omega^2 C^2_1 \rho^2}} \qquad (11a)$$

The phase angle of E_{g2} is now negative with respect to E_{g1}, and is given by

$$\Theta = \tan^{-1} \frac{C_1 \rho \omega}{1 + \frac{\rho}{R}} \qquad (11b)$$

From 9, obviously Θ will be zero (E_{g1} will be in phase with E_{g2}) for a frequency f given by

$$\omega^2 = 4\pi^2 f^2 = \frac{1}{C_1 \rho C R_g}\left(1 + \frac{\rho}{R}\right)$$

Thus, given the value of the various constants ρ, R, R , and C, and if we are able to estimate or measure the value of C_1 we can easily predict the frequency performance of an amplifier both as regards stage gain and phase angle. A curve showing the frequency response curve of such a stage of resistance-capacity coupled amplification where $\rho = 3 \times 10^4\ \omega$, $R = 6 \times 10^4\ \omega$, $R_g = 10^6\omega$, $C = .01\ \mu$fds. and $C = .0001\ \mu$fds., is shown in Fig. 18.

In this figure the ordinates of the curve marked "amplification" are to be multiplied throughout by μ the amplification factor of the valve to obtain the stage gain. It will be observed that it never rises above a value $\dfrac{1}{1 + \dfrac{\rho}{R}}\,\mu$, which is, of course, to be expected.

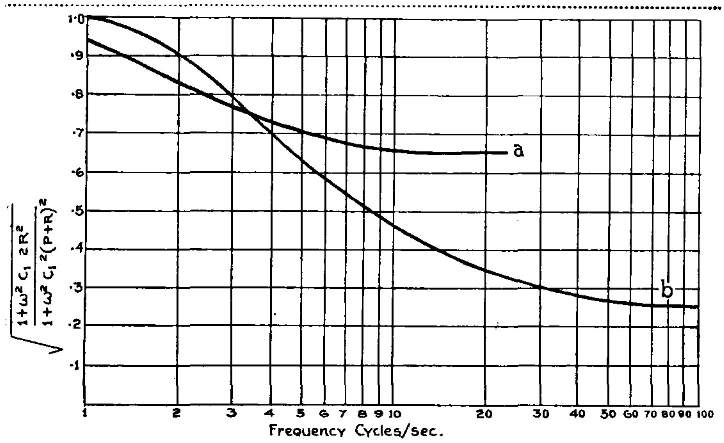


Fig. 22.—Curves showing correction factor introduced by substitution of the arm of Fig. 21 for a pure resistance.

The drop in amplification at the lower end of the spectrum is due to the fact that the reactance of C increases as the frequency decreases and so reduces the available voltage across R_G, and the drop at the high end of the spectrum is due to the capacity of the components down to earth providing a path to earth for currents of high frequency.

As we have seen in Parts I and II, the frequency response of the stage is of the greatest importance in obtaining distortionless amplification of the television signals. We must endeavour to keep the response as linear as possible, from a frequency as near zero as possible to a frequency depending both on the detail desired and on the available side band spread in the radio-frequency spectrum.

We can achieve linearity, at least from the theoretical point of view, in two ways. We can either make C very large and C_1 very small, or we can resort to artificial correction. A practical limit is set on the magnitude of C as if it is made too large the time constant CR_g will also become large and, if the grid potential of the second valve swings positive under the application of a particularly large signal so that grid current flows, the grid will not be able to lose the resultant negative potential in time to receive following signals.

Similarly, although by careful construction and design C_1 may be made very small, a limit must be reached here also. Hence it is generally necessary to resort to correction in some form or other. Such correction must provide for the requisite degree of linearity both as regards phase and amplitude. This former condition is one which arises in television technique only, as phase linearity is not essential in sound amplification.

Correction may be applied either stage by stage, i.e., each stage of the amplifier may be individually corrected, or it may be applied at one point in such a way that the combined distortion produced by the complete amplifier is corrected by a single correcting network.

In the latter case, resort to the method known as equalisation is generally adopted. Let us suppose that the curve connecting attenuation with frequency in an amplifier is as shown in A, Fig. 19, where the attenuation at any particular frequency, say, f_0, is A_{f_0}. Now if we desire to equalise this amplifier response over, say, a frequency range of f_1 to f_2, we must arrange the attenuation curve of an equaliser to be as shown in C, Fig. 19, where at the frequency f_0, the additional attenuation introduced by the equaliser is A'_{f_0} given by

$$A'_{f_0} = K - A_{f_0}$$

where K is some constant usually taken as equal to, or slightly greater than the maximum value of A_{f_0} over the frequency range of f_1 to f_2.

It will be obvious that $A'_{f_0} + A_{f_0}$ or the combined attenuation of amplifier plus equaliser is now constant. Clearly the value of K is in general greater than the average attenuation produced by the amplifier without equaliser, and so allowance must be made for this by first raising the gain of the amplifier.

Various types of equaliser networks are shown in Fig. 20 with their corresponding attenuation curves. The design of such networks is not easy. For those wishing to pursue the matter further, reference may be made to two articles, the first entitled "Distortion Correction in Electrical Circuits with Constant Resistance Recurrent Networks," O. F. Zobel, B.S.T. Journal, July, 1928, p. 438 *et seq.*, and the second which deals with a different form of equaliser entitled "An Application of the Circle Diagram to the Design of Attenuation and Phase Equalisers," N. M. Rust, *Marconi Review*, No. 33. It is not proposed to deal

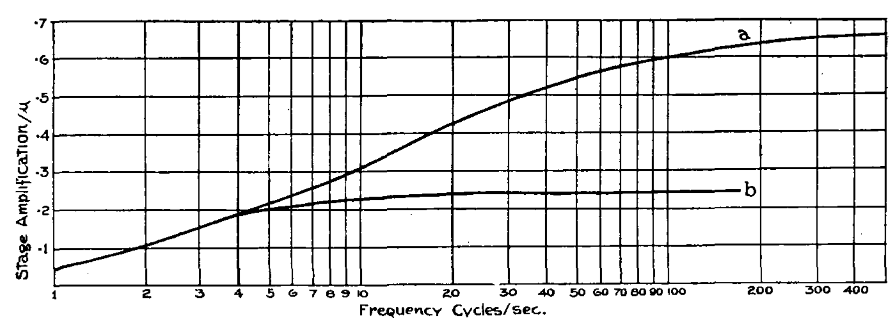


Fig. 23. Result of applying correction indicated in Fig. 22 to curve of Fig. 18.

THE TELEVISION ENGINEER

further with this type of correction, but rather to pass at once to the question of stage by stage correction of television amplifiers.

Let us consider the possibility, first, of raising the amplification at the low-frequency end of the spectrum and hence of making the amplifier more nearly linear in this region. Obviously, what we have to do is to seek some method of making the effective value of R in (10a) decrease with frequency, or alternatively, making R_g decrease with frequency. This follows from the fact that

$$| E_{g2} | \propto \frac{1}{1 + \frac{\rho}{R}} \qquad 12$$

Hence, as R becomes smaller, keeping ρ constant, $| E_{g2} |$ decreases. Similarly,

$$| E_{g3} | \propto \frac{1}{\sqrt{1 + \frac{1}{\omega^2 C^2 R_g^2}}}$$

and obviously, the same condition applies for R_g as for R to provide linear amplification.

