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Television and SHORT-WAVE WORLD

APRIL, 1938
No. 122 Vol. xi.
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COMMENT OF THE MONTH

A Promising Outlook

SEVERAL events have transpired during the past month which should do much to quicken the progress of television towards its principal objective of providing a new form of home entertainment. Of major importance was the announcement by the Postmaster-General that it had been decided to allocate 8 per cent. of the net radio licence revenue, or in all a sum of £295,000, for television. This should go far towards providing a more efficient service, which will undoubtedly be an important inducement to the public to buy receivers. It was noteworthy that in the debate that followed this announcement the only serious criticisms were regarding the lack of television facilities in the Provinces.

Secondly, the B.B.C. in their annual report stated that the year's experience is felt to have justified that confidence in the future of television which led to the establishment of the station at Alexandra Palace. The service, the B.B.C. stated, has been vigorously developed in the face of considerable difficulties, and it remains the only public service in the world to reach viewers in their homes. It can be assumed, therefore, that the B.B.C. no longer regard television as the Cinderella of broadcasting and that the service will be developed as rapidly as circumstances will allow.

Thirdly, a television sub-committee has been appointed by the Radio Manufacturers' Association for the purpose of furthering television development and providing means of interesting the public in this new form of entertainment. This committee will act as a liaison instrument between the B.B.C. and television manufacturing interests and being representative of the trade should be capable of some very valuable propaganda work.

Clearly, these developments are of paramount importance and indicate a desire on the part of all the authorities concerned, including the Government, to advance television with all practicable speed; they should result in the clearing away of a good deal of misconception that has existed and giving the public the assurance that a worth-while new form of entertainment has come to stay.

Six reasons why you should build our New Televisor :—
It has been specially designed for home construction ■ Its cost is the minimum ■ It is as simple to construct as an ordinary wireless set ■ It is guaranteed to give excellent pictures ■ Its construction will provide you with valuable knowledge and experience ■ It is quite safe to use.

THE PHASMAJECTOR

A NEW SOURCE OF VIDEO SIGNALS FOR TESTING CATHODE-RAY TUBES AND TELEVISION RECEIVER PERFORMANCE

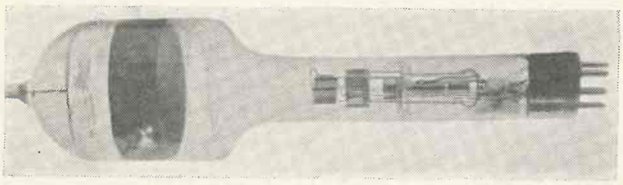
BY means of a new type of tube developed by the DuMont Laboratories, New Jersey, the experimenter, designer and tester are now entirely independent of outside transmitters previously depended upon for video signals.

The Phasmajector (Greek for image emitter) as the tube is called, provides a uniform television test signal with relatively inexpensive associated apparatus. It is a modified form of cathode-ray tube and is the latest achievement of the Allen B. DuMont Laboratories, Inc., of Upper Montclair, N.J.

In place of the usual fluorescent screen there is in the Phasmajector a metallic plate on which is printed the desired picture or test pattern. Also, the tube includes a collector electrode as well as the conventional cathode-ray tube gun and deflecting electrodes. When used with suitable sweep circuits and amplifiers, the picture printed on the metallic plate can be readily scanned and transmitted to a receiver for reproduction on a stardard television cathode-ray tube. It is also possible to use standard oscillograph cathode-ray tubes for viewing.

The new image-transmitting tube or Phasmajector operates on the principle of varying secondary emission from the image plates. In other words, as the cathode-ray beam scans the image on the metallic plate, varying amounts of secondary electrons are released depending upon whether the beam impinges upon metal or the special ink used to print the picture. A larger number of electrons are released when the ray strikes the metal than when it strikes the ink. The varying voltage output is picked up by the collector electrode and fed to the grid of the video uamplifier. This signal, it is stated, is very stable and of much better quality than can be obtained from a photo-electric mosaic pick-up tube because of the absence of capacity effects. The amplitude of the signal may be as high as 10 volts with high-impedance coupling and is able to modulate a television viewing tube directly without any video amplifier. The signal is 0.2 volt across a 10,000-ohm load.

For a simple television demonstration, two standard oscillographs such as are used by radio servicemen, can be used, one equipped with a Phasmajector tube in place of the usual cathode-ray tube, and the other with its usual tube. Certain slight modifications are required, but the oscillographs can still be used for their normal purposes when desired.



The Phasmajector tube: note the image on metallic plate for transmission.

With such a simple, inexpensive arrangement all the principles of a complete television system can be readily demonstrated. Either horizontal or vertical scanning of any desired number of lines and any interlacing arrangement can be used.

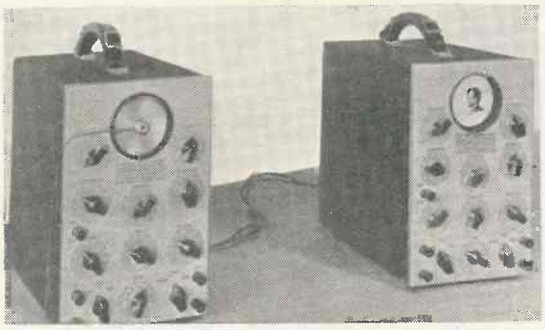
The circuit and principles involved in this simple television demonstration equipment are part of the DuMont simplified high-definition television system, which has been completed and tested in the DuMont Laboratories. Field tests for this system are to be made provided an experimental licence can be obtained, application for which has been made. This radically different method of television uses no synchronising or blanking impulses at either transmitter or receiver, and has no sweep circuits at the receiving end. This makes possible the simplification of the receiver. It is claimed that the receiver need consist of little more than a high-grade short-wave receiver with a cathode-ray tube in place of the usual loudspeaker. Furthermore, the DuMont method, it is said, requires a much narrower frequency band than that now needed for usual television transmission. Four transmitters can be operated where only one can operate at present. If this is proved to be correct it means that television can be transmitted on somewhat higher wavelengths or lower frequencies, thereby greatly extending the service area covered by a given transmitting power.

A photograph of a picture transmitted by the phasmajector.

The Phasmajector, Type 1, has the same operating voltages as the DuMont 34-XH 3 in. cathode-ray tube. It has two additional electrodes, however, the collector electrode and the image plate. The collector is operated several hundred volts positive with respect to the anode, and feeds into the grid of the amplifier tube. The image plate is normally grounded to the anode.

The Phasmajector now available to experimenters and others has on its plate a line drawing of Abraham Lincoln. In the demonstrations staged at the DuMont Laboratories, the drawing was first scanned with a half-dozen lines or less, yet the coarse image reproduced could be at least identified. Increasing the scan to about 100 lines and adjusting the intensity and focusing controls, an excellent image was obtained. The individual luminous lines were observed to disappear as they overlapped and blended together. Interesting distortion could be produced at will, such as by horizontal expansion of the image. The price of the tube is $40.000.

For the Du Mont simplified television system referred to previously it is claimed that by transmitting the wave-forms of the transmitter scanning voltages, it is possible to send pictures interlaced four-to-one, with flickerless reception at 15 frames per second, and as a consequence, the band width is only one-half as great.



Two oscilloscopes being used as transmitter and receiver and providing a very simple arrangement for test purposes.

Reduction in picture frequency introduces a high degree of flicker unless special means are taken to prevent it. The means taken in this case is a high interlace ratio, four-to-one as compared with two-to-one at present. The "field frequency" (the number of times the picture area is fractionally scanned) thus remains the same, 60 per second, in the new system as in the conventional system the only difference being that each interlaced "fractional" frame contains one-half as many lines as formerly. The number of lines, 441 (American standard), and the number of picture elements per line, 4/3 × 441 for 4-to-3 aspect ratio, remain the same. Consequently, a flickerless 441-line image is produced, even though there are only 15 complete frames per second.

A 4-to-1 interlace ratio seems impossible to accomplish when the conventional method of transmitting sync. pulses is used. In the conventional system, separate sweep-voltage generators are employed at transmitter and receiver, and sync. pulses are transmitted to maintain synchronism between them. To produce a properly interlaced picture by this method, the sync. pulses must maintain a time accuracy of less than a microsecond, even when the interlace ratio is only two to one. When an interlace ratio of only four to one is attempted, the degree of accuracy required is so great that the sync. signal method is useless. In the Du Mont system, however, all this is taken care of by eliminating the sync signals altogether. Only one sweep voltage generator (producing horizontal and vertical scanning) is employed, that at the transmitter. The wave-forms of the vertical and horizontal scanning voltages, produced by this generator, are used as modulating signals on an auxiliary carrier. After demodulation and amplification at the receiver the wave-form is then used directly as a sweep voltage for the receiving cathode-ray tube. The receiver is thereby considerably simplified, in principle at least. No amplitude-operated sync.-signal separation circuit is necessary, and no sweep-voltage generators are required.

Columbia's Television Transmitter

THE Columbia Broadcasting System's new television transmitter is now practically ready.

When completed the transmitter is to be shipped to New York for installation on the 73rd and 74th floors of the Chrysler Building. There it will provide television programmes from the nearby Grand Central Station studios now being built by Columbia and it is expected that they will be picked up within a radius of approximately 40 miles over a total area of about 4,800 square miles of a thickly populated area.

Columbia's new transmitter really consists of two complete units almost identical in construction. One of these will be used to transmit high fidelity sound and the other produces for pictures. There is only a slight difference in design of the two despite the fact that the sound transmission will cover a frequency range of up to 10,000 cycles while the wave band needed to reproduce high frequency 441 line interlaced pictures extends to 2,500,000 cycles.

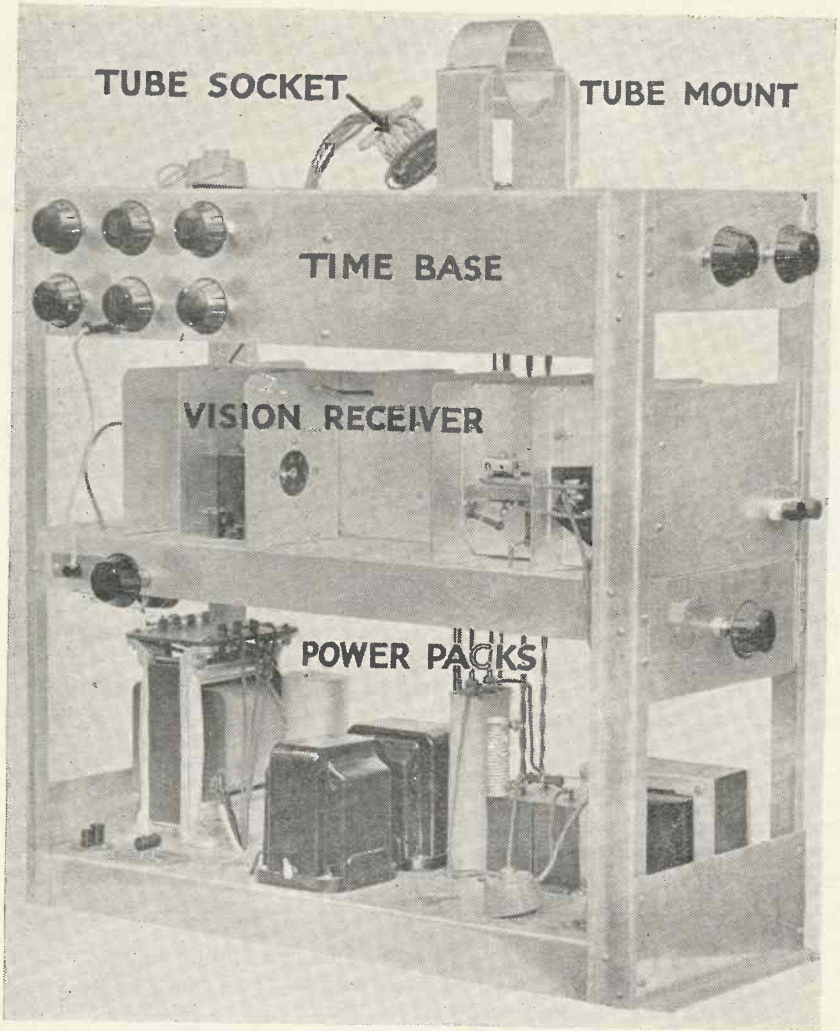
Twenty-four water-cooled valves ranging in length from ten inches to about four feet, have been especially designed for use in the two transmitters. Each of the latter has a 7,500-watt output with 30,000-watt peak modulation. Due to the fact that tremendous heat will be generated a complete air conditioning unit has been built to cool the 120 gallons of water per minute used to reduce the temperature of the valves and other parts of the equipment. In addition, 1,000 gallons of oil are needed to cool the ten transformers used.

The main power units, consisting of the transformers and motor generators, will be housed in fireproof vaults on the 73rd flood of the Chrysler Building, while the transmitter itself is to be housed on the 74th floor. The latter will be connected with a power distribution panel 16 ft. long by 7 ft. high and a transmitter panel 46 ft. long, the right-hand half of which will be devoted to sound, and the left to vision. There is to be a control desk in the centre of the transmitter panel from which operation of the whole set can be checked. The entire assembly will be finished in chrome and satis steel.

Every safety precaution has been taken in designing Columbia's new television station. The steel structure of the Chrysler Building floors is being strengthened to bear the additional weight. The control panel is equipped with lights which indicate failure of operation at any part of the equipment. A second series of controls and lamps is installed at the back of this panel so that in an emergency the transmitter can be controlled from there. Interlocking automatic circuits have been arranged so that power will be cut off and signal lamps lighted the instant a door leading to the high tension wiring is opened.

The 74th floor also contains a room where all input circuits from the adjacent Grand Central Station studios enter and another where power from the public utility company is introduced.

When all of this equipment is ready for installation, it will be necessary to construct special rigging to lift it from the 71st floor, where the elevator service ends, to the floors above.



THE SIMPLEST HOME-BUILT TELEVISOR

Designed by S. West

COMPLETE WORKING INSTRUCTIONS FOR BUILDING A SMALL-SCREEN VISION RECEIVER THAT WILL PROVIDE A HIGH STANDARD OF PICTURE QUALITY AT A MINIMUM COST

PART II.—MORE ABOUT THE VISION UNIT AND CONSTRUCTIONAL DETAILS OF THE TIME BASE

LAST month an outline of the complete simple home-built televisor was given, including all the circuits, list of components and photographs. Sufficient information was given to enable any experienced constructor to complete the work, though obviously in the space available it was not possible to enter into much detail. Part of this detail is furnished in this article and diagrams are given showing the exact wiring of the vision unit and these are followed by detailed instructions on the construction of the time base.

Normally, when a television receiver is in course of construction, the amateur approaches the time base with some temerity for he has had impressed on his mind that here is a piece of apparatus which does not comply with his acquired conception of normal radio. Fortunately, in the case of this receiver the time base is so extremely simple that it is unlikely that difficulties of any nature will be encountered.

The complete time base employs four valves only and the arrangement adopted for these results in considerable simplification.

The layout adopted is a little unusual but it has the advantage of improving the subsequent handling of the unit. It is sufficiently compact to permit the C.R. tube with its associated smoothing and potential network to occupy the same deck, thereby reducing the length and number of the various inter-connecting leads.

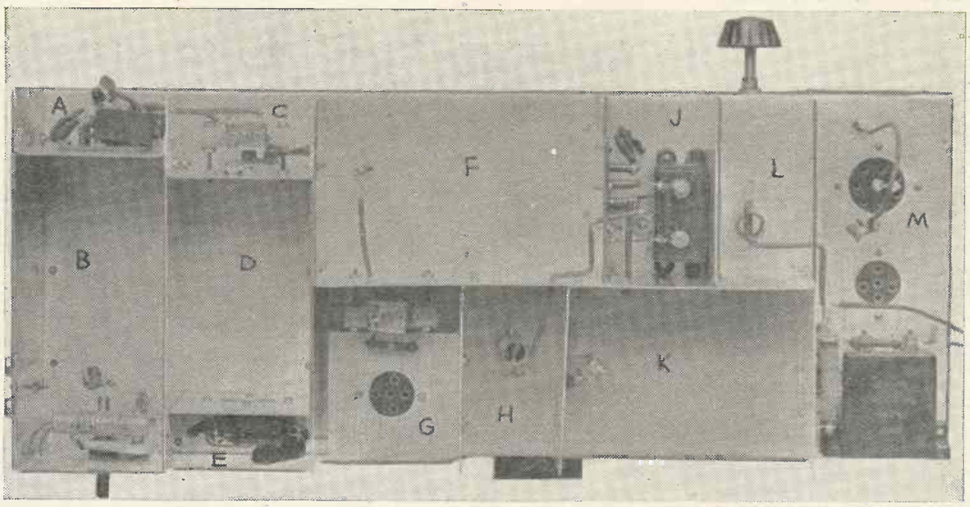
Before considering further the practical construction of the unit, let us first briefly review the circuits for the time bases and C.R. tube network.

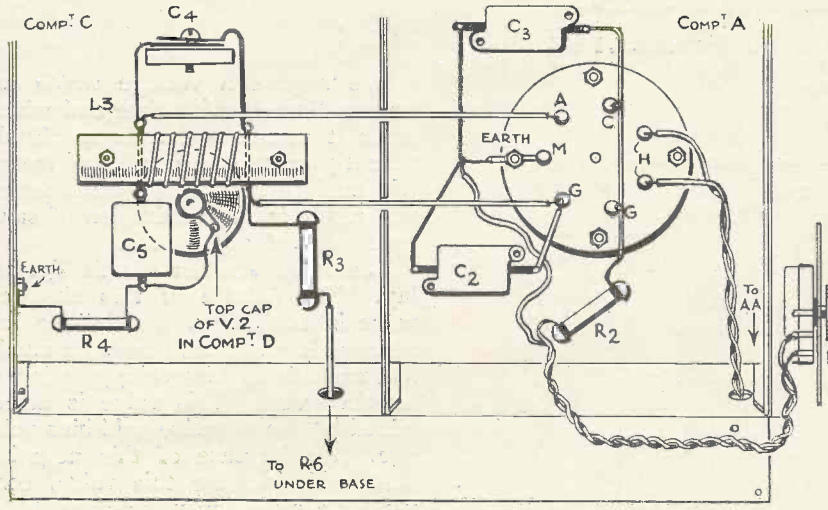
On p. 202 these circuits are shown in schematic form. The two valves shown to the left of this diagram are responsible for developing the line scan. The remaining two valves develop the frame scan. The connections to the C.R. tube socket are shown at the extreme right.

A knowledge of the manner in which a time base works is very desirable for it is not easy to arrive at

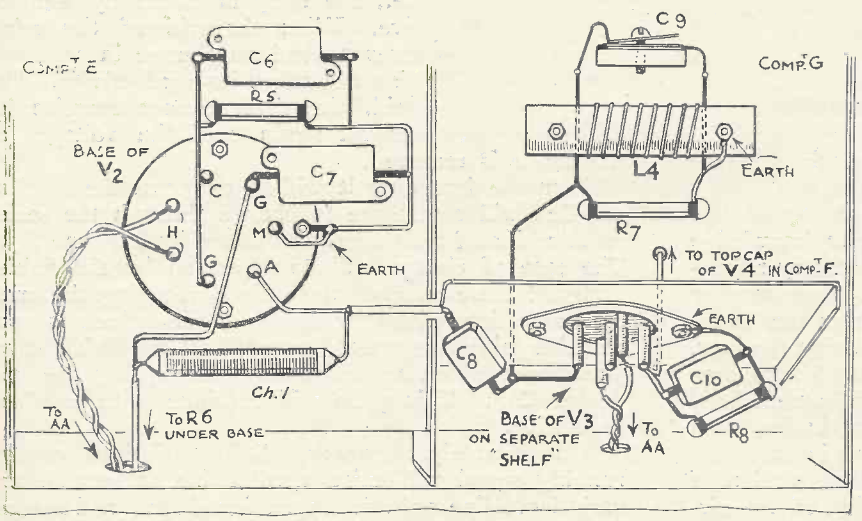
WIRING DETAILS OF VISION UNIT.

The letter references on the photograph correspond to those on the drawings given on this and the following pages.





The drawings above give the wiring details of compartments C and A of the vision unit.



These two drawings show the wiring details of compartments E and G.

THE TIME BASE

List of components with values and makes for the time base.

