

TELEVISION AT 70 MILES WITH HOME-BUILT RECEIVER

Television

and *SHORT-WAVE WORLD*

AUGUST, 1937

No. 114. Vol. x.

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MONTHLY



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Picture
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Cathode Rays
(Page 457)

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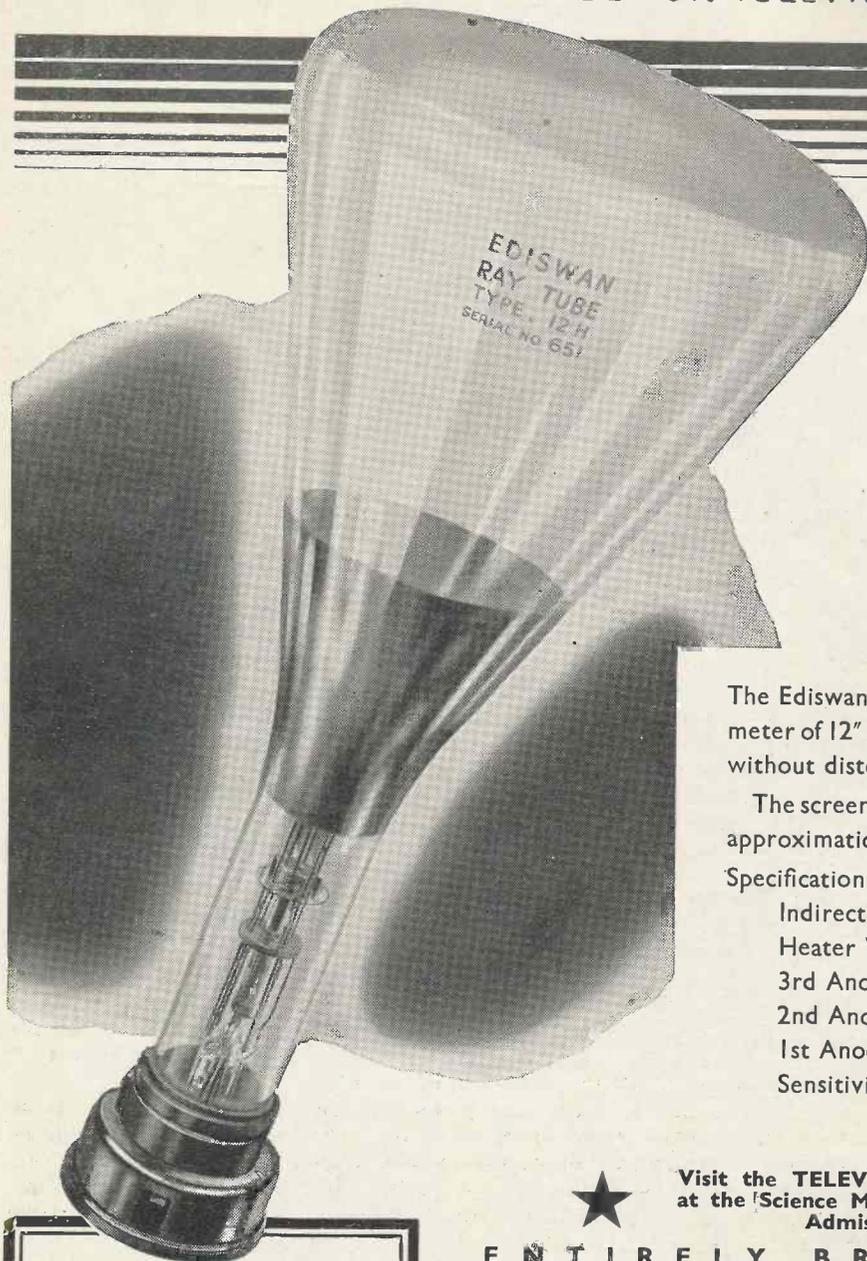
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COMMENT OF THE MONTH

Twelve Months' Progress

ALTHOUGH the actual official opening of the Alexandra Palace was in November last year, the first public television transmissions were made on the occasion of the opening of Radiolympia in August, and so for practical purposes we may assume that high-definition television is one year old this month.

Looking back over this period we are conscious that it has been a period during which a great deal has been accomplished which holds out great promise for the future. Of outstanding importance is the fact that we are now aware that television is no longer tied to the limitations of the studio or its immediate precincts. The success of the Coronation and Wimbledon broadcasts proved this beyond a doubt and opened up an illimitable field for the new entertainment. A year ago such a possibility was a somewhat vague hope—to-day, it is a certainty only requiring development. It seems an anomaly that entertainment, which is ages old, should make such a bad comparison with a technical achievement which may almost be reckoned in months, but the fact remains that it is the entertainment side of television that is retarding the sales of receivers. The ability to go further afield should do much to correct this state of affairs.

The fact that there have been no revolutionary changes in receiver design during the past twelve months is, in our opinion, a satisfactory indication that progress is upon the right lines, but its particular value is that it should do much to remove an idea that is very prevalent in the mind of the public that television receivers, being new, are certain to undergo a considerable amount of modification before approaching any sort of degree of standardisation. Improvements in receivers have certainly been effected, but they have been of such a nature as not to render the early designs in any way obsolete, and in many cases the manufacturers have made modifications to receivers already in use in order to bring them quite up-to-date.

It is gratifying to learn that plans are now under consideration for very considerable modification and improvement of the transmission facilities at Alexandra Palace, plans which involve the construction of new studios and the installation of new plant. The past twelve months may be regarded as a try-out period for television from which it has emerged in a most satisfactory manner.

A Television Word

DURING the whole period of television development there has only been one word which aptly described a television receiver—and this word is "Televisor." The word "Televisor" was, however, coined by Mr. J. L. Baird in 1925 and registered by the Baird Company as a trademark, so its general use has been precluded. On another page of this issue we publish an announcement by the Baird Company relinquishing their right to the sole use of this word, and the reason for the step is that the word is so apt and has come into such general use, particularly in the United States, that enforcement of their rights could only result in unfriendly action. We welcome the action of the Baird Company and, in future, propose to make free use of the word in describing television receivers.

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Scophony 5ft. x 4 ft. Screen Television Projector for 405 line interlaced scanning.

"DAILY SKETCH"

July 14th, 1937

Grid Leak says:

"Went to see a private view of the Scophony method of television at the laboratories yesterday. Saw admirable pictures on a screen 2 ft. by 1 ft. 10 ins. very similar to home talkies. Afterwards pictures were shown on a screen 5 ft. by 4 ft. giving even better results than the former."

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THORNWOOD LODGE,
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LONDON, W.8

"THE STAR"

in its issue of July 13th, 1937, under headline across front page
"MARVEL OF TELEVISION ON A BIG SCREEN"

"Television on a screen large enough to show effectively events such as a cup-final or a stage production has arrived."
"Today I was privileged to enjoy a demonstration of the new system. It is a revolution."

ACHIEVING "THE IMPOSSIBLE"

"The great advance is in the size of the picture and in the clearness of definition. The picture is flat, and photographic in effect. Its detail is perfect. The home set is a 2 ft. 6 in. cube and in these measurements embodies the wireless apparatus and the screen. Scophony have achieved what experts thought to be impossible."
"The result of their researches is the ability to reproduce pictures of a size previously impossible, and with a wealth of detail hitherto unattainable."



"THE DAILY FILM RENTER"

July 13th, 1937

"SCREEN-SIZE TELEVISION ADVANCE"

"A 'Daily' representative, who attended the demonstration, writes: It was the most remarkable television show I have yet seen. The pictures came out with almost perfect clarity, and the flicker, which was present at earlier demonstrations some months back, is now almost entirely eliminated.
"The screen is of the size used in the smaller kinemas, and represents a definite achievement in the field of television. It is no longer just a novelty but a real entertainment."



"MANCHESTER EVENING NEWS"

July 16th, 1937

"IMPRESSIVE DEMONSTRATION"

"To come to the actual demonstration I witnessed, I must confess it impressed me greatly. I saw television by Scophony on a home screen measuring 2 ft. by 1 ft. 10 in. They showed an excerpt of 'O.H.M.S.' and the shot of battalions of soldiers on the march was particularly thrilling because on the large screen every soldier could be clearly differentiated. Then we were shown films via Scophony television on a public hall size screen measuring 5 ft. by 4 ft. Here, again, the definition was remarkably clear, the lighting quite brilliant. And work is proceeding on a still larger screen that will compare in size with super-cinema usage."

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TELEVISION AT 70 MILES WITH A HOME-BUILT RECEIVER

By S. West

IT is now known that the original estimate of the service area embraced by the television transmitter at Alexandra Palace was conservative and that reception of pictures of real entertainment value is possible at considerable distances.

The following account of some of the writer's experiences and a description of the apparatus used at Ipswich, a distance of a little over 70 miles, will be of interest. As will be seen from the untouched photographs above the results obtained are excellent.

Since the inception of the high-definition television service a large number of tests have been made of various receiver arrangements and the apparatus described is the outcome of these experiments; it gives consistently reliable reception of good quality pictures.

At the outset it was obvious that interference would be the chief reason for poor pictures because of the relatively low field strength of the transmissions. The effect of interference on the picture is well known but interference has also a deleterious effect upon synchronism.

Employing a comparatively efficient R.F. stage before the mixer valve considerably improves the signal/noise ratio and also reduces the noise due to the oscillator valve.

Acorn Valves

It was decided that the superior performance of the Acorn type valve

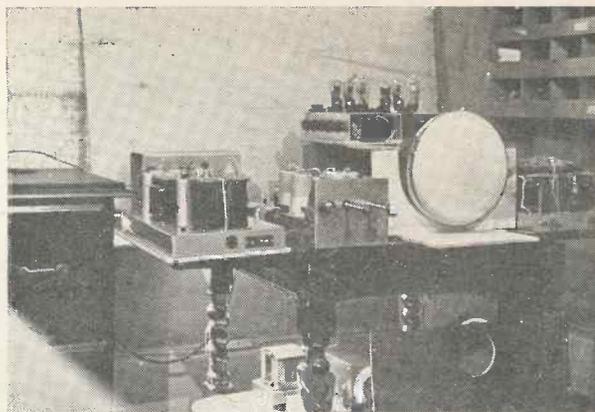
Here is a description of a home-made receiver built by Mr. S. West of Ipswich. As will be seen by the untouched photographs above results obtained are excellent and they provide proof that the home construction of receivers is quite practicable.

at ultra-high frequencies merited its use in preference to a normal valve. Tests confirmed this conclusively and also revealed that a considerable improvement was effected by employing an Acorn R.F. pentode and an Acorn triode as mixer and oscillator valve respectively. It should be mentioned

ing the circuits. In practice it is only necessary to adjust the tuning controls for the best picture, which is very easily arrived at.

Because of the difficulty of securing stability with a large number of I.F. stages, coupled with the fact that to obtain adequate frequency coverage the gain would be very little higher with a larger number than four, it was decided to use this number. These were followed by a diode detector and almost from the outset good pictures were received.

It was considered, however, that the picture was not bright enough and in spite of the disadvantages of



This photograph shows Mr. West's receiver in chassis form.

here that there is some attenuation of sidebands when all circuits are tuned to resonance because of the efficiency of the R.F. stage. As, however, the full gain is rarely required, tuning may with advantage be staggered somewhat. It has been found that this is preferable to damp-

video frequency amplification it was decided to add one stage. Accordingly some experiments were carried out with V.F. amplification with some success. By employing correct values the response of a V.F. stage can be made very good and a useful gain can be secured.

A NEW SYNCHRONISING IDEA

The final design arrived at is as shown in the schematic drawing.

Synchronising

The arrangement is comparatively straightforward and calls for little comment. The method of securing synchronism is a little unusual and the writer is grateful to Mr. Paul D. Tyers for permission to reproduce the circuit. The following brief explanation will clearly explain its action.

