SIMPLEST HOME-BUILT TELEVISOR

Television and SHORT-WAVE WORLD

MARCH, 1938
No. 121 Vol. xi.
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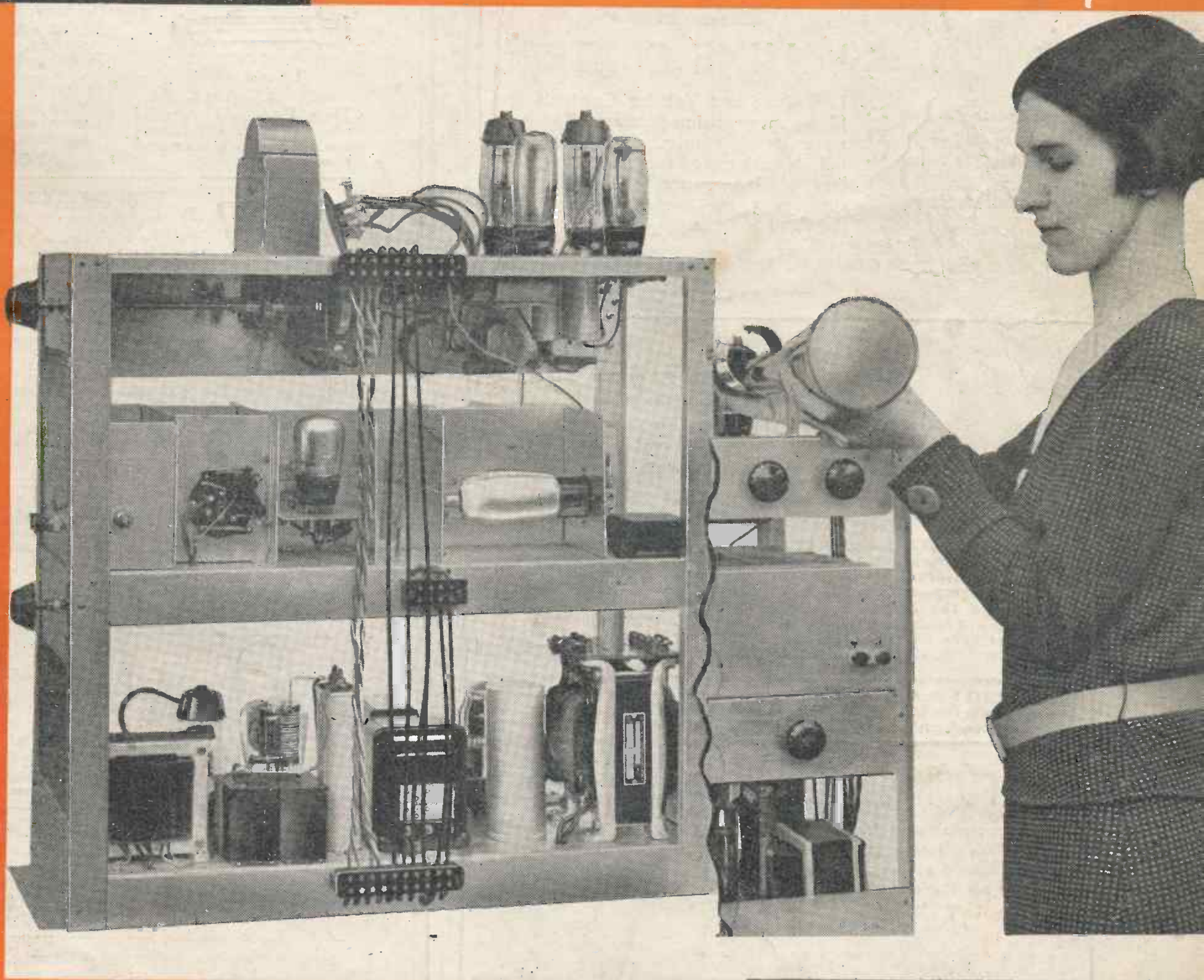

IMPORTANT DEVELOPMENTS

Announcements by:—
SIR FRANK E. SMITH, Television Advisory Committee
CAPTAIN C. G. GRAVES, B.B.C. Controller of Programmes

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IMPORTANT

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COMMENT OF THE MONTH

Clearing the Air

THE important statements made last month at the dinner given to representatives of the Press by the Radio Manufacturers' Association should do much to clear away a considerable amount of misconception that has existed with regard to television. Statements were made on behalf of the Television Advisory Committee, the B.B.C. and the Radio Manufacturers' Association and it was clear from their tenour that now there is a genuine understanding between these bodies and real appreciation on the part of each that television must eventually become as an important factor in our daily lives as is sound broadcasting at present.

The important facts which emerge from these statements were that a progressive policy of development both as regards entertainment and technique would be pursued, and the assurance that was given the public that television was no longer regarded as being in the experimental stage. It was stated most definitely that no fear need be entertained that receivers purchased now would be obsolete or useless within a few months, or even years, and that the general policy of development was to be directed with this end in view. Improvement in receiver design and methods of transmission there is, of course, bound to be, as with any other commercial article, but there is the promise that no fundamental change will be made for a period of nearly three years. We can go further than this and give the assurance that as the modern television receiver is such an exceedingly adaptable piece of apparatus, no difficulty would be experienced in modifying it for a different standard of transmission should this be decided upon at the end of the stated period.

The Simplest Receiver Yet

IN this issue we present to our readers a design of a complete vision receiver which we claim is the simplest yet evolved. Its only limitation is the size of the picture, a limitation which has been essential in reducing the cost to a very low level. Picture definition and quality, we may say, leave little to be desired and the receiver will provide adequate entertainment for home use. A careful study of the design and circuits will show how really simple is the construction. We place this receiver before our readers in the hope that they will find in it an opportunity of taking practical interest in a fascinating hobby and obtaining a share of the television entertainment which is available.

The house in the Jungfernsteig where the modern laboratory is housed.

MANFRED VON ARDENNE'S LABORATORY

The name of Manfred von Ardenne is well known to all workers in television and the following account of the development of his research laboratory during the past ten years will be of interest to readers. The photographs illustrating this article were kindly supplied by him.

ON February 1, 1928, the apparatus of the original laboratory was transferred to a house in the Jungfernsteig, Lichterfeld-Ost, Berlin, and two definite problems were undertaken for investigation. These were in the development of radio receivers and amplifying valves, but it was found during the course of the first year's work that these problems were more concerned with the whole field of high- and low-frequency technique. The experience gained during the early days, and the apparatus developed, have proved invaluable in the working out of subsequent investigations in the field of electronics, and in the development of cathode-ray oscillographs.

H.F. and L.F. laboratory. On the left-hand side are generators and potential dividers for L.F. work, with the usual oscillographic equipment. On the right is the H.F. apparatus. Wavemeters can be seen in the foreground.

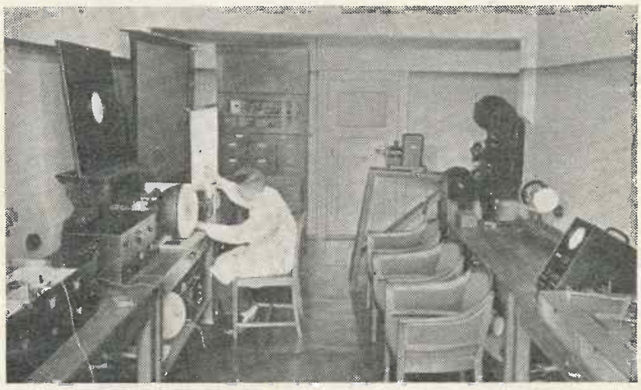
In the early years it frequently appeared that the technique of measurement had become an end in itself, but this was largely the result of temporary financial restrictions. It was not until 1933 that this branch of the work was transferred to an associated commercial company* and the laboratory resumed its work on the investigations mentioned above.

In 1930 the main interest centred round television technique and this work threatened to over-run into all the allied departments of the laboratory. Besides the main aspects of the high-frequency side of the science there were the allied investigations into optics, glass technique, electron optics and even microscopy.

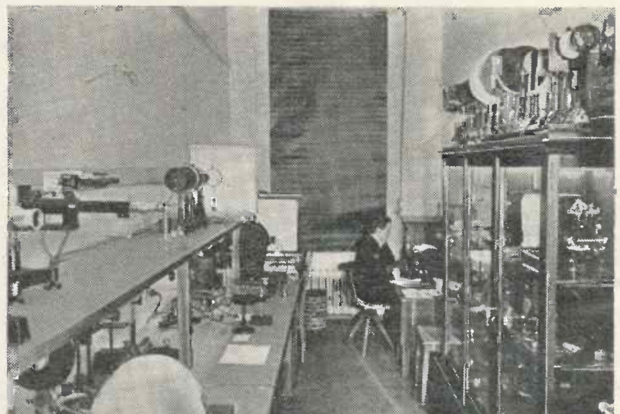
Problems presented by industry are frequently brought to the laboratory for solution, and these include research on ultra-sonic waves, physical chemistry and sound films.

The manifold nature of the work undertaken and the improvement in laboratory facilities offered by the enlarged premises have given a new impetus to the keenness of the staff, and the results obtained owe a great deal to this factor.

An important recent development has been an improved electron microscope possessing new features with great potential possibilities.



Television laboratory. The receiving set for 441 lines can be seen on the left, while in the foreground is an electrolytic trough for plotting field lines. At the back is a film scanner and apparatus for investigating stereoscopic projection.



Optics laboratory. A long room with benches holding apparatus for investigating spectra, glass stresses, etc. The main instrument cupboard is on the right.

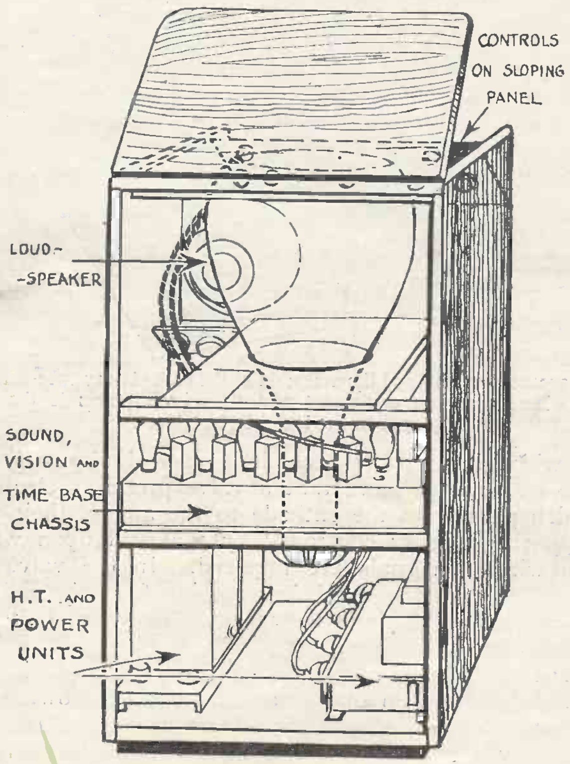
*(Leybold-von Ardenne—Ed.)

TELEVISION IN EASY STAGES

I.—WHAT THE RECEIVER IS AND WHAT IT DOES

This is the first article of a short series explaining in an easily understandable manner the salient points of television

THERE is one essential feature in a television receiver, whatever its type, and this is the production of a spot of light which is projected on to the viewing screen. The whole picture, in fact, is developed from this spot of light and upon its size depends the detail which it is possible to get into the picture. Obviously, if the detail is to be good or as we say " of high definition " then the spot must be very small.



A typical arrangement of the units of a television receiver in which the picture is viewed in a mirror placed at an angle of 45 degrees. The cathode-ray tube, it will be seen, is vertical.

The spot of light is fundamental and it can be produced by a variety of means, but as all commercial receivers that are at present on the market produce this spot by causing a stream of electrons to strike a specially prepared surface and make it fluoresce at the point of impact, this is the only method which we need consider at present.

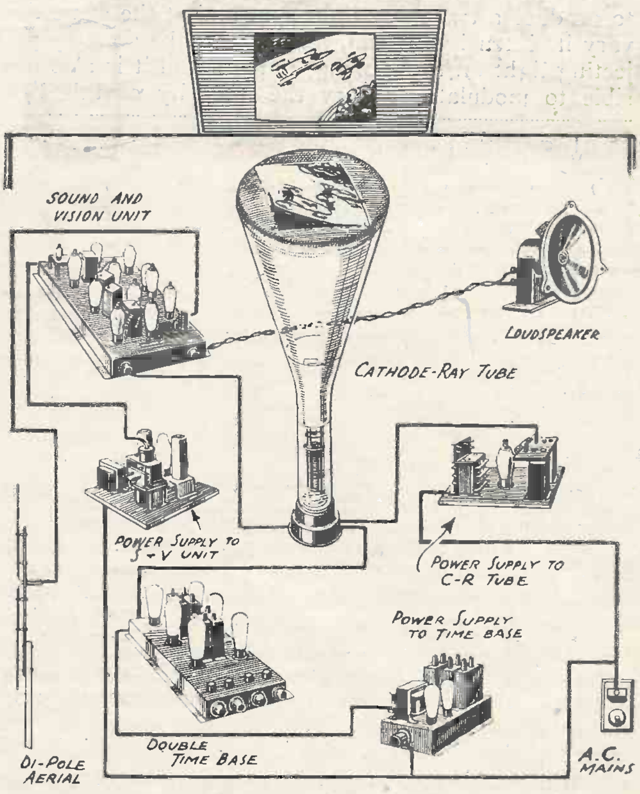
The Picture is Built Up

Now the production of a spot of light on a screen is a very simple matter, but this spot of light must have other attributes for television purposes. Some means must be provided for moving it at an extremely high speed over the screen in successive lines so that the whole screen is covered by the spot—that is, it must have occupied every part of the screen in one-twentieth of a second. Actually, with the average size television screen the speed of the spot necessary to do this is approximately 18 miles a second!

Other requirements are that the intensity of light given by the spot must be capable of variation within periods of exceedingly small fractions of a second during its traverse over the screen and that this variation must be capable of being produced by radio impulses received from a distant transmitter.

There is a third fundamental requirement and this is that the travelling light spot must synchronise exactly to the minutest part of a second with its equivalent at the transmitter.

It can now be appreciated how the production of a television picture differs from that of the cinema. In the latter case, as is well known, successive *pictures* are thrown upon the screen at the rate of twenty-four a second; they are projected as *entire* pictures, but with



Schematic diagram of the units comprising a complete sound and vision receiver. In practice the power supplies are often combined to form one unit.

HOW THE CATHODE-RAY TUBE WORKS

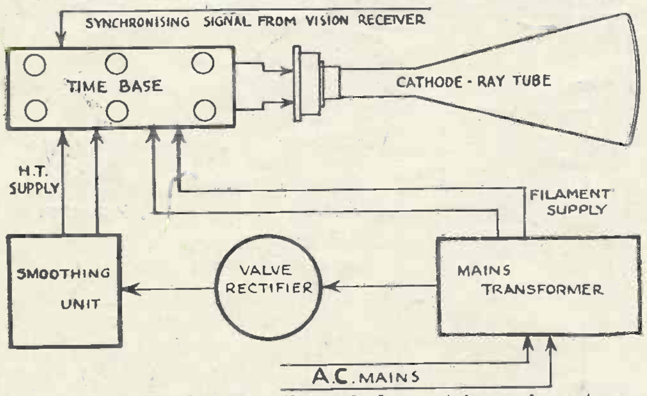
television it is necessary to *build* the picture up about the same number of times per second merely from a tiny unit of light of constantly varying intensity.

It is well to appreciate exactly why there should be this difference, for obviously it complicates the problem of picture construction. The reason is solely that it is at present impossible to transmit a picture by radio or wire all at once; with sound broadcasting this is possible and it is what may be described as the *ensemble* that is transmitted. With a picture it is therefore necessary to take it unit by unit for transmission and rebuild these units in their proper sequence and with equivalent light intensities in the receiver.

Why Short Waves are Used

Obviously, these conditions increase complication and make the whole process more difficult than would be the case if the picture could be transmitted as a whole. Another factor is that they necessitate extremely high radio frequencies if a reasonable amount of detail is to be transmitted, and for this reason the transmissions have to be on very short wavelengths, which again has certain disadvantages because the range is somewhat limited. Some day it might be possible still further to increase the frequencies employed so that to all intents and purposes the picture would be transmitted as a whole, the time intervals being so small as to be virtually instantaneous. At the present time, however, it does not appear feasible to increase the frequency to any extent.

Now there are several methods than can be employed to produce a travelling light spot and at the same time vary its intensity; it can, for instance, be done by projecting light on to revolving mirrors and it is also possible to modulate or vary the intensity of this light

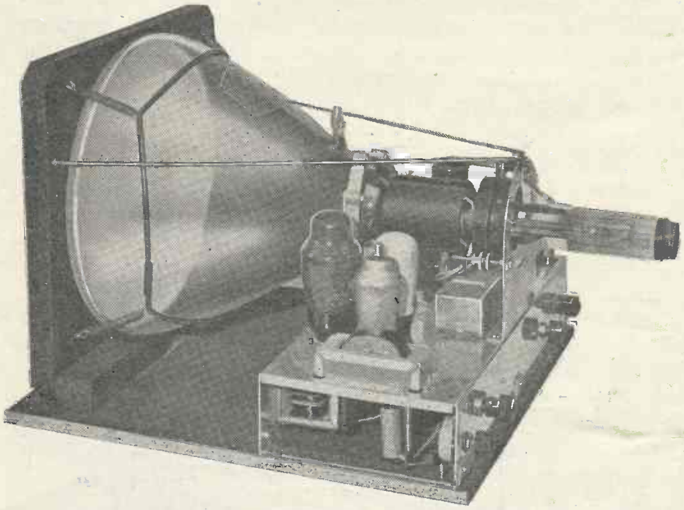


Schematic drawing showing the cathode-ray tube equipment consisting of the time base and power supplies.

either at its source or during its passage to the screen. Systems employing this method are called optical-mechanical and are entirely successful. The most general type of receiver, however, employs a cathode-ray tube which, as it has no moving mechanical parts, rather simplifies the problem though there are certain inherent disadvantages with this method, the chief of which is the limitation of the size of the picture owing to the impossibility of making tubes which are evacuated of any considerable size. This problem of picture size is, however, being tackled in another way, by producing an intensely bright picture and projecting this optically, though the problem presents certain technical difficulties which up to the present have not been entirely overcome.

The Cathode-ray Tube

Perhaps the simplest way of getting some idea of the construction and principle of the cathode-ray tube is to take the comparison of an ordinary wireless valve,



An excellent example of the assembly of the cathode-ray tube with its associated scanning equipment and time base. This is the unit employed in the Baird T11 receiver.

to which in many respects it is very similar. Everyone nowadays knows that a valve produces electrons which pass from the cathode to the anode, their rate of passage being controlled by the grid upon which the wireless signals are imposed. In the valve the electrons may be regarded as passing from the cathode to the anode in cloud formation. They are quite invisible and weightless.

In the cathode-ray tube the same principle is employed, but we go further and instead of allowing the electrons to travel to the anode as a cloud of varying intensity, they are, by suitable means, compressed into a very fine pencil or beam. Also by suitable means the electrons of which the beam is composed are caused to travel at such a high velocity that they shoot past the anode through a hole which is provided in it and impinge upon the end of the tube which may be from a foot to more than two feet distant from the cathode at which they were originally produced.

As stated before, an electron beam is quite weightless and invisible but its presence can be made visible by causing it to strike against a screen of fluorescent material which becomes luminous at the point of impact and the presence of the beam therefore is revealed as a spot of light of the same area as the cross sectional area of the beam. If this spot be moved quickly the appearance on the screen will be a line of light owing to persistence of vision.