CONDENSERS

C19 0.001-mfd. (Dubilier type 670).
C20 50-mfds. 12 v. (Dubilier type 402)
C21 0.001-mfd. (Dubilier type 670).
C22 0.001-mfd. (Dubilier type 670).
C23 0.005-mfd. (Dubilier type 670).
C24 20-mfds. 50 v. (Dubilier).
C25 0.1-mfd. (Dubilier type 4603/S).
C26 0.002-mfd. (Dubilier type 670).
C27 50-mfd. 12 v. (Dubilier type 402).
C28 0.5-mfd. (Dubilier type 4608/S).
C29 0.1-mfd. (Dubilier type 4603/S).
C30 0.1-mfd. (Dubilier type 4603/S).
C31 50-mfds. 50 v. (Dubilier type 3004).
C32 2-mfds. 1,000 v. (Dubilier type 950).
C33 Optional see text.

RESISTANCES.

R19 50,000-ohms potentiometer (Reliance).
R20 150,000-ohms ½ watt (Dubilier).
R21 500,000-ohms 1 watt (Dubilier).
R22 500,000-ohms potentiometer (Reliance).
R23 50,000-ohms potentiometer (Reliance).
R24 1,000-ohms ½ watt (Dubilier).
R25 1-megohm ½ watt (Erie).
R26 100,000-ohms 2 watts (Erie).
R27 5,000-ohms ½ watt (Erie).
R28 50,000-ohms potentiometer (Reliance).
R29 20,000-ohms ½ watt (Dubilier).
R30 2-megohms potentiometer (Reliance).
R31 500,000-ohms 1 watt (Erie).
R32 1,000 ohms ½ watt (Erie).
R33 500,000-ohms ½ watt (Erie).
R34 2,000 ohms potentiometer (Reliance).
R35 8,000-ohms ½ watt (Erie).
R36 200,000-ohms 2 watts (Erie).
R37 1-megohm ½ watt (Erie).
R38 1-megohm ½ watt (Erie).
R39 50,000-ohms 1 watt (Erie).
R40 500,00-ohms 1 watt (Erie).
R41 500,000-ohms potentiometer (Reliance).
R42 50,000-ohms potentiometer (Reliance).
R43 Optional see text.

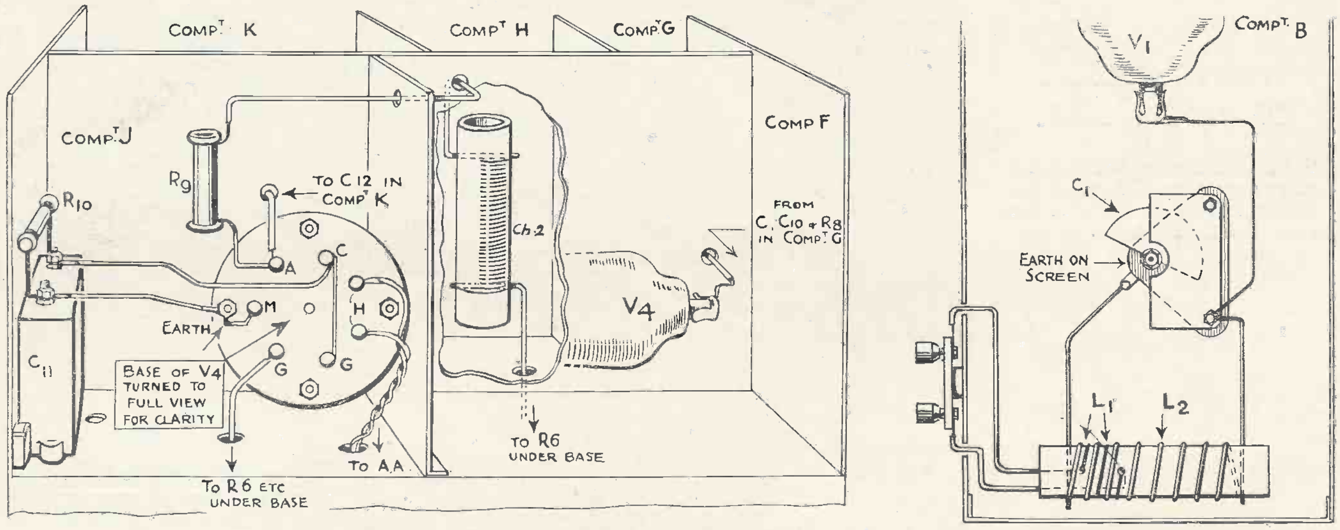
SUNDRIES.

2—High-voltage valve caps (Bulgin).
4—5-pin valve holders (Belling-Lee type 1136/9).
2—10-way connecting blocks (Bryce).
1—4-way connecting block (Bryce).
1—5-way group board (Bulgin type C31).
2—9-in. lengths ¼ in. diameter steel or brass rod.
2—Shaft couplers (Bulgin type 2005).
2—Panel bushes (Bulgin type 1048).
1—3-way terminal strip (Belling-Lee type 1253).
1—Wander plug (Belling-Lee type 1290).
1—Banana plug and socket (Belling-Lee type 1078).

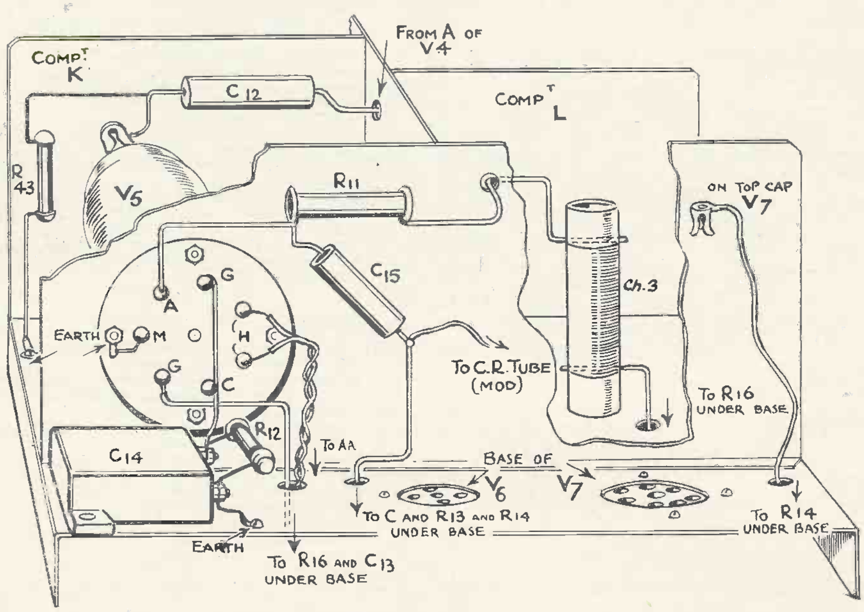
VALVES, TUBES AND CHASSIS.

V8 & V10 Mazda type T31.
V9 and V11 Mazda type AC/P.
Mullard C.R. Tube type A41-4 (white) or A41-G4 (green)
Chassis, nuts and bolts and wire, etc. (Mervyn)

HOW THE TIME BASE FUNCTIONS



Details of compartments J, F and B.



Details of compart M.

the correct settings with haphazard alterations of the various controls.

Most readers will be familiar with the theory of time bases and will already have the requisite knowledge enabling them easily to carry out the necessary adjustments. However, it is believed that a large number of amateurs comparatively new to television and therefore unfamiliar with this section of a television receiver, will undertake its construction on account of its reasonable cost. It is felt they at least will welcome a brief description of the manner in which a time base works. Accordingly the following brief treatment is provided.

It will suit our purpose to consider one section of the time base only for with the exception of the circuit constants the bases are identical. It is convenient to refer to the frame base which is comprised of the valves V10 and V11.

We require a voltage which increases linearly with time and which when it attains a certain amplitude abruptly returns to a zero mean. Obviously a repetition of this action will result in the production of saw-tooth shaped oscillations.

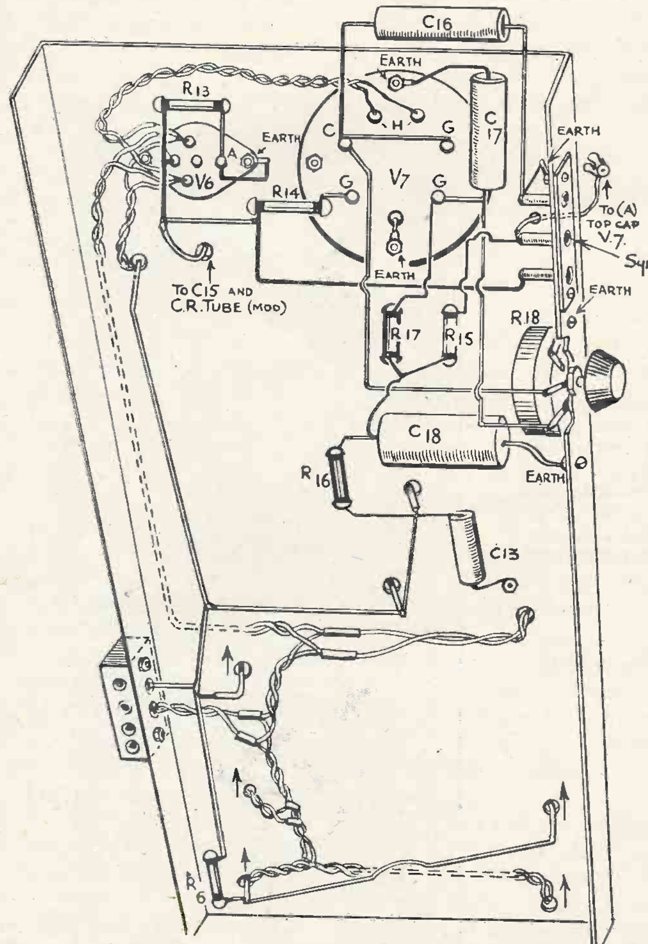
The valve V10 is a Mazda T31 relay. The feature of this class of valve is as follows. An infinite impedance is presented across its anode and cathode to any voltage below a certain value. This value is determined by the negative grid bias voltage. An increase of this negative bias will increase this value, conversely a reduction will reduce it.

For any voltage across the relay exceeding the critical value there is presented a very low impedance path, i.e., the relay is effectively conductive. When the grid of the relay loses control no change in value of bias will affect its conductivity. The grid, therefore, cannot exercise its control again until the voltage at the anode is removed.

From the foregoing it will be apparent the condenser C28 will commence to charge through the series combination of resistances comprised by R30 and R31. The rate of charge will be governed by the values assigned these components. Upon reaching the critical value determined by the grid bias which is controllable with the potentiometer R34, the relay valve V10 becomes conductive rapidly discharging the condenser C28. This cycle will continue with excellent regularity.

Unfortunately, however, slight variations of the running speed will exist, attributable to temperature variations, line voltage fluctuations, etc., and we require to arrange some form of accurate control to ensure the time bases operate in sympathy with the transmitter arrangements. This is simply contrived

THE TIME BASE CIRCUIT



This drawing gives the component assembly and wiring of the underside of the vision unit.

and the point is dealt with later.

It is important to appreciate from the foregoing the following facts. Assuming a fixed value for C28, the rate of oscillations is controlled by the value for the charge resistances R31 and R30. The latter resistance is variable, it follows then the rate of the oscillations may be varied.

The amplitude for the oscillations is controllable with the value of grid bias present at the grid of the relay valve. For a higher negative bias the amplitude is greater.

Now observe an important point. If the amplitude of the oscillation is greater with an increased bias it follows, as the sweep is linear with respect to time, that the frequency of oscillation is reduced, for a longer period is required to attain the new critical amplitude. Naturally the converse is equally true.

In brief the adjustments to the variable resistances R30 and R34 are to a great extent interdependent, but there will always exist an optimum setting for each. This fact must be borne in mind when the final adjustments are made.

Now to return to the question of ensuring that the correct operating frequency is maintained in step with the transmitter. It would be possible manually to hold a time base at the correct frequency to resolve the transmitted picture. This would entail unusual skill and is unnecessary.

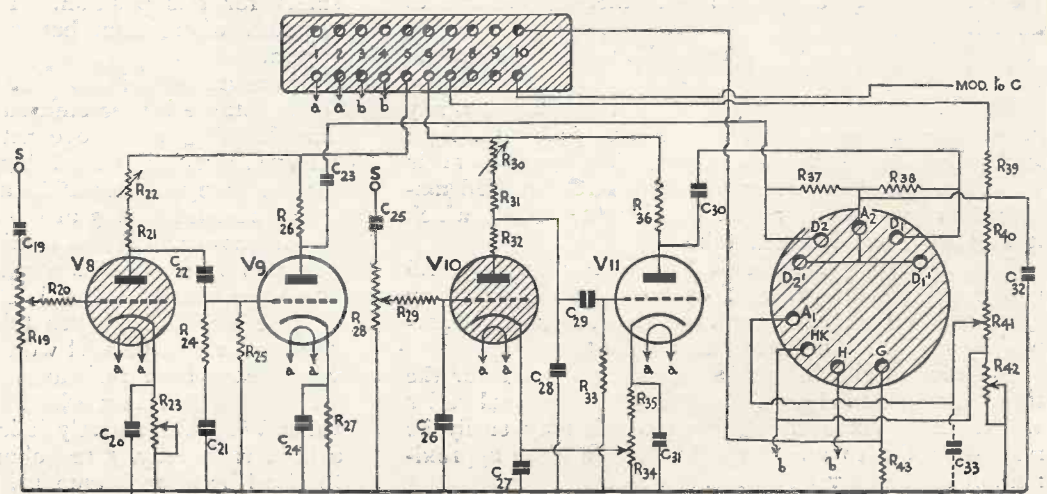
At the end of each line or frame the transmitted carrier is suppressed. (This statement is not strictly true, but a clearer appreciation of what happens is conveyed by this description.) With a suitable circuit this effect may be resolved to provide positive synchronising pulses.

If we now feed these pulses through suitable amplitude and frequency filters to the grids of the frame and line relay valves we can anticipate the normal free running conduction time because these positive pulses will reduce the relay valve's bias voltage.

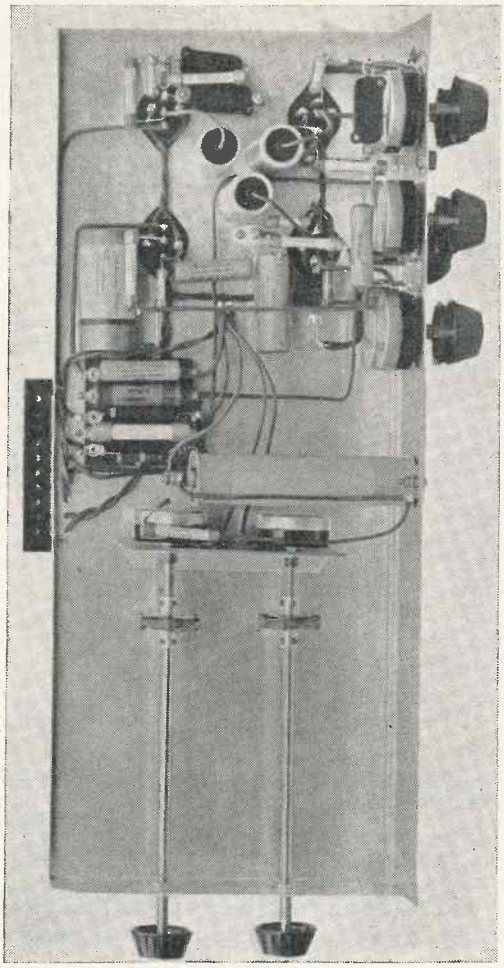
Obviously then the firing frequency of the time bases is controlled by the transmitter and correct synchronism results.

The application network comprises C19, R19 and R20 for the line time base. Frequency discrimination is sufficiently provided for hereby the condenser C19 which has a capacity of 0.001-mfd. and consequently offers considerable opposition to the low-frequency frame sync. pulses. The resistance R20 serves to

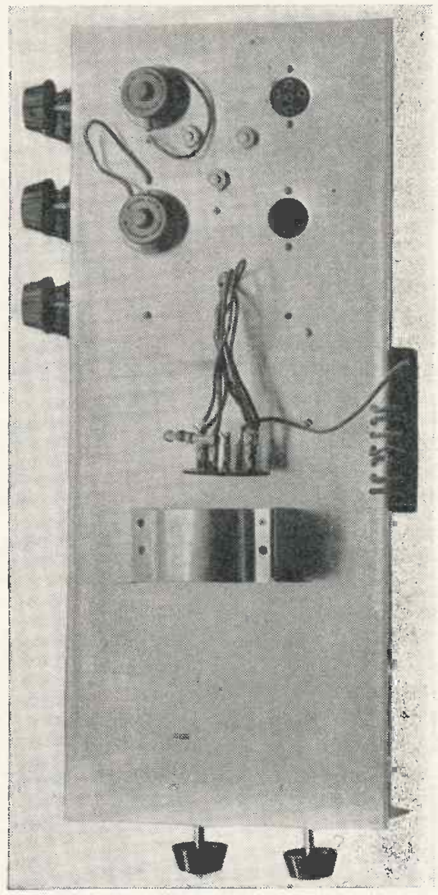
This is the circuit of the time base which is of a particularly simple type and employs four valves only.



BUILDING THE TIME BASE



These two photographs show the under and upper sides of the time base respectively. It will be noted that the component assembly and wiring is particularly simple and only calls for ordinary wireless constructional practice.



limit the peak positive pulses applied to the relay grid.

The application network for the frame time base is substantially similar. An additional condenser is included (C26), which has a capacity of 0.002-mfd. and will consequently present a low impedance path to earth for the line sync. pulses.

Simple discriminating networks such as these perform remarkably well and are furthermore simple to adjust.

Up to the present the valve V11 has received no mention.

The oscillations generated by a relay valve rarely have sufficient amplitude adequately to deflect the light spot across a C.R. tube screen. The valve V11 is therefore included. It is a simple R.C. coupled amplifying stage having a gain of about 10 times, which is ample for the Mullard tube.

The foregoing will, it is hoped, furnish a useful introduction to the mode of operation of the gas relay type of time base. An understanding of this will enormously facilitate the correct adjustment.

In order to simplify the correct adjustments for the time base, the final article of this constructional series will describe some simple tests which may easily be made in order to adjust the bases to a close approximation of the correct operating speeds.

Referring to the list of parts for the time base; two items are shown as optional, namely, C33 and R43. For certain cases a condenser will be required between the slider of R41 and earth. A condenser having a capacity of 1 or 2 mfds. will be entirely suitable, and it should be able to withstand 500-600 volts. Similarly a condenser may be needed between the tube cathode (HK in the diagram) and earth. A condenser tested to withstand 200 volts has an ample margin of safety for this position. These condensers are only required where hum bands are troublesome on the screen.

If the diagram is referred to it will be seen that if the resistance R43 is omitted the C.R. tube grid is unbiased. This will prove detrimental to tube life. If the grid circuit is traced, however, it will be seen that for the complete assembly a return circuit is formed by the resistance R13 of the vision unit.

For cases where the original arrangement is to be departed from, or if separate tests for the time base unit are contemplated, it is strongly recommended that R43 be included. When this is so it will be seen to be effectively in parallel with R13 of the vision unit, in which case both resistances should have a value of 2 megohms to retain a load of 1 megohm for the diode valve V6. Alternatively it is satisfactory to give R43 a high value, say, 5 megohms. This will only reduce the load by a small amount. Actually it will then become something over 800,000 ohms, which is a reasonable value.

Let us now examine the practical arrangement of the top deck. To the left, mounted on the flap, are the various controls for the time bases.

Approximately midway along the underside of the deck is mounted a paxolin panel which carries the brilliance and the focus controls (R42 and R41). Eddystone extension spindles continue these controls to the front of the receiver.

Mounted on the shallow right-hand flap is the Bryce 10-way connecting block. Eight terminals only of this are required to complete the connections. The correct order is preferably observed as this will make the inter-connecting leads neater.

Note especially the junction No. 10 Without a brief description some confusion may result concerning the purpose of this. A lead from the top of this, clear of other connections, yet at the same time as short as possible, is taken direct to the C.R. tube grid socket. Another lead continues from the bottom of the connection and is taken direct to the junction of C15 and R14 on the vision chassis. This is plainly revealed by the photograph in the right-hand corner of p. 140 of last month's issue. There is no need for this lead to be located at the connecting block, but it will be found convenient to make the connection in this way. Also it is simpler to keep the lead clear of others when this is done.

The actual wiring of the deck will be found straightforward. Adherence to the original layout as revealed by the various illustrations is advisable and in view of the comparatively high voltages existing for tube excitation care is desirable in wiring the apparatus associated with the potentials network.