The diode valve V_{10} is connected so that normally its cathode is at a higher potential than its anode. This

through a 0.1-mfd. condenser to the anode of V_{11} and earth. The potentiometer R_{23} is then adjusted until the noise due to the picture goes, leaving only the synchronising pulses audible.

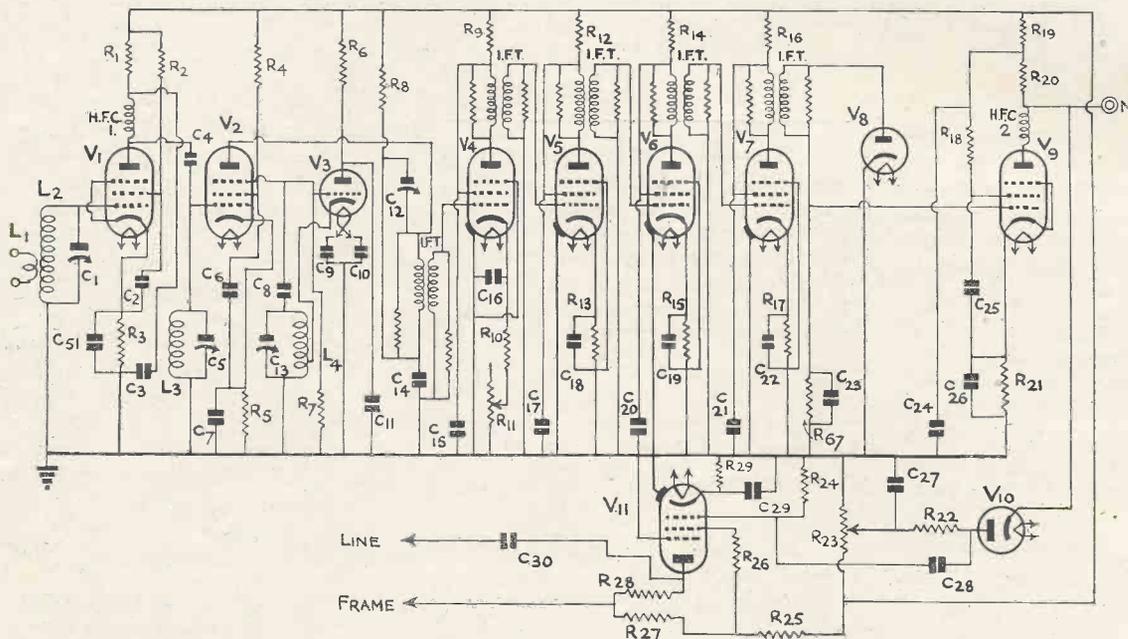
A little consideration will show that this arrangement will furnish very stable synchronism and considerable interference and fading will not affect the stability of the picture.

The diode V_{12} in the diagram reintroduces the D.C. component into the picture. It is the writer's view that this greatly improves picture quality. If this diode is used it is

tice with the exception of one or two modifications that are not really essential, although the improvement effected warranted their inclusion. These time bases furnish a good shaped raster and operate with great stability.

The condensers and resistances C_{31} , C_{39} , R_{43} are simple filter circuits to prevent mutual interference between the time bases. In the writer's experience this is a prime cause of inconsistent operation. The resistances R_{34} and R_{47} ensure rapid flyback of the spot.

It has been found that with a cer-



The complete circuit diagram of the receiver.

condition is secured by connecting the cathode to the anode of the V.F. valve V_9 and the anode to the slider of the potentiometer R_{23} , which is so adjusted that this condition exists.

It will be seen that any picture modulation will increase the anode potential of V_9 and the diode V_{10} will not conduct. During synchronising pulses, however, the anode potential of V_9 falls and the diode conducts, producing voltages across its load. As these voltages are out of phase and require amplification they are fed to the screened-grid valve V_{11} and it only remains to feed them through the application network to the grids of the time base relays.

Adjustment of the arrangement is quite simple and is best carried out with a pair of phones connected

important to note that its heater supply must be insulated to withstand the full tube 3rd anode volts to earth and preferably to arrange for it to be on before the tube H.T. is applied.

It is of interest to note that in the writer's experience it is perfectly satisfactory to reintroduce the D.C. component in this manner. There are other ways of retaining the D.C. component and there is a slightly more complicated way which might be considered preferable when picture modulation is applied to two electrodes. Tests made, however, failed to reveal any improvement and the extra complication was not considered worth while.

The Time Bases

The time bases follow normal prac-

tain adjustment of the synchronising pulse filter it is possible to alter the base charge resistances to almost any value without affecting synchronism.

It will be seen that the picture modulation is applied to the grid and 1st anode of the tube. (This reduces the voltage required for full modulation. The more normal arrangement can, of course, be used when an adequate signal is available.)

For the choke H.F.C.2 one section of an Eddystone 1010 choke is used. These are wound in four sections and it is a simple matter to remove one of these. It is wired as close to the anode pin of the valve as possible. It is important to use a resistance of adequate rating for R_{20} . Two 7,000-ohm Dubilier 2-watt resistances

SIMPLE HOME CONSTRUCTION

connected in parallel were used in the original. A single 2-watt should, however, prove quite satisfactory.

The I.F. transformers are wound with 24 s.w.g. enamelled wire on 1-in. Paxolin formers. No trimmers are used and each winding is adjusted experimentally for the best picture. As a rough guide the windings average 19 turns, close wound, and their coupling is adjusted to approximately $\frac{1}{4}$ in. Each section is damped with a 5,000-ohm resistance. Mervyn I.F. units have also been used and give excellent results.

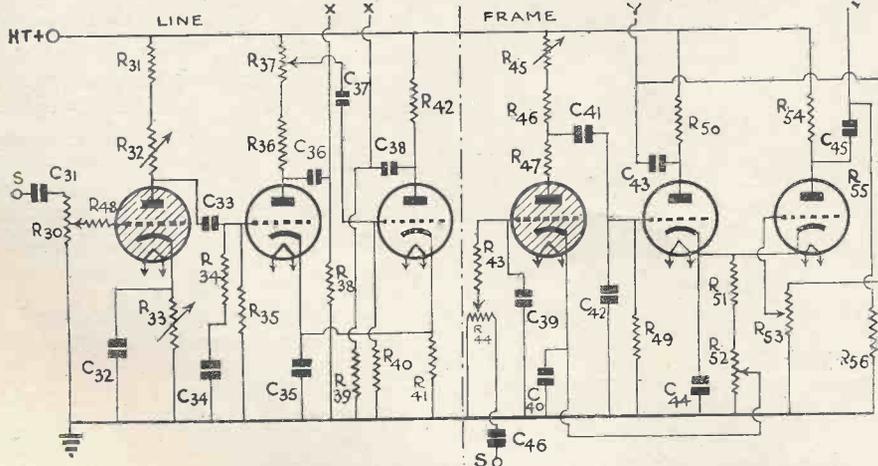
order to retain sharp division of the lines.

The Sound Receiver

No mention has been made of the sound receiver. At the time of writing the design of this is in a state of flux and the writer is endeavouring to construct a receiver embodying noise silencing circuits. Noise in the speaker now that we are accustomed to the silent background of normal listening is intolerable and some form of noise silencing circuit is very desir-

used with success. More normally, however, a converter is used in front of an ordinary broadcast receiver. This converter consists of an Acorn R.F. stage and an X41 frequency changer.

In conclusion, the writer would like to express his thanks for the assistance given by Mr. G. Parr, of the Ediswan Co., Ltd., and Mr. Paul D. Tyers; also to Mr. A. H. Croasdale, who gave advice in connection with the photography of the received pictures. In particular is he indebted to TELEVISION AND SHORT-WAVE WORLD for the valuable information given in its pages.



To simplify the diagram no arrangement for centring the raster is shown. The usual methods for performing this are applicable and are easily incorporated in the circuit. The resistances R 38 and R 56 may be connected to the slider of the centre taps of the potentiometers with approximately 200 volts across them. Alternatively a shift voltage may be obtained from the third anode end of the tube supply volts. In the interest of economy this method is preferable and is that used in the original.

Quite a compact layout has been achieved. In the first instance very elaborate screening was used, but it was found entirely unnecessary and simple screening is adequate.

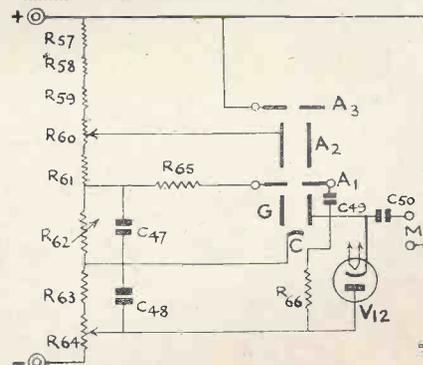
A photograph of the complete layout clearly shows the arrangement adopted. No attempt has been made to incorporate it into a cabinet as continual modifications are being tried.

In spite of the complex appearance of the outfit its construction was a comparatively simple and straightforward task and the very excellent results amply repay the time spent.

The tube in general use is an Ediswan 12H, which gives a bright black and white picture. A 10H tube is also used and the writer personally prefers the smaller picture. With increased 3rd anode volts the detail appears to be more definite; particularly is this so with printed matter and the like. It should be mentioned that the increase in 3rd anode volts with a small picture is necessary in

able where a sensitive receiver must be employed.

As a guide, however, quite a simple arrangement will give adequate



Note.—Care should be taken that the resistance R 62 is not so adjusted that the makers recommended volts are exceeded on A1. The case of C 49 unless insulated to withstand 4,000 volts must not come into contact with earth or C 50.

volume. A single Acorn R.F. stage followed by a detector and two L.F. stages with pentode output has been

Component Values.