The fact that the beam is weightless is a very valuable characteristic for it means that it is not possessed of inertia and therefore it is possible to cause it to swing about at incredibly high speeds without any lag

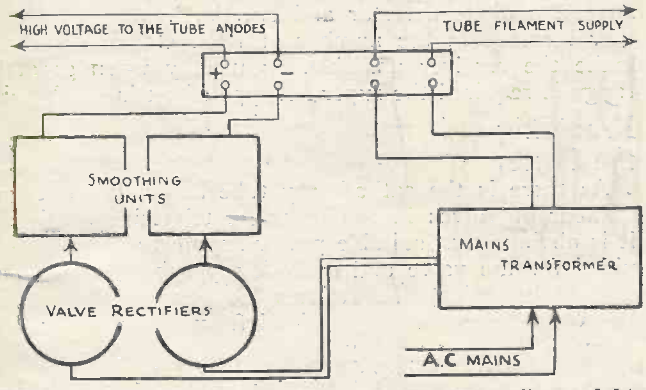
"DRAWING" THE PICTURE

when the direction of motion is changed as would be the case were it to have weight.

In the electron beam, therefore, we have a means of producing a spot of light of considerable intensity and it is moreover possible to make this spot of light travel over a screen in any predetermined direction and at practically any speed.

Moving the Electron Beam

The beam of electrons can be caused to swing about because in effect it is a conductor carrying current, and it will respond therefore to a magnet or electrostatically charged plate. Both methods are employed and the construction of the tube depends upon the



Schematic drawing showing how the L.T. and H.T. supplies are fed to the cathode-ray tube.

choice. In the case of the electromagnetically controlled tube coils of wire are placed round the neck and outside the tube, whereas with the electrostatically controlled type metal plates are fitted inside as two pairs, one pair to produce horizontal deflection of the beam and the other pair vertical deflection.

It must clearly be understood that a television receiver has to perform *two separate functions*, the first the production of a light spot which moves across the screen at a predetermined rate and sequence, and the second the modulation or intensity variation of this light spot in conformity with the variation of the impulses received from the transmitter.

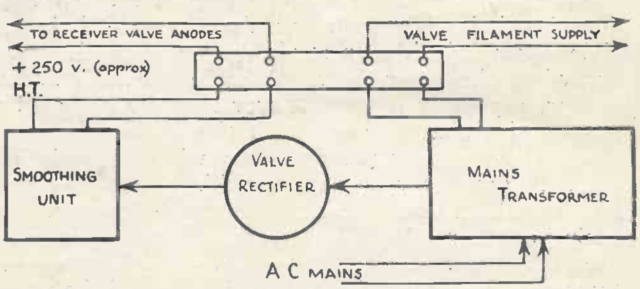
The production of the light spot and its motion is *entirely a function of the receiver*, that is, both the light and the means to provide it with suitable motion are entirely developed in the receiver. The modulation of the light, however, is a result of the received radio impulses and it may be compared with the sound produced by a loudspeaker in an ordinary broadcast set.

There is a third function which the receiver has to perform, and this is to maintain the correct speed of the light spot so that its position on the screen corresponds exactly to its equivalent at the transmitter. This correction is made by means of a triggering action at the end of every line scan and also at the end of each completed frame or picture. This is necessary because it has been found impossible to keep the spot running at precisely the same speed unless some correcting impulse from the transmitter is applied.

We are now in a position to see exactly of what a television receiver of the cathode-ray type must consist. In the first place there is the cathode-ray tube, and as is the case with a valve this must be provided with high- and low-tension supplies but with the difference that owing to the comparatively great distance that the electrons must travel the high-tension voltage must be very much greater than is the case with an ordinary broadcast sound receiver. The usual voltage, in fact, is round about 4,000. The provision of this high voltage necessitates a special high-tension unit usually termed a power pack and this is so constructed that it also supplies high- and low-tension for some of the valves employed also, the exact provision being a matter of design which may differ with different makes of receiver.

So far then we have the means of providing a spot of light, but this spot of light would be in a stationary position on the screen and would quickly burn a hole in it. The spot must be kept moving and be made to move in a predetermined manner. As was mentioned earlier, the movement of the spot is brought about by either applying voltages to two pairs of plates between which the beam passes, or passing current through coils which surround the neck of the tube.

The movement of the spot over the surface of the screen must, as has been stated, be in a predetermined manner; it must in fact be exactly the same as at the transmitter and the timing must also correspond exactly. The direction of the spot travel in practice is from left to right starting at the top and after each line is completed there is a very rapid fly-back in order to commence a fresh line. The scanning direction is,



Schematic drawing showing method of supplying low- and high-tension current for the sound and vision receivers.

in fact, exactly as one reads the page of a book—line by line from left to right with a flyback so fast as to be invisible. After the spot has completed one scan of the screen the spot then flies back to the top again to commence another scan, each complete scan representing a picture.

In order to avoid flicker it is usual now to use interlaced scanning—that is alternate lines are scanned and then the spot flies back to the top of the screen and traverses the spaces between these lines. This, however, is a refinement and does not affect the general principles.

The Time Base

The scanning movement of the spot is brought about by means of a unit called a time base, one being used

THE VISION SIGNAL RECEIVER

for the line scanning and the other (operating at a lower speed) for the picture or frame scans. This unit is the only one that has not got its counterpart in ordinary wireless practice and its purpose is solely to provide a suitable movement of the spot.

The operating function of the time base is to build up a gradually increasing electrical potential on the deflector plates of the cathode-ray tube and then suddenly, in fact practically instantaneously, discharge this potential. The gradual build-up corresponds to the traverse of the spot from the left to the right of the screen and the instantaneous discharge to the flyback.

Although the time base has no counterpart in ordinary wireless practice, it is constructed upon ordinary wireless lines and actually comprises an assemblage of condensers, potentiometers and resistances with, of course, valves. As a rule, the time base chassis also contains the cathode-ray tube mount for, of course, the tube and time base are closely associated. The construction of the time base is just as simple as any other wireless unit and with certain variable controls that are provided there is no difficulty in its adjustment to provide the scanned screen.

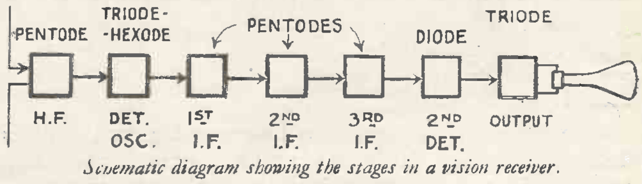
Receiving the Vision Signal

The next requirement is the reception of the vision signals that are sent out from the Alexandra Palace transmitter. As has been explained, these signals represent the actual scene or picture being transmitted but analysed into a series of units, the radio impulses representing these units following each other with extremely rapid sequence. Apart from the fact that the receiver must be capable of receiving at very high frequencies, it is built upon orthodox lines and it is possible to employ either a straight type of receiver or a super-het, the latter, however, more generally finding favour, especially if the televisor is to be operated at any considerable distance from the transmitter.

Television signals occupy a very wide band width of about two million cycles and for this reason they must be transmitted upon the ultra-short wavelengths. The tuning of the receiver obviously must be very broad to accommodate this high frequency, otherwise the pictures would lose definition. In the case of the super-het receiver it is usual to employ intermediate stages working on a wavelength of 15 to 20 metres instead of the more usual 2,000 to 3,000 as is the case with a normal broadcast receiver. Moreover, as the stage gain is quite low because of the methods employed to obtain very broad tuning, it is necessary to use two or more intermediate-frequency stages.

The diagram shows the valve arrangement of a typical vision receiver and it will be seen that the aerial feeds into a pentode H.F. stage which amplifies at speech frequencies and feeds the slightly amplified signal into a detector stage which usually consists of a double valve of the triode hexode type. The triode portion of this valve is an oscillator which converts the signal into one of about 15 or 20 metres with a slight increase in gain. The signal then passes through two or three broadly tuned I.F. stages, increasing in amplitude in each stage, after which it is rectified by a diode second detector and fed into a normal low-frequency amplifier and then into the cathode-ray tube.

From the foregoing it will be clear that the circuit of the vision receiver is exactly the same as for any short-wave super-het receiver, except that, as the tuning is so broad and the stage gain consequently so small, a larger number of valves are required. Constructionally it follows normal practice.



Schematic diagram showing the stages in a vision receiver.

For reasonably short distances, say, up to 35 miles from the transmitting station it is quite practicable to employ a straight receiver consisting of two R.F. stages, a diode detector and two V.F. stages. Further increase in the number of R.F. stages tends to make the receiver unstable, so usually when greater range is required the super-het type of set is employed.

Providing the Power

As there is the cathode-ray tube and a fairly large number of valves in the complete television receiver, it is obvious that suitable power supplies must be provided for the valve and cathode-ray tube heaters and also high-tension. Sometimes the power supplies for the whole receiver are obtained from one unit, but it is more usual to employ one unit for the cathode-ray tube and time base and another for the sound and vision receivers. The usual arrangement of a power unit for the vision unit is a mains transformer providing high- and low-tension, a rectifier (generally a full-wave) valve and a smoothing unit consisting of a choke and two large capacity condensers. This, it will be appreciated, is normal radio practice and the units only differ as regards their output. The vision and sound receiver units usually have an output of 250-300 volts at 100 milliamps. The cathode-ray tube unit, however, is more elaborate because of the greatly increased voltage that it must supply. On this account two rectifier valves are employed, these being the half-wave type. Also two smoothing units are incorporated as it is essential that every trace of mains ripple be eliminated. Condensers and chokes must be of a special kind to withstand the high voltages which are present. The provision of a thermal delay switch is also necessary in order that the heaters of the mercury-vapour rectifier valves can warm up before the high-tension is applied. This delay switch consists of a heater and two dissimilar metals which when heated expand and make contact, thus completing the high-tension circuit after the correct interval of time has elapsed.

From the foregoing explanation it will be clear that in a television receiver there is but little more complication than there is in an ordinary broadcast set—the chief difference is that there is more of it and the number of valves employed is greater, a fact which necessitates increased power.

In continuation of this series for the beginner, next month we intend describing the typical radio units in a vision receiver and explaining the difference between a vision recever and an ordinary short-wave set and what ultra-short waves are used.

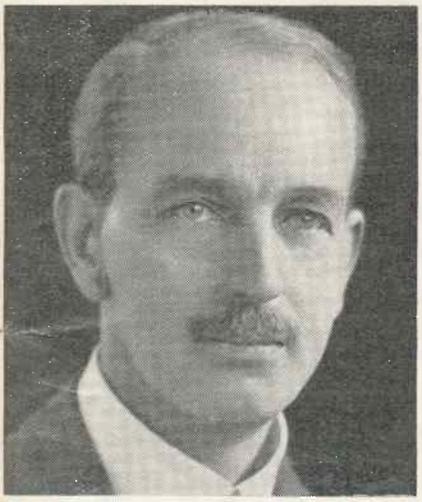
IMPORTANT DEVELOPMENTS

ANNOUNCEMENTS BY SIR FRANK E. SMITH, Television Advisory Committee and CAPT. C. G. GRAVES, B.B.C. Controller of Programmes.

We present below abstracts from two important speeches made on the occasion of the R.M.A. television dinner

SIR FRANK E. SMITH

TELEVISION is not, from a technical point of view, a weakly thing; it will undoubtedly grow into a great industry. On what this country does during the next twelve months the location of the television industry of the world may largely depend, for it will decide



Sir Frank E. Smith, Television Advisory Committee.

whether the television industry is to to be located in this country, in America, in Germany, in France or elsewhere. Is it not right that we should do our utmost to ensure that this country, which is to-day in the forefront with regard to television, should have the lion's share?

Recently representatives of the Radio Manufacturers' Association and the Television Advisory Committee met to exchange views. At that meeting the Radio Manufacturers' Association's representatives congratulated the Television Advisory Committee on some of their work, and the Advisory Committee expressed its admiration of the manufacturers' enterprise in producing

excellent receiving sets.

But—and it is a very big but—the number of television receivers at present in use is much too small.

In the London area, that is to say, in that circular area having a radius of about thirty miles and its centre at Alexandra Palace, it is reasonable to expect that there should be in use to-day some tens of thousands of receivers, and in five years' or ten years' time there should be half a million receivers in use in that area. But in actual fact the total number in use to-day is only a few thousands.

Why are the numbers so small? Is the transmission from Alexandra Palace technically poor and the picture definition bad in consequence? Are the programmes not very good or indifferent? Are the receiving sets unreliable? Are too many adjustments needed, or are the sets too expensive? Or, again, are potential viewers deterred from purchasing sets because they fear that the system of transmission may be changed within a few months? All these questions were considered, and it is clear that neither singly or collectively, are they the real reason for the poor sale of television sets. We are, indeed, convinced that

the principal reason why receiving sets are not selling

in greater numbers is because the public who can afford to purchase at present prices do not realise how good a thing it is that they are missing, or because they do not realise that the present system of transmission will remain unchanged for at least three years.

There is no doubt in my mind that of all the marvellous inventions of man, television is the most remarkable of which we know. I do not wish for a moment to suggest that the developments of television will necessarily be so far-reaching in their effects as the developments of other inventions: I merely claim that, as an invention, television is the most marvellous of all.

And this invention is essentially British! In the system of television now employed, both transmitting and receiving systems employ beams of electrons, and it is well to remember the great work of the Cavendish Laboratory on electrons and the fact that the first cathode-ray tube came to birth in that laboratory.

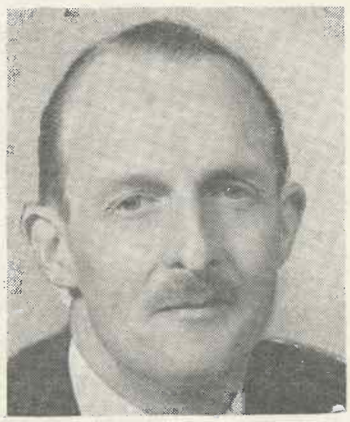
But it is no use having produced a miracle unless some use can be made of it. What can be the use of television? It can entertain and amuse, it can educate, and it can do nearly all that the theatre and cinema can do.

I confess that I have an axe to grind. The axe I wish to grind is that of British industry. I wish to see a big television industry established in this country, and I hope that all the units at present involved will help me to grind this axe. It is true to say that in other countries television is just around the corner, but here television has definitely arrived, and in its short life of only twelve months it has grown up appreciably. In ten years' time I have no doubt that the television industry of the world will have an annual turnover of over £100,000,000. What is our share to be of this new industry? I consider it imperative to get ahead now with television. We are first to-day: do let us keep the lead. The next twelve months will, I think, be a critical period.

I am glad to be able to assure you that there will be no change in the present technical standards of transmission for at least three years. The public may therefore purchase without any fear of their sets becoming useless for some time to come.

CAPT. C. G. GRAVES

MR. GRAVES said that the B.B.C. was proud to have been entrusted with the television service, particularly as television at its inauguration was—and still is—further advanced in Great Britain than anywhere else. For this reason the B.B.C. realised the importance of weighing most carefully each fresh step, thus steering clear of rash decisions which jeopardise progress and endanger the leadership which it was hoped this country would hold.



Capt. C. G. Graves B.B.C. Controller of Programmes.

The B.B.C. was happy in its relationships with the Television Advisory Committee, which, in addition

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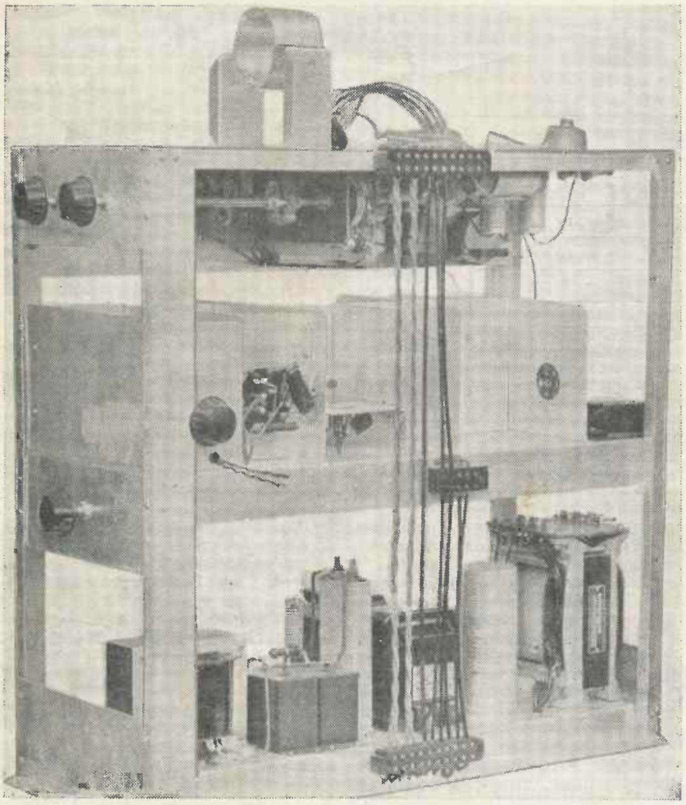
THE SIMPLEST HOME-BUILT TELEVISOR

Designed by S. West



A general view of the complete vision receiver. Chassis construction is of sheet aluminium or steel and is of the simplest type.

LAST month the general form of this new television receiver was detailed. It was shown that a straight receiver having two R.F. stages, a diode detector and two V.F. stages represents the most simple arrangement campatible with efficiency to employ, and greatly reduces the number of valves required. Furthermore, initial adjustments of the vision unit are greatly simplified as there are only three tuning condensers to adjust, two of which are of the pre-set type.

Many tests revealed the sensitivity of this receiver to be high, excellent bright pictures being easily obtained at distances in excess of 30 miles from the transmitter.

Later in this article the full constructional details of the vision unit are dealt with. Before passing on to these actual constructional instructions, however, let us first briefly consider the form the complete receiver takes.

The photographs convey an excellent impression of the finished receiver. Its compact and professional appearance is well revealed.

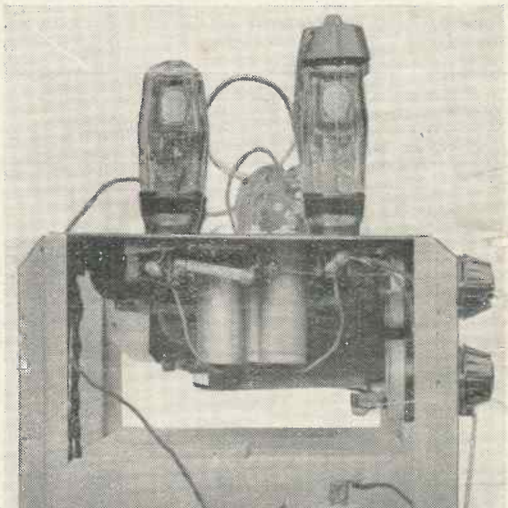
The Receiving Units

It is seen that the complete vision receiver is divided into three sections.

The bottom deck contains the power pack; in reality this consists of two separate units. The first of these attends to the vision unit's requirements, the other furnishes the necessary power for the time bases and tube operation.

The second deck contains the vision chassis and finally, as the upper deck, we have the time bases and the C.R. tube's mounting.

Whilst the arrangement adopted permits short interconnecting leads, and for this reason is efficient, it will be apparent that several alternative arrangements are possible. Constructors will have no difficulty in deciding what arrangement is best suited to their own particular needs. However, unless it is desired to utilise an existing cabinet, it is strongly recommended that the



A rear view. As will be seen the entire assembly is very simple.

GUARANTEED PICTURE QUALITY :: CHEAP TO BUILD FROM STANDARD COMPONENTS :: SIMPLEST YET

In a series of articles that have appeared in this journal during the last few months a good deal has been written regarding the possibility of greatly reducing the cost and complexity of amateur constructed television receivers.

As was revealed last month in an article entitled "Further Notes on the Possibilities of Small Tubes" p.77, the results of a large number of experiments and tests of various apparatus has been collated and a complete television receiver employing a 4 in. tube has been evolved.

A great number of tests has revealed that the range and picture quality secured with this receiver is entirely satisfactory.

Thus for the first time a constructional design for a high-definition television receiver which is capable of furnishing really first class entertainemnt at a very low cost is presented.