The blocking condensers feeding the sweep voltages to the deflector plates, C23 and C30 in the diagram, and also the load resistances for the triode amplifiers V9 and V11, are mounted on the Bulgin group board. This permits convenient grouping of leads and also serves as a junction board for some of the tube socket leads.

The remainder of the assembly is adequately revealed by the various illustrations.

A Belling-Lee banana plug and socket serve to feed the sync. pulses from the vision chassis.

The tube support bracket is constructed of aluminium. A snug fit to the neck of the C.R. tube is made by packing with sponge rubber. This bracket performs no screening function and the method employed for tube support is therefore optional.

Many constructors will prefer to contrive some form of wooden support and there is no objection whatever to this.

It will be seen from the photographs of the complete receiver that aluminium right angle section uprights hold the three units in position.

In connection with these it is recommended that no holes be drilled in the actual units, until the final assembly is undertaken. It will prove very much simpler to drill the uprights first when, with the units held in position, drilling points can be marked from the outside. This will ensure greater accuracy. Two bolts for the units at each upright are ample to ensure rigidity.

It is regretted that two errors occurred in last month's article. In the theoretical circuit for the vision unit, the inductance shown between the anode of V1 and R3 is L3. The inductance shown in this diagram as L3 should read L4.

In the list of parts the item, 1 banana plug and socket (Belling-Lee, type 1078) should be included with the parts for the time base assembly and not as shown with the parts for the vision section.

In next month's issue the final unit of the complete receiver, namely, the power packs, will be fully described.

WORLDS LARGEST CATHODE-RAY TUBE

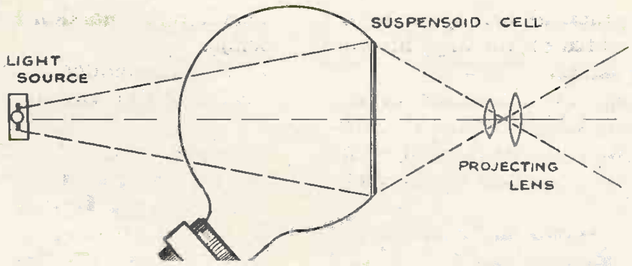
MR. I. G. MALOFF, of the Radio Corporation of America laboratories, in Camden, N.J., has completed what is undoubtedly the largest cathode-ray tube ever built. The tube is $4\frac{1}{2}$ ft. long, and 31 in. in diameter. The cone of the tube is made of $\frac{1}{4}$-in welded steel, while the end consists of special glass, 2 in. thick. The glass end is attached to the steel tube by means of special gaskets.

The picture is 18 by 24 in., and appears on a flat glass plate, made of glass of a thickness of $\frac{3}{4}$ millimetre. This thin glass plate, placed within the tube carries the fluorescent screen.

It is necessary continually to exhaust this gigantic tube when in use in order to preserve the high vacuum. Incidentally, this vacuum causes a pressure of $5\frac{1}{2}$ tons on the 2-in. glass end of the tube. The sturdy construction of the tube makes it possible to use a 10,000 volt electron gun.

Never before has there been the problem of a picture being too bright. In Mr. Maloff's tube the brightness is such that it is too intense for a darkened room. The picture can be viewed in a brightly lighted room, or in daylight, with ease.

COLLOIDAL GRAPHITE LIGHT RELAYS



By A. H. Stuart, Ph.D., B.Sc.

In view of the great amount of interest that is centred round the possibility of using colloidal solutions for light relay systems this article which deals with the physical properties of these solutions is of particular value.

IN the December, 1937, issue of TELEVISION there appeared, on page 716, an article by Mr. W. H. Stevens, entitled "An Electronic Light Relay for Large Pictures," and on page 731 of the same issue, an abstract was given of a Patent (No. 470,347), by Baird Television, Ltd., for the same purpose, which depends upon a similar principle. In both cases the electron stream, instead of impinging on to a fluorescent screen, falls on a "crystal electrode," which consists of a cell containing a colloidal solution which is normally more or less opaque, but becomes relatively transparent under the action of the electron stream.

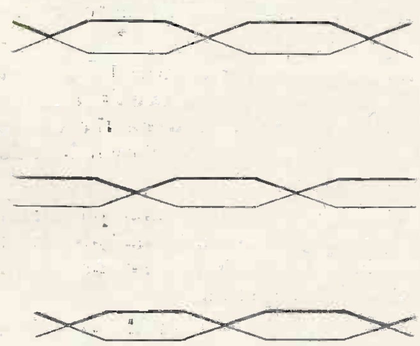


Fig. 1. Diagram showing the atomic arrangement of the carbon atoms of graphite.

It will be at once appreciated that if such a scheme could be developed into a workable proposition it would revolutionise television, since the picture could be projected like a lantern slide and there would be no limit to its brilliance, and its size would only be limited by the definition.

In Mr. Stevens' account the cell was made up of a solution in a suitable oil of Acheson's "Oildag," which is an oil dispersion of colloidal graphite. For the past three years the writer has been conducting an ingestigation into the behaviour of "dag" colloidal graphite under the influence of magnetic and electric fields, and the transmission of light has been measured under a great variety of conditions for a number of media. It is hoped that some of the results of this experimental work will be helpful to those who are experimenting on electronic light relays by giving them exact data of the properties of the material they are using which are not readily available in the literature of the subject.

Graphite Crystals

Graphite has long been known as a crystalline form of carbon shaped as flat hexagonal plates. X-ray and electron diffraction records have more recently proved that the crystal of graphite consists of carbon atoms arranged in plane hexagonal networks, these planes being parallel to each other and superimposed so that the centres of the hexagons in one plane are vertically over carbon atoms in the plane below. Fig. 1 shows a diagram of the arrangement in which an attempt at a scale drawing has been made, for electron diffraction analysis has shown that the distance between neighbouring carbon atoms in any one plane is 0.14 $m\mu$, while the distance between any two planes is 0,34 $m\mu$ (one $m\mu$ is a millionth of a millimetre).

These relative distances are important since they are responsible for the more interesting properties of the graphite crystal. The carbon atoms in any one plane are held together by "close" linkages, while the atoms in different planes are controlled by what physicists call "metallic" linkages. The result of this is that electrons are free to move along paths parallel to the planes (that is, the basal plane of the crystal) and not at right angles to this plane (which may be called the axis of the crystal).

These facts would suggest that the electrical and magnetic properties of graphite would be anisotropic, that is, they would differ according to the direction within the crystal in which they were measured, and such has been found to be the case.

Graphite has for many years been known to be diamagnetic, that is, in a magnetic field it tends to put the longest axis of any given susceptibility at right angles to the direction of the field instead of tending to lie along the field like the paramagnetic substances of which iron is the best example. Recent work has shown, however, that the diamagnetic susceptibility of graphite along the hexagonal axis is over fifty times that in a direction in the basal plane. This

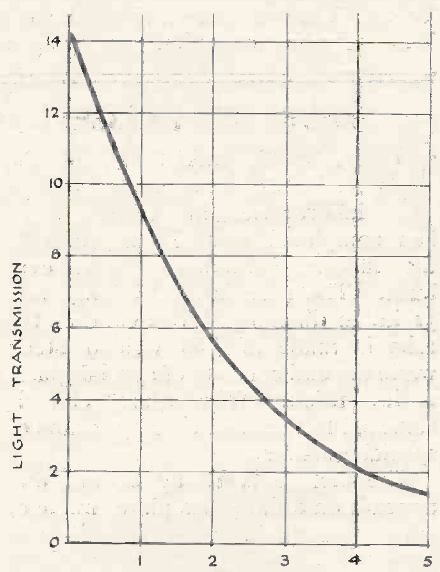


Fig. 2. Graph showing the proportion of light transmitted by solutions of colloidal graphite when acted on by a magnetic field.

is a characteristic property of the natural mineral graphite, and the writer has developed a method of utilising it as a test of the so-called artificial graphites.

Colloidal Graphite

The graphite in "Oildag" is made from selected carbon and is of a degree of purity far beyond that of the best natural product. Moreover, it is colloidalised, which reduces the dimensions of the particles to the order of 10 mμ, which is so small that the particles will remain in suspension in media such as distilled water and suitable oil over very long periods. These tiny particles are, of course, black and quite opaque, and they have the power of reducing the transmission of light to a very remarkable degree. Fig. 2 shows a graph indicating the amount of light transmitted through a column of distilled water 8 cm. high when "dag" colloidal graphite is present in very small amount. From this it will be observed that the presence of the graphite to the extent of only 5 parts in a million (say, 1 oz. of graphite to 5½ tons of water) reduced the transmission of light to one-tenth of its value through clear water.

Now if this column of water carrying these minute traces of graphite is surrounded by a coil of wire through which an electric current may be passed, the magnetic field produced in the liquid causes these very small crystals of graphite to place themselves with their basal planes parallel to the lines of force of the magnetic field and, consequently, less light is absorbed. To give readers some idea of magnitude the following table refers to the water dispersion used in the experiment giving the results shown in Fig. 2.

Concentration of graphite in parts per million.	Increase per cent. of light transmitted when magnetic field operated.
1	13½
2	21
3	32½

These effects have been produced hundreds of times under a great variety of conditions, from columns 8 cm. high as in the case just given, down to films one-thousandth of an inch thick. A great variety of media have been employed in addition to water. Oils of different viscosity and a number of special liquids such as a mixture of carbon tetrachloride and bromoform which has a specific gravity equal to that of graphite.

In addition to a magnetic field the phenomenon may be produced in an electrostatic field, as Mr. Stevens pointed out in the article abovementioned. It is, however, not quite so easy to arrange an electrostatic field parallel to the incident light, as was the case with a magnetic field, and the experimental work, therefore, presents more difficulty.

It is not suggested that the results of these experiments solve the problem of the electronic light relay for the worker in television. It would, however, appear that colloidal graphite possesses a very valuable property which is capable of development. Much work remains to be done; for example, what is the best medium, what is the most efficient thickness of the film, what is the best method of imposing the orientation forces? About all these and a number of similar matters we at present know very little, and since the initial work at any rate does not require elaborate apparatus, the writer suggests that it is within the capacity of many amateurs.

PICTURE RETENTION

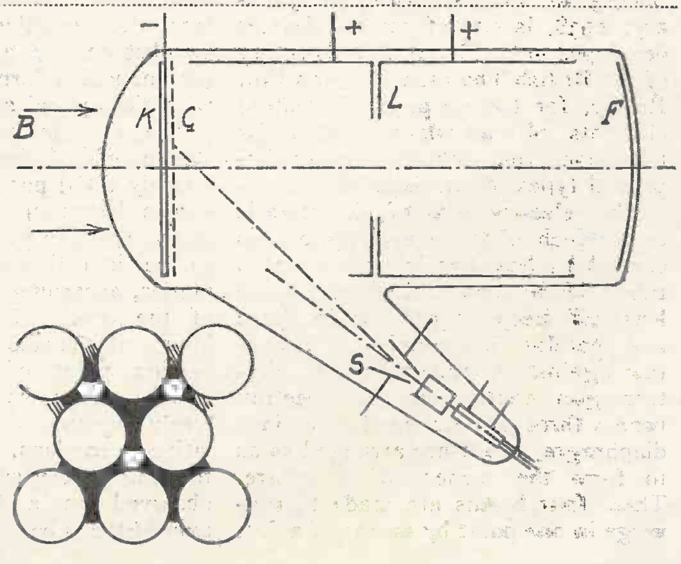
We have received from Mr. T. de Nemes, research engineer of the Hungarian Post Office, the following particulars of a method of cathode-ray tube construction which it is claimed will enable the picture to be retained on the screen during the whole period of a complete scan.

The principle is illustrated in the diagram and it will be seen that the scanning beam is caused to scan a grid mosaic which is placed in front of a semi-transparent photo-emissive surface K.

The construction of the grid is shown by the small diagram and it consists of small metallic elements separated by insulating material, the plain circles in the drawing representing holes and the black parts metal, the remaining part consisting of insulating material separating the units of the metal mosaic. A steady source of light B is caused to fall on the surface of K.

In operation it is claimed that the mosaic units will acquire charges according to the intensity of the electron beam which is caused to scan them and will control the emission from the cathode which will continue at the same value until they are again scanned by the beam. An electron lens system enables the image to be projected on to the fluorescent screen.

The chief claims made for the system are greater freedom from flicker, as the picture is retained during the whole period of each scan, and increased brightness, as the entire picture, it is stated, is retained during the period of each scan.



Schematic diagram of the Nemes tube for picture retention during the whole period of scan.

TESTING ELECTRON LENSES

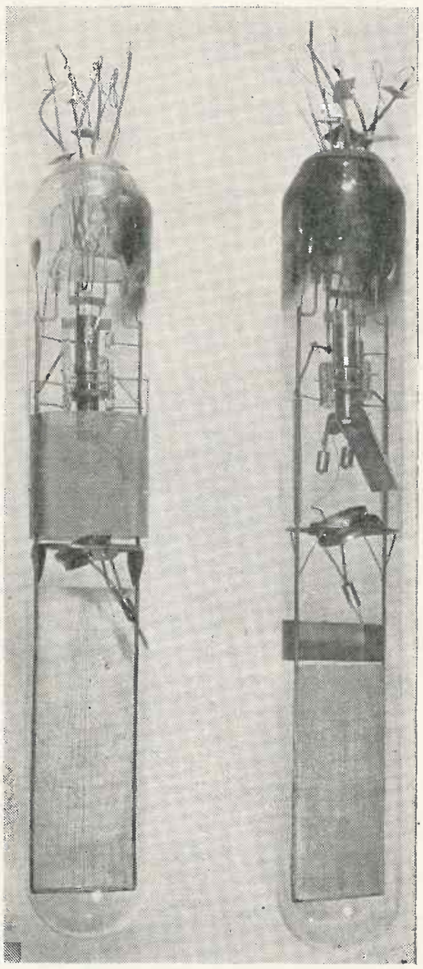


Fig. 1. Photograph of two tubes. In the tube at the right the swivelling lens and the screen for the location of the object point can be clearly seen. In the tube at the left the space between the two lenses is shielded from wall charges by a gauze, which covers the tilting screen from view.

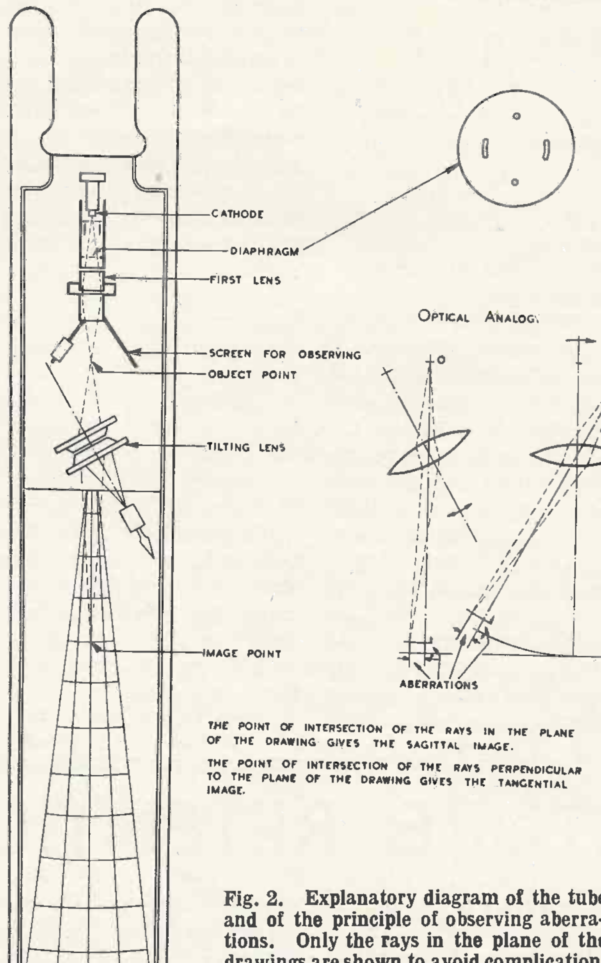


Fig. 2. Explanatory diagram of the tube and of the principle of observing aberrations. Only the rays in the plane of the drawings are shown to avoid complication.

THIS apparatus, which was shown at the annual exhibition of the Physical and Optical Society in South Kensington, January, 1938, is one of several devices developed in the Research Laboratory of the British Thomson-Houston Co., Rugby, for the purpose of testing elements of cathode-ray tubes for television, and for developing improved types of television tubes.

The electron lens of electrostatic type which is to be investigated is carried by bearings in an evacuated tube. If the whole tube is tilted, the lens will keep its position in space and therefore will change its inclination against the tube axis. An electron gun emits four thin electron beams through four small holes in a diaphragm, which are arranged so as to form the corners of a square. These four beams are made to converge in one point by means of a first lens. The position of this point can be observed on a tilting fluorescent screen, which forms a grazing angle with the optical axis.

The electron beams will hit the screen only if the tube is in an extremely tilted position, otherwise the screen keeps out of their way and allows them to pass through the lens to be investigated, under variable angles, according to the tilting angle of the tube. This lens forms an image of the above-mentioned intersection point of the four beams, which serves as an object point, freely movable in two dimensions relative to the lens. The image can be forming a very small angle with the observed on a fluorescent screen, axis of the tube. The position of the image point can be located in a system of polar co-ordinates, ruled on the screen.

In this way it is possible to find the image corresponding to any position of the object point, and to any voltage ratio that may be applied to the lens. Moreover it is possible to measure the aberrations of the lens, i.e., its departure from ideal behaviour, especially at large inclination angles of the object. The aberrations, called image distortion, field curvature, astigmatism and coma can be observed one by one, and the data so obtained can be utilised for the construction of improved lenses.

Dr.—Ing. D. Gabor,
Research Laboratory,
British Thomson-Houston Co. Ltd., Rugby.

Telegossip

A Causerie of Fact, Comment and Criticism

By L. Marsland Gander

I WALKED into Mr. Gerald Cock's room at Alexandra Palace the other day to find the Director of Television in even more optimistic mood than usual. His office resembles a glass-fronted conning tower from which he surveys the roof-tops of London stretching away in the valley below Alexandra Park—a great territory to be conquered for television.

Mr. Cock held a handful of postcards, delivered by the last post in answer to the microphone appeals made during the week. It has been a long-standing dilemma of regular viewers that if they switched on their television sets at 9 p.m. they missed the National news bulletin.

Now that programmes are being extended after 10 o'clock so frequently, viewers also run the risk of missing the Regional bulletin as well. So Mr. Cock proposed to record the 9 o'clock news and broadcast it at the end of the television programme on the ultra-short wavelength. Accordingly, for several consecutive nights, he had broadcast to viewers a request to express their opinions on this innovation.

He told me that the results had been surprising and vastly encouraging. Anybody who has experience of broadcasting or newspaper work knows that it is extremely difficult to persuade people to write unless you are offering them something tangible or you have made a mistake.

"Postcards are coming in from all points of the compass," he said. "Even places outside the normal service area, such as Eastbourne, Colchester, Southend, Sittingbourne, and Cambridge are represented. We know now that we have a great circle of viewers spreading through Essex, Kent, Hertford, Surrey, Sussex, and even extending to Hampshire."

Mr. Cock had not had time to analyse the correspondence and was speaking from memory. It was also only the second day after the first appeal. The demand for a recorded version of the news was overwhelming, and by the time these notes appear the wish of the majority will have been granted.

"What pleases me most," said Mr. Cock, "is that there is not a single unfriendly communication in the whole lot. Many have taken the opportunity of writing a constructive commentary on the programmes as a whole, and I warmly welcome such expressions of opinion.

"This ballot has shown me conclusively that we have an audience of 'fans.' That people who have television sets use them night after night."

Yes, Mr. Cock, you and all who have helpel to launch television in London if you have done nothing else, have created a definite and a growing demand. But you have also shown that British pioneer effort can still lead the way and wrest success from a morass of difficulty while all the world hesitates and watches.

The "Big Push"

Last month I urged the B.B.C. to speed-up their work of preparation for longer and better programmes. Now, fully aware of the obstacles and the reasons for delay I repeat the admonition with all the vehemence I can.

It was a great disappointment to find at Alexandra Palace that no start had yet been made on the conversion of the old theatre. The Postmaster-General has now declared that a further 8 per cent. of the B.B.C.'s total licence revenue will be granted for television expenditure.

