NEW RECEIVERS : NEW DEVELOPMENTS : NEW METHODS

TELEVISION

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and SHORT-WAVE WORLD

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TELEVISION

Interlaced Scanning—
First Details of the Methods

The New German
Television Receivers

Simple Explanation of
the Iconoscope

High-definition Amplifiers

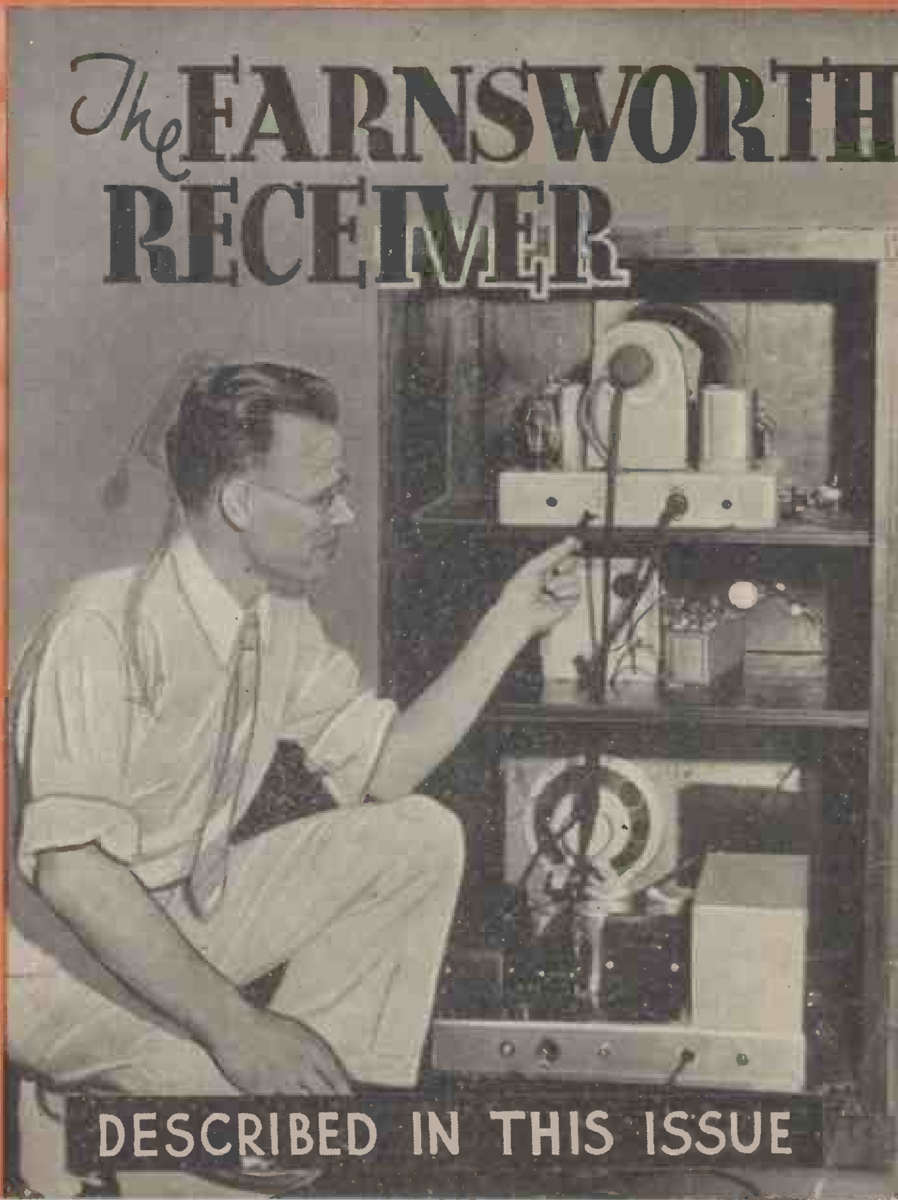
SHORT WAVES

2-V-1 Short-wave Receiver

Meter Economy in
Transmission

Station Monitor and
Field-strength Meter

Microphone Head Amplifier



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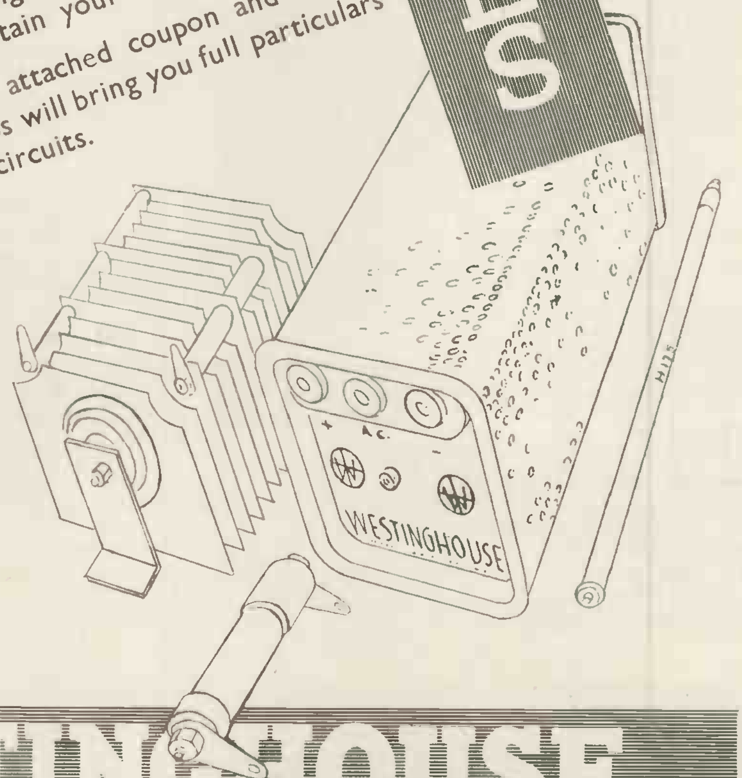

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IMPORTANT

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COMMENT OF THE MONTH

"Hanging Fire?"

THERE is certainly a sharp contrast between the methods of the Postmaster-General's Television Committee and the present Advisory Committee which by no means redounds to the credit of the latter. Within a period of about eight months the first Television Committee had inspected a number of television systems—some of them several times—made two trips abroad and investigated foreign progress, taken a large amount of evidence, formed conclusions which received general approbation, and drawn up a comprehensive report which was a far-sighted and masterly survey of the whole television position.

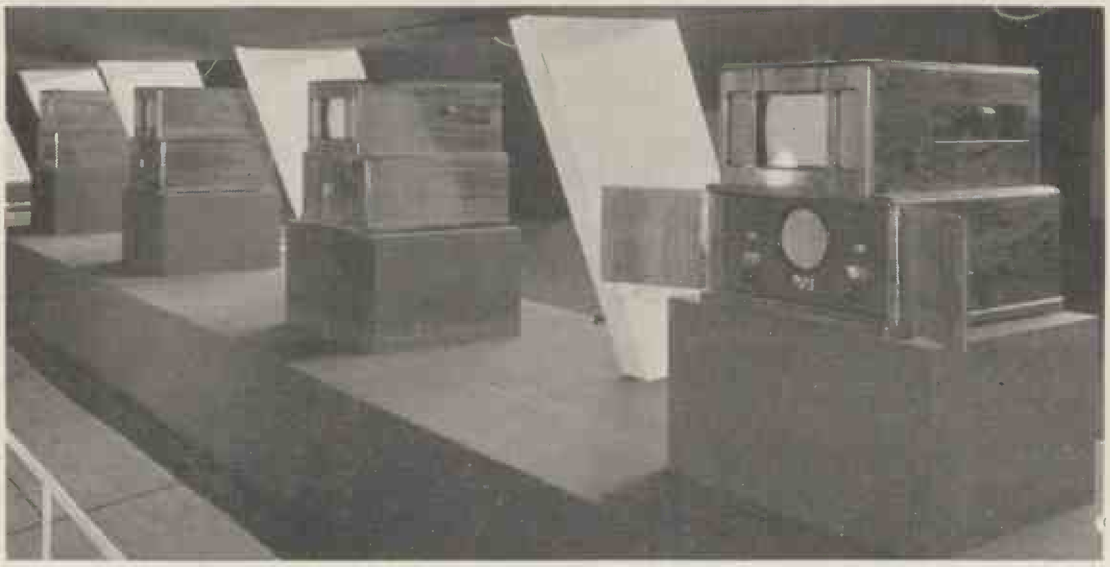
The labours of the present Committee have now occupied seven months and the sum total is the recommendation of a double scanning standard which has been almost universally condemned, the decision to use the Alexandra Palace for the first transmitting station and the recommendation that the Baird and Marconi-E.M.I. Companies should be requested to proceed with the installation of transmitting gear suitable for their respective systems. And the last-mentioned is a matter which to all intents and purposes was settled for them by the original Committee.

There is a general opinion in the public mind that television is " hanging fire," and not without reason. It is an opinion which, if the Advisory Committee has the interests of television at heart, it should do its best to remove. It can rightly be assumed that the duty of the Committee is the furtherance of television, but an impression is certainly gaining ground that it has adopted a " ca' canny " policy. We are now told that it will probably be about six months before the first transmission will be made, and no indication is given that in the meantime test transmissions will be available to enable manufacturers to proceed with the design of receivers. Consideration in this respect is now vitally essential, otherwise the first six months of transmission will be wasted. We suggest that temporary arrangements could be made with the Baird Company which has all the necessary apparatus available.

The Television Society.

THIS Journal now numbers many thousands of new readers and we should like to draw the attention of these to the excellent work that is being done by the Television Society. The Society is almost entirely of an academic nature, its principal object being the scientific development of television. It is entirely devoid of commercialism and we venture to say that membership will be of material benefit to those who intend making a serious study of television. We mention the matter at this time as the winter session of lectures which are given monthly are due to commence shortly, and in view of the progress that is being made these are certain to be of an instructive nature. It is perhaps unfortunate that the present activities of the Society are confined to London and in our opinion the time is now ripe for their extension to the provinces by the formation of affiliated societies in all the large centres. We commend the proposal to the executive of the Society.

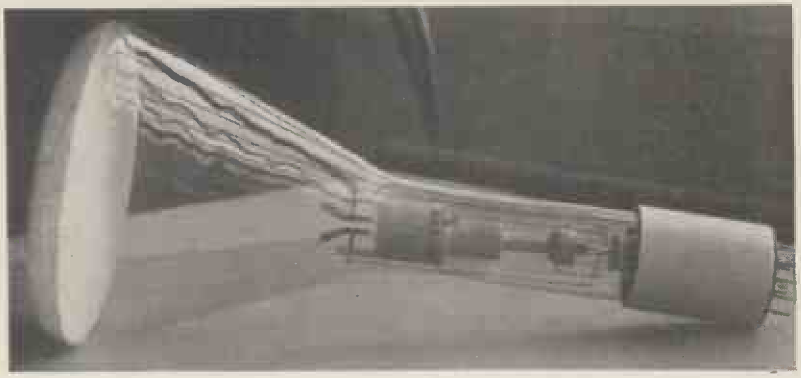
"A STREET OF TELEVISION"



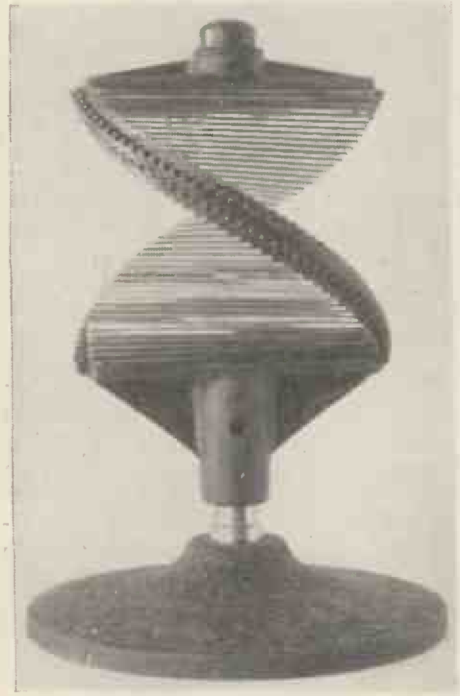
A view of the "Television Street," showing a series of complete home receivers made by Fernseh A. G.

RECEIVERS AT THE BERLIN SHOW

IN contrast to Radiolympia, television formed a very important section of the Berlin Radio Exhibition where the utmost was done to show the public the advancement of this new side of broadcasting. Several of the receivers exhibited are shown on these pages and we hope to give more detailed and technical descriptions in our next issue.



An entirely new construction of cathode-ray tube for television purposes produced by C. H. F. Muller, Hamburg.



Tekade mirror-screw for interlaced scanning.

Probably the most outstanding exhibit was the large screen demonstration which gave a picture approximately 6 feet square with a definition equal to 100 lines. Exact technical details of this apparatus are not available yet, but as the screen was composed of 10,000 lamps, apparently the system is similar to that demonstrated by Baird some time ago.

It is interesting to note that the German concerns have not formed the idea that mechanical scanning is unsuitable for high-

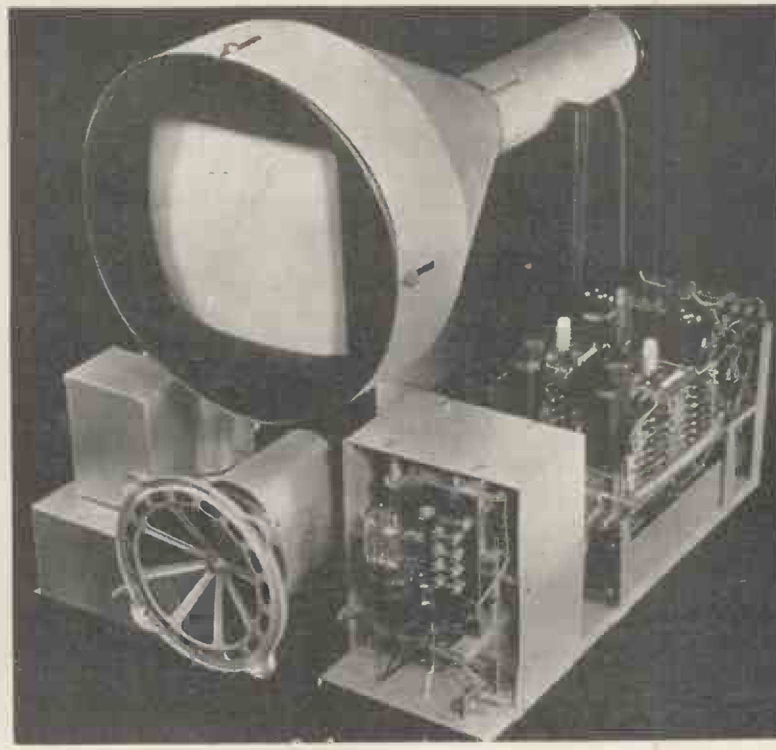
Latest Loewe receiver.

definition work, for Tekade showed apparatus employing the mirror-screw for high-definition interlaced scanning. A photograph of one of these screws and of a complete mirror-screw receiver are shown here.

An interesting cathode-ray tube development was shown by the firm of Müller, well-known as manufacturers of X-ray tubes. This tube is to the design of Dr. Busse, whose aim was to produce a tube which was interchangeable. Another feature is the use of ceramic insulators for the support of the electrodes.

Several receivers were shown which are actually available to the public at a cost of approximately £65; these give a picture measuring about 8 ins. by 7 ins. Of these the Loewe is a very fine example, and this, as the photograph shows, is entirely chassis constructed; both vision and sound are incorporated in the same receiver.

Fernseh, A.G., had a very special display of home receivers all of which were the cathode-ray type. The appearance of these can be judged from the photograph in the heading. Though 180-line scanning has been practically standardised in Germany it does not appear that there is any intention of stopping at this for Fernseh showed a 320-line picture.

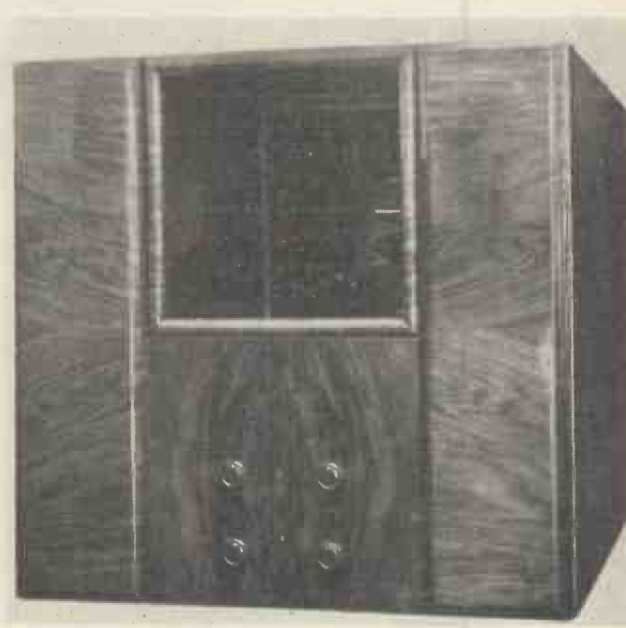


Chassis of the Loewe receiver.

As far as could be ascertained none of the transmissions were by direct pick-up and the reason for this may be that some restriction has been placed upon this method by the authorities, the "television eye" being reserved for air-force experiments. As reported on another page in this issue a disastrous fire broke out at the Exhibition which, with the exception of the hall in which television apparatus was displayed, was almost completely destroyed.

TWO-HOME RECEIVERS

A view of the Lorenz television receiver with a tube by Manfred von Ardenne showing an actual television picture.



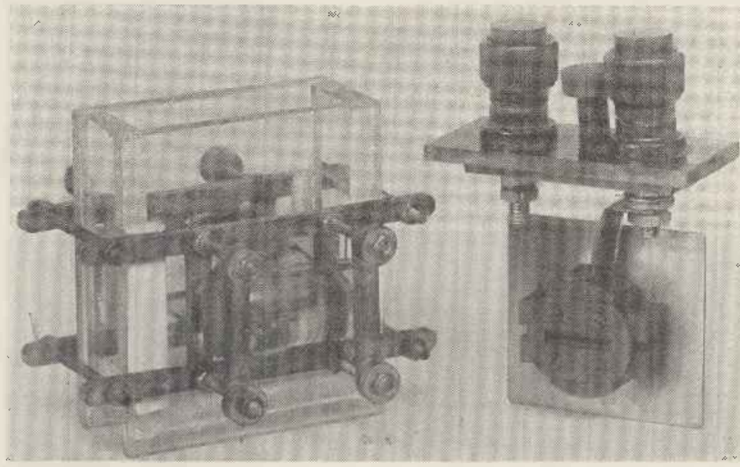
Tekade 180-line mirror-screw.

IMPORTANT SCOPHONY DEVELOPMENTS

FIRST DETAILS OF THE SCOPHONY DOUBLE-IMAGE KERR CELL

THE Comptroller-General of the British Patent Office recently decided in favour of Mr. G. W. Walton, of Scophony, Ltd., in respect of an application made by him on August 19, 1932, for the grant of Letters Patent covering the use of double image Kerr cells.

Electro-optical light valves based on the Kerr phenomenon have been known and widely used for a considerable time past; however, even some of the recent constructions were optically very inefficient. In this type of light valve, it is necessary to split the beam of light into two components, into the ordinary and extraordinary rays, and the usual construction eliminates the extraordinary ray by total reflection, thereby causing immediately a 50 per cent. loss of light in the device.



The Scophony double-image Kerr cell for high-definition removed from its case.

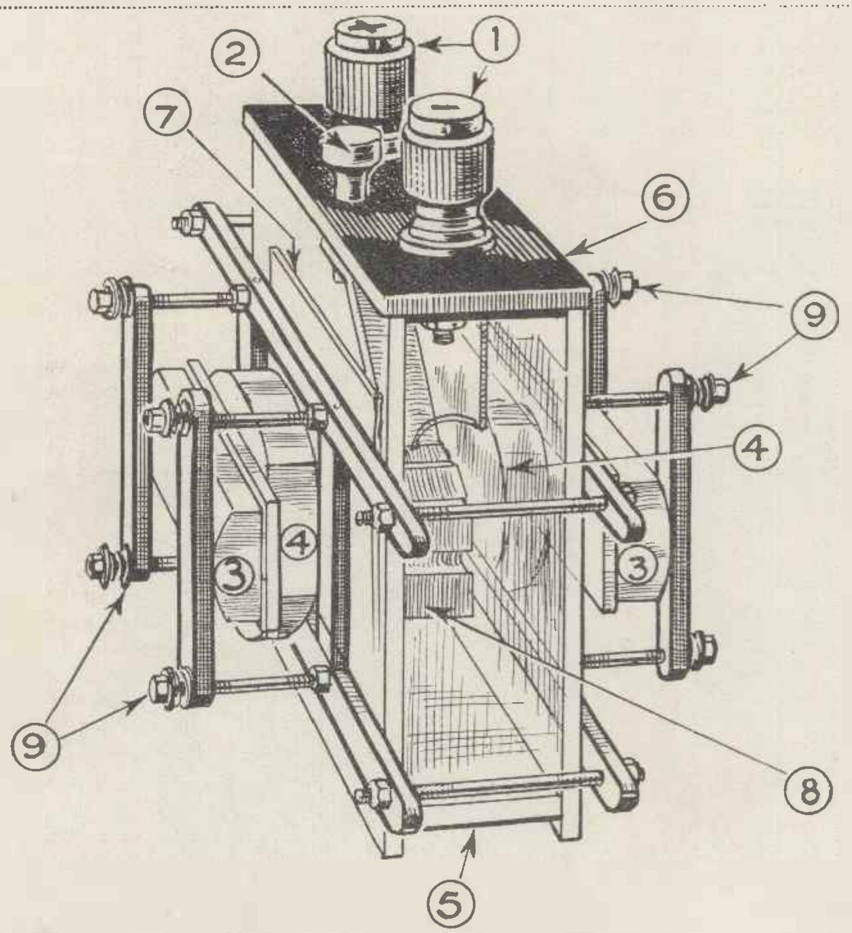


Fig. 1. — Experimental double-image Kerr cell for high-definition work. 1, Terminals. 2, Filling plug. 3, Cylindrical lenses. 4, Double-image prisms. 5, Glass container. 6, Insulating top. 7, Shield for extraneous light. 8, Double-gap electrodes. 9, Supporting frame for the lens-prism assembly.

Mr. Walton claimed in his provisional specification an invention which has for its object "means whereby a greater amount of light can be passed . . . by using both the ordinary and the extraordinary rays of light from polarising devices." Instead of using a Nicol prism, he showed the use with Kerr cells of double-image prisms for polarising and analysing, such as, for instance, Wollaston prisms.

For Projected Pictures

The Marconi Wireless Telegraph Co., Ltd., opposed the grant of a patent on various grounds, largely, however, on the ground that in the opinion of the Marconi Co., the complete specification described and claimed an invention other than that described in the provisional specification, and that such other invention formed the subject of an application, No. 19,748/1933 (424,196), of a later date made by the Marconi Company and others for a patent, which, if granted, would bear a date in the interval between the date of the application and the leaving of the complete specification by G. W. Walton.

The views, submitted by the Marconi Company, were not shared, however, by the Assistant-Comptroller, who decided to grant the patent to Mr. Walton and awarded him costs against the Marconi Company.

This decision is no doubt of con-

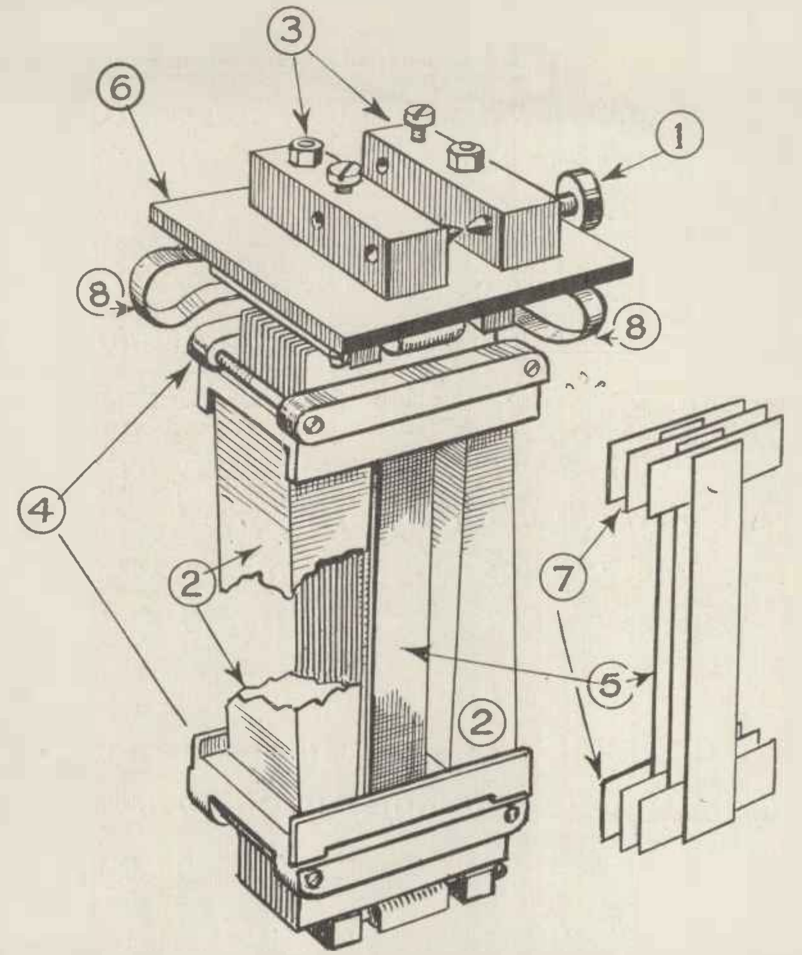
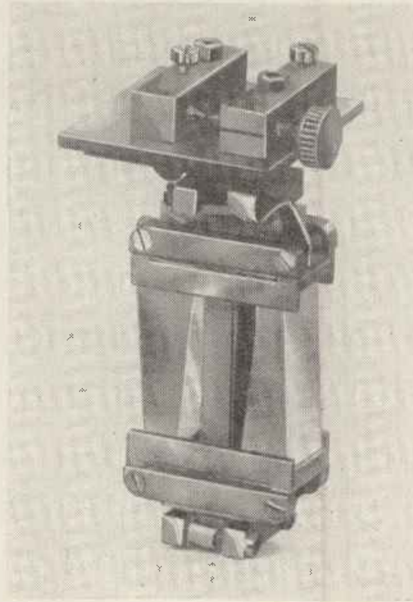


Fig. 2.—Experimental double-image Kerr cell for low-frequency work. 1, Safety spark gap. 2, Double-image Iceland spar prisms. 3, Terminals. 4, Metal frame. 5, Electrodes. 6, Insulating cover plate. 7, Supporting vanes. 8, Connecting springs.



This photograph shows a laboratory model of the type of cell shown on the left.

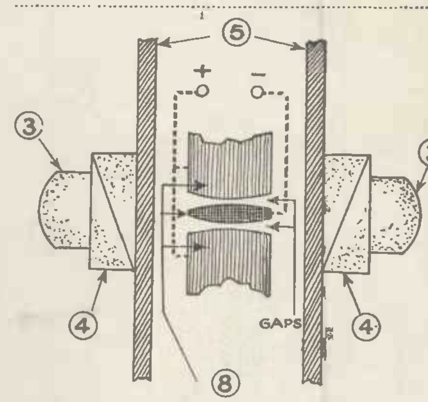


Fig. 3.—Details of the electrode assembly of th high definition cell. The references correspond to those of Fig. 1.

siderable interest to all those engaged in the television industry.

The double-image Kerr cell is a definite advance on the old known type of Kerr cell, and may be of great value in achieving *projected* television pictures.

The rights under this Patent No. 407,385 belong to Scophony, Ltd.

The great advantage of this type of Kerr cell is that both ordinary and extraordinary rays are used, which results in an improved brilliancy of the projected image.

The cell shown by the photograph and drawing, Fig. 1, is of this type, and used for H.F. work; it is a double gap type, using Wollaston prisms.

The other assembly shown without container and in detail in Fig. 2 incorporates further ideas. These are as follows:

The double-image prisms are prismatic pieces of Iceland spar used for the polarisation of the beam, and at the same time they act as support of the electrodes and as insulators. Further, the optical arrangement of these prisms is such, that any dispersion of colour produced by the prisms is mutually compensated in the central super-imposed image if the assembly is immersed in nitrobenzine. Nitro-benzine has a refractive index, which is approximately the same as the mean of the two refractive indices of the Iceland spar, and the angle of the prisms is so chosen that ordinary and extraordinary rays are obtained, but optical errors of the prisms are compensated.

The cells shown by the photographs are, of course, laboratory models.

DEATH OF 30-LINE SERVICE

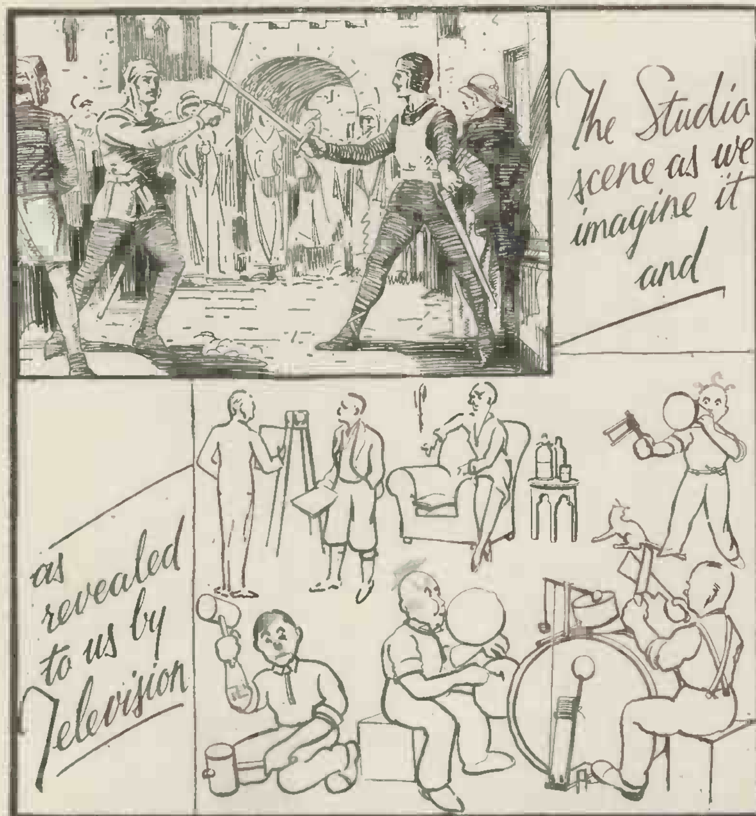
As we go to press B.B.C. announces that the present experimental 30-line television service will be discontinued as from September 15.

The Mirror Screw

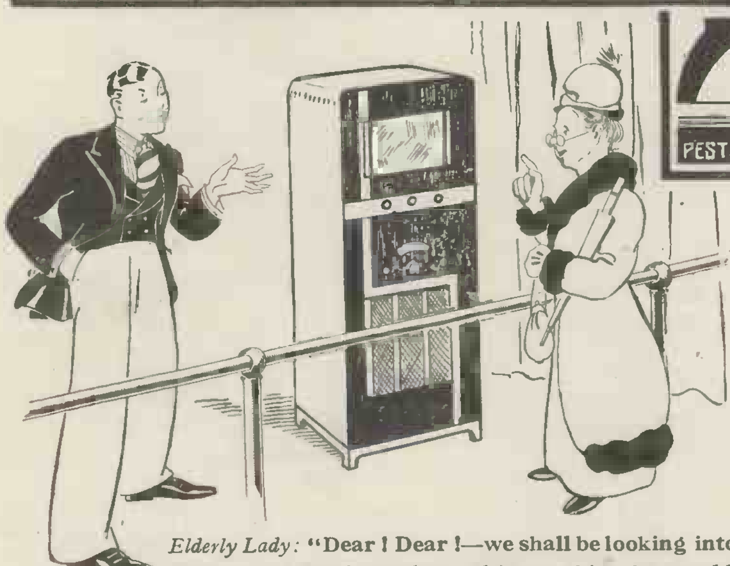
WE are informed that Scophony, Ltd. have granted to Messrs. Suddeutsche Telefon-Apparate, Kabel-und Drahtwerke A.G. (TeKaDe), of Nurnberg, a licence to use, manufacture and exploit under the Scophony patents in Germany, a television receiver incorporating the device, known as the mirror-screw, for direct viewing, i.e., for viewing television pictures on the mirror-screw itself.

The development of the mirror-screw by Dr. F. von Okolicsanyi (at present with TeKaDe), and by Mr. G. Wikkenhasuer (at present with Scophony, Ltd., London), commenced in the Telehor television laboratory in Berlin, and was subsequently con-

(Continued at foot of next page.)



Clairvoyant: " Might just as well shut up shop now she has a Televisor."



Elderly Lady: **"Dear ! Dear !—we shall be looking into the future next."**
Salesman: **" Well, madam, this machine is capable of picking up a picture from Australia, and it is to-morrow there—NOW."**

PROPHETIC HUMOUR

The originals of these cartoons appeared in this journal seven years ago

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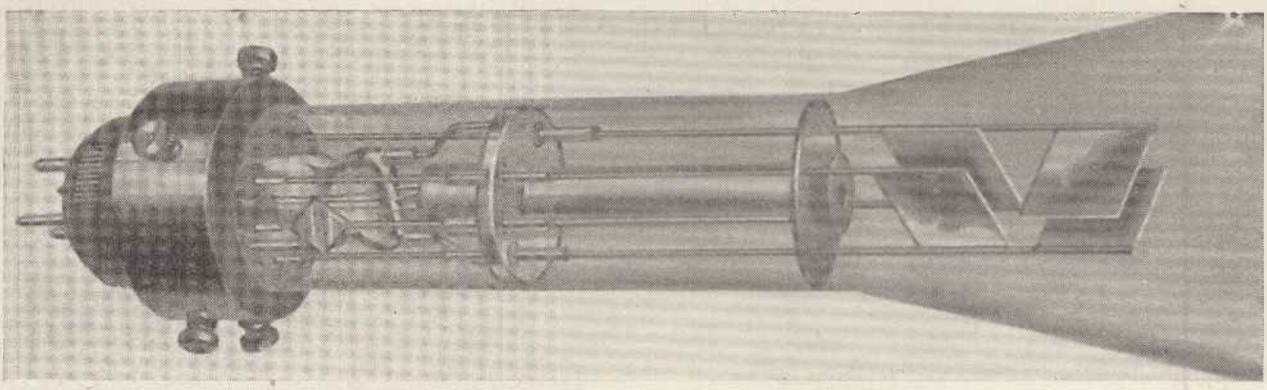
"Important Scophony Developments."

(*Continued from preceding page*)

tinued by TeKaDe, who made further improvements therein.

The mirror-screw represents a very efficient, inexpensive and simple-to-operate type of television receiver. It was shown at successive Berlin radio exhibitions together with the cathode-ray tube receivers, and its optical definition for the same number of lines then proved to be superior to that of the cathode-ray tube. It should, therefore, be a competitor to the cathode-ray tube in the market for the lower-priced type of receivers. Further developments in the mirror-screw were shown at the Berlin Radio Show last month.

It is rumoured that the relations between Scophony and TeKaDe may not be limited to the mirror-screw only. It is very likely that as a result of the present arrangement, some closer co-operation may be effected between the two companies, covering the use of the whole of the sphere of the Scophony inventions in Germany.



TIME BASES AND INTERLACED SCANNING

By J. McPherson

THE FIRST PUBLISHED DETAILS

We believe this to be the first published description of the method employed to produce interlaced scanning with the cathode-ray tube. Like many other problems it is simple when the fundamentals are explained.

IN the July issue of TELEVISION AND SHORT-WAVE WORLD the writer gave an account of the underlying principles of Interlaced Scanning. Knowing now what it is, and why, readers may be wanting to know how the idea can be put into practice, and, more especially, whether it will involve any complicated alterations to a receiver designed for sequential scanning. It is the purpose of this article to devote some consideration to practical methods of interlacing.