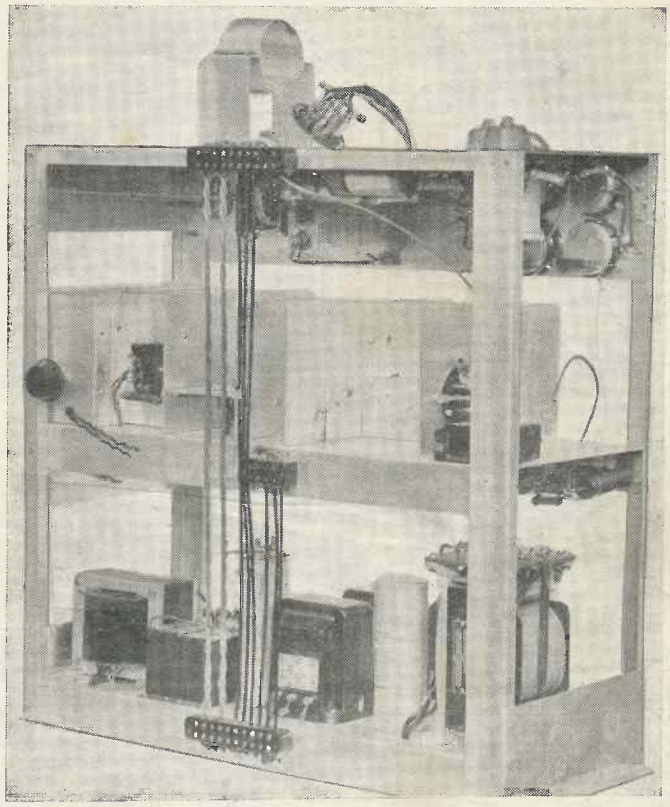
This, the first article of the series, concerns the construction of the vision unit. The following articles in the series [illegible] with the remaining sections.

[illegible] information is contained in [illegible]cles to permit any amateur [illegible]erage ability to construct the [illegible]er and be assured of first [illegible]

TUBE MOUNT AND TIME BASE ☛

VISION RECEIVER ☛

POWER PACKS ☛



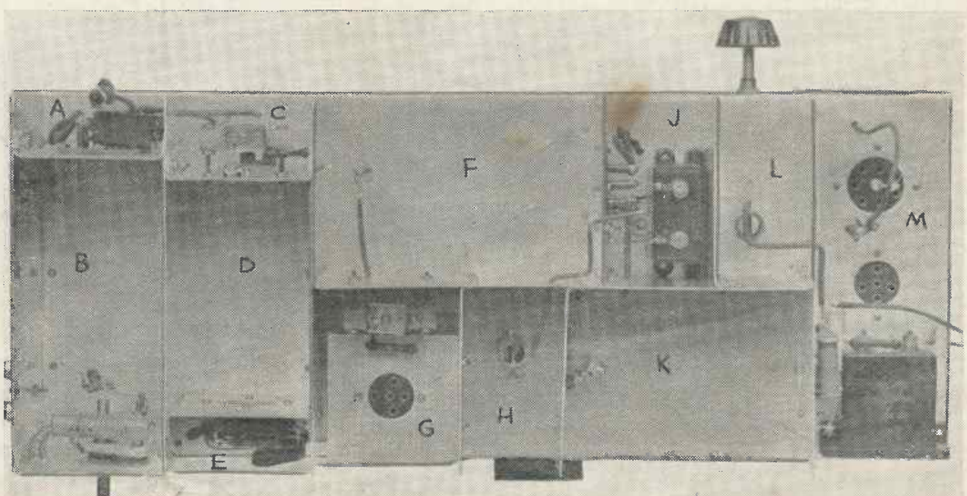
Each chassis unit is easily detachable by undoing a few screws and the wires shown in this picture.

arrangements adopted for the original be adhered to.

Adverting once more to the photographs, it will be seen that only three controls are located at the front of the chassis. These are respectively, the brilliance and focus controls, and the gain, or as it is sometimes termed, the contrast control.

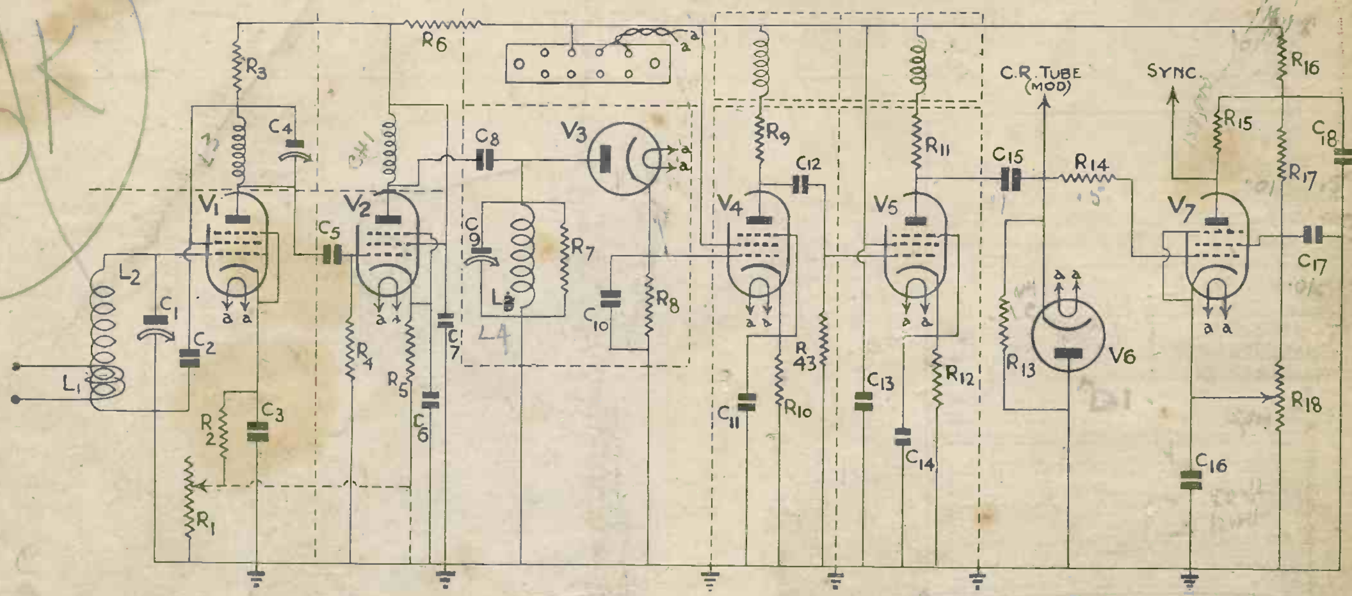
As normally no adjustment of the remaining controls is required after the initial correct settings are found, these are all conveniently grouped at one side of the chassis.

No unusual safety precautions are included in the design to prevent accidental contact with any point at high potential. It was deemed unnecessary to include the elaboration that this would involve. It will be as well to bear this in mind when making any adjustments. Particularly are these remarks applicable to the tube

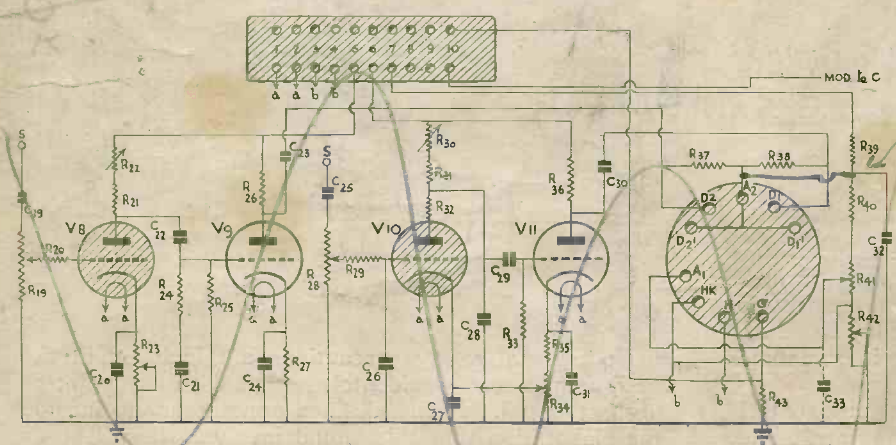


This is a plan view of the vision chassis with all the components assembled. The reference letters apply to the various sections shown in further detail by other illustrations. This chassis is built up with turned edges secured by screws and its construction is particularly simple. Measurements are given by a drawing in a later page.

VISION RECEIVER, TIME BASE AND POWER PACK CIRCUITS

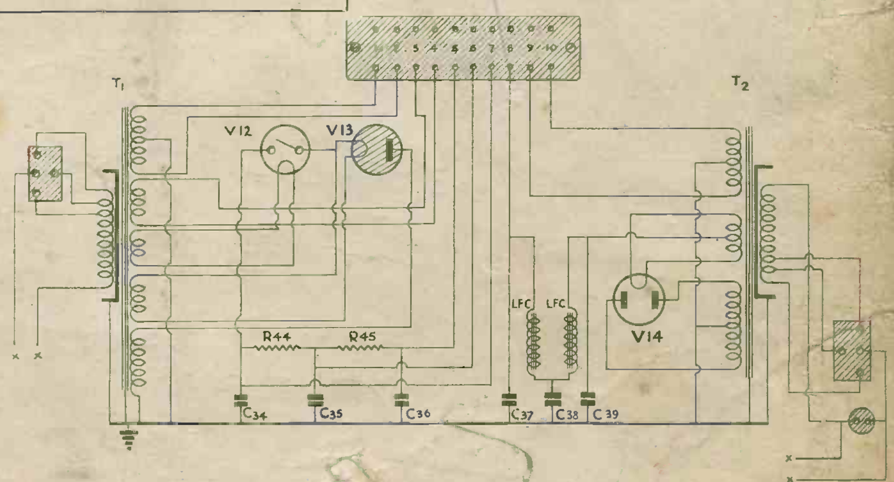


Above—The vision unit circu[...] the main advantages of a r[...] type is the fact that within r[...] will always provide some so[...] no matter how inaccurate the g[...]. This makes testing a very simple matter and does not call for special test equipment.



Left—Circuit of time base. Constructors should not have any difficulty in building this time base. The cathode-ray tube base shows the actual connections to be made.

THE DRAWINGS ON THIS PAGE GIVE THE ENTIRE WIRING OF THE WHOLE RECEIVER



The two power packs provide 1,000 volts for the cathode-ray tube and approximately 300 volts for the valves in the vision receiver. V12 is a delay switch to prevent application of the high voltage to the anode of the rectifier valve before the heater warms up.

PARTS VALUES AND MAKES FOR COMPLETE RECEIVER

THE VISION UNIT

CONDENSERS.

C1 15-mmfds. variable (Raymart).
C2 0.01-mfd. (Dubilier type 670).
C3 0.01-mfd. (Dubilier type 670).
C4 Trimmer 30-mmfds., max. (Eddystone type 1023).
C5 0.0005-mfd. (Dubilier type 690W).
C6 0.01-mfd. (Dubilier type 670).
C7 0.01-mfd. (Dubilier type 670).
C8 0.0005-mfd. (Dubilier type 690W).
C9 Trimmer 30-mmfds. Max. (Eddystone type 1023).
C10 0.00002-mfd. (Dubilier).
C11 500-mfds. 12 v. (T.C.C. Type 501).
C12 0.1-mfd. (Dubilier type 4603/S).
C13 0.1-mfd. (Dubilier type 4603/S).
C14 500-mfds. 12 v. (T.C.C. type 501).
C15 0.1-mfd. (Dubilier type 4603/S).
C16 50-mfds. 12 v. (Dubilier type 402).
C17 0.01-mfd. (Dubilier type 670).
C18 0.5-mfd. (Dubilier type 4608/S).

RESISTANCES.

R1 30,000-ohms potentiometer (Reliance).
R2 100-ohms ½ watt (Dubilier).
R3 500 ohms ½ watt (Dubilier).
R4 100,000-ohms ½ watt (Dubilier).
R5 100-ohms ½ watt (Dubilier).
R6 1 000 ohms ½ watt (Dubilier).
R7 10,000-ohms ½ watt (Dubilier).
R8 3,500-ohms ½ watt (Dubilier).
R9 3,500-ohms 2 watts (Dubilier).
R10 200-ohms ½ watt (Dubilier).
R11 3,500-ohms 2 watts (Dubilier).
R12 100-ohms ½ watt (Dubilier).
R13 1-megohm ½ watt (Dubilier).
R14 500,000 ohms ½ watt (Dubilier)
R15 150,000-ohms 1 watt (Dubilier).
R16 10,000-ohms 2 watts (Dubilier).
R17 10,000-ohms 2 watts (Dubilier).
R18 5,000-ohms potentiometer (Reliance).

SUNDRIES.

Ch.1 High frequency choke (Eddystone type 1011).
1—Stand-off insulator (Eddystone type 1019).
1—Banana plug and socket (Belling-Lee type 1078).
5—7-pin valve holders (Belling-Lee).
2—4-pin valve holders (Belling-Lee).
1—Terminal block (Eddystone type 1046).
2—½ in. Coil formers (Bulgin).
2—⅝ in. Coil formers (Bulgin).
5—Valve thimbles (Belling-Lee type 1175).

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 ½ 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 1299).

THE POWER PACK

CONDENSERS.

C35 2-mfds. 650 v. (Dubilier type LEG).
C36 2-mfds. 650 v. (Dubilier type LEG).
C37 8-mfds. electrolytic (Dubilier type 32814).
C38 & C39 8-8-mfds. electrolytic (Dubilier type 9203F).
C39 1-mfd. 1,500 v. (Dubilier type 950).

RESISTANCES.

R44 50,000-ohms 15 watts (Bulgin type PR 17).
R45 10,000-ohms 1 watt (Dubilier).

SUNDRIES.

3—4-pin chassis valve holders (Belling-Lee).
2—Voltage-selector boards with fused bridges (Clix).
1—High-voltage valve cap (Bulgin type P.92).
2—Smoothing chokes (Varley type DP 11).

TRANSFORMERS.

T1 Mains Transformer (Keston Mfg. Co.).
Primary 200-250 v.
Secs. 4 v. 1 a.
4 v. 1 a.
2-0-2 v. 5 a.
1,000 v. 15 m/A.
2 v. 2.5 a.

T2 Mains Transformer (Sound Sales).
Primary 200-250 v.
Secs. 300-0-300 v. 90 m/A.
2-0-2 v. 5 a.
2-0-2 v. 8 a.

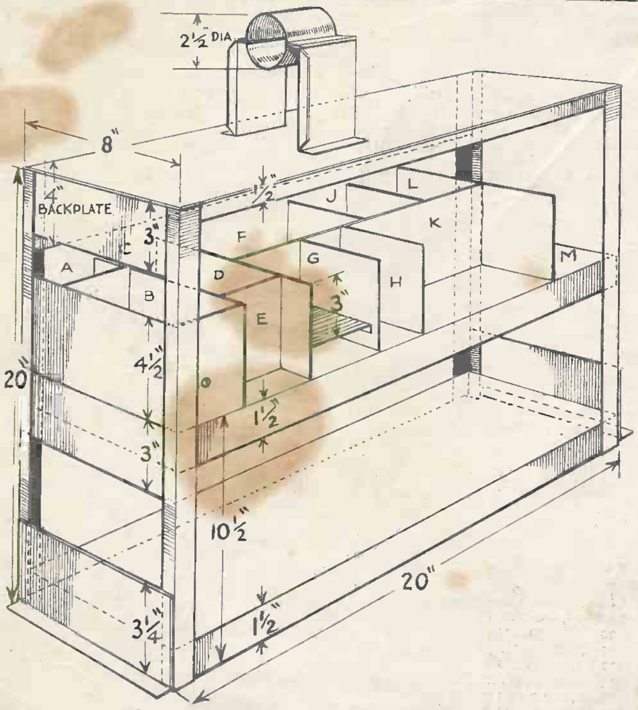
VALVES, TUBE AND CHASSIS

V1, 2, 4, 5 Mullard TSP4.
V3 & V6 Osram D42.
V7 Osram MSP4.
V8 & V10 Mazda type T31.
V9 and V11 Mazda type AC/P.
V12 Mazda DLS1 vacuum delay switch.
V13 Mazda type MU2 rectifier.
V14 Mullard type IW3 rectifier.
Mullard C.R. Tube type A41-4 (white) or A41-G4 (green).
Chassis, nuts and bolts and wire, etc. (Mervyn)

socket, the legs of which are not insulated and are, in some cases, at high potential. It can be remarked, however, that at no point does a voltage higher than a little over 1,000 exist, therefore any possibility of a dangerous shock is non-existent.

As we have already considered the circuits employed fairly fully in the articles preceding this series, it is not necessary again to describe the various theoretical considerations underlying the design. We will, however, briefly review the general form of the arrangement adopted, for in this way a clearer insight into the functions of the various units is obtained. This will greatly facilitate construction and subsequent adjustment.

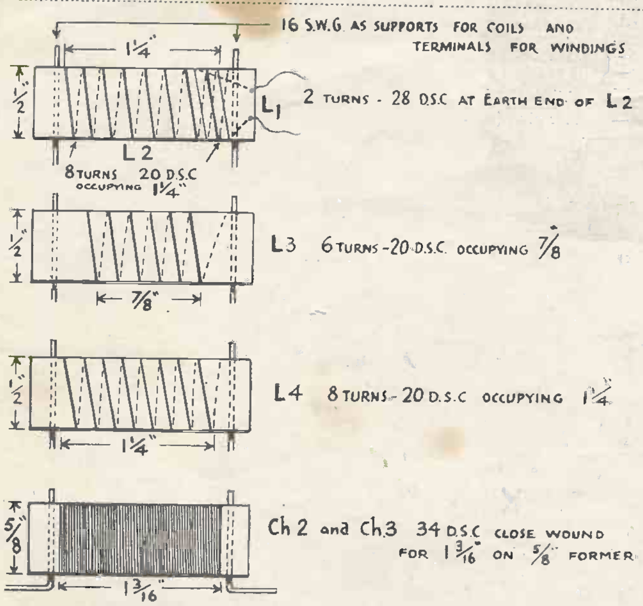
THE RECEIVER CHASSIS AND COILS



Dimensioned drawing of complete chassis.

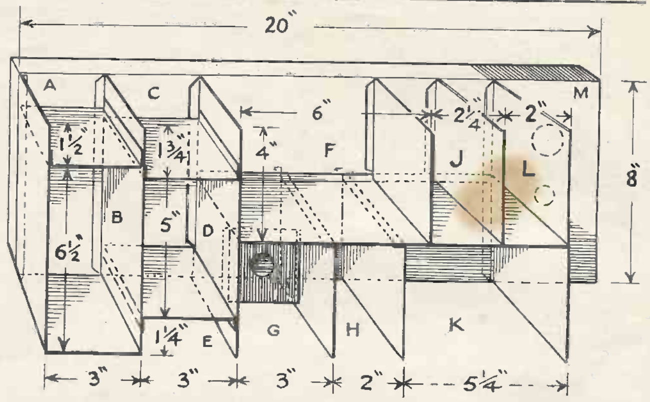
The Time Base

The time base employs four valves, two for each scan voltage generated. The arrangement adopted is quite conventional, Mazda type T31 relays are employed to generate the high- and low-frequency saw-tooth oscillations. These oscillations are then, in each case,



Winding data of coils employed in vision unit.

increased to the required amplitude with triode valves (Mazda type AC/P). For the slow speed scan, the shape of the saw-tooth wave is slightly "faked," otherwise as this deflection voltage is applied to normally disposed deflection plates aspect distortion would result.



Details of vision unit chassis.

The Vision Unit

The vision unit employs a straight circuit. Seven valves in all are used. Two of these valves function as radio-frequency amplifiers and are followed by a diode valve which rectifies the amplified carrier provided by these two stages. This rectified signal is passed to two further valves operating as video frequency amplifiers. The output from the final video frequency stage is used to modulate the grid of the C.R. tube.

The remaining two valves for which we have not as yet accounted are a diode valve and a screened grid valve. The diode valve functions as a D.C. restorer, the screened grid valve is responsible for synchronising pulses selection. The method favoured is well known and makes use of the fact that by suitably apportioning the valve's electrode potentials a short operating characteristic having an abrupt termination is secured. This short characteristic can only accommodate that part of the signal due to the synchronising pulses, rapid attenuation of any signal higher in amplitude taking place. The effect is further augmented by including a high resistance in series with the grid of the valve.