The old difficulty arises that this is income and there is no provision for capital expenditure. But nevertheless the announcement removes doubts which, we were told, were the principal reason for delaying television's Big Push.

I understand that the position now is this. Plans have been prepared for the adaptation of the theatre and are in process of being approved. Orders have actually been placed for the alteration and re-equipment of the No. 2 studio.

But I see no reason to revise my estimate that it will take a year before the theatre is converted into a studio. The idea is to have four cameras in No. 2 studio and another six camera units in the theatre, which will become Studio No. 3. This makes an impressive total of fourteen cameras in all. It is proposed that the glass-panelled two-storeyed structure in No. 2 shall now be converted into a central control room, from which transmissions in all three studios can be controlled.

Central Control

Some such central control is essential. The producers have long laboured under the handicap that when No. 1 studio was in use it was impossible to hold a camera rehearsal in No. 2. All rehearsing for an evening show has to be crammed in between 5.30 and 9 p.m. With a centralised control-room it will be possible to make full use of all studios simultaneously. Thus extension of the evening programme will be facilitated.

The most immediate improvement will be that all the existing Emitron cameras are to be replaced with the new "long-gun" type. I understand that these cameras are not so sensitive as the super-Emitrons, but they are easier to manufacture and will give finer detail than ordinary types. Viewers must have noticed that one or two of the cameras at present in use are nearly worn-out, and replacements are overdue.

O.B.'s

In the corridors at Alexandra Palace I ran into Mr. Philip Dorté, the energetic chief of the Outside Broadcasting section. He expects the second outside televising unit, complete with three cameras, to be ready for action in July. Should it be available in time it will enable him to improve upon the very elaborate plans which he had made for televising the Oval Test Match.

I, personally, am looking forward to the cricket televising more than any other future broadcast. Mr. Dorté tells me that he intends to have one camera behind the bowler's arm, and another behind the opposing wicket. Viewers will thus be able to see the bowler take his run and deliver the ball. Then they will see the ball travelling towards the batsman. He proposes to have one camera mounted on the roof of the Pavilion and the other on a special rostrum behind the mound stand.

The Oval Test Match is the last of the series and, if the Rubber is undecided, will be a fight to a finish of indefinite duration. Another camera will range over the crowd. Telephoto lenses which, by the way, do not seem to have been used since Armistice Day, will be very necessary for the Test cricket. I understand that one reason for the restricted use of the telephoto lens in television is that at present rapid panning is impossible. If it were not for this drawback a considerable improvement could have been effected in the televising of the University Sports from the White City.

I wonder if viewers have noticed that Mr. Dorté has adopted a signature tune for each type of sporting broadcast? Thus, for the University Sports it was "I'm Young and Healthy." For rowing it will be the Eton Boating Song; for boxing, "I Saw Stars." Any suggestions?

An amusing programme of the near future will be a Sunday obstacle race by Old Crocks at Hurlingham, arranged by the Veteran Car Club. The ancient vehicles will have to go round or over obstacles such as small walls, but the principal trial of the drivers will be to stop and start their groaning engines. I expect about eight cars will be in the race.

Another light-hearted programme which should raise a laugh is the one with which Sunday programmes are to be inaugurated on April 3, the day after the Boat Race. A review of boat races from 1829 to 1938 sounds a serious and ambitious undertaking but it will not be as solemn as all that. Mr. G. Drinkwater is to give the commentary, and one of the star turns will be an illustration of the days when Blues raced in top hats, each oarsman having a slice of lemon tied to the thwart.

The B.B.C. intend to re-enact the historic scene when the stroke of one crew lost his topper overboard and it was handed back with old world courtesy by No. 2—"Your hat, sir."

Zeebrugge

For the Zeebrugge epic, to be reproduced in the lake of Alexandra Park on St. George's Day, Mr. Michael Ellison, M.C., of Harrogate, is making a most impressive fleet of models. His ingenuity is remarkable. For instance, a cruiser has holes covered with oil-silk. When the ship is torpedoed a firework touched off by electrical contact explodes inside, blowing out the silk and letting in the water with a rush.

This is a list of the vessels which will be seen: Belgian fishing trawlers, the *Vindictive,* the *Iris,* the *Daffodil,* three block ships, two submarines, a destroyer flotilla led by the cruiser *Warwick,* and motor-boats laying a smoke-screen. The Admiralty has given special permission for the transmission and sections of film will add to the realism.

The Copyright Question

One of the most important events during the month has been the sudden issue by the B.B.C. of the notice before certain sporting broadcasts banning reproduction in public. The notice ran: "The reproduction in any form of the outside broadcast which follows, including projection in places of public enntertainment, is strictly prohibited." This action was taken largely because the promoters of the Len Harvey-Jock MacAvoy fight insisted that before permission would be granted for televising the contest some protection must be given against the possibility of free reproduction in cinemas.

Now while I have every sympathy with the motives of the fight promoters who naturally must protect their own interests, the need for some protection for those firms which have spent thousands of pounds on the development of big screen television is also imperative.

The B.B.C. cannot put down a bar to progress. After all it has been the loudest to complain when obstacles have been put in the way of broadcasting. So Dictators permitting, and if the Government can spare the time amid the more pressing problems of the moment I would suggest that some clear ruling must be given on the legal aspects of big-screen television. Some way must be found of utilising the results achieved by time, effort and money spent over a long period of years. When achievement is near it is futile and wrong-headed to raise artificial obstruction. Rather must some way be sought out of an apparent impasse, some way of applying big-screen television to the profit of all parties—the programme providers, the public, the B.B.C. and the manufacturers. It is not impossible.

And now, my coat off for programme criticism. Among programmes which I liked least of all during the month I would mention the film "Tell Me if It Hurts," and the play "The Cup that Cheers." The former portrayed in an amateur imitation of the Russian impressionist school a visit to a dentist. Intended to be lightly satirical, I liked it rather less than the toothache. The censor banned it and for once the worthy censor was right, but for the wrong reasons. He thought that it held up the profession of dentistry to ridicule; I thought that it was sadistic and unpleasant. Added to all this the reproduction on my screen was not good.

V. C. Clinton-Baddeley's play, "The Cup that Cheers," went all wrong. The impression of a typical suburban family at breakfast was depressingly accurate, and not a bit funny. But why have a pantomime dame as the mother? Finally, by a desperate twist, came a tragi-comic ending when mother assassinates a second pantomime dame who came in to criticise. The sketch somehow didn't seem to hang together at all.

Best among the offerings of the month I think I liked the Yeats' play "The Words Upon the Window Pane." Mr. Eric Crozier is a producer who knows his medium. His portrayal of a spiritualist séance was sympathetic and effective. He built up atmosphere most ingeniously, and preserved perfect continuity though he never had more than two or three characters on the screen at a time.

The performance of Beatrice Wilson as the medium was a *tour de force,* Terence de Marney (Count of Monte Cristo) was well cast for the young undergraduate, and William Devlin made a dramatic impression as the spirit of Swift.

A New Raymart Catalogue.

Over 200 components are listed in the new Raymart catalogue which is priced at 1½d. Some of the new items listed include chassis, panels, feed-through bushes, special mica condensers, heavy duty morse keys, neutralising condensers and a whole host of receivers.

This catalogue should be of particular interest to short-wave listeners and the constructing short-wave transmitting amateur. We advise all who operate on shirt waves to write to Raymart Manufacturing Co., 44 Holloway Head, Birmingham, 1, for this catalogue.

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are intended for visual indication of the correct tuning point in a receiver, or for any circuit where small change in current is required to be indicated visually. They consist of a fluorescent target and an indirectly heated cathode to provide a source of electrons which on striking the target cause a glow to appear. The glow area is controlled by a third electrode internally connected to a triode amplifier.

Points to note with the G.E.C. 'Tuneray':

(1) The indication is positive and clear cut, being provided by a single sector of shadow in a field of brilliant fluorescence.

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(3) A "variable-mu" characteristic to the triode grid enables the exact maximum of strong signals to be indicated without "overlap" of shadow angle, and at the same time there is increased sensitivity on very weak signals.

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TELEVISION IN EASY STAGES.—II

HOW THE VISION SIGNALS ARE RECEIVED

This article fully describes the difference between a receiver for vision as compared with the conventional short-wave super-het receiver.

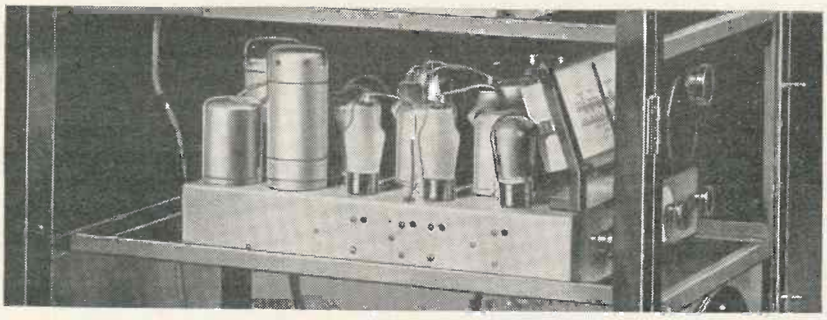
WE have described the composition of a typical television receiver but many readers will wonder just what is the difference between a radio receiver designed for short-wave reception and the multi-valve vision receiver.

This is very simply explained, but it is as well to know just why the vision receiver has so many more valves than the ordinary sound receiver.

Most constructors interested in television will have some knowledge of radio reception and know that the average short-wave receiver is made up of about 5 valves.

Of these the first is the H.F. stage at signal frequency which is generally sharply tuned to obtain the best possible selectivity before the first detector stage. This detector stage uses either a pentode or screen grid valve into which is injected the oscillation generated by the local oscillator. The local oscillator can be in the same bulb as that of the first detector and can either be electronically coupled or externally coupled.

Next follows the intermediate-frequency amplifier which operates in most receivers at a frequency of 465 kc. This frequency gives ample selectivity and high gain but does not amplify too many second channel beats which cannot be removed. The final two valves are the second detector, usually a triode or diode triode and the output pentode.



A good example of vision receiver design.

That is the valve line up of the typical short-wave receiver and it does not matter whether it is operated on 7 or 70 metres, it will give all-round results.

The natural query is then, "Why have all these extra valves in the vision receiver if five will do for ordinary broadcasting."

This brings us to a point we have not so far raised. In the radio receiver although we have a need for selectivity, the problem of quality, or more accurately, band width does not arise.

With sound broadcasting, to pick-up all the frequencies transmitted both on speech and music less than a 12,000 cycle band width is required.

This simply means having H.F. and L.F. couplings that will pass this narrow band of frequencies.

It is quite a different matter, however, with vision signals for if full definition is required the receiver must be capable of passing a band of frequencies no less than 2.5 to 3.0 million cycles wide. This has to be compared with 12,000 cycles on the radio set.

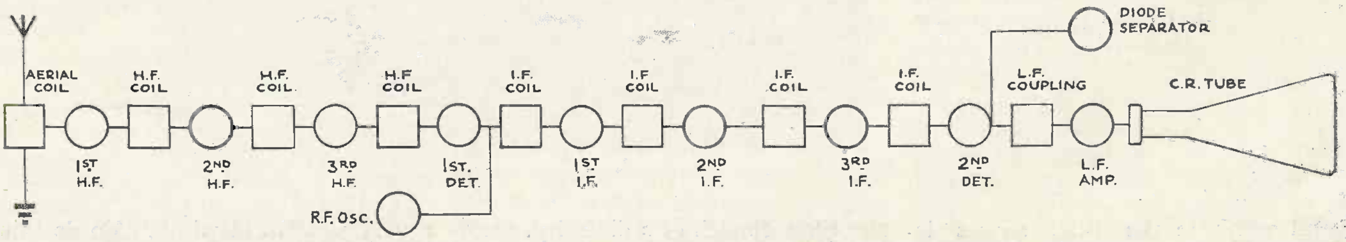
That is the problem that has to be solved and accounts for the extra valves used in the receiver designed to pick up vision signals.

The usual way to increase the band width of a receiver is to tightly couple the coils together which reduces the selectivity of the stage. If this is done in every section and carried to extreme limits it will cover about half of the frequencies sent out by the vision transmitter.

So to increase the band width of the receiver still further low-value resistances are connected across the primary and secondary of the coupling coils. The value of these resistors depends on the amount of broadening that has to be done and the amount of stage gain available.

In some instances the coils themselves are wound with resistance wire as in the case with the first television receiver we published. In this system the band width can be made very broad, but it also decreases the stage gain to such an extent that many more valves are needed to bring it back to the level of the ordinary short-wave receiver of normal band width.

That is the secret of the extra valves. As the band width is



This schematic diagram gives a very clear idea of the valve and coil line up in a typical vision receiver.

COUPLING :: THE VIDEO STAGE

widened, particularly as the resistance values are reduced, the stage gain drops alarmingly. In fact where one high-frequency stage would do in an ordinary receiver no less than three stages are required when the band width is increased to 2 million cycles.

Next comes the problem of the intermediate-frequency stages. In the average receiver where the I.F. stages have a frequency of 465 kc. quite a high gain can be obtained with one stage. As this frequency and degree of selectivity would be too high for television reception the coupling between coils is brought to maximum and across both primary and secondary low-value resistors are connected as with the H.F. transformers.

This reduces the gain from a figure nearer 200 otherwise to a figure not exceeding 10. Consequently the number of stages has to be increased. That is why some commercial receivers use as many as five stages of I.F. amplification.

Many old ideas, long discarded as useless, have been brought into use with television receivers. It has been discovered that the old tuned-anode system gives a very broad tuning curve and on the lines of what is wanted for vision reception. Many receivers use this scheme with success and find that three stages of tuned anode H.F. amplification and three stages of I.F. amplification will provide sufficient gain for most areas.

With tuned anode couplings the lay-out can be made very simple and as the number of coils is reduced by half, the final trimming and ganging is greatly simplified. This point should be borne in mind by constructors.

Although at first glance it may not seem possible to apply the same methods to low-frequency couplings it so happens that obtaining high-band width in the L.F. stages is quite a problem that has not the same scope of action as with coil couplings.

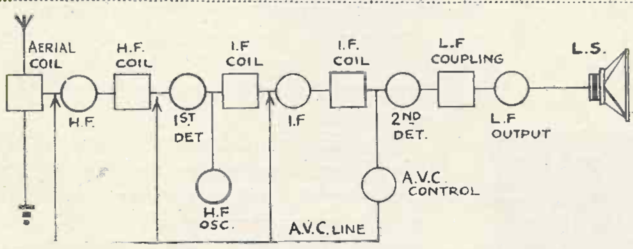
The second detector is always a diode in which all stray capacity has been eliminated. The slightest capacity across the circuit tends to attenuate the higher frequencies very rapidly. For example the standard output triode with ebonite base and conventional base connection will reduce the top note response by as much as 500,000 cycles without any other matter being taken into consideration.

That is why wherever possible the grid contact is brought out to the top cap so reducing interelectrode capacity and also grid to earth capacity.

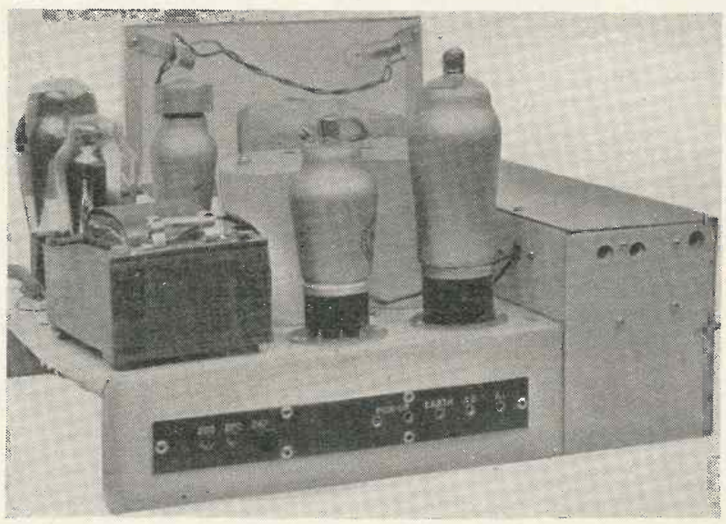
All resistance values have to be modified in order to obtain the maximum gain, but as it is not advisable to increase the number of low-frequency stages the valves have been improved and made specially for television amplifiers.

Modern television valves have the high slopes of 9 and 10 mA. per volt in order to obtain the maximum stage gain without additional valves.

Also in the low-frequency stages if another stage were added this would cause a negative picture and, although not much of a difficulty, there is no need to complicate the receiver without cause. The main reason for not having more low-frequency stages is due to the trouble experienced in filtering the residual 100 cycle from the power supply.



Although there are many less valves in this sound receiver the system is the same as for the vision receiver.



This super-het receiver is designed for all-wave reception and should be compared with the vision chassis illustrated on the preceding page.

While on the subject of the low-frequency amplifier it is well to mention that the name low-frequency is still the old name taken from the speech amplifiers in conventional radio receivers. In such receivers the speech frequencies passed were quite low in comparison with the high frequency band. With vision receivers where the final amplifier has to handle frequencies up to 3 mc. it is better to use the more modern name of video amplifier.

That gives a good idea why the vision receiver uses so many valves, but it does not explain how these receivers are so easy to make as compared with a radio set having a similar number of valves.

With the normal radio set having two high-gain stages it is very difficult entirely to eliminate instability in the high-frequency stages. Constructors feel that if two stages are unstable in a radio set, what is going to happen with three or four stages in a vision receiver?

The solution again lies in the band width. As the band width is so great, the stage gain is reduced to a fraction of the former value. Consequently there is no more trouble in stabilising three H.F. stages in a vision receiver than there would be with one stage in an ordinary radio set.

It can be assumed that the vision receiver is fundamentally the same as a radio set except that it must pass a very wide band width. To do this the number of valves must be increased. The type of couplings are the same, the system is similar, the valve types are of the same pattern but of greater efficiency so that the first change comes with the cathode-ray tube which for the purpose of comparison takes the place of the loudspeaker.

Constructors who have used the normal super-het. receiver below 10 metres will have noticed that most of these sets suffer from frequency drift. By that we mean that when a station has been tuned in the tuning is inclined to change on its own.

This problem has also been automatically solved with the vision receiver. As the band width is great and the tuning so flat, small variation in oscillator setting which would cause the so-called frequency drift are not noticed because they do not wander outside the band covered by the receiver.

HOW THE SIGNALS ARE FED TO THE TUBE

Paradoxically, one of the best methods of feeding the signal to the grid of the cathode-ray tube is by omitting the video amplifier altogether and connecting the diode direct to the grid.

In previous articles we have seen that the only way in which the D.C. component can be maintained at the tube terminals is by direct connection to the preceding valves or by the use of a diode to restore the brightness level. The load resistance of the diode detector contains the D.C. and A.C. currents after rectification and thus by connecting the grid of the tube directly to the load resistance we shall automatically take care of the brightness level.

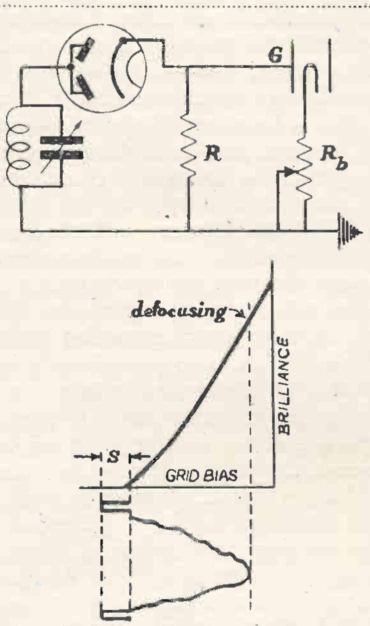


Fig. 1 The tube can be directly connected to to the diode as shown, if sufficient voltage is available.

Fig. 1 shows the circuit in which this can be done. The output from the last radio frequency tuned circuit is rectified by the diode and this rectified current flows through the load resistance R. The grid of the tube is connected to the top of R and the bias of the grid is obtained from the cathode resistance R_b. This is adjusted so that the beam current is just cut off when there is no picture signal. If we suppose that a "black" signal is being radiated before the start of the transmission the rectified voltage across R will be proportional to the amplitude of the synchronising pulse and we can adjust the bias of the tube so that the beam is not visible on the screen with this value of potential applied to the grid. This is shown in the lower diagram as " S," and it will be seen that with the bias adjusted to the correct position the amplitude of S is insufficient to start the flow of beam current. Now suppose the picture signal starts. The rectified voltage across R will rise and will be of such a polarity that it wipes out the negative bias on the tube grid. The beam current will flow and the brightness of the screen will vary according to the lower curve. We shall have to take care that the brilliance does not increase beyond the point marked " defocusing " as at this point the beam current is excessive and the spot will be blurred.