- L1, 2 turns 26 D.S.C. at earthy end of L2.
- L2, 11 turns 16 S.W.G. enamelled on $\frac{1}{4}$ in. former.
- L3, 11 turns 16 S.W.G. enamelled self-supporting.
- L4, 6 turns 16 S.W.G. enamelled cathode tap 2 turns from earth end.
- C1, 25 mmfds. variable.
- C2, 0.0003 mfd.
- C3, 0.0003 mfd.
- C4, 0.0003 mfd.
- C5, 25 mmfds. variable.
- C6, 0.0003 mfd.
- C7, 0.01 mfd.
- C8, 0.0001 mfd.
- C9 and C10, 0.01 mfd.
- C11, 0.001 mfd.
- C12, 20 mmfds. trimmer.
- C13, 25 mmfds. variable.
- C14, 0.005 mfd.
- C15, 0.005 mfd.
- C16, 0.1 mfd.
- C17, 0.005 mfd.
- C18, 0.1 mfd.
- C19, 0.1 mfd.
- C20, 0.005 mfd.
- C21, 0.005 mfd.
- C22, 0.1 mfd.
- C23, 0.000035 mfd.
- C24, 8 mfd.
- C25, 25 mfd.
- C26, 500 mfd.
- C27, 0.5 mfd.
- C28, 0.1 mfd.
- C29, 0.1 mfd.
- C30, 0.0001 mfd.
- C31, 0.001 mfd.
- C32, 50 mfd.
- C33, 0.001 mfd.
- C34, 0.001 mfd.
- C35, 12 mfd.
- C36, 0.1 mfd.
- C37, 0.002 mfd.
- C38, 0.1 mfd.
- C39, 0.003 mfd.
- C40, 50 mfd.
- C41, 0.5 mfd.
- C42, 0.2 mfd.
- C43, 0.1 mfd.
- C44, 30 mfd.
- C45, 0.1 mfd.
- C47, 0.1 mfd.
- C48, 0.1 mfd.
- C49, 0.1 mfd.
- C50, 0.1 mfd. 4,000 D.C. working.
- C51, 0.1 mfd.
- R1, 20,000 ohms.
- R2, 150,000 ohms.
- R3, 2,000 ohms.
- R4, 150,000 ohms.
- R5, 1,500 ohms.
- R6, 50,000 ohms.
- R7, 50,000 ohms.
- R8, 3,500 ohms.
- R9, 3,500 ohms.
- R10, 100 ohms.
- R11, 5,000 Pot.
- R12, 3,500 ohms.
- R13, 250 ohms.
- R14, 3,500 ohms.
- R15, 250 ohms.
- R16, 3,500 ohms.
- R17, 250 ohms.
- R18, 10,000 ohms.
- R19, 1,000 ohms.
- R20, 3,500 ohms. (2w.).
- R21, 100 ohms.
- R22, 2 megohms.
- R23, 100,000 Pot.
- R24, 100,000 ohms.
- R25, 50,000 ohms.
- R26, 10,000 ohms.
- R27, 5,000 ohms.
- R28, 5,000 ohms.
- R29, 250 ohms.
- R30, 20,000 ohms. Pot.
- R31, 1 megohm.
- R32, 0.5 megohms Pot.
- R33, 50,000 ohms.
- R34, 2,000 ohms.
- R35, 1 megohm.
- R36, 80,000 ohms.
- R37, 15,000 ohms.
- R38, 1 megohm.
- R39, 1 megohm.
- R40, 1 megohm.
- R41, 5,000 ohms.
- R42, 100,000 ohms.
- R43, 20,000 ohms.
- R44, 50,000 ohms.
- R45, 2 megohms Pot.
- R46, 750,000 ohms.
- R47, 1,000 ohms.
- R48, 150,000 ohms.
- R49, 2 megohms.
- R50, 200,000 ohms.
- R51, 8,000 ohms.
- R52, 2,000 ohms. Pot.
- R53, 0.5 megohms Pot.
- R54, 200,000 ohms.
- R55, 1.5 megohms.
- R56, 1 megohm.
- R57, 2 megohms.
- R58, 1 megohm.
- R59, 0.5 megohm.
- R60, 0.5 megohm Pot.
- R61, 0.5 megohm.
- R62, 0.5 megohm Pot.
- R63, 100,000 ohms.
- R64, 100,000 ohms.
- R64, 100,000 ohms. Pot.
- R65, 1 megohm.
- R66, 250,000 ohms.
- R67, 5,000 ohms.
- V1, Mullard AP4.
- V2, Mullard AP4.
- V3, Mullard AT4.
- V4, V5, V6, V9, Mullard TSP4.
- V8, Osram D42.
- V10, Osram D42.
- V11, Osram MSP4.
- V12, Osram D42.
- HFC 1 Eddystone type 1011.
- HFC 2 See text or approximately 90 turns 39 DSC. on $\frac{1}{4}$ in. former.

TELEVISION PROJECTION WITH THE CATHODE-RAY TUBE

AN ACCOUNT OF SOME RECENT R.C.A. DEVELOPMENTS

The results of recent research work by the Radio Corporation of America in the production of large pictures by Cathode-ray projection were disclosed at the 25th anniversary Convention of The Institute of Radio Engineers. For a portion of the information given in this article we are indebted to "Electronics," New York.

AT the twenty-fifth anniversary Convention of The Institute of Radio Engineers (U.S.A.) a series of papers on television subjects were read by technicians of the Radio Corporation of America. Of outstanding importance was the paper by Dr. V. K.



A projection tube of the type described being demonstrated.

Zworykin and W. H. Painter on "The Development of the Projection Kinescope."

The authors said that several years of research work were required before the problems of designing a suitable projection system were clarified. Actually, the earliest development of this type of television tube dates back to 1930, when conventional cathode-ray tubes were scaled down to produce a small image of great brilliance which might be projected. These attempts were not successful, however, and it was not until a completely new line of attack, including entire redesign of the electron gun, was made that acceptable results were obtained.

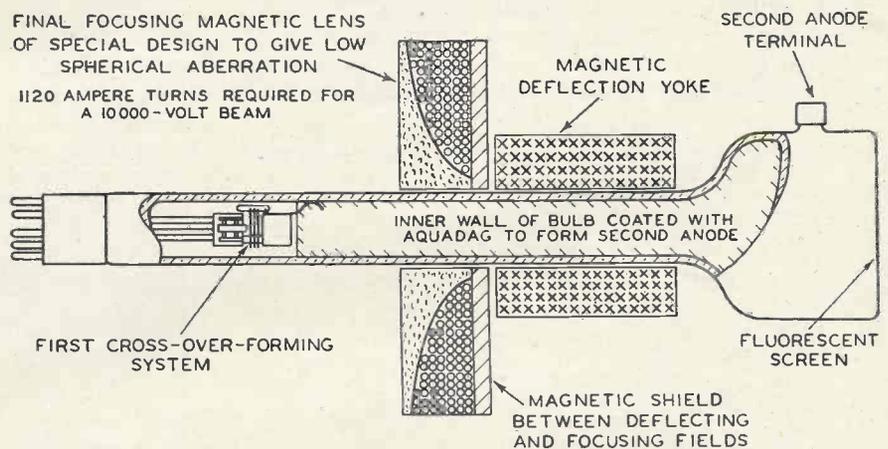
During the course of the paper a tube for projection purposes was demonstrated. This tube contains an electron gun capable of delivering 1.0 to 1.5 M/a. at the cathode, of which about 0.4 M/a. is actually delivered to the beam itself. (This beam is accelerated by a potential of 10,000 volts on the last anode, producing a spot about 0.005 in. in diameter on the fluorescent screen. The brilliance at the screen surface is about 280 candles per square foot, which when projected is capable of producing a highlight brilliance of about 1.9 foot-lamberts. This compares with a brilliance of 2.7 foot-lamberts for 16 mm. home movies and 2.7 to 5.2 foot-lamberts for commercial motion pictures. The size of the projected picture is normally 18 by 24 in. but much larger pictures can be projected at correspondingly lower brilliance. The actual picture on the fluorescent screen itself, before projection, is about 1½ in. by 2 in. The

projection tube is intended for use with a lens of f/1.5 aperture.

The screen material of the projection tube is principally zinc orthosilicate of carefully controlled crystalline structure, which gives a brilliant yellow-green light and which is very stable under prolonged heavy bombardment. Tests with this type of material, under a beam current of 200 M/a. at 10,000 volts, showed a reduction of lighting efficiency of only 27 per cent. in 1,200 hours' operation.

Electron Gun for Projection Tube

An electron gun of the projection tube of unusual design was described by R. R. Law in his paper "A High-current Gun for the Projection Kinescope." The cathode itself is indented and covered with a very small spot of barium-strontium oxide. In front of the cathode are four aligned apertures, each maintained at successively higher potentials with respect to the cathode. The last aperture has a potential of 10,000 volts. The first two apertures nearest the cathode control the bril-



Sectional diagram of high intensity cathode-ray projection tube showing the focusing and deflecting coils.

liance of the spot by their grid-like action on the beam electrons. Both these apertures are operated together as the control grid. The final aperture makes contact with the Aquadag coating which returns the electrons from the fluorescent screen.

The final electron lens of the focusing system is an electromagnetic lens of unusual design which reduces the spherical aberration to a small amount. The deflection control is entirely electromagnetic, using a conventional scanning yoke.

PICK-UP SENSITIVITY

In the demonstration a vision signal from a secondary emission plate (fixed Iconoscope) was fed to the two control apertures. The vision signal represented a still picture and was sent 30 frames a second 343 lines, without interlacing. A special directional reflection screen, about 3 ft. by 4 ft. in size was used to receive the image from the projecting system, which employed a highly corrected f/1.4 lens of about 3 in. aperture. The brilliance of the image and its high quality were readily apparent. As an additional demonstration the small screen was removed and the image projected on to the standard screen used for the lantern slides. This

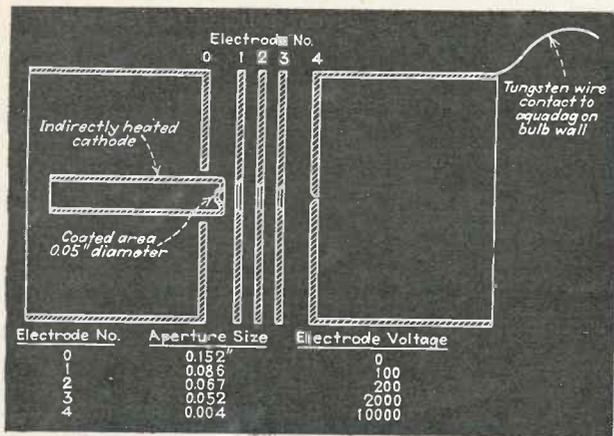


Diagram of the electron gun for projection tube showing beam cross-over electrodes.

screen, about 8 ft. by 11 ft. in size, was completely covered by the image and with a brilliance sufficient to make it readily visible and enjoyable to all those present in the room, which was about 50 ft. long. The picture was later further enlarged so that only a small portion of it filled the entire 8 ft. by 11 ft. screen.

OUTDOOR SCENES AND TELEVISION TRANSMISSION

Two papers were contributed in this special series by Harley Iams, R. B. Janes and W. H. Hickok entitled "The Brightness of Outdoor Scenes and its Relation to Television Transmission." The authors said that until recently devices for converting light into television picture signals have required a very large amount of light to give a useful signal. To-day, it is practical with such electronic devices as the Iconoscope to transmit pictures of outdoor scenes, even on cloudy days.

In the transmission of outdoor scenes with an Iconoscope a lens is used to focus the picture on the Iconoscope mosaic. The output of the picture pick-up tube depends, among other things, upon the amount of light that reaches it from the scene to be transmitted. This amount of light depends upon the intrinsic brightness of the scene. Studies were made to determine the typical brightness values which would have to be covered in television pick-ups.

These values vary from nearly 0 to over 1,000 candles per square foot. Typical values recorded by the group were 16 candles per square foot for a football game on a dull day to 100 candles per square foot for a baseball game on a bright day in September and a figure of 2

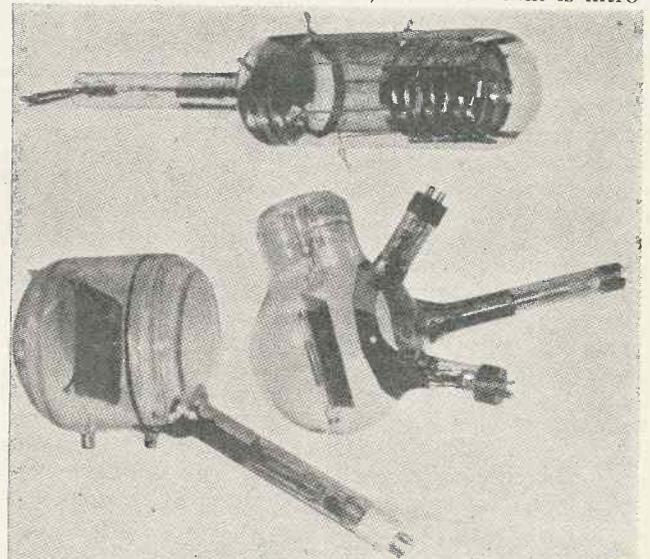
was obtained in the shadows of tall buildings on a clear day. With recent pick-up tubes (the sensitivity of which is approximately three times as great as those of several years ago) scenes with brightness of 15 candles per square foot can be transmitted with an f/4.5 lens. If the surface brightness falls to a figure as low as 2.5, the scene can be reproduced but it is without entertainment value. The authors held out the hope that in time the Iconoscope type of tube would be able to pick-up and transmit nearly everything the human eye can see, and some things it cannot see.

Dr. V. K. Zworykin, G. A. Morton and L. E. Flory dealt with the theory and performance of the present pick-up type of tube and gave promise of newer tubes now under development. It was pointed out that still greater sensitivity was desirable and that there were two methods by which this sensitivity could be improved. One is by use of secondary emission signal multipliers and the second is by using secondary emission intensification.