The Power Packs

The power packs are perfectly straightforward, and for this reason will require little description. One of these furnishes 250 volts at about 80 milliamps for the vision unit. Adequate smoothing is required as the post-detector gain is comparatively high. An indirectly-heated rectifier is employed as this avoids the application of high voltages before the various valve's heaters have attained their normal operating temperature.

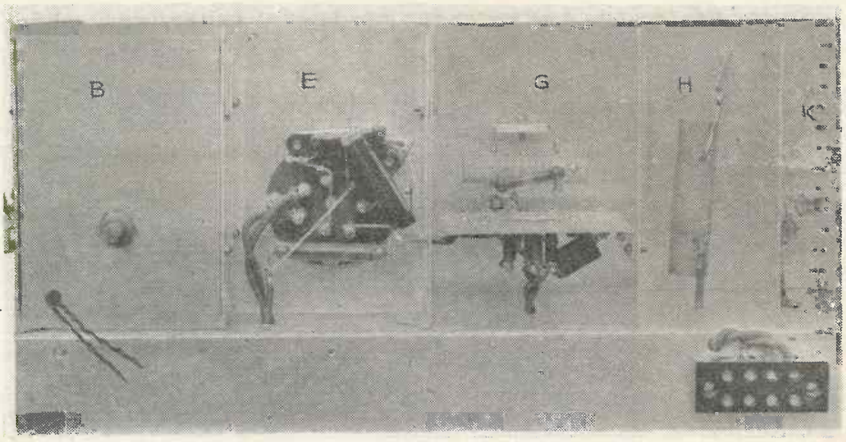
The other power unit furnishes a little over 1,000 volts at about 15 milliamps. The full voltage is available for C.R. tube excitation, and roughly 500 volts of it furnishes power for time base operation. In this case the excess voltage is dropped across a power resistance and thereby sufficient smoothing of this supply is provided. A Mazda vacuum-type delay switch is used to switch this voltage.

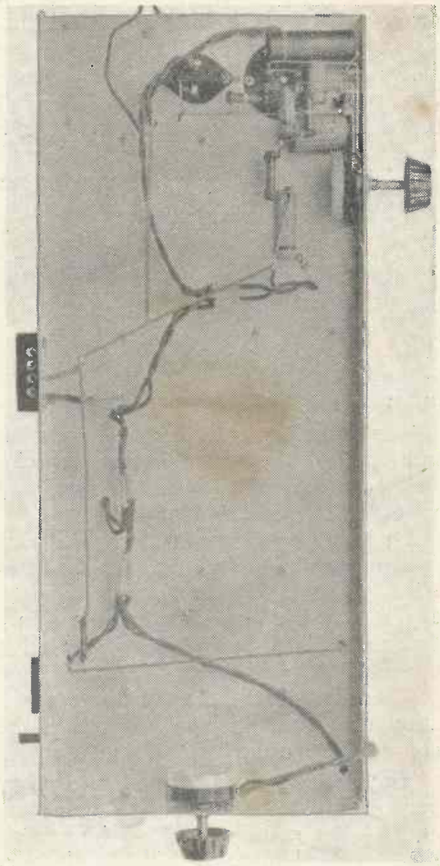
The Vision Unit Circuit

The circuit for the vision unit is shown earlier. It is seen that seven valves in all are employed and their

C

THE COMPONENT ASSEMBLY





The photograph above shows part of the component assembly of the vision unit and that on the right the underside of vision unit.

respective functions have earlier been remarked. We have already seen that a video frequency amplifier from the television viewpoint is extremely efficient. For this reason two stages are employed and furnish a concerted gain of about 450 times. This is mentioned at this stage for then the need for employing only two R.F. stages is apparent.

A single R.F. stage employing one of the high-mu R.F. pentodes will, with care, furnish a gain of about seven times. Obviously the gain through two such stages is almost fifty times. The total gain of a receiver employing two R.F. and two V.F. stages is about 22,000 times.

This amount of amplification proves adequate for all locations situated at distances up to 25-35 miles from the transmitter.

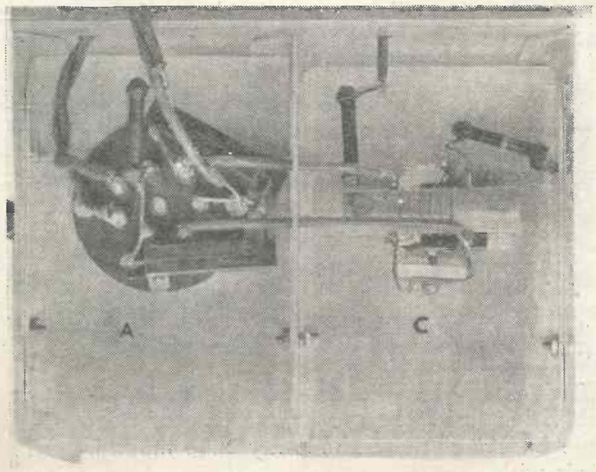
Wiring the Vision Unit

The photographs and drawings will make clear the construction and wiring of the unit.

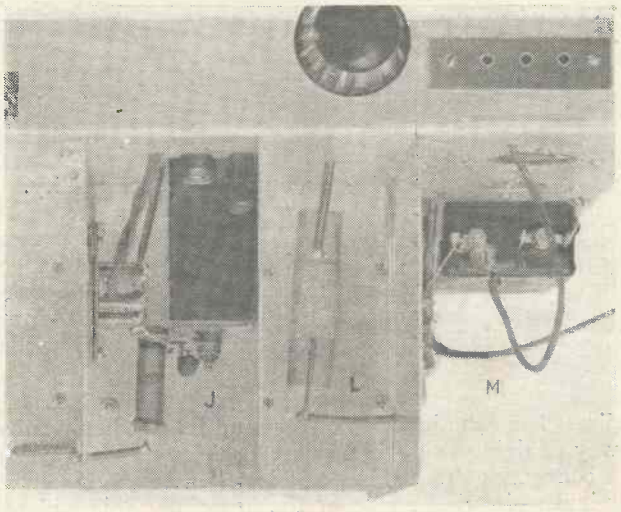
The metal work is carried out in either aluminium or metal sheet. Aluminium is, of course, very much simpler to manipulate and drill. For this reason its use is to be preferred.

It is well known that better R.F. stability is secured when one heater connection is directly made to the chassis and usually this is the arrangement adopted when wiring the heater supplies for a vision receiver. It is perhaps not so well known, however, that when more than one V.F. magnifying stage is used, then, this arrangement for the heater wiring can cause a great deal of trouble. It is often the explanation for an inability to secure good synchronism.

The reason for this is simply that mains hum is



Component assemblies in compartments A and C.



Component assemblies in compartments J, L, and M, shown with the unit turned on its side.

WIRING THE VISION UNIT

provoked, the amplitude of this hum often proving sufficient entirely to take charge of synchronism for the slow speed scan, causing the picture to lock at some intermediate position. It can also adversely affect the line synchronism. Apart from these deleterious effects, even when a sufficiently powerful signal, which can furnish synchronising pulses having sufficient amplitude to overcome the existing hum level is obtained, there is always an annoying dark horizontal area present to mar the picture quality. It is for this reason that twisted heater leads and a centre tapped heater winding are employed.

The Coils

The winding data for the coils and the correction inductances are given in the drawing.

L1 consists of two turns of silk-covered instrument wire at the earth end of L2.

L3 and L4 are quite straightforward.

The correction inductances Ch2 and Ch3 consist of No. 38 s.w.g. d.s.c. instrument wire occupying 1 3/16 in. winding length on a ⅝ in. coil form. The turns are close wound and it should be possible to get approximately 110 turns into this space.

These inductances, as also the coils L1-L4, are readily supported when wiring by means of the 16 s.w.g. tinned copper wire used for terminating the windings.

The condenser C1 tunes the inductances L2. To permit adjustment of this condenser a slot is filed at the end of the spindle. The trimmer adjusting tool can then be used to rotate this condenser. This trimming tool is simply fashioned from a size 4 or 6 knitting needle. The point is removed and a blade end is fashioned with the aid of a fine file.

The original components layout as revealed by the various photographs should be adhered to, as far as is possible. The R.F. by-pass condensers, C2, C3, etc., are soldered directly to the valve holder sockets. All leads are kept short and are preferably taken direct to each appropriate junction. Right-angle bends whilst making for a neat appearance should be avoided.

Actually it is extremely unlikely that any trouble will be experienced due to instability for the radio-frequency gain is quite low.

The resistance R7 across the coil L4 is included as the input impedance of the diode valve V3 is higher than is the impedance of the R.F. valves V1 and V2. It is permissible to omit it if slightly higher gain is desired without seriously affecting picture quality.

Care with the disposition of the coupling condensers C12 and C15 is required. These are mounted away from the chassis for otherwise the stray shunt capacities formed will reduce the response at the higher frequencies. Furthermore, the extra capacity so introduced is sufficient to render inaccurate the correction inductance constants.

Modulation is applied to the grid of the C.R. tube direct from the junction of C15 and R13. A convenient way of doing this will be described later. In addition, a connection from this point is taken to the small terminal strip at the side of the chassis. This will permit simple connection of headphones to facilitate the initial tuning adjustments. An extra socket on this terminal strip serves as the synchronising feed binding post.

Reference to the circuit discloses that no chassis connection is made to the 4-way Bryce connecting block. A little consideration reveals this to be unnecessary for the metal uprights of the complete assembly will complete the earthed circuits. If, as was suggested earlier, a different arrangement is adopted, it is important to bear this fact in mind. Provision to complete the inter-chassis earth connections is then required.

Some doubt may exist regarding the correct connections for the gain control R1. This control is not actually mounted on the vision unit proper. Reference to the illustration reveals it to be mounted on a small sub-panel at the front of the complete receiver. This will introduce no constructional difficulty; the control is simply attached to a twisted pair having sufficient length to permit this mounting to be made.

As is indicated by the dotted connections in the circuit diagram the potentiometer may control either the gain of a single R.F. stage or its control may be extended to be applicable to both stages. In either case the same resistance value for the potentiometer is entirely satisfactory.

The actual wiring up of the unit will be found straightforward and no difficulty whatever should be encountered if the information conveyed by the diagram and illustrations is intelligently applied.

Tinned copper wire, insulated with sleeving where required, can conveniently be used for the wiring. Twisted 14/36 slide back type wire is very suitable for the heater connections. The usual care in connection with the avoidance of dry joints and the application of excessive heat is observed and where chassis connections are to be made a clean bright surface contact must be assured.

Having completed the wiring the valves may be inserted and if a power pack is available preliminary tests can be conducted.

For these preliminary tests headphones are connected across the appropriate sockets of the terminal strip. It is preferable and in any event it is essential, if it is required to check the functioning of the synchronising pulses filter, to include a condenser having a capacity of about 0.1 mfd. in series with the headphones. It is seen from the diagram that this condenser becomes necessary when the phones are attached to the anode of the sync. separator valve V7.

Adjustment of the filter stage is carried out with the potentiometer R18. A position for the control is found where the noise due to the picture vanishes leaving only the regular beat due to the synchronising pulses.

Actual tuning of the R.F. sections is extremely simple. The various circuits are in each case adjusted to resonate at the frequency of the vision carrier, i.e., each is tuned for maximum signal. The gain control is preferably reduced during this operation for this will sharpen the tuning and render the task of accurate adjustment simpler.

This completes the construction and adjustment of the vision unit. In the next article of this series the time base and the cathode-ray tube mounting will be dealt with.

Telegossip

A Causerie of Fact, Comment and Criticism

By L. Marsland Gander

TIME and television march on. We enthusiasts are interested now mainly in one thing, namely, when the new expansion plans, of which there has lately been so much talk, will have due effect on the programmes.

I am sorry to open on a doleful note but I must, in candour, comment that the B.B.C. are characteristically making haste slowly. Just before writing these notes I was privileged to make an exhaustive tour of Alexandra Palace. Though I am assured that much progress has been made on paper there was absolutely no sign of a practical start on the alterations and extensions.

The reason, I believe, is still that the B.B.C. do not yet know exactly how much extra the Government intend to grant to television. I freely admit that the B.B.C. must cut its coat according to its cloth. But there is another equally important consideration.

Educating the Public

Recently the B.B.C. Television Advisory Committee and the Radio Manufacturers' Association joined forces to persuade the Press and the public that television is a good, stable and expanding thing. I gave some hints of this move last month.

One of the offerings made on the altar of confidence was a promise that no change would be made in the standard of definition for three years. Now this is a diminishing factor. As time goes on it becomes two and a half years, two years, and so on.

Therefore speed is the essence of the contract.

Another point is that the attacks made in a Big Push must follow one another in quick succession or the ground gained will be lost again. Much time and trouble have been spent in convincing the newspaper editors that television is going to push ahead.

Now are we all to sit down and have a good think about it? Or is there to be immediate and convincing follow-up action. I hope, Mr. Gerald Cock, that you will take this perhaps needless urging in the spirit intended and like the grand leader I know you to be!

As regards this question of the "three years' limit" it is most important that the trade should try to educate the public. Nobody likes to buy an article with a time-limit to its utility. Experts have often told me that moderately simple alterations could be made to existing sets to adapt them to higher standards of definition. Yet statements are repeatedly made which suggest to the hesitant buyer that in 1940 he can just throw his £60 set straight on to the scrap-heap.

Baird Colour Television

After regrets an apology! I apologise for referring to colour television which I know will be described in detail elsewhere in this issue. But as the outstanding television event of the month I must make some slight reference, and I offer to Mr. J. L. Baird and his technical staff my sincerest congratulations. I saw a demonstration at the Dominion Theatre in the company of Lord Selsdon, chairman of the Television Advisory Committee, Dr. Clarence Tierney, chairman of the Television Society, and others. I shared the opinion expressed to me by Dr. Tierney that the colours, whatever the deficiencies of definition, were more natural than those of most colour films. Lord Selsdon, who in his official capacity is not permitted to make public statements, was plainly as impressed as other members of the audience.

Mr. Baird told me that he is off to the Radio Convention in Sydney, where he will stay just a fortnight. If the part of a pioneer has its trials it also has compensations.

An hour's Sunday programme, as a modest first instalment of the extension plans, begins on the afternoon of April 3. I hear that the most probable inaugural programme will be one from Mortlake where the mobile unit will be resting from the triumph(?) of the Boat Race on the previous day. Mr. Philip Dorté has an amusing project in mind. He is thinking of reproducing some of the historic races of the past, when they rowed in top-hats, gum-boots and spurs, or whatever they did wear.

The Boat Race

I am a little troubled about the Boat Race. It must be done, but until we have a television equivalent of the launch *Magician* to follow the crews, how? As it is we shall just see a flash of the finish and the exhausted crews coming ashore, with the possibility of panting interviews.

During my recent tour of Alexandra Palace, I paid a visit to the theatre which is to be converted into a super studio. Incidentally, work at A.P. just shows the B.B.C. boys what a sheltered life they lead. Passing from the warmth of the B.B.C. section across the frozen waste of the Great Hall, where the heaters were turned off, to the theatre was rather like a trans-Polar trip.

As I have said it was a disappointment to find that no start has been made on the adaptation, but it was equally surprising to see that it is already such a busy spot.

Properties

This is the carpenter's shop, where they make everything from a hard-boiled wooden egg to a reproduction of the Parthenon. Such a great amount of space is taken up by storage that there will plainly have to be considerable enlargement of the B.B.C. quarters at Alexandra Palace to accommodate the growing stock of property when the great move takes place.

I came prepared for boredom and was soon marvelling at industry and craft. One man stood like the Prince of Denmark, skull in hand. But he was not contemplative; he was modelling a cunning replica in papier maché absolutely indistinguishable from the original. Another was busy on modelling in the same material a Corinthian capital, the intricate ornament which surmounts fluted marble columns. These aforesaid columns were being made of wooden strips which were finally pieced together in a most ingenious way.

Yet another was making a replica of a horse-pistol with which Clive of India vainly tries to take his life. This was a remarkable piece of work and the craftsman has difficulty in

PLANNING THE A.P. THEATRE

persuading me that it could not actually be fired.

I was shown round by Mr. T. Edwards, the master-carpenter, who takes a proper pride in his very efficient team. There seemed to be nothing they could not make—I saw a mandoline, three violins, and an oriental palanquin, a blunderbuss which could be realistically fired with the aid of a puff of french chalk. " No Man's Land " for " Journey's End " was a shock. I had thought it was a section of film, deceived by the smoke, the churned earth and the tumbled wire. Yet here was the model complete. We viewers do not realise the effort behind production. Yet I confess to a pang of regret when seeing the model of futuristic machinery for " RUR," On the screen my first thought was " That would never work in any circumstances." Here, I thought: "What beautiful workmanship!" Moral to the B.B.C. Don't think too much in terms of " Behind the Scenes."

The A.P. Theatre

I was chiefly interested to discover what sort of a studio the theatre will make. It measures from one extremity to the rear of the stage at the other 141 ft. The width is 61 ft. and it is approximately 60 ft. high. First steps will be the levelling of the floor which at present slopes in theatre fashion. Though it is definite that the place will be adapted on film studio lines and not on theatre lines, the fate of the stage is uncertain. This may be included in the general levelling or the studio may end where the stage begins while the rest of the space is devoted to some other purpose. Perhaps the stage could be used for the orchestra.

In any event the converted theatre will make a studio more than twice the size of either existing studios.

I met Mr. Harry Pringle in the corridors and he told me an entertaining story about Koringa, Mr. Bertram Mills' woman fakir. When she came to the studio she had as co-performers three huge pythons and three medium sized crocodiles. At one point in the proceedings an 8-ft. crocodile got out of hand. He made a bee-line for the camera man, snapping fearsome jaws. Koringa had to " step on everything " to pursue and hypnotise him. Croc was duly subdued. But behold one of the pythons had now decided to make whoopee by wrapping himself round the wire wheels of the camera truck. Once more Koringa had to do her stuff to disentangle the brute.

Koringa's turn must have given some viewers the shudders, for among other things she thrust a dagger through the skin of her throat as, in schooldays, we used to run pins through the upper flesh of the finger.

The New Announcer?

Also in the corridors I saw the young Empire announcer, R. N. Dougall. Is he to be Leslie Mitchell's successor I wonder? He certainly has the appearance, young, dark and handsome. And the voice. Officially I am told that there are still four candidates in the field.

Mr. Dougall has been doing a certain amount of " Picture Page " interviewing, I was told, so it looks very much like a " try-out."

Whether viewers like it or not it seems certain that amalgamation of the ordinary sound and television programmes is upon us. The first programme which was broadcast to the medium wave audience besides being televised was a " White Coons " show the other day. I am dubious of the success of this attempt to serve two masters and the artists on the screen showed that they were either thinking of one thing or the other. Movement was restricted, for example.

Broadcasting House and A.P.

However, there is to be another " Sound and Vision " show on March 14. Mr. Harry Pringle will be the producer. He told me that there is to be a " Monte Carlo " setting, with a tea garden and cabaret chorus of twelve Beauty Queens, with eight boy friends.

The biggest job for the mobile unit is to be the first broadcast of an athletic meeting from the inter-Varsity sports at the White City on March 12. Viewers will see the 100 yards, pole vaulting, the 120 and 220 yards hurdles, the high and long jumps, and putting the weight. To depict the mile race satisfactorily Mr. Philip Dorté has under consideration the installation of the camera in a central tower, using telephoto lenses. Throwing the discus and the javelin will also be shown. The whole transmission will last 70 minutes, with ten-minute intervals from 2.30 until 4.

By the way, I understand that the committee of the Amateur Boxing Association was present in force at the last televised display of the Alexandra Boxing Club and apparently are satisfied that television holds no terrors for the amateur boxer. At any rate we have heard nothing more about the ban. As a matter of fact the grounds for the original ban seem vague for, according to Mr. Dorté, no complaint was ever made that the extra lighting or the heat ever caused any inconvenience. So this experimental evening was arranged, two super-Emitrons were on parade, the B.B.C. were on best behaviour and all's well that ends well.