Output Voltage Required

If we assume that the voltage developed across the diode load is sufficient to swing the grid of the tube to the full extent shown by the lower curve we can estimate the value from the " modulation sensitivity " of the tube. This is always specified by the makers and may be, for example, 20 volts. Now in the total signal voltage, only 70 per cent. corresponds to vision and the remaining 30 per cent. is allocated to the synchronising. For 20 volts of " picture " the total voltage developed across the load resistance of the diode is therefore about 30, and unless the diode can develop this value from the radio frequency input the tube is not going to be fully modulated.

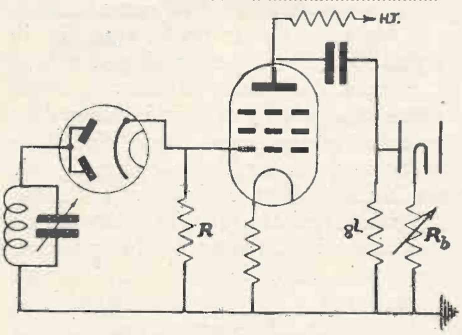


Fig. 2. The addition of a single video stage results in reversed polarity if no alteration is made.

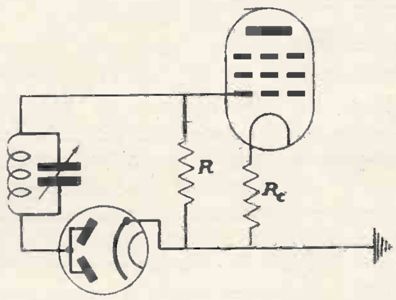


Fig. 3. How the polarity of voltage across R can be altered.

As a general rule, in the simpler types of television receiving circuit it is not possible to obtain this value of voltage without a large number of radio frequency amplifying stages, and we are therefore forced to use an extra amplifying stage after the diode—the video amplifier.

Inserting a Video Amplifier

Fig. 2 shows a single stage of video amplification inserted after the diode. The leads have been disconnected from the tube and connected directly to the grid of the pentode. (The connections to the other electrodes have been omitted for clearness.) As soon as we connect the video amplifier stage in circuit we must isolate the grid of the tube from the H.T. supply by the condenser

NEGATIVE AND POSITIVE PICTURES

shown, but the loss of D.C. component does not worry us as we already know how to restore it.* What will worry us far more is that on switching on we shall get a negative picture in which the whites and blacks are reversed!

The reason for this will be seen on looking again at the curve of Fig. 1 and imagining it to represent the anode current of the video valve. The grid of the valve is biased by the cathode resistance shown, and the signal voltage will increase the anode current in exactly the same way as it increased the brightness of the tube. These variations in anode current will be handed on to the grid of the tube through the coupling condenser, but instead of producing a decrease in bias they will be of such a polarity that they increase the bias. The inclusion of the video valve without any modification has therefore resulted in a reversal of polarity.

Reverse Polarity

How can the reversal of polarity be cured? One method would be to add yet another stage of video frequency amplification, as the signal undergoes successive reversals in polarity as it goes through each stage. Two stages after the diode would therefore bring the polarity right again. This method is not always desirable, however, both on economical grounds and because of the excessive gain, resulting in poor detector efficiency.

Reasoning backwards from the argument in the previous paragraph, we can see that if we reversed the polarity of the signal applied to the grid of the valve we should obtain a correct polarity of signal on the tube. We can reverse the signal polarity on the load resistance of the diode by reversing the connections, and this is shown in Fig. 3. It will be seen that the resistance R is now virtually in the anode circuit of the diode instead of the cathode circuit and the top end will therefore become more negative as the rectified current increases. The grid of the video amplifier will thus be driven more negative with an increase of signal and the grid of the tube will correspondingly be driven more positive, which is what we require.

At the same time we must make one important alteration to the operating conditions of the valve, as it is already biased to a negative value. The increase of negative potential on the grid would therefore have no effect and the last state would be worse than the first with no signal on the tube at all!

To overcome this difficulty we reduce the bias on the valve to a very low value—actually just sufficient to prevent the flow of grid current. The application of an increasing negative potential then reduces the anode current, the variations due to the signal then appearing as in Fig. 4. This should also be compared with Fig. 1 of last month's article.

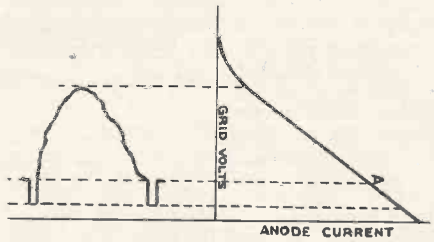


Fig. 4. The working characteristics of the video amplifier with low bias.

It will be noted from Fig. 4 that the first few milliamperes change in anode current are due to the voltage developed by the synchronising signal, and this suggests a neat method of separating the synchronising impulse from the video signal. The method has been used by Murphy Radio in their television receivers.

The value of the bias resistance is chosen so that the change in anode current produced by the synchronising signal gives a potential of, say, 10 volts across the resistance. Another diode is connected across the bias resistance with its cathode joined to a potential divider across the H.T. supply. The cathode can thus be made positive with respect to earth by any desired value of potential.

This potential is such that it is equal to the voltage developed across the bias resistance when a certain value of anode current is flowing. Any value of current less than this, such as occurs during the picture signal, produces less potential drop across the bias resistance. The anode of the diode is therefore less positive than the cathode and no current flows.

As soon as the current exceeds the value the anode of the diode becomes more positive than the cathode, and when the bias is reduced to zero during the synchronising pulses the anode voltage is 10 volts positive and the diode passes current. The synchronising signals thus produce pulses of potential across the resistance in the diode circuit, and these pulses cease as soon as the picture signal reduces the anode current of the valve.

* See page 156, March issue.

The R.M.A. Television Sub-Committee

THE Radio Manufacturers' Association has recently appointed a sub-committee to discuss and provide means of developing television. The first meeting has already been held and a decision was reached to tackle the problem under the following divisions:—

(a) Liaison with the B.B.C. and the Television Advisory Committee to secure development of programmes, both as regards time and quality.

(b) Regular contact with the Press.

(c) Discussion of common technical and trading problems.

The sub-committee will meet regularly at fortnightly intervals.

The R.M.A. sub-committee of the technical advisory committee on receiving set problems at its first meeting considered interference of television reception by short-wave sound receiving sets. Interference is caused not only by one television set with another and by sound receivers tuning down to the television sound channel, but also through harmonics arising from short-wave receivers which are not actually tuned to television sound.

A Receiver for Television Sound

READERS who are interested in picking up the television sound broadcasts as a preliminary to buying a television receiver should make a note that the new Invicta receiver, Model 310, is suitable for this purpose.

This receiver which covers all wavelengths from 6.5 to 17 metres, 16.5 to 52 metres, and the usual medium and long wavelengths, is priced at £13 19s. 6d. It uses five valves in a superhet circuit and will pick up the television sound programmes at quite long distances.

Full details can be obtained from Invicta Radio, Ltd., Radio Works, Parkhurst Road, London, N.7.

Scannings and Reflections

TELEVISING THE BOAT RACE

THE finish of the Oxford and Cambridge Boat Race on April 2 will be televised from the Middlesex bank at Mortlake. One camera, fitted with telephoto lens, will be installed opposite the winning post to show the crews finishing the race. Two other cameras will be operated in the enclosures of the Quintin and Ibis Rowing Clubs respectively to show the crews afloat immediately after the race and in close-up as they bring in their boats.

During the first part of the race, viewers will be able to watch the progress of the boats on an animated chart. The sound commentary to be given on the National wavelengths by John Snagge, with Edgar Tomlin and Tom Brocklebank, will accompany the television broadcast until the finish at Mortlake, when a special television commentary will be given by Howard Marshall.

TELEVISION FOR SCHOOLS

One of the first television installations in schools is that at Leigh Hall College, Westcliff, near Southend. It appears probable that this step marks the inauguration of a new aid to education which will doubtless be followed at other schools and colleges.

THE NEW TELEVISION ANNOUNCER

Mr. David Hofman has been appointed announcer in place of Mr. Leslie Mitchell, who resigned to become a news-reel commentator. Mr. Hofman commenced his duties on March 7. He is thirty years of age, has had ten years' experience on the stage and in films, including eight years in Canada and the United States. He has also been a radio announcer at Station CFCF Montreal.

On his return to England two years ago he appeared in *Parnell* at the Gate Theatre, and has since worked with the Sheffield Repertory Company besides appearing in touring productions.

CRAZY PROGRAMME

Following the amusement caused by his Crazy Cabaret last year, in which the compère was seen throughout in his bath, Cecil Madden is once more devising a presentation which he is calling "Nice Work," an even crazier programme, which follows a general theme. This is to be given on April 1.

Joan Miller will be seen as Cleopatra in a skit on the producers' 100 per cent. Broadway programmes, with Guy Glover as Hyman Kaplan Anthony in a new sketch "You Can't Take Your Needle With You, Cleo!" specially authored for the occasion by Shakespeare and the producer.

There will be burlesques on aspects of television programmes from American Travelogue films in which Charles Heslop and Cyril Fletcher will appear. Others taking part will be the Bashful Boys, the Three Pirates, the Three Romps, and the Narkover Gang, Campbell Rogerson, George and Frank Dormonde.

MORE FILM TELEVISION

The B.B.C. is to extend its activities in the televising of films and work is proceeding in the making of stock films which will assist in studio productions, the idea being to have a film library which can be drawn upon as occasion demands. The possibility of using amateur-made films is not being overlooked and inquiries are being made in America and on the Continent with the object of securing films in which the question of television copyright does not arise.

£295,000 FOR TELEVISION

Major Tryon, Postmaster-General, in the House of Commons on March 9 submitted a supplementary estimate of £360,000 for the B.B.C. He said that it was expected that by the end of March 8,540,000 licences would have been issued, whereas the original estimate was 8,400,000.

It was proposed that 8 per cent. of the net licence revenue should in future go to the B.B.C. for television.

Expenditure would be necessary for additional studio accommodation at the Alexandra Palace, and £295,000 would be the amount of the additional grant for television.

TELEVISION IN THE COMMONS

During the debate on the B.B.C. supplementary estimate several M.P.'s criticised the conduct of the television service.

Mr. H. Morrison (Soc., S. Hackney) described television as "indeed a wonder of the age," and said he did not think it right that a national service of this kind should be monopolised by London. He would, he said, like some indication as to when television would be available for the larger centres of the country, the provinces, Wales, and Scotland.

Mr. Graham White (Birkenhead, E., L.) said that it was important that the cost of television should be reduced and that the service should be brought within the range of a very much larger number of people.

Mr. Simmonds (Birmingham, Duddeston, U.) said that television had not yet been developed either geographically or technically, and it was clear that the B.B.C. was not using its most expensive artists, as compared with broadcasting, which meant that television had an air of amateurism. Perhaps that was one reason why more television receivers had not been sold. He urged that regional developments should be carried out with the least possible delay.

Mr. Magnay (Gateshead, L. Nat.) congratulated the Postmaster-General and the B.B.C. on their new venture in television.

Mr. H. Morrison (Hackney, S., Lab.) asked what effort had been made to get television made more readily available to people of limited means? At present television was limited to a great extent to London and the Home Counties. It was not right that a national service of this kind should be monopolised by London, and he hoped that it would be extended to the provinces, to Scotland, and to Wales.

MORE SCANNINGS . . . .

PROHIBITION OF PUBLIC SHOWS

The B.B.C. has placed a ban upon the showing of its television programmes in public. The announcement of this was made visually before the televising of the Oxford and Cambridge sports from the White City when the following notice appeared on the screens of television receivers. "The reproduction in any form of the outside broadcast which follows, including projection in places of public entertainment, is strictly prohibited."

This decision was the outcome of the arrangement to televise the fight between Jock McAvoy and Len Harvey for the light-heavyweight championship of Britain from the Harringay Arena on April 7. The promoters of this fight made it a condition of their contract with the B.B.C. that reproduction in cinemas should be prohibited.

The question of copyright in the B.B.C. television programmes has never been raised, but obviously it exists and sooner or later the position will have to be defined. At present it appears that the ban is directed against reproduction in cinemas and public halls and if it is upheld it will create a difficult situation in respect of big-screen televisionn unless the cinema interests were prepared to make their own transmissions by cable. A short time ago the matter was raised in Parliament, but as up to that time only experimental transmissions had been made to places of public amusement it was not considered necessary that the position should be clarified.

SHORT-WAVE RECEPTION FROM AMERICA

At the present time it is interesting to find that the average commercial all-wave receiver will bring in quite a number of programmes radiated by the popular stations such as Boundbrook, Pittsburg and Schenectady. This is rather unusual for we are at present in the middle of a period which should be rather bad for general short-wave reception.

When conditions are good it is possible to pick up some excellent programmes which are comparable with local programmes. This is mainly due to the efficiency of the transmitters and the use of beam aerials, for receivers built three or four years ago are still capable of picking up these long distance programmes.

Conditions at the present time are so good that it is quite usual to hear simultaneously American broadcasters on 19, 25 and 31 metres.

TELEVISION IN AUSTRALIA

That something is to be done about television in Australia seems evident. Tests have been conducted on television wavelengths with a transmitter operating from the heart of Sydney, and observations have been made for a range of approximately 15 miles.

PITCAIRN ISLAND

One amateur broadcasting station has been in operation at Pitcairn Island since the first week in March, but now short-wave listeners have discovered that there is a second Pitcairn station in operation using the call-sign VR6AY. This station uses a wavelength of approximately 21 metres and is perhaps one of the most out-of-the-way stations that listeners in this country can hear. Although mail boats to Pitcairn are very few and far between messages are now being sent by radio so that this lonely island can be kept in constant touch with the rest of the world.

TELEVISION AT THE IDEAL HOME EXHIBITION

Television is to be shown all day and every day between April 5 and April 30 to visitors at the Ideal Home Exhibition. Most of the transmissions will be on a closed circuit, but several items are to be televised actually from a studio at the Exhibition and radiated for the benefit of ordinary viewers. A great number of interesting personalities have promised to be televised so making this period a very interesting one for all who are watching the rapid progress of television.

THE HARVEY-McAVOY FIGHT

Viewers were looking forward with extreme interest to the relay of the Harvey-McAvoy fight from the Harringay Stadium. This relay was to have been the most ambitious yet attempted by the B.B.C. television engineers and it was unfortunate that Harvey should have damaged his hand and so called the fight off. However, the fight is to be relayed on April 7 for a full 15 rounds and there is every indication that anyone who can look-in on that evening will do so. Broadcasts of this kind will make broadcast listeners realise just what they are missing by not having a vision receiver.

The recent exhibition of "Catch-as-catch-can" wrestling between McCready and Foster gave quite a good indication of the possibilities of the Harvey-McAvoy fight relay being a most successful one.

THIRTY RECEIVERS AT THE IDEAL HOME

At least thirty television receivers supplied by Marconiphone, Baird, G.E.C., Cossor, H.M.V., Murphy, and many others, will be in operation from 11 a.m. to 10 p.m. for the duration of the Ideal Home Exhibition. Visitors will also be able to walk round three sides of a glass-walled studio and watch the television scenes being acted. On the opening day Mr. Gilbert Frankau will make an afternoon speech from the studio and at 8.30 p.m. two well-known actors, Mr. Robertson Hare and Mr. Alfred Drayton will be televised.

FAMOUS ARTISTS TO BE TELEVISED

Many famous artists are to be televised between April 5 and 30, and these will include Miss Kay Cavendish, Mr. Lupino Lane, Sir Hugh Walpole Dr. A. J. Cronin and the well-know author, Mr. Rafael Sabatini. Amongst the sporting personalities to be televised are Tom Webster, Miss Kay Stammers and Mr. Stanley Doust.

A fashion show is to be televised and the compère will be Miss Enid Stamp-Taylor, the well-known actress, while Mr. Leslie Howard, who is at present filming in *Pygmalion,* will also appear before the television camera.

Several London night clubs and theatres are to supply artists and extracts from stage shows and these will include the Coliseum, London Casino, and the Prince of Wales Theatre.

London Films will loan some of their artists from Pinewood and Denham, amongst those expected will be Mr. Robert Donat, Mr. Clive Brook, Mr. Leslie Banks, Mr. Rex Harrison, Mr. Raymond Massey,

. . . . . . AND MORE REFLECTIONS

Mr. Ralph Richardson, Miss Margaretta Scott, Miss Vivian Lee and Miss Valerie Hobson.

AEROPLANES AND TELEVISION

Low-flying aircraft certainly do interfere with television reception and in some instances interference has been noticed even when the planes have been at a high altitude.

This is rather extraordinary for the electrical system in the average aeroplane is completely screened with all leads bonded in order to prevent interference to radio apparatus installed in the plane. In view of the number of complaints made by viewers regarding interference from aeroplane engines, it appears that the ignition systems are only sufficiently screened to prevent interference on the wavelength at which the aeroplane receiver is being operated. This allows interference to be radiated on much lower wavelengths so interfering with television reception.

NEWS BULLETINS AND TELEVISION VIEWERS

By this time most viewers will have heard the News Bulletin broadcast at the completion of each evening's programme. This News Bulletin is actually a recorded version of the nine o'clock bulletin broadcast on the National wavelength. No vision accompanies this transmission although for the period an announcement is left on the screen and in the corner of the announcement board is shown an electric clock. This gives the correct time very accurately for the large second-hand can clearly be seen.

SPECIAL OUTSIDE BROADCASTS

The television engineers at Alexandra Palace, and particularly those in charge of the outside broadcasting van, deserve congratulating on the excellence of their transmissions despite many difficulties. The relay of the womens' hockey from Kennington Oval, the 'Varsity sports from the White City, and the International Rugby from Twickenham were three of the most interesting events. However, these will be very much put in the shade by the televising of the Boat Race and the F.A. Cup Final from Wembley Stadium. Viewers have seen enough of the outside broadcasts to realise that they will be able to follow the action of all these broadcasts quite comfortably.

The interference noticed by viewers on the outside broadcasts last year seems to have stopped, although there was a slight trace of this trouble during the Rugby International relay.

TELEVISION PROGRAMMES FOR CINEMAS

Although the B.B.C. specifically bans the showing of television in public places, there is a scheme on hand fostered by cinema proprietors to install large screen television equipment and to produce their own programmes in a central studio which could be connected by line to the various cinemas interested. This idea seems to be quite a good one, but it seems that there will probably be some difficulty in maintaining the standard of entertainment. Most viewers seem to appreciate the unusual programmes such as the relay of the Cup Final, rather than a normal type of entertainment that can be seen in any cinema or theatre.

ENGLAND v. SCOTLAND

On April 9 the mobile television unit will be installed at Wembley Stadium to show viewers the International Soccer match between England and Scotland. This relay is by permission of the Football Association and Wembley Stadium, Ltd., who are also granting facilities for televising of the Cup Final at Wembley on April 30.

THE FIRST SUNDAY PROGRAMME

The first Sunday evening television programme on April 3 will include a special version of Clemence Dane's great biographical play, "Will Shakespeare," with Henry Oscar in the name part. When the play was first presented at the Shaftesbury Theatre in 1921, John Galsworthy described it as "the richest, most imaginative blank verse we have had since Shakespeare's own day."

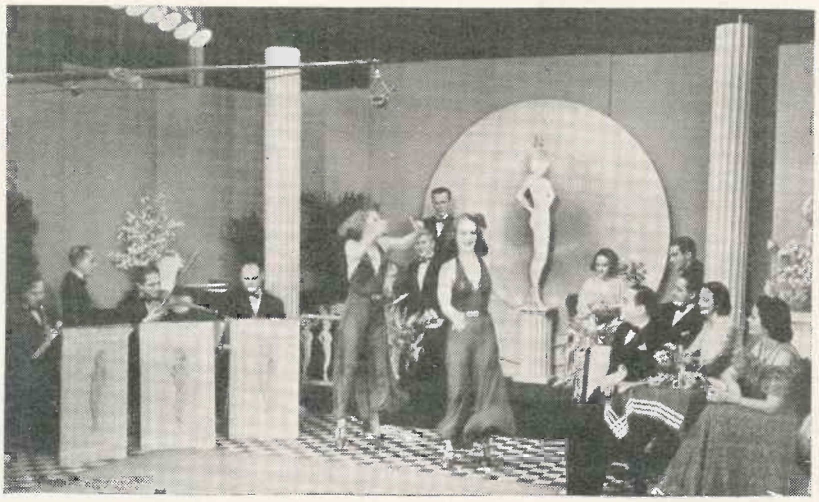
In a series of dramatic vignettes, the play takes us from Stratford, where Shakespeare is estranged from Ann Hathaway, to London, where the dramatist falls in love with Mary Fitton, produces plays, meets the Queen, makes merry at Deptford with Kit Marlowe, quarrels with him, and becomes involved in a tragedy which may or may not have an historical basis.