We may apply correction for low-frequency response then in either the anode or grid circuit by placing a condenser in series either with R or R_g, for the effective impedance of a network shown in Fig. 21 decreases with frequency, tending to infinity at zero frequency and to R at infinite frequency.

The effect, therefore, of replacing the anode resistance by a resistance and capacity in series is to convert the constant multiplier

$$\frac{1}{1 + \frac{\rho}{R}}$$

in (10a) to an operator

$$\frac{1}{1 + \frac{\rho}{R + \frac{1}{j\omega C_1}}}$$

where C_1 is the added capacity, which may be written

$$\sqrt{\frac{1 + \omega^2 C_1^2 R^2}{1 + \omega^2 C_1^2 (\rho + R)^2}} \cdot e^{j\phi}$$

where the first factor influences the amplification and the second the phase angle. Neglecting the effect of this latter, we may plot the first against frequency. This is done in Fig. 22 for two cases; (a) in which $R = 6 \times 10^4$ ohms, $\rho = 3 \times 10^4$ ohms, and $C = 1\ \mu$fd., and (b) in which $R = 10^4$ ohms, $\rho = 3 \times 10^4$ ohms, and $C = 1\ \mu$fd.

The effect of this variation on the amplification curve of Fig. 18 is shown in Fig. 23 for the two cases. It will be observed that linearity is improved and is almost achieved in the case of (b) from 10 cycles per second onwards. The stage amplification is, however, reduced owing to the drop in load impedance at the higher frequencies. Allowance will, therefore, have to be made for this.

It will, of course, be necessary to provide some by-pass resistance in parallel with C_1 in order to provide the D.C. feed to the valve. This will modify the results somewhat. For a more detailed discussion of these methods of low frequency amplifier correction, the reader is referred to an article by O. E. Keall in *Marconi Review*, No. 54, entitled "Correction Circuits for Amplifiers" on which article the general analysis given here is based.

"The Goldmark Electron-optical System"

(*Continued from page* 664.)

.75 mm. when figuring 25 per cent. overlapping between adjacent lines on the projection screen.

The schematic drawing of the optical enlargement and projection is shown in Fig. 6. In order to use the largest possible part of the light beam collected by the projector lens L, the latter is placed nearly at its focal length from the fluorescent screen and the deflecting mirrors of the drum, therefore, are in the path of an almost parallel beam of light, its diameter D being practically identical with that of lens L.

The image of the moving fluorescent spot is reproduced on the screen thus: first by the lens L, then either by the mirrors M these being concave, representing a positive lens, or by a second lens placed after the mirrors, in which case these are plane. The first alternative using concave mirrors (of small curvature, large focal length) is more favourable, giving a greater light efficiency and eliminating a second lens which, due to the large angle between mirrors, is bound to introduce distortion. In Fig. 6 the mirrors are used as concave projectors having a focal length f_2, while the focus of lens L is fl. The distance between flourescent screen and lens L is a_1, while the distance between concave mirror M and screen S is b_2.

The diameter of the fluorescent spot is x_1, and the diameter of its image on the projection screen S is y_2. The ratio x_1/x_2, therefore, is the magnification of the system, called previously ε.

Following relations can be obtained from the lens equations which for the present case are: $1/a_1 - 1/b_1 = 1/f_1$ and $1/a_2 + 1/b_2 = 1/f_2$, further $x_1/y_1 = a_1/b_1$, and $x_2/y_2 = a_2/b_2$, where $b_2 - a_2 = s$, distance between lens L and mirror M.

The magnification of the entire system then is:

$$y_2/x_1 = \varepsilon f_1 . b_2 / [a_1 f_1 - s(a_1 - f_1)] \quad \ldots\ldots\ldots\ldots\ldots \quad 21)$$

and the distance between projecting mirrors and screen S is:

$$b_2 = f_2[a_1 f_1 - f_1)] / [a_1 f_1 - (s + f_2).(a_1 f_1)] \quad \ldots. \quad (22)$$

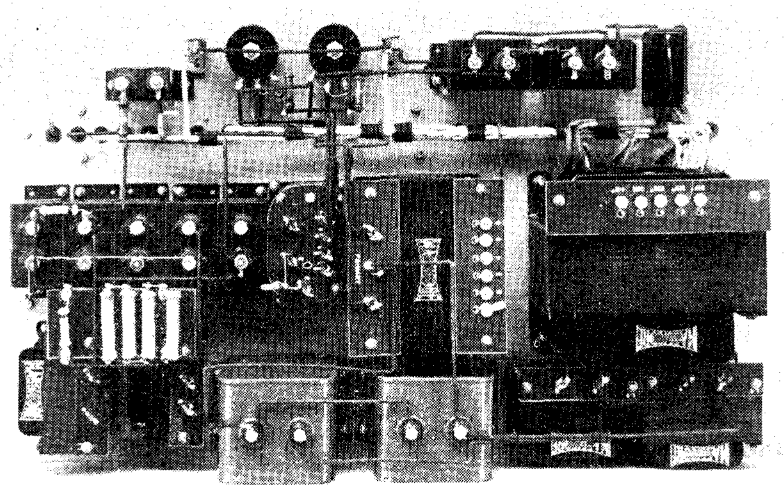
For instance, lens L has a diameter D = 10 cm., focal length f_1 = 20 cm., s = 10 cm., a_1 = 20.5 cm. Focal length of mirrors f_2 = 50 cm.

From formulæ 22 and 21 it follows that b_2 = 77.0 cm., and the magnification ε = 3.8 times.

The lens L in the above example was d:f = 1/2, while the mirrors, when having an area of $4 \times 8 = 32$ cm^2 have an average aperture ratio of 1:6.

Details of the synchronising arrangements and transmitter will be published in the next issue.

We publish below the first constructional details of an amplifier designed on entirely new principles. Credit for the original design is due to Marconiphone engineers but several important features originated by W. Bryan Savage have been incorporated which makes it particularly efficient.



All the components are mounted on a plate.

A 45-watt Low-loading Amplifier

IN the early part of August we were interested in the design of a new M/O valve designated the DA30. This valve, a power triode of unusually low impedance, was specially designed for use in push-pull circuits with anode voltages up to 500. This was very good for it enabled slightly increased output to be obtained over the PX25 type of valve.

According to information received in letters and in our contacts with transmitting amateurs and engineers interested in public-address equipment we found that the ordinary type of Class-A amplifier did not give sufficient wattage for the cost.

The transmitting amateur was buying American valves of the 46 and 59 class and using them in special circuits so as to get high output with reasonable quality. It has been admitted in several quarters that although this arrangement was satisfactory for speech when the output was pushed to optimum limits, quality from records deteriorated. This may or may not be the case, but we did know that some reliable means of obtaining high output was really necessary.

By high output we meant something really high, not 12 watts or even 20 watts, but with an A.C. output sufficient for P.A. work to load half a dozen big speakers and for modulation enough to load up a 100-watt carrier with anode modulation.