Interlaced scanning is one of those ideas which at first sight seem more difficult to achieve than they turn out to be. Starting with the simplest of television scanning devices, the Nipkow disc, it should be clear, from a recollection of the previous article referred to above, that as we have to make two scanning sweeps across the image for every completed scan (first a sweep over the odd lines, and then another over the even), two spirals on the disc will be needed. If

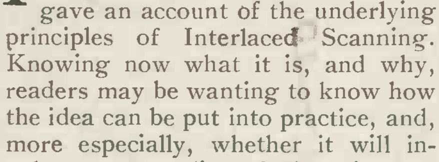


Fig. 2.—Form of scanning produced by cathode rays. (exaggerated). Dotted lines indicate "fly-back."

the interlaced picture is to have, say, 30 lines, then we must use two spirals each of 15 holes. In each spiral successive holes are radially spaced from each other by the width of two holes, instead of the usual one. Fig. 1 shows a drawing of a disc for scan-

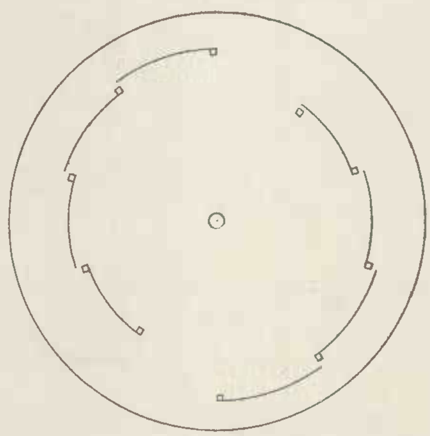


Fig. 1.—Scanning disc with holes arranged for interlacing. Successive holes are radially spaced by the width of two holes.

ning with ten lines interlaced. Such a low number has been chosen purely for clarifying the illustration. It will be obvious that the holes of one spiral will fill in the gaps left by double spacing of those in the other. Similarly, with a mirror-drum the mirrors are arranged to give two successive scans per revolution. With both disc and mirror-drum, and, in fact, any mechanical scanning machine, it is just as easy to effect interlaced as any other kind of scanning, though conversion from one system to another is practically impossible without changing the disc or drum. This must be regarded as a drawback where two separate standards of scanning are to be used such as in the case of the forthcoming dual Baird-E.M.I. transmissions from the Alexandra Palace; though the interlacing is no more of a drawback than the different number of scanning lines pertaining to each system which automatically demands separate discs, drums, or other mechanical scanning equipment.

However, though at first sight such an objection seems a serious one, it may be that it will be possible to make receivers with two readily interchangeable discs or drums, and that the extra cost of these might not exceed a small fraction of that of the whole equipment.

Interlacing with Cathode Rays

Turning to the question of reception with cathode-ray tubes, to which the Television Committee and other authorities consider the immediate

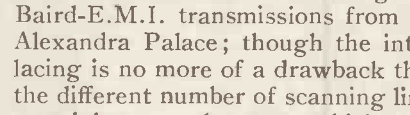


Fig. 3.—Showing 5-line scanning interlaced ("fly-backs" omitted).

future of television to be closely bound, here we have a great deal of latitude in that the number of scanning lines, spot sizes, direction of scanning, etc., are all determined

WHY 405 LINES ARE USED

within quite wide limits by the associated circuits rather than the construction of the tube itself. This, of course, is one of the reasons why the Advisory Committee has adopted the double standard for the two systems. Fortunately, it happens that interlacing can easily be effected with cathode-ray tubes by proper manipulation of the accompanying time-base circuits, and it does not involve any difficulties such as one encounters with mechanical systems. Let us consider the matter further, first reminding ourselves of one or two important points in connection with the operation of the tube as a scanning device. Full details will have been found in previous articles in this journal.

The spot has forces acting on it in two directions, due to potentials on the deflector plates, at right angles to each other. Let the tube be placed with one set of deflector plates in a vertical position. If an alternating potential be applied to these plates only, the spot will move back and forth in a horizontal line. Now let another alternating potential of lower frequency be applied to the other plates. Since now the spot has forces acting on it in two directions, its path will not be quite horizontal, but will be inclined slightly to the diagonal, as shown roughly in Fig. 2. The dotted lines indicate the "fly-back" which is made so rapid as to be practically invisible. The lines will continue downwards until the vertical deflector potential reverses sign and returns the spot to the beginning again. For ordinary scanning this is made to occur when the spot reaches the end of the line. This means the horizontal deflecting frequency must be a whole multiple of the vertical deflecting frequency. The latter determines the image-repetition frequency, and and the former the total number of scanning lines; e.g., a 30-line, $12\frac{1}{2}$ pictures a second image requires $30 \times 12\frac{1}{2} = 375$ cycles per second as the horizontal deflecting frequency: 240 lines, 25 pictures will need $240 \times 25 = 6{,}000$ c.p.s.

The Necessary Conditions

In order to bring about interlacing, we depart only very slightly from the scanning process described. One method is quite simple: make the number of scanning lines required an odd number, double the lower deflecting frequency and multiply it by half the total number of lines to get the higher deflecting frequency. Thus, if the ordinary 30-line scanning were required to be interlaced, in order to obtain the advantages mentioned in the previous article, we would have a 25-cycle lower deflector frequency, and $\frac{31}{2} \times 25 = 387.5$ for the higher. Similarly, to interlace the 240-lines, 25 pictures per second, we need deflecting frequencies of 50, and $\frac{241}{2} \times 50 = 6025$, respectively.

How Interlacing is produced

To see how interlacing is produced by this process let us trace the progress of the spot with the help of a sketch. To minimise the drawing and clarify the illustration, we will assume that there are to be 5 lines, 25 pictures per second, interlaced to give an apparent 50. The lower time-base frequency will therefore be 50, and the higher $\frac{5}{2} \times 50 = 125$. Starting from the top right-hand corner of Fig. 3, the spot will draw out a line screen until at the end of 1/50th of a second $\frac{125}{50} = 2\frac{1}{2}$ lines will have been traced, at the point X. (To avoid confusion the "fly-backs" are not shown.) The fly-back of the lower deflector frequency now moves the spot upwards by the same amount as it has been pulled down, so that it finds itself at the point S_2, and makes a second start from there along a path parallel to the original first line as shown by the dotted lines.

It will now be obvious that this second scan will exactly fill in the spaces between the first $2\frac{1}{2}$ lines after which the spot will return to the point S_1, and begin the cycle of operations again. It will be clear now why the E.M.I. Co. are proposing to use, in the forthcoming tests from the Alexandra Palace, a total of 405 lines, the odd number being necessary to bring about interlacing.

From the foregoing it will be seen that interlacing need involve no more complication, in the case of cathode-ray tube reception, than control over a fairly wide frequency range on the time-bases; and it should be possible to receive interlaced and non-interlaced transmissions with the same apparatus.

"TELEVIEWING"

Televiewing is the title of a book by Ernest H. Robinson, which, as the author says, "explains television in words that anyone can understand." The author makes good his claim, for he does manage to convey to the non-technical reader a concise outline of the principles involved and show what developments have led up to the progress that has been made. History is combined with explanation, and probably this is the most simple way of dealing with the subject in a popular way.

No phase of television has been left untouched, though in order to make the exposition simple the treatment in some cases is necessarily brief. Descriptions are given of all the practicable mechanical systems, the operation of the cathode-ray tube and special devices such as the Iconoscope and image dissector; these are sufficiently adequate to give the average reader an insight into the means which are available at present for the transmission of images by radio. The author has drawn very largely upon the pages of this Journal for much of the information, as he duly acknowledges. Nearly forty pages are devoted to the finances and the future of television, and naturally most of this is of an entirely speculative nature; the arguments are, however, reasonable and they will provide the reader with food for thought regarding the vast future potentialities of television. The book is one that can be recommended as an excellent introduction to television. It is published by Selwyn & Blount, Ltd., Paternoster Row, and the price is 6s.

The Iconoscope is the invention of Dr. Valdimir K. Zworykin of the R.C.A. research laboratories. It has a remarkable similarity to the human eye. This simple description will be of interest as the Iconoscope is likely to be employed in one of the systems of high definition transmission which are to be inaugurated from the Alexandra Palace.

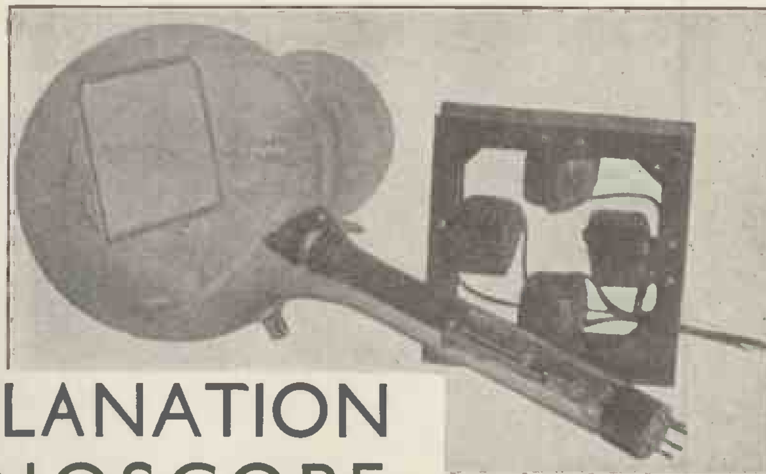


Fig. 1. The Iconoscope tube and deflecting coils.

A SIMPLE EXPLANATION OF THE ICONOSCOPE

COMPARATIVELY little information has been published on the Iconoscope, the reason probably being that it is still in process of development. When Dr. Valdimir Zworykin, the inventor, introduced the device, he said "In ordinary television systems every point of the picture acts on a photo-electric cell for a very short duration of time. This time is of the order of one 1,500,000th part of a second. This duration is only obtained in the case of very good pictures. During this period a photo-cell of the highest sensitivity will deliver only 60 electrons to the amplifiers, an amount so small that good amplification is impossible.

"In the Iconoscope, the picture acts on the photo-cell all of the time, and there is provision in the structure which collects the energy of the light, or, so to speak, memorises it and then transmits it, point by point. This involves a new principle for storing electrical energy, which may be called the 'electrical memory.'"

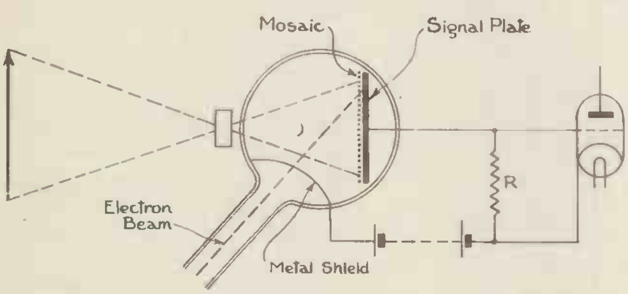


Fig. 2.—Diagram showing the operating principle of the Iconoscope.

The Iconoscope is a special form of cathode-ray tube which is shown by the photograph, Fig. 1. The glass envelope is of a somewhat different shape from the normal cathode-ray tube. The electron beam is produced by an "electron gun" system in a similar way to that of the ordinary cathode-ray tube. The novel feature is the square plate seen in Fig. 1. This consists of a metallic coating on one side of a sheet of mica. The other side of the mica sheet—the side exposed to the electron beam—is covered with a fine mosaic of minute particles of photo-electric material deposited on the mica.

How the Iconoscope functions will be understood by reference to Fig. 2. Here the metal plate is shown edge on, and it will be seen that it is in two parts, the actual photo-electric mosaic and the back metal plate which Zworykin calls the signal plate. The narrow neck of the tube and a part of the spherical bulb are metal-coated internally, this acting as a second anode for the electron beam which is directed on to the photo-electric mosaic in the usual manner.

Two local oscillators supply the energy to deflecting magnets which surround the neck of the tube. These can be seen in Fig. 1 detached from the tube. An image of the object to be transmitted is focused on the mosaic by a lens system, as shown diagrammatically in Fig. 2. The mosaic is, of course, systematically swept by the electron beam under the influence of the framing and line-scanning "saw-tooth" currents applied by the coils.

The cross-section of the electron beam which scans the photo-cell plate must be held within very accurate limits. It must be equal in size to the area of one picture unit. The greater the number of elements into which the picture image is divided, the greater the definition of the received image.

Iconoscope Resolution

Actually the resolution of the Iconoscope is considerably better than the rest of the system is capable of transmitting. As a result of this, it is possible to scan an area considerably smaller than the full size of the Iconoscope plate before the resolution of the Iconoscope becomes the limiting factor. This makes possible an unusual flexibility in the use of the camera. By changing the horizontal and vertical scanning amplitudes simultaneously, the effect of moving the camera forward or away from the subject is obtained without actually moving the camera. By adjusting the position of the scanning pattern to various sections of the mosaic, the effect of turning the camera may also be obtained.

An Iconoscope camera is shown by Fig. 3. The partition *a* through the centre is an electrostatic shield separating the picture-frequency amplifier from all other voltages applied to the Iconoscope. This shielding is quite essential due to the magnetic and electrostatic

THE ELECTRICAL EQUIVALENT OF THE EYE

fields around the deflecting coils and plates. The deflecting coils for causing the scanning beam to move vertically are seen at *b*. The deflecting plates for causing the beam to move horizontally are not visible in the photograph. They are mounted directly on the electron gun structure. *C* is the amplifier.

The photo-electric elements of the mosaic are of microscopic size, it being estimated that there are some three million elements on the mica sheet. The scanning spot of the electron beam is thus large compared with each photo element, so that a large number of elements is instantaneously under the influence of the beam as indicated somewhat approximately in Fig. 4. Thus if the whole mosaic is uniformly illuminated the average number of elements under the influence of the electron beam is everywhere fairly uniform, so that the sensitivity is fairly uniform all over the mosaic. The mosaic itself is made up of minute silver globules, each of which is photo-sensitised.

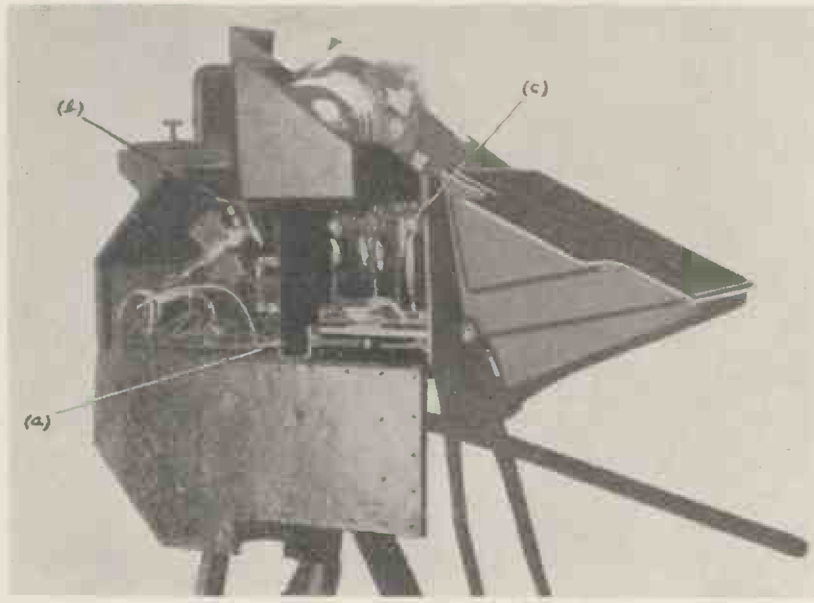


Fig. 3.—The Iconoscope camera.

Keystone Effect

Since the scanning beam and the optical image strike the same side of the Iconoscope mosaic, it is impractical for the axis of both the electron gun and the lens to be at right angles to the mosaic plate. The use of standard lenses requires that the plate be perpendicular to the optical axis of the lens. This requires that the scanning beam strike the plate at an angle.

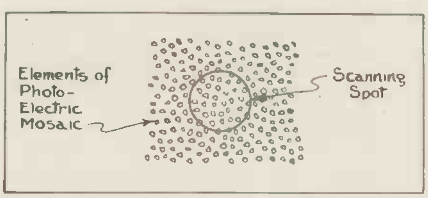


Fig. 4.—Diagram showing how the resolution of the Iconoscope is greater than the scanning spot size

If the Iconoscope is subjected to the regular scanning a " keystone " shape pattern will be formed due to the longer beam path to the top of the mosaic plate as show in Fig. 5b.

The deflecting means serve only to vary the direction of travel of the electron scanning beam. Hence the amplitude of the deflection at the plate depends upon the distance from the deflecting means to the plate. In order to scan a rectangular area, Fig. 5d, on the Iconoscope plate and avoid distortion of the transmitted picture, it is necessary to deflect the beam by the scanning action in such a way that if it fell upon a plate at right angles to the average axis of the beam, it would scan a pattern such as Fig. 5c.

Fig. 6 provides a simple explanation of the electrical action of the Iconoscope. The first diagram (a) shows the various parts in their actual physical relations as already shown in Fig. 2. PC is the photo-electric cathode (mosaic) while PA is the metal coating of the tube which acts also as the anode of the photo-electric combination. The photo-electric material is insulated from the back metal plate by the mica sheet, but has a capacity to the metal plate which is shown by the condenser C.

The same elements are shown at *b* as a conventional photo-electric cell and condenser, in order to simplify the circuit. When light from the projected picture falls on the mosaic, each element of it (PC) emits electrons and charges the condenser. When the electron beam is impinged on a photo-electric element that element *receives* electrons from the beam and discharges or partially discharges the condenser.

The discharge current will, of course, depend on the charge on the photo-electric condenser element and therefore on the light-intensity on that particular element. The charging and discharging currents into

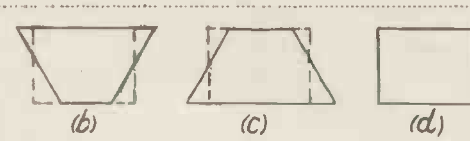


Fig. 5.—Diagram explaining how the formation of a keystone effect is obviated.

and out of the condenser are thus transformed into signal voltages across the resistance R (Figs. 2 and 6) and applied to the grid of the first amplifying valve. The action is rather complicated, but it will be understood that the Iconoscope contains all the elements necessary for progressive television scanning of a picture. Thus when a picture is focused on to the mosaic, the regions of light and shade are progressively scanned by the electron beam and varying currents

HOW THE ICONOSCOPE SYSTEM OPERATES

(corresponding to these graduations of light and shade) are set up in the resistance R. In accordance with the normal arrangements of television these currents are amplified and used to modulate the carrier. After rectification at the receiver, corresponding currents (or voltages) are then applied to vary the *intensity* of the electron beam in a receiving cathode-ray tube, which also has its beam deflected by "saw-tooth" framing and line-scanning voltages synchronised with the corresponding movements of the transmitter.

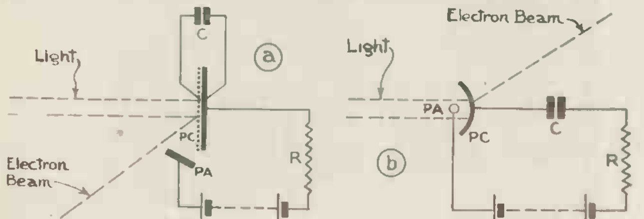


Fig. 6a. and b.—The electrical circuit of the Iconoscope (a) compared with an ordinary photo-electric cell circuit (b).

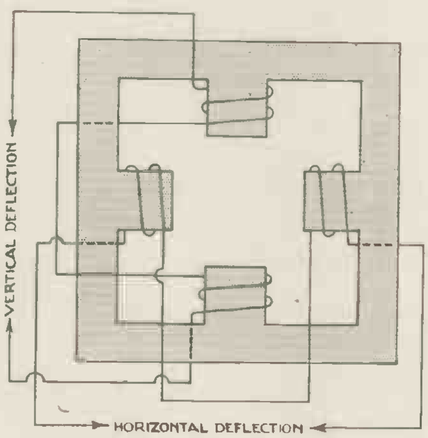


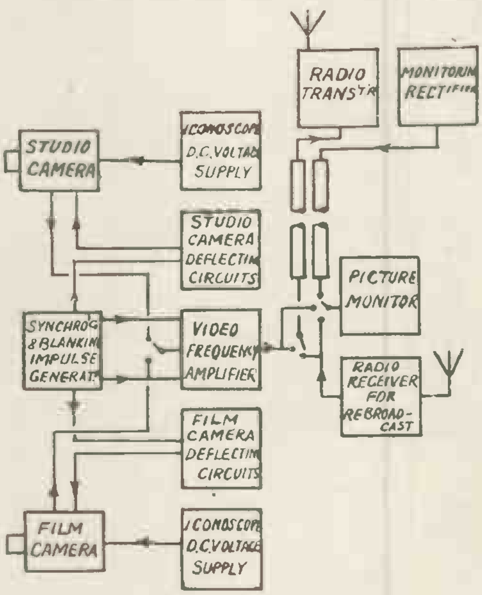
Fig. 7.—Diagram showing the magnetic deflecting system for the Iconoscope tube.

tion, undergoing subsequent acceleration merely to produce increased brightness.

Deflection of the electron beam, for the "saw-tooth" movements of framing and line-scanning, is done by current-carrying coils, placed around the narrow neck of the tube. The coils are wound on a magnetic system after the manner indicated diagrammatically in Fig. 7, where it will be seen that although carried on the same magnetic system the coils have no coupling to each other. The arrangement has also the merit of applying both horizontal and vertical deflecting (magnetic) forces at the *same point of the electron beam.*

Focus of the electron beam on the fluorescent screen is a joint function of cathode emission and the potential of the two anodes. The first anode operates at about 1,000 to 1,200 volts, and the second at about four times this value. The control electrode is set at about −5 volts with respect to the cathode, at which potential the brightness of the spot is of intermediate value. Variation of the control electrode by ± 5 volts about this value gives variation of the intensity of the beam with a linear response between full intensity and something approaching total extinction.

Fig. 8. — This diagram shows the various units in an experimental Iconoscope transmitting system and their relationship to each other.



The Receiver

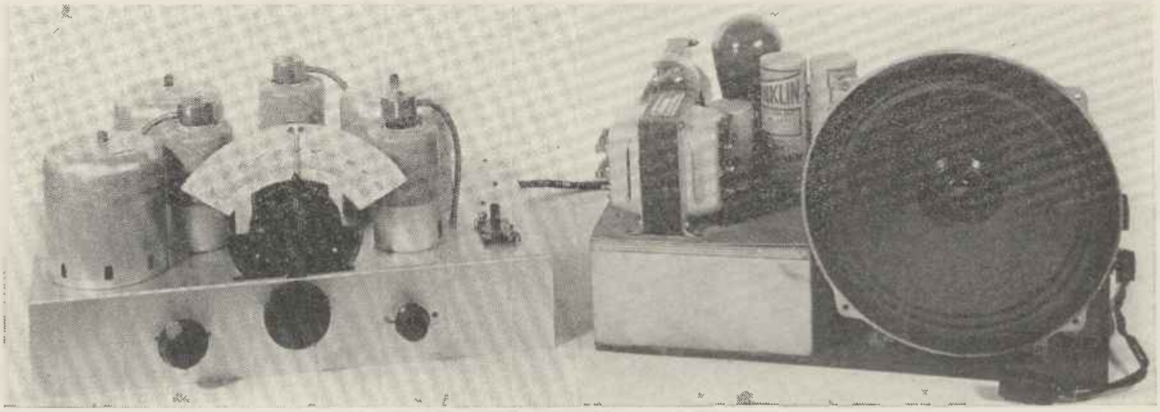
Zworykin's receiver is much more conventional. The cathode is indirectly heated and is contained within a control electrode with a central orifice. The first or main anode producing the electron beam is in the form of a tube with a number of orificed diaphragms. The control electrode is not used for the purpose of controlling the focus of the electron beam, but is employed to vary the *intensity* of the electron beam, without altering its focus at the fluorescent screen. The inside of the glass envelope is metallised, and this metal serves as a second anode.

The electron beam is produced by the first anode, after the manner of the usual cathode-ray tube, and receives additional acceleration by the second anode so that it produces a brighter fluorescence on the screen. The deflection of the beam is, however, effected just after its emergence *from the first anode* where, at its lower rate of acceleration, it is more sensitive to deflec-

The Complete System

The arrangements of the units which comprise the transmitter are illustrated schematically in Fig. 8. The Iconoscope is contained in a camera and an image of the object is optically focused on the mosaic screen in the manner already described. The two scanning deflections (framing and line-scan) are applied from "saw-tooth" generators by means of deflecting coils of the type already discussed. The picture-forming voltage variations are applied to a first amplifier housed within the camera, thence to a second amplifier, modulator, etc.

A 2-V-1 Short-wave Receiver



Both units are linked together by means of a five way plug and cable.

OWING to the difficulty in reducing noise level and eliminating medium-wave harmonics on the top and 3.5 mc. bands, it was decided to experiment with a receiver embodying two stages of R.F. to see whether or not the super-het could be bettered on these bands. Although the most efficient super-het brings in all there is to receive on the higher frequency bands, it generally falls off as the frequency decreases. So far these remarks apply to both commercial and amateur-built sets.

During the past few months conditions on the two low-frequency bands have been getting steadily worse, so much so on 1.7 mc. that DX contact after dark have been almost impossible. Extensive tests have shown that a 1-V-1 receiver would, very often, provide cleaner signals and sometimes greater signal strength than a multi-valve super-het when the field strength of the station was low and the background noise level high.

It is not practicable to use such a receiver owing to lack of selectivity, particularly where several top-band amateurs are working together. Trawlers also take a great deal of moving with such a simple receiver. This left no option but to attempt a two-stage R.F. receiver giving super-het selectivity with straight set noise level.

A standard amplifier being already available, all that was required was the receiver portion, so expense was kept down to a minimum. But for those who have not such an amplifier, all that is required is 250 volts 25 milliamps, and 4 volts at 3 amperes, that is, of course, in addition to the supply required by the L.F. amplifier.

The Circuit Arrangements

Several circuits were tested such as band-pass input and two H.F. transformer-coupled stages, a loose-coupled input and two tuned-grid stages and finally a combination of both. The circuit chosen uses a loose-coupled aerial circuit, with a fairly large-capacity pre-set in series with the input, a sharply tuned transformer stage followed by a fairly flat tuned-grid stage with normal Reinartz reaction but with a highly sensitive detector circuit.

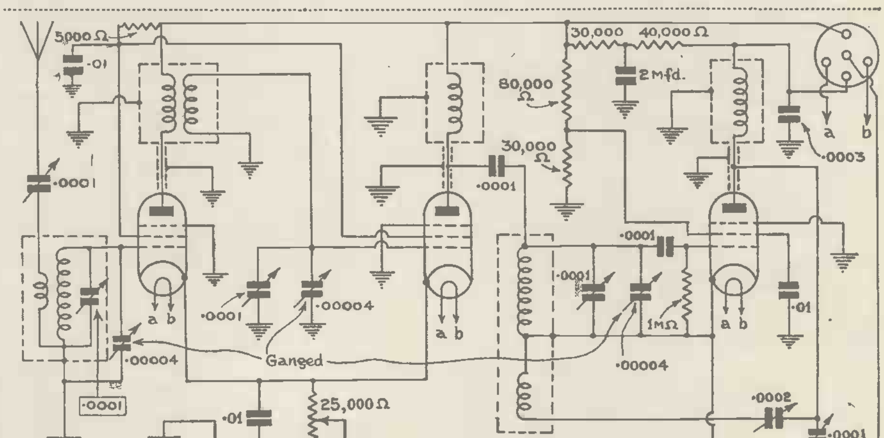
> *It is generally agreed that above 50 metres a good straight receiver is better than the average super-het. This receiver, which is a straight type, was designed specially for use on the 1.7 and 3.5 Mc. bands. After several months' use it was found that very high R.F. stage gain was obtained on the 7 and 14 Mc. bands, so making the receiver suitable for all purposes.*

After the receiver has first been constructed it was found that with a normal condenser, band width was far too narrow for amateur work, so Eddystone were approached and they made up a three-gang 40-mfd. condenser which is ideal for the purpose.

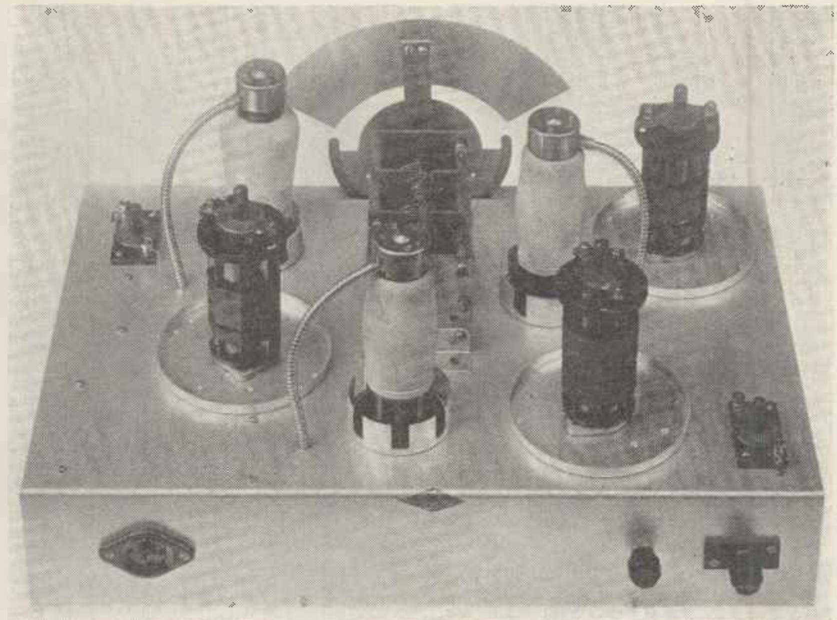
This gives a permanent semi-band spread and spreads the 160-metre band almost over the entire tuning scale. The only difficulty experienced with this arrangement is that the coils have to be very carefully matched as the condenser is not provided with separate trimmers.

Accurate coil winding not being particularly simple the problem was overcome very satisfactorily by connecting small .0001-mfd. J.B. preset condensers in parallel with the secondary of each coil. In this way the coils were wound to more or less the required waveband and carefully adjusted until all double humps were eliminated. Another advantage of this idea is that it is not necessary to make such bulky coils as would be the case with a small parallel capacity.

By using two tuned grid stages trouble was experienced with H.F. chokes, while at the same time a transformer stage in addition to being more selective and more sensitive, was considerably cheaper as no H.F. choke was required. The H.F. chokes finally used were of the Eddystone screened type. These chokes did not resonate in any awkward spots so they should be used if maximum results are to be obtained. With certain chokes of other makes it was noticed that the local



Three pentodes are used in this circuit. In this way optimum gain is obtained.



This is one of the most powerful short-wave receivers obtainable in this country. It is suitable for tropical use.

Regional programme was inclined to trickle in.

Valves

Components have been kept down to a minimum and by choice of special valves several accepted components have been omitted. The first two stages use variable-mu H.F. pentodes, which have been designed to withstand a pressure of 250 volts on both anode and screen. Theoretically this eliminates any screen and anode voltage-dropping resistances, but as a precautionary measure the screened grids were coupled together and linked to the H.T. supply through a 5,000-ohm resistance suitable by-passed by an .01-mfd. condenser.

Similarly in the grid circuit no decoupling is included as it was found unnecessary. The cathodes of the first two valves are joined together and connected to earth via a 25,000-ohm potentiometer. This provides an easy means of volume control by simply varying the bias applied to the H.F. valves.

The second H.F. stage is coupled to the detector by a small .0001-mfd. capacity condenser, which is reasonably critical. The detector valve only oscillates freely if the screening voltage is correct, while it is very touchy as to grid damping. Generally if a larger capacity coupling condenser is used some difficulty may be experienced in obtaining smooth oscillation over all wavebands.

During the first tests difficulty was experienced in obtaining reaction until a variable potentiometer was connected in the screened grid circuit of the detector valve. This was adjusted to give optimum results and then the value measured. This is a very unsatisfactory way of obtaining resistance values, but it turned out quite well in the end. The values used in the original receiver were 80,000 on the positive side and 30,000 on the negative side. After measuring one or two samples of the ACS/2Pen., there was only a very slight variation in screened current so that this value should be perfectly satisfactory. In case poor oscillation is experienced, vary the value of the 80,000-ohm resistance in this circuit. As an additional precautionary measure a baseboard mounting pre-set has been connected between the anode of the detector and chassis. This should be varied as it has a great bearing on the reaction. To make quite sure that all H.F. is completely filtered a .0003-mfd. fixed condenser is connected between the high-potential side of the detector H.F. choke and chassis, so making a very effective filter circuit.

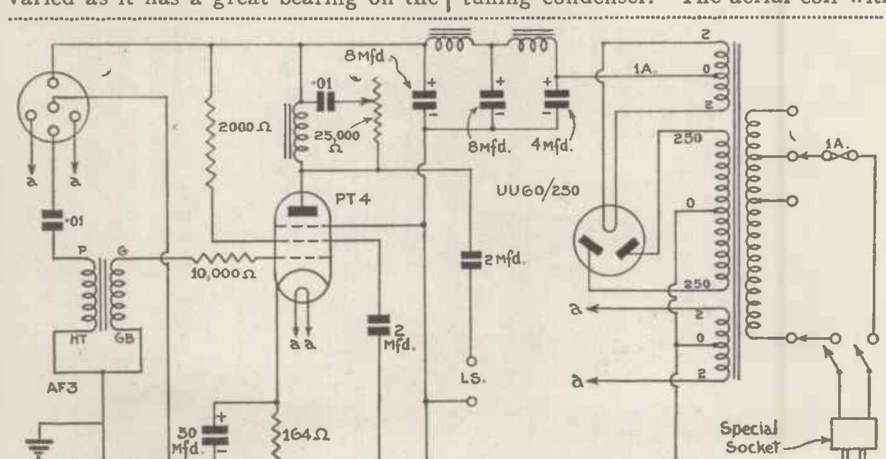
As compared with the efficiency obtained from a triode valve the pentode used is vastly superior, but the gain can be increased still further by increasing the value of the anode resistance nominally set at 40,000-ohms. Any increase in gain, however, may cause instability, so to make quite sure the receiver will function quite perfectly without any difficulty the gain has been kept down to within safe limits.

Home-made Coils

All coils have to be home-constructed. They are perfectly straightforward and should, of course, be of slightly higher inductance than the conventional 1.7 or 3.5 mc. coils, owing to the small tuning condenser. The aerial coil with

Components for 2-V-1 Short-wave Receiver

CABINET
1—special Twin de Luxe (Peto-Scott).
CHASSIS
1—Special aluminium 16 × 10 × 3 inches (Peto-Scott).
CHOKES, HIGH FREQUENCY
2—type 983 (Eddystone).
COIL FORMERS
1—set of 3 special four-pin (B.T.S.).
CONDENSERS, FIXED
2—.01-mfd. type tubular (T.C.C.).
1—.0003 mfd. type tubular (T.C.C.).
2—.0001-mfd. type 665 (Dubilier).
1—2-mfd. type 990 (Eddystone).
CONDENSERS, VARIABLE
1—type Gang SW 3-Sections 40-m.mfd. (Eddystone)
1—.0002-mfd. type 957 (Eddystone).
5—.0001-mfd. baseboard mounting pre-sets (J.B.).
DIAL, SLOW MOTION
1—970W (Eddystone).
HOLDERS, VALVE
3—SW 41 (Bulgin).
3—SW 42 (Bulgin).
PLUGS, TERMINALS, ETC.
2—terminals type B marked "Aerial" and "Earth" (Belling Lee).
2—Screened anode connectors with hoods (Belling-Lee).
RESISTANCES, FIXED
1—5,000-ohm 1-watt type (Erie.)
2—30,000-ohm " " "
1—40,000-ohm " " "
1—1-megohm " " "
1—80,000-ohm " " "
RESISTANCE, VARIABLE
1—25,000-ohm (Reliance).
SCREENS
3—3½-inch coil cans (Colvern).
3-Valve cans open top type (Colvern).
SUNDRIES
2 doz. 4 B.A. nickel nuts and bolts (Peto-Scott).
2—Ebonite strips 1½ × 2 × 3/16 (Peto-Scott).
1—Ebonite strip 1½ × ½ × 3/16 (Peto-Scott).
Connecting wire and sleeving (Coltone).
A complete kit of parts can be obtained from Peto-Scott, Ltd.



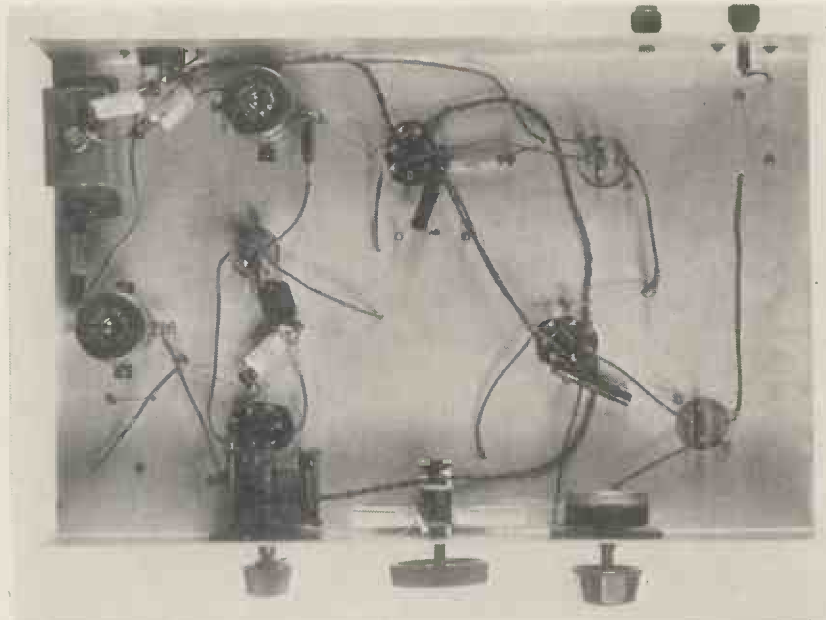
A fourth pentode is used in the amplifier section. This amplifier was first described in the May issue.

its small primary should be adjusted to give the required degree of selectivity. It should not be too selective otherwise there will be loss in signal strength, and remember that the input can be reduced by means of the aerial series condenser. The aerial coil consists of 65 turns of 28 gauge double silk-covered wire on the grid side and 18 turns of a similar gauge wire spaced ⅛ of an inch from the earthy end of the grid coil for a coupling coil.