Margaret Rawlings will be seen as Mary Fitton, and Esmond Knight as Marlowe.. The cast also includes Catherine Lacey as Ann, and Barbara Everest as Mrs. Hathaway.

George More O'Ferrall, who is producing "Will Shakespeare," considers that the play should be ideal for television. It will be televised again on April 8.

TELEVISION DRAMA

Another biographical play, "Wren of St. Paul's," by a young English playwright, Christine Hahlo, will be seen on April 4 and 9. Sean O'Casey's comedy, "The End of the Beginning," is another highlight scheduled for April 5 and 13. "The Seventh Man," a play by Michael Redgrave, based on the story of "Q," will be televised in the evening on April 8 and repeated on April 11.



A scene in the R.C.A. television studios.

AN EASILY-MADE DIPOLE AERIAL

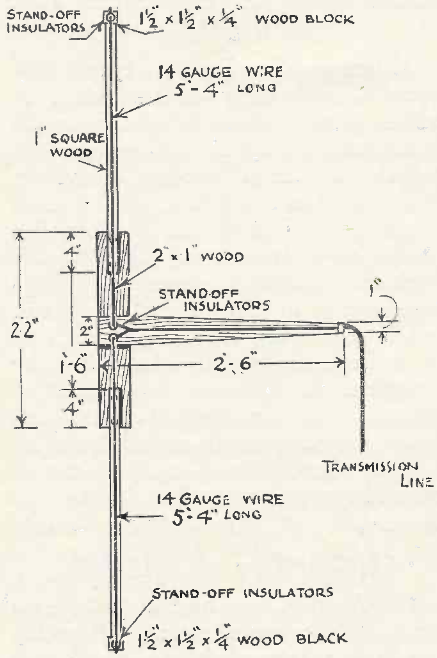
THE dipole television aerial described below was constructed at short notice with materials that are readily available, and it probably represents the cheapest construction that is possible.

As will be seen from the sketch, it is made chiefly of wood, the actual aerial consisting of two lengths of 14-gauge copper wire, which are supported on two Bulgin stand-off insulators (type 110), which cost eightpence each.

The wooden framework consists of two lengths of 1-in. square deal, each 4 ft. 9 in. long, screwed to another piece 2 ft. 2 in. long, 2 in. wide, and 1 in. thick. This allows an overlap at each end of the aerial supports of 4 in. and provides for the support of two lengths of wire each 5 ft. 4 in. long with a space of 2 in. between the inner ends.

At the two exreme ends of the aerial framework the stand-off insulators are mounted on two small squares of oak which are previously screwed to the ends of the 1-in. pieces. The necessity for these small pads is because the bases of the stand-off insulators are a larger diameter than the frame arms, and it is not desirable to increase the weight by using thicker wood.

The centre stand-off insulators are mounted on a piece of wood 2½ in. wide at one end and tapered off to 1 in. at the other. This piece of wood is 2 ft. 6 in. long and serves the double purpose of providing a mount for the stand-off insulators at approximately the same level as the outer ones, and also a support for the down lead.



The construction of the aerial will be clear from this dimensioned drawing.

The assembly, as described, provides supports for two lengths of 14-gauge copper wire, each 5 ft. 4 in. long, and with a space of 2 in. between the inner ends. This measurement of wire length is important, and it represents a quarter wavelength in each case.

Clamping screws are provided on the stand-off insulators, and loops are accordingly made at the ends of the wires to take these. At the inner ends it was thought desirable to further ensure a good and permanent connection by soldering the wire to the screws after the lead-in had been attached.

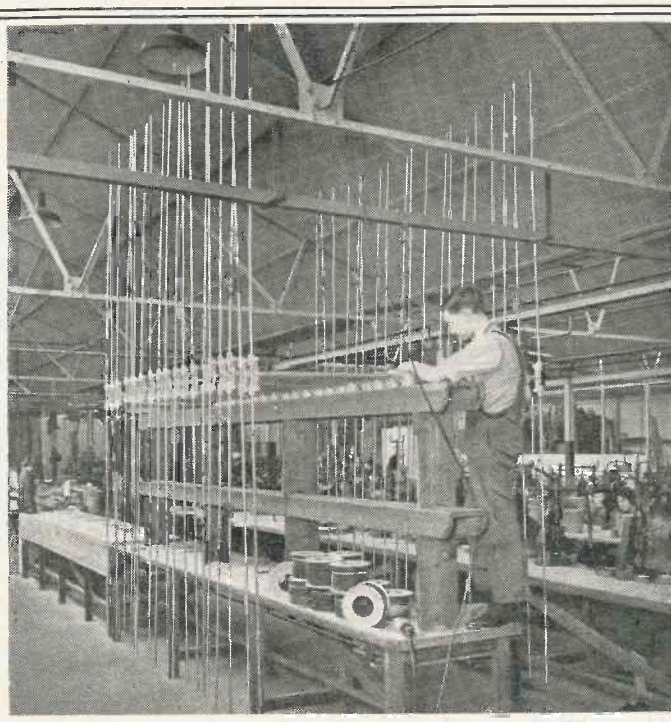
The lead-in, as will be seen, is carried along the horizontal arm, being secured to the outer end by a porcelain cleat. In the first instance, ordinary twisted flex was tried for the lead-in, but it was obvious that the greatest efficiency was not being obtained and in its place the new Belling-Lee 80-ohm transmission line was used. This is a recent production which it is claimed has negligible losses at 7 metres and the results obtained after its installation certainly bore out this claim, for there was a general all-round improvement in picture quality; further, it has the advantage that it cannot become water logged, and it is practically impervious to weather.

The Yorkshire Television Association

THE annual general meeting of the Yorkshire Television Association was recently held at the Regent Picture House, Leeds, when there was a full gathering of members.

In presenting his annual report, the secretary remarked on the excellent financial position of the association considering that quite a large sum had been expended in transmitting equipment. He recalled the many well attended meetings held during the year, and also a day tour which would be difficult to better and one which will long be remembered by those who took part. This was a visit to the works of Messrs. A. C. Cossor, Ltd., at Highbury Grove, a tour of the Alexandra Palace television station, an inspection of the large screen television gear erected by Mr. Baird at the Dominion Theatre, London, and also a visit to the Phoenix Theatre, London, to hear the first demonstrations of " Mirrophonic " sound.

Prospective members are requested to get in touch with the secretary, Mr. A. Buckley, 110 Finkle Lane, Gildersome, near Leeds.



A batch of dipole aerials in course of construction at the Belling Lee works

WIDE-BAND TELEVISION AMPLIFIERS

The following article is an abbreviated form of one which appeared under the same title in "Electronics." It is by F. A. Everest, of the Oregon State College, and gives an outline of the theory underlying the frequency range of television amplifiers.

IT seems probable that the newly-developed electron multipliers will eventually supplant the resistance-coupled amplifier on account of the very high gain obtainable at very low noise level. In the meantime the resistance-capacity coupled amplifier can be made to serve very well for video-frequency amplification until it is supplanted, and the object of this paper is to show how it can be adapted to the handling of the high frequencies present in television.

The circuit of the resistance-capacity amplifier is shown in Fig. 1a, and the equivalent circuit for high frequencies is shown in 1b. At these frequencies the reactance of the coupling condenser C is negligible. C′ represents the output capacity of the first valve and C″ the input capacity of the second valve. The signal voltage *e* applied to the first grid can be considered as a voltage equal to μe acting in the anode circuit in series with the valve impedance R .

The anode resistance R and the grid leak R_g are effectively in parallel and can thus be replaced by an equivalent resistance R′ which is given by $\frac{RR_g}{R+R_g}$.

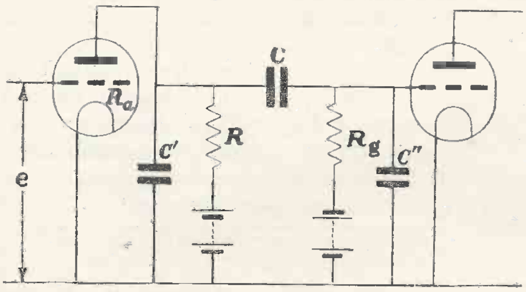


Fig. 1a. Circuit of R.C. coupled stage showing shunt capacities.

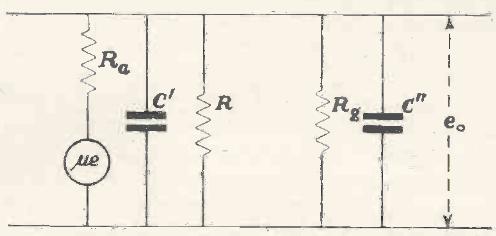


Fig. 1b. The same circuit without valves showing capacities and resistances effectively in parallel.

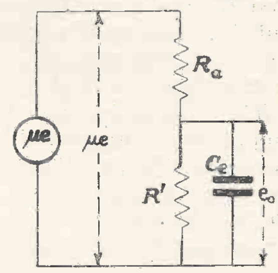


Fig. 1c. A further simplification showing how the stray capacities shunt the output voltage.

If the capacities C′ and C″ are added to form the equivalent capacity C_e, we can simplify the circuit of Fig. 1b into that of Fig. 1c, as shown.

Effect of High Frequencies

At high frequencies the reactance of the capacity C is very low and it forms a shunt across the resistance R′, lowering the proportion of the voltage μe which appears across it. As the stage gain is equal to the ratio of the output voltage e_0 across R′ to the input voltage μe, the gain will steadily decrease as the frequency rises.

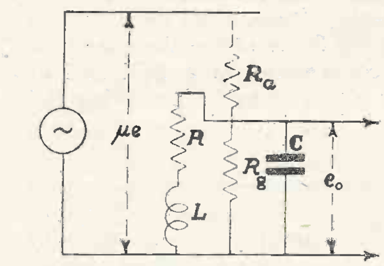


Fig. 2. The addition of an inductance L to the equivalent circuit of Fig. 1c.

The first step towards improving the stage gain is to minimise the shunting effect of the capacity C_e. If the value of the grid leak R is high in comparison with R_g (as it would be in practice) the value of R is the main factor in determining the effective impedance across the output. Values were calculated for a fixed value of grid leak of 1 megohm and various anode resistances from 50,000 to 1,000 ohms and it was seen that the frequency response increased with decreasing values of R. With 50,000 ohms a stage gain of 11 is obtained with a type '56 valve and the response curve is flat to 100 kc. With 5,000 ohms, however, the response is flat to 300 kc., but the gain is reduced to 5. It is clear that the selection of the value of the coupling resistance is governed by the compromise between gain and frequency response.

The above considerations do not take into account the Miller effect, which causes the total shunting capacity to be considerably larger. Since this effect depends on the amplification factor of the valve and the grid-anode capacity, it is possible to reduce the shunting capacity by lowering the latter.

This is done in the screen-grid valve, and thus we should expect to obtain much better results by using screened pentodes in the amplifying stage. As an example of the reduction in capacity obtained, the figure for a triode type 56 is 57.8 $\mu\mu$f. while that of the acorn pentode is only 11 $\mu\mu$f.

With an anode resistance of 10,000 ohms and the same value of grid leak, the stage gain is raised to 11 in the case of the acorn pentode, with a flat frequency response to nearly 1 megacycle.

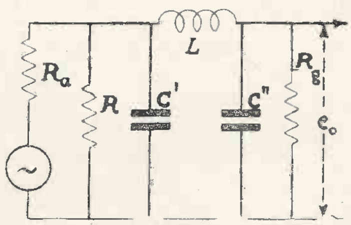


Fig. 3. The equivalent circuit of a filter coupled amplifier corresponding to Fig. 1b.

Use of Inductance

A favourite method of neutralising the effects of the shunt capacity is by the introduction of a small inductance in series with the anode resistance R. This actually forms a resonant circuit, but the resonant frequency is higher than the highest frequency it is desired to amplify. Fig. 2 shows the equivalent circuit of the amplifier with the addition of an inductance in series and the resulting response curves show that for an inductance of 1.1 millihenry the impedance across the output terminals actually exceeds the value at the middle range of frequencies and a greater proportion of the input voltage μe appears across the output.

This means that the stage gain is increased above 300 kc. and this effect may be used to compensate for a falling off in other parts of the circuit. Care must be taken, however, that the peaking of the voltage output does not reach such a value that the amplifier oscillates at the high frequencies.

The calculation of the response of amplifiers including inductance is involved as the impedance of the combined choke and resistance must be found for each frequency value required.

This equivalent impedance is then substituted in the formula for stage gain.

Filter-coupled Amplifiers

The use of filter circuits in amplifiers has been described by Beardsall* and the following table gives some results calculated for the filter-coupled stage shown in Fig. 3.

Cut-off freq.	C ($\mu\mu$f.)	L (mH.)	R	Approx. Gain.
2	6	2.105	13,220	14.5
3	6	.935	8,830	9.7
4	6	.526	6,620	7.3
6	6	.234	4,410	4.9
8	6	.132	3,320	3.7
4	12	.262	3,320	3.7
6	12	.117	2,200	2.4
8	12	.066	1,650	1.8

The frequency is in megacycles, and $C_1 = C_2 = C$.

The value of the cut-off frequency selected should be 2-10 times the maximum frequency desired to amplify. It should be noted that the value of the grid leak R is exceptionally low, and it is in fact the characteristic impedance of the filter.

Phase Shift

The phase shift accompanying the amplification of the signal may assume important proportions as its effect is a displacement of the picture element from its proper position.

For a 300-line 24 pictures/sec. transmission on a screen 10 in. wide a phase shift of 45° results in a displacement of .009 in. at certain low frequencies.

The phase shift of the inductance compensated circuit described above is appreciable with inductances of 0.5 mH and over and this is an important factor in determining the final value of inductance to use.

* The original paper referred to appeared in T. & S. W. W. for February 1936, p.95.

AMERICAN TELEVISION

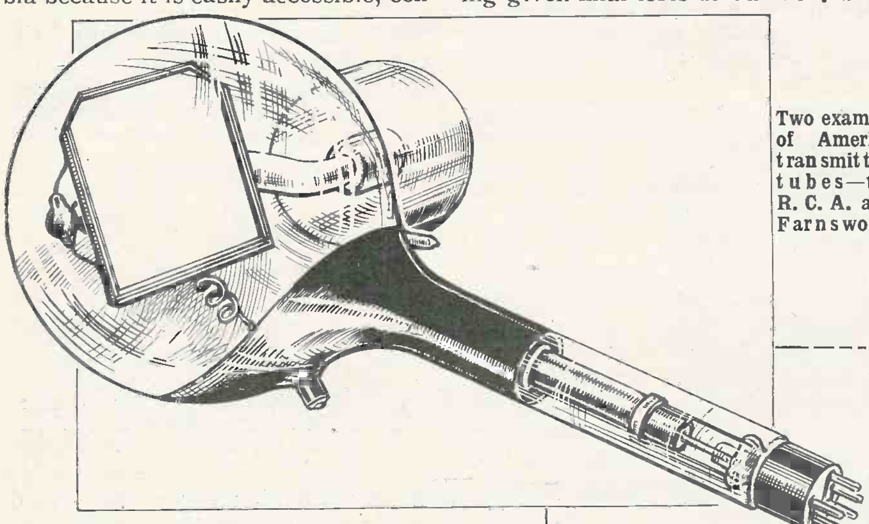
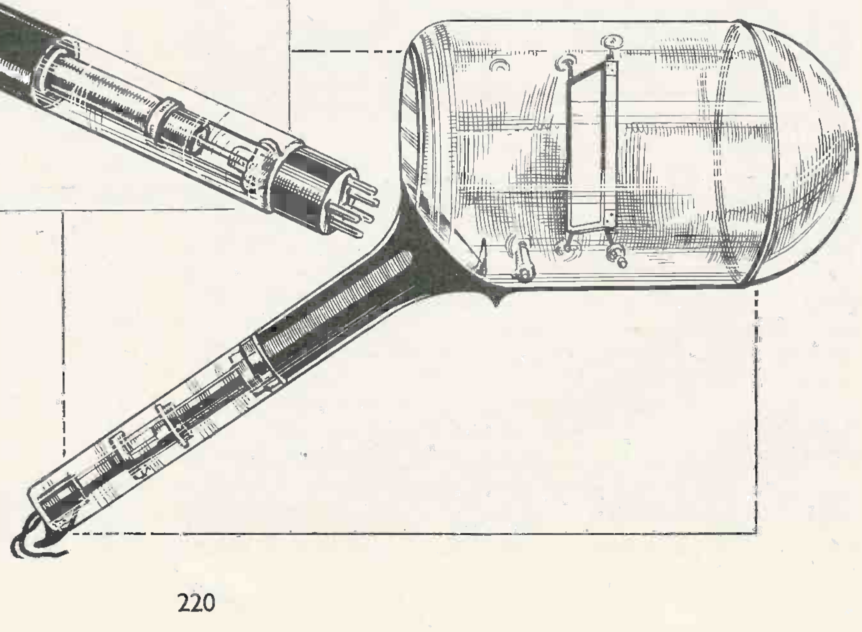
The Studio

THE Grand Central Studio across the street from the Chrysler Building was chosen by Columbia because it is easily accessible, centrally located and near the transmitter. This will make programme production easier as well as assure power transmission with the least possible loss or distortion. The problem of power transmission is further simplified by the fact that the aerial for the new station is located just under the stainless steel needle of the building, only 90 ft. from the transmitter.

The studio space is directly over the main waiting room of the station and is 40 ft. high, 230 ft. long and 60 ft. wide. In addition to dressing rooms, laboratories, etc., there is room for two large studios, but only one is to be constructed immediately.

The television cameras are now being given final tests at Camden. They are mounted on counterweighted "dollies" so they can be moved about easily and raised and lowered at will. Each is connected to its control equipment by a flexible cable $1\frac{1}{2}$ in. thick which contains a total of 32 circuits, four of which are coaxial.

Experiments now are going on in Camden to determine the type of aerial best suited for the transmitter and also for the Chrysler pinnacle around which it is to be constructed. A complete "electrical reproduction" of the top floors of the skyscraper has been constructed in a field and different kinds of aerial are being built and tried out on this structure.

Two examples of American transmitting tubes—the R. C. A. and Farnsworth

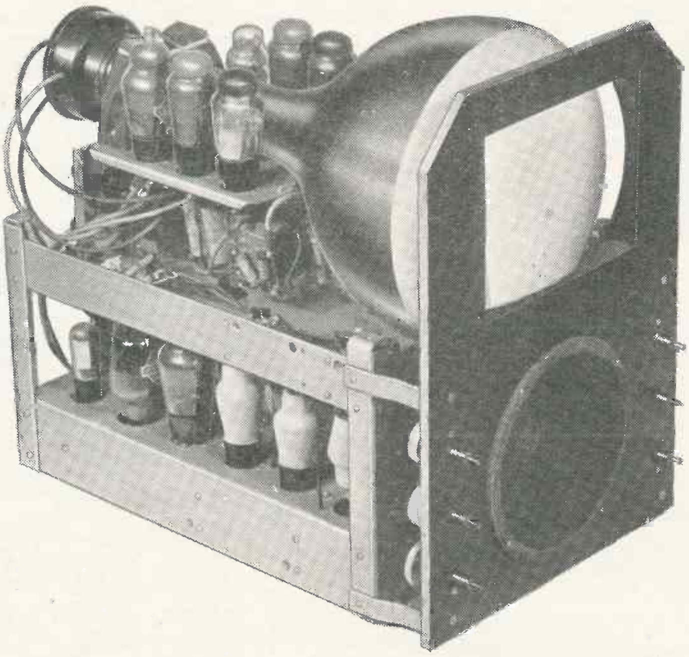
COSSOR TELEVISION

The results of our laboratory and practical tests on the Cossor television receivers are given in this short review.

A. C. COSSOR, LTD., have produced three different types of television receiver all of which give a bright black and white picture which is viewed directly on the front of the tube face.