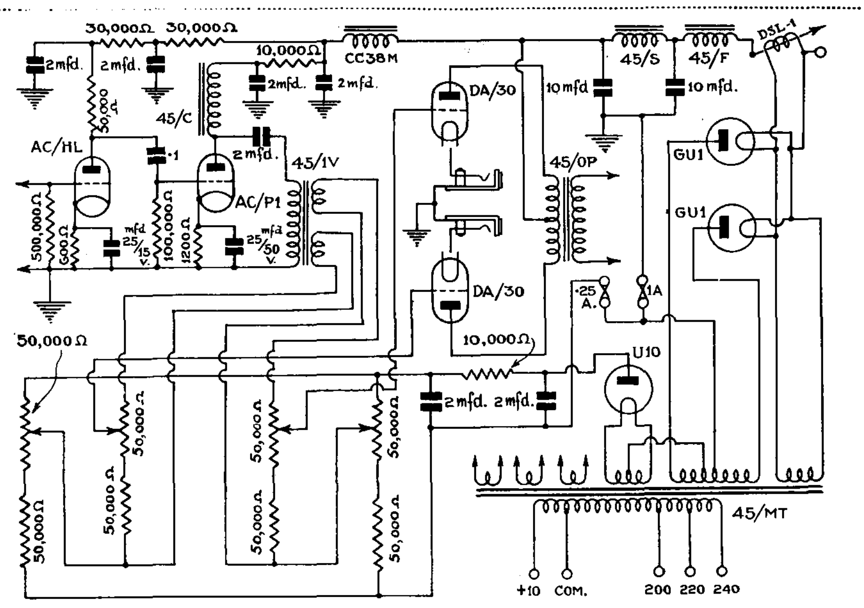
Our own station which many readers saw at the Exhibition originally had a modulator giving an output of 45 watts. This was obtained by using a pair of 75-watt triode valves driven by a pair of low-impedance triodes following the speech amplifier. This circuit was very satisfactory, quality being of a very high order, but the output valves cost about eight guineas each, the mains transformer had to give a thousand volts at 200 milliamps, smoothing chokes were all of the heavy-duty type, while the fixed condensers had to be 1,500-volt working to stand surges.

That sort of amplifier was not altogether suitable for every amateur, while the cost was very high. Ultimately we modified it to what was almost a Q.P.P. circuit and this gave almost 80 watts of audio but still did not remove the original defects. We then became interested in the DA30's. The fundamental circuit used for these valves was designed by M/O engineers and gave approximately 45 watts of audio output with only 3.8 per cent. third harmonic distortion. The really important feature, however, was that the cost was so low as compared with Class-A. The mains transformer had an output of 500 volts, while the chokes and condensers, etc., were all of a comparatively normal type.

By obtaining the collaboration of M/O and Bryan Savage, we have finally arrived at a design which still further reduces the cost by making use of a patented Savage bias circuit, eliminating the use of a separate transformer, as is usual in low-loading circuits or in circuits where the anode current fluctuates.

Here then are the actual details of this final design. First of all the two DA30's around which the circuit was moulded. These valves cost 30s. each, which is a very low price considering the high power output and other advantages. The following are the actual characteristics under normal conditions.

Filament volts—4.0 A.C.
Filament current—2.0 amps. approx.
Grid-anode capacity (filament earthed) —13 micro-microfarad.



A point is the second valve, an A.C.P1, is choke coupled which partially accounts for the absence of hum. Notice the patented bias circuit.

Anode-filament capacity (grid earthed) —6.5 micro-microfarad.
Grid-filament capacity (anode earthed) —10 micro-microfarad.
Anode volts—500.
Control grid volts— −134.
Anode current—60 ma.
Anode impedance—910 ohms.
Amplification factor 3.5.
Mutual conductance—3.85 ma/volt.

These valves used in push-pull with 500 volts H.T. should be biased 145 volts negative, so giving an anode current of 50 milliamperes. Full load conditions with an anode voltage of 475 are as follows:

Combined anode current—220 ma.
Grid bias voltage— −145.
Power output—45 watts.
Percentage 3rd harmonic distortion—3.8.
Grid input volts (peak value)—145.
Load resistance (anode to anode) (equivalent to 850 ohms for each valve)—3,400.
Maximum anode dissipation—30 watts.

Under these conditions the combined feed current at full load should not exceed 220 milliamperes, while on no load the anode voltage must not rise above 500 volts. Also to obtain maximum output the anode-to-anode load resistance must be 3,400 ohms. A lower value increases the anode dissipation beyond the rated figure of 30 watts.

In a design of a low-loading amplifier of this kind many features have to be taken into account. First to prevent resonant effects of high audio frequencies the secondary of the intervalve transformer must be resistance damped, the value of resistance used being a compromise between damping and sensitivity.

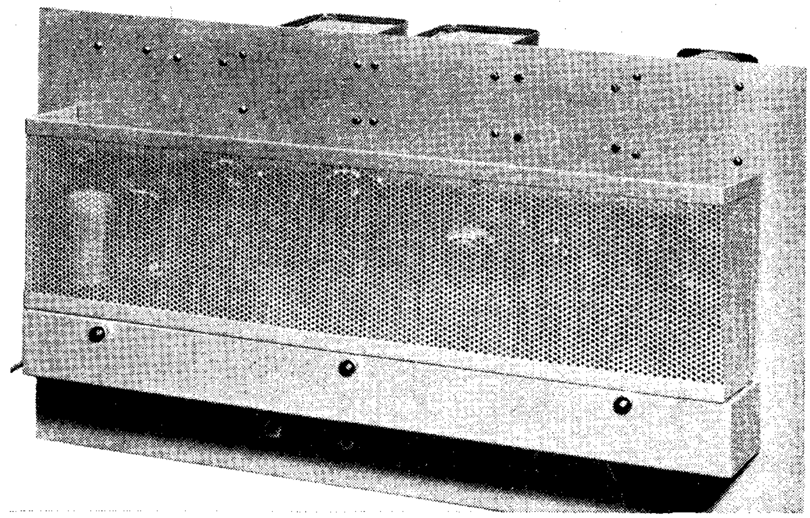
Second, to obtain best results when the valves are imperfectly matched it is recommended that the input voltage to each DA30 be adjusted so as to be proportional to its grid bias so that each valve works at full capacity.

This can be done automatically by adjusting the bias by means of a pair of ganged input and bias potentiometers, but the secondary of the transformers must be electrically similar. Variation, of course, can be taken up by additional loading resistances across whichever half of the secondary gives the higher output.

Third, stopper resistances of 1,000 ohms are required in each grid lead to prevent self-oscillation near full load.

Fourth, automatic bias is not advisable owing to the difficulty in decoupling the bias resistances at low frequencies. It can be seen from the circuit how we have ingeniously overcome this defect.

Bias to each valve has to be adjusted on no load until each DA30 passes the required 50 milliamperes. Two jacks are provided in the cathode circuit for measurement of anode current. The jacks in the anode circuit are not recommended owing to the possibility of oscillation.



The valve guard can be removed without undoing any screws while the base of the valve rack can be removed by undoing three terminals.

Fifth, H.T. voltage calls for special attention as the unit must be capable of giving a current varying between 100 and 220 milliamperes with a maximum voltage variation of between 500-475. This corresponds to an internal resistance for the unit of about 210 ohms so that rectifying valves of the gaseous type are essential. Naturally the H.T. transformer has to have exceptionally good regulation, so to this end Bryan Savage have designed one specially for this type of low-loading circuit.

Sixth, the load condenser which normally follows the rectifying valve has to be separated from the rectifier by a choke. The condenser in the smoothing circuit has to have a capacity of at least 10 microfarads to ensure that the sudden current surges do not cause any serious voltage drop.