The H.F. transformer is wound in a similar way, the primary consisting of 30 turns and the secondary consisting of 60 turns, the gap between coils being equal to space occupied by six turns. The final coil in the tuned grid stage has 60 turns on the grid coil and 17 turns reaction winding, the gap between the reaction winding and the earthy end of the grid coil being equal to four turns.

Construction

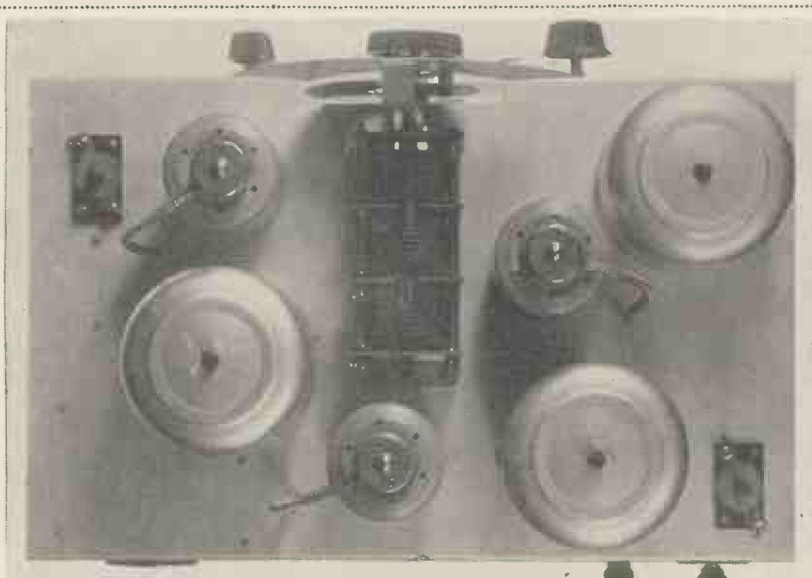
The reaction condenser, of the slow-motion type, is mounted off from the panel in common with the volume control. A one-inch hole is cut in the face of the chassis to allow ample clearance for the spindle, while the volume control and condenser are fixed to small ebonite strips, which in turn are bolted to the panel. Screened anode leads are essential and it is particularly important that they be earthed by means of soldered connections from the cable to the chassis. The 2-mfd. detector decoupling condenser is of a special type which only requires one connection. The negative side of this makes contact automatically through the base. The valve holder mounted at the back of the chassis is used as a terminal point. H.T. is taken to the anode socket, the output for the amplifier to the grid, heaters across the heater pins and cathode to the centre pin. This is then linked up to the amplifier having a correspondng valve holder.



There are very few components beneath the baseplate. Notice the volume and reaction controls are busl.ed off from the chassis.

Components for the Standard Amplifier

CHASSIS
1—Wooden approx. 8 × 10 × 3½ zinc covered (Peto-Scott).
CHOKES, LOW FREQUENCY
2—L34M (Bryan Savage).
1—HT 35 (Wearite).
CONDENSERS, FIXED.
2—.01-mfd. type tubular (Erie).
1—2-mfd. type BB (Dubilier).
1—2-mfd. type 990 (Eddystone).
1—50-mfd. 50-volt working (Franklin).
1—4-mfd. 600-volt working (Franklin).
2—8 mfd. 600-volt working (Franklin).
HOLDERS, VALVE
1—7-pin type Air-sprung (Clix).
2—5-pin type Air-sprung (Clix).
LOUD SPEAKER
1—Stentorian Senior (W.B.).
RESISTANCES, FIXED
1—10,000-ohms type 1-watt (Erie).
1—2,000-ohm type 1 watt (Erie).
1—164-ohm type 1-watt (Graham Farish)
RESISTANCES, VARIABLE
1—50,000-ohm (Erie).
SUNDRIES
1—type P36 five-pin plug (Bulgin).
1—special combined fuse holder and mains plug (Belling-Lee).
1—yard five-way cable (Bulgin).
2—Insulated plugs and sockets red (Clix).
2—Insulated plugs and sockets yellow (Clix).
2—Insulated plugs and sockets blue (Clix).
SWITCH
1—DPDT (Wearite).
TRANSFORMER L.F.
1—Ferranti AF3.
TRANSFORMER MAINS
1—Special type to specification (Sound Sales).
VALVES
1—PT4 (Ferranti).
1—UU62/50 (Mazda).
A complete kit of parts can be obtained from Pe to Scott, Ltd.



The lay-out is very clean. Most of the components are beneath the baseplate.

The amplifier is quite conventional, consisting of a steep-slope pentode and a full-wave rectifying valve giving 250 volts at 60 milliamps. Smoothing is very complete, consisting of two chokes and 20-mfd. capacity. A variable tone corrector is an integral part, while a double-pole single-throw switch completely isolates the amplifier from the mains when required.

This receiver is at the moment in use at G5ZJ and has proved satisfactory on 20, 40, 80 and 160 metres. Surprisingly high stage gain is obtained on 20 metres, so much so that phone contacts can be made when conditions are so bad that noise level on the super-het blots out all signals. By careful coil construction each waveband can be made to spread over almost the entire tuning scale, so making the receiver an ideal one for amateur use.

Readers who would like to hear the actual receiver under operating conditions can do so at G5ZJ.

Scannings and Reflections

By THE LOOKER

The Alexandra Palace

AS the B.B.C. lease of the South Wing of the Alexandra Palace runs for twenty-one years it seems certain that the London television station will be located there for many years to come and the accommodation appears to be admirably suitable for the job. The place is so vast that the work already in hand has made but a small impression.

The pointed roof has been removed from the southern tower, where a sixty-foot aerial mast is to be erected, space in the tower beneath the aerial has been allotted to office accommodation, while below in the main building studios and transmitters will be erected.

All in Duplicate

Owing to the decision of the Advisory Committee that two systems should be given equal facilities everything must be duplicated. Three large halls are being split into two big studios, each about seventy feet long, and there are to be two separate transmitter rooms.

Studios of this size should be large enough for the most ambitious interior shots, and if distant views are wanted it will only be necessary to take the electronomic camera outside on to the terrace, which on a fine day commands a view of many miles across London.

Outdoor scenes can be played in the Park, which includes a racecourse, a boating pool and tennis courts. Maybe television will bring fame to the race meetings and tennis tournaments. It cannot fail to stimulate interest in the Palace and the Trustees have reason to be grateful for the choice of site.

Besides the studios inside the Palace a small theatre has been acquired and this will also be available for television use. Altogether the superficial floor area of the section taken over is as great as Broadcasting House, so despite the duplication which is inevitable for parallel running there should be plenty of room for all normal requirements.

Improving the Show

How immensely Olympia would have been improved by a television demonstration and what a sad reflection upon everybody concerned that there wasn't one. Some visitors to Olympia expressed disappointment at not finding television apparatus on our stand or a television demonstration provided by the Exhibition promoters. Rules and regulations prevented our doing anything in the matter, the Radio Manufacturers' Association having, for the first time, barred any exhibitor from including television apparatus. The Association stated some months ago that it was itself arranging for a demonstration, but this came to nothing. Visitors at our stand had one favourite question! "Where can I see high-definition television?" Not an easy question to answer.

On Monday evening, August 19th, fire destroyed a large part of the Berlin Radio Exhibition, the damage amounting, it is expressed, to the round sum of £500,000. Fortunately, the hall in which the television exhibits were staged was not affected, but two other halls appear to have been completely ruined.

Manfred von Ardenne's Receiver

No television at Olympia but plenty at the German Radio Exhibition held, more or less, during the same period in Berlin. For years the Berlin Exhibition has done its best to demonstrate to the public the progress being made in the art. A new exhibit was the Lorenz von Ardenne television receiver so mounted in a glass case that every part of the chassis was clearly visible. The receiver is to the design of Manfred von Ardenne whose work is well-known in this country; it is manufactured by the Lorenz Company, and gives a picture measuring 19 x 22 centimetres—not quite 8 ins. x 9 ins.

German Greeting

By the way, Mr. H. de A. Donisthorpe, of the General Electric Company and well-known to radio societies throughout Great Britain, telephoned from the Lorenz stand a description of the Berlin Exhibition to his own Company's stand at Olympia, London, and Baron von Ardenne sent over the telephone a special greeting to the Olympia Exhibition.

What Lee de Forest Thinks

Lee de Forest, the American inventor to whom some of the greatest inventions in early radio were due, has recently stated his opinion that "the inherent limitations of the cathode-beam tube will prevent its general acceptance. The combination of an acceptably large picture, brilliant illumination and long life of the tube are irreconcilable—at least until someone has discovered a fluorescent layer of an entirely different order from anything known in the cathode-beam art to-day." He goes on to say that "a mechanical scanner has been developed which is small, noiseless, cheaply made, without rotating parts and possessing infinite endurance," and he believes it to be capable of solving the problem of an acceptably fine, brilliantly illuminated, reasonably large screen picture in the home. He looks to see this system actually introduced within the next twelve or eighteen months.

In Belgium

It is not only in Great Britain that the television enthusiast is dissatisfied with the rate of progress. Is that a comfort? We are informed that the Belgian authorities have received no less than 50 applications for permission to transmit television for purposes of experiment. The requests are being ignored due, it is thought, to lassitude on the part of the authority concerned.

The Television Director

Mr. Gerald Cock, released from his work on Jubilee relays, became Television Director on August 1, and his executive is Mr. Leonard Schuster, who had a similar post in the Outside Broadcast Department. No other appointments have yet been announced to the staff of the new organisation, but it is possible to estimate some of the requirements.

Even at the start there will be work for several producers. Presenting two programmes per week has been more than a whole-time job for Mr. Eustace Robb and this department will have to be strengthened as soon as daily programmes begin. Ultimately a programme director will be needed to plan and cordinate the effort and there should also be posts for artistic film directors.

No doubt the administrative resources of Broadcasting House will be available to the new unit, but television will be making fresh contacts in the business world and it is clear that some official will have to study its peculiar problems. Close co-operation with broadcasting programme departments, particularly variety and drama, will be essential and producers taking auditions in St. Georges Hall are already noting acts which might be suitable for television.

A studio manager and office and house staff, too, will be required. B.B.C. training and experience is an obvious qualification for most of these posts, which I expect to be filled from the staff at Broadcasting House. Anyway, no applications have been invited from the public.

The Shape of the Mast

What delays progress at Alexandra Palace, London, N., where the first television transmitter is to be built—or is it being built? Quite a number of things, we are afraid. Difficulty has even arisen regarding the shape of the aerial mast. We should have thought that as this mast has merely to support the di-pole aerial its shape would not matter in the least. But there is much argument on the matter, and, in consequence, delay.

Congratulations

" I am writing to congratulate you upon your series of articles on the cathode-ray tube," says the chief of a well-known research laboratory in a letter to the author of the series of articles that have been appearing in our pages. " It is very difficult indeed to write in the manner that you have adopted and few of us have the gift. At least one reader thoroughly appreciated the style and derived pleasure from reading your copy." Mr. Parr's articles are continued in this issue.

Last Month's Best

The best performance of the month was given by the Penguin sponsored by the Zoo man. Presented by nature with a colouring which is perfect for the screen and gifted with a dignity which would be impressive in a mayoral parlour, " Percy " made an elegant picture—even when eating fish.

Mr. D. Seth Smith struck the right note, cramming his talk with information, without being either dry or flippant. Since the first Zoo programme two years ago Mr. Seth Smith has become a regular broadcaster in the Children's Hour, and I should like to congratulate him on this evening's effort.

There was a doubt whether the lion cub would be able to show up as his mother had rolled on him a few days before the programme, but a spell in the Zoo sanatorium put him in form for the night. He was far less reluctant to leave his box in the studio than the panda.

Cocky, the old white cockatoo, made his second appearance and those firm friends the pied hornbill and ariel toucan were again a most successful double act. The fish exhibited needed running water and after their appearance were refreshed in the sink.

Sure!

One American visitor to our stand at Olympia was surprised at the lack of television apparatus as he was under the impression that we were ahead of America! So we are, but hate people to know it.

The Second Television Station?

Birmingham becomes hot favourite as the site for the second television station since the Post Office announced plans for the construction of a new line from London capable of carrying television signals. The new cable should be completed by next summer and if successful will be extended northward. When not in use for television it will carry as many as 200 telephone calls simultaneously, which would justify the high cost of operation. Repeaters will be needed every seven miles. This line is undoubtedly the first link in a simultaneous broadcasting system for television.

Fast Work

Have you noticed that when the ordinary broadcasting fails to finish to time, there is a tendency to delay the 30-line transmission? Delay due to faults is of very infrequent occurrence, but there was a fifteen-minute unexpected delay in starting the 30-line programme a few weeks ago. The bearings of the electric motor, which drives the drum scanner, suddenly ran dry and the machine had to be removed from the scanner and dismantled before the programme could start. Fifteen minutes' really fast work on the part of the B.B.C. engineers put the apparatus in good running order again.

200,000!

Television proved an immense attraction at the Berlin Exhibition. It is estimated that there was considerably more than 200,000 visitors in the first two days. It is highly significant that the most important section of the whole show was devoted to television. It had a hall to itself. The cheapest television receiver in the Berlin Exhibition cost about £66 and gave a picture roughly 8 ins. × 7 ins.

Short-wave Range

Mr. Douglas Walters' record for long-distance reception on ultra-short waves suggests that lookers well outside the 20-25 mile radius from Alexandra Palace will be able to enjoy good pictures under favourable conditions. B.B.C. engineers are cautious in their estimates of range since they must always think in terms of service, but it seems likely that in certain directions signals will be receivable at a considerable distance.

British Artists

At the holiday season the producer lightens the programmes and I enjoyed several good mixed bills composed of British and foreign variety and cabaret turns.

In the proportion of native to other artists employed Eustace Robb seems to me to strike a fair balance and I was astonished to read that " practically all the pioneers who have kept the present 30-line service going have come from outside this country." The critic proceeded to cite a well-known Australian dancer, so perhaps his statement is not intended to be as harsh as it seemed. While preference is always given to British artists, it would be ridiculous to impoverish these or any other programmes by taking a strictly insular view. It has been tried with conspicuous failure in other branches of entertainment.

Let Mr. Robb continue to encourage the British artist while welcoming talent from overseas which has something fresh to offer to our screens. In this matter of nationality names sometimes mislead. Here is a short list of British television pioneers picked at random:—Ruth Makand, Heddle Nash, Robert Easton, Maria Sandra, Peggy Cochrane, Doris Sonne, Hermione Darnborough, Elizabeth Pollock, Jane Carr, Gordon Little, Dudley Rolph, Ronald Frankau, Leonard Henry, Lupino Lane, Sandy Powell, Dennis Noble, Lydia Sokolova, Robert Algar, Billy Milton, Patrick Waddington, Helen Raymond, Betty Bolton, Gavin Gordon, Leila Megane, Roy Royston, Olive Groves, Katherine Arkandy, Gus Chevalier, Leslie French, Anton Dolin, and Alicia Markova.

All these artists have a claim to special treatment when the new service starts.

The Big Screen

Mr. Marsland Gander, in the *Daily Telegraph,* speaks of the Karolus screen about 6 ft. square erected at one end of the Television Hall in the Berlin Exhibition. It consists of about 10,000 small electric light bulbs, which give a 100-line picture, and provides the best big screen television picture he has yet seen.

A Practical Problem

The introduction of commercial all-wave receivers seems to have convinced listeners that short waves are at last of some use. Several inquiries were made at our stand at Olympia as to how to learn the superficial details of short waves and whether it would be better to buy an all-wave set or a cheap broadcast set and to make a simple converter.

In Holland

The Netherland Institution of Television, Utrecht, under the direction of M.P.-F. Van den Boogaard, has been very active recently. The P.T.T. has put at its service cables linking the big towns with the studio for television experiments. The Batavia Radio Society has asked the Institution to consider the installation of television for the Dutch Indies and the Institution is discussing the matter with television engineers.

The P.M.G.'s Announcement

THE Postmaster-General announces that, on the recommendation of the Television Advisory Committee, he has now authorised the British Broadcasting Corporation to make arrangements with the Baird Television Co., Ltd., and the Marconi-E.M.I. Television Co., Ltd., for the provision of complete transmitting equipment for the operation of their respective systems at the Alexandra Palace, and, subject to the settlement of certain outstanding points, orders will be placed accordingly. The work of manufacture and installation is expected to be finished in approximately six months; and the first test transmissions should, therefore, start in the early part of next year, to be followed by a regular public service as soon as practicable thereafter. Constructional work at the Alexandra Palace has already begun.

Such technical information regarding the characteristics of the television signals radiated by the two systems as will facilitate the designing of television receivers capable of picking up those signals will be published at an early date.

Assurances are being obtained from the companies concerned that licences will be granted to any responsible manufacturer to use their patents for the manufacture of television receiving sets in this country on payment of royalty on reasonable terms.

GENERAL POST OFFICE.
12th August, 1935.

Interlaced Scanning

The method of producing interlaced scanning has been closely guarded in this country, but you will see for yourself that this issue of TELEVISION AND SHORT-WAVE WORLD contains a special article showing how it is done. In Berlin a new mirror-screw for producing interlaced scanning has been exhibited. We shall describe it shortly.

Fernseh

A series of home receivers made by the Fernseh company and shown at Berlin, is of compact design and in its appearance makes the most of the viewing end of the cathode-ray tube.

In Italy

S.A.F.A.R., the Italian radio concern, are now conducting an experimental service of 240 lines and 25 pictures per second. It is the intention of this firm to place receivers on the market giving pictures 8 ins. × 10 ins.

Scophony

Scophony. Ltd., have now transferred their laboratories to Campden Hill, Kensington, where a large house has been adapted for their special requirements. This situation was chosen largely because it is one of the highest parts of central London.

Components at Olympia

There was decidedly more interest at Olympia this year in small components. Every maker was showing at least one short-wave component.

Three set makers showing at Olympia were issuing short-wave kits and issuing booklets describing the theory of short-waves and the way to make the most of the kit. There were many inquiries during the course of the Exhibition as to the possibilities of all-wave sets.

The Busse Tube

A new cathode-ray tube shown for the first time at the Berlin Exhibition has been designed by Dr. Busse and produced by C. H. F. Müller, of Hamburg. The electrodes are supported by ceramic insulators.

5-Metre Work

There is negligible interest in five-metre receivers other than with the S.W. amateurs. This will remain so until this band has some programme value.

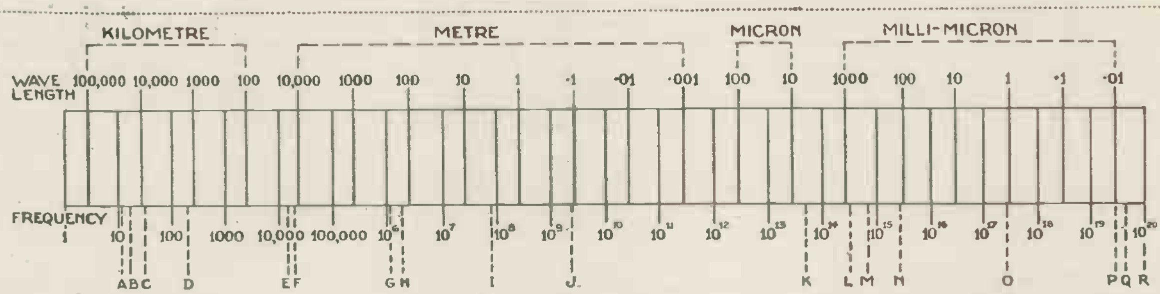


Fig. 1.—DIAGRAM OF ENERGY SPECTRUM.

A to F.—30-line low-definition television signal requirements. B to H.—Approximate high-definition television requirements. C to E.—High-Fidelity sound. G.—Carrier of 30-line television. F to J.—Radio waves of practical value, no doubt J to K will also have practical uses. I.—Approximate position of high-definition television carrier. K to L.—Infra-red. L to M.—Visible light. M to N.—Ultra-violet. O to P.—X-rays. Q to R.—Radium rays with cosmic rays about R onwards.

COLOUR VALUES IN TELEVISION

By R. L. Ashmore

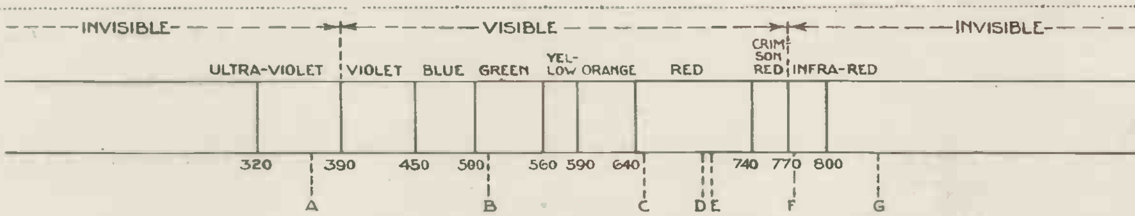


Fig. 2.—DIAGRAM OF VISIBLE SPECTRUM.
Wavelength in Millimicrons.

A to B.—Response of ordinary photographic emulsions. A to E.—Response of panchromatic photographic emulsions. C to G.—Caesium photo-cell peaks very strongly in this zone. F.—Peak point of caesium cell. Ultra-violet to left of 320 is filtered out by glass.

LAST month we dealt with illumination and simple photometry and after discussing practical methods of the latter, concluded with the statement that in any picture recording work the methods given were practically useless. To show why this is so we must first investigate other properties of light.

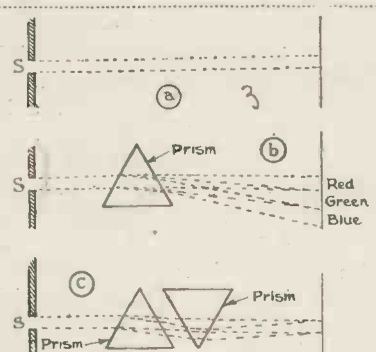


Fig. 3.—Experiment showing the composition of white light.

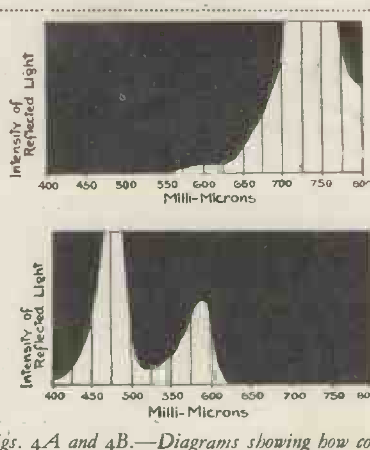
It is generally accepted that what we term light is wave motion in the ether similar to "wireless" waves. Light occupies a very small part of the ether wave family whose range is illustrated in Fig. 1, while Fig. 2 is the small part in the neighbourhood of the "visible" opened out for clearer inspection. From this diagram we see that light is comprised of about one octave of vibrations or frequencies, which as most of us know produces the effect of colour, which, though seriously complicating practical photometry, would make a very drab world if they did not affect the eye in the way they do.

The relation of colour in illumination is somewhat intricate, for it involves physical, physiological and æsthetic considerations, though luckily in picture recording work—such as television and photography—only the physical effects concerns us, as long as we are dealing with only a monochromatic reproduction.

In colour work one invariably refers to daylight as "white light," which is generally considered to have an equal amount of the whole of the visible light range. Actually this is not the case as the following table, taken from Abney's results, shows:

Colour.	*Sunlight.*	*Skylight.*	*Arclight.*	*Gaslight.*
Red	100	100	100	100
Green	193	256	203	95
Violet	228	760	250	27

With relatively cheap apparatus one can demonstrate that "white light"—daylight—is composed of



Figs. 4A and 4B.—Diagrams showing how colours are absorbed by "coloured" objects.

various coloured lights. We will not go into detailed mechanical construction of such apparatus as this could be made very elaborate, so only the essential principals will be given. Referring to Fig. 3 A, if one has sunlight streaming in through a small round aperture S of about ⅛ in. diameter, in an otherwise blacked-out window frame, one will get on the opposite wall an image of the sun, say, at 1. Now if a glass prism is placed in the beam of light (Fig. 3B) instead of the image of the sun a streak of coloured light is produced with the colours of the rainbow, from red to violet.

If another prism is added the same way up the coloured streak of light will be elongated but no new colour introduced, while on the other hand, if the second prism is reversed as C Fig. 3, a white image of the sun will be produced, which though somewhat displaced demonstrates that coloured lights can produce white light. Such an arrangement is the most simple form of spectrometer and readers interested in the subject should refer to the usual text books on light.

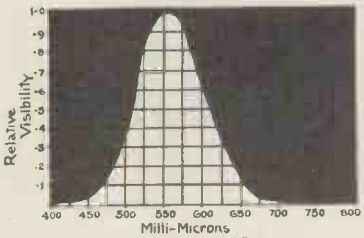


Fig. 5.—Spectral luminosity curve of the eye.

Our experiment thus shows us how daylight is composed of different coloured lights which can all be remixed to form the original white light.

Looking at a red book in daylight the book appears "red" because from the white light it selects mainly the "red" for reflection, strongly absorbing green and blue, shown graphically in Fig. 4A by reflected spectrum; an apparently blue book produces spectrum such as B Fig. 4. If we looked at the red book in blue light, the book would appear black as the book only reflects red light; similarly if the blue book was viewed by red light.

Now supposing one viewed a row of coloured lamps covering the visible spectrum from red to violet and all these lamps were of the same brightness, the eye would not register them as of being of equal intensity, as the eye is most sensitive to a yellow-green light, diagramatically shown in Fig. 5.

In any monochrome reproduction of a coloured scene the luminosity of the various detail which goes to make the whole should be rendered as the eye visualises them. Let us examine to what extent this is done. One of the commonest forms of picture recording is the amateur "snapshot," which, generally speaking, rarely resembles the luminosity or tone values of the original scene. The reasons are many but for the moment we will only consider colour distortion.

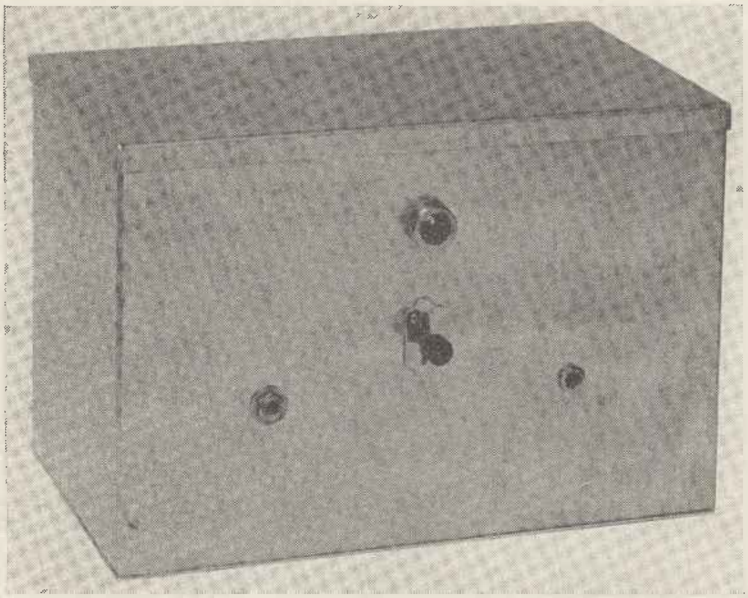
Ordinary photographic plates or

(*Continued on page* 519.)

Fig. 6.—Two examples of a coloured picture photographed with ordinary emulsion (A) and panchromatic with filter (B). With acknowledgments to "Passing Show."

Print from negative made on a plate of the ordinary kind. *Print from negative on Ilford panchromatic plate with Gamma filter.*

Fig. 7.—The Ilford Co.'s Test Chart. The left-hand half of each chart is in colour while the right-hand half is the monochrome equivalent.



In the centre is the master switch which controls the H.T., L.T., and microphone battery.

A Microphone Head Amplifier

By Malcolm Harvey

As amateurs are beginning to use high quality microphones such as the condenser and ribbon types with low outputs, details of this head amplifier should prove of particular interest.

THIS head amplifier was originally designed to boost the output from one of the low-output Reisz microphones, so the voltage given would be comparable with that of a pick-up. It was found that unless the entire amplifier was completely screened a certain amount of hum was introduced which could not be eliminated.

Actually the unit consists of a microphone energising battery and step-up input transformer, the output of which feeds into the grid of a catkin triode via a screened h.f. choke into a conventional R.C. coupled stage.

After several weeks of continual use, it was discovered that two H.F. chokes were very necessary and both must be of the screened variety. As can be seen from the theoretical circuit, one is in the grid of the amplifier, the other in the anode, the latter being suitably bypassed to earth by a .0003 condenser.

The aluminium cabinet specially made for this unit by Paroussi, measures 12 ins. × 7 ins. × 8 ins. Dimensions could not be reduced any further owing to the fact that a 99-volt battery of suitable capacity takes up the bulk of the space. It must be remembered that this cabinet houses, in addition to the H.T. battery, three 4½-volt dry cells for energising the microphone, and a low-tension accumulator.

If the stage gain is increased beyond a certain limit, there is a possibility of trouble being set up, particularly should the speech amplifier be a little dithery. It is not unusual for a speech amplifier to be held down by artificial means so that directly an additional amplifier is coupled to it the result is complete instability.

In a measure the two H.F. chokes prevent any possibility of this, but as a further safeguard the stage gain has been kept down by using a low value anode resistance. In a later circuit a screened grid valve has been used which gives almost three times the gain. This development, while being perfectly satisfactory, is not at the moment suitable for general construction.

Automatic Bias

It will be noticed that automatic bias is employed. Actually this increases the expense, for a 1-mfd. condenser and a 500-ohm resistance cost more than a 4½-volt grid cell, but the saving in space makes this worth while. If the output of the amplifier is taken to the speech amplifier via a single metal-braided cable no hum pick-up will be noticed providing the cable is earthed at both ends.

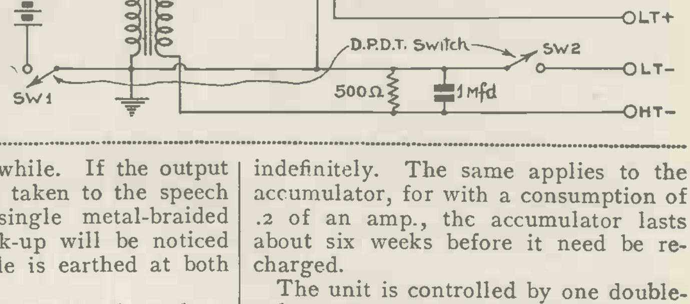
This unit at the moment is at least 20 feet from the main speech amplifier, and there is no trouble with interference whatsoever. Without the head amplifier in circuit to obtain sufficient modulation one has to speak right into the microphone—of the Reisz type—but with the help of the amplifier, sufficient modulation is obtained from up to 10 or 12 feet. .

It makes a very great difference to the efficiency of the station. Without the amplifier, unless one speaks directly into the microphone, fading effect sets in as the head is moved from side to side. This, of course, is now almost impossible as small input variations do not appear to have very much effect.

Anode consumption is approximately 2 milliamps. so that the battery will last indefinitely. The same applies to the accumulator, for with a consumption of .2 of an amp., the accumulator lasts about six weeks before it need be recharged.

The unit is controlled by one double-pole make-and-break switch, which cuts off the L.T. and energising battery. A red dial light indicates when the micro-

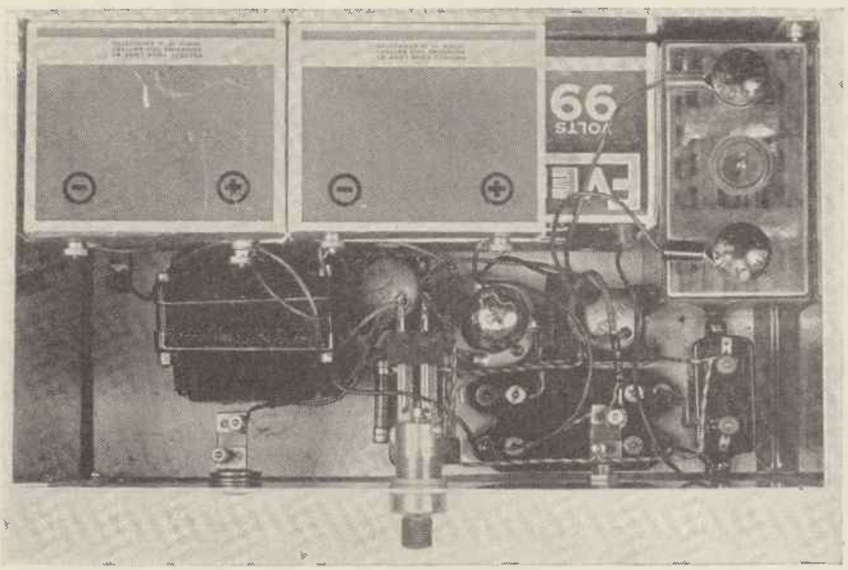
Resistance values can be obtained from this circuit. All chokes are of the screened type. A dial light can be connected across the L.T. if required.



phone is live, so that altogether this head amplifier adds very much to the appearance and efficiency of the average amateur station.

Construction

Construction will not present any difficulty and for that reason we have not issued a blueprint for we are under the impression that anybody wishing to build apparatus of this kind will have sufficient knowledge not to bother about a blueprint. Most amateurs only want when the entire equipment is completely screened. After the amplifier has been built, as a matter of interest, try the effect of rotating the box, and should it be noticed that any particular spot causes a decrease in hum level then loosen the screws that fix the transformer and rotate this until the best position is found. Incidentally the H.F. choke in the grid circuit is provided with a pigtail so that there is no difficulty in moving the transformer owing to short leads.



The position of the microphone transformer has to be determined by experiment before fixing.

a theoretical circuit to jog their memories.

A point to remember, however, is that very bad hum can be set up if the L.F. transformer has its windings on the wrong plane. This still happens even

Components for Head Amplifier

CABINET.
1—aluminium 12×7×8 in. (Paroussi).
CHOKES, HIGH-FREQUENCY.
2—H.F. P.A. (Wright & Weaire).
CONDENSERS, FIXED.
1—.0003 mfd. type M (T.C.C.).
1—.01 mfd. 250-volt working (T.C.C.).
1—2 mfd. electrolytic 50-volt working (T.C.C.).
1—Paper type 1 mfd. (Dubilier).
HOLDER, VALVE.
1—Short-wave type (B.T.S.)
PLUGS, TERMINALS.
2—Wander plugs marked H.T.—, H.T.+ (Clix).
2—Spade terminals marked L.T.—, L.T.+ (Clix).
2—Closed circuit jacks type J7 (Bulgin).
2—P15 plugs (Bulgin).
RESISTANCES, FIXED.
1—2½ watt type 40,000 ohms. (Ferranti)
1—2½ watt type 20,000 ohms. (Ferranti)
1—1 watt type 500 ohms. (Franklin)
SUNDRIES.
1—Dial light type D9 (Bulgin).
1—packet insulating washers (Bulgin).
2—yards 1 mm. flexible wire (Goltone).
Connecting wire and sleeving (Goltone).
SWITCH.
1—Rotary type I22 (Wearite).
TRANSFORMER, MICROPHONE.
1—R.D.124 (Ferranti).
ACCESSORIES.
ACCUMULATOR.
1—type Y (Ever Ready).
BATTERIES.
1—high-tension 99-volt Winner (Ever Ready).
2—Microphone energising type 126 (Ever Ready).
VALVE.
1—H.L.2 Catkin (Marconi).

The microphone batteries are provided with terminals, but it is a good sound scheme to solder these for the terminals have a happy knack of coming loose. If there is any doubt about the goodness of the H.T. battery, put a large capacity condenser across it, for the slightest rustle out of this battery puts a nasty crackle into the modulation.

Only one contact need be made to each of the jacks for one side of the input circuit and one side of the output circuit is made automatically to the case.

"Colour Values in Television"

(*Continued from page* 517.)

films, for practical purposes, are insensitive to green or red light and only record blue and ultra-violet, while specially treated emulsions, known as panchromatic, can be made to reproduce in monochrome the correct luminosity or tone value of the scene. Fig. 6 illustrates the point in the reproduction of the front cover of a well-known weekly journal, the subject of which is rather appropriate for a television journal. This colour distortion is perhaps more clearly shown in Fig. 7.

Messrs. Ilford, Ltd. (by whose courtesy this picture is reproduced) have very carefully prepared a colour test chart, which comprises on one side (the left) a series of coloured strips ranging from dark red to violet, while exactly opposite is a monochrome counterpart of correct visual luminosities of the coloured half. Actually for correct rendering certain colour filters are used when photographing as a panchromatic emulsion by itself is not sufficient.

Turning to television one finds that the response of the photo-electric cell is very different to colour to that of the eye. Some cells peak in the blue end of the spectrum while others the red. Most of the cells normally used are of the latter type, as such cells have a greater emission per lumen than blue sensitive type. No photocell has the same response as the eye to colour, though they can be definitely made very similar by first passing the light through suitable filters. These filters unfortunately, however, reduce the overall sensitivity of the response of the cells. In the projected spot principal of television (such as used by the B.B.C.) it is possible to put filters in the light beam and so produce the same effect, though with a falling off of photo-cell response. (This would also be true of a floodlight system.)