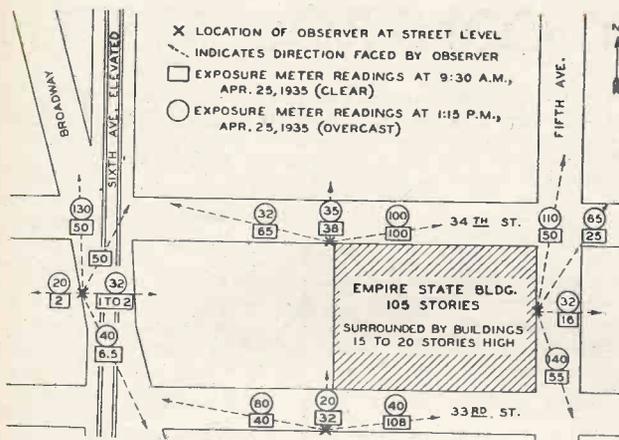
The present overall efficiency of the Iconoscope type of pick-up is about 5 to 10 per cent. and the difficulty in amplifying the tube output to desired levels is the noise. If the signal is 10 times as strong as the noise a good picture will result, but if the noise can be reduced to 3 per cent. of the signal, it is unnoticeable.

Calculations of the light required on the mosaic were given taking into account the tube efficiency, the size of the mosaic, and other factors. The authors showed that excellent pictures may be transmitted of 20 to 50 candles per square foot representing a mosaic illumination of $2\frac{1}{2}$ to 6 milli-lumens per sq. cm.

Increasing sensitivity may be attained by reducing the noise, by increasing the overall efficiency, or by increasing the tube output per unit of light flux. By increasing overall efficiency, laboratory tubes with efficiencies as high as 50 per cent. have been made. The authors discussed the development (purely experimental to date) of two types of new pick-up tubes. By using a secondary emission multiplier instead of collecting the secondary electrons unused, the noise that is intro-



Three experimental Iconoscopes. Top: images multiplying Iconoscope. Left: "dipper" type showing flat glass surface before the mosaic. Right: electron multiplying Iconoscope with T multiplier in each projecting arm.



duced by input and output resistors to the amplifying tube is eliminated completely. In this manner an increase in sensitivity of about three times is possible, and in this case the sensitivity increases with lower values of beam current and leads to the development of mosaics with thicker insulating layers to reduce the capacity per unit area. In practice a T-type multiplier has proved satisfactory.

The second method of increasing sensitivity consists in intensifying the entire image by a secondary emission amplifier instead of multiplying individual electrons. Here the image falls upon a mosaic, the elements of which extend through the mosaic. The scanning beam sweeps across the back of the mosaic removing the stored picture in the usual way, but with increased output. Experimental tubes have a sensitivity about ten times as great as the conventional Iconoscope.

The Baird Trade Mark

The Question of the word "Televisor"

BAIRD TELEVISION, LTD., desires to inform the public and their friends in the trade that in future all their goods will be marketed under the Trade Mark "Baird," which has already been largely used by the company.

As is generally known, the company is the registered proprietor of the trade mark "Televisor," but this word, which was originally invented by Mr. Baird in 1925 and registered by him as a trade mark, has now become in the United States the generally recognised word for describing television apparatus, and although the company has taken the necessary steps to protect its rights in this country it has become apparent to them that to continue doing so would be likely to result in the necessity for unfriendly action on their part against competitors and others without any counterbalancing advantage. Television apparatus is still, comparatively speaking, in its infancy and the company considers that it would be right to use as its trade mark words which will be regarded by all as distinctive of its goods rather than a word which many contend should be available for the use of all as a descriptive word for any kind of television apparatus. Accordingly, Baird Television, Ltd., announces that it is abandoning its registration of the word "Televisor" as a trade mark and that this word will in future be free, so far as they are concerned, for all to use as a word descriptive of television apparatus generally.

The above announcement does not in any way affect the rights of the

company in respect of its other registered trade marks which it will continue to use and defend if occasion arises.

"Miniature Television"

(Continued from page 456)

(type 885) is taken directly to the plate through the isolating condensers shown. This may lead to a certain amount of defocusing, although it will be tolerable with a very small tube. The amplitude of the sweep is controlled by applying the full thyatron output to a potentiometer and tapping off a portion of this for the plates. The author makes no mention of the exact speed for which the circuit is designed and it will be necessary to make adjustments to the condensers for the E.M.I. system. It also remains to be checked whether the thyatron will operate at full amplitude at 10,000 cycles.

As stated above, a valuable point about the receiver is the economy in H.T. Both the video receiver, sound receiver time base and tube are fed from 350 v. H.T. This value is reduced for the video receiver by a series resistance of 2,000 ohms, the current consumption of this part of the set being about 50 ma.

Reverting to the time base, the synchronising pulses are applied to the grids of the thyatrons in the

usual way, a simple filter being inserted in the leads. The H.F. filter is a 50 mmfd. condenser in series with 50,000 ohms, the grid being connected to earth through a .05 mfd. condenser to act as a by-pass.

Experimental Tests

In our experimental laboratory a start is being made with the construction of the H.T. unit and time base and the results with the specified values and the modifications found necessary will be reported in next month's issue.

Reports Wanted

SCOPHONY, LTD., are desirous of receiving reports on their two radio transmissions taking place daily from Thornwood Lodge, Campden Hill. These transmissions are being sent out to the Science Museum at South Kensington to the apparatus which they are demonstrating to the public. The sound transmitter is operated at 47 megacycles and roughly 100 watts in the aerial. The transmitter is crystal controlled by a number of doubling circuits using 6L6 valves and RK 25's, feeding a pair of Taylor type T55 valves in push-pull. Modulation is applied to the grids and the overall frequency response of the transmitter is flat from 10 to 30 kc. The vision transmitter is identical except that the frequency is 49 megacycles with a special form of grid modulation employed to handle the vision frequencies. The address of Scophony, Ltd., is Thornwood Lodge, Campden Hill, London, W.8.

OUR POLICY
The Development
 of
TELEVISION

THE SUPERSONIC LIGHT CONTROL SYSTEM

A SIMPLE EXPLANATION OF THE DEVICE DEVELOPED BY SCOPHONY

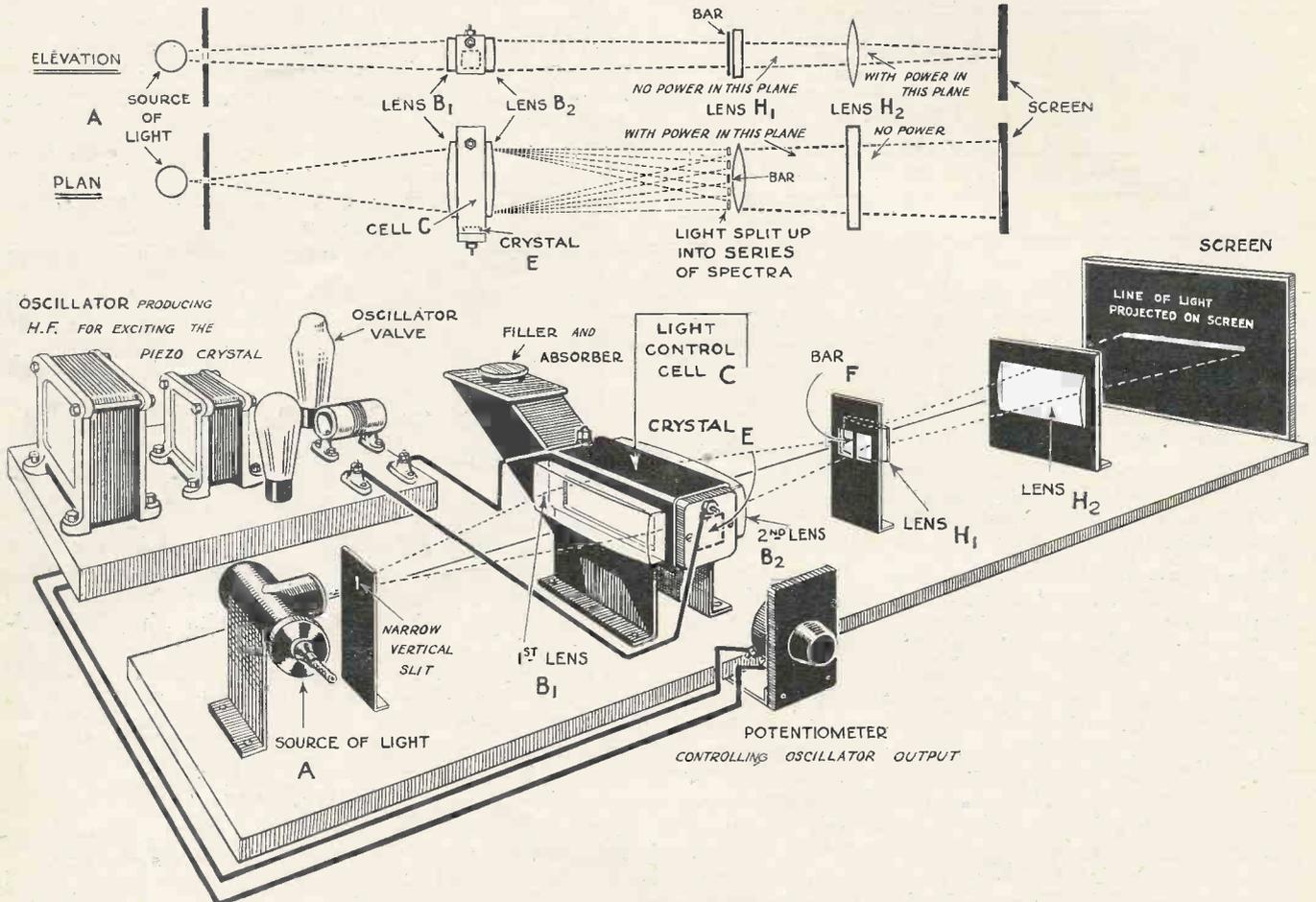


Diagram of a model of the Scophony supersonic light control.

The Scophony System is based on a number of fundamental inventions, which result in the achievement of a far greater light efficiency than has hitherto been possible. It is because of these inventions, some of which are absolutely revolutionary in their character, that Scophony, Limited, has been enabled to produce large-size projected high-definition pictures.

The two most important of these inventions are the Supersonic Light Control and the Beam Converter, which are illustrated here from models which are at present on view in the Science Museum Television Exhibition.

Present day television is hampered by the unavoidable loss of light through "scanning." As is well known, the picture is scanned in the normal way by a single spot, whether it be at the transmitter or the receiver. This spot has to traverse the whole picture in a certain time. If the picture is made up of 240 lines and contains 320 elements along its line, the number of times the single spot goes into the picture is about eighty thousand; consequently there is only one eighty-thousandth of the light which could be obtained if no scanning were employed as is the case with the cinema picture. The Scophony light control reduces this deficiency considerably.

The Scophony supersonic light-control consists of a container, filled with a liquid, at one end of which is a quartz crystal. When the quartz is actuated by a modulated carrier frequency, the fundamental frequency of which is the same as that of the quartz, supersonic waves are set up at a speed corresponding to the velocity of the sound waves

in the particular liquid used. The container has on either side of it a lens, and when light is passed through the container and focused on to a scanner and from the scanner on to a screen, with suitable lenses an image of the light control itself can be formed on the screen, the width being the width of one line of the picture and the length determined by the length of the light control liquid column. If the modulation is now applied to the quartz crystal nothing will be seen on the screen until the scanner which is between the screen and the light control is rotated at such a speed that it follows the speed in the liquid exactly. The modulation then becomes visible on the screen. In the liquid each wave produced by the carrier frequency on the quartz crystal is equivalent to one scanning spot on the screen. A large number of scanning spots can thus be and are used simultaneously.

The action of the control will be clear from the drawing of the model and the following explanation.