The two larger models first produced a little over 12 months ago have not been modified since they were first introduced which speaks well for the design in the first instance.

The receiver which should be of



A view of the fine chassis of the Cossor television receiver model 437T.

particular interest to our readers is the smaller table model 437T, priced at 45 guineas. This receiver has one of the largest pictures available in what is generally known as the cheaper models.

The sensitivity of this instrument on both sound and vision is practically the same as with the larger models which are priced at 70, 80 and 90 guineas.

We have been testing the model 437T under very bad local conditions where the field strength is so low that only the most sensitive receiver will provide a picture of any kind.

Despite this handicap the picture received is a definite black and white with ample contrast. The sensitivity of the receiver is such that there has not been any need to peak the radio units for vision or to reduce the band width in order to obtain increased gain.

Contrary to the usual practice in the cheaper instruments two distinct receiver chassis are used, one for vision signals and the other for sound reception.

Both of the aerial inputs are fed from a common aerial in rather an unusual manner. Between the input of each receiver and the common 80-ohm feed line is a rather unconventional ¼-wave matching stub. In this way the two frequencies are adjusted in such a way that they reflect into almost an infinite load so that both receiver units can be fed from the common aerial without loss.

Super-het. receivers are used in both cases which is rather better than having one or two stages in the vision receiver fulfilling a double purpose.

In the vision receiver there are two high-frequency stages before the mixer which is a triode-hexode of high conversion conductance.

Following the mixer are but two intermediate-frequency stages feeding a double-diode-triode of special design having a very low inter-electrode capacity. This is, of course, essential in order to prevent possible attenuation of the very high frequencies handled.

A single video stage is used followed by one double-anode valve for synchronising and four valves in the time bases, three straightforward rectifiers and five valves in sound receiver making a total of 20 valves in all.

The sound receiver has a single H.F. stage in front of the mixer with a single I.F. stage, a double-diode-triode second detector and an output pentode in the final stage.

With this 437T receiver there are five controls and one switch on the front of the cabinet with seven additional pre-set controls at the back of the cabinet out of the way.

It has been our experience that the receiver is easier to operate than the average all-wave receiver for most of the controls remain untouched for long periods.

The main controls on the front of the panel are, on-off switch, sound volume, trimmer for sound receiver, brightness, focus and contrast.

It is not really necessary to touch any of these controls with the exception of the switch, once they have been set. The more important controls, which are at the back of the cabinet, are pre-set when the receiver is installed and need not be touched.

These controls are for adjusting the width and height of the picture, the horizontal synchronising, the

The external appearance of the 437T receiver giving an 8¼-in. by 6½-in. picture.

vertical synchronising and interlacing.

Once the receiver has been ad-

20 VALVES :: A COMPLETE INSTRUMENT

justed the picture remains quite steady and interlaces perfectly. It is advisable to have the contrast control retarded as much as possible in order to use the receiver with minimum stage gain. Interference from motor-car ignition systems can be troublesome if the receiver is used in a bad location or if too high a degree of sensitivity is used.

This interference will make itself noticeable by a number of white spots appearing on the screen. This interference can be cured in all but the most distant areas in which case a small unit can be fitted which has the effect of converting the white spots into black ones. This " spotter " or phase reversing unit costs an additional 25s., including fitting.

The picture size of this Cossor receiver is about $8\frac{1}{4}$ in. by $6\frac{1}{2}$ in., which is ample for the average home. In addition, as the definition is so good a number of people can view at the same time. For example upwards of a dozen people viewed the relay of International Hockey from Kennington Oval and the same number saw the Varsity sports from the White City.

The size of picture was ample fully to appreciate the action going on while some of the camera work in the hockey relay was extremely fine. In many instances the ball was followed in flight from the moment of impact.

We have found this receiver quite trouble free, in fact, less troublesome than the average multi-valve receiver. Many readers with a receiver of this kind will find that the only control to be used is the main switch.

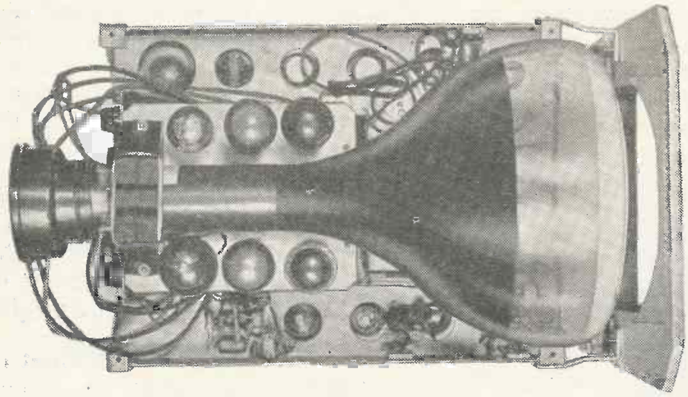
The standard cabinet is of grained walnut $22\frac{1}{2}$ in. high, $14\frac{1}{2}$ in. wide and 25 in. from back to front. A table on which to mount this receiver can also be obtained, the price of which is 3 guineas.

For those who need a combined television and radio instrument there is the model 137T, which has been designed for reception of the normal broadcast stations on 200-2,000 metres.

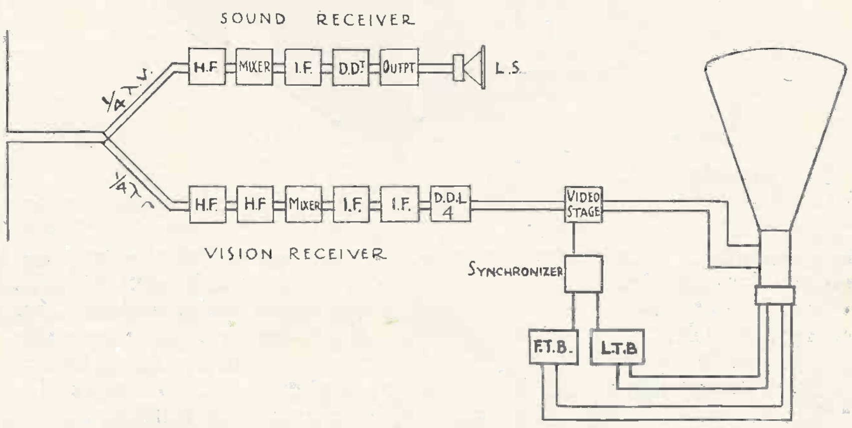
This instrument gives high fidelity reproduction and a high output in addition to a large picture size of 10 in. by 8 in. This instrument complete with the special aerial, installed and adjusted, costs 70 guineas, which includes a guarantee and maintenance for twelve months.

For those who require all that radio and television can offer there is a special receiver, model number 237T, which provides a large black and white picture, broadcast reception with high fidelity reproduction and a gramophone pick-up with a fully automatic record changer.

This instrument costs 90 guineas and is a very fine complete home entertainer.



This is a plan view of the Cossor small receiver. Notice the compact lay-out.



This schematic diagram gives a very good idea of the valve line-up in the small Cossor receiver.

Both the 137T and 237T have a special switch which receives the T.V. sound without the picture. This is a most useful device in that such items as the News Bulletins may be received without wasting the extra wattage consumed by the tube.

Full information on these receivers can be obtained from A. C. Cossor, Ltd., Cossor House, Highbury Grove, N.5.

Book Review

Principles of Radio, by Keith Henney (Chapman & Hall, 17s. 6d.). Good text-books suitable for the student and the advanced constructor interested in the working of circuits built are all too few. This is one of the reasons that we were so pleased to find that KEITH HENNEY, the well-known editor of *Electronics*, had issued a third edition of his " Principles of Radio."

This book gives a simple explanation of most radio problems in a direct manner while at the same time the technical aspect is not overlooked. The chapters include Ohm's Law, Capacity, the Valve as an Amplifier, Low-frequency Amplifiers, and several chapters on transmission, aerials and oscillators.

Each chapter is complete in itself and although a certain amount of formulæ is essential none has been included without fulfilling some definite purpose. It is also very interesting to have the American point of view on several problems which are common to engineers in both countries. This book fills a want and is one of the most concise books of its kind available. It is to be strongly recommended to all interested in the principles of radio.

RECENT TELEVISION DEVELOPMENTS

A RECORD OF PATENTS AND PROGRESS

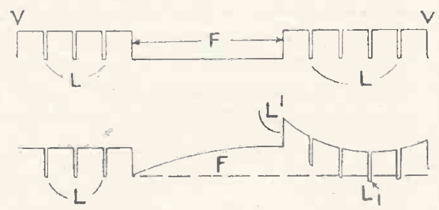
Specially Compiled for this Journal

Patentees: Baird Television Ltd., L. R. Merdler and A. H. Gilbert :: Telefunken Ges. fur drahtlose Telegraphie m.b.h. :: N. V. Philips Gloelampenfabricken :: M. J. Goddard and I. M. K. Syndicate Ltd. :: Zeis Ikon Akt. :: Baird Television Ltd. and D. M. Johnstone :: F. W. Cackett

Line and Frame Impulses

(Patent No. 475,046.)

LINE-synchronising signals usually consist of rapid "dips" L below a datum line V-V of uniform voltage, the frame-synchronising signals F being of similar form



Obviating a synchronising defect. Patent No. 475,046.

though longer in duration. It is found that at the end of each framing impulse, there is a tendency for the line impulses to acquire an undesirable variation in amplitude, as shown for instance at L1 in the lower curve.

The effect is said to be due to the setting-up of forced oscillations in the line-scanning oscillator by the sudden change of voltage at the end of each framing impulse.

According to the invention, this defect is corrected by suitably coupling the valve that separates the picture from the synchronising signals to the oscillator valve producing the line-scanning oscillations. The coupling transfers an impulse which neutralises the voltage "kick" shown at L1 in the figure.—*Baird Television, Ltd., L. R. Mèrdler,* and *A. H. Gilbert.*

Synchronising Systems

(Patent No. 475,189.)

In order to secure accurate synchronisation of the "line" and "frame" impulses, the latter are divided into two parts, the first serving to prepare the way for the second, which actually "triggers" the timing valve.

Both the line and frame impulses are applied to a pair of discharge valves. The line impulses actuate one valve in the ordinary way, and simultaneously build-up a voltage which blocks the grid of the second valve. This blocking voltage is removed by the first or preliminary part of the "framing" impulse leaving the valve ready to respond to the second or operative part of the impulse.

During the transmission of the two-part framing impulse no line signals are transmitted.—*Telefunken Ges. für drahtlose Telegraphie m.b.h.*

Cathode-ray Tubes

(Patent No. 475,772.)

In order to produce a "white" light from a fluorescent screen, it is usual to use a mixture containing zinc or cadmium sulphide. It is found, however, that this tends to shorten the life of the tube, because in the course of time such screens liberate "free" sulphur which attacks and "poisons" the oxide coating of the cathode.

According to the invention a part of the wall of the tube, between the cathode and the screen, is coated with a layer of an alkaline earth metal. This absorbs any free sulphur that may be emitted from the fluorescent screen, and so prevents it from damaging the cathode.—*N. V. Philips' Gloeilampenfabrieken.*

Light Valves

(Patent No. 475,971.)

Relates to known forms of light valve in which the refractive medium is subjected to high-frequency mechanical vibrations from a piezo-electric crystal, and in which a number of image points are thrown on to the viewing-screen simultaneously so as to form a line or strip of light.

The arrangement is now modified by using a number of piezo-electric crystals to produce two or more parallel trains of vibrations through the medium, thus forming two or more different strips of picture-points, separated by intervals corresponding to one or more scanning lines. These are projected simultaneously on to the viewing-screen in their correct relative positions.—*M. J. Goddard* and *I.M.K. Syndicate, Ltd.*

Image Dissectors

(Patent No. 475,995.)

The signalling currents produced in a television transmitter of the "dissector" type are intensified by

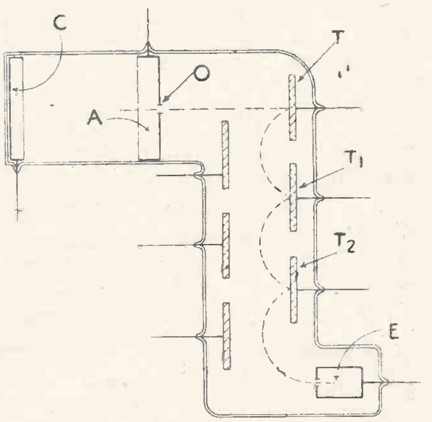


Image dissector. Patent No. 475,995.

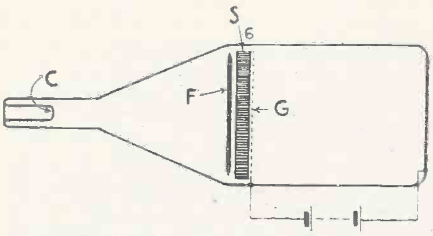
secondary emission before being used to modulate the outgoing carrier-wave.

As shown in the drawing, the picture to be televised is first focused upon a sensitive electrode C, and the electrons so liberated are moved past a scanning aperture O in the anode A by suitable deflecting electrodes (not shown).

The emerging stream falls directly on to a "target" electrode T where it produces secondary electrons. These are thrown, by combined electric and magnetic fields, in turn against similar target electrodes T1, T2, as shown by the dotted lines. At each impact the stream is further intensified by secondary emission, until it reaches the output collector E, where it is converted into a signalling current.—*Zeiss Ikon Akt.*

Intensifying Picture Signals
(Patent No. 476,233.)

In a cathode-ray television receiver, the incoming signals are first reproduced on a fluorescent screen F by the electron stream from the cathode C in the usual way. The light from the far side of the screen F then falls upon a photo-sensitive electrode S of the " mosaic " type, consisting of a large number of photo-electric particles set in a plate of insulating material. The fluorescent light sets up



Tube for increasing picture intensity. Patent No. 476,233.

charges on each of the mosaic cells at the side nearest to the screen F. Meanwhile a steady illumination acts upon the opposite face of the electrode S, so that each individual cell is discharged in a period of time equal to that required to complete the scanning of one picture-frame.

The electrons emitted, as each cell discharges, first pass through a grid G, and are then focused and accelerated on to a second fluorescent screen K, where they form an intensified image of the original picture.—*Baird Television, Ltd.*, and *D. M. Johnstone.*

Generating Saw-toothed Oscillations
(Patent No. 476,336.)

Saw-toothed oscillations, suitable for scanning, are produced in a circuit of which the inductance is formed by the deflecting coils of the cathode-ray tube, and the capacity is the inherent capacity across the windings of the same coils.

The deflecting coils, shunted by a biased rectifier, are included in the plate circuit of a valve, and the arrangement is such that the current taken from the valve is reduced to a minimum for the work it has to do.—*F. W. Cackett.*

Summary of Other Television Patents
(Patent No. 475,047.)

Cathode-ray tube provided with a storage grid backed by a parallel high-potential grid, and with a cathode emitting a wide homogeneous electron beam, for scanning.—*Baird Television, Ltd., V. Jones,* and *P. W. Willans.*

(Patent No. 475,100.)

Electron discharge device fitted with a photo-electric cathode, consisting of silver telluride coated with tellurium, and a photo-sensitive material.—*Baird Television, Ltd.,* and *A. K. Denisoff.*

(Patent No. 475,715.)

Electron tube containing a transparent " mesh " anode and a high-resistance photo-electric screen or target, backed by a parallel scanning-member.—*Electrical Research Products Inc.*

(Patent No. 475,807.)

Photo-electric cell of the evacuated type, in which a funnel-shaped "control" electrode is inserted between the cathode and anode.—*Baird Television, Ltd.,* and *E. B. King.*

(Patent No. 475,928.)

Television transmitter in which the picture signals are intensified by secondary emission from a mosaic-cell electrode.—*Electric and Musical Industries, Ltd.,* and *H. G. Lubszynski.*

(Patent No. 475,999.)

Optical multiplying system for use with a mirror scanning-drum.—*R. G. Wilson* and *W. D. Silver.*

(Patent No. 476,181.)

Scanning a continuously-moving film by an " interlaced " line-group method.—*Radio Akt. D. S. Loewe.*

(Patent No. 476,256.)

Composite H.F. inductance for a television transmitter designed to show high damping-losses.—*Baird Television, Ltd.,* and *D. W. Pugh.*

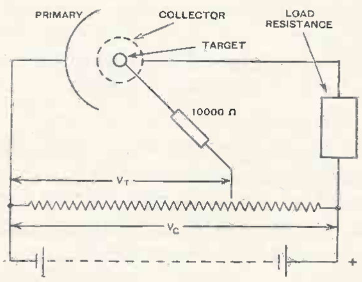
(Patent No. 477,433.)

Means for preventing the electron beam in a cathode-ray tube from burning-out the fluorescent screen.—*Philco Radio and Television Corpn.*

G.E.C. Secondary-emission Photo Cells

RECENT research work on photo-electric cells at the laboratories of the G.E.C. has been directed almost entirely to work on secondary emission cells of the single and multiple stage types. The progress achieved in the development of the former has led to the production of secondary emission cells of the cathode-on-wall type, known as the CWS24. A smaller size, type CWS8, similar in dimensions to the well known CMG8 is also available. With regard to the multiple-stage secondary-emission cells, experience has been gained with their use in the development of a television transmitter used for test purposes, but they are not yet available for the general market.

The CWS24 secondary-emission cell consists of a primary cathode, a target and a collector. When light falls upon the primary cathode, photo-electrons are emitted. These electrons are accelerated by means of a suitable electric field towards the target, where, upon impact, they release secondary electrons. The ratio of the number of secondary electrons emitted to the number of primary electrons incident upon the target in unit time, is a function of the impact



Circuit diagram of CWS.24 secondary emission cell.

velocity and the target surface. For targets employing the complex cæsium cathode, the ratio may be as much as ten times.

The secondary electrons are attracted towards a collector, which plays the same part as the anode in the ordinary photo-cell, and it follows that the collector current can be several times greater than the original photo-electric current.

In the CWS24 and the CWS8, the primary cathode is formed upon the inner wall of a glass bulb, the target on a silver tube in the middle of the bulb and the collector is a wire helix coaxial with and surrounding the target.

The circuit recommended for use with these cells is shown here. The following values should be noted:—

V_T = 75 per cent. of V_C.

Recommended value for V_C = 400 volts but may be between 100 and 800 volts.

Potentiometer current—1 milliamp.

FINDING AND REMEDYING TELEVISION RECEIVER FAULTS—III

By S. West

The two preceding articles in this short series dealt with the location of faults in the vision receiver and time base. This article, in conclusion, deals with picture distortion and faults in the power unit.

WE will now assume that the raster is obtained and picture modulation is applied. The resulting picture is synchronised and has good detail. Unfortunately, however, aspect distortion occurs, the picture tending to compress at one edge.

This is invariably due to assymmetrical deflection voltages. In isolated cases the tube itself may be to blame or the saw-tooth wave shape may be poor.

With the feed to the grid of the paraphase valve completely cut down for each time base, the picture will have a certain reduced size.

Now the important point is this. When the picture is increased in size with alteration to these paraphase feed potentiometers, symmetrical deflection is obtained only when the picture is approximately twice this reduced size. This is perhaps not strictly true, but it is sufficiently true for our purpose. It is seen, therefore, that the operating conditions of the relay valve will require to be fairly accurately determined. These operating conditions will control also the accuracy of shape for the saw-tooth oscillation.

For the actual relay valve, we are concerned with two variable factors, which control the periodicity of ignition. It is here assumed that the other concerned constants are correct. These are the time constant for the charge device, i.e., the charge resistance and its associated condenser and the control voltage at the grid of the relay valve.

To retain the correct operating frequency and picture size these two factors will require to be varied inversely. However, the amplitude the charge voltage can reach, and therefore the picture size, is directly controllable with the voltage at the grid of the relay valve.

Obviously then, we are able to control the picture size when we incorporate a variable charge resistance in addition to an arrangement which will permit variation of the bias voltage of the control grid.

Similarly, an understanding of the manner in which a condenser acquires a charge will show that these constants will require to be correct for good saw-tooth waveform.

In the "Low Cost" Television Receiver to which these notes are primarily referred, for each time base fixed charge resistances are included. A number of excellent reasons governed the decision to adopt this arrangement when the receiver was designed but, with some operating experience gained, there is no reason why the refinement of variable charge resistances should not be included. This course is recommended where it has been found impossible to avoid aspect distortion.

The Power Unit

We come now to the final link of the complete receiver, the 4,000 volts power unit.