It will now be realised that when one reads that a photo-cell emission is so many micro-amperes per lumen that this information is very vague, as is so many candle-foot necessary to take a photograph. To really be of any value one must be given the colour or wavelength of the light, a point which so far we have never seen in print.

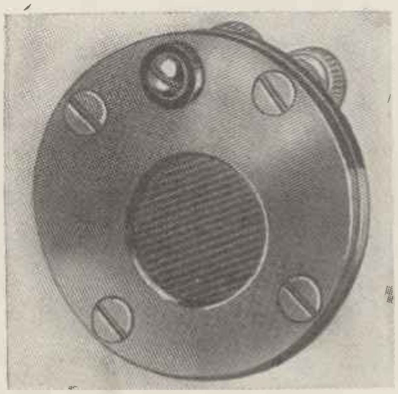
In practice the complete measurement of light intensity and wavelengths for televison or photographic purposes becomes an extremely complicated subject outside a laboratory, the definite repetition of a standard light source or recording device being a serious problem which so far has hardly been overcome. Next month we will look into some of these problems from the practical point of view.

Change of Address

Scophony, Ltd., have moved from Dean House, 2-4 Dean Street, W.1, to Thornwood Lodge, Campden Hill, London, W.8. Telephone: Park 8181. Visitors are respectfully requested to 'phone for an appointment before calling.

HOME-MADE CUPROUS-OXIDE PHOTO-CELLS

THE cuprous oxide type of photo-cell is self-generating and on this account they are of practical use in measuring technique where the apparatus must be small and of light weight. Photometers employing cells of this type are on the market and in combination with sensitive meters they provide a compact device for light measurement.



An actual cell: contact is made with the wire grid and the back of the copper-oxide plate.

The cuprous oxide photo-cell consists of a plate of copper, having integrally formed on one side a layer of cuprous oxide. The characteristics of the cell, and its current output, depend a great deal on the thickness of this layer of oxide.

Two Types

In some cells the light has to pass right through the oxide, which acts as a red filter, so that the sensitivity to green light is very small indeed, though the cell is extremely sensitive to the red and the infra-red regions of the spectrum.

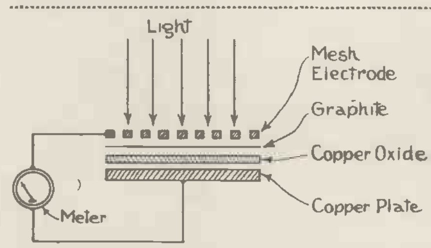
In other cells the action takes place on the surface of the cuprous oxide, and is called the "front-wall" effect. In this case the light passes first through a thin transparent film of gold deposited on the oxide layer. The current output here is considerably greater, and the cell is extremely sensitive to green light; its sensitivity in the red region being very little less than was the case for the cell using the "back-wall" effect.

There is a wet-type cuprous-oxide cell, the plate coated with cuprous oxide being immersed in some electrolyte, which may be either a solution of a copper salt, a solution of dilute sulphuric acid, or a solution containing ammonium chloride and hydrogen peroxide. Working with the first-named solution, it is usual to have both electrodes of cuprous oxide on copper, one plate being illuminated and the other kept in the dark. In another variation one electrode is cuprous oxide on copper, while the second electrode is lead, carbon, or cadmium. This type of cell offers a wide field for the experimenter, and has the advantage that very little apparatus or involved technique is required.

Making Dry Photo-cells

Interesting experiments can be carried out with dry cells by the simple method of coating the cuprous-oxide surface with a thin layer of finely powdered graphite. The plate of oxidised copper is prepared as follows:

A piece of copper sheet of 18 or 20 gauge, of any convenient size, say one inch by two inches, is heated in the Bunsen or blow-lamp flame to a temperature of within a few degrees of its melting point. It is most important that the copper is heated to a sufficiently high temperature. It is then "quenched" by dropping it into a bowl of water at a temperature of 40° to 60° C. A few trials will enable anyone to produce perfect ruby-red surfaces of cuprous oxide in this manner. Graphite (blacklead) is then gently rubbed into the oxide surface with a piece of wool or chamois leather. Care should be taken that the surface is free from cracks or minute "pinholes" before graphiting. Only perfect surfaces should be employed. A contact is then taken from the back surface of the copper, previously cleaned with emery paper, and from the graphite surface.



This drawing shows the electrode arrangement of the simple dry cuprous oxide photo-cell.

A current of 15 or 20 micro-amps. can be obtained from a cell of this description by shining the light from a 30-watt lamp close to the surface. Greater currents may be obtained by using a larger lamp, or an arc lamp, in conjunction with a condenser lens.

Another method of producing the oxide layer is by heating the copper base to a high temperature in an oxidising atmosphere, and then quenching in hydrochloric acid of a strength, so chosen as as to produce the required crystalline structure of the red surface layer of cuprous oxide. It is necessary to remove any contaminating by-product, such as the black cupric oxide, by immersion in dilute nitric acid.

It is also possible to use other photo-sensitive substances for the control electrode. These are all members of the sixth periodic group, i.e., the oxygen series. Such substances are molybdenum sulphide, silver sulphide, silver selenide, and various mixtures of oxides with sulphides, selenides, and tellurides.

Television-Cinema Invention in U.S.S.R

The construction of a television-cinema apparatus for transmitting moving-pictures over a distance by radio has been completed in the laboratory of the Chief Administration of the Electrical Low Tension Industry in the U.S.S.R. under the supervision of the inventor, Professor A. F. Shorin.

Philips and Television

We understand that in Philips' laboratory at Eindhoven new cathode-ray tubes have been developed for use in television experiments which are being carried on in that laboratory. These experiments have already led to the construction of a new receiving apparatus for television, by means of which reception tests were recently conducted in Berlin.

RECENT TELEVISION DEVELOPMENTS

A RECORD OF PATENTS AND PROGRESS
Specially Compiled for this Journal

Patentees :—Radio-Akt, D. S. Loewe. :: A. C. Cossor Ltd., L. H. Bedford and O. S. Puckle. :: Fernseh A. G. :: C. Des Compteurs et Materiel d'Usines a Gaz. The General Electric Co. Ltd., B. P. Dudding and L. C. Jesty. :: Electrical Research Products, Inc.

Picture Definition

(Patent No. 427,546.)

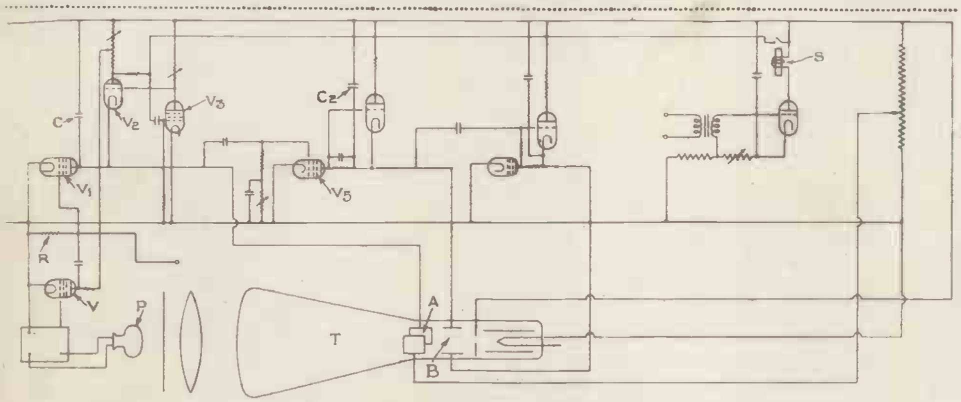
Image points of great brilliancy are produced in simple fashion by the use of indirectly-heated cathodes in which the emissive surface is cup-shaped towards the anode. The stream is focused by an electron-optical system consisting of a cylinder negatively biased with respect to the first apertured electrode, in combination with an anode positively biased with respect to the cylinder. The arrangement makes it possible, even when using a relatively small number of image points, to produce pictures of large size which are well recognisable, at a considerable distance, without the use of auxiliary lenses.—(*Radio-Akt. D. S. Loewe.*)

Velocity-modulation Systems

(Patent No. 427,625.)

The picture is reproduced by varying the speed of the scanning-spot in accordance with the original differences in light and shade. At the transmitter a special control voltage is derived from the photo-electric cell, and is "integrated" by a time-base circuit at the receiver in order to regulate the rate of change of deflection of the ray.

As shown in the figure scanning-voltages for one set A of the deflecting plates in the cathode-ray transmitter T are derived from a condenser C, which is charged through a valve V1, and discharged through valves V2, V3. The other pair of deflecting plates B are energised from a condenser C2, which is linked through a valve V5 with the condenser C1 and receives an additional pulse as the latter discharges. Transmission is thus controlled directly by the voltage appearing on the grid of the valve V1, which in turn is dependent upon the output of the photo-electric cell P and amplifier V. The current from the latter passes through a resistance R in the grid circuit of the charging valve V1. Scanning is interrupted for a period longer than one line at the end of each picture by a relay S controlled by a time-base circuit.—(*A. C. Cossor, Ltd., L. H. Bedford and O. S. Puckle.*)

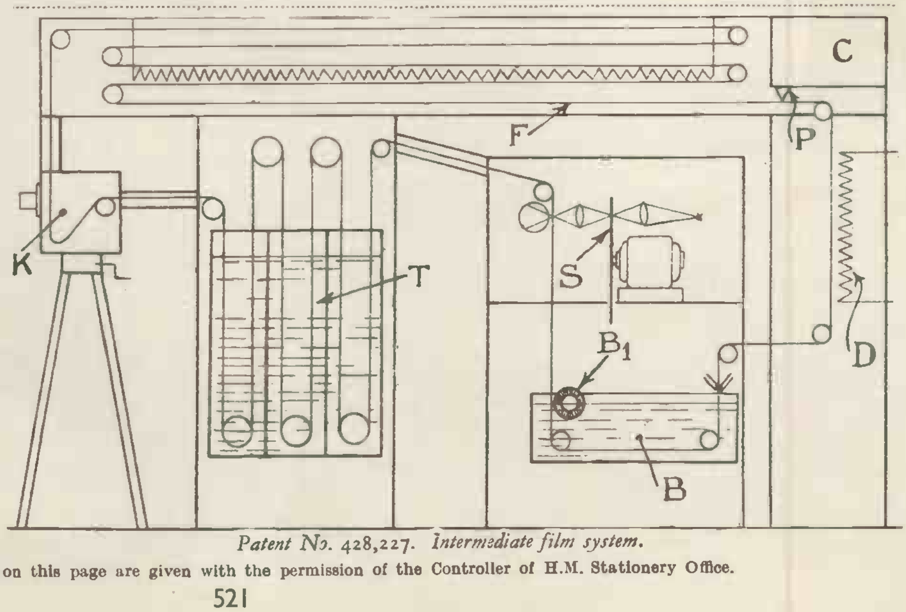


Patent No. 427,625. Circuit of velocity modulation system.

Scanning Systems

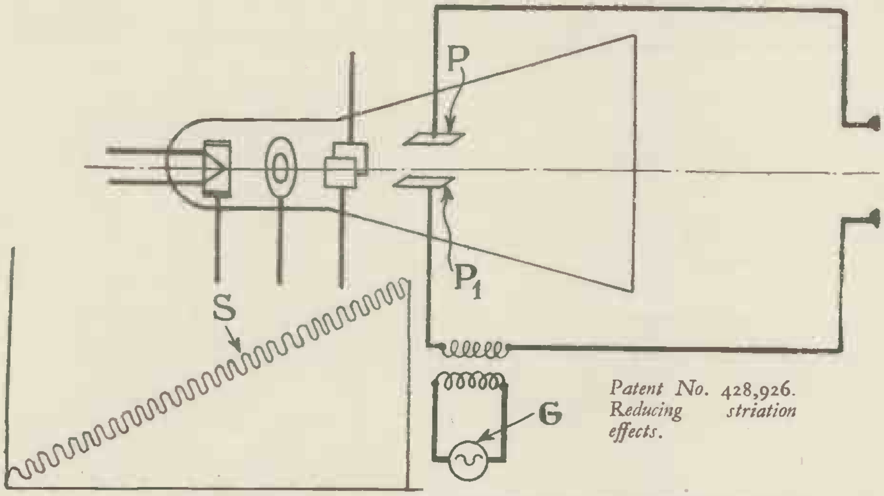
(Patent No. 427,630.)

In velocity-modulated systems it is a disadvantage to employ a modulating voltage derived directly from the displacement of the scanning spot, because the higher-frequency components suffer relative attenuation, and are accordingly subject to serious distortion by interfering voltages. In order to offset this, there is accordingly superposed on the displacement voltage, a second voltage which is modulated according to the rate of displacement or velocity of the spot. In other words, the second or com-



Patent No. 428,227. Intermediate film system.

pensating voltage is a time-derivative of the first, and is obtained by inserting a resistance in series with the ordinary condenser-discharge circuit.—(*A. C. Cossor, Ltd.*, and *L. H. Bedford.*)



Patent No. 428,926. Reducing striation effects.

"Film" Television

(Patent No. 428,227.)

The length of film which can be handled by a television transmitter of the "intermediate" type is limited in practice to a total length of 600 metres—which is sufficient only for an item of twenty minutes' duration. In order to extend this time, the film is made as an endless band, and is continually re-sensitised after use. As shown, the film F first passes under a spout P which applies a layer of light-sensitive emulsion from a container C. It is next fed forward to the camera K for exposure, passing from there through developing and fixing tanks T on to the television scanning device. It is then taken to a bath B, where the original emulsion is removed by brushes B1, and on through a drying apparatus D back to the point P, where a fresh coating of emulsion is laid on.—(*Fernseh A.G.*)

Reducing "Striation" Effects

(Patent No. 428,926.)

There is a tendency as the luminous spot strikes the screen, under the influence of the signal modulation, for it to produce an unpleasant striation effect in the high-light parts of the picture. To overcome this defect, an auxiliary high-frequency oscillation of small amplitude is applied from a generator G across the pair of plates P, P1 controlling the slow or "frame" scanning motion. This in turn introduces a small but rapid vibration S.

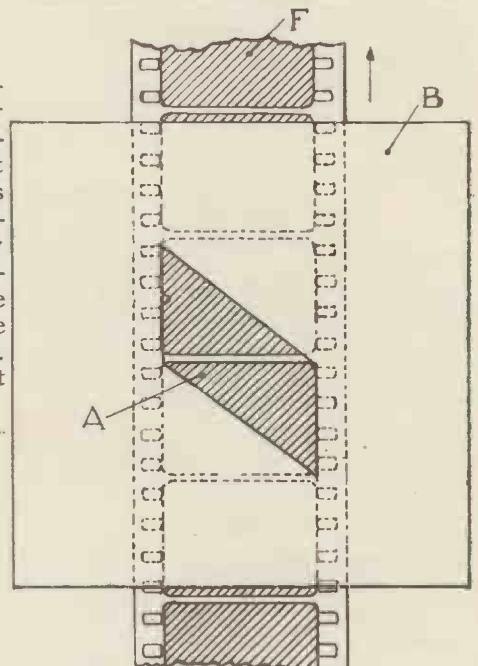
As a result the eye sees, during each horizontal scanning, a line the thickness of which varies very slightly owing to the superposed oscillation, whilst the brilliancy varies strictly with the signal modulation. The undue concentration of light which produces the striation effect is therefore avoided.—(*Cie Des Compteurs et Materiel D'Usines à Gaz.*)

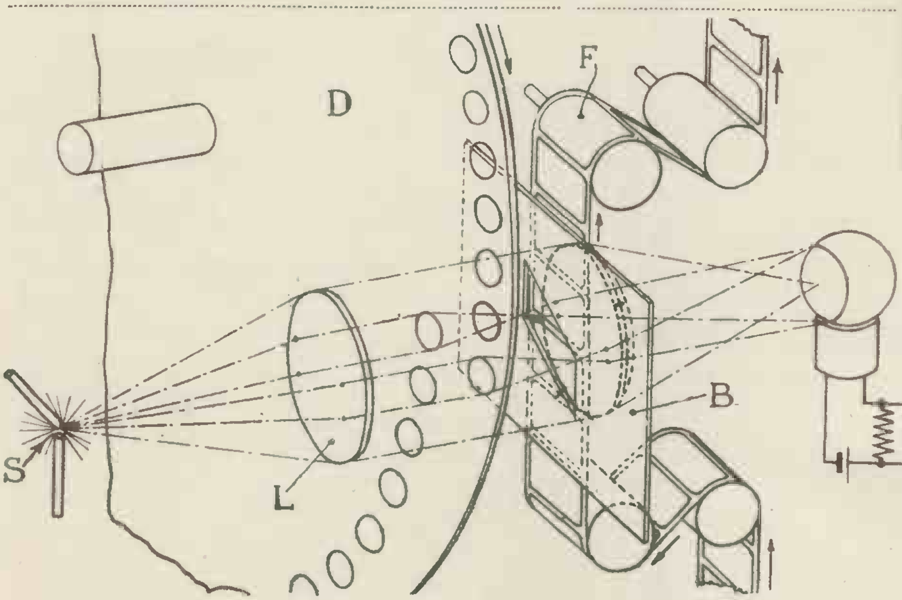
Cathode-ray Tubes

(Patent No. 429,045.)

In the case of large cathode-ray tubes, say of length greater than 45 cm., and width greater than 15 cm., it is difficult to make the glass bulb thin enough to stand the temperature changes to which it is subjected in operation, and yet thick enough to withstand the atmospheric pressure when evacuated. For this reason the glass bulbs are liable to collapse without warning.

The region of greatest stress is at the flared end of the tube, because tension and compression are liable to occur within a short distance of each other. Accordingly the flared end of the glass tube is so shaped that the radius of curvature is nowhere less than 1:7.5. This allows three-quarters of the maximum diameter of the bulb to be used as the viewing-screen without giving rise to appreciable distortion.—(*The General Electric Co., Ltd., B. P. Dudding* and *L. C. Jesty.*)





Patent No. 429,570. Fig. 1 (left) and 1a (above). Method of scanning film.

"Film" Television

(Patent No. 429,570.)

Instead of providing the usual "gate" motion, the film is driven uniformly, and a "baffle" is interposed between the scanning disc and the film. The baffle is provided with an aperture of such size and shape that each "frame" is completely scanned, before scanning of the succeeding frame is commenced. Fig. 1 shows the disposition of the light source S, lens L, scanning-disc D, baffle B, and film F; whilst Fig. 1A shows the shape of the aperture A formed in the baffle. As shown in shaded lines, the aperture is set obliquely so as to compensate for the forward movement of the film, and is approximately the same height and width as a picture frame. As the scanning disc rotates, the spot of light crosses the aperture in parallel vertical paths, which slightly overlap and move horizontally over the width of the picture frame.—(*Electrical Research Products, Inc.*)

Summary of Other Television Patents

(Patent No. 425,687.)

Saw-toothed oscillation generator with means for shifting the "flyback" of the scanning spot outside the field of vision.—(*Radio Akt. D. S. Loewe* and *K. Schlesinger.*)

(Patent No. 425,723.)

Scanning system utilising an electro-dynamic arc as the source of light.—(*W. W. Triggs.*)

(Patent No. 426,742.)

Scanning system including (a) a "camera" wherein the light-rays from the picture are radially diffused, and (b) a slotted rotating drum which houses a photo-electric cell.—(*J. B. King.*)

(Patent No. 427,090.)

Preventing distortion of the scanning lines in cathode-ray television. —(*E. Hudec.*)

(Patent No. 427,092.)

"Light valve," comprising two doubly-refracting crystals.—(*Radio Akt. D. S. Loewe.*)

(Patent No. 427,112.)

Scanning systems for cathode-ray tubes of the photo-sensitive type.—(*Marconi's Wireless Telegraph Co., Ltd.*)

(Patent No. 427,168.)

Saw-toothed oscillation-generator in which in order to prevent linear deviation the charging-valve is biased to a degree depending upon the anode current.—(*Radio Akt. D. S. Loewe* and *K. Schlesinger.*)

(Patent No. 427,830.)

Improvements in the gas-filling of the discharge tubes used for generating scanning oscillations.—(*Telefunken Co.*)

(Patent No. 428,168.)

Scanning system for cathode-ray tube transmitters of the "mosaic" cell type.—(*Marconi's Wireless Telegraph Co., Ltd.*)

(Patent No. 428,382.)

Rapid process of photography for use in film or "intermediate" television.—(*W. W. Groves.*)

(Patent No. 428,459.)

Optical system for increasing the number of scanning lines obtained from a mirror-drum.—(*H. A. Richardson.*)

(Patent No. 428,602.)

Line-by-line synchronising systems in which a time-interval is imposed at the end of each frame cycle.—(*A. C. Cossor, Ltd., L. H. Bedford* and *O. S. Puckle.*)

(Patent No. 428,661.)

Method of repeating, at the receiving end, slow changes in overall brightness which occur when televising pictures from a film.—(*Telefunken Co.*)

(Patent No. 428,852.)

System for keeping the average brightness of the reproduced picture in step with slow changes of illumination at the transmitting end.—(*Electric and Musical Industries, Ltd., C. O. Browne* and *J. Hardwick.*)

THE FLUORESCENT SCREEN

THE atmospheric pressure on the flat end of a 7-in. cathode-ray tube is over a quarter of a ton! The inner surface of the tube is coated with a material that glows or "fluoresces" when electrons impinge upon it, thereby producing a bright spot of light. The material is usually bound on with pure waterglass. Several different materials, and combinations of them, are in current use for different colours of fluorescence. The most active material for producing visual light is zinc silicate (in the form of the powdered mineral *willemite*). This glows a bright yellow-green, to which the human eye is most responsive.

For oscillograph use, where the trace of the cathode-ray beam is to be photographed, calcium tungstate, which glows a bright blue colour, is better, since its light is about thirty times as active on a photographic plate as is that from zinc silicate. Cadmium tungstate may also be employed and mixtures of these substances are often used to produce a fluorescence fairly well suited for joint visual and photographic requirements.

The impact energy of the electrons varies as the square of their speed, or, in other words, with the square of the voltage on the anode, so the fluorescent-spot brilliancy increases rapidly as this voltage is increased.

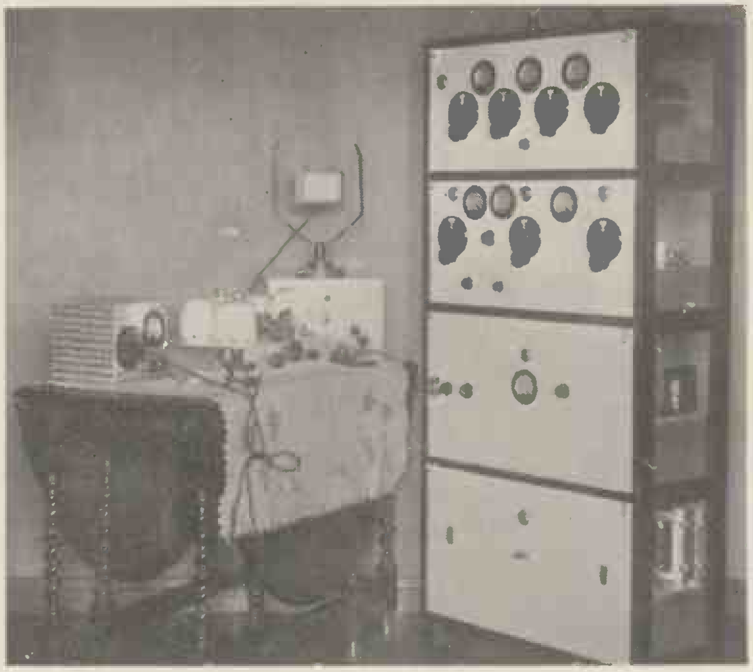
A spot that is too *intense* will cause deterioration of the active material with which the screen is coated, due to intense bombardment resulting at the point of impact of the electron stream on the coating of the screen. The electron stream bombards the screen much as rapidly-fired machine-gun bullets would bombard a target, excepting that the machine-gun bullets would have a muzzle velocity of only about 2,000 miles per hour, whereas the electrons in an ordinary cathode-ray tube operated with 1,000 volts on the plate have a velocity of approximately 42 million miles per hour!

Because of this intense bombardment of the screen, the beam should never be allowed to remain motionless, for if this occurs, the full impact energy of the electrons will be concentrated at the focused spot on the screen, causing the fluorescent material to disintegrate. A black spot will be observed in the screen after this occurs.

According to *Electronics*, improvements in technique have enabled the Allen B. Du Mont Laboratories, of Upper Montclair, N.J., to overcome the blackening of the fluorescent screen when the electron beam is allowed to remain stationary. This means that the life of the screen is materially increased as the darkening caused deterioration of the fluorescent screen and hence loss of light. Furthermore, because of this defect in cathode-ray tubes previously it has not been practical to use them for certain uses, such as sound recording or indicating meters where the spot or considerable period of time.

G5ZJ—"Television and Short-wave World's" Transmitter

Next month we are to begin the description of our 50-watt phone transmitter which many readers examined at Radiolympia. Most of the components can be obtained from component manufacturers or be home constructed.



The top rack houses the push-pull oscillators, while in the second rack are a crystal oscillator, frequency doubler, and link-coupled buffer. Ten valves are used in the speech amplifier—modulator—power pack in the third rack, while four valves are used in the bottom rack for the two power packs.

THOSE readers who have seen the 40- and 20-metre phone transmitter operated by G5ZJ have remarked on various points in the design and construction. While our station is very much an experimental one, we have endeavoured to keep it as neat as possible, but, at the same time, it can be modified without having entirely to rebuild. Although it is a matter of opinion whether experimental apparatus should be erected in breadboard or rack formation, we do feel that the latter arrangement has a much more commercial appearance and gives the station an infinitely more efficient look. There are five transmitters in operation at G5ZJ on various wavebands, and all of them, including the 57-Mc. rig, are rack-built.

Level Field Strength

This station has been in operation for only two months, but has been heard very consistently, while reports show that quality is distinctly above average and that the field strength remains as constant as possible, bearing in mind the variations that occur on 40 and 20 metres.

We do not claim anything entirely original for this outfit, except that the layout is as neat as possible and the way we have used four separate racks makes modification particularly simple.

The illustration shows very clearly the construction of the apparatus. The framework is of wood stained black, and polished, with five-ply panels hand cellulosed steel grey. In the bottom rack are two entirely separate power packs, the outputs of which are fed into four sockets. The first socket gives 300 volts at 50 milliamperes and 4 volts 1 ampere for the crystal oscillator stage. The second point gives 550 volts at 75 milliamperes and 4 volts 2½ amperes for the triode frequency-doubler or neutralised amplifier. Next comes the third plug which provides 1,000 volts at 100 milliamperes and 10 volts 3 amperes for a triode neutralised amplifier. Finally, the fourth plug gives up to 1,500 volts 150 milliamps and 6 volts at 8 amperes for the push-pull P.A. valves. As the wattage can be increased up to 250, resistances are connected in series with each anode with shorting bars so that the apparatus can be run at almost any wattage required.

Speech Amplifier and Modulator

In the first stage a pentode valve is used as a crystal oscillator on 7135 kc. At this frequency the second valve is used as a neutralised amplifier and run at about 25 watts. The second valve is actually a Mullard OZ/520. The third valve, a Tungsram OQ 75/1,000 75-watt oscillator, is suitable for use up to 60 megacycles. This is link-coupled to a pair of ESW 501 valves in push-pull. These are rated at 50 watts, but they can be used up to 150 watts at 40 metres without affecting the life in any way. As a general rule, during broadcast hours the push-pull stage is left out of circuit, the link coupling is removed and the aerial coupled to the anode of the second buffer. In this way low-power transmission can be obtained without any difficulty.

The second rack houses the speech amplifier and modulator. This consists of an H.L. type amplifier, resistance-coupled to a low-gain triode amplifier, which is in turn transformer-coupled to a pair of ML4's in class-B. These drive a pair of ES75H's—75-watt carbon anode triodes—which are run at 125 watts, this being the maximum safe dissipation.

80 Watts of Audio

This line-up gives an A.C. output of a little over 80 watts of audio with low-percentage distortion. A tapped H.T. secondary enables the modulator voltage to be reduced so that the valves can be run at approximately 50 watts if required.

As all voltages are adjustable, the apparatus is suitable for almost any wattage dissipation, with the minimum difficulty in change-over. The speech amplifier has variable tone correction so that bass and treble can be increased or decreased as required. As this reduces the gain to a considerable extent, the Reisz microphone is fed into the speech amplifier through a one-stage battery-operated head amplifier.

(Continued at foot of page 527.)

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THE DESIGN OF HIGH-DEFINITION AMPLIFIERS

By L. E. Q. Walker

In this article, the second of a short series, the writer continues with the considerations of the factors involved in the design of high-definition amplifiers with particular reference to their response to transient signals.

WE have seen that a single sinusoidally-shaped pulse lasting from t = O to t = T, and of period 1/T can be represented mathematically by the expression of a steady state sine wave $E \sin \frac{2\pi}{T} t$

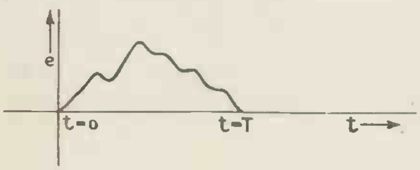


Fig. 9. — Arbitrary wave as generated in television signals.

multiplied by an expression for a unit impulse lasting from t = O to t = T.

Similarly, any arbitrarily shaped pulse as shown in Fig. 9 can be represented by

$$f(t) = \frac{1}{\pi} \int_0^{\infty} \frac{1}{\omega} [\sin \omega t - \sin \omega (t - T)] \, d\omega \quad \ldots\ldots(7)$$

where f(t) represents the Fourier Series for the pulse if regarded as periodic and of period T. That is to say, f(t) would represent the wave shown in Fig. 10.

Now, actually, these are the types of signals with which we have to deal in television transmission and reception. The time T corresponds, of course, to the time occupied by one complete scan line, i.e., in the case of the proposed B.B.C. transmissions to 1/240 or 1/405 second.

The question as to how wide a frequency-band we must transmit perfectly to represent these signals, the nature of which varies, in some cases very widely, from

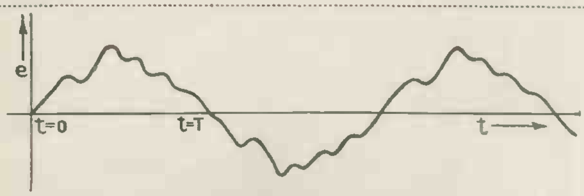


Fig. 10.—The wave of Fig. 9 repeated in a periodic fashion.

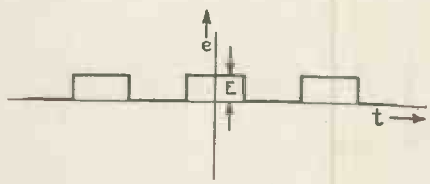
one scan line to another, is easily answered. We must transmit all frequencies from zero to infinity, equally well. This, of course, both from the point of view of amplifier design and also from the point of view of the frequency band available in the radio spectrum, is quite impossible, and we must therefore arrive at some compromise between signal distortion and amount of detail which is necessary in the original signal.*

* Another factor influences this compromise, i.e., that of distortion due to the finite size of the scanning aperture. It is not, however, proposed to deal with this matter here.

Clearly, f(t) in (6) is of the form given in (1), i.e., it consists of a series of sine terms whose amplitudes may be of any value and whose frequencies are once, twice, three times, etc., the scan-line frequency. Although we have stated that the amplitudes may be of any value, invariably in representing any signal of the form shown in Fig. 9 we find that the amplitudes of the various components show a tendency to decrease as their frequency increases.

In the case of most simple wave forms, such, for instance, as the square wave shown in Fig. 11, we have a progressive decrease, the amplitude of the nth harmonic being $1/\omega$ the amplitude of the fundamental. Plotted with frequencies as abcissae, we have the relative amplitudes of the Fourier Series for this wave given in Fig. 12, where $f = \frac{\omega_0}{2\pi}$ is the frequency of the

Fig. 11. — Square wave symmetrical about t = o.

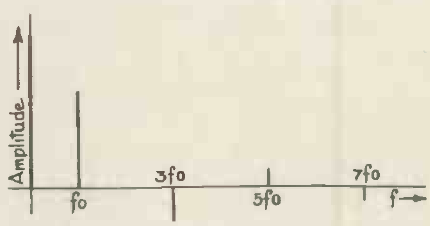


fundamental, for the expression for the wave can be written.

$$e = \frac{E}{2} + \frac{E}{\pi}\left(\cos \omega_o t - \frac{1}{3} \cos 3\omega_o t + \frac{1}{5} \cos 5\omega_o t - ..\right) \ldots(8)$$

Transmission of this wave, therefore, merely consists of the transmission of an infinite number of separated frequencies. If we are concerned with the transmission of a limited number of pulses of the wave only, the frequencies involved are no longer separated but continuous in the frequency spectrum. Thus for three pulses of the wave shown in Fig. 11 we have a fre-

Fig. 12. — Relative amplitudes of Fourier components for wave of Fig. 11.



quency distribution as shown in Fig. 13, which ultimately, in the case of one pulse only, develops into the same curve as that shown in Fig. 8 (August issue), or in the dotted curve of Fig. 13.

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It will be observed that the frequencies are grouped round maxima occurring at the frequencies of the Fourier Series components for the steady state wave. Clearly the frequency distribution curve is built up by considering the frequency distribution curves of single

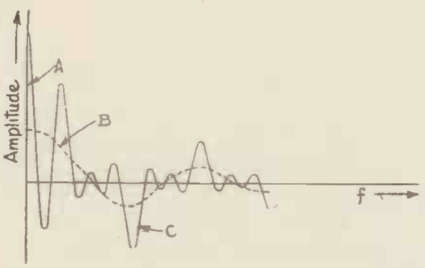


Fig. 13. — Frequency distribution of three pulses of wave shown in Fig. 11.

sinusoidally-shaped pulses. That part of Fig. 13 marked A would correspond to the transmission of the term E/2 in (8), that marked B to the transmission of the term $\frac{E}{\pi}\cos\omega_0 t$, etc.

Now the series corresponding to the above wave contained only cosine terms of odd harmonics. If instead of a square wave we are interested in the transmission of a single pulse of an entirely arbitrarily-shaped wave as, for example, that of Fig. 9, we can, by pursuing an exactly similar argument, draw a curve representing the frequencies involved. Fig. 14 shows such a curve where negative amplitudes are regarded as positive since their sign is immaterial. The maximum amplitudes of the components round f_0. $2f_0$, $3f_0$ . . . . may be of any value, according to the exact shape of the curve of Fig. 9, but in general, the amplitude of a component at nf_0 will diminish as n increases. Similarly, the exact shape of each hump will alter as the exact wave shape alters, but the general shape of the complete curve will be as shown. f_0 will, of course, correspond to $\frac{1}{T}$ in Fig. 9.

Clearly, the type of curve shown in Fig. 9 is the type of curve in which we are interested in television. The distribution of light and shade, and consequently the current variation per scan line might very well be of the form of Fig. 9. From the very nature of the problem we cannot specify the exact shape of the curve expressing this variation, for it will alter from scan line to scan line. All we do know is that T corresponds to the time taken for one scan line.

We see, therefore, from Fig. 14 that to transmit the signal corresponding to each scan line perfectly, we must be prepared to deal with an infinite band of frequencies. Not all frequencies are as important as others, however. Firstly those frequencies corresponding to once, twice, three times, etc., the scan-line frequency will be of paramount importance, and secondly, as the frequency increases, so will the necessity of transmitting that frequency become of less importance.

Summarising, therefore, we see that in the case of television signal amplifications we have to deal with a very large band of frequencies extending from as near zero as possible to a figure which is controlled on the one hand by the degree of detail, which in turn is a function of scan lines per picture and pictures per second, and on the other by the limitations of our amplifier. The fact that there are comparatively empty spaces in the frequency spectrum of such a signal will have very little influence on the design of the amplifier, although it may be of importance in designing special types of coupling circuits between stages.*

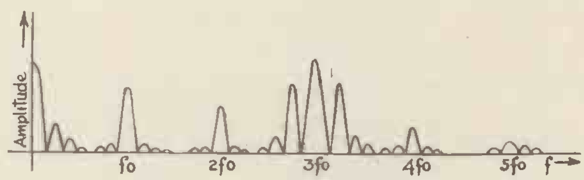
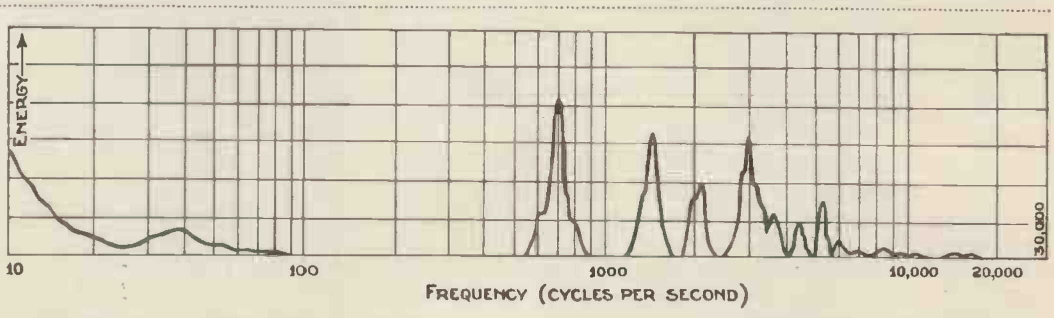


Fig. 14.—Typical frequency distribution for wave shown in Fig. 9.