The oscillator, shown as a chassis on the left of the diagram, supplies a high frequency to the quartz crystal E.

This quartz crystal, which forms the end of a glass sided cell C, containing a transparent liquid, vibrates mechanically at the frequency of the oscillator and thus produces "sound" waves in the liquid, which travel horizontally across the cell at the speed of sound, and are completely damped out by appropriate absorbent material at the far side of the cell.

The light (which is to be controlled in intensity for projection on the screen to form the final picture), is made parallel through the liquid

THE SCOPHONY BEAM CONVERTOR

by the lens B_1 and after passing through the liquid is brought to a focus at F by the lens B_2 .

At F there is a blackened bar just the size and shape of the original source of light, and when there are no sound waves in the cell the whole of the light is stopped by this bar, and no light falls on the television screen.

When the crystal is vibrating, however, the compressions and refractions in the liquid cause the light to be very slightly deflected. The oscillator frequency is so high that the wavelength of the sound waves is of the order of $1/10$ mm., and the system of waves thus acts as a "diffraction grating."

As a result the light which was previously all stopped by the bar F now passes by on each side of it and is collected by the lenses H_1 and H_2 on to the screen.

The valve oscillator may be modulated with the incoming vision signal by any of the usual methods. The amplitude of the mechanical vibration will be proportional to the signal sent by the transmitter, and therefore the amount of light passing the bar F is also proportional to this signal.

The whole of the light passing through the cell is not brought to a

single spot on the screen. The waves take about 100 microseconds to pass from the crystal to the far end of the cell, during which time the television transmitter has completed one full line of the picture. Thus at every instant the wave pattern adjacent to the crystal corresponds to the signal being transmitted, while the remainder of the cell contains, strung out along it, the vision signals of the previous 100 microseconds.

Lens H_1 forms an image of this train of waves on the screen while the high speed scanner (placed near H_1 in a receiver) has a speed of scanning equal and opposite to the velocity of this train of waves at the screen. In this way the scanner performs the double function of (1) scanning and (2) cancelling (or "immobilising") the motion of the liquid waves.

The advantages of this type of light control are:—

(1) Small *controlling* power even for the highest definition television, and for full size cinema screens.

(2) Great increase of light, up to 500 times, since a full line of the picture is projected instead of one spot.

(3) Reliability, freedom from electrical breakdown, etc.

THE BEAM CONVERTOR

The object of the Beam Convertor is to make possible the use of a small diameter, long scanner instead of the equivalent large diameter, short scanner.

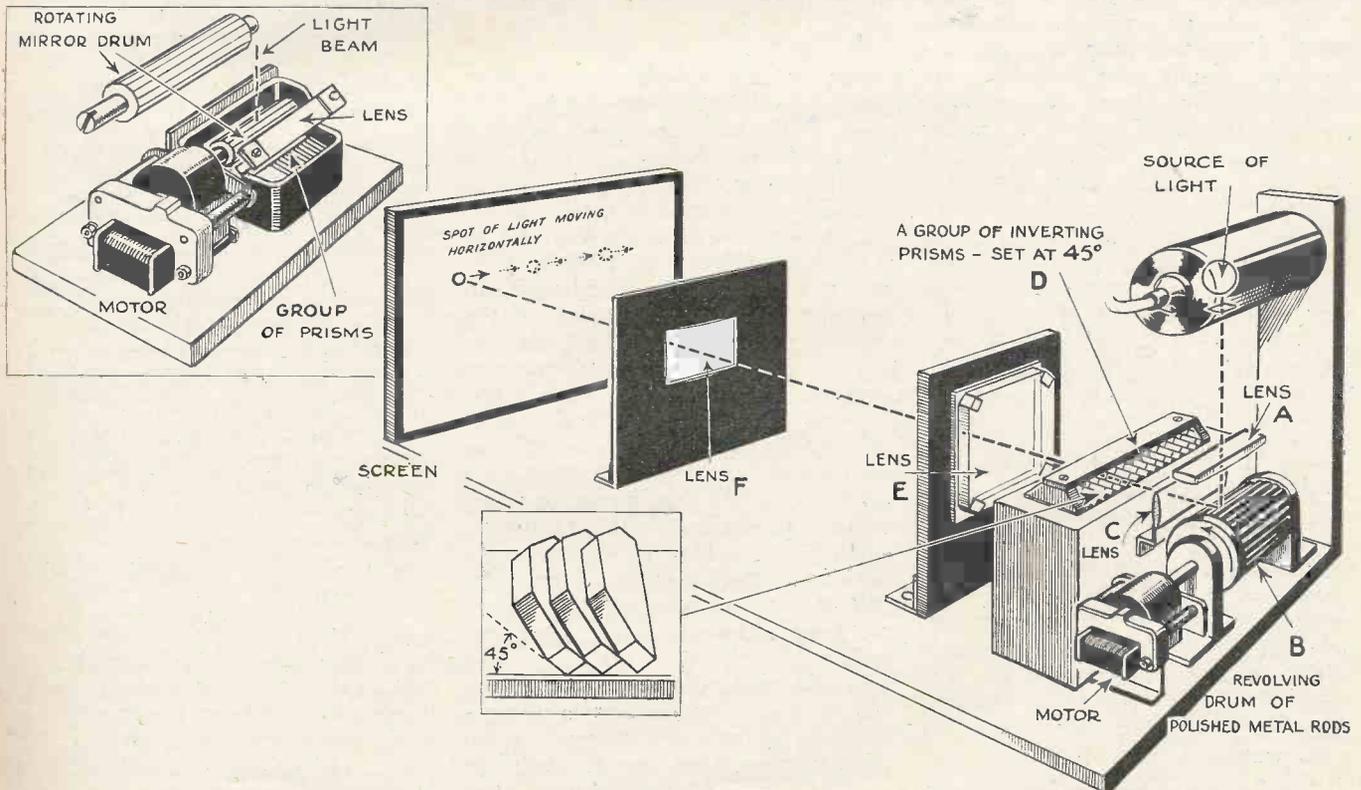
The light leaving the scanner B is in the form of a flat sheet moving downwards across the lens C . When it falls on the beam convertor D it is split up into a number of sections and each section is rotated through a right angle, with the result that the emergent beam of light, still in the form of a flat sheet is now moving in the plane of the sheet, instead of perpendicular to it.

The beam convertor itself consists of a number of right-angle prisms tilted at 45° to the horizontal. Anyone who has the opportunity to handle a right-angle prism will notice at once that on looking "through" the prism—i.e., from short side to short side via reflection

at the base, the angle of vertical objects depends on the angle at which the prism is held, and that the objects rotate twice as fast as the prism is rotated.

Thus when the prism is at 45° to the horizontal the objects seen through it have been rotated through 90° —i.e., objects actually moving vertically appear to have horizontal motion.

The main drawing shows an early form of this device with a novel form of scanner consisting of a number of polished metal rods, while inset is a later model, utilising a very small scanner, and a beam convertor having two stages of reflection from serrated surfaces. This latter model, with its 1 cm. diameter scanner, can deal with the same amount of light as a normal scanner 20 cm. in diameter.



Diagrams of models of two types of beam convertor.

BAIRD TELEVISION LTD.

WORLD PIONEERS & MANUFACTURERS OF ALL TYPES OF TELEVISION EQUIPMENT

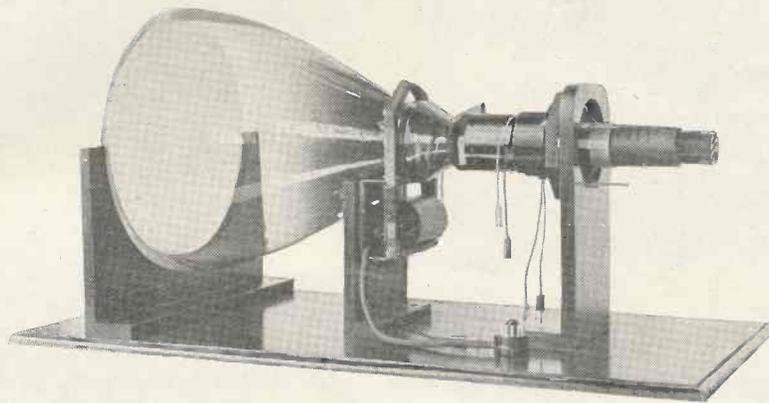
BAIRD TELEVISION RECEIVERS

The Baird Receiver, Model T.5, is the finest set offered to the public. Although costing only 55 guineas it provides a brilliant black and white picture larger than that obtainable on any make of receiver now marketed. Among the factors contributing to the set's performance, are simple operation, wide angle of vision, high fidelity sound and excellent picture detail.

Free installation and one year's service.

Remember, Baird Receivers mirror the world! So place your order now.

PRICE 55 GNS.



"CATHOVISOR" CATHODE RAY TUBE Type 15 MW1 Complete with Electromagnetic Scanning and Focusing Equipment.

BAIRD MULTIPLIER P.E. CELLS

Baird Multiplier Photo Electric Cells are made in two main types. The first has a small cathode of 15 sq. cms. for use with a concentrated light beam, while the second has a large cathode of 250 sq. cms. for diffuse light.

The Baird Multiplier has a chain of electron permeable grid stages and current gain factors of the order of 100,000 can be obtained. Cathode sensitivity is approximately 30 microamperes per lumen and the good spectral response enables the cells to be used for infra red detection and infra red signal amplification. Details on application.

BAIRD CATHODE RAY TUBES

TECHNICAL DATA	TYPE 15 MW1.
Heater volts	1.8 volts.
Heater amps	2.4 amps.
Peak to peak volts, between black and highlights	30 volts.
Maximum electromagnetic sensitivity	2 mm/AT.
Modulator/earth capacity	2 $\mu\mu\text{F}$ (approx.).
Modulation sensitivity (slope)	6 $\mu\text{A/V}$.
Anode volts	6,500 volts.
Maximum input power to the screen	3.5 milliwatts/sq.cm
Maximum anode current for highlights still in good focus	100 μA .
Screen colour	Black and white.

The Baird Cathode Ray Tube, type 15 MW1, has a hard glass bulb whose screen diameter is 38 cms., total length 74 cms., and neck diameter of 4.45 cms. Apart from manufacturing processes, stringent tests are made for electrical emission, tube characteristics, filament rating and screen quality, and following normal picture reconstitution under service conditions, the completed cathode ray tube is subjected to a very high external pressure test.

All "Cathovisor" Cathode Ray Tubes are completely electromagnetic in operation, a feature of outstanding advantage. Furthermore, not only is the electrode system extremely simple and robust, but due to the special form of cathode employed, a high intensity cathode ray beam is produced which results in a very brilliant picture.

The ideal tube for really large television pictures—12 in. by 10 in.—without distortion.