The tests applicable here are strictly limited to those that can be carried out with the unit disconnected from the mains, for amateurs having meters suitable for checking such high voltages are in a minority. There is a way in which it can be ascertained that the voltage is present, but it cannot be too strongly emphasised that extreme care is required.

A screwdriver having a long well insulated handle is required for this check. The blade of this is placed in proximity to a high voltage point, when a light discharge will indicate the presence of high voltage.

A few puzzling faults that often are extremely difficult to locate result where insufficient attention has been paid to the insulation requirements of the high-voltage leads. Also the writer has had personal experience of condensers which are handling a high voltage, developing an internal leak which no normal test will reveal.

Fortunately the fault is usually revealed as a definite pattern on the screen of the cathode-ray tube.

Other leakages are revealed as intermittent flashes not unlike heavy ignition interference. It can be borne in mind that very light discharges can produce a field which is picked up by the vision unit, when it is amplified and passed on to modulate the grid of the C.R. tube.

For those with normally developed olfactory senses the characteristic odour of ozone is an excellent indication of an electrical discharge taking place somewhere. Its location should not prove difficult to find in a well-darkened room.

In the writer's experience certain types of potentiometer can be guilty of an intermittent internal brush discharge which will mar the picture; also rubber-covered cable, no matter how heavily insulated, must always be regarded with suspicion unless the rubber is of excellent quality and in good condition.

Whilst the information given in this article has necessarily been in condensed form, it is hoped that sufficient information has been provided to enable the majority of faults that can occur rapidly to be located.

Useful Data on Light Intensities.

Source of Light	Approx. Intrinsic Brightness Candles per sq. cm.
Carbon Filament	20
Tungsten Filament (Gasfilled Lamps)	350 to 1,650
Sodium Lamps	c. 10
High Pressure Mercury 1 atmosphere, 230 volt	160
High Pressure Mercury 125 Watt. Pearl Bulb*	50
Brightness of column alone*	1,000
Mercury Water Cooled. 400 watts/cm., 400 Volts/cm.*	30,000
Mercury Water Cooled. 800 Watts/cm., 400 Volts/cm.*	60,000
Ordinary Carbon Arc	13,000 to 17,000
High Current Density Carbon Arc	50,000 to 80,000

* Starting volts double running volts. **Dr. C. C. Paterson** G.E.C. Research Laboratories.

Our Readers' Views

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

Mr. A. F. Bulgin's Opinion of the Television Outlook

MY own experience, over a period exceeding 15 months of daily reception of the B.B.C. vision and sound transmissions, is more than encouraging. It is a confirmation of my belief that television is a steady, reliable contribution to civilised amenities, long past the laboratory or experimental stage. The only breaks in our reception were occasioned, not by any trouble with either the B.B.C. transmissions or our televisor, but simply by our own experimenting with various types of aerial. The installation has not been touched now for six months, however, as we have found our L.16 television aerial kit entirely satisfactory.

It is simply a matter of switching on at the appropriate times each day. There is never any disappointment, and the quality of the pictures has remained extraordinarily good. Although the receiver (which is a perfectly normal and unaltered commercial model) is situated in a room next to the big machine shops, with numbers of electric motors and miles of wiring in its vicinity, the problem of interference has not arisen since the first few days of reception, when the use of a suitable transmission line from the di-pole aerial and a few condensers effectually removed the last trace of interference on both sound and vision frequencies.

The Years Ahead

The installation now seems a permanent fixture in the works. It has aroused the keen interest, not only of the technical staff, but of the other employees, to whom "viewing"—or whatever word is to be used in the future—is a fascinating entertainment eagerly enjoyed whenever opportunity is offered.

We are authoritatively assured that the present system of transmission will be employed for a long time to come, so that there is no question of our receiver, although it is already nearly two years "old," becoming obsolete for years to come. This, combined with the promised extension of hours of transmission and the exploration of wider and wider fields for choice of programme material, makes us feel that the initial outlay is entirely justified.

Lower Prices Unlikely

We are not greatly surprised to gather that the prices of televisors will remain very much at their present level for the next few years at least. We know something of the work and material that has to be put into efficient vision receivers and our surprise is rather that prices are as low as they are. Experienced technicians know that quality in materials and reception cost money; this is more true of television than of sound reception. For our part, we are entirely satisfied that any purchaser of a modern televisor will not regret the expenditure and to put off buying one hoping for prices to fall considerably is to miss excellent entertainment for the whole family.

Mr. A. F. Bulgin is Governing Director of A. F. Bulgin & Co. Ltd., the well-known radio component manufacturers.—ED.

Radio Service Employment

SIR,

In view of the interest inspired by recent articles in various organs on the subject of service and the engineer, we, the undersigned, although recognising the good intentions of bodies now in existence, incline to the opinion that radio-service engineers stand in urgent need of an organisation, formed and equipped by themselves, to give collective voice to the immediate and overdue necessity for the regulation and control of hours, wages and status in the retail radio industry, and empowered to negotiate to that desirable end.

We also believe that a general shortening of hours and the stabilisation of service conditions would be welcomed by many dealer-employers.

With a view to obtaining the opinions of fellow engineers on the formation of such a body we invite all interested to write to A.J.B., c/o 86 Myddleton Avenue, Enfield, Middlesex.—Yours faithfully,

F. EDMONDS, D. A. GRIFFIN, H. FITZGIBBON, E. V. RUSSELL, H. WATSON, L. J. OSBORN, H. JAMES, A. WALKER, G. F. JESSUP, J. HOLDEN, L. LEADER.

An Open Letter to Radio Societies and Short-wave Amateurs.

THE British section of the International Short-wave Club has devised a plan to affiliate all radio clubs and societies with The International Short-wave Club with a view to increasing the benefits obtained by the members.

It is hoped to create a powerful national body which would elect a central committee of officers to represent radio amateurs and listeners on the numerous councils and commissions.

The International Short-wave Club receives the full support of the G.P.O., the radio manufacturers and radio amateurs and is strictly a non-commercial organisation.

A body representative of all the amateurs in this country would be able to approach the proper quarters with a view to obtaining legislation regarding the suppression of interference to radio and television.

Affiliated societies could exchange views with regard to current radio topics while lines of research would be indicated by the main committee.

The International Short-wave Club has many thousands of members in 140 different countries and invites all short-wave listeners and radio amateurs to join its ranks. Membership costs 5s. per year from the time of joining, and all members receive the club publications "International Short-wave Radio" and the Short-wave News Letter which keeps amateurs in all parts of the world in constant touch with each other.

Local Chapters where members can meet are open in various parts of the country and more Chapters are being organised in various centres where the need arises.

The London Chapter meets every Friday at 80 Theobalds Road, W.C.1. The club have their own transmitter, while morse instruction is given to members. Readers desirous of further information should write to the Secretary, International Short-wave Club, 100 Adams Gardens Estate, London, S.E.16.

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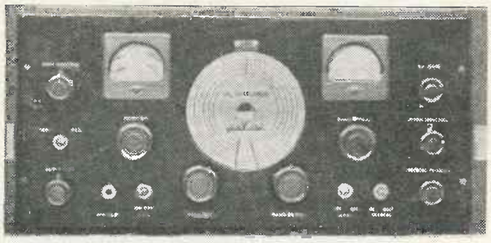

EVERY HALLICRAFTER RECEIVER IN STOCK

1938 Super Skyrider. The finest 5 to 550 metre Superhet calibrated "R" meter. 1,000 degree band spread. Accurate calibration all bands. Crystal gate model complete, 230 volt mains. £32.

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New Improved Model of the 1937 Challenger. Incorporates 1,000 degree band spread, crystal gate, "R" meter terminals. Price complete, **£25.** Available from stock March 1st.

TWO MORE NEW MODELS

Announced by Hallicrafter, release date April 4th. New Improved Sky Buddy at **£9.** New 7 tube (1 R.F.) "SKY CHAMPION" **£12 10s. 0.**

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Every worth while TUBE—and COMPONENT of British or American manufacture is carried in stock at WEBB'S LONDON and BIRMINGHAM Depot. Stocks include full range Eddystone, Raytheon, Taylor, Eimac and Johnson products.

Communication Type Receivers. RME-69, DB-20, all Nationals and Hallicrafters always in stock.

Transmitters. Complete built transmitters, including Temco and Harvey.

NEW RME-501X U.H.F. Frequency Expander. Frequency coverage 27.8 to 70 megacycles. Built-in Power Pack. Overall sensitivity less than one microvolt. Accurately calibrated. Release date—April 10th.

RADIO AMATEURS' GLOBE, 12 inch diameter, full colour, continental boundaries, produced by Webb's : 27/6 Post Free

GREAT CIRCLE MAP of the World, 30 inches by 40 inches, full colour, every international prefix plainly marked, time zones, continental boundaries.

On heavy paper ...	4/6
On linen, with rollers	10/6

NATIONAL CRM 1" OSCILLOSCOPE. See review in this issue. Complete Instrument for 230 v. operation, with 913 tube and rectifier. Price complete **£6 0. 0.**

NEW T.40. TZ40. IN STOCK.

First consignment in England came into our depot March 31st. Price **24/-**

CUSTOM BUILT

T.20 . . . TZ20. Now	**16/-**
866 Rectifier	**10/-**
866 Junior	**7/-**
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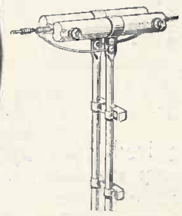
WRITE FOR TAYLOR MANUAL
New edition 6d. post free



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All types in Stock

5 metre Q complete,	**26/6**
10 „ Q „	**25/6**
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Johnson Freed Thru' Insulators 1" **8d.,** 1½" **10d.**
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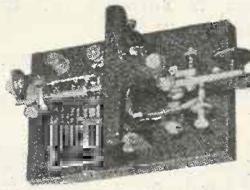

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1938 Model de Luxe Bug, 50/- reduced to **38/-.**
New Junior Bug, reduced from 22/6 to **17/6.**
McElroy Straight Key, latest model, heavy cast base, large contact. Reduced from 10/- to **7/6.**
McElroy Hummer, 1,000 cycle, mechanical oscillator for morse practice, again available from stock, **10/-.**

SEE THE NEW HARVEY UHX-10 TRANSMITTER
(Reviewed in February issue)
10 watt R.F. output all bands. 5 to 160 metres inclusive. Transmitter complete, two band operation, **£19.** 230 volt A.C. Power Pack, **£6 10s.** 6 volt Gene Motor, **£9 16s.**

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Phone : MIDLAND 3771

The National Oscilloscope

THE new National Oscilloscope, a photograph of which appears below, is one of the neatest instruments we have tested for a long time and it cannot fail to make an immediate appeal to the amateur transmitter and research worker.

As the photograph shows, it contains an R.C.A. 1 in. type 913 tube together with the necessary H.T. supply and a 50-cycle potential for the horizontal sweep. An H.T. voltage of 500 is obtained from a type 6Z5 rectifier operating in half-wave and the supply potentials are derived from the usual potential divider chain. Part of the transformer winding is connected to a potential divider R2 through an on-off switch S2. This is located at the top right-hand corner of the panel and one of the horizontal deflector plate terminals is connected through it to the potentiometer or left free. The operation of freeing the plate terminal applies the 50 cycle-sweep to the plate itself, the amplitude being adjusted by means of R2.

The vertical deflector plate is connected to earth through a 5-megohm fixed resistance which will not appreciably load the input circuit.

The plates are brought out to two terminal strips mounted one on each side of the case. One terminal of each pair is marked "G," denoting its connection to earth.

The controls on the front panel are as follows:—

Top left—Input potentiometer R2.
Bottom left—Focus.
Bottom right—Brilliance.
Top right—Switch S2.

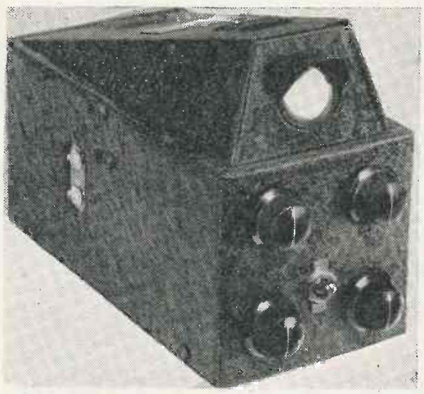
Internal Construction

Access to the interior of the case is obtained by removing the screw at the back which holds the cover in place. The tube socket is mounted on a swivelling bracket by which the angle can be altered and the socket can also be rotated to align the trace in the horizontal plane.

The transformer is remarkably compact, measuring only $2\frac{1}{4}$ in. square by $3\frac{1}{4}$ in. deep. As will be seen in the diagram supplied, only a single condenser is used for smoothing the supply.

Operation

The supply is switched on by the switch on the front of the panel. The makers say that the brilliance and focus controls should be turned as far anti-clockwise as possible before switching on the tube, and the switch S2 turned to the left. After 15 seconds the controls can be turned up to focus the trace on the screen. The usual precautions should be observed regarding the presence of a stationary spot on the screen. The thickness of the trace is said to be 1/32 in. when correctly focused.



This small oscilloscope can be used for measuring modulation percentage with either a transmitter or on received signals.

A booklet provided with the tube gives some suggestions for its use in checking modulation in receivers and transmitters together with sketches of typical figures obtained.

Subscription rates for "Television and Short-wave World" post paid to any part of the world are: 3 months, 3/6; 6 months, 6/9; 12 months, 13/6.

Test Results

The instrument when connected to 110-volt mains consumed approximately 200 mA. At this supply voltage the tube anode was 425 volts, which dropped to 375 volts at 100 volts input. In both cases the sharpness and brilliancy of the trace were excellent and it could be seen in broad daylight. There was no trace of A.C. interference from the transformer. The approximate sensitivity measured with an A.C. deflecting potential was 0.3 mm. per volt r.m.s.

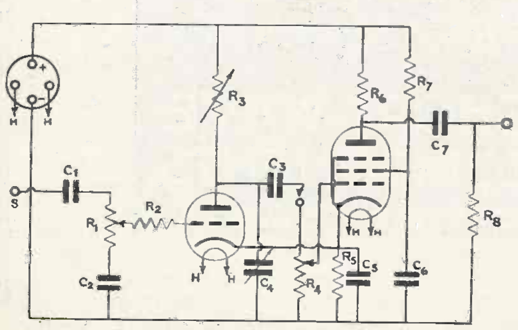
It is understood that the 110-volt model only is available at present, but most amateurs will have an auto-transformer which can be used to step down the British mains voltage to this value.

At a price of £5 the instrument is very good value for the money and will give long and trouble-free service.

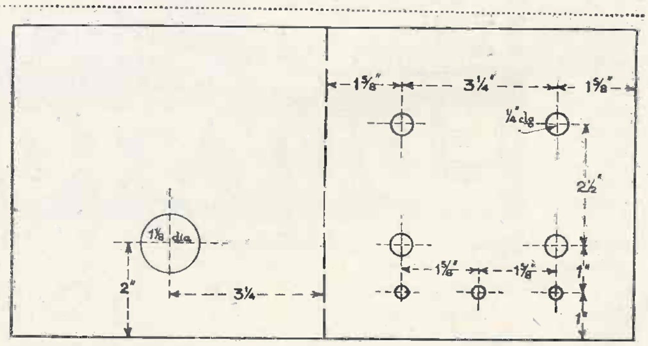
A Linear Time Base for the Oscilloscope

In the issue of TELEVISION AND SHORT-WAVE WORLD for August, 1937, appeared a description of a linear time base which will be found of use with the National Oscilloscope described above. This unit is housed in a "Magnum" steel box measuring $6\frac{1}{2}$ in. cube and is self-contained with the exception of the power supply.

The H.T. required is 250-350 volts, which can be obtained from a standard power pack circuit, with the addition of 4.0 volts for the valve heaters. The input to the unit is from a 4-pin socket mounted at the side of the box, the following connections being used: Filament pins, 4.0 volts A.C. Anode pin H.T.+, Grid pin H.T.−, and earth. Copies of the issue containing the description of the unit are available from this office, price 2s. 2d.



The circuit diagram of the linear time base attachment.



Drilling dimensions showing the side of the cabinet to the left and the face to the right.

mitter previously referred to. The linearity of this curve is increased still further in the larger variactors.

The saturable reactor is placed in series with the primary of the final anode transformer. It is seen from Fig. 6 that with no audio signal (minimum DC) the reactance of this reactor is quite high (450 ohms). This effects a great voltage drop to the primary of the anode transformer, as the effective impedance of this primary is quite low. However, as the saturating DC is increased, the reactance is decreased, and the consequent voltage drop is decreased. The primary voltage rises in accordance with this, and with proper design reaches almost maximum at normal maximum audio output.

Even with the reactor practically saturated, a small reactance and consequent voltage drop exists. To compensate for this, an auto-transformer is used on the line side of the reactor which increases the total impressed voltage. This auto-transformer does not have to be used if the anode transformer primary is wound or tapped for the reduced voltage obtained after the reactor drop. In either case, this voltage drop does not represent a power or efficiency loss, as the drop is almost entirely reactive and results primarily in a change of power factor; i.e., the ratio of VA/watts increases only.

It is apparent, on examining the circuit of Fig. 7, which shows a typical applicataion of this reactor type controlled carrier modulation to an already existing transmitter, that the actual applicaation of this reactor type con- Except for the auto-transformer-reactor combinataion and a non-critical condenser, 1.0 to 8-mfd. (if it is not already present in the modulator), no additional equipment is necessary. The circuit changes are extremely simple. The DC coil of the reactor is connected in series with the H.T. plus lead of the modulator. The auto-transformer primary is connected to the line and the primary of the class-C anode transformer is connected across the output side of the auto-transformer with the AC coils of the reactor in series. That is all there is to obtaining controlled carrier modulation from an existing transmitter. A simple switch, as indicated in Fig. 7, permits instantaneous change-over from standard to controlled carrier.

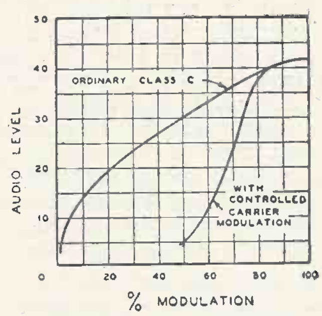


Fig. 8. Percentage of modulation in ordinary and controlled carrier transmitters at various audio levels.

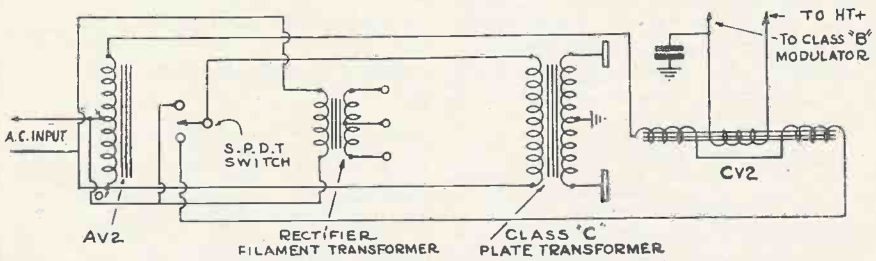


Fig. 7. Circuit of controlled carrier transmitter.

OPPORTUNITIES SECTION

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The charge for miscellaneous advertisements on this page is 12 words or less 2/-, and 2d. for every additional word. Single-column inch rate displayed, 12/6. All advertisements must be accompanied by remittance. Cheques and Postal Orders should be made payable to Bernard Jones Publications Ltd., and crossed, and should reach this office not later than the 15th of the month previous to date of issue.

INDEX TO ADVERTISERS

A Cheap All-wave Radiogram

We are interested in the new Murphy all-wave radiogramophone which has just been released. It is priced at £20 for the A.C. model and £22 for the D.C. model. This is one of the cheapest receivers of its kind to include all-wave tuning and if it is to the normal Murphy standard is good value for the money. There are no less than 12 new Murphy receivers now available and we advise readers to write to Murphy Radio, Ltd., Broadwater Foad, Welwyn Garden City, for further details.

Motor Tuning in Ekco Receivers

Press-button motor-tuning is now being incorporated in Ekco receivers. This system of tuning which is already sweeping America enables the operator to tune any selected station by merely pressing a button.

Tuning is carried out by means of a small motor while the station is accurately tuned-in by means of an automatic frequency control circuit.

The most interesting Ekco receiver using this system of tuning is the model PB199, which is a 10-stage instrument priced at 18½ guineas.

Mention of "Television and Short-wave World" when corresponding with advertisers will ensure prompt attention.