Seventh, a time delay switch has to be embodied so as to prevent H.T. being switched on until the GU1 heater is completely warm.

None of these points will cause the constructor any concern. Bryan Savage can supply the necessary chokes and transformers. Dubilier are making special 951 type oil-immersed condensers 10-mfd. 750-volt working. These are comparatively inexpensive. The gaseous rectifiers are Marconi GU1's, while the time delay switch is a standard Ediswan DLS1.

The circuit chosen consists of an MH4, resistance coupled to an AC/P1 driving two DA30's. A U10 full-wave rectifier supplies bias to DA30's but no additional bias transformer is required. Actually this is the first time that this type of bias circuit has been published as it is of patented design.

To understand the Savage bias supply circuit, sight must not be lost

(Continued on page 686).

Components for 45-watt Low-loading Amplifier.

CHASSIS.
1 Special with rack and guard to specification (Bryan Savage).

CONDENSERS, FIXED.
7—2-mfd. type L.E.G. 650-volt working (Dubilier).
1—.1-mfd. type L.E.G. 650-volt working (Dugilier).
2—10-mfd. type 951, 750 volt working (Dubilier).
1—25-mfd. 15-volt working electrolytic (Dubilier).
1—25-mfd. 50-volt working (Dubilier).

CHOKES, L.F.
1—type 45/C (Bryan Savage).
1—type 45/S (Bryan Savage).
1—type 45/F (Bryan Savage).
1—type CC38M (Bryan Savage).

HOLDER, FUSE.
1—type F14 twin fuse holder (Bulgin).

HOLDERS, VALVE.
2—5-pin less terminals type standard (Clix).
6—4-pin less terminals type standard (Clix).

METER.
1—type E66M 300 m/a (Sifam).

PLUGS.
2—type P15 plugs with 2 J6 jacks (Bulgin).

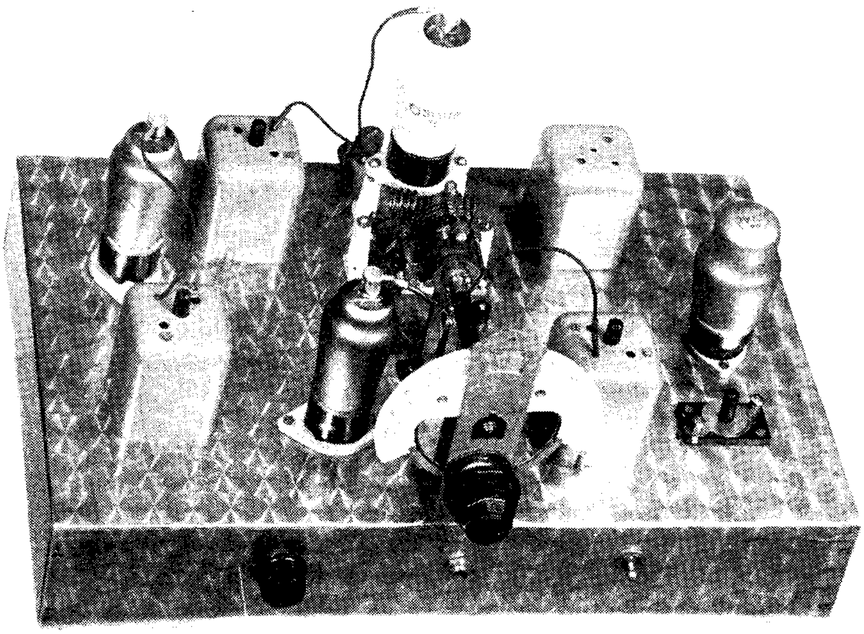
RESISTANCES, FIXED.
6—50,000-ohm type 1-watt (Erie).
2—30-000-ohm type 1-watt (Erie).
1—600-ohm type 1-watt (Erie).
1—1,200-ohm type 2-watt (Erie).
1—100,000-ohm type 1-watt (Erie).
1—10,000-ohm type 3-watt (Erie).
1—10,000-ohm type 2-watt (Erie).

RESISTANCES, VARIABLE.
2—2-gang 50,000-ohm potentiometers (Reliance).

SUNDRIES.
3-dozen 2BA round head nickel-plated bolts, with nuts and washers.
32 4BA round head brass bolts, with nuts and washers.

TRANSFORMERS.
1—45/IV (Bryan Savage).
1—45/OP (Bryan Savage).
1—45/MT (Bryan Savage).

VALVES.
1MH4 met. (Marconi).
1—ACP1 (Mazda).
2—DA30 (Marconi).
1—U10 (Marconi).
2—GU1 (Marconi).
1—DSL1 (Ediswan).



Various opinions have been expressed as to the efficiency of triode-heptodes on five metres. Here are some details of a hook-up used during the past summer by A. C. Weston, which has proved satisfactory.

An Experimental 5-metre Super

ALL my original experiments on wavelengths below 10 metres were made with super-regenerative receivers until a little over twelve months ago. Of course, I am not counting my first misguided effort way back in 1930 in building a two-valve straight receiver for seven-metre reception. This contraption worked, but it was absolutely no use for anything over ten miles away.

The super-regen. receivers worked just like super-regens. Noise level was reasonably high and, although it quietened down very considerably on strong stations, they were of little use for DX. When a weak station was in the offing the signal strength was never sufficient to damp down the quench noise.

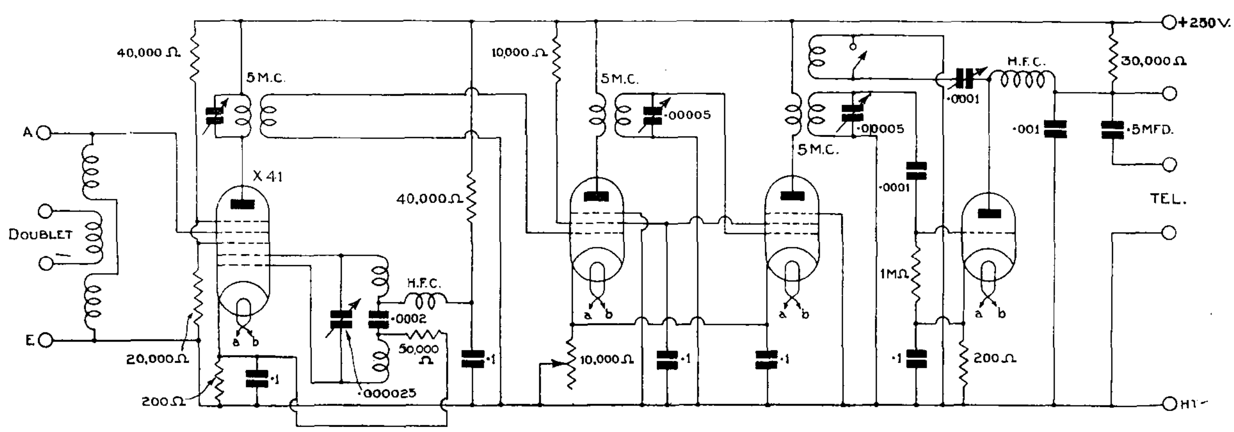
With the introduction of the triode hexode in the early part of this year, I hastily assumed that this would be the solution to all five-metre problems, for the few experiments made with a screened-grid detector and triode oscillator indicated that I was on the right track towards getting at an efficient five-metre circuit. The first triode-hexode that came along was a factory sample, and it was hastily rigged up into a conventional super-het circuit. Instrument tests showed that it was quite satisfactory, docile to use, and that the total noise level was of a very low order. Some practical tests were then made in conjunction with a small five-metre transmitter and these signals were received up to a distance of ten miles. Unfortunately, I did not go beyond ten miles, otherwise I might have been saved a considerable amount of trouble, but, as signal strength was R8/9 at that distance, I assumed the receiver to be satisfactory.