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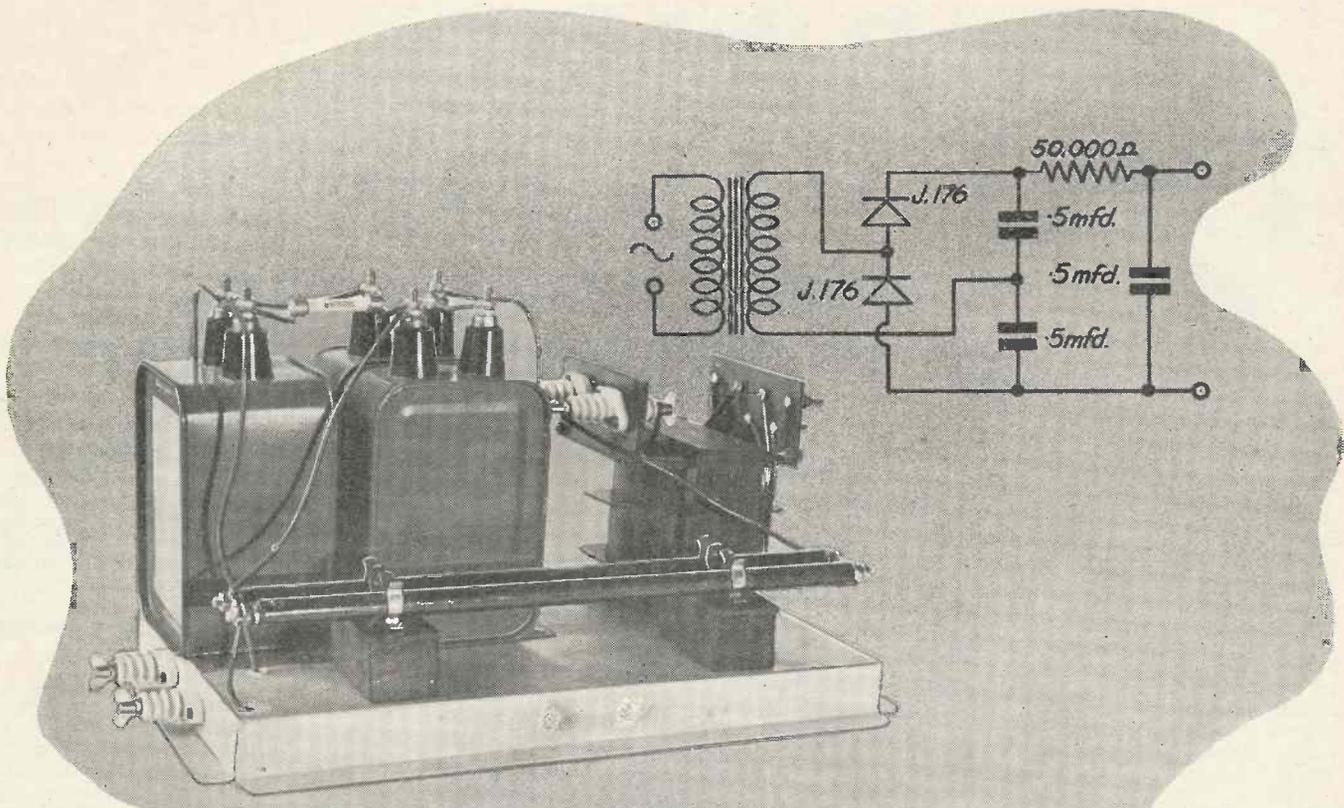
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3,000 VOLTS FOR TELEVISION TUBES

The simple and robust unit, for the supply of power to television tubes, shewn above, may be easily constructed by using two J.176 Westinghouse Metal Rectifiers in the voltage-doubler circuit. This enables full-wave rectification to be obtained without resort to the dangerous centre tap method, where the transformer would be called upon to deliver a total of no less than 6,000 volts. The input to the J.176 units is only 1,400 volts, so that the transformer is very much cheaper and less bulky.

Full details of the J.176 type units are given in "The All Metal Way." A 3d. stamp to Dept. T. will bring you a copy by return.



J. TYPE METAL RECTIFIERS

WESTINGHOUSE BRAKE & SIGNAL CO., LTD., 82, York Road, King's Cross, London, N.I.

A NEW ELECTRON CAMERA

FIRST DETAILS OF A RECENT DEVELOPMENT COMBINING THE PRINCIPLES OF THE IMAGE DISSECTOR AND THE ICONOSCOPE

AN invention which may have an important bearing on the future development of electron cameras has just been disclosed by the publication of a patent* granted to G. Lubszynski and Sidney Rodda. Although the results of practical experiments have not yet been disclosed, the invention presents so many special features that a description will be of particular interest.

In essentials, the invention represents a combination of the principles of the Farnsworth Image Dissector and the familiar Emitron camera; while both of these forms of electron camera suffer from certain inherent

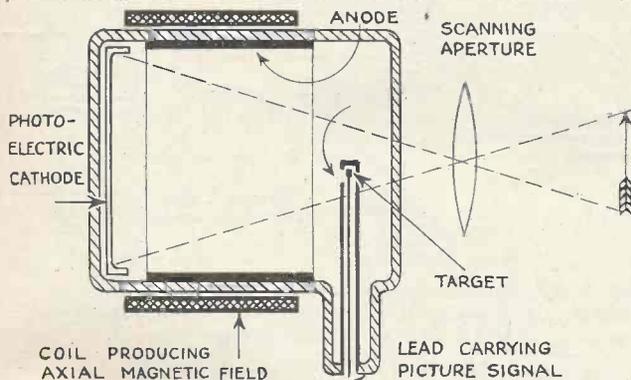


Fig. 1.—Diagram of Farnsworth image-dissector tube.

defects, the new invention appears to overcome them. If the practical construction of the new tube can be successfully carried out, it is likely to be a development of the first importance.

In the Farnsworth camera (Fig. 1), an image of the scene to be transmitted is projected by an ordinary optical lens on to a photo-electric cathode enclosed in an evacuated tube. Electrons are emitted from every point of the cathode in proportion to the intensity of light, and, by means of a high positive potential applied to the cylindrical anode and by means of an axial magnetic field, the electrons are drawn forward and focused as an electron image at the plane of a small scanning aperture. At the same time, the whole electron image is caused to traverse in horizontal and vertical directions by means of transverse magnetic fields, and the image is thus scanned by the aperture.

In the Farnsworth system the fact that the number of electrons entering the scanning aperture at any instant is only equal to the number released by the corresponding area of the cathode in the scanning time must set a definite limit to the illumination intensity and the order of definition with which the camera may be employed, though this first difficulty can be overcome to some extent by electron multiplication.

In the Emitron type of electron camera (Fig. 3) an image of the scene to be transmitted is projected on to

*B. Patent No. 442,666.

a photo-electric mosaic, thus causing the individual elements of the mosaic to emit electrons in proportion to the intensity of light falling on them. The emission of electrons leaves the elements of the mosaic positively charged, and these are discharged to a uniform potential by the scanning of a beam of cathode rays. Each element of the mosaic forms a minute condenser with the "signal plate" behind the mosaic and the currents which flow on the discharge of each little condenser give rise to a voltage across a resistance in the earth lead of the signal plate. This voltage is applied to the first valve of the train of amplifiers.

One of the principal difficulties of the Emitron type of camera is to construct a mosaic screen of sufficient sensitivity to provide an appreciable voltage for the initial amplifier. (The discharge currents of the normal type of mosaic are extremely minute and "noise" in the circuit is liable to be troublesome.)

The New Camera Tube

With the new tube it is claimed that the factors which give rise to the lack of sensitivity experienced with both the Farnsworth and Emitron types are eliminated by an ingenious combination of the two systems. One form of the new camera is shown diagrammatically by Fig. 4.

An optical image of the scene to be transmitted is projected on to a plain photo-electric screen, which, however, is made so thin as to be semi-transparent. Although the photo-electric screen is shown as a separate screen in Fig. 4, it is stated that it can be formed on the plate-glass window of the tube by depositing a very thin layer of silver and coating it with a

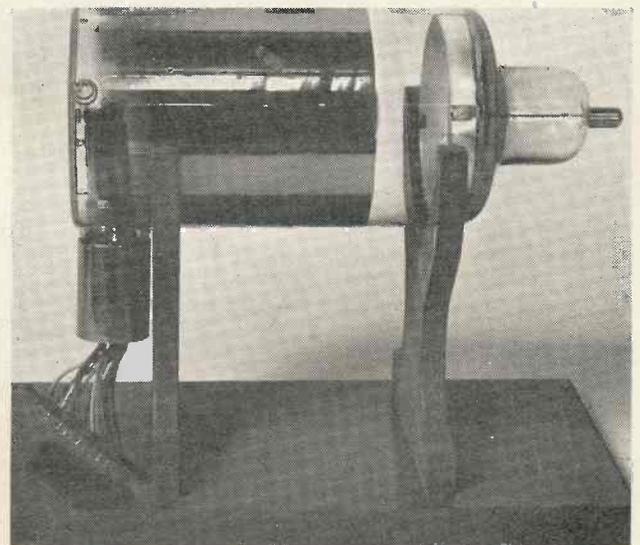


Fig. 2.—Photograph of image dissector as made by Baird Television, Ltd.

OVERCOMING THE "KEYSTONE" EFFECT

layer of photo-electric caesium. Alternatively, the screen may be made of a very fine wire mesh upon which is deposited a photo-electric coating of caesium.

Whichever form of construction is adopted, the electrons which are emitted under the action of the incident light are drawn forwards, i.e., away from the scene being transmitted, by means of high positive potentials applied to the cylindrically shaped anodes. The electrons are caused to preserve their relative positions and

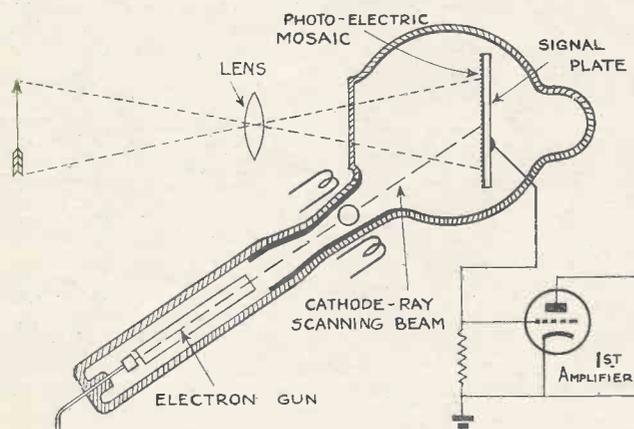


Fig. 3.—Diagram of Emitron television camera.

are thus "focused" by means of an axial magnetic field on to a mosaic electrode shown on the right in Fig. 4. On reaching the mosaic electrode, the high velocity which has been imparted to the electrons by the positive potentials on the anodes causes each electron to produce the emission of several secondary electrons from the mosaic surface, thus charging the elements of the mosaic at a potential three or four times as great as they could attain without the principle of secondary multiplication.

As in the case of the Emitron camera, the mosaic electrode consists of a thin sheet of mica, upon the front face of which is deposited a very large number of minute metallic globules, generally of silver. By a special process, these globules are coated with a photo-electric surface of caesium and caesium-oxide. On the back of the mica sheet is deposited a layer of aluminium or silver which forms the "signal plate," and with which all the individual globules of the mosaic form separate little condensers. When an optical image is projected on to the mosaic surface, as in the case of the Emitron, or when it is bombarded by an electron image from the photo-electric cathode of the new camera, the individual globules are caused to emit electrons. Since the electrons consists of negative particles of electricity, the globules are left more or less positively charged, the amount of the charge being proportional to the intensity of the illumination of each part of the image.

To obtain the actual picture signal, the mosaic is scanned in a conventional manner by means of a beam of cathode rays which discharges each globule of the mosaic in turn by restoring to it sufficient electrons to bring its charge back again to a neutral level. The discharge current is thus dependent on the charge accumulated by the globule since the last scan and, as the scanning beam sweeps over the multitude of tiny

globules, voltages are developed across the resistance in the earth lead of the signal plate which are proportional to the illumination intensity of the corresponding points of the image.

One of the difficulties of the Emitron camera, and also of the type of camera illustrated by Fig. 4 is due to the fact that the angle subtended at the point of deflection of the cathode beam by a horizontal line of given length at the top of the picture is smaller than the angle subtended by a line of the same length at the bottom of the picture. This difficulty arises from the acute angle of scanning which must be adopted, and to avoid the distortion which would otherwise result a special form

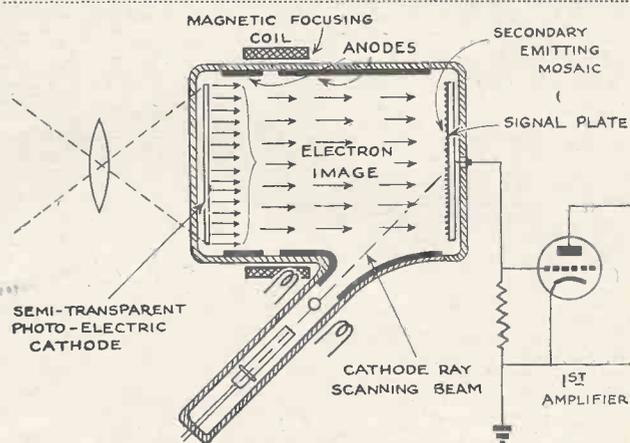


Fig. 4.—The new electron camera, a combination of the Farnsworth and Emitron systems in which the principle of secondary-emission multiplication is used at the mosaic to obtain increased sensitivity.

of generator known as the "Keystone generator" has to be employed to control the deflection of the cathode-ray beam.