Before leaving the question of the actual frequency distribution in the signal and passing on to the actual design of the amplifier, it is of interest to note that the energy distribution as deduced above is in agreement with actual frequency analyses of television signals which show the energy confined to bands at multiples of the scan-line frequency with spaces of relatively small energy in between.

Theoretical estimation of the width of these empty spaces can be made and it is found that, although the figure varies for different types of subject scanned, the empty spaces are approximately equal to the useful spaces. In other words, the parts of the frequency spectrum that must be transmitted constitute approximately 50 per cent. of the total frequency band. This figure agrees with results found in practice. As a result, the width of each individual idle band is numer-

Fig. 15. — Typical frequency distribution of television signal.



* See British Specification No. 392,229.

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ically about half the scan-line frequency. Thus, in a 240-line 25-picture per second system each idle band would extend over approximately 3,000 cycles.

It has been proposed to utilise these bands for other purposes, e.g., transmission of speech, music, etc., or the synchronising signals, and some systems employing this scheme have been put into practice. It has also been proposed to reduce the band of frequencies needed for a given television transmission by shifting the useful bands together and eliminating the idle regions. This, it is true, is theoretically possible, and would lead to, say, a reduction of half the band, but the attendant difficulties are great and no practical solution of the problem has, as yet, been found.

We have mentioned above that the theoretical distribution of frequencies in a television signal agreed with practical results. One example of a practical measurement of a signal transmitted from a 50-line 15-picture per second system is shown in Fig. 15. The subject scanned in this case was a black diamond on a white background, and the measurements were taken by filter circuits interposed between the television transmitter and a valve voltmeter.

We have to consider then, firstly, what effect frequency limitation in the amplifier will have on the television signal, and what other conditions have to be met in the design of television amplifiers. For theoretical treatment we cannot deal with the most general type of signal as shown in Fig. 9, and shall therefore consider, as regards the effect of frequency limitations, the unit impulse wave of Fig. 4. It will be seen that no loss of generality attends this method for the unit impulse wave is, virtually, the multiplier which renders possible the existence of the more complicated transients, and the effect of frequency limitation on this latter will be obtained from the effect on the unit wave.

We must in effect estimate the effect of altering equation (5) to

$$\frac{1}{\pi}\int_{\omega_1}^{\omega_2}\frac{1}{\omega}\,[\sin \omega t - \sin \omega\,(t - T)]\,d\omega \;\ldots\ldots\; (8)$$

where the amplification is sensibly constant from $\frac{\omega_1}{2\pi}$ to $\frac{\omega_2}{2\pi}$ but does not extend from zero to infinity. That is to say $\frac{\omega_1}{2\pi}$ is the lower frequency limit of amplification, and $\frac{\omega^2}{2\pi}$ is the upper limit. The mathematical analysis of the above is too complicated to be given here. We shall therefore only briefly discuss the results. If $\omega_1 = 0$ we have the effect of high-frequency cut-off, as shown in Fig. 16, which merely indicates the general shape of the distorted wave, its exact shape, of course, depending on the value of ω_2. The general tendency, however, is for the overall shape of the wave to be similar to the square prototype but for imperfections in contour to occur.

If ω_2 now tends to infinity, i.e., if there is no high-frequency cut-off in the amplifier, and ω_1 is no longer zero, i.e., if low-frequency cut-off exists, an impulse as shown in Fig. 17 will result. In general, the wave will suffer, not so much in the sharpness of building up and decay, but in the average amplitude of the impulse.

Any arbitrary Fourier Series wave when multiplied by these distorted impulses will show the same imperfections. We may therefore deduce theoretically what has actually been found in practice, i.e., that elimination of low frequencies results in fluctuations in the apparent brightness of the picture and of large background areas, etc., whilst elimination of high frequencies influences the detail obtainable on small and involved parts of the picture.

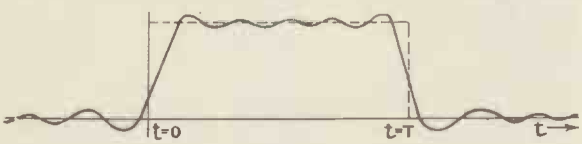
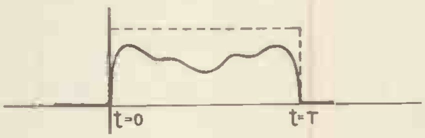


Fig. 16. (*left*)—*Effect of high-frequency cut-off on a square-topped wave.*

Fig. 17. (*right*)—*Effect of low-frequency cut-off on a square-topped wave.*



(*To be continued.*)

G5ZJ—"Television & Short-Wave World's" Transmitter.

(*Continued from page* 524)

A 350-volt power pack feeds the first four valves in the L.F. section, while a 1,000-volt supply is used for the modulators only.

Both power packs with thermal-delay switches are completely filtered. All anode circuits in the amplifier are decoupled, while H.F. chokes are fitted where necessary in the decoupled grid circuits. The third rack, looking from right to left, shows oscillator tuning, frequency doubler and buffer, while the top rack, reading from left to right, shows the double-gang grid condenser, double-gang P.A. condenser, both, of course, split-stator and the two aerial condensers in the Collins coupler. Each stage is linked to its associated power pack by means of a four-pin socket and flexible cable, while all coils are of the plug-in type, including the link-coupled anode and grid coil. Other apparatus shown in the photograph is, reading from left to right, the phone monitor, the 2-V-1 receiver, key, head amplifier and Reisz microphone.

We intend to describe the construction of this transmitter with its associated equipment in sections, starting in the October issue. G5ZJ is operating from 20,00 to 00.30 most evenings on 7135 kc. or 7120 kc. When conditions are good on 20 metres the frequency used is 14,270 kc. The 10-metre band is also occasionally used. Reports will be welcomed from any listening station.

Five Metres in Scotland

Members of the Glasgow and District Radio Society have been listening to signals broadcast by G6ZX, situated in Clarkston, near Glasgow. The receiving point was on top of Ben Loman, a distance of approximately 33 miles, making a five-metre Scottish record.

THE FARNSWORTH RECEIVER

We are indebted to " Radio Craft " for the following information upon the Farnsworth receiver. An experimental station which will operate upon the Farnsworth system is now in course of erection at Philadelphia.

OUTSTANDING in American television development is the Farnsworth system, which was one of the first in the world to employ electron scanning at transmitter and receiver. The Farnsworth " image dissector " was described in the April issue of this Journal and the following are particulars of the receiver.

The Farnsworth reproducer, which incorporates all the essentials of a television receiver except the radio-frequency and detector circuits, is shown in the photographs.

Magnetic fields are employed entirely for focusing and deflecting. These, it is claimed, offer two outstanding advantages: simplicity and cheapness of construction and a sharpness of focus throughout the picture field which is difficult to obtain by other means.

A single amplifier stage for the picture signal is included on the chassis. Another valve amplifies and detects

A side view of the cathode-ray tube with deflector magnet and deflector coil in position.

the line and picture-frequency synchronising impulses which are transmitted with the signal.

The scanning circuits are designed for a 240-line picture field, a value which has been shown to give very pleasing picture detail. The picture-frequency is 25 per second and therefore the line scanning frequency is 6,000 cycles. An oscillator supplies current of this frequency and of a saw-tooth wave-shape for transverse or line scanning. The return of the scanning spot requires but one-tenth as long a time as the scanning of one line; approximately 1/60,000-second. During this short period, an impulse is received over the picture channel

This photograph shows the cathode-ray tube chassis and screen.

to synchronise the oscillator, automatically holding it in step with the transmitter. The oscillator employs one valve of an ordinary type and a small transformer of special design.

A picture of the complete Farnsworth receiver is shown on the cover of this issue.

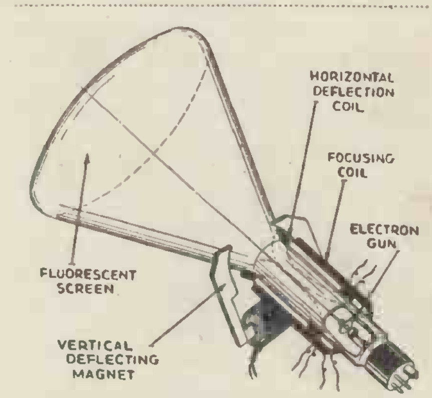
Interlaced Scanning

Vertical scanning is accomplished with saw-tooth currents which are generated by an oscillator similar to that used for line scanning. This scanning runs at 50 cycles per second so that the picture field is scanned twice during each picture. Between successive scannings the whole picture field is displaced vertically by an amount just sufficient to cause the lines of one scanning to fall between those of the preceding one. This, of course, is interlacing; it has the effect of reducing flicker and line structure of the reproduction.

The anode of the cathode-ray tube is supplied with 4,000 volts. The high-voltage transformer is quite small, and standard types of condensers are used for filtering.

The cathode-ray tube is a Farnsworth " Oscillight " with a 9-in. screen, which produces an image 5 ins. × 6 ins. The image is black and white and bright enough to be viewed in a partially lighted room.

The diagram shows the details of this tube. The beam, as stated before, is focused by means of a magnetic field. A pair of magnetic deflection coils (whose action is analogous to the corresponding pair on the image dissector, which is used in the transmitter) is fed with a current of the same frequency and wave-form as that feeding the latter. The low or image frequency magnetic deflecting field of the Oscillight differs from that in the dissector in that an iron-core electromagnet is used, but its action is essentially the same, since it displaces the cathode-ray beam at right angles to the lines at a uniform rate, so that successive lines are displaced by the width of the spot from the preceding line. Thus at any instant the position of the spot on the fluorescent screen of the Oscillight corresponds exactly to the position of the scanning



A drawing showing the arrangement of the tube, vertically deflecting magnet horizontal deflecting coil.

aperture on the electron image in the image dissector tube, and the brightness of the spot corresponds to the brightness of the corresponding point on the optical image.

Since the saw-tooth generators of the image dissector and the Oscillight are separate electrical units, it is necessary to provide some means of exactly synchronising them. This is accomplished by means of synchronising impulses which are sent along with the signal impulses. The line-

(Continued at foot of page 530).

TELEVISION AND SHORT-WAVE WORLD

THE A B C OF THE CATHODE-RAY TUBE—VI

By G. Parr

THE "BLINKING" NEON

LAST month we saw how the beam was made to traverse the screen by the regular charging of two condensers connected to each pair of plates. The return of the beam to its initial position on the screen is accomplished by discharging the condensers periodically as soon as they have attained a given charge. As pointed out last month it is impossible to do this mechanically owing to the high speed required—in 30-line working the condenser requires to be discharged every 1/375th second, while in high-definition working this rate will be increased to 1/6,000th second!

So we must provide an electrical device for discharging the condenser at a given time, which we can control, and moreover continue to discharge it regularly and quickly at the exact moment. Just think what is required of this electrical short-circuiting switch. It has to operate instantaneously every 1/6,000th second. Suppose it is late in closing by 1/10,000th second. This will correspond to nearly half a line travelled by the beam in high-definition scanning. As a result the beam will be late in returning to its starting point and will lose step with the transmitting spot. The picture will thus be spoilt for that fraction of the whole traversing movement, and if the lateness persists the whole picture will be ruined.

Is there really an electrical device which will operate at such a high speed without hesitation? Yes—anything depending on electrons for its working can be made to perform at incredibly high speeds. 1/10,000 second in radio work corresponds to a frequency of only 10 kilocycles, and we know that electrons are used to responding to millions of cycles per second without any trouble!

A High-speed Switch

And this wonderful high-speed switch has its beginnings in nothing more than the ordinary neon lamp. Did you know that a neon lamp could be used as an egg-timer? The possessors of D.C. mains are fortunate for once in a way since they can rig up a very simple form of clock which will indicate the passage of minutes, half-minutes, or any interval of time that may be required. The circuit is shown in Fig. 1, and its similarity to the sketches of last month's article will be seen. There is the condenser and resistance connected across the H.T. supply (only if you use D.C. mains be careful to put a small fuse in circuit) and across the condenser is an ordinary "bee-hive" neon, or even a small neon indicator lamp.

Timed "Blinking"

If the condenser is very big, about 4 mfds., and the resistance is several megohms, a little while after switching on nothing happens. Then there comes a flash from the neon, followed by a long pause, then another flash, and so on. The lamp is blinking at a definite rate, which can be checked by a watch and adjusted to a given time interval by altering the values of the condenser and resistance. The bigger the resistance and condenser the longer the interval between blinks, and vice versa.

This property of the neon lamp was discovered by Anson and Pearson in 1922* and since then has been used in all sorts of circuits for producing regular discharge effects and for timing other circuits.

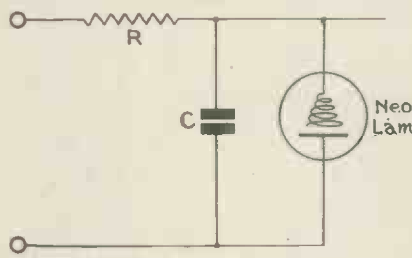


Fig. 1.—A neon lamp connected across the condenser and resistance circuit as described last month.

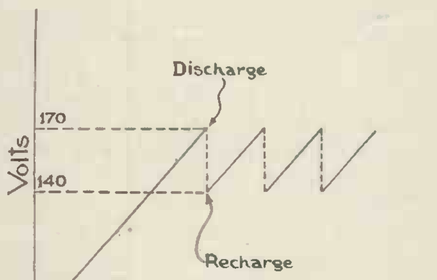


Fig. 2.—The voltage across the condenser as the lamp discharges it, is shown by the curve.

How does the lamp blink? First of all the lamp glows by what is called "ionisation" of the gas in the bulb. If the potential between the electrodes (the flat plate and the "beehive" or ring) is sufficient the gas becomes conducting, the current between the electrodes being carried by "ions." These are gas atoms which have lost electrons by collision (see article No. 1 in this series) and which are positively charged. They will thus drift to the negative electrode, forming the "ionisation current."

To cause the gas to ionise, a certain minimum voltage has to be applied between the electrodes, which varies with the gas used. In the neon lamp this voltage is about 170. But here is the curious thing which was noticed by Anson—if the voltage is reduced gradually after the ionisation has started it will be some time before the lamp goes out again, that is, the voltage can be lowered and the glow will still persist, although it will not *start* at a low voltage. This

* Proc. Phys. Soc., Vol. 34.

is really a sort of lag effect. The ions require at least 170 to form, but once the conducting path is established in the bulb, a reduction of voltage is possible before they disappear and the lamp goes out. Figures vary with different makes of lamp, but the main thing is the difference between the voltage required to make the lamp conduct and that to which it can be reduced before it goes out.

Now with this effect in our minds, we can understand the behaviour of the lamp when it is connected across the condenser in Fig. 1. When the circuit is closed, the voltage across the condenser rises slowly (see last article) until it gets to about 170. All this time the lamp is out, as the voltage is too low to start the discharge. When the condenser reaches 170 volts, however, the lamp lights up, and the condenser immediately discharges through the conducting path across the electrodes. As the condenser discharges through what is practically a short circuit, the voltage immediately falls. The lamp now goes out, since the ions no longer persist, and the condenser is left free to recharge. This takes it back again to 170, when the lamp lights again, and so on.

The Saw-tooth Waveform

The cycle of changes is shown in Fig. 2, the curve giving the variation of voltage across the condenser. Look at it carefully since it is typical of the voltage changes in a lot of oscillatory circuits. Its shape is characteristic of the teeth of a saw, hence it is usually called a "saw-tooth" wave. Going back for a moment to the circuit of Fig. 1, if we make R and C sufficiently high, it will take a long time for the voltage to creep up to 170 after it has dropped to 140, and hence there will be a correspondingly long interval between blinks.

Now to apply the circuit to the scanning movement of the beam. This is simple, since we have found our electrical switch. All that is necessary is to alter the values of condenser and resistance until the blinks occur at a quicker rate—every 1/375th second for low-definition and every 1/6,000th second for high-definition. Then the condenser will be automatically short-circuited every 1/375th second or every 1/6,000th second, and the beam will be flicked back to the initial position ready to move across again as the condenser recharges.

Unfortunately there is one snag in this simple circuit—there is not sufficient difference between the voltages at the start and finish of the discharge. The voltage required to push the beam right across the screen is about 200 to 300 in the case of small tubes and even more in the larger tubes.

The available change in voltage across the neon lamp is only 170—140 or 30, so we must amplify this voltage 10 times before applying it to the beam. This can be done by the usual valve amplifier arrangement, shown in Fig. 3, the change in voltage across the anode of the valve being applied to the deflector plates.

Keeping the Beam on the Screen

Another point to be noticed is that the voltage never drops below 140 when the condenser-neon circuit is going. This means that a permanent bias of 140 volts is applied to one of the deflector plates and the beam will be pushed to one side of the screen. We can always remedy this by applying an equal and opposite push to the other plate, which would have to be done by inserting a bias battery in series with the lead to the plate. Another plan is to connect the plate across a potentiometer, so that the amount of push can be adjusted to suit the individual conditions. This potentiometer is then connected across the H.T. supply and since its function is to shift the beam about on the screen it is referred to as the "shift potentiometer."

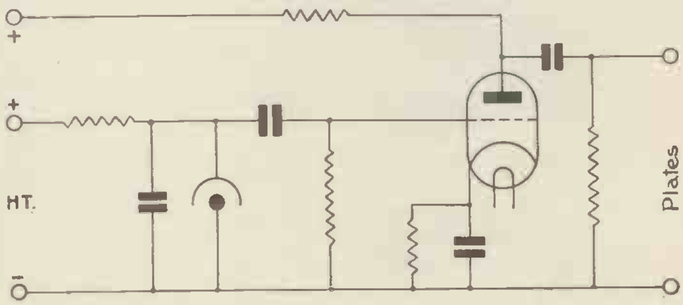


Fig. 3.—A circuit for amplifying the voltage changes across the neon lamp.

So in Fig. 3 we have the very elementary outline of a television scanning circuit for producing the line screen on the tube. Only one condenser circuit has been shown, but the circuit will of course be duplicated for moving the beam in both the vertical and horizontal planes.

Next month we shall see the improvements and modifications which have been made in this circuit to give better results and to overcome one or two disadvantages which are inseparable from the neon lamp as a discharge arrangement.

"The Farnsworth Receiver"

(*Continued from page 528*).

frequency generator feeding the image dissector is coupled to the output circuit of the image dissector in such a manner that it delivers a large impulse into this circuit during the back trace of the scanning line.

At the receiving end this impulse comes through with the signal impulses and is amplified along with them. By means of a tuned selective filter circuit this synchronising impulse is separated from the television impulses and after additional amplification is led into the line-frequency saw-tooth generator which feeds the Oscillight deflecting coils. If this added impulse amounts to several per cent. of the impulse produced by the generator it is sufficient to "lock" the line-frequency generator of the receiver firmly in step with the corresponding generator at the transmitter.

Since the "back trace" of the scanning line is not instantaneous it is desirable to extinguish the cathode-ray during this back trace so that it does not appear on the fluorescent screen. This is done by coupling the line frequency generator to the modulator electrode of the Oscillight in such a way that a large negative potential is applied to this electrode during the back trace, thus extinguishing the cathode-ray beam during this interval.

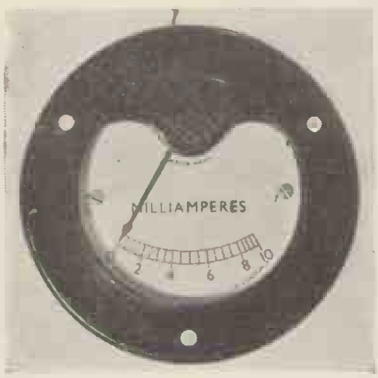
Meter Economy in Transmission

By R. C. Horsnell, G2YI

WHEN it is proposed to go in for the transmission side of short-waves, it is often a source of great expense to obtain suitable meters, if serious work is to be done.

With any kind of receiver it is possible to build up, tune in and obtain perfect results without the aid of a single measuring instrument.

But with a transmitter we are up against a very different problem.



This type of meter by Sifam is suitable for the purpose. It is one of the cheapest reliable meters available.

Often one will see a keen amateur build a transmitter with, perhaps, only one small milliammeter in the stage feeding the aerial, and a bulb in series with the radiating system to indicate resonance in that part of the circuit.

Usually, however keen our enthusiasm, our pockets will not allow for the expenditure on a sufficient number of instruments fully to equip the transmitter.

Each stage, crystal drive, power amplifier, modulator and speech amplifier should, for correct adjustment, have a milliammeter inserted in its anode circuit, also a voltmeter between the anode and earth so as to measure the watts dissipated at the anode.

It must be realised that with a transmitter we hear nothing as a result of any adjustments we make, unless we listen to "side-tone."

It is possible with a single milliammeter to measure current and anode voltages on any stage of our apparatus. We shall see by this how our interest in the subject will increase as faults show up and are easily located in the respective stages. We can do this by plugs and jacks or "shorting strips" to close up when the meter is removed. This, however, is a very unsatisfactory way, as jack contacts are apt to develop resistance, or make intermittent contact when the plug is removed, especially at currents of 40 to 50 millamps.

The following is my method of eliminating these troubles, also any chance of damaging the only meter. Examine the circuit which shows a four-stage transmitter with a crystal drive, power amplifier, choke modulator and one speech amplifier (two are usual at least, but one serves to illustrate the point).

The instrument required is a milliammeter reading 5 milliamps full scale. This instrument will often cost a little more than the conventional 25- or 50-milliamp type, but the extra cost will more than justify itself.

I am assuming that the transmitter is of the baseboard type, as this is usually favoured by the beginner as being the cheapest and easiest to adjust. The meter is mounted, as shown in the illustration, on an old plug-in coil mount, the celluloid binding of the coil being used to hold it tight and the two terminals connected to plug and socket respectively.

The Clarke Atlas coils are ideal for the average watch-size milliammeter, and probably everyone can find one of these in the junk box. For the circuit illustrated we need one of these to mount our 0-5 milliamp instrument and six baseboard coil mounts.

Note that in each anode circuit our coil mounts are wired in series with the plate circuit, care to be taken to connect each the same way, i.e., plate to plug in each case and H.T. feed to socket.

With expense no object we should put a 50 milliamp meter in the power amplifier and modulator stages, and in the crystal oscillator and speech amplifier stages a 25 milliammeter.

When the 0-5 milliammeter is purchased, inquire the self-resistance so that the values of shunts required can be calculated.

Just in case anyone is not quite conversant with shunting meters I will explain it briefly, as a calculated resistance bridged across the meter, to enable a greater part of the flow to go through the "shunt" and a small amount only through the meter.

The formula is :—

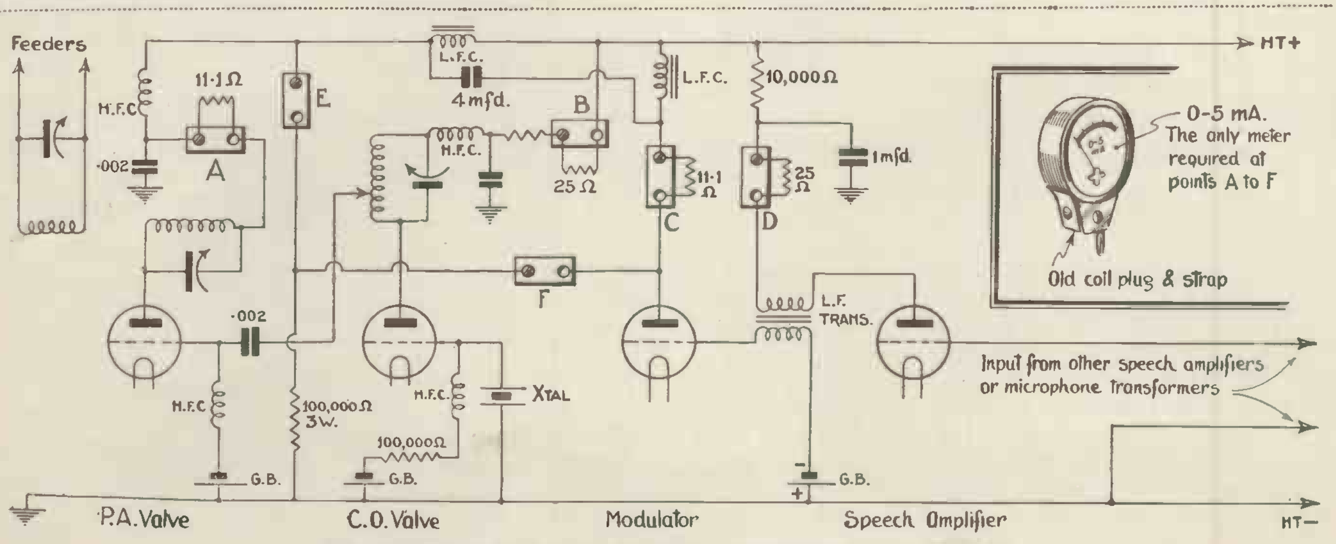
$$\text{Shunt value in ohms} = \frac{\text{resistance of meter}}{N-1}.$$

Where N equals the number of times we wish to increase the scale.

For example, take the two stages requiring 50 milliamps each and assume the meter has a resistance of 100 ohms.

Our figures then are :—

(*Continued on page* 533.)



The same meter is used in each anode circuit. All resistances can be home made.

THE ULTRA-SHORT-WAVE TELEVISON TRANSMITTER AT BERLIN

The following is a translated abstract from Dr. Moller's article in "FERNSEHEN UND TONFILM"

DURING the past year two experimental transmitters have been erected at the television building in Berlin, which serve to modulate the ultra-short-wave transmitter at Witzleben. The transmitters are:—

1. A film transmitter.
2. A light-beam transmitter for scanning head and shoulder pictures.

Both transmitters are intended for a normal scanning of 180 lines. It was intended that the light-beam transmitter should show the head and shoulders of the announcer in the intervals between changing the films on the other, but it can also be used for illustrating lectures given on the short-wave transmitter.

The most important development in connection with these transmitters is in the use of a multi-hole disc running in an evacuated chamber. With high-definition scanning the multi-hole disc has decided advantages over the mirror-drum, in that the mass to be held in synchronism is less and the extraneous noise is reduced. Experiments have shown the advantage of running the disc *in vacuo*. Working and synchronising power is reduced to a minimum, and the vibration is negligible. As an example of the reduction in power, a 40-watt motor is sufficient to drive a 900 mm. disc at 6,000 r.p.m. Owing to the absence of vibration, the thickness may be reduced to .1 mm. Further, the absence of air precludes the clogging of the holes in the disc by dust particles.

Arc Light Source

The light source for both transmitters is an arc lamp which, in conjunction with a very efficient objective system, gives a maximum light intensity through the disc. In the film transmitter, for example, a beam of light of 1/20th lumen can be obtained which corresponds to 6 mV photo-cell output. The noise level of the amplifier lies between 10 and 20 μV, which is some 30 times less. From these figures it is possible to say that with mechanical scanning a picture definition of 270 lines is possible, and under special conditions even 360 lines could be attained. At this latter figure, however, a certain distortion occurs due to the high speed of the disc.

The principal points borne in mind in the construction were simplicity and safety, since the transmitter had to be used for daily service and to run continuously for a number of hours.

Film Transmitter

The arc is mounted on a heavy cast iron base which also carries the projection head and built-in disc. There is accommodation for a photo-cell amplifier and beneath the base plate are the film boxes, sound amplifier and main switchgear. The vacuum chamber is made from forged steel, since cast iron is not sufficiently vacuum-tight. The motor is mounted on rubber to muffle vibration as much as possible. It is water-cooled by means of copper coils inlet in the stator, while the rotor is built to withstand considerable rise of temperature. The holes in the disc are hexagonal and are punched through a thickness of .02 mm. It will be appreciated that the constructional requirements of such a disc are unusually high, and the displacement of the disc by only .01 mm. from the correct position will produce distortion of the received picture.

A projection head specially built by Zeiss Ikon was used, which varies from the usual model in that the film is drawn uniformly through the gate. This enables the vertical scanning movement to be accomplished by the mechanical movement of the film itself.

The film window is water-cooled, minimising danger from fire. When the film is not in action, only a narrow slit is exposed, the remainder being in the cooled chamber.

A phase compensator is also incorporated, enabling the position of the film to be adjusted relative to the scanning, and ensuring the correct framing of the picture in the receiver.

Framing and Synchronising

The picture framing is accomplished by means of a synchronising impulse sent out together with the light impulse. Both these are provided by the scanning disc in the following way:—A series of slots are cut in the disc through which the light impulse is allowed to pass at every fourth revolution (25 pictures per second). A small synchronous motor with a masking disc is provided, which allows the synchronising light impulse to pass to the photo cell at pre-determined intervals. The line frequency impulse is transmitted in a similar manner through slots in the transmitting disc, the optical system being mounted on the opposite side of the main motor shaft.

The vacuum chamber is equipped with mercury manometers which are adjusted to give an alarm when the vacuum falls. Alarms are also fitted to guard against stoppage in the cooling water system. The oil pump for evacuating the chamber is housed in a cast iron sub-strucuture.

The arc for the transmitter is an Artisol 75 made by Zeiss Ikon, which gives a total light of approximately 12,000 lumens with high intensity carbons. The whole of the projection system is carefully constructed to avoid light leakage at any point.

On the switchboard below the main arc mounting are two moveable winding phase compensating transformers to synchronise the scanning motor and the motor impulse. The switchboard also contains the various indicating instruments and an attenuator for the picture signals.

Light-beam Transmitter

The light beam transmitter has been developed along similar lines to the film transmitter just described. Greater attention was paid to the light source in this case, since the lines are greater than in the case of the film scanner. A Nipkow disc 75 cms. in diameter is used at 6,000 r.p.m. This is also enclosed in a vacuum chamber and driven by a 100-cycle synchronous motor. The disc is substantially made, since the peripheral speed is approximately 240 metres per second.

The disc is drilled with four spirals, and the correct scanning frequency is ensured by a masking disc which rotates in front of the main disc. The masking disc is interesting in that it is constructed from opaque glass with transparent slits provided at intervals along the circumference. Owing to the reflecting surface of the glass disc it did not tend to heat up which proved of great advantage in the running of the equipment since there was no means of conducting the heat away from the interior of the vacuum chamber.

The window in the vacuum chamber is made of quartz, which is better able to withstand the temperature than is ordinary glass.

The arc itself is a "Magnasol" made also by Zeiss Ikon. It was intended for use in large cinemas, but suited the purpose very well. As in the "Artisol" it is fitted with a parabolic reflector 300 mm. diameter. The image of the positive crater is smaller than the picture field, so that the image lies between the transmitting disc and the objective. This avoids upsetting the picture by any slight adjustment of carbons.

The construction of the remainder of the transmitter is substantially the same as that of the film transmitter. The picture synchronising impulse is provided by slots in the masking disc. The projection head is fitted with objectives of various focal lengths mounted on a triple nose piece, enabling a quick change to be made from close-ups to three-quarter-length views.

The author has found that the best results are obtained by enclosing the subject in a small cabin, the walls of which reflect light as much as possible. This prevents disturbances in the picture, and shadows which would occur in a larger room. The actual size of the cabin is 1.5 metres square, which just enables two people to be scanned at the same time. It is intended that the cabin be made adjustable by providing sliding walls.

The current in the photo-cells corresponds to illumination of 1/300th lumen so far as can be estimated with a caesium cell.

In the early experiments the holes in the disc were larger than the theoretical size, but it was found that sufficient light could be obtained if they were reduced to the correct proportions. No attempt was made to design the amplifier for the very lowest frequencies, since variations in the photo-cell illumination such as would be caused by opening the cabin door, etc., would upset the normal working of the amplifier, the effective picture signal being so small.

A low-frequency compensator is added to the later stages of the amplifier, which restores the black tones to a certain extent.

Meter Economy in Transmission

(*Continued from page* 531)

$$\text{Shunt} = \frac{100}{10-1} = \frac{100}{9} = 11.1 \text{ ohms.}$$

10 being the number by which we multiply the scale to assume each division to be tens instead of units, i.e., on scale now equals 10 milliamps.

Two resistances of 11.1 ohms can soon be made up. For the 25 milliamp stage we multiply our scale by 5, which is:—

$$\frac{100}{5-1} = 25 \text{ ohms.}$$

These can easily be made up from No. 26 gauge Eureka wire, which has a resistance of approximately 5 ohms per yard. For the 50-milliamp range, remember that this wire has to carry 45 milliamps as the shunt, and the meter the remaining five, so we cannot use too thin a wire; also the resistance of this gauge makes it easier for calculation.

These shunts have to go across the meter and the meter is to go into the coil mounts, so now we can see what the circuit indicates, namely, the shunts connected permanently across the coil mounts into which the meter plugs.

The removal of the meter does not leave any contacts to close themselves, or shunts to short out, but only the 11.1 or 25-ohm resistances, which, being so small, have no effect on the circuit. The meter can be plugged quickly in and out of any circuit, A, B, C or D and readings accurately taken.

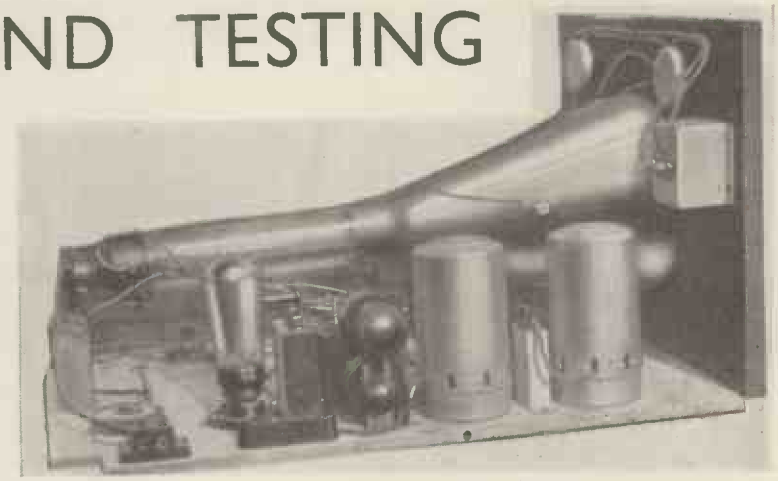
Now to explain the functions of sockets E and F. They are from plate of power amplifier or modulator and have their sides joined to earth potential through a 100,000-ohm, 3-watt resistance.

By Ohm's Law we know 500 volts causes 5 milliamps to flow through this particular resistance if applied to its ends. So, if we have 400 volts at our modulator or power amplifier anodes we shall have a reading of 4 milliamps. If we plug the meter into the sockets E or F it will act as a voltmeter, giving us an accurate reading of voltage at our anodes. It takes only a small current so that the readings will be fairly accurate, but do not leave it in circuit constantly as H.F. leaks may occur.

The figures given are those ordinarily required for a complete reading of constants for a 10-watt transmitter, but it can be varied proportionately to suit requirements.

THE DE LUXE CATHODE-RAY TELEVISION VIEWER

FITTING UP AND TESTING THE 30-LINE SCANNING CIRCUIT



This article, continued from last month's issue, describes the final steps in the fitting up and operation of the low-definition time-base for the "de luxe viewer."

AFTER the time-base has been tested and found to be working satisfactorily, the tube can be inserted in its holder and aligned. To do this, switch off the H.T. unit and discharge the condensers. It is advisable to include a word of warning here which is applicable to all H.T. condenser circuits. To prevent the charge remaining in the condensers a 3-megohm resistance is connected across the terminals. This does not discharge them instantaneously, but the voltage will decline at a rate which is determined by the time constant of the capacity and resistance. In this particular case the time constant is 4 mfds. × 3 megohms, or 12 secs. This means that at the end of a quarter of a minute or so the voltage across the condenser will still be about 50 per cent. of the maximum and capable of giving a severe shock. The condensers will ultimately discharge, but will take an appreciable time to do so, and should therefore be avoided for some time after switching off.

It might be thought that a lower resistance would be better as a discharger, but this would impose an unnecessary load on the H.T. circuit. As it is, the current through the discharge resistance is 0.7 mA and this is quite sufficient for the type used. When the cathodes of the tubes are glowing the condensers will, of course, discharge more quickly through the anode circuits, but when the H.T. unit is switched on by itself the above warning should be borne in mind.

Connecting the Tube

Insert the tube in the socket so that the "B" plates are in the horizontal plane. Then connect the second accelerator terminal to the terminal on the base marked to correspond, and the flexible leads from the shift potentiometers to "A2" and "B2" (see p. 397 last month).

A1 and B1 are connected to the terminals on the condensers C15 and C11.

On the side of the Ediswan tube a small cap will be noted which makes contact internally with the graphite screen. This cap should be joined to the second accelerator terminal, but the focus of the tube may be improved if it is taken to A2 plate and both connections should be tried.