For a period of two months, schedules were arranged and tests carried out but no signals of any kind were received. Various check tests were made from time to time, but these only showed the receiver to be working satisfactorily.

Apparatus was finally erected to check the comparative stage gain of the receiver. This showed that the X41 would only operate satisfactorily with an oscillator grid input of over 20 volts; weak signals were inaudible.

Several more tests then proved con-

(*Continued on page 682*)



Two I.F. stages appear to give ample stage gain.

NOTICE!

"Sound News"

We should like to take this opportunity of thanking our numerous customers for the kind letters we have received, not only expressing appreciation of our products, our business methods and incidentally our advertising, but wishing us success in our new factory at Marlborough Road, which is over six times the size of the old Tremlett Grove Works.

We did not realise that we had so many friends, and so many people privately interested in the growth of our Company. It is extremely encouraging to know that so many people wish us to attain our main objective—BETTER REPRODUCTION, or, if we may make use of a double meaning, BETTER "SOUND" IN EVERY SENSE. We do not like to add that our apparatus "Sounds" better, but we offer you a cordial invitation to visit our works and find out for yourself.

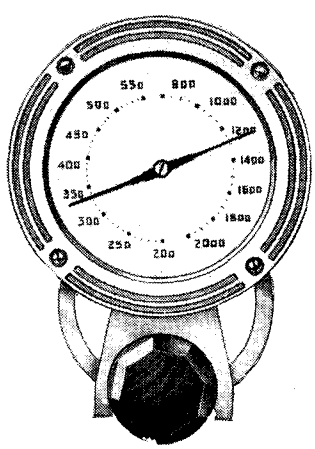
Again thanking you all, we remain,

SOUND SALES

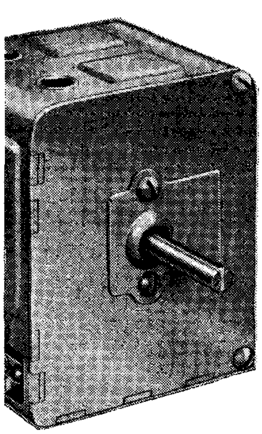
SOUND SALES LIMITED
Marlborough Road, Upper Holloway, London, N.19.
'Phone: ARCHWAY 1661-2-3.
(Contractor to the G.P.O., etc.)

N.B.
If unable to call don't fail to send for literature of all our products.

THIS IS THE DIAL



Airplane dial with trimmer. A choice of three finishes—chrome, oxidised silver and bronze. *Price* **6/6.**

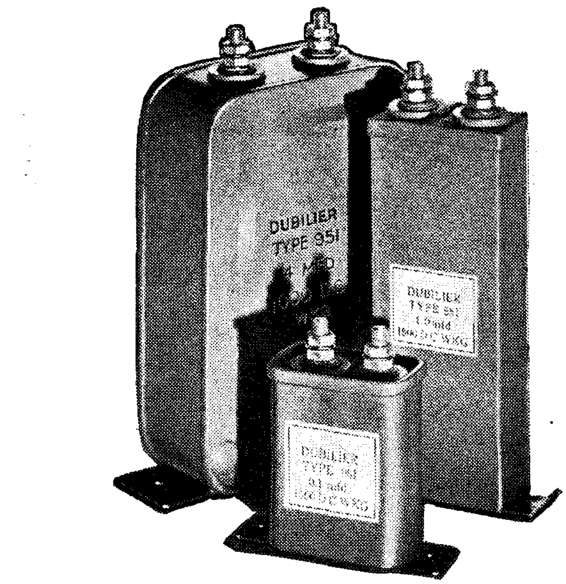


AND THIS THE CONDENSER

Baby two Gang ·0005 mfd.
Price - - 10/6.

Which complete the success of the "ADVANCE ALL-WAVE SUPERHET"

JACKSON BROS. (LONDON) LTD.,
72, St. Thomas Street, S.E.1.
Telephone : Hop 1837.



DUBILIER oil-immersed paper dielectric condensers

The technique of design of radio apparatus has been advanced by the introduction of this range of Oil-Immersed Condensers.

The requirements of high fidelity amplifiers and television apparatus are adequately catered for by types 950 and 951 Dubilier Oil-Immersed Condensers.

These Condensers are the smallest and most compact on the market in relation to the capacities and working voltages. Write for a copy of the Dubilier illustrated Catalogue.

Type.	Capacity mfd.	D.C. Working Volts.	D.C. Test Volts.	List Price Each.
950	0.02	1,500	3,000	10/-
950	0.1	1,500	3,000	10/9
950	0.5	1,500	3,000	11/-
950	1.0	1,000	2,000	11/6
950	1.0	1,500	3,000	13/-
951	1.0	2,000	4,000	15/-
951	1.0	3,000	6,000	20/-
951	1.0	3,500	7,000	25/-
951	1.0	4,000	8,000	30/-
950	2.0	1,000	2,000	13/-
951	2.0	2,000	4,000	17/6
951	4.0	1,000	2,000	17/6
951	4.0	2,000	4,000	21/-
951	10.0	750	1,500	17/-

Capacity Tolerance ± 15%

DUBILIER CONDENSER CO. (1925) LTD.
DUCON WORKS, VICTORIA ROAD, N. ACTON, W.3

O.I.2

"An Experimental 5-metre Super"

(Continued from page 680)

clusively that the valve was not suitable for five-metre work in its present condition. Apparently the makers discovered this at the same time, for another valve came along which was infinitely more satisfactory. With this new valve a conversion conductance of approximately 550 microhmos was obtained with only an oscillator input of 12 volts peak. And, at the same time, this conversion conductance did not drop below 520 microhmos with an oscillator input of only six volts. Another point was that even down to 58 Mc. there was no appreciable "pulling" between the oscillator and signal frequencies, while the valve was very insensitive to variations in oscillator voltage.

In practice, a variation of plus or minus 50 per cent. in oscillator peak voltage only gives about the same order of change in conversion conductance as is normally obtained with a plus or minus 20 per cent. difference in other types of valves. The oscillator voltage is most easily measured by connecting a microammeter in series with the 50,000-ohm leak in the oscillator grid circuit.

It was not found necessary to tune the input circuit of the X41 as selectivity was not required and no extra gain was experienced, while it was a drawback having to tune two circuits.