Obstruction

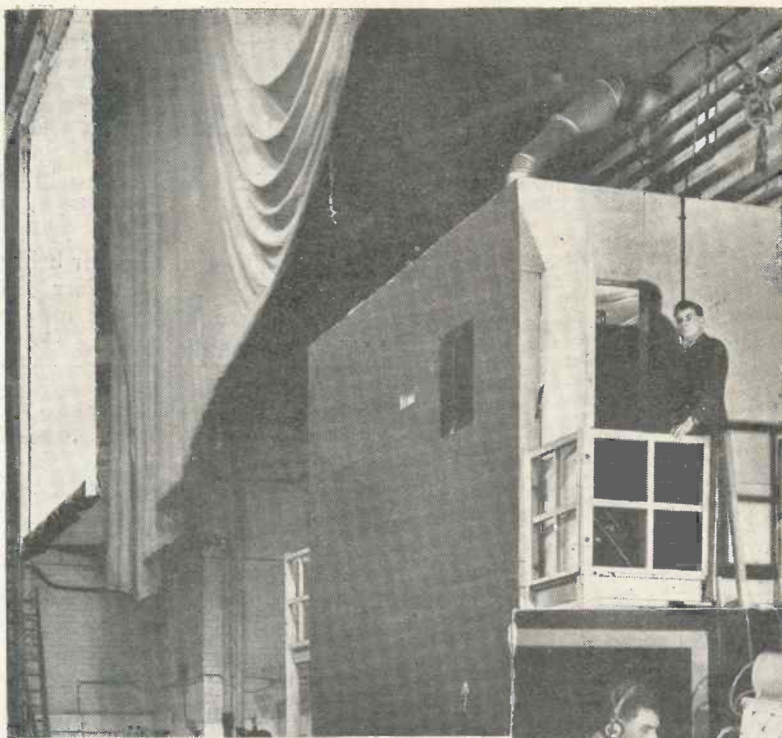
May there be a similar end to the difficulties with the Epsom Grand Stand Association over the televising of the Derby. That any responsible body should be obstructive is regrettable but a common enough experience. Such instances have often occurred in the history of broadcasting and will be repeated in television. It should only be necessary to prove, on the analogy of broadcasting, that so far from keeping people away from the Derby television will stimulate interest and swell the crowds, to overcome the opposition.

I have been taken severely to task, in conversation, for saying that I preferred the television version of " Rush Hour," Herbert Farjeon's revue, to the stage show under the new name of " Nine Sharp." How can I pretend, I am asked, that the small television screen can rival the life and colour of the real stage?

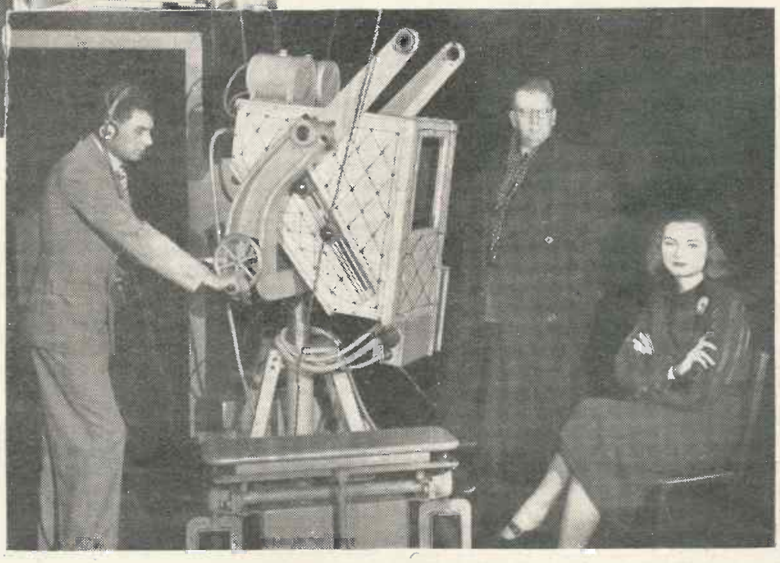
My answer is (and I am prepared to defend myself to the last ditch) that the television producer scored better points and through the necessities of compression skimmed the cream of the show. Also several numbers which I liked very much had been omitted from the stage show, others, which I considered inferior, being substituted. In other words I was discussing the material and manner of presentation rather than the medium. If television does sometimes show us things " as through a glass darkly " it occasionally has a rare essence in its entertainment.

BAIRD COLOUR TELEVISION

Here is an account of the Baird colour television which was demonstrated at the Dominion Theatre, Tottenham Court Road, last month. We understand that the system has been personally developed by Mr. John L. Baird.



An exterior view of the projector room at the Dominion Theatre. The large screen can be seen at the extreme left of the picture.



The transmitter at the Crystal Palace. This is mobile and can be used for close-up or distant shots.

REMARKABLE results in colour television were demonstrated by the Baird Company at the Dominion Theatre, Tottenham Court Road, last month. The demonstration was remarkable in several ways and it was the first of its kind ever given, though in 1928 Mr. Baird showed a picture a few inches square in colour at the British Association meeting in Glasgow. This, however, was transmitted by wire.

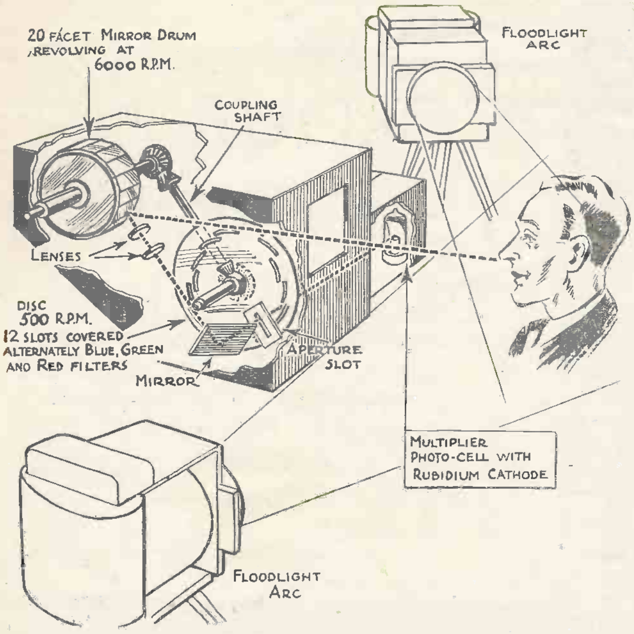
In this latest development the size of the picture is 12 ft. by 9 ft. and the transmission by radio from the South Tower of the Crystal Palace, a wavelength of 8.3 metres being used. Another special feature of the demonstration was that the colour is exceedingly good and on the whole more pleasing to the eye than are the latest colour films. No claim was made that the definition came up to the standard of the ordinary transmissions and Mr. Baird clearly stated that this was regarded as a preliminary experiment. Even so, the demonstration was most impressive and the results came as a surprise to those who witnessed it.

The present apparatus is shown by the photographs and drawings. It transmits a 120-line picture, the scanning at both transmitter and receiver being by mechanical means. The transmitter consists of a mirror drum with twenty mirrors inclined at differing angles revolving at 6,000 r.p.m. These mirrors reflect the scene to be transmitted through a lens, causing an image to be formed on a rotating disc with 12 concentric slots at different distances from its periphery. By this means the field given by the 20-line drum is interlaced six times to give a 120-line picture repeated twice for each revolution of the disc. Each of the slots is covered with a light filter, blue, green and red being used alternately, the effect of this being to transmit alternate lines of the picture corresponding to a blue-green image and a red image.

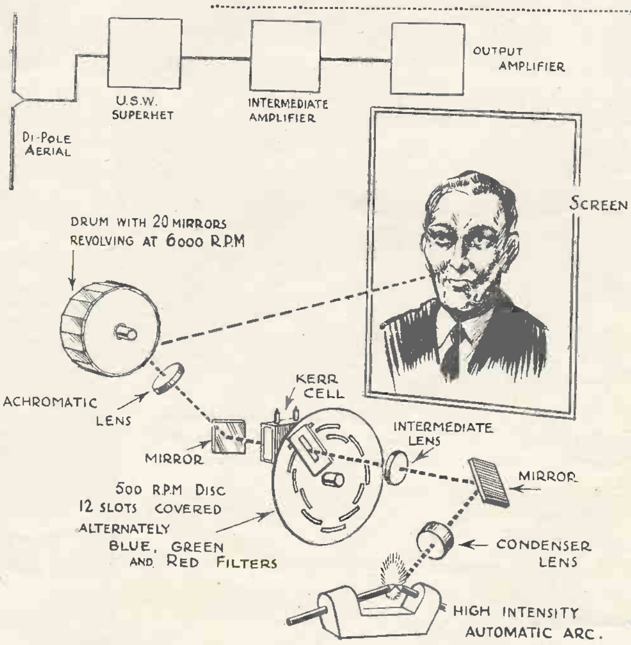
At the receiving station a similar device is employed, the rotating drum in this case being much larger (12 in. in diameter in place of the 8 in. drum at the transmitter).

Light from a high-intensity arc lamp is concentrated on the moving aperture in the disc and yields sufficient light to fill a screen 12 ft. by 9 ft. The projected picture could be seen from all parts of the Dominion Theatre, which has a seating accommodation of 3,000.

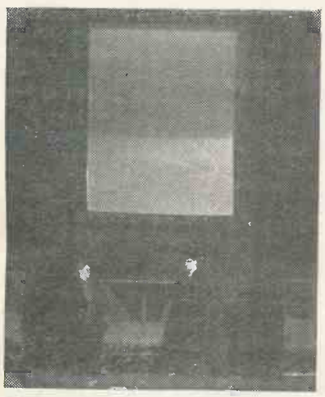
The programme included impersonations of a military officer, a shiek and a Turk. Two ladies exhibited various coloured hats, and the programme concluded with the White Ensign and a coloured photograph of the King. The actual objects televised were afterwards inspected at



Schematic drawing of the Baird colour television transmitter



Schematic drawing of the receiver.



Some idea of the size of the screen will be obtained from this photograph of the stage.

the Crystal Palace, and it was apparent what excellent reproduction had been obtained.

There are some very interesting features about this apparatus and a very large number of practical difficulties had to be solved before it could be put into successful operation. One trouble was in the construction of a mirror drum that at the high speed of revolution would not distort the mirrors or burst. Depending upon the method of securing the mirrors to the drum, they would either bend outwards and become convex or inwards and become concave until a suitable method of construction had been developed. The fire regulations of the L.C.C. had also to be overcome and this necessitated the entire receiver and projector being enclosed in metal cases with only a small peephole through which the arc crater could be observed. This latter, by the way, takes a current of 150 amps. and the heat generated makes water cooling essential.

The general layout of both transmitter and receiver will be clear from the schematic drawings and it will be seen that the drum and disc are directly coupled together by means of reducing gearing, one motor being used to drive both. The Kerr cell used for light modulation is of the ordinary type with an aperture about 3/16 in. square. Other types of cell using both rays were tried, but it was found that gains obtained in one direction were more than lost in others and that the ordinary type gave the best results. Actually the transmitter is mounted on a bogie of much the same type as is used for the Emitron camera and it is therefore reasonably flexible in use. The entire apparatus is a beautiful piece of work and reflects great credit on the production engineers of the Baird Company.

Book Review

Fundamentals of Radio. Terman—McGraw Hill & Co., 21s., 450 pp., 278 figs. in text.

The author's larger book "Radio Engineering" was recently reviewed in these columns, and to those who cannot afford the higher cost of the full text-book, this new abbreviated work will appeal. The author admits that it is an abridged version of "Radio Engineering," but the treatment has been so cleverly done that nothing of importance has been omitted.

The chapters are divided into: Fundamental Components, Circuit Elements, Vacuum Tubes as amplifiers, power amplifiers and oscillators, Modulation, Radio Transmitters and Radio Receivers.

Although the treatment is elementary, a complete set of problems is appended to each chapter, and the serious student cannot fail to obtain a thorough grasp of the subject in working them out in conjunction with the notes given.

It is not too much to say that either "Radio Engineering," or its younger brother "Fundamentals of Radio," are vital books to the radio engineer and no one can afford to be without at least one of them.

Radiolympia 1938

The dates for the next Radio Exhibition have now been fixed. The show opens Wednesday, August 24, and closes on Saturday, September 3.

Scannings and Reflections

THE LONDON-BIRMINGHAM CABLE

IT was alleged at a meeting of the Electrical Association for Women, held in Stafford recently that disagreement between the B.B.C. and the Post Office regarding the charges that were to be made for use of the London-Birmingham cable is hindering the development of television in the Birmingham area. This statement has, however, been denied by an official of the General Post Office in London, who said "There is no truth at all in the suggestion that there has been a discussion about charges between the B.B.C. and the Post Office. There has been no discussion and therefore no dispute. Presumably, if and when a channel is required by the B.B.C., the existing arrangements would be followed. If the B.B.C. are giving an outside broadcast from Birmingham and needed a line, that line would be rented from the Post Office when required."

This denial appears to be borne out by the recent statements that have been made in authoritative quarters to the effect that the installation of a transmitter in Birmingham was not contemplated until more experience had been obtained in the London area. Actually, this cable, although laid, has not as yet been used for telephonic communication.

AMATEUR BOXING BAN LIFTED

The Amateur Boxing Association has lifted the ban which, it will be remembered, it recently placed on the televising of boxing matches of its associated clubs. It is understood that some objection was made to the lighting conditions.

THE DERBY AND TELEVISION

The Derby is not to be televised. The Epsom Grand Stand Association, which controls the racecourse, and with which the decision finally rested, has announced that under no circumstances would permission be given for the televising of any races on the Epsom Downs. This decision is unfortunate, for tests had proved that excellent reception could be obtained from the site.

MARCONIPHONE BIG-SCREEN TELEVISION

The Marconiphone Company recently demonstrated a receiver with a screen measuring 22 in. by 18 in. The picture is projected through a special f/1.5 corrected lens on to a vertical screen, via a mirror placed at an angle of 45 degrees. This screen hinges horizontally on to the top panel of the cabinet when not in use. The projection tube has a diameter of 3 in., and the maximum voltage employed in the receiver is 20,000 volts.

A 7-valve (plus rectifier) all-wave superhet chassis, covering short-wave ranges of 11-35 and 35-100 m. is incorporated, and the A.F. amplifier of this is used for television sound. The total number of valves, including rectifiers, is thirty-seven. This model is intended for clubs, hotels, other similar premises and houses of the larger type. The price is 200 guineas.

R.M.A. TELEVISION DINNER

A dinner was given by the Radio Manufacturers' Association on February 4 with the object of explaining the television position in this country to the leading Press executives. The authorities represented were the Television Advisory Committee, the B.B.C., and the Radio Manufacturers' Association, and the points of view on behalf of these three bodies were put forward. Abstracts from these speeches are given on other pages in this issue. The speakers were: Sir Frank Smith, Secretary of the Royal Society, for the Television Advisory Committee; Capt. C. G. Graves, Controller of Programmes, for the B.B.C.; and C. O. Stanley, for the R.M.A. In the unavoidable absence of Lord Hirst, Lt.-Col. J. T. C. Moore-Brabazon was in the chair, to act as "compère," as he put it.

TELEVISING INTERNATIONAL RUGGER

Television's first Rugger game—the international match between Scotland and England—will be seen by viewers on March 19. Three cameras will be used: one on the north stand, and two opposite the respective twenty-five yards lines. It will thus be possible to cover the whole field, both in comparative close-ups and with plan views. Captain H. B. T. Wakelam's commentary in the National programme will accompany the vision transmission.

TELEVISION IN THE COMMONS

The Postmaster-General, Major Tryon, answering a question by Capt. Arthur Evans (Con., Cardiff S.), as to what reasons he could assign for the public response to television not reaching the standard expected, said that every effort was to be made to provide programmes of an interesting and attractive type.

Transmission standards, he said, would not change for at least three years, and the public, therefore, might buy television sets without fear that they would become obsolete for a considerable time to come. "I am confident," concluded Major Tryon, "that rapid progress will be made with the development of television, and that it will eventually become a normal adjunct of the sound broadcasting service."

ADDITIONAL PROGRAMME TIME

As announced on other pages in this issue, Sunday television programmes are to be inaugurated on April 3 from 9.5 to 10.5 p.m. A second hour will follow as soon as possible, and week-day evening programmes will be extended by an extra half-hour as soon as possible with a view to permanency.

ZEEBRUGGE IN TELEVISION

Alexandra Park lake will be the scene of a miniature naval battle on St. George's Day (April 23), when the attack on the Mole at Zeebrugge is to

MORE SCANNINGS . . . .

be re-enacted with models for television. The demonstration will be given in the evening programme.

The models, built to scale, will be worked automatically, and it is hoped to achieve a large measure of realism on the television screen. The episodes will include pre-war scenes in the quiet little port, followed by a foretaste of war with the sinking of a liner by a submarine.

The demonstration will be staged in darkness, but batteries of searchlights combined with the gun flashes should yield all the illumination necessary to make a good picture. It is expected that three television cameras will be used in conjunction with the mobile television unit.

MORE O.B.'s

A considerable increase in the number of outside broadcasts is contemplated and another broadcast van has been ordered. This order has been placed with the E.M.I. Co.

BAIRD COLOUR TELEVISION

A surprise experimental demonstration of colour television was given by the Baird Company at the Dominion Theatre, Tottenham Court Road, on February 4. Full details of the system used are given on other pages in this issue. Transmission was by radio, from the South Tower of the Crystal Palace. The wavelength employed was 8.3 metres.

MANCHESTER AND TELEVISION

On February 7, the Postmaster-General, in the House of Commons, was asked by Mr. W. R. Duckworth (Moss Side—C.) when arrangements would be made to provide a television service for the Manchester area.

Major Tryon replied that the question of extending the television service to areas outside the present range of the London station had been considered by the Television Advisory Committee, who had decided that further research was necessary on certain aspects of the problem. This research was still in progress, and until it was complete the committee would not be in a position to make any recommendation concerning the establishment of additional television stations.

RECEPTION AT 100 MILES

Engineers of the Ecko Company have recently carried out a number of tests of long distance reception. Birmingham was chosen for the site of reception, which is approximately one hundred miles from the Alexandra Palace. Car interference, it is stated, proved the greatest difficulty, otherwise the pictures would have been good.

THE CAIRO CONVENTION

The International Telecommunication Conference at Cairo is now in full swing and amateurs all over the world are waiting for some of the results to become known.

This convention is perhaps the most important ever held for many countries interested are trying to curtail amateur activity on several wavebands.

The opinion in many quarters is that the amateur is no longer of any real help in the development of radio communication so that the channels allocated to amateurs can be put to more general use.

This may or may not be the case, but the fact remains that with the exception of America and possibly Great Britain most other countries will vote for a curtailment.

One point in favour of the amateur operator is, however, the fact that in time of war a ready made supply of telegraphists are available within a very short space of time so for this reason it is not likely that amateur activities will be stopped altogether.

However, most amateurs will be glad when the results of the conference are known. The amateurs are being represented at the conference by Mr. A. E. Watts, G6UN, President of the Radio Society of Great Britain, and Mr. K. B. Warner, Secretary of the American Amateur Relay League and International Amateur Radio Union. Amateur interests could not be left in better hands.

SUN SPOT ACTIVITY

Although further sun spot activity was expected on February 21 little difference was noticed by short-wave listeners. The conditions did not seem to fall off although some of the more distant stations were not quite so strong as usual.

On the contrary, despite the fact that this year short-wave reception should be more difficult than ever, listeners are finding conditions quite satisfactory.

During the Northern Lights display a little while back Douglas Walters, G5CV, had an interesting experience. At 11 p.m. he found that even with high power he could not transmit signals over a distance greater than about 10 miles. A report at this distance indicated that his transmission was attenuated from maximum strength down to R3 to R4. This is most extraordinary in view of the short distance being covered.