This defect is avoided in a second form of the new type of camera which is illustrated in Fig. 5 and in which a new form of mosaic is employed which is scanned from the back. Such a mosaic presents very considerable difficulties in its construction, but if the practical difficulties can be overcome, it seems probable that such a camera would not only be more sensitive than the present types, but would also require less complicated apparatus for its operation.

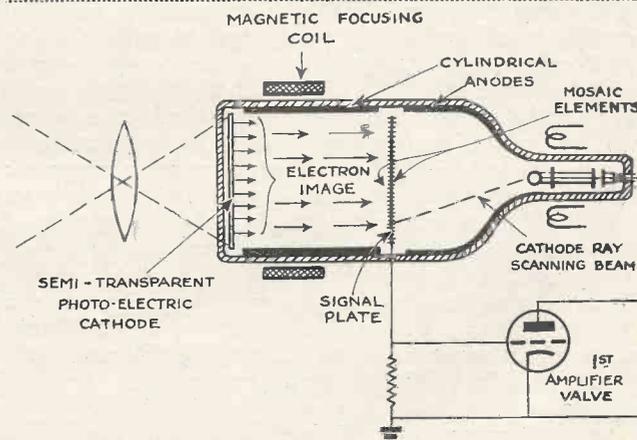


Fig. 5.—An alternative form of the new camera in which the secondary-emitting mosaic is so constructed that its elements can be scanned from the back.

Scannings and Reflections

DAVIS CUP MATCHES TELEVIEWED

ALTHOUGH normal television programmes closed down for three weeks on July 24, special relays from Wimbledon took place on July 26 and 27. (The Davis Cup Challenge Round was also televised in order to include the whole of this series.

As before, two cameras were used at Wimbledon, one near the south-west corner of the court to give near and panoramic views, and the other in a fixed position at the other end of the court to give a general view of the play and the spectators.

The mobile television unit at Wimbledon employed a radio link to Alexandra Palace. No film was employed, transmission being instantaneous.

"THE MAN WITH A FLOWER IN HIS MOUTH"

Pirandello's unusual play, "The Man with a Flower in his Mouth," which was televised in the afternoon programme on July 20 and in the evening of July 22, made television history on two previous occasions. It was the first play to be televised by the low-definition system in 1930, when it was produced by Lance Sieveking, with Val Gielgud as "The Man"; shortly afterwards it was seen on the same flickering screen in a puppet presentation by Jan Bussell, who, incidentally, is now a television producer at Alexandra Palace.

Viewers who can remember the early television production of the play will be impressed by the contrast in production methods. In the old days only one camera could be used and it could not track forwards or backwards. In producing "The Man with a Flower in his Mouth," Royston Morley employed all the devices of modern television and introduced a concealed camera taking shots through the window.

TELEVISION DRAMA

Excerpts from "Peer Gynt" are to be televised in the autumn with

William Devlin in the name part. (This will be the first Ibsen play to be presented in the Alexandra Palace studios. William Devlin, who took the part of Peer Gynt during two seasons at the Old Vic, is almost a regular visitor to the television studios. He was seen as Clemenceau in "The Tiger," and as Michael Ransome in the mountaineering play "The Ascent of F6," by W. H. Auden and Christopher Isherwood.

Jean Forbes Robertson will be seen as Juliet in Shakespearean excerpts to be televised on August 16.

PROGRAMME RECEIVED AT COVENTRY

For the first time the entire television programme from Alexandra Palace was received at Coventry ninety miles away, more than three times the official reception range. This is by far the greatest distance, so far, at which television has ever been received satisfactorily. The programme was received by the G.E.C. works at Coventry, and the set was a standard G.E.C. receiver with some small modifications, including the use of a different type of high efficiency valve. A perfectly standard aerial assembly was used.

"Although we have often received signals and snatches of programmes, this is the first time that we have held synchronisation throughout," said Mr. W. H. Peters, G.E.C. chief radio engineer. "It must be admitted that the programme was not of a complete entertainment value, but it was recognisable and the reception showed that the long distance from the transmitter is not a basic technical difficulty but only a practical problem. If three or four times the output wattage power were being used, then I think it might be possible to get a really good picture."

PHASE SHIFT IN THE SYNCHRONISING SIGNALS

It has been found by Scophony, Ltd., that there is a considerable amount of irregular timing and phase shifting in the synchronisation sig-

nals radiated from Alexandra Palace, and this has made them unsuitable for receivers using scanning systems possessing inertia. Representations have been made on the subject to the Television Advisory Committee and the B.B.C., and the B.B.C. are, we understand, taking steps to remedy the defect. As soon as this trouble has been overcome, Scophony commercial apparatus will become available.

DEVELOPMENTS IN CANADA

The question of television was discussed during the Convention of the Engineering Institute of Canada, held on June 16 in Montreal. Mr. H. Ouimet, of the Canadian Broadcasting Corporation, said that great progress had been made, and that television was, in the opinion of European experts, far enough advanced to justify its inauguration as a public service. Mr. Ouimet gave it as his opinion that, while it might cost a hundred million dollars to provide the whole country with television, that was no reason why cities could not have installations; radio was first developed for local service and the same thing should apply to television. He said that the idea of starting only when it was available everywhere was new in engineering, for in the past progress had been made from small beginnings.

THE SCOPHONY SUPER HIGH- PRESSURE MERCURY LAMP

A super high-pressure mercury lamp is the latest product of the laboratories of Scophony Electronics, Ltd. This is the latest development in illumination technique and it is the most efficient and brilliant light source known. For television purposes the Scophony mercury lamp is operated from a D.C. source at a voltage of 70 with a consumption of only 3½ amperes, the total consumption being approximately 250 watts. The brilliancy of this light source is such that an efficient carbon arc consuming 500 watts would only give one-third to one-fourth of the light

MORE SCANNINGS

obtained with the mercury lamp. In use in the receiver the mercury lamp is first focused on to the light control, from the light control to the high speed scanner (a stainless steel polygon) and from there on to the low speed scanner which gives the picture repetition frequency, and through a projection lens on to the 2 ft. screen. Very few optical bodies are used and no corrected lenses of any sort are embodied in the apparatus.

TELEVISION IN GERMANY

The existing telephone-television service between Berlin and Leipzig is to be extended to include Hamburg, Munich, Kiel, and Frankfurt. Also, it is understood that the two transmitters on the Feldberg and the Brocken will begin operations during the coming autumn, probably using 441 lines definition.

TELEVISION AND THE DEAF

The introduction of television would appear to offer great possibilities for those unfortunate people who are deaf and cannot obtain entertainment from radio. For the first time serious experiments have been made to ascertain to what extent television, which depends upon sound as well as vision for its full effect, would appeal to the totally deaf.

As a result of suggestions made to the General Electric Company by those interested in the welfare of the deaf, a series of practical tests with television are being carried out. A set was installed by the G.E.C. at the Tower House Home for Deaf and Dumb Men at Erith, and the results have been most promising.

The programme was first shown to about thirty men, most of whom have been totally deaf from birth. In order that those conducting the experiment should share to some extent the reactions of the deaf people, the sound was cut out and only the vision shown. The programme consisted of a fashion parade, a showing of zoo animals, a news bulletin and a short play. As the vision appeared on the screen, the men turned to each other excitedly gesticulating and one after another they began to put their thumbs up, the sign in their language meaning "good." Only the play appeared to suffer from the lack of sound, but it made little difference to the deaf men who followed it intently and then burst into spontaneous applause at the end.

Later, through an interpreter, the men explained their reactions to television. All of them were delighted with it and they wanted to know whether they would be able to see important events, particularly football matches. All appreciated the possibility of having this source of news and entertainment continually available. After further tests have been made it is probable that a complete report will be sent to the B.B.C. in the hope that it will be possible so to arrange programmes that each session contains at least one item which does not depend on sound.

SCOPHONY TRANSMITTING EQUIPMENT

The Scophony transmitting equipment, which is used for the transmissions to the Science Museum Exhibition, consists of a main film projector which incorporates the "split focus" principle, there being only one scanner similar in size to the receiver scanners. The light source is an arc lamp of the low-intensity type and the film is continuously moving. The sound head is, of course, also included in the projector. The spot of light after passing through the film, falls on to a photo-electric cell of the electron multiplier type. With a normal film, one-tenth of a volt is obtained across the photo-cell resistor after the electron multiplier. The vision signals are amplified by a three stage amplifier which feeds directly into a line amplifier with an output impedance of 100 ohms. This is then fed to the radio transmitter through a co-axial cable.

TELEVISION AT NEW YORK'S WORLD'S FAIR

David Sarnoff, President of the Radio Corporation of America, and Grover Whalen, President of the 1939 New York World's Fair, have signed an agreement whereby television will be given a public demonstration by the Radio Corporation of America and the National Broadcasting Company at the 1939 World's Fair. Millions of visitors to the Fair from the far corners of the earth will have an opportunity to watch demonstrations of every aspect of radio and television. The N.B.C. television transmitter on the Empire State Building, will televise outstanding World's Fair events, and will bring

to visitors joint demonstrations of the marvels of sound and sight broadcasting.

The signing of the agreement, the ceremony by which television is assured as a major attraction of the Fair, was televised in the television studio of the National Broadcasting Company in the R.C.A. Building where representatives of the Press both saw and heard the major participants, Mr. Sarnoff, Mr. Whalen and Lenox R. Lohr, President of the National Broadcasting Company.

Mr. Sarnoff said: "The progress we are making daily in the development of transmitting sight through space gives promise that by the time the World's Fair opens in 1939, television will be greatly advanced over its present-day position. While the problems of developing a nation-wide television system are enormous, we have faith in the future of this new radio art."

Speaking on behalf of the Fair Corporation, Mr. Whalen said: "Personally, I can imagine no greater scientific accomplishment than the broadcasting of sight, and in this ceremony this afternoon, you are giving visible evidence of your ability to achieve this miracle. This business of sitting in front of a television camera and having someone see and hear me far away, is both wonderful and fearful in its potentialities. I am not only impressed, I am over-awed. I know our Fair visitors will be similarly affected."

THE CLOSE-DOWN PERIOD

During the television close-down period from July 26 to August 14, inclusive, there will be two test transmissions daily, with the exception of Saturdays, when the morning transmission alone will be given. These will be solely for the benefit of the radio industry. There will be no transmission on Sundays or on Saturday, July 31, or Monday, August 2. The transmissions will be radiated from 11 a.m. to 12 noon, and from 2 to 3 p.m., and will consist of the television demonstration film, short magazine films and news reels, accompanied by sound, and exterior shots from the balcony with gramophone records, all of which will be interspersed with periods of cruciform pattern with tone on the sound transmitter. If the exterior conditions are

AND MORE REFLECTIONS

bad, a set scene from the studio will be substituted for the outside shot.

From August 16 to 21 inclusive normal programme hours will be followed. On August 23 and 24 there will be three hours' transmission of film with sound announcements from 11.30 a.m. to 12.30 p.m., 3 to 4 p.m., and 9 to 10 p.m.