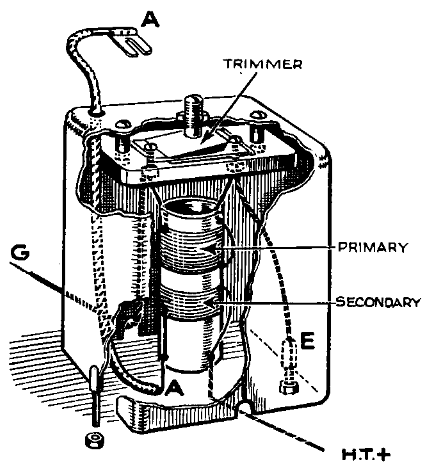
Ultimately a doublet aerial was used with rather an interesting input circuit. The grid coil (an H.F. choke) and matching coil were wound on small half-inch paxolin tube. The grid coil consisted of two sections, each section being 32 turns of 36-gauge enamel-covered wire wound as a solenoid with a ⅜-in. gap between the end of one coil and the beginning of the other. The doublet aerial was then fed into a small coupling coil made up of 20 turns of 36-gauge enamel-covered wire which almost occupied the entire ⅜-in. gap.

The remainder of the circuit was more or less conventional. I.F. transformers were wound to resonate at five megacycles and to have identical primaries and secondaries. The first I.F. transformer, however, has a semi-tuned primary, as against semi-tuned secondaries with the second and third transformers. The reason for this variation was that unless the primary of the first transformer was tuned, a very bad break-in from the local regional station was obtained. This point also occurred with standard short-wave superhets.

The screens of the I.F. valves—AC/VP's—were linked together and connected to 250 volts H.T. via 10,000 ohms. A 10,000-ohm potentiometer in the common cathode return was used as the volume control, while a reaction winding with preset condenser and a make-and-break switch were included to form a rough and ready beat-note oscillator for C.W. reception.

No L.F. amplifier was found necessary, for with headphone work it was rather difficult completely to eliminate hum, unless the output was taken directly from the second detector.

This hook-up as it stands operates most successfully on five or seven metres; for amateur band use it is ideal, owing to the low noise level, while by simply rewinding the transformers to between 10 and 12 megacycles, with, of course, the correct frequency response, it would be suitable for television experiments. Single-dial control is very useful and incidentally the oscillator circuit also proves satisfactory on 20 and 40 metres.



A rough idea of how the coil should be constructed can be obtained from this illustration. The frequency is 5 Mc.

Those interested in the construction of the I.F. transformers will gain a good idea from Fig. 2. This shows the basic construction of the coil and the connections from the two windings. The first I.F. transformer, however, has the trimmer connected in parallel with H.T. positive and A, instead of in parallel with G and E; the third transformer has an additional reaction winding between the anode and grid coils. The paxolin former is 2 ins. high by ½ in. diameter, coils being wound as follows: primary 35 turns of 36-gauge enamel-covered wire, secondary 55 turns of the same gauge wire, regeneration winding 20 turns, all coils wound in simple solenoid fashion.

During my experiments I found that the Hivac AC/VP valves gave particularly high gain as I.F. amplifiers. The Osram triode hexode is essential. Experimenters would be well advised to consider the Amplion resistances for the wire ends are unusually flexible and do not break off unless they are roughly handled.

Finally, a word about the potentiometer. A noisy one is absolutely useless, while, should the voltage flicker owing to intermittent contact, reception will be made difficult. The Reliance potentiometers seem to do their job very efficiently.

Calls Heard

***B.R.S.* 1784, *M. G. Bourke, Jersey, Channel Islands.* (*14-mc. Phone.*)**

VP2KM, VP6YB, HH1W, CO8YB, PY2BA, LU4BL, OK2HM, K4DDH, HI6O, PY2GJ, HI7G, CO2RA, CO2HY, VP9R, TI2RC.

(*7-mc. Phone.*)

GI5MZ, VP6YB, HI7G, CO8YB, PAOWJ, G6GO, G5VS, G6LU, G5TP, G6IF, G5QB, G5ZJ, G2IL.

R. Everard, Sandy, Beds.

(*14-mc. Phone.*)

K4DDH, CX2AK, PY2GI, PY2DA, VP2KM, SU1CH, VP6YB, HH2W, CO6OM, CO8YB, OE1CM, LU6AP, HB9U, LA1G, and 90 W1-9.

(*7-mc. Phone*).

LX1AI, EA4K, HI7G, EA5BE, EA4BM, EA8AB, F8ZA.

2BAI, K. Howell, Acton, W.3.

(*7-mc. Phone.*) *Receiver* 0-*v*-1.

PAOLJ, G6XQ, G6US, G5VD, G5DM.

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

ON4LA, OZ8Z, G5ZP.

(*14-mc. Phone.*)

VP6YB, W1CHT, VE2BG, W1ONL, W1CJD, VP9R, W3EOZ, W3BOF.

B.R.S.* 1847, *J. A. Jagger, Guildford, Surrey.* (*28-mc. C.W.*) *Receiver* 18-*valve Mid-west.

G2HG, G5WP, G6NA, ZS1H, W9NY, W1CCZ.

(*1.7 mc. Phone.*)

G2XC, JU, DQ, GG, LZP, UW, KT, PL, JG, NV, PK, QF, OG, VO, UJ, G5KJ, OC, RD, KG, IN, ZJ, JW, AR, VT, JV, IL, WL, ZQ, OD, BI, WW, BC, OP, BG, FJ, CD, G6FF, QM, QB, DO, KD, NF, PA, GO, SO, FV, AJ, NU, PL, SR, IF, LW.

(*14-mc. Phone.*)

(September 2, 17.35-23.05)—W3EOZ, VE2CA, W4BJS, W4KH, VE3GS, VE1CA, W2MB, VE2CA, VE2EE, W2AH, W5BMZ, W3EBC, W2CLS, W4CJ, VE1FE, HI7G, W2CGK, W6DCQ, W8JK, W4ABG, VE5EH, W2HMD, W2FLO, W2HFS, W3BDI, W5AOP, W3ERK, W5AEB, W3EDK; (September 3, 20.15-23.38)—HI7G, W2GED, W2BY, W2BSD, W2JJ, W9BPK, W2CMJ, W4ABG, W4BTR, W5ALT, W3ABN, VP6YB, W3CRG, W2DYR, VE9CNE, CO8YB, W2HFS, W8JV, W6KSE, W7AOF, W3DMI, W9BHU, W1WK, CO2HY, W6BWE; (September 4, 18.30-22.45)—W2ABN, W8JV, VE2CA, W3HN, W4ZF, W3CC, W6PQY, W4BTR, W8IV; (September 5, 22.25-23.15)—W3CRG, W4DLH, HH2W, W2BSD, W2KR, W2AMD, W2EVG; (September 6, 22.35-23.14)—K4DBE, W4AHO.

Recent Books

Television, by M. G. Scroggie, B.Sc., A.M.I.E.E. (Blackie and Son, Ltd.). This is a small handbook in the " Technique " series and the aim of the author has been to present a brief survey of the principles of television in an easily understandable form. The book contains 68 pages and the contents include a survey of the principles, equipment, mechanical systems, cathode-ray systems and a chapter on special devices which have come to the fore of late. The treatment is necessarily brief, but it will provide an excellent introduction to the subject for those who wish to make a start with the new science.

Photo-electric and Selenium Cells, by L. J. Fielding (Chapman & Hall, 6s. net). The object of this book is the survey of photo-electricity in a manner which can be readily understood by the not too technical person. It is a practical treatise and provides information on the construction of apparatus within the ability of the amateur. Included are constructional details of selenium cells and photo-cell amplifiers and the latter part of the book is devoted to suggested and industrial applications of light cells of various types. The amateur will find a wealth of information in this book.