ULTRA-HIGH FREQUENCY WORK

Experiments below 6 metres have shown that long distances can be covered on these very short waves. In America so much use is being made of the ultra-high frequency channels for communication work that they are now being split up into bands on the lines of more normal short waves. As the amateur allocation is between two commercial bands the use of self-excited oscillators cannot go on much longer. Crystal control on the ultra-highs will then become more general in other parts of the world for with radio at any rate America leads.

J. L. BAIRD GOING TO AUSTRALIA

Mr. J. L. Baird has been invited to go to Australia to attend the anniversary celebrations of New South Wales being held there this year. Mr. Baird sailed on February 26, and we take this opportunity of wishing him a pleasant journey. We are glad that the New South Wales' Government are recognising the work of John Logie Baird for in view of the sensational developments made in the past few years many are apt to forget the pioneer work put in by him in the early days.

A FRENCH AMATEUR RECORD

In view of the publicity that has been given to British and American amateurs who have worked all the Continents of the world on phone in record breaking times it is interesting to note the record made by the French amateur F3JD. He has worked all six radio continents at the same time being able to talk and hear other amateurs situated in Africa, South America, Asia, North America, Australia and Europe in a "round table conference."

Although this record was made last September, the confirmation from each continent has just been obtained. Short-wave listeners will appreciate this feat for although it is possible to hear several continents within a very short space of time it is not very often that all continents are heard at the same time. F3JD has done this and, in addition, has carried on two-way conversations with them.

TELEVISION ACTING

In the *News Chronicle* dated February 18 was an interesting article under the above heading. Joan Miller, the "Picture Page" girl, was interviewed, who said: "The effect of television acting is to make one play for smaller and neater effects. Unlike radio plays, you have to learn your part by heart, often at short notice. It is almost impossible to get a prompt, a prompt being horribly audible. Another difficulty in doing a long play is that of changing clothes, since there is no interval. A cinematographic background, depicting train journeys, etc., taking place, provides a gap."

RADIO STATION LIGHTS THE HOUSE

A German court has recently found guilty three men who were charged with stealing electric current from the Hamburg radio station. As is well known an inductance placed within the field of a transmitting station's aerial will pick up a percentage of the radioated energy, the amount depending on the size of the inductance and its closeness to the aerial.

If a large number of people were to try this idea a considerable amount of energy could be obtained free of charge, but whether each experimenter could obtain more than enough current than to light a small flash lamp bulb is a matter of some doubt.

There is also the question as to whether this would affect the radiated power of the transmitting station. In some schools of thought it is suggested that this would be the case, and in addition it is claimed that the more people that listen-in the less is the signal strength at long distances. These are both interesting points that need more fully explaining.

TELEVISION AT THE IDEAL HOME EXHIBITION

As usual the Ideal Home Exhibition will be full of surprises, but this year those interested in television should not on any account miss the demonstration that is being staged there.

The British Broadcasting Corporation in conjunction with most of the leading television set manufacturers, are to demonstrate the wonders of modern television.

A glass-walled studio, 2,100 ft. in area, will enable visitors to see the stars as they are actually being televised. From April 14 to 18 the B.B.C. mobile television van will be stationed at the Exhibition so that the programmes from the show can be radiated back to Alexandra Palace. In turn the programmes will be picked up again at the Exhibition where visitors will be able to see the programmes being made and received at the same time.

TELEVISION SOCIETY

The third annual Kerr Memorial Lecture will be held on March 21 next in the lecture theatre of the Institution of Electrical Engineers at 7 p.m.

The lecture will be on "Luminescence and Luminescent Materials" and will be delivered by Dr. L. Levy.

Dr. Levy and his partner, Mr. D. West, are well-known to physicists as workers in the field of luminescent compounds and the demonstration after the lecture will no doubt be of special interest to users of cathode-ray tubes.

Visitors are welcomed and tickets of admission can be obtained from the Hon. Lecture Secretary, Mr. G. Parr, 68 Compton Road, N.21.

Plastic Lenses

A FACTORY just completed at Slough has begun the work of making lenses, for the first time in history, from a material other than glass. Last year a new company, Combined Optical Industries, Ltd., showed at the British Industries Fair the results of several years of research into the uses of highly transparent plastic materials for making lenses by moulding processes.

In refractive index and dispersion the plastic materials used resemble crown glass, while their transparency, especially in the ultra-violet, is so high, it is stated, that the loss of light by absorption is appreciably less. A plastic material of good optical and mechanical properties has the obvious advantage over glass that it enables lenses to be mass-produced with complete uniformity. Whilst hitherto plastics have had the drawback of softness, giving a surface easily scratched, the process perfected by Combined Optical Industries, Ltd., gives a surface hardness that will withstand all normal usage.

A New Baird Receiver

BAIRD Television have produced an entirely new television receiver which represents a very high technical achievement in combined television and radio entertainment for the home. A brilliant black-and-white picture, $13\frac{1}{2}$ in. by $10\frac{3}{4}$ in. in size, viewed in a hinged part-

The new Baird T14 Receiver.

mirrored lid is produced by the 15 in. "Cathovisor" cathode-ray tube, which is mounted vertically in the cabinet. The picture brilliance is such that viewing is easily possible either in daylight or with ordinary room lighting. The receiver is characterised by extreme simplicity of control.

A single switch brings the all-wave super-heterodyne receiver into operation. This receiver has an output of eight watts with really fine quality reproduction. There is also incorporated in the model the very latest design of Collaro automatic record changer. Nine records of any size can be played in any order and when desired any single record can be repeated any number of times.

The receiver, which is styled the T14, is housed in a luxurious figured walnut cabinet and can be supplied with record storage compartment or cellarette. The prices are 130 guineas with record storage and 135 guineas with cellarette.

FOR THE BEGINNER

MORE ABOUT "BRIGHTNESS" LEVEL

RESTORING THE D.C. COMPONENT

This is the second article on the D.C. component and explains how the brightness level of the carrier is reproduced on the cathode-ray tube.

IN last month's article it was shown how the carrier radiated by the transmitter is modulated so that the instantaneous amplitude is always directly proportional to the light value of the particular scene which is being televised.

It was also shown that the voltage developed across the diode detector load was proportional to the carrier amplitude.

This voltage, therefore, not only gives the contrast values in the picture, i.e., the ratio between the maximum and minimum voltages present, but also the background level in terms of a more or less steady voltage.

We may now consider the video amplifier stage and the cathode-ray tube from the point of view of handing on this voltage without alteration, our aim being to reproduce the contrast values plus the background level in actual brightness of the beam on the screen.

In video amplification we have to decide how many stages are desirable, and the factors affecting the choice. Since a higher gain per stage can be obtained from a video amplifier than from a radio-frequency amplifier it would seem at first sight that the more stages the better, but in actual practice the difficulties involved in using several stages are such that it is preferable to use only one stage. One of the difficulties can be explained as follows:

The diode detector does not give linear rectification at small signal inputs: in other words, its characteristic is curved so that low voltages are not rectified without distortion of the wave form. If the diode is followed by two stages of video amplification, the gain is so high that only a very small input from the diode is required to fully load the tube. With a low input of carrier wave the proportion which is allocated to the synchronising signal (30 per cent. of the carrier amplitude) is so small that it is difficult to make proper use of it and synchronising becomes difficult.

Assuming then that we decide to use a single stage of video amplification we can now consider the voltage relationships at the diode and the grid of the cathode-ray tube. To produce an increase in picture brightness we require a decreasing negative potential on the grid of the tube, or a positive potential in opposition to the tube bias. In passing through the valve stage this potential change is reversed, so that a positive change of potential in the output requires a negative change applied to the grid. To obtain the correct variation on the tube we therefore require an increasing negative potential on the grid of the video amplifier. This is in direct opposition to the usual method of working an amplifying valve where we normally have a nega-

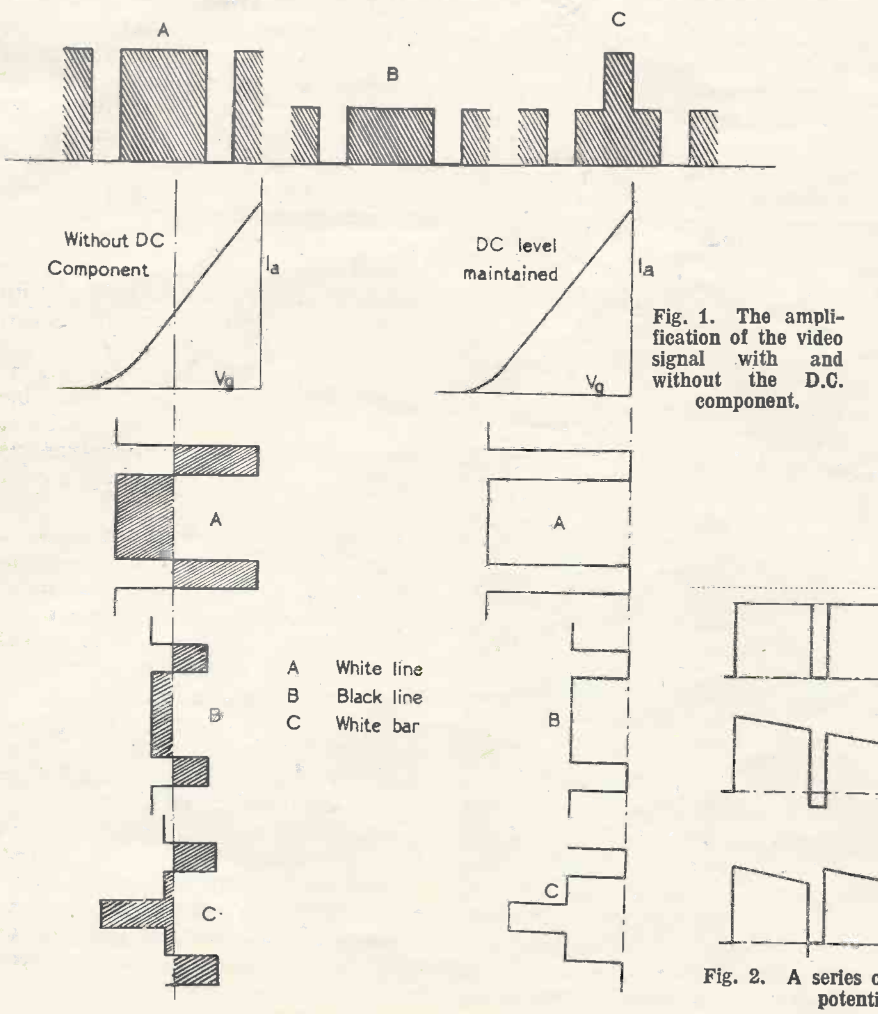


Fig. 1. The amplification of the video signal with and without the D.C. component.

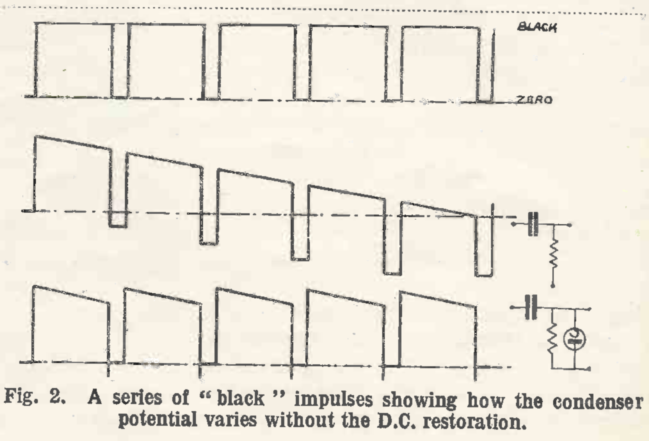


Fig. 2. A series of "black" impulses showing how the condenser potential varies without the D.C. restoration.

MAGNETIC TUBES AND THE D.C. COMPONENT

tive bias which is reduced by the action of the signal.

To handle the change in potential on the grid without distortion we must arrange that under no-signal conditions the grid of the video valve is at zero potential. Then the arrival of the carrier will increase the bias and reduce the anode current in proportion if the characteristic is linear. This condition is shown in the right-hand diagram of Fig 1. At the top of the diagram three types of signal have been drawn, one a " white " signal containing the synchronising impulse, the next a carrier corresponding to a black signal, and finally, a signal corresponding to a line with a sharp peak of full white in the middle such as would be given by a white line against a dark background.

These three signals are shown applied to the grid of the video amplifier in the drawing of Fig. 1. The " troughs " of the sync. signals, which correspond to zero carrier amplitude, will all lie on the line of zero bias of the valve, and as the signal rises in value the negative bias of the grid increases. The amplitude of the signal will be adjusted so that the maximum height corresponding to the peak white signal will just swing the anode current down to minimum value.

It is useful to compare this action with that of an ordinary amplifier in which the grid is coupled to the diode load through a condenser and leak as shown in the left-hand diagram of Fig. 1. You will remember that in last month's article it was shown that the presence of the condenser prevented the D.C. component being applied to the grid and as a result there are only the A.C. fluctuations. As soon as the signal is applied, the level of potential will alter across the condenser so that the area of wave on each side of the centre line is the same. As the signal is applied in both senses about a mean point, instead of swinging the grid always in a negative direction we must bias the valve to the mid-point of its characteristic as shown.

Actually, when the first voltage impulse is passed on to the grid from the diode load the potential will swing positive or negative by the correct amount, but the charge on the condenser will immediately start to leak away via the grid leak. When an impulse corresponding to the " peak white " value is applied the total change in voltage is correctly reproduced, but the condenser is still charged to a fraction of the potential initially applied. As a result the second signal will find the grid bias momentarily displaced from the centre working point and it will overswing the grid beyond the working region of the curve as shown.

The same effect will always be obtained as the nature of the line signal alters from line to line and although the *changes* in light value will be reproduced in the output of the valve the *actual* light values would be wrongly shown. The valve is also working under less efficient conditions. In the first case we can handle a swing up to 70 per cent.

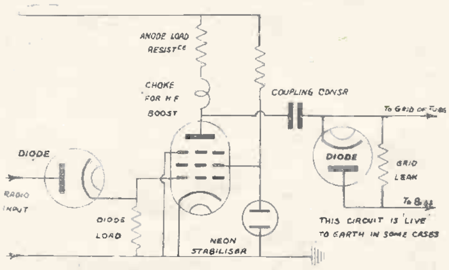


Fig. 3. A complete video amplifying stage showing the D.C. restoring diode and components referred to in this article.

of the maximum available and in a direction in which the valve can operate without distortion, while in the second case we are already biased to a point half way down the curve.

From this we see there is no question that the most efficient method of handling the signal in the video stage is by direct connection between the diode load and the grid of the amplifier. It would be equally satisfactory if we could pass on the signal to the grid of the cathode-ray tube by the same method of direct connection, but unfortunately there are too many practical difficulties.

Electrostatic Tubes

In electrostatically focused and deflected tubes it is usual to operate the tube with the final anode at earth potential, *i.e.*, connected to chassis, which is the negative of the receiver H.T. supply. This means that the grid of the tube to which modulating signal is applied is at 6,000 volts potential *negative* to the chassis and earth. Hence, direct connection with the anode of the video amplifier is impracticable. We could certainly overcome the difficulty by insulating the diode and all that follows from the chassis and operating it at 6,000 volts negative potential below earth. This could be done by coupling it to the radio-frequency stages through an air-core transformer insulated to withstand the full H.T. potential, but it is far from satisfactory.

Magnetic Tubes

In the case of magnetically operated tubes it is possible to run with the cathode at earth potential and a direct method of connection would be possible. In this case, however, there is another difficulty connected with the tube. The life of the tube is to a certain extent governed by the emission current which is in turn affected by the bias voltage. If the grid were directly connected to the anode of the video valve it would be impossible to avoid the risk of sudden surges affecting the bias and producing momentary abnormal beam currents. If, for example, the anode current of the video amplifier were reduced to zero the tube bias would be reduced to correspond and the screen would be brilliantly lit with the full emission of the cathode.

These considerations make it essential that the grid of the tube be connected to the video stage through a condenser in the usual way, and at first sight it seems that having gone to a great deal of trouble to preserve the D.C. component up to the output of the receiver we are now compelled to sacrifice it at the last.

Fortunately there is a method by which the effect of the D.C. can be restored, and this is explained in the diagram of Fig. 2. Across the grid leak of the tube we connect another diode, its cathode to the grid terminal. We can now consider the effect of a signal applied to the combination. Taking the simple case of the black line again, with the synchronising pulse, we have seen that the mean potential level will alter across the condenser as the, signal goes on. This is shown in greater detail in Fig. 2a.

At the top of the diagram we have a succession of " black " impulses with the synchronising pauses at the end of each line.

(*Continued on page* 159)

RECENT TELEVISION DEVELOPMENTS

A RECORD OF PATENTS AND PROGRESS

Specially Compiled for this Journal

Patentees :- Baird Television Ltd. and J. L. Baird :: N. V. Philips' Gloeilampenfabricken :: Baird Television Ltd. and L. C. Bentley :: Baird Television Ltd. and C. Szegho :: Baird Television Ltd. and L. R. Merdler :: Baird Television Ltd. and V. Jones

Mirror Drum Construction
(Patent No. 473,150.)

IN order to produce a well-finished mirror at low cost, a thin sheet of glass is first fixed to the face of a small holder, and a reflecting film is laid over it and worked down to any desired thickness. The back of the film is then cemented to a backing piece. When the cement is dry the first holder is pulled forcibly away, so as to leave the glass surface exposed, with the reflecting film fixed in position between the glass and the backing-piece. The latter can then be fitted to the mirror drum used for scanning.—*Baird Television, Ltd.*, and *J. L. Baird.*

Saving the Screen
(Patent No. 473,173.)

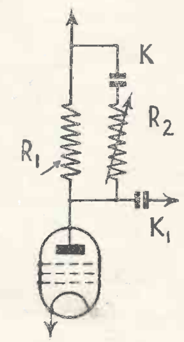
It is found that the amount of light given off by the fluorescent screen of a cathode-ray tube is seriously affected by any metal vapour present in the tube, particularly copper or nickel, even in small quantities. When such metals are used for making the electrodes of the tube, a certain amount of vapour is set free from them during the preliminary heat-treatment and exhaustion processes used in the process of manufacture.

This is avoided according to the invention by making the electrodes wholly of chrome-iron or chrome-steel alloy.—*N. V. Philips' Gloeilampenfrabrieken.*

Television Amplifiers
(Patent No. 473,895.)

It is well known that the effective amplification of a valve can be regulated by varying the load impedance or resistance in the output circuit, but in general this gives rise to corresponding changes in the steady or D.C. voltage applied to the plate. In certain cases, and particularly when the valve is directly coupled to the Wehnelt cylinder of a cathode-ray tube, it is undesirable to alter the steady bias on that electrode.

The figure shows how the effective amplification of the valve can be regulated without affecting the D.C. voltage on the plate. The usual anode resistance R1 is shunted by a variable resistance R2 in series with a blocking condenser K. The overall impe-



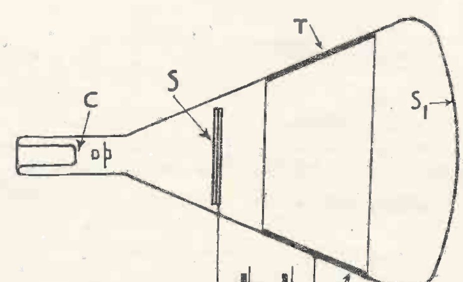
Television amplifier. Patent No. 473,895.

dance of the anode circuit, and therefore the effective "gain" of the valve, can now be changed by varying the parallel resistance R2, though this does not affect the D.C. voltage applied through the resistance R from the H.T. supply to the plate. The output is taken off either directly or through a condenser K1.—*Baird Television, Ltd.*, and *L. C. Bentley.*

Increasing Picture Size
(Patent No. 474,391.)

The picture is first projected on to a fluorescent screen and is then enlarged by projection on to a second screen mounted inside the same cathode-ray tube.