The tube connected, switch on again and adjust the cathode temperature as described earlier. The shield bias should be set to a maximum and the first accelerator to a minimum. When the H.T. is on and the time-base is running, increase the first accelerator slightly and reduce the bias until a blurred scanning screen should appear. If no fluorescence is seen on the end of the tube, continue to increase the accelerator and cautiously decrease the bias after each alteration.

If no spot appears even when the first accelerator is at a maximum it is possible that the screen may be pushed to one side of the tube, and the shift potentiometers should be moved to centralise the picture. If it appears, then adjust the focus sharply by a combined movement of the first accelerator potentiometer and the shield bias. For the reception of the actual picture it is preferable to blur the focus slightly to reduce the gaps between the lines, but at the testing stage use a sharp focus to see that all is in order.

The line screen will probably be far from correct, so proceed to obtain a rough adjustment as follows:

Obtaining the Correct Screen

Taking the full diameter of the tube as one of the dimensions of the television screen, mark out the width of the picture on a basis of 7:3, and draw two lines across the centre of the screen with indelible pencil or black ink.

Now alter the width of travel of the horizontal scan until the picture occupies the width outlined on the tube. The lines may not be correct in number, but this can be adjusted later.

Now proceed to set the horizontal scan to 12½ per sec. Connect a 4-volt transformer winding to the terminals marked I, I and alter R14, the modulation potentiometer, until a series of black bands appear on the screen. These are due to the 50-cycle supply modulating the beam intensity.

They will travel across the screen since the speed of the scan is either faster or slower than an exact multiple of the supply frequency. Alter the horizontal time-base speed until four bands appear evenly spaced across the screen. The speed is then 12½ per second. If the width of the picture is wrong, the width alteration must

(*Continued at foot of page 537.*)

FIRST STEPS IN HIGH-DEFINITION RECEPTION

By J. H. Reyner, B.Sc., A.M.I.E.E.

This article is the second of a series which describes actual experiences and the apparatus used in picking up and resolving the experimental high-definition television transmissions put out by the Baird Co. from the Crystal Palace. Last month the aerial arrangements were dealt with and below are details of the vision receiver used.

IN last month's issue I discussed the arrangements for the reception of signals and gave detailed information as to suitable aerial systems to employ. The article concluded with a brief reference to the type of receiver. In the present article I propose to go into this question in a little more detail.

The superheterodyne receiver appears to offer the simplest solution to the problem of television reception but the ordinary type of circuit is useless owing to the very wide band-width required. It is generally stated that a band-width of two megacycles or even more is necessary for the satisfactory reception of 240-line television, and, as most readers will be aware, this is usually achieved by employing i.f. transformers operating at frequencies around 12-15 megacycles (corresponding to 20-25 metres). At such frequencies the band spread of two megacycles is a reasonable proportion and although the individual gain per stage is necessarily quite small at such high frequencies it is possible to use several stages without difficulty.

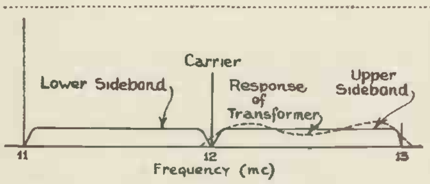


Fig. 2. Diagram showing the use of one set of side bands.

Even at 12 megacycles, however, a simple circuit is not satisfactory for it gives a band spread of a few hundred kilocycles only, which is nothing like enough. There are two methods of attack. One is to employ an over-coupled band-pass circuit and thereby obtain a double-hump resonance curve in which the peaks are separated by perhaps one megacycle, and the other is to use a single circuit but so to proportion the constants (and perhaps deliberately flatten the tuning) as to obtain a very wide spread.

Neither solution is really satisfactory but they do represent practical solutions to the problem with which results can be obtained. The difficulty is one of maintaining sufficient amplification while obtaining the very wide band spread, and it seems at the moment that the only solution is to sacrifice gain to obtain satisfactory response.

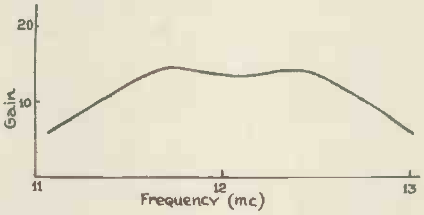


Fig. 1. The response curve of a typical band-pass arrangement.

Fig. 1 illustrates the response curve of a typical band-pass arrangement. It will be seen that the spread here is still short of the two megacycles theoretically required. However, greater separation of the peaks is hardly practicable owing to the difficulties of tuning. Even with the arrangement shown the transformer is not at all easy to tune and it is understood that in order to avoid this difficulty special forms of transformer will be marketed in which the tuning is adjusted by the manufacturer and does not require alteration subsequently.

Using One Side Band

It has been suggested that the difficulty of the band spread can be overcome by using only one set of side bands, as illustrated in Fig. 2. For this arrangement the receiver is tuned so that the carrier does not occur in the middle of the tuning band but to one side, in which case if the response of the transformer is reasonably flat we have a more or less uniform amplification of all the side frequencies up to and slightly in excess of one megacycle, which is all we require. The band-width of two megacycles is only necessary where we are tuning both side bands as in the case of an ordinary radio set.

This tuning of one side band only will give a satisfactory picture, the tuning being actually accomplished as follows. As the tuning control is rotated, the synchronising signal will be heard over quite a large arc on the dial. There comes a point, however, where the 6,000-cycle signal begins to get weaker and disappears, followed immediately by the 25-cycle signal; in fact with most receivers the two will disappear together. When this is done the low-frequency modulation is being cut off by the tuning, leaving the upper frequencies still preserved. The correct adjustment therefore is at a point just before the synchronising signal begins to disappear and with a little practice this point can be located without difficulty.

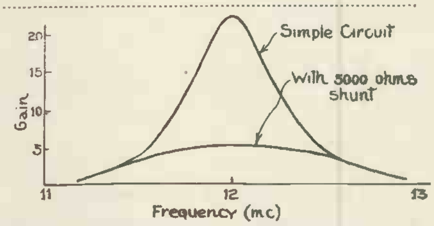


Fig. 3. Response curve of a single circuit with a resistance shunt across the coil.

Fig. 3 shows a typical response curve of a single circuit using a resistance shunt across the coil. One might think that in order to obtain any reasonable spread very heavy damping would have to be introduced. This is the case, but we can afford quite an appreciable loss because the single-circuit tuner is at least twice as efficient as a band-pass in point of view of amplification, and with the over-coupled form of circuit used the discrepancy is even greater than this, so that it is possible to add sufficient resistance to flatten out the response curve without losing too much gain. The advantage of this form of construction is that the circuit can be tuned in the set by the user without serious difficulty.

CIRCUITS FOR HIGH-DEFINITION RECEPTION

I.F. transformers of both types are on the market and probably other and improved forms will appear during the ensuing season. At least two stages are necessary and probably three will be required for outlying districts. This is a matter which will have to be decided by experience to some extent. Up to a point the less the high-frequency amplification the less will be the top-cut due to the tuning.

On the other hand, if any question of selectivity enters into the problem, then tuning circuits are essential. Fortunately, at present the ether in the 50-100 megacycle region is not crowded and difficulty will not arise on this account just yet. The only point to be considered is the sound channel which is scheduled to operate on 7.2 metres and the vision receiver (on 6.6 metres) must, of course, be sufficiently selective to avoid any interference from this source.

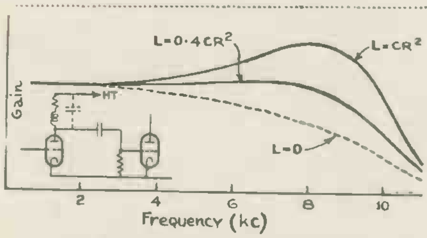


Fig. 4. Graph showing how the effect of self-capacity is compensated for by the inductance.

Some amplification is desirable after the detector stage. Modern radio practice is in the direction of feeding the output valves straight from the detector, or at any rate using only one stage of amplification. Television technique at present seems to indicate that at least one, and preferably more, stages are desirable between the detector and the output valve. The reason for this is that on such stages one can introduce correcting circuits which will increase the amplification of the extremely high frequencies in order to compensate for the loss in the tuning circuits, and thereby improve the definition in the picture.

There are two forms of top-correcting circuit which can be used. The first of these is the inductive resonance circuit in which a small coil is included in series with the resistance of a resistance-capacity-coupled arrangement. This latter arrangement, by the way, is practically universally used because it can be made to fulfil the very exacting requirements of extremely low and extremely high frequency amplification.

It will be seen that the self-capacity of the circuit, which includes the valve capacity and is shown dotted in the figure, forms with the coil and the coupling resistance a very flatly tuned resonant circuit. This circuit will have a tuning point which can be adjusted to occur towards the top of the frequency band required. The effect will be that the amplification at this point rises instead of falling off as it should normally do owing to the shunting action of the self-capacity. The rise, of course, does not continue indefinitely and the gain falls off very sharply subsequent to the resonant point, which is in some ways an advantage.

The circuit is not a true resonant circuit in the ordinary sense of the word. With a normal tuned circuit the actual resonant point only occurs at one frequency, so that the effect of the self-capacity can only be accurately cancelled at one point. Owing to the presence of the resistance in this circuit, however, the behaviour is considerably modified, and it can be shown mathematically that the effect of the self-capacity is compensated for by the inductance over quite a considerable range of frequency before the cut-off point occurs. Fig. 4 shows the type of compensation which can be obtained and illustrates the cut-off which would occur due to the self-capacity without the compensation.

Top Correction

This form of high-frequency accentuation is quite successful but it can only exercise a limited effect. The resonant rise is rarely more than about 30 per cent. of the normal—in fact it cannot be more than 50 per cent. On the other hand, two stages of amplication, both operating in this manner, would give nearly double the amplification in the top, which would compensate very largely not only for the effect of the self-capacity in the video amplifier but also for top loss in the tuning circuit.

An alternative form of top correcting circuit which can be made to give rather greater correction is that shown in Fig. 5. Here the voltage developed in the anode circuit of one valve is handed on to the next valve through an isolating condenser in the ordinary way. The second grid, however, is not connected to the top of the grid leak but to a point some distance down, while the top portion of the grid leak is shunted by a condenser.

Normally, the tapping of the grid down the grid leak reduces the effective voltage and consequently reduces the amplification of the stage as a whole. At high frequencies, however, the condenser connected across the top portion of the grid leak acts as a short circuit and therefore the second grid is effectively connected to the top of the grid leak and the full amplification is obtained. This action obviously does not take place suddenly, but occurs gradually, the amplification slowly rising after a certain frequency is reached and an increase of 20 or 30 to one can be obtained quite comfortably. This again will more than compensate for any loss of amplification due to the shunting effect of the self-capacities, and the residual correction can be used to counteract the top-cut in the amplifier.

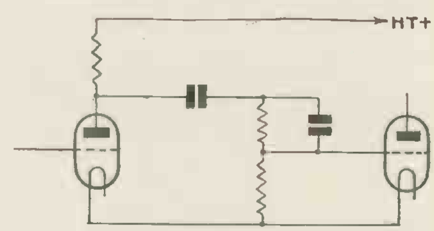


Fig. 5. An alternative form of top correcting circuit.

The correct inductance for optimum correction with the first of the correction circuits shown can be assessed by using the formula

$$L = CR^2,$$

where L is the inductance in henries,
C is the stray (and valve) capacity in micromicrofarads,
and R is the anode resistance in megohms.

For the second form of correction the behaviour can be estimated quite simply by working out the reactance of the top-shunt condenser and comparing it with the resistance of the top half of the grid leak across which it is shunted, with due allowance for phase. It must be remembered that the bottom half of the grid leak is shunted by the input capacity of the succeeding valve, and therefore the top correcting condenser should be several times as great as this. In other words it should have a capacity of the order of .0001 to .002 μF. and the value of the grid leak should be adjusted accordingly.

Valve-capacity Effects

As in the case of the radio-frequency side of the circuit, the amplification has to be limited. Although we can correct for a certain amount of top loss, it is essential that we should start off with as little loss as possible. This necessitates reducing the self-capacities of the valve. These capacities are of two forms. First of all we have the anode-cathode capacity of the first valve, and secondly we have the grid-cathode capacity of the second valve. In addition to all this we have the stray circuit capacity, but this can be kept small by careful design.

Now the anode capacity of the valve we can do little with unless we construct special valves, and these are not yet available. The grid capacity of the second valve, however, is a matter with which we can deal. This capacity is made up of two parts. Firstly we have the static or geometric capacity between the electrodes themselves, which is of the order of 7-10 micromicrofarads in an ordinary valve, and secondly we have the Miller effect, which is a "reflected" capacity due to currents which are forced back from anode to grid of the valve through its internal self-capacity.

This is not a real capacity, but what happens is this. The amplified voltages in the anode circuit of the valve cause currents to flow through the valve itself and subsequently in the grid circuit, and these additional currents are of the same order and in the same phase as would be obtained if we connected an additional capacity across the circuit. Therefore we say the valve has an effective additional capacity due to the feed-back or Miller effect.

We can minimise this in two ways. One is by reducing the effective amplification of the valve, which is not what we want to do if we can help it; and the other is by reducing the internal capacity of the valve. This can be done by using the screen-grid valve, and in fact the screen-grid type of valve is universal in high-frequency amplification for this very reason. In order to avoid trouble due to the secondary-emission characteristic of the customary screen-grid valve we prefer to use pentodes, but the reason for their use remains the same.

With a pentode, therefore, we are left with a relatively small stray capacity amounting to 7 or 8 micromicrofarads from the anode of the first valve, a similar amount from the grid of the second valve, and 4 or 5 from the stray capacities in the circuit. We can reduce this a little further. One method is to use valves having the grid brought out at the top. This reduces the grid-cathode capacity, but on the other hand it increases the anode-cathode capacity, so we are more or less where we stood.

The other is to mount the various components on pillars up in the air and generally to arrange the wiring in such a way that the capacity to earth of the various coupling condensers and resistances is very small.

Stray Capacities

Even when all this is done, however, we find that we are left with, say, 15 micromicrofarads at the best. Now the reactance of a capacity of this order at a frequency of one megacycle is roughly 10,000 ohms, which means that we must use coupling anode resistances of the same order. In actual practice the self-capacity is nearer double this value, which means we are restricted to about 5,000 ohms. A valve having a slope of three with an anode resistance of 5,000 ohms would give a gain of 15, so that, although we are accustomed to think in terms of hundreds when dealing with the gain of screen-grid valves, we are once again forced to be content with very much less when dealing with television.

"The De Luxe Cathode-ray Television Viewer" (*Continued from page* 534.)

be made at the same time as the speed is adjusted, since the alteration of one will produce a change in the other.

Having got the correct running speed in the horizontal plane, count the number of lines. They should be approximately 30. If they are not, the length of the vertical travel may be slightly altered and this will usually be found sufficient to bring them into correct speed and number. If they are widely out it may be due to the characteristic of the relay and the resistance R6 or R7 will need alteration. Decreasing this resistance increases the speed and the number of lines, and vice versa. The values of the resistances quoted in the text are those actually used in the original model, but variations in condensers and relays make it impossible to give the value accurately for all cases and the constructor must be prepared for alteration.

When the scan is satisfactory and stable the four black lines referred to will be stationary on the screen and the tube should be left for a little while to see that no bad contact develops to upset the scan. The transformer can then be disconnected and the input connected to the radio receiver. The music will produce a variegated pattern on the screen and the input and beam intensity should be altered until sharp black-and-white contrasts are obtained. If the pattern is too faint, even with full modulation, either the signal is too weak or the shield potential is too high. When this point is attended to the tube will be ready for television reception.

The receiver used should not contain transformer coupling or a hopelessly distorted picture will result. It is suggested that an S.G. followed by detector R.C. coupled to an output pentode such as the Mazda A.C.2/Pen. will give ample signal strength at reasonable distances from the London transmitter.

More Components for the S.W. Amateur

AMATEURS will be glad to know that the Rothermel Corporation are now in a position to supply the famous Hammurlund short-wave transmitting and receiving appartus.

Amongst the components listed we notice midget condensers of capacities between .00002 and .00032 mfd., split-stator condensers of standard and double-spaced types, and single- and double-spaced midget for band-spread.

For the transmitting amateur the tuning condensers will be of interest. The gap between plates varies between .192 inch for 6,500-volt working to .038 inch for 1,000-volt working. These condensers are also available in the split-stator types.

Coil formers and valve holders of Ceramic construction are also available in addition to I.F. transformers with variable air-space trimmers.

THE FIRST TELEVISION BROADCASTS

The First Television Dance

Appreciation

Our Readers' Views

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

The Mihaly-Traub System

Television at a Municipal College

The First Television Dance

SIR,

It may prove of interest to readers of TELEVISION AND SHORT-WAVE WORLD to know a little of the ways and means by which a dancing "item" was included in the television broadcast programme for the first time a few years ago.

This picture depicts the first television dance broadcast; the limitations were then such that only the feet and the legs could be televised. The artist was Miss Ailsa Bridgewater.

The event took place in the Baird Company's studio, then in Long Acre, when television development was in its early stages, and the scope of the artistes considerably limited. The space that could be allotted for the performance of a dance was a matter of 2 to 3 square feet! As can be imagined it was no easy task to arrange any steps to such a confined space, so it was with no little trepidation that, as the first dancing artist I appeared for rehearsal.

The combined ingenuity of the staff had provided a small stage, which was placed in the dark space of the studio, divided by a thin partition from the control room. Owing to the fact that a full-length picture was then impossible, after a short introductory speech I mounted this stage, which was more in the form of a table than anything else (shown in the photograph), and commenced to show the rudiments of ballet technique within the carefully marked out space.

The broadcast was unique in that it started at the somewhat untimely hour of midnight after all other wireless activities had ceased and all London was calm. From the moment when the red light showed suddenly and brightly, and the immediate "all quiet please" came from the announcer, an indescribable feeling of romance inevitably pervaded the tense moments of the next half-hour. Despite a certain amount of natural nervousness at facing both the microphone and televisor, to a far greater extent was the thrill and realisation that this was the foundation of a new means of presenting the art of dancing to the public.

AILSA BRIDGEWATER (London. N.W.)

* * *

Appreciation

SIR,

Please allow me to express my appreciation of your wonderful journal, which I may say is a real "he-man" edition in radio. Perhaps at a later date I may be able to paint a more livid picture of your journal, when I have tried out a few more of your tips, with which it is filled to overflowing.

T. T. CHRISTIE (Walkerburn).

* * *

The Mihaly-Traub System.

SIR,

With reference to the description of the Mihaly-Traub system which appeared in your issue for July, 1935, and the additional correspondence which appeared in August, 1935, we should like to point out that the system is covered by British Patents No. 394,446, 412,026, 419,120, and 425,552, which date from the period 1931 to 1933.

Due to the fact that publication of full technical details of the system was withheld up to recently, the impression might be created that the system is of recent date, and that there are in existence patent applications for similar arrangements previous to this company's patents. The dates of application of the patents cited above indicate that this is not so.

INTERNATIONAL TELEVISION CORPORATION (London, W.).

* * *

SIR,

It seems advisable to mention that the Patent Specification Nos. 428,349 and 428,459 as printed in my letter in the Correspondence Columns of the August number of TELEVISION AND SHORT-WAVE WORLD, should both be 428,459 and not two separate specifications.

H. RICHARDSON. (Buxton).

* * *

Television at Portsmouth Municipal College

SIR,

Your readers will probably be interested in an account of our College television transmissions. The picture, which was taken during an actual 10-metre 30-line transmission, does not show all the apparatus.

Definition and radiation of this 30-line transmission is very good and a number of 10-metre receiver experimenters intend co-operating with us in this series of tests. Experiments are being carried out in scanning and optical systems together with "no screen" images. These experiments have been carried out also in a local kinema and I hope to let you have details of this later.

The following is a brief resumé of the present apparatus: 30-line discs; light source 3 kW arc; focusing system a series of lenses and condensers evolved by experiment; P.E. cell

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.

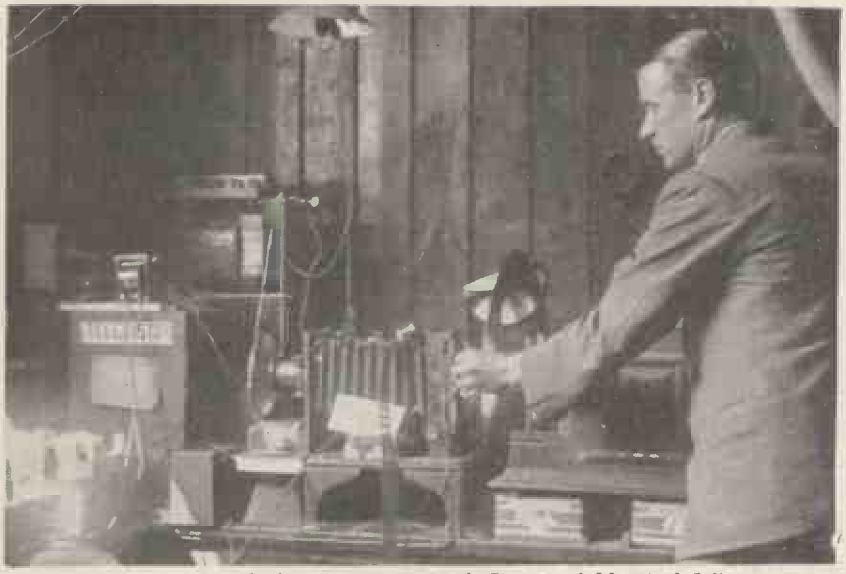
bank fed into a sub-modulator and amplifier. This is then fed into a pre-oscillator modulator or control stage to finally modulate a 10-watt 10-metre band radiator.

There are three separate pre-transmitter amplifier stages, all well matched, and as clear from distortion as possible. The amplified light-converted electrical modulations are then fed into the main output transmitter.

H.T. supply is a 400-700 volt 4-valve mains rectifier, automatic bias being used in amplifiers.

Other experiments now being carried out are microwave 60-centimetre transmissions

The aerial on the roof of the College is fed by parallel transmission lines over 120 feet in length, matched for the wave to be used and the type of aerial array employed. No originality is claimed in this feature, but it is unique in being in a position to offer to students first-hand practical instruction in television transmission.



The experimental television apparatus at the Portsmouth Municipal College.

After the vacation (September 17) we shall be radiating at intervals on all allocated wavelengths. I shall be pleased to send circuits and technical details after the above date.

I would welcome co-operation of your readers for these tests and our 5-metre, 21-metre, and 41-metre experiments. ALBERT PARSONS (The Municipal College, Portsmouth).

HIGH-DEFINITION DEMONSTRATIONS

TO mark the opening of a new wing, Messrs. Bentalls, of Kingston, are providing a special series of demonstrations of high-definition television from September 9th to the 22nd inclusive. Since few people have had the opportunity of witnessing anything beyond 30-line television, which has been with us for some years, this demonstration should be particularly attractive.

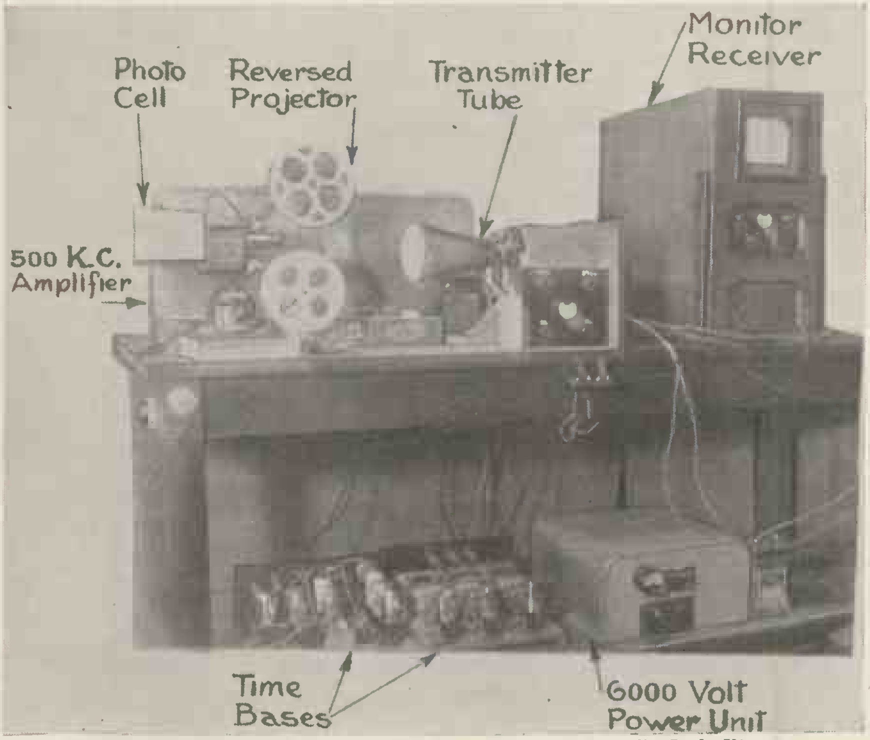
There are, of course, no high-definition transmissions available at any regular times at present and it has been necessary to provide some signals specially for the purpose. The equipment, therefore, comprises a complete 120-line transmitter feeding a number of cathode-ray receivers of up-to-date type. An interesting feature of the equipment is that a cathode-ray tube is also used for scanning at the transmitter, a special 6,000-volt Cossor transmitter tube being used for this purpose.

Ediswan type A.H. tubes are used for the receivers with black and white screens giving quite a bright image, roughly 6 ins. square, capable of being seen comfortably by 20 or 30 people.

For simplicity the subject matter is provided by standard 16 mm. Agfa film. The procedure is to choose a suitable "still" and to demonstrate on this the effect of varying the number of lines, altering the modulation, disconnecting the aerial and so forth and then to run through a short length of film giving a brief idea of what can be done with 120 lines.

240 lines is, of course, appreciably

(Continued on page 560.)



The film transmitter in use at the 120-line demonstrations at Bentalls, Ltd., Kingston.

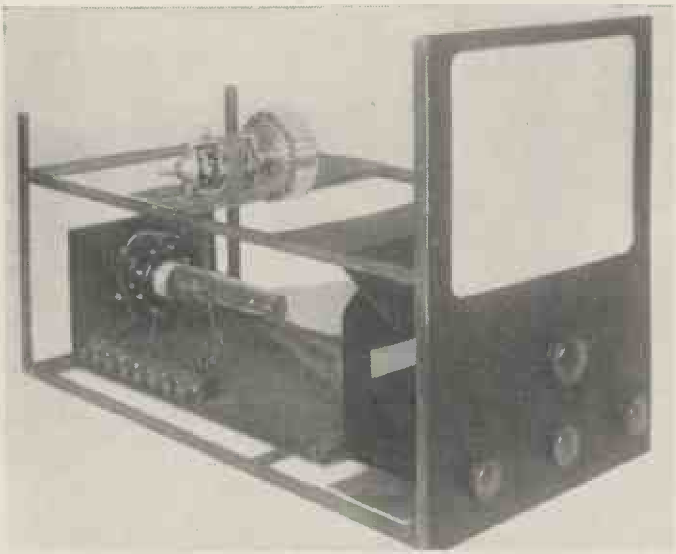
TELEVISION APPARATUS FOR THE AMATEUR

A corner of the test bench showing various types of scanner. Note the perfectly flexible disc in the foreground used for experimental work. View includes a standard 60/- disc set and Duosphere mirror drum unit.

MOST of the older readers of TELEVISION will know The Mervyn Sound and Vision Co., Ltd. as the concern which placed highly specialised apparatus necessary for television within the reach of the amateur. Previously either the apparatus was not available to the ordinary person or the price was prohibitive and many who would have liked to experiment were debarred. The company is continuing this policy to meet the demands in high-definition work.

The firm was founded in 1932 and since that date various types of apparatus of unique design were introduced, including mirror-drums and attendant apparatus that were unobtainable at this time. For instance, 1933 saw the introduction of a reasonably-priced Mervyn disc receiver capable of receiving the 30-line B.B.C. vision transmissions. This set was a great stimulant to the amateur enthusiast and did much to further the interest in television.

In 1934 the *Daily Express* Television Kit was launched. Many thousands of these complete sets were sold and appreciative letters were received from all over the country and some even from Spain and Northern Africa. The kit was designed by Mr. W. J. Nobbs and its excellent results were largely due to the patented Mervyn Nu-glo lamp, at this period the finest lamp of its type. In this set was used the original 16-in. disc introduced in 1933.



A view of the experimental cathode ray mechanical unit. Note the slit aperture. The optical slots are in front of this, directing a concentrated line to the drum.

Combined Mechanical and Electrical System

Production work, research, and development of existing ideas were carried on side by side, including exhaustive experiments into the field of high-definition vision reception which has resulted in the latest Mervyn system of a combined electronic - mechanical type of receiver capable of accepting both 240- and 405-line transmissions. This new apparatus, which successfully employs a cathode-ray tube together with mechanical projection, is shown in one of the photographs.

While full details of the new high-definition receiver cannot be given at this stage, it is understood that a cathode-ray tube of special design is used for the line-scan and a mechanical device for the picture traverse. Interlaced scanning is taken care of by changing the picture traverse scanner. Modulation is not obtained by control of the shield voltage but takes place after one direction of scanning has been achieved.

Development work has also been carried to an advanced stage with a type of tube which has a multiplicity of modulation systems inside. Further, for one form of receiver demodulation has been achieved in the tube by an entirely new application of an electro-optical nature.

Increased light has been obtained in two ways:—

(a) By a new system the tube is operating at maximum brilliancy at all times.

(b) By the employment of a line-cathode and a new optical slot system placed directly on the end of the tube.

The latter system has successfully been employed with a purely mechanical system and more light than is possible with normal methods has been obtained.

A great deal of attention has been given to various gas-discharge lamps among which are the patented Nu-glo and the latest Duplex Nu-glo and "Meraco" series.

Research has been directed to high intensity gas-discharge lamps with a view to their employment in modulation systems employing the Kerr cell effect and in combination with oscillating crystal systems. The object is to produce a concentrated light source which is not directly modulated or only partially modulated.

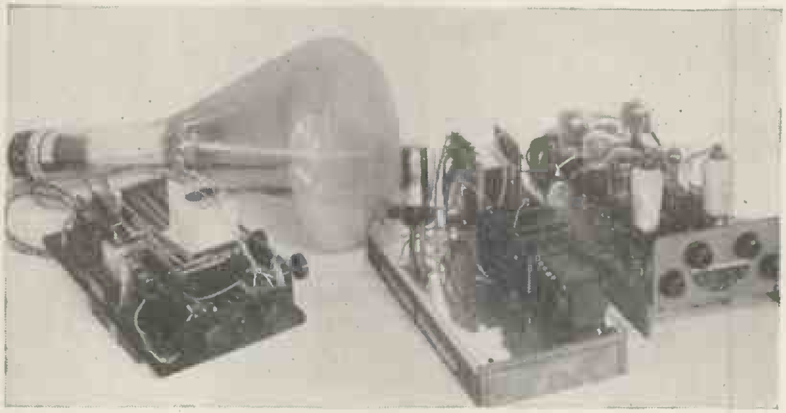
Synchronism has received special attention and a new valve, combining the function of time-base relay and impulse filter produced. This tube at the moment is undergoing running tests and details of its exact functions will be made available at a later date. Its chief merit lies in its ability to be controlled directly from the transmitter and be independent of the time-base settings.

Another activity of the Mervyn Co. is the production of short- and all-wave receivers. Particular effort has been directed to the perfection and production of radio receivers of a scientific grade above the ordinary commercial grade set. Development has taken place along two lines. One the design of a suitable complete instrument and the other of a unit system for the home-constructor.

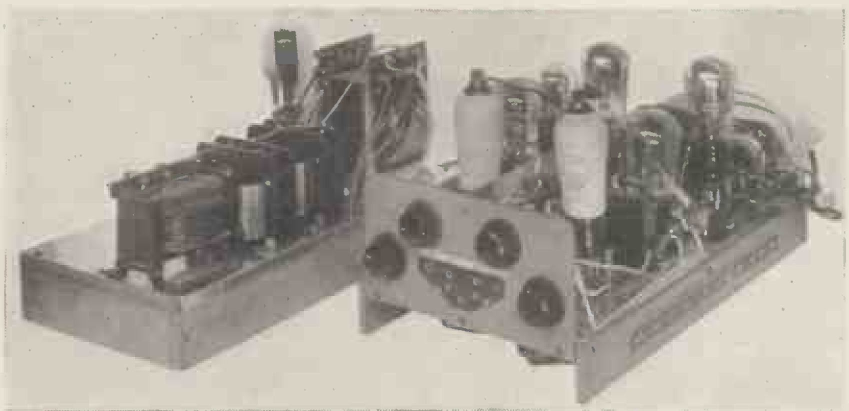
Already the company produces the Faraday All-wave receiver, the original All-wave Superhet (15-2,000 metres); also a model tuning from 6 to 2,000 metres with single dial control without coil changing has been developed.

The Faraday is a scientifically-constructed radio receiver capable of standing up to the severest extreme climatic conditions. Australia, United States, America, etc., is received direct during daylight hours. We understand that the bulk of these sets are purchased for work abroad notably in the colonies and South America. Many of our British Consuls abroad use the Faraday. It is also installed in many ships of the Royal Navy and the Mercantile Marine.

While this is not a complete recapitulation of Mervyn research and development, it gives an indication of the lines on which the technique is progressing. Apparatus of the types outlined will be available for the market in due course.



View showing 240-405 cathode ray apparatus. On the left is the tube (12 in. dia.) and its exciter unit. On the right the time base and H.T. unit. Four controls are used to make the change from 240 to 405 lines.



A close-up view of the time base and exciter units. Note the extra smoothing chokes on the H.T. units.

The experimental 7-metre vision receiver for home assembly. On the right is seen the single control tuning unit, in the centre I.F. complete units, and on the left the L.F. section.

The Striking Voltage of Neon Lamps

THE normal striking voltage of the neon lamp is 180, but it has been found that by the application of X-rays it is possible to reduce this figure to 143. If the lamp has been idle for a considerable time, its striking voltage may be even higher than 180, but once the discharge is started by some external means, it will continue at a lower voltage.

Another remarkable observation is that although 180 volts are required to start the discharge in the dark, exposure to light reduces the critical voltage by about 16 volts. The intensity of the light seems to be immaterial provided it exceeds a certain minimum value.

This lowering of the critical voltage provides an extremely sensitive test for detecting radioactive substances. One milligram of radium bromide, placed 6 ft. from the lamp, reduced the striking voltage by 18.

Heard on the Short Waves

By Kenneth Jowers

A famous American YL's station which is well heard over here. Power used is 650 watts call W9DXX.

CONDITIONS are very queer on 40 and 20 metres at the moment and it is almost impossible to tell with any degree of certainty just which of the two bands will provide most DX. Most of the G station operators I have met during the past few days are of the opinion that the 20-metre band is having one of its bad spells again.

Changing Conditions

If the receiver is switched on at all odd times of the day on 20-metres results are bound to be satisfactory. I distinctly remember one afternoon in particular when between 15.00 and 16.00, W1's, 2's, 8's and 9's were coming in on the loudspeaker. At 16.15 the band was absolutely dead and no more stations were heard until 21.00 when stations came in just like they did during the best periods last winter.

That stations are coming over is proved by Robert Everard in his report from the "Listening Post" in Standon, Herts. He received a very fine number of W6's and 7's all on the loudspeaker. The actual details can be obtained from "Calls Heard." In addition to all these W's, he also logged about two hundred VP, CO, VE4, VE5, PY2, LU8, LU6, TI3 and so on. Mr. Everard also comments on the strength of European 20-metre phone signals, LA1G in particular.

2BDN, who is almost a neighbour of mine, also reports excellent DX on 20 metres. He sent me a very fine log including CO2RA, CO2WD, VE2BG, VE5JK, VT6YD, W4OC, W4KH, in addition to a huge number of other W stations. HB9J has also been heard by 2BDN on 20 metres.

40-metre fans who have logged G6LH from Sleaford, in Lincolnshire, will be interested to know that the transmitter on the air during July was a portable operated from a point 25 miles west of Boston. The transmitter is a simple CO-PA input 6-watts obtained from a pair of car radio motor generators. The best DX with this arrangement was OM4MC using phone. G6LH is the first English clergyman to get a full call, although G2AT can claim the privilege of being second. G2AT was originally a VQ4.

The "Daily Telegraph" Tests

Last month I mentioned about G5KA and the five-metre tests from the *Daily Telegraph* building. I competely forgot to mention that all of these tests were arranged and carried out by the International Short-wave Club. Arthur E. Bear, of 10 St. Mary's Place, S.E.16, is the European and Colonial representative of this club. He has sent me full details of the I.S.W.C. 1935 DX Contest. The contest is open to every short-wave listener, whether a member of the club or not, who resides in Great Britain. Those who enter have to log as many stations as possible during the period of the contest and obtain verifications. The contest opens on September 1 and closes on November 30, so allowing three months in which to listen. A further two months will be allowed so that verifications can be obtained from more disant stations. 53 prizes are to be allotted including a seven-valve Mid-West all-wave receiver for the winner.

An Enthusiast

I am amazed at the amount of time that BRS 1295, John Preston, of Muirkirk, Ayrshire, spends listening to short-wave stations. Although he is over 400 miles from my transmitter, he appears to receive every call that I put out. I have in mind one particular instance. A very short call was made—not more than two minutes—at a quarter past twelve in the morning, nevertheless BRS 1295 gave me a full report. G stations having any doubt about their transmissions should drop a card to this listener for from his records he is bound to be able to give the required information.