Popular Television, by H. J. Barton Chapple (Pitman & Sons, 109 pp., 46 figs. Price 2s. 6d.). The recently aroused interest in the developments in television has brought forth a crop of books on the subject intended to give non-technical readers an insight into the problems and methods involved.

This book is the latest addition to the number and should appeal to those who have adequate knowledge of radio terms but who have not had an opportunity of studying the newest branch of the science. The necessity for the apparently complicated apparatus used in television is explained together with brief descriptions of the most recent types of scanning apparatus—the Iconoscope, Farnsworth's image dissector, etc.

The author is not always happy in his choice of words—" eschew " is surely better replaced by " avoid " each time that it occurs; and " those who administer the law " are judges, although from the context " police " is the word meant.

These are details, however, and the subject is covered in a concise and informative manner which will give the book a wide circulation among those who wish to obtain an acquaintance with television.

Television Society.

New Members.

The Secretary of the Television Society points out that payment of subscriptions by new members for September-December, 1935, will be carried over to cover their subscription to the end of December, 1936. The Business Secretary is always glad to answer inquiries from members and non-members regarding the introduction of new members into the Society.

USING THIRTY-LINE APPARATUS

Our Readers' Views

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

Reception in the Provinces

SIR,

I agree with "Looker No. 2." Although I am about 140 miles from London, the pictures received on my disc television receiver were clear and distinct, also the names and designs on the caption machine were easily readable.

I was very interested in the description of "Skyline" given in your journal, I have no sound receiver, and so it was very interesting to check what I saw.

The panorama was very clear that night and I recognised it immediately on seeing it in your journal.

I cannot understand why the B.B.C. did not have a census of the television receivers then in use, I am sure that the number must have increased since the last census.

I am looking forward to the high-definition transmission. I am only 22 miles from Birmingham and so shall be able to receive transmissions from that town.

I do not agree with the double transmissions from the Alexandra Palace, part of the money supplied to pay for the double apparatus could be used to start the station at Birmingham, also the double transmissions will only complicate receivers at a time when they should be as simple as is possible; a high number of lines also reduces the range, which is quite small enough.

T. SPARRON (Bridgnorth).

Don't Scrap Your 30-line Gear

SIR,

No doubt many of your readers are feeling at a loose end and wondering what to do now that the 30-line transmission has ceased. They are also probably bemoaning the waste of money on the equipment which is now worth a few pence as scrap. May I through your columns offer them my sincere condolences and a few suggestions to put it to use while they are waiting for the next move on the part of the B.B.C.

I am in the fortunate position of having very little to scrap as I was bitten by the television bug when the cathode-ray tube was first introduced as a commercial article. After playing with it for some time, I made up the "Simplest Cathode-ray Viewer" in last year's TELEVISION, and got excellent results. Since then I have been continually experimenting with fresh scanning circuits and have gained a great deal of invaluable experience which will help when high-definition becomes an accomplished fact.

I found very quickly what most of us have found—that two half-hours a week were useless for experimental work, particularly as I had one or two visitors most evenings. So I made up a very crude scanner from a 30-line disc and a small transparency, and immediately discovered that I had let myself in for a whole host of fresh things to interest me. The design and adjusting of the amplifier and the synchronising were quite enough to keep me occupied for a long time.

Now I am playing with a high-definition scanning circuit and am seriously thinking of making my own high-definition scanner as I want to try out an amplifier with a wide frequency range!

So I suggest to those who want to keep their hands in—don't scrap the mechanical scanner: make it into a transmitter of your own. If you cannot afford a cathode-ray tube yet, link up the scanner with a similar mechanical reproducer and try and get the best out of your amplifier.

It is surprising how difficult it is to get really good reproduction of the standard B.B.C. patterns (see TELEVISION AND SHORT-WAVE WORLD for February, 1935.—Ed.). You will be in a better position to deal with some of the snags in high-definition when you have got a perfect response on the cruder stuff.

Don't hibernate this winter—there are lots of things to be done.

J. W. STEEVENS (Highbury, N.).

Guide to Amateur Radio

SIR,

In one of our recent advertisements describing the contents of our Third Edition of "A Guide to Amateur Radio," it was stated that a one-valve pentode crystal controlled 160-metre transmitter was described.

I regret that this information was incorrect. The article in question was, however, published in the August issue of the Society's Journal, a copy of which will be sent to any reader on receipt of 6d. in stamps.

J. CLARRICOATS
(Secretary, Radio Society of Great Britain).

A Mystery Transmission

SIR,

Recently I have been receiving a television transmission on the 40-metre amateur band. The station is working quite regularly every afternoon between about 3 and 6 B.S.T. and is transmitting 30-line television (Baird system).

The vision is coming in with QRK varying between R3 and R8. On Thursday (September 19) the pictures were very good at times and I saw very definitely a picture of the head of a nigger.

The operator also appeared. He had spectacles on and nodded his head a few times.

I heard it rumoured that this station is situated in England (Birmingham). Actually I did not hear his call-sign. Can you tell me which station I have been looking-in at or can any reader of TELEVISION AND SHORT-WAVE WORLD help? My receiver is a 6-valve superhet, type ACR-136 R.C.A. Victor. For amplification I used a 25-watt power amplifier which feeds the neon lamp of the disc televisor.

J. H. ADAMA (PA0FB),
(Den Haag, Holland).

[We shall be glad to know if any reader can assist in the location of this station.—Ed.]

Your personal opinions and experiences are helpful to other readers. We pay half-a guinea for the letter published on this page which is of the most general interest.

"A 45-Watt Low-loading Amplifier"

(*Continued fronm page* 678).

of the fact that while current will flow through a valve while the anode is positive and the cathode earthed, it will flow equally well if the anode be earthed and the cathode made negative to earth. Reference to the diagram will show that the cathode of the bias rectifier is connected to a tapping on the H.T. winding of the mains transformer—in this case 200 volts from the centre tap—while the anode is effectively joined to earth.

This tap accordingly becomes alternately positive and negative with regard to the anode. During the positive half cycle as the cathode is positive to the anode, no current can flow through the bias rectifier although at the same time current actually flows through the adjacent half of the mains H.T. rectifier. During the negative half cycle, however, in fact, while this half of the H.T. winding is idle, in so far as the main H.T. rectifiers are concerned, current flows through it from the main H.T. negative and in so doing passes through the potentiometer and resistance network, causing the voltage drop necessary for biasing the output valve.

The output transformer has to be carefully made so as to load up to 3,400 ohms, while with the particular Savage transformer we have used, the secondary is tapped so as to give 80, 40, 20 or 10 ohms. This is suitable for all types of P.A. work. Transmitters wishing to modulate must obtain a modulation transformer with a secondary wound to match up with the final P.A. This type of transformer is also available.

We cannot stress too highly the system of construction. It is another feature which has not before been published for the benefit of the home constructor. The use of a chassis or baseboard is eliminated, for all the com-

(*Concluded on page* 688).

" A Simple Explanation of the Offical Specification "

(*Continued from page* 636.)

frame frequency is the same. The line frequency, 6,000, is, of course, derived by multiplying $240 \times 25 = 6{,}000$ (compared with 10,125).

The picture ratio is 4 units width by 3 in height (instead of 5×4) which is exactly the ratio of modern talking films, so that there should be no waste when transmitting these.