As shown in the figure the first screen S is transparent, and is coated with fluorescent or phosphorescent



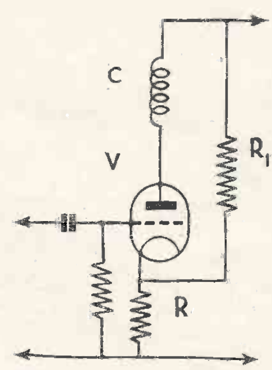
Cathode-ray tube construction for increasing picture size. Patent No. 474,391.

material on the side facing the cathode C. On the other side it is coated with photo-electric material. The electron stream reproduces the picture, in the first instance, in fluorescent light on the near face of the screen S. The light so produced then liberates a stream of electrons from the photo-sensitive layer on the opposite side of the screen.

These electrons are accelerated by the electric field from the conical electrode T, which also acts as a magnifying lens to form an enlarged image on the final viewing screen S1. In its passage the electron stream is focused by the magnetic field from a coil (not shown) mounted outside the tube.—*Baird Television, Ltd.*, and *C. Szegho.*

Correcting for Focus
(Patent No. 474,399.)

It has been noticed that as the "average" brightness level of a received picture varies, there is a ten-



Method of correcting focus. Patent No. 474,399.

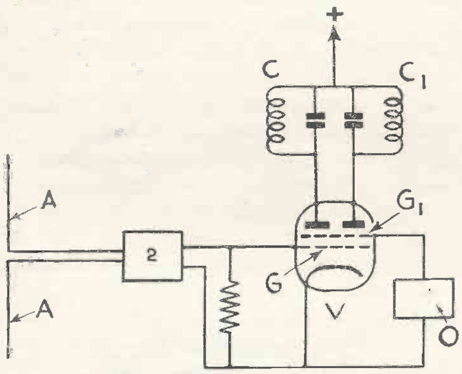
dency for the electron stream through the tube to change its focus too, so that the picture falls off in definition.

To correct this, the current passing through the magnetic focusing coil is made to vary, in the proper sense, with changes in the overall illumination. As shown in the figure, the magnetic focusing coil C is arranged in the output circuit of a valve V, the incoming signals being applied to the grid. Because the output load is mainly inductive, and also owing to the effect of the biasing resistance R (which is in series with a resistance R1 shunted across the H.T. supply) the output current through the coil C is controlled by the mean bias on the grid. This, in turn, depends upon the changes which occur, from time to time, in the background illumination of the received picture.—*Baird Television, Ltd.*, and *L. R. Merdler.*

Combined Sound and Picture Receivers

(Patent No. 474,684.)

Both sets of signals (picture and sound) are picked up on the same dipole aerial A, and are fed direct to one of the grids of the "twin" valve



Combined sound and vision receiver. Patent No. 474,684.

shown in the figure. Local oscillations from O are fed to the other grid G1.

The valve has two separate plate circuits C, C1. The circuit C is tuned to the difference or "beat" frequency produced between the picture signals and the local oscillations, whilst the circuit C1 is tuned to the corresponding beat frequency produced by the sound signals. In this way the two sets of signals are separated, so that each can take its proper path through the subsequent circuits of the set.—*Baird Television, Ltd.*, and *L. R. Merdler.*

"Relaying" Pictures

(Patent No. 475,517.)

In certain cases, for example when the available line or channel is only fit to carry a limited band of frequencies, it may be necessary to transmit a picture at low-definition over this part of its path, and then to "relay" it at higher definition.

For this purpose the picture is first reconstituted on a fluorescent screen, where it forms a "transient" image at the end of the low-definition line. It is then immediately scanned again at a higher speed, both as regards the line and frame frequencies, by an electron camera, which relays it on to its final destination as a high-definition image.—*Baird Television, Ltd.*, and *V. Jones*

Summary of Other Television Patents

(Patent No. 474,386.)

Television receiver comprising a cathode-ray tube fitted with electrodes for separating the synchronising and picture signals.—*Marconi's Wireless Telegraph Co., Ltd.*, and *D. L. Plaistowe.*

(Patent No. 474,834.)

Preparing the surfaces of electrodes used for secondary emission.—*Baird Television, Ltd.*, and *E. B. King.*

(Patent No. 474,970.)

Scanning system in which compression waves of high frequency are made to travel through a light-cell at an angle to the incident light.—*Scophony, Ltd.*, and *F. von Okolicsanyi.*

(Patent No. 475,008.)

Modulating system for producing television signals suitable for transmission over a line wire.—*Standard Telephones and Cables, Ltd.*, and *M. W. Baldwin.*

"MORE ABOUT BRIGHTNESS LEVEL"

(*Continued from page* 157)

At the start, when these pulses are applied to the condenser, the potential will momentarily rise to the point shown at the start of the second series of pulses. If the resistance in the grid circuit is comparatively low this potential will leak away, and at the end of the first line it will have fallen according to the slope of the line. The occurrence of the synchronising pulse at this point will send the condenser potential in the reverse direction, and when it ceases there will again be a reversal to the same height as before. A second leakage will now take place and the tops of the impulses will steadily drift downwards, as shown, until the potential is established about the middle line so that the energy at charge and discharge is equal. Now suppose we connect the diode across the leak. At the end of the first line when the synchronising pulse occurs, the condenser potential will momentarily be negative. This will make the cathode of the diode negative and it will conduct. The condenser will thus discharge through the low-impedance path of the diode, and its potential will immediately fall to the level of the zero line. This is indicated by the little kicks at the end of each line in the downward direction.

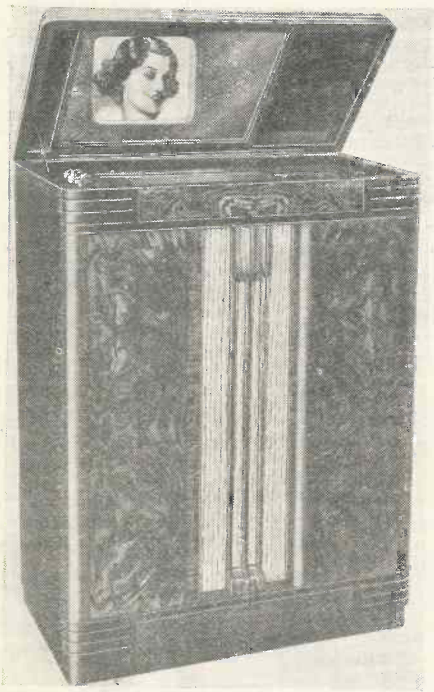
Effect of Diode

The effect of the diode is thus to automatically restore the level of the condenser potential at the end of every line and give it a fresh start from scratch, so to speak. The shape of the impulses will then correspond to those originally impressed on the grid through the condenser, with the exception of the slight droop during each line, and this can be minimised by making the grid leak as high as possible.

The same argument applies to a more complex signal which contains both the light and shade variations and the background value, and we can sum up by saying that the presence of the diode restores the D.C. component by correcting the potential of the grid at the end of each line of the picture. The last diagram, Fig. 3, shows the circuit of a complete video amplifier stage with the diode connected. The potential of the diode is very nearly that of the cathode of the tube and the best method of obtaining the heater current for it is to wind a separate heater supply on the tube heater transformer. It is important to remember that the insulation of this winding must be as good as that of the tube cathode winding, and it is usual to mount a small separate transformer near the tube, well insulated from chassis.

If it is not convenient to arrange for this supply, the alternative is to use a metal rectifier of the type used for radio-frequency detection. The characteristics of a metal rectifier are a little different from those of the diode, and it is usually preferable to dispense with the grid leak and rely on the resistance of the rectifier to provide a path for the tube bias. A series resistance of 20,000 ohms should also be connected in series with the rectifier to limit the current through it in accidental surges. This resistance also helps to reduce the shunting action of the rectifier at high frequencies.

THE ULTRA TELEVISION RECEIVERS



The Ultra Model T40AW with vision and sound and all-wave radio.

ULTRA ELECTRIC, LTD., manufacture three types of television receiver—the T40AW, a de luxe model for sound and vision with all-wave radio; the T30AW, sound and vision and all-wave radio; and the T20, a low-priced receiver for sound and vision only, the last giving a picture $7\frac{3}{4}$ in. by $6\frac{1}{4}$ in. In each case a magnetically focused and deflected cathode-ray tube is used, the size of the tube being the only point of difference except that with the T40AW the picture is viewed in a mirror in the lid of the cabinet, whereas with the other two models the picture is viewed direct.

The television and sound receiver comprises three units: the radio chassis which is a super-het receiver using eight valves of which the first three valves are common to both television sound and vision signals; the cathode-ray tube unit employing thyratron time base generators for separating the signal impulses, a special feature of Ultra receivers, which makes for economy in the number of valves used; and the power unit, the chassis of which also carries the moving-coil loudspeaker.

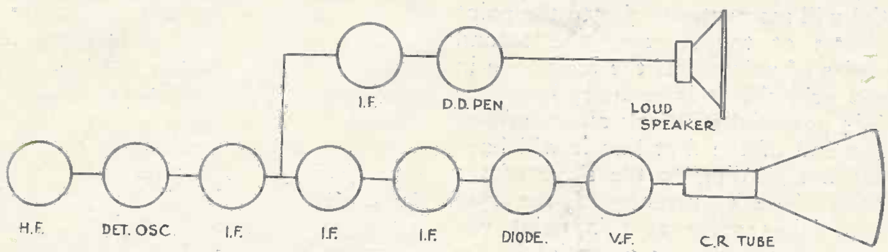
The valve sequence is shown by the diagram and it will be seen that it consists of an H.F., Det. oscillator, three I.F.'s, a diode, and vision frequency amplifier, the first three of which are common to sound and vision, a double channel I.F. transformer being used to feed through a separate sound I.F. valve into a DD/Pen. for the sound output.

The oscillator of the triode hexode frequency changer operates at 39 megacycles, thus giving the lower of the two possible sound intermediate frequencies when a vision intermediate frequency of 6 megacycles is chosen. The sound I.F. amplification is therefore effected at 2.5 megacycles. The vision intermediate frequency amplifier is designed to amplify the lower side band and the T.R.F. circuits, which are very flatly tuned are, therefore, adjusted to 44 megacycles.

The aerial normally supplied with this receiver is a half-wave type resonant at 44 megacycles fitted with a quarter-wave matching section and a 75-ohm balanced feeder. This terminates in a centre tapped aerial transformer primary. The secondary of this transformer is loaded by the transfer load from the primary, and the electron damping of the first valve. The AC/SP3 high frequency pentode valves used as H.F., I.F. and V.F. amplifiers in the receiver have a static mutual conductance of 10 and a working slope of approximately 7.5 mA. per volt.

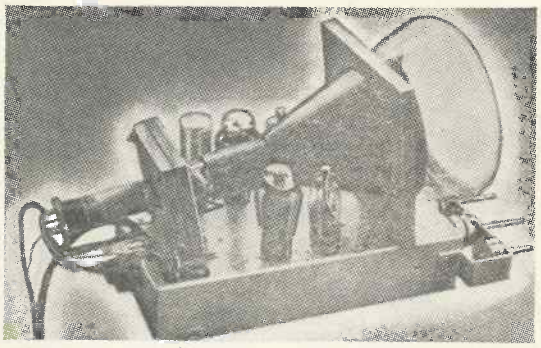
The tuned primary-tuned secondary transformer coupling the radio frequency amplifier to the frequency changer grid is over-coupled inductively and resistance loaded. In the anode of the frequency changer are two series circuits, the first having a small " C " and resonant normally at 5.1 megacycles, in series with this a small " L " and large " C" which resonates at 2.5 megacycles. The sound I.F. carrier developed across the dynamic impedance of this circuit is injected by means of a condenser across a resistance connected between the bias of the first I.F. valve and the low H.F. potential end of the vision I.F. secondary winding. This tuned circuit having small impedance at sound intermediate frequency, allows the sound to be passed almost without attenuation to the grid of the first I.F. valve, whilst inductive coupling is arranged between primary and secondary of the vision transformer and also adjustable top capacity coupling.

A similar coupling unit is employed in the second I.F., but in this case the sound resultant present across the 2.5 megacycles resonant circuit is condenser injected into the grid of a separate I.F. valve

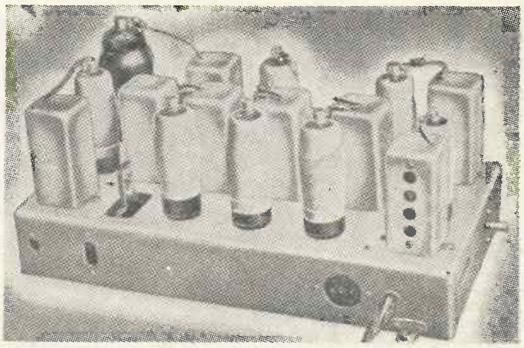


The valve sequence of the sound and vision receivers.

The Ultra Model T20 sound and vision only, providing a picture $7\frac{3}{4} \times 6\frac{1}{4}$.



These two photographs show the cathode-ray tube unit and time base on the left and the radio chassis for sound and vision on the right.



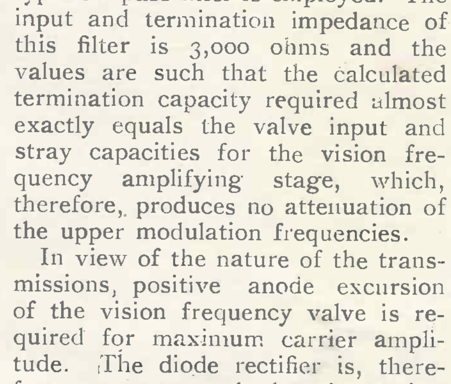
coupled by a further single circuit coupling to a double diode pentode output valve.

At vision intermediate frequencies the impedance of the sound I.F. circuits is very small on account of the high "C" and consequently vision on sound is not experienced as care is taken with high tension de-coupling.

Missing for the moment the next I.F. for vision, we pass to the coupling between the last I.F. valve and the half-wave diode vision demodulator. This coupling is similar to the vision section of the first two I.F. coupling units, and comprises a resistance wire wound primary and secondary coupled both inductively and by an adjustable top end capacity. Exactly the same components are used in all these three units as regards vision I.F.

This arrangement provides an I.F. amplifier substantially flat from 6 megacycles to a little below 4 megacycles with the 50 per cent. of the mean response point at 6 megacycles. The sound amplifier is relatively sharply tuned, and therefore, by adjusting the oscillator condenser on sound the receiver is automatically operated in the correct position for single side band vision reception. Three transformer couplings together, when designed to give a gain of fifteen times per stage can be simply constructed without introducing a considerable dip in the centre of the pass band, and between the second and third I.F. is a single circuit coupling coil, resistance wound, which largely compensates for the drop in response otherwise present in the centre of the pass band. Resonance of the signal frequency circuits at 44 megacycles completes the necessary compensation for this dip, and standard production receivers are expected to have an overall response of ± 1.8 D.B. over the modulation band 25 cycles – 2.15 megacycles. In order to prevent intermediate frequency carrier reaching the grid of the vision amplifying valve a two half-cell pi derived prototype low pass filter is employed. The input and termination impedance of this filter is 3,000 ohms and the values are such that the calculated termination capacity required almost exactly equals the valve input and stray capacities for the vision frequency amplifying stage, which, therefore, produces no attenuation of the upper modulation frequencies.

In view of the nature of the transmissions, positive anode excursion of the vision frequency valve is required for maximum carrier amplitude. The diode rectifier is, therefore, so connected that increasing carrier amplitude produces increasing negative potential across the demodulation load. Then from a consideration of the nature of the transmitted waveform where the synchronising periods are represented by a complete cessation of carrier, and where a certain fixed amplitude of carrier (30 per cent.) represents the black level of transmitted picture intelligence, it follows that during all periods of transmission, with the exception of the synchronising intervals, there is a negative potential of at least one-third complete rectified carrier across the demodulation load resistance. Thus by direct connection between the demodulation load through suitable isolating resistances, the gas discharge triodes generating the line and field sweep voltages receive a positive excursion during synchronising periods of their grid voltage relative to the black signal level of the rectified carrier. A suitable time constant is introduced in the grid circuit of the picture time base to provide line and frame separation.



The chassis of the power unit also carries the moving-coil speaker.

The primary sweep for both line and frame scans is derived from gas discharge triodes connected across condensers in a straightforward resistance condenser network. The H.T. supply of this part of the circuit is of some 250 volts but in view of the small sweep voltage required to swing the grids of the amplifying valves little difficulty is experienced in obtaining the sufficiently linear primary sweep for practical purposes. In the case of the line scan generator this is coupled through an AC/4 Pen. valve to a pair of hank wound high impedance scanning coils. The AC/4 Pen. is a beam tetrode with a dissipation of some 15 watts. Anode supply to this valve is maintained through a choke which capacity feeds the scanning coils in order to avoid displacement of the scan by direct current through the coils. In order to prevent "ringing" in the scanning coil circuit and also to reduce the peak voltage across the valve during the fly-back period a resistance condenser network is connected across the scanning coils. An adjustment is provided for the resistance value of this network. A variable resistance is in series with the mean brilliance control, the function of which is to allow a wide variation in tube grid bias without necessitating changes in standing bias resistance internal to the unit. A Stalloy shield is then placed around the complete coil structure. Frame deflection is derived by amplification of the gas dis-

(*Continued on page* 189)

FINDING AND REMEDYING TELEVISION RECEIVER FAULTS—II

Last month the location and remedying of faults in the vision receiver and power supply were dealt with in detail. This article, the second of a series of three, deals with the rectification of time base faults.

UP to the present, with the exception of a brief reference, we have not considered the synchronising arrangement. This is comprised of the valves V10 and V11. A detailed description of the functioning of this all important section of the receiver is outside the scope of this article. However, the following brief treatment will ensure an ability to locate an existing fault and also enable the correct operating condition readily to be found.

Reference to the schematic diagram, Fig. 1, on page 91 of last month's issue discloses that the diode valve V10 is connected—its cathode to the anode of the valve V9, its anode through the high resistance R36 to the slider of the potentiometer R38. Now refer to the drawing, Fig. 3, this pictorially illustrates the form of the voltage at the anode of V9. It is seen that this is positive. It is convenient to divide this signal into two parts. The curved line between A-B is the actual picture modulation. Maximum brilliance occurs at A and minimum at B. The synchronising pulses are represented by the signal between B and C. From the cathode-ray tube viewpoint, therefore, they are blacker than black, i.e., they are not visible on the screen of the tube.

It will be obvious that we are able to adjust the voltage at the anode of the diode valve V10 to be equal to that existing at the point indicated on the synchronising pulse in the diagram, Fig. 3.

This point is practically represented by a condition reached when the anode of the valve V10 is a volt or so more positive than the steady voltage existing at the anode of V9.

It is now clear that all that part of the modulation above the point X will render the cathode of the diode V10 more positive than its anode, consequently it does not conduct. The modulation below the point X, which is the synchronising pulse will, however, cause the cathode of the diode to become negative in respect to its anode, current will flow leaving the anode more negative by an almost equal amount. In brief the diode effectively allows part or whole, depending upon the setting of R38, of the synchronising pulse to pass to the grid of the valve V11.

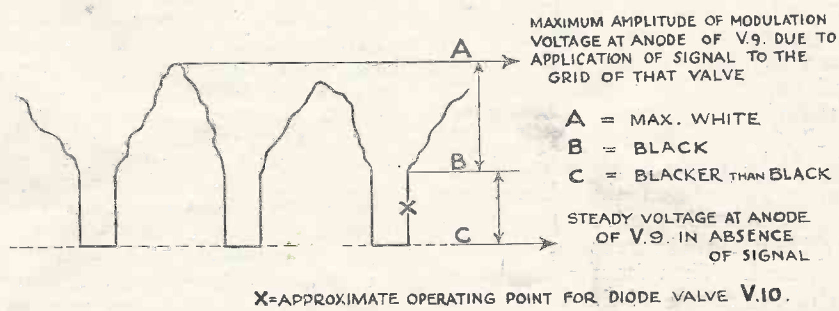


Fig. 3. Graph showing pictorially the voltage at the anode of the valve V.9 in the circuit diagram Fig. 1 shown on page 91 of last month's issue.

As the signal at the anode of V10 is negative, the new signal at the anode of V11 is positive, which is what we require as will be apparent when we consider the time base operation.

It only requires to mention that the valve V11 is so adjusted that the amplitude of each synchronising pulse is identical. This is simply achieved by arranging the valve's operating conditions for a short grid base.