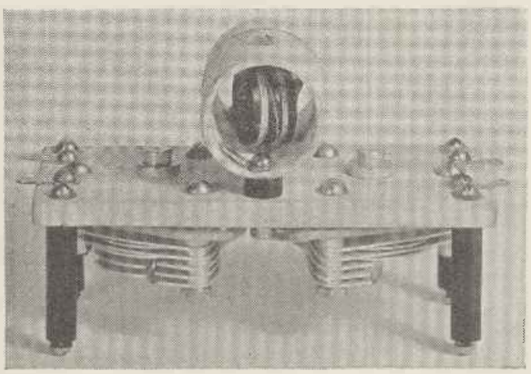
ON4VC, operating the station at the Brussels Exhibition, under the call-sign of ON4WS, is on the air most evenings at the top end of the 40-metre band. After about 21.00 his signals reach R9, so excellent QSO's can be made.

G2PX last month made a most interesting contact in W9QJ. This W station is operated by Patrolman Michaelson, of the American Police. W9QJ put out a transmission in which he sent a message to the King congratulating him on the Jubilee. G2PX passed on the message to Buckingham Palace, from where he received a very nice letter in reply, and a further letter was sent to W9QJ.

Further news has just come to hand regarding G2PX. A recent station that he has worked was W9DXX operated by Alice R. Bourke, the official scribe to the Society of Wireless Pioneers. W9DXX, originally a crime-reporter for the *Chicago Tribune*, who operates a fine station on 20 and 40 metres. The equipment consists of a crystal-controlled type-47 oscillator, 801 doubler, 203A buffer, with a pair of 203A's in push-pull in the final PA. The input is 650 watts on 40 metres.

DX includes all W, all VE, in addition to CM, D, EA, F, G, HH, K4, K5, K6, LU, LY, NY, OA, ON, TI, VK, VO, VP2, VP4, X, ZL.

J. W. Greenshields sends me another colossal log of stations heard in Burnt Oak, Middlesex. It includes VP6YB, W5ZS, HP1A, TI3AV, TI3RG, CO2AL, CO2HY, CO2LL, HI7G, VP9R, W5ZS, W5BNV, at 9 o'clock in the morning, in addition to ten other pages of amateur 20-metre phones. I did intend to publish the circuit of Mr. Greenshield's two-valve receiver, but unfortunately this will have to be held over for the present.



This is the B.T.S. I.F. unit. Fitted with air-spaced trimmers on a Ceramic base it should prove useful in short-wave supers.

BRS 1353, S. Bradbury, in Bradford, wants to know whether the call W10XDA has been re-allocated. He thinks he has heard this call sign, but has not been able to get a verification. Can any reader help?

J. Moore, writing from Swinton, in Lancashire, has sent me a long list of stations heard on 40 metres. Most of these are G's with the exception of ON4ZQ and F8HJ. He wants to know from where he can obtain the addresses of these stations. As the reply to his letter should interest a considerable number of short-wave listeners, here are the details. First of all the best thing to do is to join the R.S.G.B. It only costs 15s. a year for country members. Then all of your reports can be sent to the R.S.G.B. who will forward them. Other than that buy a copy of the Radio Amateur Call-Book.

G6KV deserves a pat on the back for his new speech amplifier and modulator. The quality from his station on 1.7 mc. in particular is really very fine; we ought to be hearing great things from this station.

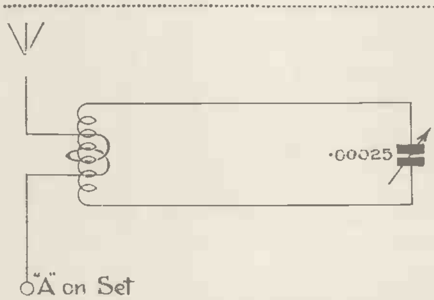
A new station is now operating in Hull under the call-sign of G6FQ, while A. G. Dunn, also of Hull, has now graduated to BRS 1936. This area seems to be getting very active, so I suppose the next thing we shall hear about is a new radio society. BRS 1936 reports reception of XZNTC, XP1A, W3DAZ, CT2BC, LU7AZ, ZB1E, SU1RO, VE2DR.

A Simple Trap

I was surprised to find that quite a number of transmitters do not realise how effective a simple loosely coupled trap can be in removing B.C.L. interference. I have been using a simple trap that has proved very effective in this way. Neighbouring receivers ten yards away without the trap find their sets completely swamped from my transmission on any band. With the trap in circuit and tuned to the proper waveband, interference is either reduced to a negligible quantity or eliminated altogether.

The trap consists of a circuit tuned to the wavelength of the transmitter and loosely coupled to a three or four-turn coil. One side of this coil is connected to the aerial lead and the other side to the aerial terminal on the set. The idea is to tune the coil to say 40 metres or whatever band is used and then reduce the number of turns on the coupling coil until the trap sharpens up and the interfering signal goes out. During the past month I have been radiating continually during broadcasting hours and so far have not caused any interference to listening stations. There is nothing very new in the idea but let this be a memory jog.

B. McDougall, who has migrated out to Stornoway, reports having heard G6YU—R4, G6GO—R6, G2DD—R6, and G6VJ—R5. These are the only G stations heard in that area.



A loosely coupled trap of this kind will wipe out B.C.L. interference.

A fifteen-year-old enthusiast, Peter Elms, of Wendover, sent me a very nice list of stations heard on 20 metres, all using phone. The receiver in use is a one-valver which makes reception even more meritorious. Amongst the 42 stations heard were W1AJZ—described elsewhere in the issue, W4CJ, W4AHH, W4AH, W4CNR, LU3BIM, W3BFH, W3IL. On 40-metre phone PAODK, PAOWJ, PAOOE, F8NU, F8UL, F8NH, G5VR, G5XG, G5ZJ, G2XC, and G6GO were heard.

Oliver Amlie, President of the International 6,000-12,500 mile DX Shortwave Club, tells me that VK2ME, VK3ME and VK3LR are not being heard well in Europe, although he can claim 256 complete hours of reception from these stations. He suggests the main difficulty is that we do not listen at the correct time. VK2ME goes on the air at 7-9 a.m. G.M.T. on Sunday mornings. VK3ME should be heard between 12 noon and 2 p.m. Wednesday, Thursday, Friday and Saturday. VK3LR radiates from Monday to Saturday, 12.30 p.m. to 4.30 p.m.

Oliver Amlie is giving a special broadcasting over W3XAU the American short-wave station on 31 metres. Listeners are requested to send reports direct to Oliver Amlie, at 56th and City Line Avenue, Overbrook, Philadelphia, or to me, and I will forward.

The question very often crops up as to how percentage modulation should be measured. As the percentage of modulation is the ratio of the difference between the maximum amplitude and the carrier amplitude to the carrier amplitude multiplied by 100, this formula is obtained.

$$M = \frac{i\ \mathrm{mod} - i\ \mathrm{car}}{i\ \mathrm{car}} \times 100.$$

28 Mc. seems to be of particular interest at the moment, G2PL, G2YL, G6DH and many others are very enthusiastic. Here is some information received from C. T. Barnard, of Brighton, regarding a schedule for 28 Mc. W1CCZ works daily between 10.00 and 11.00 and 12.00 to 15.00 E.S.T. on C.W. using 700 watts. Reports will be appreciated on this transmission.

The new Marconi-Osram Det-8 seems to me to be a very interesting valve. Although it is fundamentally the M/O 25-watt pentode rehashed, with the suppressor grid brought out to a separate connection, this slight modification makes all the difference.

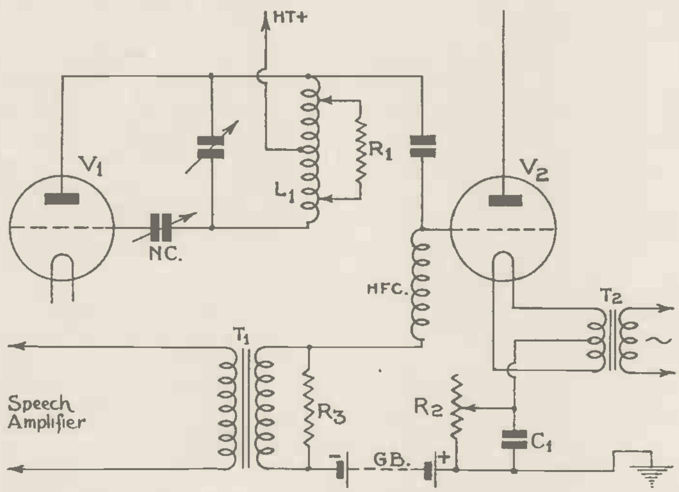
A simple portable transmitter could be built giving up to 25 watts, while modulation would not present any difficulties as the audio required is less than 1 watt with suppressor grid modulation. A pair of these valves in push-pull would make a very satisfactory rig, particularly if they go down to 56 Mc. I will try them and find out.

Next year this valve should be very much in evidence on N.F.D.

More Efficient Grid Modulation

By E. N. Adcock, G2DV

WITH the conditions prevailing on the 14 mc. band during the past month or so, and the number of American phone stations heard here, the thoughts of many C.W. enthusiasts have turned to telephony. As in the majority of cases the use of phone would be limited to a small period of the operating time throughout the year, and the cost of the necessary additional apparatus being a consideration, many have attempted the use of grid modulation—in most cases with poor or indifferent results, chiefly due to insufficient appreciation of the underlying principles of this method of modulation.



V_1 Buffer amplifier (LS5). V_2 Modulated amplifier (T61D). R_1 25 watt lamp or 2,000 ohm 10 watt non inductive resistance. R_2 2,000 ohm variable resistance (to carry 100 ma). R_3 10,000 ohm speech amplifier load stabilising resistance. T_1 Ferranti 1 : 1 output transformer. T_2 Separate filament transformer or winding for V_2. C_1 4 mfd. 250 volt wkg.

These notes are meant, not as a theoretical dry-as-dust treatise, but as an introduction to a new and more effective system, with practical operating data. However, it is essential that the operator should have a little knowledge of what makes the wheels go round, and why normal grid control methods give such poor results. Let us therefore briefly run over the salient principles.

In the radiated wave from a fully-modulated transmitter two-thirds of the power is in the carrier, while the remaining third consists of sidebands carrying the modulation. With plate modulation, the sideband energy is obtained from the increase in plate input to the modulated radio-frequency amplifier due to the A.C. output from the modulators valve(s). For full modulation this must be sufficient to cause the power output of the modulatee to increase 50 per cent.

With grid control no modulator (from which the additional power may be obtained) is used. However, it is possible to increase the efficiency of an R.F. amplifier by increasing its bias, and providing the input remains constant, increase its output accordingly.

In spite of a total disregard by many writers, it is this principle of variable efficiency upon which grid bias modulation is based. The R.F. amplifier being modulated (the modulatee) is biased to a certain point on its curve, and under modulation its bias is varied by the swing of the audio-frequency voltage output from the speech amplifier, the output of which is coupled in series with the bias supply.

Those who have attempted grid modulation will have found that when the modulator is adjusted for high efficiency and full modulation, terrific distortion results. This is because the time interval during which plate current flows is not constant. Under modulation, as the grid is swung more positive and more negative, the instantaneous plate current flows for a longer or shorter interval of time. The only condition under which the time of plate current flow is constant is when the valve is biased to cut-off. The percentage of distortion increases in proportion to the ratio of operating fixed bias to cut-off bias.

The lowest possible position of operating bias must equal cut-off bias plus the value of one-half of the peak audio voltage output from the speech amplifier. Under these conditions the unmodulated efficiency of the modulatee is only some 20 per cent. Such efficiency is useless for amateur purposes, so that many of those who have attempted normal grid modulation have discarded it in disgust.

A New Idea

Recently, however, an idea was hit upon which allowed the high efficiency we require, with good quality output under full modulation. This consists of using fixed cut-off bias (as previously mentioned, necessary for even time flow of plate current), with the addition of a biasing resistance connected, as in L.F. amplifier practice, between filament and earth. It is apparent that the bias voltage developed across this resistance is proportional to the plate current and hence also to the grid voltage. As a result the time of flow of plate impulses will be constant—the condition for the prevention of amplitude distortion, and due to the high value of bias, the efficiency is high—87 per cent. under modulation, hence $43\frac{1}{2}$ per cent. for unmodulated carrier (theoretical calculations which by good design should be closely approached in practice).

Practical Data

Let us now take a specific case. (See the diagram.) V_2, the modulatee, is a T61D running at 100 watts input. V_1, the buffer amplifier, is an LS5. Capacity coupling is shown, this still being most popular. Where inductive coupling is used, R_1 should preferably be connected to the grid circuit of the modulatee. The H.T. supply is 1,100 volts at 100 mA.

With R_2 shorted and drive off, V_2 should be biased to cut-off. Batteries should be employed for bias, as V_2 runs into grid current under modulation, and the regulation of mains bias supply is not good enough. By the same token the cut-off bias value should be obtained from valve curves, as the usual H.T. pack will lead to error unless a heavy bleeder is used.

With aerial coupled, apply drive until the valve is dissipating normal power. The load stabilising resistance R_1 should be tapped across a portion of L_1 until, on removing it, a 50 per cent. drop in input to the buffer is shown.

Now calculate the value of R_2 necessary to treble the bias to V_2 (1,000 times plate voltage divided by anode current in mA), and adjust to this value (in our case 1,240 ohms). Drive should now be increased until normal dissipation by the modulatee is obtained. Aerial coup-

(Continued at foot of page 546.)

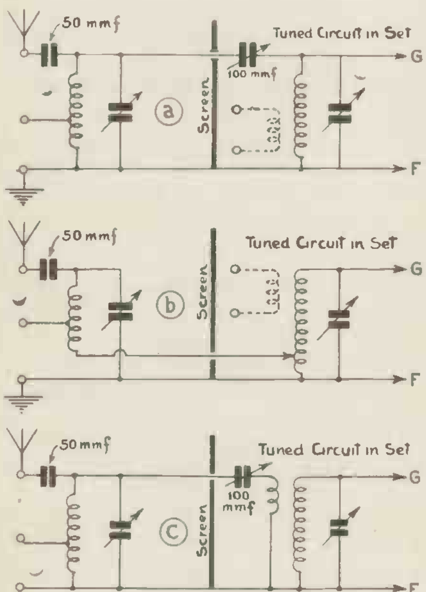
The Short-wave Radio World

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

Increasing Selectivity in Short-wave Receivers

THERE is a definite need for increased selectivity in the straight type of short-wave receiver. As a means of increasing the selectivity of regenerative sets, the German magazine "Radiowelt" recently published several circuits for adding a tuned circuit to existing receivers. We have chosen three of the most useful.

The first (A) consists of the addition of a coil and condenser identical with the tuning coil and condenser in the receiver. The new tuned circuit is shielded from the set, coupling being obtained through a small preset condenser.



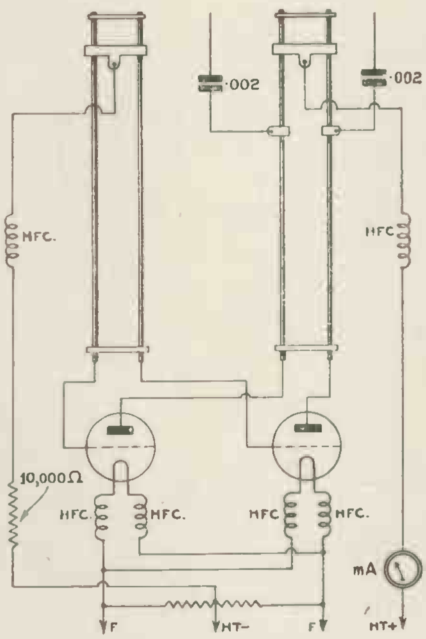
Simple tuned circuits for increasing the selectivity of short-wave receivers.

The second circuit (B) also uses an additional coil and condenser, but in this case the secondary or grid coil is tapped to provide the required degree of selectivity.

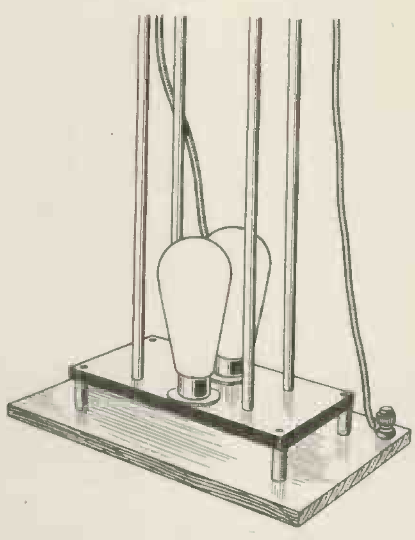
A very effective method is indicated in C which uses the entire tuning coil in the receiver, including the primary, coupling being obtained through a .0001 variable condenser. The step-up ratio of the aerial coil through the grid coil and the use of a variable coupling condenser provides the required adjustment of selectivity. These circuits are also adaptable for use in super-het receivers, where the input circuit is inclined to be unselective.

Five-metre Linear Transmitter

AS the mechanical dimensions of tuning coils for high-frequency work become so small it is an advantage to dispense with coils altogether and to depend on the distributed capacity and inductance of metal conductors. Such oscillators of the Lecher type are commonly called long-line or linear. They are very stable and, if properly adjusted and modulated, can be received on a super-het receiver.



Long-line transmitters give frequency stability.



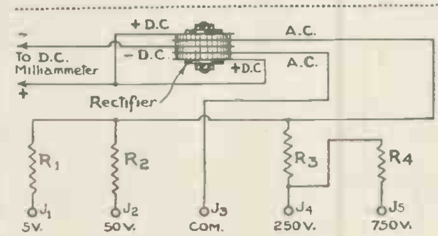
This is the way a long-line transmitter is constructed.

The illustration is almost self-explanatory and it shows how the transmitter is tuned. No variable condensers or coils are required, greatly simplifying construction when high power is used. It is essential that the H.F. chokes be carefully wound and be non-resonant for that band. A push-pull linear transmitter uses four rods and six H.F. chokes. The value of grid leak is rather important, 10,000 ohms being an average value. Any stiff conductor will work satisfactorily although half-inch copper rods are more satisfactory. These rods should have a screwed end and be clamped both top and bottom to prevent movemest.

An A.C. to D.C Meter Converter Unit

EVERY amateur is almost bound to have at least one D.C. milliammeter not in use, but very few amateurs have A.C. milliammeters. A solution for this difficulty is an A.C./D.C. converter unit. From the theoretical circuit it will be seen that this unit consists of a copper-oxide rectifier. This rectifier is made out of a series of copper discs having on their surfaces a coating of copper oxide. The electrical resistance of these discs depends chiefly on the polarity of the voltage applied; it is considerably higher for one direction than for the other.

When this rectifier is connected to the meter in a conventional bridge circuit, full-wave rectification takes place, so that when an A.C. voltage is applied to the input of the bridge a pulsating direct current will flow through the meter to indicate the average D.C. value. A calibrated A.C. voltmeter can be made very simply this way by inserting non-inductive multipliers of the correct value in the A.C. input line to the bridge.

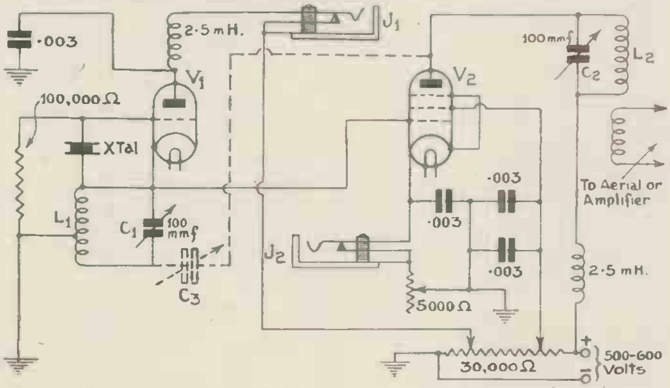


Every amateur should make up this AC-DC meter. Westinghouse will supply the rectifier.

The unit can be mounted in a small case with plugs and sockets for varying voltages so that the complete A.C./D.C. tester can be made up quite simply.

A Junior Transmitter

"RADIO," a magazine published in Los Angeles, has designed a very simple two-valve crystal-controlled two-valve transmitter for the beginner. A type-56 triode acts as the crystal oscillator. Any low impedance British valve, such as the Mullard 104V, will be suitable.



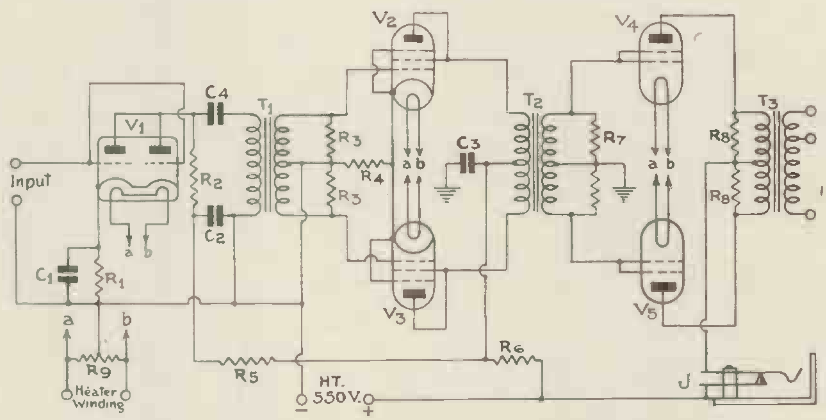
A simple but efficient rig for the beginner. Suitable for all amateur wave-bands.

The crystal is connected between grid and cathode, while the anode tank circuit, consisting of L1 and L2 is between cathode and ground, the anode being fed directly through a small H.F. choke. The oscillator is directly coupled to the amplifier doubler, which is a type-59 pentode. There is no English equivalent, but this valve can be obtained from Claude Lyons.

The grid cathode input circuit of the type-59 is across the oscillatory circuit L1-C1, the common return path being the chassis. V2 is driven by the oscillatory power developed in L1-C1 and works either as a straight amplifier on the crystal amplifier or as a multiplier amplifier on harmonics. The coils are of the plug-in type wound on standard receiving type coil formers and for 40 metres have the following characteristics. L1 15 turns 18-gauge d.c.c., 1/16-in. space with a tap five turns up. L2 is 15 turns of the same wire, 1/16-in. space with a link coil four turns of 22 d.c.c. close-wound ¼ in. away from the cold end of the coil.

Low-cost 35-watt Modulator

WE notice in the American publication "R 9" details of a modulator with an output of 35 watts. In the words of the designer it will push out enough audio to 100 per cent. peak modulate an 80-watt carrier.



A simple way of obtaining a high audio output. Only five valves are used.

Five valves are used in three stages, the microphone is fed into a type-53 via a head amplifier into two 2A5's in push-pull followed by two 46's in class-B. No provision has been made for adapting the input circuit, but if a crystal microphone is used it must be connected directly into the input circuit across a 10-megohm resistance. With all other types of microphone a resistance of 500,000 ohms will be required to provide a load for the coupling transformer.

The gain of the amplifier is such that a two-button microphone of average damping will fully load the 46's when speaking one foot away from the microphone at average speech level. According to tests, the frequency response is well above average and the curve shows only a slight attenuation at 50 and 10,000 cycles.

The H.T. supply need not be well filtered. One choke and two condensers will provide ample filtering for any hum in the plate circuit of the push-pull valves will be cancelled out.

Television in Canada

THE Peck Television Company, of Montreal, Canada, have just completed field-strength measurements with a view to the inauguration of a regular television service on about 6 metres. Transmission will be from station VE9AK, and a scanning frequency of 180 lines with 24 pictures per second will be employed. The Peck system was fully described in the February issue; it is entirely mechanical, the scanning system consisting of a lensed disc both for transmitter and receiver. Bright pictures approximately 14 inches square, it is claimed, are obtained with this system.

Light modulation at the receiver is by means of a special type of Kerr cell which permits the use of a low-power incandescent lamp of the ordinary type. Vision, as stated before, will be transmitted on about 6 metres, but the sound receiver which is incorporated in the receiver is an all-wave type. The matter so far transmitted has been entirely from films, but it is intended to build scanners suitable for studio and outdoor work.

Our Policy
"The Development of Television."

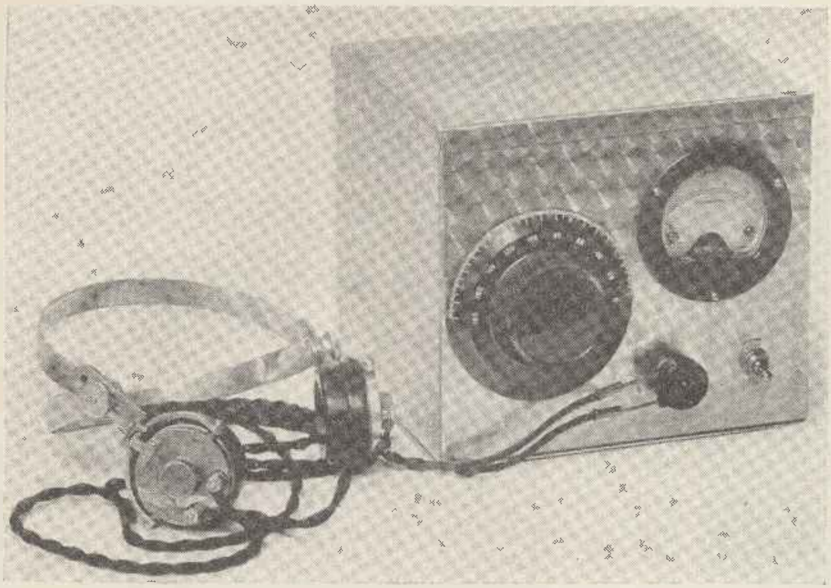
"More Efficient Grid Modulation"

(*Continued from page* 544).

ling should be as loose as possible commensurate with good output.

The speech amplifier (which has previously been tested on a speaker) should now be coupled to T_1. No details of this amplifier are given, as these will be dictated by the microphone used. An output of 1½ watts will be sufficient for up to 100 watts input, and pro rata for higher powers.

On speaking into the microphone, R_2 should be varied slightly until the modulatee's plate meter barely flickers. Any greater variation indicates insufficient drive or too tight aerial coupling. The aerial ammeter should rise some 25 per cent. on a prolonged whistle into the microphone.



The switch on the right-hand side brings the phones in or out of circuit as required.

Station Monitor and Field-strength Meter

By

Kenneth Jowers

IN the March issue was published the bare theoretical circuit of a simple radiation meter. I have used this idea but have increased its usefulness by using it as a phone monitor for checking my transmissions. Surprisingly enough very few people seem to have made use of the undoubted advantages of a cold detector. In several stations I have seen monitors using diode detectors or even single-valve receivers, but while that idea is quite satisfactory, it is rather objectionable having to keep an eye on high-tension and low-tension batteries, particularly if a lot of equipment is in general use.

Originally I made use of a crystal monitor which worked quite well on low power but packed up completely when the input exceeded a certain voltage. At one time I spent several days trying to cure a little distortion in my amplifier which actually did not exist. It was simply the crystal being overloaded. With this present arrangement, I know without a shadow of a doubt whether or not my radiation varies, and if my quality is up to standard. It does make me entirely independent of outside reports.

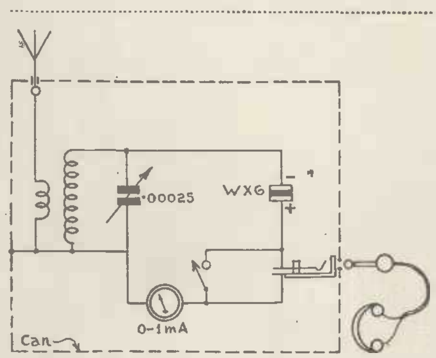
It is difficult to obtain reports on quality for different operators have different ideas as to how a station should sound. As it is now I adapt my amplifier and depth of modulation to a point where I feel the quality is of a high order. As every transmission is regularly monitored, it is almost impossible to put out a bad transmission for any length of time.

Field-strength Measurement

Reverting to field strength measurement, by connecting the meter to a very short aerial of about 6 inches total length and terminating at the free end in a four- or five-turn coil, the actual effective radiation can be measured with a fairly high degree of accuracy. Of course, with this meter the reading is only comparative, but from day to day I can watch the reading and make sure that the transmitter is functioning correctly.

Visitors to G5ZJ have expressed interest in the combination station monitor and radiation meter which is in general use there. In view of this interest we are publishing here the constructional details.

I have found that this meter saves a very considerable amount of worry for very often I have been given bad signal-strength reports which have turned out to be due to poor receivers or local conditions. Another use for this instrument is for the checking of hum. I have noticed that a standard broadcast receiver is inclined to accentuate the hum level and to introduce a certain amount of modulation hum. With this monitor, a very good idea can be gained as to the quietness of the carrier without any difficulty at all.



This is the circuit of the unit. The meter must be in the earthy side of the tuned circuit.

The meter is very simple and really does not require much explanation. It consists of a tuned coil in series with one side of which is a cold detector, a pair of headphones, and an 0-1 milliamp. meter or a galvanometer terminating at the earthy side of the coil. With the switch across the headphones open-circuited, the unit acts as a simple receiving circuit. A fairly high reading will be noticed on the meter, but this should be ignored as it is higher than normal owing to pick-up on the headphone lead.

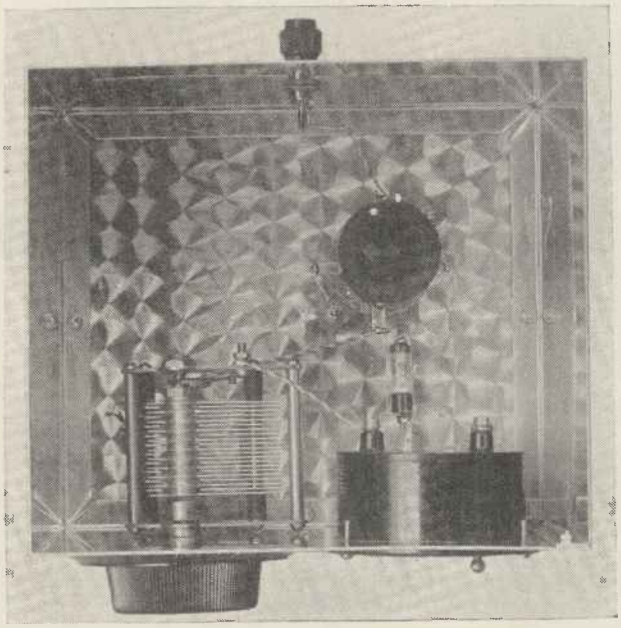
For some reason or other although the phone leads are on the earthy side of the rectifier they cause the meter reading to increase by 50 per cent.

Checking Radiation

When the meter is to be used for checking radiation, the headphones are taken out of circuit, the switch closed, and the meter fixed on to a fence or post somewhere in the garden underneath the aerial where it can be seen from the transmitter. In this way the transmitter can be tuned without taking any notice of the current readings in the feeders. Some surprising results will be obtained, for not everybody remembers that maximum radiation is not obtained with maximum feeder current.

After having checked the effective radiation I leave the unit screwed to the wall above my receiver, for as it happens I cannot see the radiation meter on my transmitter, which is some distance away from the receiver. There is a time lag of several seconds before radiation commences, so I simply watch the reading on my radiation meter and start operations when it reads a given figure. Consequently the minimum time is lost in changing over.

On 160 and 80 metres a standard Eddystone plug-in coil gives a full-scale deflection on a 10-watt transmitter with the 6 in. aerial suggested. On the higher frequencies, when the efficiency of the Westector drops off rather rapidly, either a larger aerial has to be used, or the number of turns on the coupling coil increased. Actually in my case I use 15 feet of wire along the roof of the shack for both 40 and 20 metres. This gives a half-scale deflection.



At the back of the chassis is the aerial terminal. Do not forget to bush this from the metal.

Curiously enough, six inches of wire as an aerial is quite useless unless it terminates in a small coil. It is impossible to leave the headphones in circuit continuously owing to the fact that the reading on the meter varies according to the position of the headphone leads. This does not have any effect when monitoring, but if the unit is to be calibrated, then the phones must be taken out of circuit and the jack short-circuited.

The entire unit is self-contained, no batteries of any kind are wanted, and therefore the initial expense is final.

Components for Station Monitor

CABINET.
1—Aluminium 8×7×7 in. (Paroussi).
CONDENSER, VARIABLE.
1—Popular Log double-spaced .00025 mfd. (J.B.).
COILS.
1—set of 932 for wavebands required (Eddystone).
DIALS.
1—Plain 4-in. (J.B.).
HOLDER, VALVE.
1—Mycalex short-wave type (Wearite).
METER.
1—0-1 mA flush mounting type (Ferranti).
HEADPHONES.
1—Pair Brown A (National Radio Services).
PLUGS AND TERMINALS.
1—type B marked " Aerial " (Belling & Lee).
RECTIFIER.
1—metal type WX6 (Westinghouse).
SUNDRIES.
Wire and sleeving (Goltone).
1—P15 plug (Bulgin).
1—closed circuit jack, type J3 (Bulgin).
1—packet insulating washers (Bulgin).
Small quantity 6BA nuts and bolts.
SWITCH.
1—type S80T (Bulgin).

Untuned R.F. and the Doublet Aerial

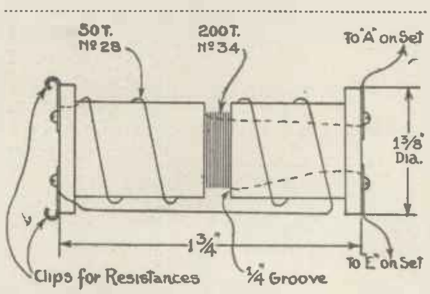
By B.R.S. 1636.

Many short-wave listeners use a receiver with an un-tuned R.F. stage. Some are in difficulty when it comes to using a doublet aerial. Here are some details supplied by the operator of a well-known receiving station which provides a simple remedy for the difficulty.

TO obtain maximum results from a doublet aerial, the feeders and the grid of the first valve must be carefully coupled. If the down feeders link into a conventional grid coil then no problem arises, but with an un-tuned H.F. stage having either a choke or resistance anchoring the grid to earth it is of little use connecting the feeders across the aerial and earth terminals in the usual way.

The device about to described removes that difficulty and at the same time obviates the use of either choke or resistance. The idea consists of a wooden spool about 1⅜ ins. by 1¾ ins. with a ¼-in. grove in the centre. A piece of wooden doweling is an excellent substitute for the reel.

Wind 200 turns of 36-gauge enamel-covered wire or something similar into the grove in hank formation. This coil is then connected between grid and earth of the first valve. Cover the wire with a single layer of insulation tape and make quite sure that the outside is perfectly flat. Over the spool wind 50 turns of 28-gauge wire spaced to fill one inch. The two ends of this second coil are then taken to the down feeders. In the original unit two Fahnstock clips were screwed into the spool, the coil terminating at these clips.



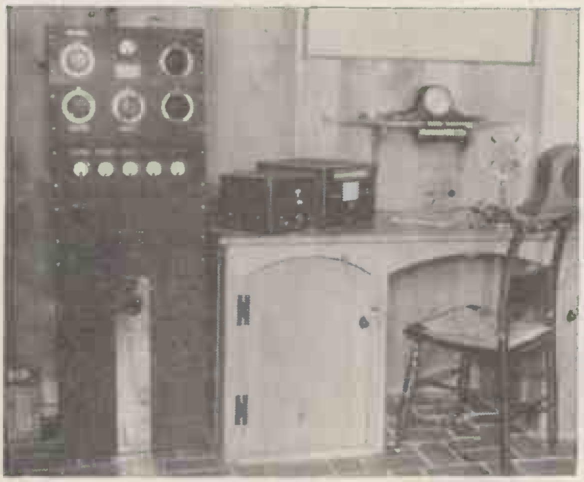
This wooden spool is easy to obtain but remember a length of ebonite ribbed tube can be used instead.

An increase in efficiency will be noticed if the down feeders are connected to the coupling coil via a series resistance in each leg of the feeder. These resistances should be non-inductive and have a value of about 50 ohms. Alternatively as a makeshift, flashlight battery carbons fitted in a grid leak holder can replace the 50-ohm resistances.

There is no question but that a doublet aerial will give vastly improved results below 100 metres. Those listeners who are prevented from using this type of aerial owing to difficulty in matching will now be able to adapt their receivers by constructing this inexpensive unit.

The same idea is applicable for ultra-short wave reception. It is, of course, necessary to alter the windings otherwise the details remain the same. Instead of 200 turns in the centre 80 turns will be ample, but of the same gauge of wire.

Two Amateur Stations



W1AJZ operates on 20 metres from 18·00 and is a very easy signal to pick up.

W1AJZ Cape Cod

A VERY big percentage of our readers will have heard W1AJZ calling from Cape Cod. This station, operated by Rienzi B. Parker and his YL Sally, is a very prominent 20-metre phone station which has contacted with amateur radio stations all over the world. During the week previous to when this report was received, W1AJZ contacted with Sao Paulo, Brazil, Honolulu, New Zealand, Great Britain, all using phone.