We find that the D.C. component is similarly transmitted and, finally, that 2 megacycles is also the maximum sideband required.

This is a little difficult to understand without further information as the first " zero frequency " is approximately 1,900,000 and for equal definition in either direction we should expect a response of only about 1 megacycle to be necessary. While with a maximum of 1 megacycle modulation applied to either system we would expect the same amount of detail (though not distributed in the same way) it is difficult to judge the improvement which 2 megacycles would effect in the Baird system. However, as 2 megacycles is also recommended for the E.M.I. reception and receivers will have to be designed to accommodate such a modulation frequency, experience will soon show what the advantages are.

The comparative details of the two systems in tabulated forms are given in the panel on page 636.

"A 45-watt Low-loading Amplifier"

(*Continued from page* 686.)

ponents are mounted on the front steel panel. A valve platform is bolted to this panel so that all valves are easily get-at-able for replacement, while heat is more easily dissipated. Hum is also kept down to a low level.

With regard to the valve sequence, the most important valve, other than the DA30's, is the ACP1 in the second stage. Unless this valve is used we cannot be sure that the rated output of 45 watts will be obtained. Actually in practice this amplifier with maximum drive gave an output of 62 watts, more than enough for all normal purposes.

The valve makers tell us that they have not life tested the DA30's for this colossal output so they cannot be responsible if the valves should fail. We, however, have found that the DA30's will stand up quite well to this output, but those readers who do not wish to take the risk can rest assured that the amplifier will give between 45 and 50 watts, the valve then having an indefinite life.

The majority of the components are of a straightforward type. Resistances are 1- and 2-watt type, condensers standard stock, similarly the ganged potentiometers; the valve holders are Clix chassis mounting type which have a large gap between the anode pin and chassis and are suitable for high voltage. The input and output transformers, the chokes and transformers in the H.T. circuit are all of a special type. For example, the smoothing choke has a resistance of only 10 ohms.

In our opinion the low-loading circuit will in most cases supersede normal push-pull, for the output is so greatly increased with only a slight increase in constructional costs.

The Mazda Valve Mannual

We have received from the Edison Swan Co. a copy of their latest valve book, of which the full title is "The Mazda Valve Manual for Radio Engineers and Service Men." There is, however, a great deal to interest the ordinary user of receiving valves and there is sure to be a brisk demand for copies.

The contents include detailed particulars of all the range of Mazda receiving valves and Ediswan transmitters, together with operating notes and suggestions for obtaining the best results, together with data on cathode-ray tubes and their associated valves. This latter feature makes the book of particular interest to our readers.

At the end a series of typical circuit diagrams is given, one of which is of a high-fidelity push-pull amplifier.

Copies of the manual can be obtained by recognised radio dealers free of charge on application to the Edison Swan Co., 155 Charing Cross Road, and mention of this journal. Non-trade readers can obtain one on forwarding P.O. or stamps for 6d. to the same address.

THE CONSTRUCTORS' CIRCLE

Application for Membership

To be filled in and sent with a *stamped envelope for reply* to the Editor, "Television and Short-wave World," Chansitor House, Chancery Lane, London, W.C.2.

* (1) I already subscribe to your journal at the address below.
(2) I have placed a regular order for TELEVISION and SHORT WAVE WORLD with my booksellers, Messrs................
....
....
and desire to be enrolled as a member of the TELEVISION and SHORT WAVE WORLD. "Constructors' Circle."

Please send membership badge *free of charge* to

Name (in block letters) ....

Address ....

....

*Strike out lines not applicable.

"TELEVISION and SHORT-WAVE WORLD." COUPON
FOR FREE INQUIRY SERVICE

Name ______________________

Address ______________________

November, 1935

MISCELLANEOUS ADVERTISEMENTS

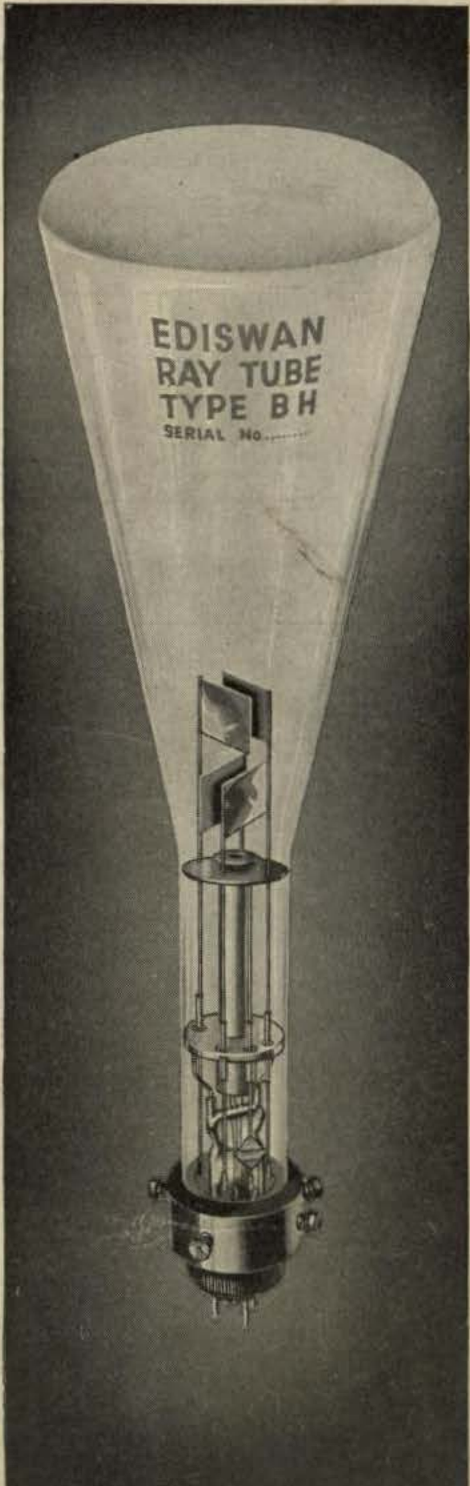
The charge for advertisements in these columns is 12 words or less 2/-, and 2d. for every additional word. All advertisements must be accompanied by remittance. Cheques and Postal Orders should be made payable to Bernard Jones Publications Ltd., and crossed, and should reach this office not later than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

INDEX TO ADVERTISERS

Purveyors of Electric Lamps By Appointment

EDISWAN

Manufacturers and Purveyors of Electric Lamps By Appointment



Television developments

Here is the Cathode Ray Tube specially developed for television reception. Ediswan have been associated with the application of Cathode Ray Tubes to television from the commencement and have kept to the front with the most recent improvements.

Ediswan High Vacuum Cathode Ray Tubes are made in two sizes:

Prices

Type AH - **£10.10.0** Type BH - **£8.8.0**

All have special screens giving a black-and-white image. Green or Blue screens can be supplied without extra charge.

We also manufacture:

- *Mercury Vapour Rectifiers* ● *High Vacuum Diodes*
- *Transmitting Valves for ultra-short waves*
- *Grid controlled discharge tubes for time bases*

These have been specially developed for line-scanning circuits.

Full information on the tube and its associated circuits can be obtained on application to the Technical Service Department, at the address below.

ENTIRELY BRITISH MADE

EDISWAN RADIO VALVES

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

USED BY ALL GOVERNMENT DEPARTMENTS

R.E.245

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.