At the anode of this valve, assuming the adjustments to have been made correctly as indicated above, we have the frame and line synchronising pulses. These are applied through simple frequency and amplitude filters to the grids of the relay valve. There they accurately control the firing frequency by anticipating the normal firing time.

Time Base Faults

Now let us consider the time base. It is not proposed to describe the generation of saw-tooth oscillations fully. This has received adequate treatment already. Those interested are referred to a concise description due to G. Parr, which appeared in the January and February issues for 1936 of this journal, pp. 30 and 91 respectively, or to the more adequate treatment in the above author's recent book "The Low Voltage Cathode-ray Tube and its Applications," chs. 4 and 5. Only those points pertinent to the actual rectification of faults likely to be encountered generally are here dealt with.

Firstly, we will assume that no raster at all is obtainable. It is improbable that this will result in a simple, stationary, concentrated light spot on the screen. It is more likely that a small variably shaped pattern will be observable, the reason for this being that various potentials due to leakage and other effects will be present at the deflector plates causing at any rate some form of spot deflection.

This inability to obtain a raster may be due to any of several possible faults. It is proposed to deal with the most probable of these first, namely, the complete or almost complete absence of high tension.

Before going further into the matter it will be advisable to note particularly that when the H.T. is removed from one time base only, either the frame or line, the effect at the screen will be a single horizontal or vertical line, the length of which may be varied with the controls of the base which is functioning. Obviously when this is so the fault is located in the other time base, or alternatively the connections to this base may be incorrectly made or entirely absent.

H.T. Supply

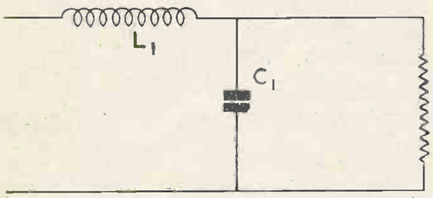
It is feasible roughly to check for the presence of high tension with a good quality high-reading voltmeter.

(*Continued on page 189*)

Power Supply Filters

The design of filter circuits should be given more consideration by constructors. This article shows up the salient features and has been prepared by the United Transformer Corp. of America.

POWER supplies for modern radio equipment are generally obtained by rectifying an A.C. supply. This process is carried out in two steps. In the first step, the A.C. voltage is converted to a pulsating D.C. In the second step this pulsating D.C. is passed through a filter which smoothes out the pulsations to a point approaching the smoothness of direct current. The filter unit serves the function of supplying electrical inertia to the change in magnitude of the pulsating current. The pulsations in the rectified D.C. are multiples of the power supply frequency if a half wave rectifier is used and are multiples of twice the power supply frequency if a full wave rectifier is used. Similarly in a three phase half wave rectifier the pulsation frequency is three times the power supply frequency and in a three phase full wave rectifier six times the power supply frequency.



$$\% \text{ Ripple} = \frac{1}{\omega^2 L_1 C_1}$$

Fig. 1. Calculating ripple value.

The function of the filter circuit is to attenuate both the fundamental frequency and the corresponding harmonics to a point that is not objectionable. Economic considerations generally determine the extent of this attenuation.

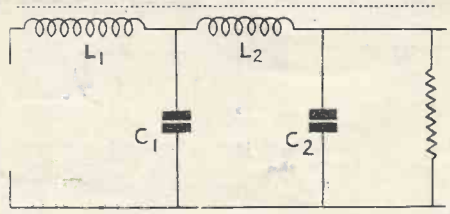
Regulation

Another factor which must be considered in connection with filter circuits is the question of power supply regulation. In addition to the regulation or change between no load and full load caused by the resistance drop in the filter chokes, the regulation of the rectifying circuit or unit itself must also be considered.

As an example, typical half wave rectifier may have a 50 per cent. regulation from no load to full load as compared to a typical full wave rectifier having 10 per cent. regulation. In some filters a condenser is placed immediately after the rectifying unit to assist filtering. Under no load conditions this condenser tends to store the electrical energy so that a peak voltage equal to 1.4 times the R.M.S. voltage applied to the anodes is obtained. As a load is applied, the charge built up on this first condenser is drained and the peak voltage can no longer be maintained, the D.C. voltage dropping to a point approaching the average value. It is rather difficult to pre-determine in a simple manner the exact D.C. voltage using this type of filter. As the ratio of load current to capacity is increased, the voltage will tend to drop down.

On the other hand, if a condenser having infinite value could be used, the peak voltage would be maintained regardless of load current. A typical instance where the ratio of capacity to load current is high may be found in the anode supply of a cathode-ray tube. In this type of filter a condenser of 1.0 mfd. is generally used and a current of approximately 1 mA. is drained. Under this condition, a half wave rectifier with 710 volts on the anode will effect a D.C. output voltage of 1,000.

To improve regulation, a bleeder is generally used. This consists of a resistance shunted across the D.C. output and in most cases drains approximately 10 per cent. of the full load current. Another device frequently used to maintain good regulation, where the current changes through a wide range, is a swinging choke preceding the first condenser. With proper design, increasing load will lower the impedance of this choke sufficiently to allow the voltage to build up across the condenser following. In computing regulation, the IR drop in the chokes must always be considered.



$$\% \text{ Ripple} = \frac{1}{\omega^4 L_1 L_2 C_1 C_2}$$

Fig. 2. A more effective arrangement.

Certain applications such as class-B audio amplifiers produce wide change in D.C. current with a corresponding tendency for poor power supply regulation. In many of these applications, distortion or non-linear modulation may be produced by the voltage fluctuation of the power supply. To offset this condition, the UTC Transformer Co. have developed a form of saturable choke which is inserted in series with the primary of the anode transformer.

A D.C. winding is coupled to this choke and inserted in series with the D.C. load. As the load is increased, the series choke is saturated and more A.C. voltage is impressed across the anode transformer primary which consequently compensates for the additional drop in rectifier and filter circuit. This form of UTC control unit is termed a Variactor.

As a typical instance of the application of the UTC Variactor take the case of a class-B-46 amplifier. A typical ordinary anode supply for this purpose delivers 400 volts on the anode at no signal and 350 volts on the anode at maximum audio output. Using a Variactor the voltage can be actually made to start at 400 and end up with 405 volts and at full load.

Hum Suppression

After analysing the filter requirements with reference to regulation, the next point is the analysis of the actual hum suppression desired. Since in a rectifying system the attention of all frequencies is desired, a low-pass filter is used which theoretically should have a cut off point at zero frequency. However, this theoretical condition would entail inductance and capacitance elements of infinite value.

For practical purposes, the magnitude of these elements are controlled by economical considerations, but in any case must be sufficiently large to attenuate the lowest frequency present. To exactly determine the ripple at the output of a filter, is a rather complex proposition. Fortunately in all commercial applications the reactance of each condenser is small compared with the reactance of the preceding inductor and the reactance of the load.

Under this condition, the analysis of ripple may be simplified and can be evaluated as indicated in Figures 1 and 2. To simplify this calculation, the chart of Figure 4 has been prepared, from which the attenuation of hum in typical, practical circuits can be readily obtained. In most cases the higher harmonics can be practically neglected as the attenuation of this type of filter varies as the 4th power of the frequency.

To improve the filtering efficiency, resonant or hum-bucking circuits are sometimes used. The most practical device of this nature is the UTC hum-bucking choke. In typical rectifiers the use of hum-bucking chokes will increase

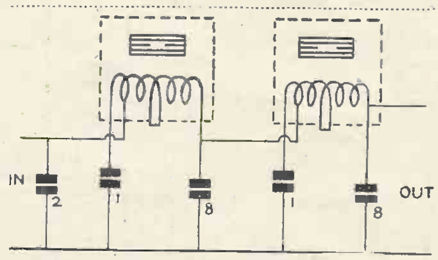


Fig. 3. The hum-bucking circuit.

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"Power Supply Filters."

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the filter efficiency four times as compared to an equivalent amount of inductance and capacity in a standard filter. Figure 3 illustrates a typical hum-bucking circuit.

Cautions

A number of important points must be watched in the use of filter circuits. peak A.C. voltage applied to the rectifier. This also applies to the first filter choke. It is important in the use of the chart of Figure 4 and the formulas of Figures 1 and 2 that a knowlege of the actual inductance and capacity values be had. Many condensers have been found to be far poorer than their rated capacity, particularly in the electrolytic type. The inductance of filter

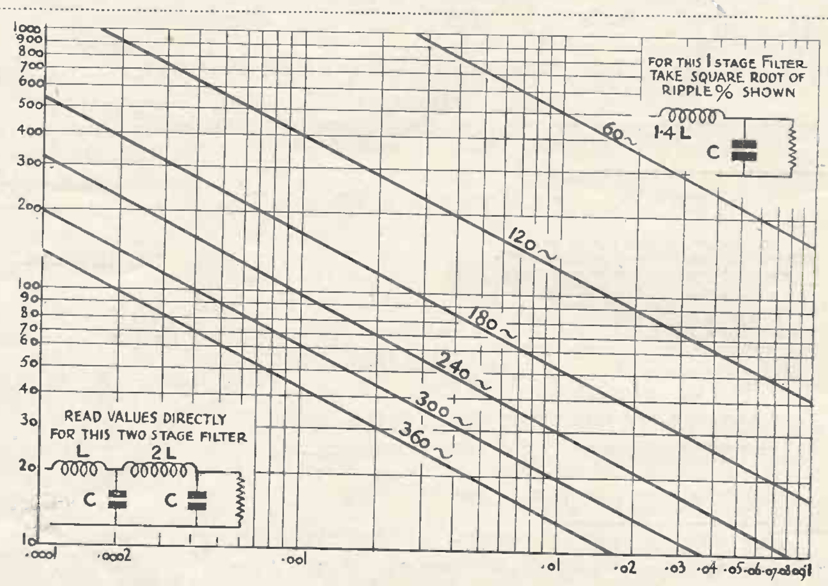

Fig. 4. This chart enables designers to determine the amount of ripple in different circuits.

One important fact is that at least one of the filter inductances should always be placed in the positive leg. If all inductors are used in the negative leg, the distributed capacitance of the transformer winding will by-pass the rectifier and allow a non-filterable residual voltage to appear across the load.

Another important point is the fact that there should be a negligible coupling between the filter inductors. If a co-efficient of coupling of even 1 per cent. occurs between the first and later filter chokes, the amplitude of the higher harmonics across the load becomes very appreciable. To prevent this UTC Linear Standard chokes for use in high attenuation filters are housed in high permeability cast cases.

Choke input circuits are always used in polyphase rectifiers and should also be used with high power single phase rectifiers because of the high ratio of average to peak current that is obtainable with choke input.

The first condenser in a filter circuit should be capable of operating continuously with a D.C. voltage equal to the chokes varies appreciably with D.C. and many units are not rated with inductance at the actual value of D.C. used.

"THE ULTRA TELEVISION RECEIVERS"

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charge primary sweep by a pentode valve type AC/2 Pen. Negative feed-back is employed in both line and frame amplifying valves by omission of the cathode bias by-pass condensers.

Velocity controls for the line and picture time bases are brought to the front of the cabinet by means of a dual potentiometer, one of which controls the cathode bias on the line gas-discharge triode, the other controlling the cathode bias on the picture gas-discharge triode. Variable resistances are included in the charging circuit to the time base condensers in order to effect variation of the amplitude.

An iron-cored focus coil with a paraxial gap is employed and this coil carries the complete H.T. load of the sweep and radio circuits except for a small variable by-pass current.

The D.C. Component

It has been found unnecessary to include provision for passing direct current through the scanning coils to provide shift, and the scan is centralised in the mask by moving the tube mounting bracket to the right or left when frame shift is required, and up or down when shift is required in the direction of line scan. To restore the D.C. component in the modulator electrode of the cathode-ray tube a low-capacity diode is used. Whilst D.C. is maintained as far as the anode of the vision frequency valve (with the exception of slight screen regulation) a condenser is employed between this point and the modulator electrode in order to prevent damage to the cathode-ray tube as a result of either valve failure or withdrawal. (The modulator electrode would, therefore, normally receive the right relative changes in voltage from instant to instant, but would receive these changes about a floating datum line, unless some means be provided to ensure that the datum line is restored at frequent intervals. In practice an overall time constant is employed which is long compared with the duration of one scanning line, whilst the diode is so connected that the correct level of mean modulator electrode voltage is restored at the end of each line. A large capacity electrolytic condenser is connected in shunt across the focus coil in order to prevent points of defocus occurring on the scan of the tube as a result of supply hum. In order to economise in smoothing equipment on the cathode-ray tube anode supply the tube is operated with the cathode at earth potential and not with the anode grounded as is customary with electrostatic tubes.

These receivers are capable of giving satisfactory entertainment from the Alexandra Palace at distances up to 60-70 miles provided local conditions of interference are such that the full gain of the receiver can be utilised.

"FINDING AND REMEDYING TELEVISION RECEIVER FAULTS"

(*Continued from page* 162).

Reasonable care is desirable by reason of the hoped for presence of comparatively high voltages. Alternatively, where a gas type rectifier is used some indication of its functioning is given by the visible presence of ionisation in the bulb.

In this connection the following is informative.

If when the high voltage is switched to the rectifier's anode, a momentary blue glow ensues, which in a few seconds disperses, then it can fairly safely be assumed that the power unit is in order and the fault exists in the time base. This is plain if it is pointed out that the momentary glow is due to the current required to charge the condensers of the power unit.

It is desirable to interpolate a word of warning here. It is essential if this effect has been noted to discharge the various condensers before attempting any further adjustment.

Secondly, in comparatively rare cases, the ionisation glow may almost completely fill the bulb. This is likely to be accompanied by indications that the mains transformer is labouring. This will almost certainly indicate the existence of a short circuit. The usual procedure to ascertain the reason for this is resorted to.

For normal operation, with the load involved with a conventional time base, the discharge in the rectifier is quite light and is confined to the immediate vicinity of the electrodes.

Assuming examination reveals these things to be in order, then a

(*Continued on page* 192)

Premier High-voltage Transformers

As many amateurs are finding that high voltage low-current operation is more efficient than low-voltage high-current working, the problem of obtaining suitable H.T. transformers becomes a serious one.

We have been checking transformers built by several manufacturers and have found that the new Premier mains transformers are quite satisfactory, give the rated output to within near limits and can withstand gross overloads.

For example, one of the first models tested has a secondary giving 1,000-0-1,000 volts at 250 mA., and is priced at 21s. On test the current was increased to 300 mA. without causing noticeable voltage drop or heating up of the transformer. The core is of a very generous size, designed to prevent magnetic saturation and to reduce hysteresis losses to a minimum. This transformer is tested at 2,000 volts between winding and frame.

A second transformer which is of particular use to those who have purchased a T20 type valve is the model SP750. It gives 750-0-750 volts at 200 mA., and is priced at 20s.

These transformers are, of course, without filaments windings, for Premier feel as we do, that it is much more satisfactory to produce a good transformer for one high-voltage output, than to add a filament winding to it, which increases the price and, of course, the size of the core.

One of the most interesting transformers for the ordinary user is the model ST500, which gives 500-0-500 volts at 150 mA., and is priced at 15s.

The cheapest transformer in the range is the S300, giving 300-0-300 volts at 60 mA., for 10s.

Full information on these interesting transformers can be obtained from the Premier Supply Stores, Jubilee Works, 167 Lower Clapton Road, London, E.5.

A New System of Large Screen Projection—February issue

ERRATA

12th line down, 2nd column, page 96, read S_2 instead of S_1.

5th line down, 1st column, page 96, "frame and line" should read "line and frame."

Lines 24-25, 3rd column, page 96, "the inverse of" should be inserted between "slightly less than" and "that of the first surface."

Lines 36 and 38, column 1, page 98, "cathodes" should read "surfaces."

Page 126, line 45, column 1, lines 24 and 39, column 2, "ultra" should be deleted.

"FINDING AND REMEDYING TELEVISION RECEIVER FAULTS"

(*Continued from page* 189)

detailed investigation of the time base is called for.

It will be obvious that if the relay valves are not operating no scan voltages are generated and even when the rest of the circuit is in order no raster will be formed.

Where one base is operating, and the indications given that this is so have been mentioned earlier, interchanging the relays will indicate if one is faulty. The visible scanning line will assume a new axis at right angles to that previously noted.

Similarly the paraphase amplifying valves can be checked. If no variation in raster size occurs with changes of the paraphase valve feed potentiometers (in the specific case of the Low-cost Televisor, these are the potentiometers R8 and R23) a fault is indicated and exchange of valves will show if this is due to a faulty valve or valves.

Finally, it is advisable to ensure that the condensers interposed in the feeds of the deflector plate are in order.

(*To be concluded.*)

"Neutralising Triode Valves."

(*Continued from page* 180)

denser must be connected to same terdenser is connected. If connections are minal where the anode lead to tank conmade at opposite sides of the tank condensers the resistance of the anodes causes a voltage change and stage will slide out of neutralisation when resetting the tank condenser.

In multi-stage transmitters consisting of two or more triode stages, which must be neutralised and which are supplied with anode voltage from a common supply, it is conventional practice to place a switch in the HT plus supply lead to each of these stages so that anode voltage may be removed from the stage when being neutralised.

However, in a transmitter in which one of the stages (usually the final amplifier) is supplied with voltage from a separate supply, many amateurs remove plate voltage from this amplifier stage, when neutralising, simply by opening a switch in the primary of the anode supply transformer.

With this arrangement, especially in medium to high power transmitters, it seems impossible to effect complete neutralisation. Although complete neutralisation may be obtained, a small light bulb in a pickup loop, coupled to the plate tank coil will light up brightly when the tank is turned to resonance.

This condition is possible when stray RF is induced in the leads and is applied to the anodes of the rectifier. This stray RF is then rectified and finds its way to the plates of the amplifier tubes.

A switch to completely remove all anode voltages from the stage being neutralised, should be connected in the HT plus supply lead to the stage, or it may be connected in the center-tap lead of the H.V. transformer secondary.

Bargains for Experimenters

AMATEUR constructors and experimenters should not on any account forget to write to Galpins Electrical Stores of 75 Lee High Road, S.E.13 for one of the new lists just available. Some of the bargains are too good to miss and at very low prices.

We noticed for example, Epoch moving coil loudspeakers to handle 20 watts of audio for 45s. High voltage condensers of 1 mfd. capacity for 2,000 volt working priced at 3s. each. These are very suitable for use in transmitting high voltage power packs.

Another bargain is two 60 mA. chokes and two 2 mfd. condensers for 3s. the lot. There is also a large range of autotransformers for use with 110 volt equipment making it suitable for use on 200-250 volt mains.

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.

A Radio Engineering Library

LAST year we mentioned the Phoenix Book Co. in connection with the publication of Hutchinson's Technical Encyclopædia, and this year we have pleasure in again drawing attention to their enterprise in offering to radio engineers the nucleus of a first-class technical library at terms which are within the reach of all.

The Radio Engineering Library comprises five books each written by an acknowledged authority and published by the McGraw-Hill Publishing Company. The titles are:—

Principles of Radio Engineering—Glasgow.
High Frequency Phenomena—Hund.
Thermionic Vacuum Tubes—Chaffee.
Measurements in Radio Engineering—Terman.
Radio Engineering Handbook—Henney.

They are in no sense reprints or abbreviated editions, but are the actual volumes selected as being representative of the best books on the theory and practice of the subject. The Radio Engineering Handbook contains 866 pages of formulæ and tables together with notes on r.f. and a.f. amplifiers, television, photocells, and motion pictures.

The set of volumes costs £7, which can be paid in 18 equal instalments spread over a period of 18 months. Alternatively, the payments can be spread over 12 or 3 months, the latter avoiding the nominal charge of 5 per cent. interest. The Phoenix Co. cater specially for those who find it inconvenient to expend a large lump sum and their service has proved a boon to many engineers and students who wish to keep abreast of their work by additional study. The Radio Engineering Library is a first-class investment and we recommend it to our readers with confidence. Further particulars can be obtained from the Phoenix Book Co., Chandos Street, Charing Cross, W.C.2.

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