Actually, W1AJZ is located at Harwichport, 60 miles south-east of Boston, and half way up on Cape Cod, Mass. The house, built five years ago, is modelled in general fashion after the seafarers' homes built along the Cape during the early part of the nineteenth century. It is in a grove of pine trees and about a thousand feet above the sea.

Of course, the trees made it necessary to have some means of elevating the aerial above the highest of them, so for this purpose two 60-feet masts are used and spaced 150 feet apart. It is interesting to note that these masts are made of steel pipe, welded into one piece and, because of the severe coastal storms, sunk ten feet in cement.

We were very fortunate in obtaining such an excellent photograph of the station. The radio frequency part of the transmitter, a Collins 30FXB, consists of a C.O. using two 47's in parallel, a buffer with two 46's in parallel, and a final P.A. using a 203A operating at 200 watts input. A matched impedance aerial system is used to link the P.A. through a single-wire transmission line adjusted carefully to the proper point of termination at the aerial. The aerial itself is at 14 megacycles, 2 wavelengths long and .9 wavelength above ground.

An Astatic crystal microphone is connected directly to the grid of the first valve in the speech amplifier, a type 57. Then follows two stages of low-frequency amplification, using 56's with a pair of 2A3's operating in push-pull and working as class-A driver for modulators operating class-B. It is claimed that the audio-frequency range of the transmitter is 70-10,000 cycles per second within plus or minus 1.5 db.

For reception, a National FBX super-het fitted with two stages of R.F. is used for all wavebands, but on 14 mc. a doublet type of aerial is preferred.

By reference to the photograph, a small switch can be seen in the centre of the table. This is connected to both receiver and transmitter in such a way that by merely pulling the switch backwards and forwards automatic control of transmitter and receiver is effected.

The present station call has been operative since 1920, while R. B. Parker has been active for over 23 years. Sally Parker has been second operator since the station has used phone.

Short-wave listeners will appreciate the fact that every letter received by W1AJZ is fully answered and the operator wishes me to thank all English listeners who have reported his signals for the help they have given.

G5RL St. Ives

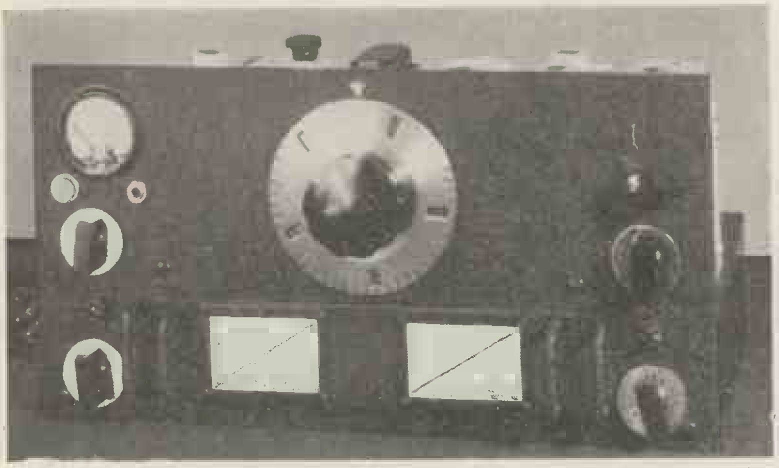
This is one of the Huntingdonshire stations with a QRA at St. Ives. The power used is 10 watts on all bands.

THE St. Ives station, G5RL, is making itself heard on a very low power. As a general rule the input is less than 10 watts on 20, 40, 80 and 160 metres. The station is licensed for 10- and 5-metre operation, but the transmitter for these bands is in course of construction. From the illustration can be seen the set-up which is purely experimental and arranged so that alterations to circuit can be made with the minimum amount of trouble.

In the bottom rack are all the bias batteries and a 350-volt power pack. All the separate filament transformers plus the 500-volt power pack are housed on the second shelf, while a speech amplifier and modulator take up the whole of the third shelf. The speech amplifier consists of two R.C. coupled stages feeding into a modulator with choke control modulation of the P.A. Above the modulator is the actual transmitter consisting of the conventional crystal oscillator, frequency doubler, or neutralised P.A., and the output power amplifier.

It is interesting to note that the receiver in use is an Eddystone Ham Band Two which has proved to be very satisfactory. This is the only piece of apparatus run from battery supply. The aerial in use is a half-wave Windom for both 40 and 20 metres. Transmission reports are always welcomed and will be acknowledged except when stamps are omitted. It is always better to send cards via the R.S.G.B.

Commercial Receivers for the Short-waves: No. 6



The meter on the left is calibrated directly in the R. S. T. code, so making reporting simple. This set will tune to medium waves if required.

The H.R.O. Crystal-Gate Receiver

WE do not make a general practice of reviewing foreign receivers owing to the difficulty of obtaining supplies, but in view of the fact that the new HRO receiver, manufactured by the National Company, in Malden, Mass., can be obtained from the Quartz Crystal Co., of Malden, Surrey, we are giving details of this remarkable receiver.

To say that this receiver is the best obtainable for amateur use is rather a sweeping statement, but we can say it is as good as the best European receiver of a similar nature.

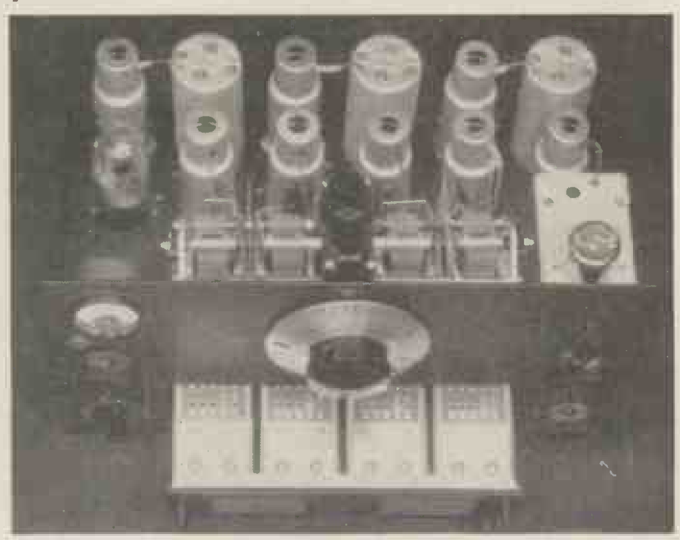
The HRO communication receiver consists of nine valves, two stages of R.F., first detector, separate oscillator, crystal gate I.F. followed by a straight I.F., combined diode detector, A.V.C. and first L.F., output valve and beat note oscillator.

Four tuned circuits are linked and accurately balanced to give maximum level sensitivity on the 1.7-4, 3.5-7.3, 7-14.4, and 14-30 mc. bands. It has been so arranged that the sensitivity remains constant over each waveband. There are several controls, including main tuner, variable selectivity control for the single-signal crystal filter, phasing control and crystal filter switch, an H.T. switch so that the receiver can be put out of action but the heaters kept going, radio frequency gain control, beat-note oscillator switch and vernier tuning control. Another switch cuts the A.V.C. in and out of circuit as required, while a final switch connects the second detector either to head phones or into the L.F. amplifier. A press-button switch which is not often used brings the signal meter into circuit. Incidentally this signal meter is calibrated so as to correspond with the R.S.T. system of reporting.

This is an excellent arrangement, for it is very difficult to judge the signal strength of a station accurately as it depends so much on the operator's idea of volume. This meter gives you the actual figure required.

A complicated switching arrangement converts the receiver to band spread for amateur band use. Actually two additional condensers are connected into each circuit and arranged so as to lower the maximum effective capacity and limiting the tuning range. When used for reception of C.W. the beat-note oscillator has to be brought into circuit while the A.V.C. can be switched off. When used for phone reception it is not recommended that the crystal filter be left in circuit unless interference or static is particularly heavy. The effect of the crystal on phone reception is to reduce volume, attenuate response above a few hundred cycles, but to increase selectivity to a very high degree.

The entire receiver is completely shielded so that it can be used close to a transmitter without grid choking. It is excellent for duplex working even with high power installations. Coil changing means only one operation with the four coils, while a tuning curve is fitted to the coil carrier. This receiver is one of the most outstanding American designs for amateur use and it can be thoroughly recommended for those who really intend to go in for DX work. It is also suitable as it stands for tropical work so our Colonial readers should bear this point in mind.



All four coils are changed at one operation. The crystal filter is in the screened container on the right of the chassis.

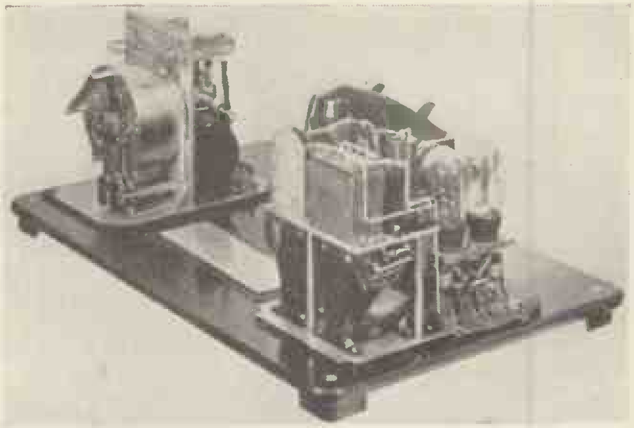
European readers can obtain supplies from The Quartz Crystal Co., Malden, Surrey, the price being £47 15s. 6d. complete, less valves.

Another 5-metre Field Day.

The Golders Green and Hendon Radio Society are arranging another 5-metre field day to take place on September 15 at 10 a.m. This should be particularly interesting in view of the fact that on the last field day the 5-metre band sounded more like the 1.7 on a Sunday morning. Full details can be obtained from the Secretary, 8 Denehurst Gardens, Hendon, N.W.4.

Post Office Activities on Five Metres

It is not generally realised just how far ahead the Post Office are when it comes to regular five-metre working. The average amateur should try and imitate some of their feats for the apparatus is simple while the power used rarely exceeds 8 watts.



A Venner time switch is used to switch the transmitter on and off at pre-arranged times.

TAKEN as a body, amateurs are not successful on five metres. Many stations do work two-way up to 30 or even 40 miles, but as a general rule five to ten miles is the average. Even those who in desperation put up the power to 50 or 100 watts do not appear to be very much more successful than low-power stations.

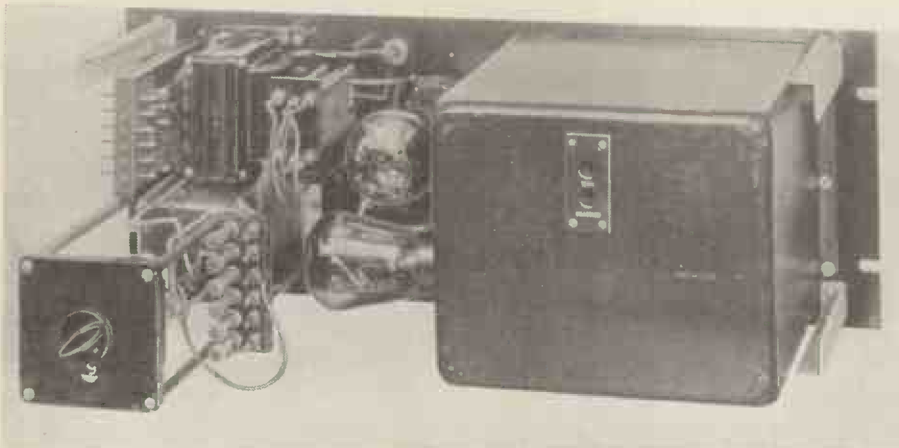
We have been under the impression for quite a long while that if the amateur were to be a little more optimistic, and not to be of the definite opinion that a five-metre station with low power is not likely to reach more than about 20 miles, we might be able to put up a much better performance. Several years ago we saw a five-metre transmitter and receiver constructed at the Post Office which had been erected at Weston-super-Mare. It was in continuous two-way contact with Cardiff on the other side of the Bristol Channel, and was so effective that the land-line between Weston and Cardiff was redundant. The transmitters were so stable that they could be left running continuously for three hundred hours without frequency shift, a great achievement.

Bare Aerials

In this case the transmitter consisted of a self-excited oscillator using low-slope valves in push-pull and coupled to an aerial with reflectors. Since then, post office engineers have been experimenting on the short waves with very great success. For example, two years ago a station was erected at Port Patrick for communication with Belfast, approximately 36 miles away.

A six-circuit ultra-short wave receiver and so designed that all circuits could be operated in close proximity without mutual interference. This equipment was subjected to some preliminary tests across the Bristol Channel and, owing to a demand for additional circuits to Northern Ireland, was transferred to operate across the North Channel. Since the behaviour of ultra-short waves becomes erratic when the distance between transmitter and receiver considerably exceeds optical ranges, two sites were chosen at such elevations that an optical transmission path was secured. These two sites are respectively near Ballygomartin, about three miles north-west of Belfast, and at Enoch Hill, about one mile west of Port Patrick, the elevations being 800 feet and 250 feet respectively above sea-level, and the distance apart being approximately 36 miles.

The erection of the necessary huts and aerials was effected in November-December, 1934, and the circuits were brought into commercial operation on Christmas Day, since which date they have been in everyday use. All the radio circuits on the Irish side were extended to the Belfast Telephone Exchange, while on the Scottish side three circuits normally extended by land-line to London, two to Glasgow and one to Liverpool, were linked with Port Patrick.



This gives some idea of the compactness of the P.O. equipment used at Portpatrick.

4-6-metre Channels

Twelve radio frequencies are used, six in each direction, with corresponding wavelengths lying between 4 and 6 metres. Individual transmitters, each operating on a different frequency are used for each conversation, and in these speech is amplified before passing to a Class "B" final amplifier arranged to modulate the output from the high-frequency oscillator. This oscillator consists of a pair of valves in push-pull working in a self-excited circuit, *reaction being applied between the grid of one valve and the anode of the other valve through a small condenser.* The anode circuit of the oscillators is tuned by a variable condenser which is specially compensated to correct variations in the transmitted frequency due to temperature changes; and by means of this condenser and by the use of secondary cells for all power supplies the frequencies of the transmitters are maintained sufficiently constant to give the necessary degree of transmission stability. The high frequency power output from each transmitter is of the order of 5 *watts.*

The Receivers

Receivers used are of the super-regenerative type. Individual high-frequency circuits are used for each speech channel, but with a common quench oscillator. The feed from this oscillator to the high-frequency stages is taken through buffer amplifiers to avoid cross modulation. This type of receiver automatically maintains the output at a constant level, and tests have shown that the overall gain can be maintained sufficiently constant to dispense with the need of voice-operated devices.

Directive aerials, suspended from wooden telegraph poles and fitted with reflecting curtains are used in conjunction with both the transmitting and receiving equipments. The transmitting aerials are grouped together, but are separated from the receiving aerials by a distance of some 100 yards to avoid cross-talk between transmitting and receiving circuits. Energy is fed to and from the aerial systems by parallel open wire transmission lines kept at constant spacing by means of pyrex tube insulators. All receivers and transmitters are coupled to the transmission lines by variable mutual inductive coupling.

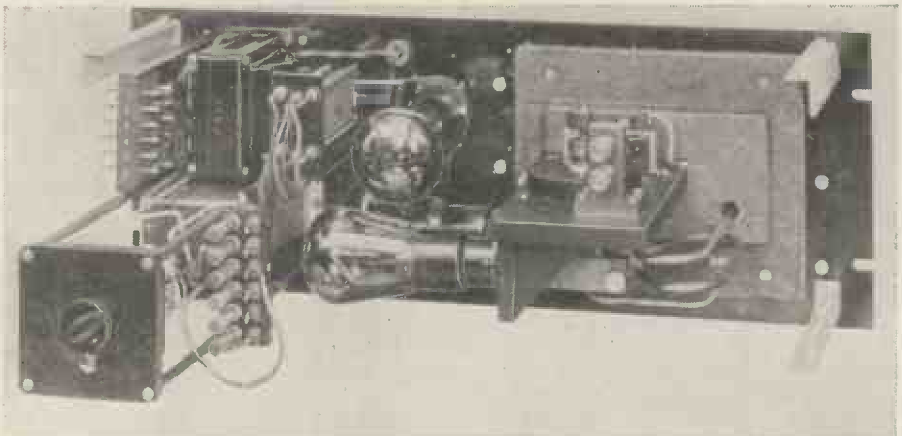
Batteries supplying power to the transmitters and receivers are maintained at constant voltage by means of thyratrons which automatically control the charging equipments. No machines are used, all charging being effected from the public power supply mains by means of cuprous-oxide rectifiers.

Connection between the radio circuits and the land-line circuits is effected by means of hybrid coils at the terminal exchanges, normal 4-wire trunk working thus being adopted; and ringing facilities, etc., are similar to those provided for normal repeated trunk circuits.

The radio equipments were designed for unattended operation, and experience shows that comparatively few troubles are to be anticipated. This apparatus has shown that the use of ultra-short wave radio threatens to become a very serious competitor to the submarine cable as a means of bridging short sea routes, particularly in those cases where tidal action of considerable shipping activity is present, and the maintenance of submarine cables is a relatively expensive process.

110 Mile Range

During the latter part of 1934 a further experimental station was erected at Glastonbury, in Somerset, to bridge the south coast and Channel Islands, a distance of 110 miles. This service has again proved satisfactory and a hundred per cent. efficient link has been set up. This is, perhaps, one of the most important of the post office five-metre transmitters for it is bridging a distance almost twice as great as was at first thought possible. It is not necessary to give any details of how the Post Office have heard ultra-short wave signals from Canada in Ireland, as this is quite well known. However, the experiments conducted by the Post Office should encourage amateurs who are at present restricted to a range of two or three miles. The whole secret lies in the aerial system and making quite sure that the radiating section is high above near-by objects, the use of long feeders will therefore be necessary.



The entire layout can be seen from this illustration. Both the valves mounted horizontally are the oscillators.

An Absorption Wavemeter

A SIGNAL generator for station or receiver monitoring is an almost indispensable accessory. Heterodyne wavemeters are all very well in their way, but the average amateur finds difficulty in keeping the voltages constant to prevent variation in frequency. The absorbtion type of wavemeter, while being fairly satisfactory if measurements need not be particularly accurate, is hardly suitable for general purpose work.

A way of overcoming the difficulties experienced with these two wavemeters and combining the advantages of both has been devised by Eddystone and incorporated in their new Buzzer Wavemeter. This meter has been arranged so that it can be used as an absorption wavemeter or signal generator, calibrations remaining constant in both cases. The meter is built in a die-cast metal box so that there is no possibility of movement and loss of calibration.

Down to 28 m.c.

Three coils are supplied which between them cover all wavelengths from 9.5 to 225 meters. Each meter is individually calibrated with three picked coils and three separate charts are supplied. With the particular model we have been using, the first coil tuned between 9.5 and 30.5 metres, the second from 38 to 89 metres, and the third from 80 to 225 metres, so there is ample overlap in each case. The tuning condenser is fitted with a large direct drive dial, calibrated from zero to 180 degrees.

With coil 1 the 28-mc. band is tunable at 10 degrees, the 14-mc. band at 90 degrees. With coil 2, the 7-mc. band is tunable at 30 degrees and the 3.5-mc. band at approximately 130 degrees. With coil 3 the centre of the 1.7 mc. band comes at 100 degrees. As the amateur bands are spaced so well, the meter becomes particularly useful for amateur use.

Although the buzzer note is almost inaudible, it gives a very strong, clear, high-pitched note when coupled to a receiver. We feel that this meter will prove very useful, particularly to amateur listening stations who require some easy means of frequency measurement. The price of this Eddystone wavemeter is 3 guineas complete with three coils and tuning curves.

This wavemeter is a combination buzzer-absorption. It is selective and will tune down to 9.5 metres.

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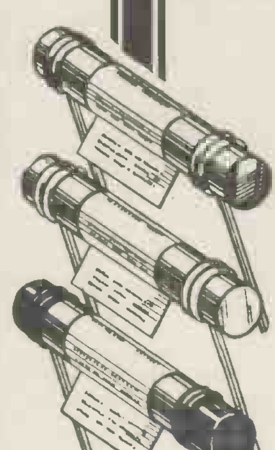

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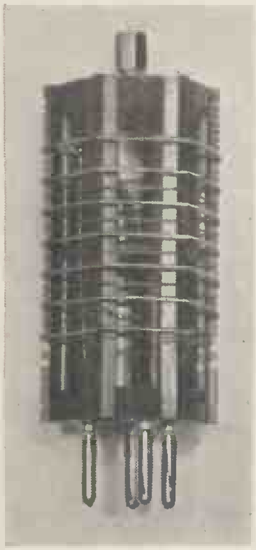
Mention of " Television and Short-wave World " will ensure prompt attention.

1936 Short-wave Components

AFTER carefully examining most of the stands at Radiolympia I came to the conclusion that this winter will prove very interesting to the short-wave amateur as for the first time



This Wright and Weaire short-wave coil does not use any metal other than the four base pins and the top terminals.

a reasonably good show of components are available.

One naturally links Eddystone with short-wave components. They have some really good lines, including a short-wave converter that is really easy to handle and can be added to any existing radio set so that the world's programmes can be received.

Hivac, with their midget valves having steatite bases, have anticipated the short-wave enthusiasts' requirements by introducing a low-capacity valve, which is noiseless and does not suffer from microphony. It is excellent as a detector for short-wave or television purposes and for use in a head amplifier.

Those .002 condensers which are used so much for anode and grid by-pass are being supplied by T.C.C. Although these are only rated for about 250-volt working, we know many amateurs who are running them up to 400 volts.

B.T.S. had a very imposing show of components including trimmers, both baseboard and panel mounting, five-metre coils, a special five-metre aerial, valve holders with silver-plated contacts, etc. All insulation is a new material called Megacite, evolved for B.T.S. The high-light of their range, however, is an eight-valve ultra-short wave receiver, with variable I.F. selectivity operating on 24 Mc. with an L.F. response of up to 2.5 Mc.

An aeroplane dial by Jackson can be adapted for short-wave use by simply using a plain scale, while their baseboard mounting trimming condensers are excellent for balancing in ganged circuits.

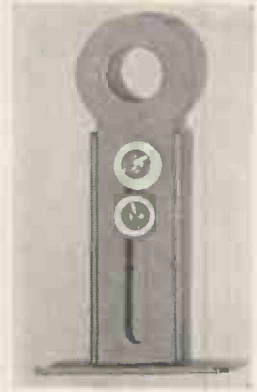
Ediswan have a new valve which until just recently has been very hush-hush. It is designated the ES60 and is, of course, a 60-watt valve. It costs £5 10s. The A.C. output is 12 watts

Rectifiers for high-frequency use and rectifiers for meter conversion are being specially made by Westinghouse. They have a very fine range of units.

Although Sound Sales specialise in transformers and associated equipment, their I.F. transformers with variable selectivity are one of the most advanced and certainly most useful of the season.

Quite a number of high-quality microphones are available, including transverse current type from T.M.C., which at seven guineas are good value.

Colvern strike an original note with their plug-in short-wave coils which



A variable condenser can be mounted at any height from the baseboard with this adjustable Eddystone bracket.

give the appearance of being very efficient. The reports on the coils are very complimentary. We rather like the Graham Farish short-wave coils; here again a Ceramic insulator is used, while the lower wavelength coils are wound with tape wire.

Calls Heard

REPORTS this month indicate that the most lively band has been 7 mc.—40 metres—probably because it is most productive during the evening. The 20-metre band has been good after 11 p.m. On 160 QRM seems to have put an effective stop to DX work.

BRS 1353, S. Bradbury, 15 Hollingwood Mount, Bradford.

(160-*metre phone*).

G6GO, G2AO, G2LZ, G5OP.

(7-*mc. phone*).

G2LZ, G2QM, G2GL, G2XK, G2TU, G2RF, G2DC, G2LD, G2AX, G2IL, G2FC, G2XC, G2XO, G2UY, G2QO, G2ST, G2PX, G2AO, G2XS, G2QY, G2KT, G2MV, G2AV, G2QH, G2XW, G2MN, G5PT, G5XG, G5IX, G5PW, G5MX, G5OV, G5BV, G5BS, G5JW, G5YW, G5ZJ, G5LC, G5MR, G5RK, G5CG, G5YY, G5GF, G5SO, G5IL, G5LI, G5TP, G5GC, G5BD, G5CY, G5PP, G5KG, G5WW, G5MU, G5US, G5MY, G5BM, G5MN, G5JM, G5ML, G5JK, G6ZX, G6GC, G6GO, G6PL, G6ZJ, G6YU, G6QZ, G6LH, G6SU, G6NI, G6PK, G6VD, G6XD, LX1RS, LX1SA, EA1AB, EA1BP, EA1BS, EA1BQ, EA1AZ, EA1BB, EA3EY, EA4BM, EA5AE, ON4CR, ON4DN, ON4RR, ON4MJ, ON4ZQ, ON4OK, ON4US, ON4RA, ON4KS, ON4IF, ON4RM, ON4AJ, ON4AM, OK2HF.

(80-*metre phone*).

G2XF, G2DQ, G2LZ, G2FC, G2WC, G2KT, G2JZ, G5KG, G5UF.

T. H. Wingate, 24 Obelisk Road, Woolston, Southampton.

(20-*metre phone*).

W8LD, W2GOX, W2DFH, W2ZC, W1OZ, W2DBU, W2AIE, W1AJZ, W2AMD, W4AG, W9FJ, OH1NP, CT2DC, OK2OP, ZU8S, LA4R, LA5B, LA5N, ZB1E, VE1FN, VE1EA, CX1BG, CX1CC, CM1JU.

Norman Brandon, Alvestone Avenue, East Barnet, Middlesex.

(80-*metre phone*.)

G5PT, G5SO, G5KJ, G5GS, G6KV, G2IL, EA1AS, EA1BZ, EA3EQ, F8PI, F8QP, F8KW, ON4BDR, HB8H, PAOMQ, W1BBN, W2BOG, W2HFA, W2HYG, W3VXC, W3CWG, W4BRT, W4CS, W8KBJ.

BRS 1,448, E. L. Wills, 15 Monkswell Road, Exeter, Devon.

(20-*metre phone*)

J2GX, ZB1H, YR5AA, ZB1T, LY1AG, ES1C, LY1ZB, PY2AE, VE2BB, YL2CG, YL2AB, VK2EO, VK3EF, PY2AE, YM4DSH.

BRS 1,730, C. M. Clackson, 15 Norval Place, Rosyth, Fife, Scotland.

(20-*metre phone*).

70 stations including the following all over R6:—LY1J, LY1AG, CO2LL, CO2YW, CO2OM, HP1A, OK1KA, OK2KO, LU6DG, VP6YB, G5PP, G6WV, VO1I, VE1CI, VE3HC, VE3JV, VE3OX, CT1DA, SP1ON, EA7AO, TI2FG, W3AIU, W3DX.

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

(160-*metre phone*)

G5GC, G6PQ, G6GO, G5ZJ.

E. W. Trebilcock, St. Peters, S. Australia.

(7 *mc. C.W.*)

G2BM, G2DV, G2IC, G2MI, G2NM, G2OA, G2QT, G5LA, G5WP, G6DL.

H. D. Simonson, Blenheim, New Zealand.

(14 *mc. C.W.*)

G2HX, G5BN, G5QW, G5SY, G6BS, G6IF, G6KU, G6XN.

(*More "Calls Heard" on third page of cover*)

Short-wave News

FOR the first time a chart has been issued which shows fully the workings of the Japanese short-wave transmitters. Up till now these had given rise to many mistakes and confusions. The chart is of an official character since it is issued by the transmitting company itself, the Kokusai-Denwa Ksaiha, Ltd. (International Wireless Telephone Company of Japan, Ltd.), of Tokio.

According to this, the company works the following transmitters:—

For Europe:

JVP	7510 kc/s.	20 kW
JVN	10660 ,,	,,
JVH	14600 ,,	,,
JVA	18910 ,,	,,

For U.S.A.:

JVT	6750 kc/s.	20 kW
JVM	10740 ,,	,,
JVF	15620 ,,	,,

For Java and the Philippines:

JVQ	7470 kc/s.	10 kW
JVE	15660 ,,	,,
JVB	18190 ,,	,,

For Manchukuo:

JVU	5790 kc/s.	10 kW
JVO	10375 ,,	,,
JVI	13560 ,,	,,

For Formosa:

JVV	5730 kc/s.	10 kW
JVL	11660 ,,	,,
JVG	14910 ,,	,,

For Ships:

JZG	6330 kc/s.	10 kW
JZF	8500 ,,	,,
JZE	13020 ,,	,,
JZD	16910 ,,	20 kW

Besides these stations, which are used exclusively for commercial purposes, the said company has also four short-wave installations which are used for transmissions from the Tokio broadcasting station, JOAK, which are of particular interest to short-wave listeners. They are:—

JVT	6750 kc/s.	20 kW
JVP	7510 ,,	,,
JVN	10660 ,,	,,
JVM	10740 ,,	,,

These stations at Nazaki all work with a vertical doublet mast. The schedule for the transmission of the Tokio broadcasting programme is as follows:—

00.00-00.10 G.M.T.—Weather forecast, market quotations.
02.40-02.45 G.M.T.—Market quotations.
03.40-04.10 G.M.T.—News, market quotations.
06.50-07.20 G.M.T.—News, market, quotations.
09.00-12.30 G.M.T.—Children's Hour, News, Lecture, Entertainment, Music, Drama, etc.
12.30-13.000 G.M.T.—Time signal, News, Weather Forecast, etc.
22.20-22.40 G.M.T.—Physical Exercises.

The correct position of the Nazaki-transmitter is: Lon. 138° 51′ 00″ E. Lat. 36° 10′ 44″ N. The address: Kokusai-Denwa Ksaiha, Ltd., Osaka Building, Kojimachiku, Tokio, Japan.

The most powerful short-wave transmitter in the world—as far as broadcasting is concerned—is being erected in France. M. Pellenc, chief of the French radio organisation, recently stated at a conference that the French Ministry of Post had decided to erect two short-wave transmitters of 100 kW each. These will be used exclusively for broadcasting to the colonies. Up till now this has been done from Pontoise. The Russians also wish to bring their short-wave transmitter in Moscow up to 100 kW.

The French Colonial transmitter in Pontoise recently altered its wavelength. Instead of 25.23 m., it is now to be heard on 24.49 m. (12.270 kc/s.) where it greatly interferes with Iceland's new short-wave transmitter TFK, which works on 10 kc/s. only. Reykjavik's short-wave transmitter, which was opened a few days ago by the King of Iceland, was intended to operate on 21.48 m., 33.11 m., and 59.31 m., but from the very first day was received on the frequency mentioned, 22.49 m.

After a break of five years, regular transmissions are again being sent out from the Dutch East Indies.

The Universal Avominor

A METER that will prove suitable both to the television and short-wave experimenter has been designed and introduced by Automatic Coil Winders. This meter, the Universal Avominor, listed at £5, is a high-grade instrument at a very low figure.

It is, of course, only a miniature instrument, but is suitable for both A.C.

The Universal Avominor.

and D.C. voltage tests in addition to D.C. current and resistance measurement.

There are 22 ranges in all with a resistance network brought out to sockets, all appropriately marked. A three-inch calibrated scale is fitted, while the moving-coil meter has a total resistance of 200,000 ohms. In the voltage range there are six ranges varying between 75 millivolts and 500 volts in reasonable steps. In the current range the lowest scale is 0 – 2.5 m/a followed by 0 – 5, 0 – 25, 0 – 100, 0 – 500 m/a. As regards resistance measurement, there are six Avominor reads 0 – 5, 0 – 25, 0 – 100, ranges: 0 – 20,000, 0 – 100,000, 0 – 500,000 ohms, 0 – 2, 0 – 5, and 0 – 10 megohms.

Measurement of A.C. voltage is always a problem, but this little 0 – 250 and 0 – 500 volts. Dimensions are $4\frac{1}{4} \times 3\frac{1}{4} \times 1\frac{1}{4}$ ins. with a weight of 1 lb. 3 ozs.

The Avo-Oscillator, which provides any local signals, modulated or unmodulated, is indispensable when lining up intermediate-frequency amplifiers. It is provided with a dummy aerial and a variable attenuator unit all for £5 10s.

1936 W-B Stentorians

LAST season Whiteley Boneham imagined they had reached the maximum flux density possible with their Stentorian loud-speakers. This year, in addition to using larger magnets throughout, they have been able still further to increase the flux density, which means in practice that readers will be able to obtain greater volume for the same input. In addition to this, quality is improved owing to the better attack.

Five speakers are listed this season ranging from a Duplex model at four guineas, the Senior Stentorian at 42s., the Junior at 32s. 6d., a Baby at 23s. 6d., and a Midget at 17s. 6d. All these units can be obtained in cabinet form if required at a slightly increased price, the Senior, for example, being three guineas.

Users of small battery - operated receivers will find that the Stentorian Baby at 23s. 6d. will meet their requirements satisfactorily. It gives excellent quality with the slight bass boost necessary with small receivers. It has a handling capacity in the region of 3 watts.

Technically-minded users will appreciate the new centring arrangements. The design permits centring to be carried out after the loud-speaker has been completely assembled.

Wearite Testing Instruments

Wright & Weaire of Tottenham have introduced a range of testing instruments for commercial and serious amateur use. A portable shielded R.F. and A.F. signal generator covering the entire broadcast and I.F. range of fundamentals has been priced at £6 15s. od. Frequency range is actually 1,400 Kc. to 100 Kc.

For £6 17s. 6d. the portable meter unit will cover 21 ranges including D.C. and A.C. voltage, D.C. current, resistance, capacity and inductance. Inductance scale is directly calibrated from 5 to 120 henries. For valve testing a special unit has been evolved, which will handle all types of valves including diodes, triodes, pentodes, heptodes and octodes in addition to normal valves. Side contact valves are also accommodated and can be tested for emission, cathode electrode leakage, vacuum, loose electrodes and inter-electrode insulation.

Amateurs will be interested in the frequency meter covering from 3,000 to 20,000 Kc. (100 to 15 metres). Extra coils can be supplied. A small $1\frac{1}{2}$ volt cell is self-contained and energises an interrupter for radiating signals. A bulb is also provided to indicate resonance of the transmitter.

"High Definition Demonstrations"

(*Continued from page* 539.)

better, but the cost of generation and transmission rises very rapidly after the 120-180 mark has been passed, and in order to maintain a reasonable simplicity in the apparatus it was decided to limit the definition. The results are nevertheless surprisingly good.

The equipment has been designed and installed by Mr. J. H. Reyner, B.Sc., A.M.I.E.E., and a qualified lecturer will be in attendance to answer questions and demonstrate the apparatus. We hope to give a more detailed description of the transmitting and receiving apparatus used in our next issue. The lettered photograph above shows the transmitting gear.

More Calls Heard

BRS 1784, M. C. Bourke, Jerse Channel Islands.

(*3-5 mc. phone.*)
HB9B, VE1EI, VE1EA, VE1D W1EOP, W2VO, W1DY, W1Z OZ1CU, HAF1A, W1ADM.

(*1.7 mc. phone.*)
G2DQ, G5KG, G5PB, G2XC, G5 G5MM, G5OC, G6GO, G5NW, G2 G5PW, G6UU, G5HO, and G6PQ.

S. J. Hayter, Winton, Bournemou

(*7 mc. phone.*)
G2AD, G2IL, G2JM, G2ST, G5 G5PT, G5ZJ, G6JC, G6UI, G6 G6LH, G5KJ, G2RK, G5CG, G2A G5XG, ON4ND, PAOOE, F8QX.

(*14 mc. phone.*)
W2HFS, W2HHU, VE1CL, W4D W3MD, W1CCV, W1CJG.

Robert Everard, Standon, Ware, He

(*14 mc. phone.*)
W4AZL, W6ITH, W6CZ, W6BY W6AQK, W6FQY, W6BHO, W6F W6CNE, W7DAA, W7QC, W7A W7AO, W7AIT, W7BCI, K6C VE2EP.

B. McDougall, 2 Newton Str Stornoway, Lewis, Scotland.

(*40-metre phone*).
G6PL, G2HT, G2RF, G6UI, G5Y G2UY, G5CY, G2FC, G6XO, G6 G5CW, G6VI, G6GO, G2LV, G6 SP1LM, G5KG, G6OS, G2BK.

When to Listen for Short-wave Stations during September

By 2BWP, C. J. Greenaway.

B.S.T.	3.5 mc.	7 mc.	14 mc.
0500		W4	
0600		W1, 4, 9	
0700	W1	OA ; VK ; W1, 4, 9 ; ZL	
0800		FM8 ; HC ; NY ; TI ; VK ; W5 ; ZL	
1700			SU ; FM8
1800			FM8 ; SU ; W1 ; Z
1900			FM8 ; SU ; W1, 8 ZS
2000			FM8 ; SU ; W1, 2,
2100		SU ; W1	PY ; VQ4 ; W1, 9
2200		VE1, 2, 3 ; VK ; W1, 2, 8	HC ; K5 ; NY ; VE W1, 2, 3, 8, 9
2300		FM8 ; VE1 ; W1, 2, 3, 4, 8	W1, 2, 3, 9
2400		VE1 ; W1, 4	W1, 2, 9

DISWAN

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

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