RADIOLYMPIA TRANSMISSIONS

During Radiolympia, from August 25 to September 4, inclusive (Sundays excepted), there will be three hours' transmission daily as follows:— 11.30 a.m. to 12.30 p.m., film; 4 p.m. to 5 p.m., actuality transmission; 9 p.m. to 10 p.m. actuality transmission.

After Radiolympia, from September 6 onward, normal programme hours (3 to 4 p.m., and 9 to 10 p.m.) will be given, with an extra morning hour purely for trade purposes made up as follows:—10.30 to 11 a.m., cruciform pattern with tone; 11 a.m. to 12 noon, demonstration of magazine film with sound.

GERMAN TELEVISION DEMONSTRATION AT THE PARIS EXHIBITION

The Press were recently invited to view a demonstration of German television at the Paris Exhibition, under the auspices of the Reichspost. In their opinion the results were excellent and comparable with those seen in London. The visitors were present at a scene taken on the pavilion terrace by direct vision camera and were later conducted to the hall where the image was reproduced by wire link.

The pictures were reproduced by the Telefunken system, giving 375 lines, 25 frames interlaced scanning, and the panoramic shots gave an excellent view of the whole of the Exhibition grounds. Films were then shown on the same system, using a direct scan from the Iconoscope and continuous film. The results were equally good apart from a slight blurring of the background, due, as explained by the engineer in charge, to wandering of the focus of the film.

The principal attraction was the "visio-telephone" of the Reichspost, similar to that installed between Berlin and Leipzig last year. In this the scanning is by flying spot with a definition of 180 lines, 25 pictures per second.

The illumination required is not

high, owing to the dim interior of the cabinet, and a 6-amp. arc is used.

It is considered that 180-line definition is sufficient for the visio-telephone for the present, since only heads or head-and-shoulders at the most are transmitted; nevertheless the Telefunken Co. are investigating the possibility of transmission at greater detail.

THE NORTH POLE WIRELESS STATION

Reports have at last been received regarding the transmissions broadcast by the Soviet scientific expedition, which has erected a short-wave station approximately at the North Pole. This station, which operates on approximately 20 metres, with a power of 70 watts, has been heard by an amateur living in Norway and by one or two commercial bodies in London. We have so far not been able to receive reports from amateurs in this country who have been fortunate enough to pick up this interesting station. Who will be the first listener to receive a QSL card from the North Pole?

SHORT WAVES AND ATLANTIC FLYING BOATS

It is quite well known that both the *Caledonia* and the American *Clipper III* were using radio to keep in contact with base stations. Both planes use 900 metres for the first hour or so of their journey, later switching over to short-waves. We are not permitted to give the exact wavelength used by these planes, but already amateurs have accidentally fallen on the correct frequency and have been able to follow the progress of the *Caledonia* and the *Clipper* across the Atlantic.

A NEW COMMERCIAL SHORT-WAVE STATION

Hicksville, a hitherto unknown American town, has now come right into the news owing to its new short-wave station, W2XBE, which is operating on approximately 17 metres. For some reason as yet unknown, this station is putting over a signal to Europe at a strength twice that of the average commercial broadcasters on the same wavelength. This station can be heard most evenings between 5 and 7 p.m. even when conditions are poor.

THE PALEY REWARD

William S. Paley, of the Columbia Broadcasting System, is presenting an annual award to the amateur who, through amateur radio, has contributed most either in research, technical development or operating achievement. The first award has been won by Walter J. Stiles, W8DPY, for his services during the Pittsburgh floods at the end of last year. W8DPY maintained communication from a town entirely cut off from the rest of the country. Not only did he maintain a portable station, but he travelled through many miles of flooded country before the station could be erected. The whole of the gear and the power supply was portable, and it says much for his arrangements that continuous service was maintained.

A TELEVISION THEATRE

A new radio store is being opened in Oxford Street, London, consisting of six floors devoted to radio and television. In addition to the television demonstration room there is to be a television theatre fully equipped so that complete programmes can be seen by intending purchasers. This will be one of the most central television demonstration rooms in London.

TELEVISION AND THE RADIO EXHIBITION

The first real show of television will be at the R.M.A. Exhibition at Olympia which opens on August 25, and carries on until Saturday September 4. Provision has been made for no less than 50,000 people to see television broadcasts for the first time, and no fewer than fourteen manufacturers have booked space so that they can demonstrate their receivers. This is the first time that television on a large scale has been shown by the Radio Manufacturers' Association.

TELEVISION PROGRAMMES

Although many viewers still criticise some of the programmes transmitted from Alexandra Palace, it is generally agreed that television fulfils its most useful purpose when there are transmissions of an unusual type. One of the most popular broadcasts during the past month was the televising of the new L.N.E.R. streamline train *Dominion of Australia*. A tele-photo camera picked up this train at a distance of three-quarters of a mile travelling at 60 miles an hour.

DEATH OF MARCONI

A BRIEF HISTORY OF HIS ACHIEVEMENTS

WE regret to announce the death of the Marchese Marconi, which took place in Rome on July 20. Death was due to heart failure. Guglielmo Marconi was born at Bologna on April 25, 1874. His father was an Italian country gentleman who, in 1864, married Miss Annie Jameson, of Daphne Castle, County Wexford, Ireland. He was educated privately at Bologna, Florence and Leghorn. As a boy he took a keen interest in physical and electrical science. In 1895 the idea became firmly rooted in his mind that a system of telegraphy through space could be provided by means of electric waves, the existence of which had been foreseen mathematically by Clerk Maxwell in 1864 and later investigated experimentally by Heinrich Hertz, Oliver Lodge, Righi, and others.

Early Experiments

In the early summer of 1895, Marconi conducted a number of experiments at his father's country house at Pontecchio, near Bologna. These experiments, made with crude and inefficient apparatus, soon began to give results which appeared to Marconi to be remarkable, communication being established in that year over distances in excess of a mile.

In 1896, Marconi came to England, and on June 2 of that year took out the first patent ever granted for wireless telegraphy based on the use of electric waves. He continued his experiments in London, and in the same year demonstrated his invention before officials of the Post Office and other representatives of British and Foreign Government departments. These demonstrations were first carried out on the roof of the General Post Office, St. Martin's-le-Grand, London. Later experiments for the Post Office were carried out on Salisbury Plain and across the Bristol Channel.

In June, 1897, at the invitation of the Italian Government, Marconi went to Spezia, where a land station was erected and communication with Italian warships was established up to a distance of 12 miles. He was then invited to demonstrate his apparatus in Rome, where successful

tests were carried out. Other tests also took place at the Italian Chamber of Deputies.

The time was now almost ripe for wireless telegraphy to be applied to commercial and utilitarian purposes, and in July, 1897, a company was formed in London to acquire the Marconi patents in all countries except Italy. This company was called the Wireless Telegraph and Signal Co., Ltd., which in 1900 changed its name to that of Marconi's Wireless Telegraph Co., Ltd. For some time the company's efforts were confined to furthering Marconi's pioneer work.

Wireless telegraphy was first used for commercial purposes in 1898, when the Kingstown regatta races were reported for the *Dublin Express* by Marconi by means of wireless apparatus installed on a tug which followed the yachts in the Irish Sea.

The utility of wireless in saving life at sea was demonstrated for the first time when, on March 3, 1899, a steamer collided with a lightship. The accident was at once reported by wireless to the South Foreland, enabling lifeboats to be promptly sent to the assistance of the light vessel. In March, 1898, Marconi established communication across the English Channel between England and France. During this year wireless was also first utilised in the naval manoeuvres for communication between warships over distances of 74 miles. The first military application of wireless took place during the South African war.

A Famous Patent

During this period numerous improvements embodied in patents taken out by Marconi were utilised. On April 26, 1900, he applied for a patent for "tuned or syntononic telegraphy as well as multiplex telegraphy with a single aerial." This patent, the number of which was 7,777, became famous in the history of wireless, and its validity was upheld in the High Court.

In October, 1900, the erection of a long distance wireless telegraph station in Cornwall was commenced by Marconi and preliminary tests were carried out up to a distance of about 200 miles. On December 12, 1901,



The Marchese Marconi.

Marconi, on his first attempt, succeeded in transmitting and receiving signals across the Atlantic Ocean from Poldhu in Cornwall to St. John's, Newfoundland. This achievement completely confirmed Marconi's opinion that electric waves would not be stopped by the curvature of the earth and therefore could be made to travel any distance separating any two places on our planet, a view he had held for many years in the face of considerable opposition. The wireless conquest of the Atlantic may be regarded as the culminating point of Marconi's pioneer work.

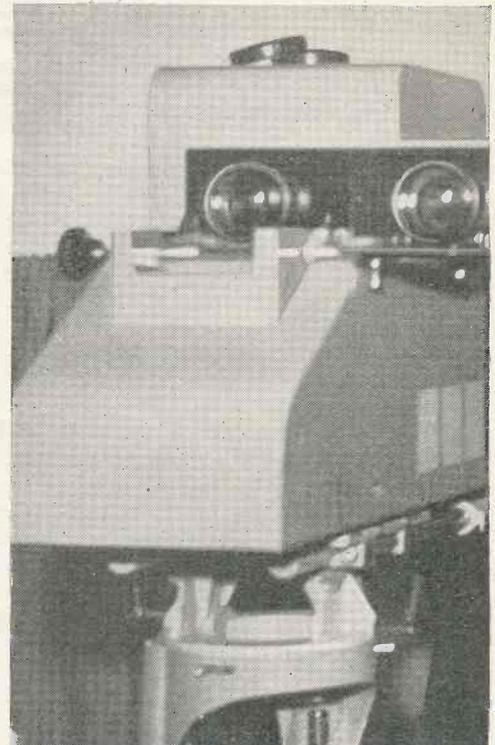
In 1916, during the world war, experiments were commenced by Marconi in Italy with very short waves, with the object of devising a directive, or beam system, of wireless telegraphy for war purposes. This was a principle on which he had also worked during his earliest experiments, but work on these lines had been put on one side in favour of the use of longer and longer waves combined with higher power. Later, in England, with the assistance of Mr. C. S. Franklin, important results were obtained by the use of 15-metre waves between London and Birmingham.

The anticipations of Marconi were fully justified by the results obtained since that time with short waves by British and foreign experimenters. Marconi was the first to discover in October, 1924, that short waves of the order of 30 metres in length could be transmitted and received over the greatest distances during daylight.

The value of Marconi's work has been recognised by governments, universities and learned societies all over the world.

THE TELEVISION CAMERA.

HOW THE PHOTOGRAPHIC EMULSION AND THE PHOTO-ELECTRIC MOSAIC COMPARE



The Emitron camera as used at the Alexandra Palace.

IN the June issue an article was published comparing the television camera with the ordinary photographic type. It will now be interesting to compare the photo-electric mosaic of the former with the photographic film or plate.

Considering the photographic plate first, the emulsion consists of very small particles of silver bromide suspended in gelatine. The exact methods of commercial manufacturers are not divulged though the general principles are the same for all. A solution of potassium bromide in gelatine is first prepared, to which is added a solution of silver nitrate. A reaction takes place which results in a precipitate of silver bromide and potassium nitrate in solution, the latter being washed out of the emulsion.

The actual crystals of silver bromide are about 1/10,000 of an inch across and there are several thousand millions to the square inch on a normal plate or film. What actually happens to the silver bromide on exposure to light is still not definitely known, though many theories have been put forward. Certain principles are, of course, well known in the working of the emulsion. For example, it is necessary to have a certain intensity of light before any recording is possible, while the effect produced is not by any means instantaneous in the proper sense of the word, the "effect" being the product of time and light intensity; there is also a point where no further effect takes place (see Fig. 1).

Obviously tonal or "effect" distortion will take place if the light image projected on to the emulsion is above or below certain limits of intensity. It is for this reason that pure white or black is rarely seen in film studios from which the highest

photographic quality is required.

The "effect" or latent image on an exposed plate remains for a considerable time, though in the course of some years, under normal storage conditions, it will fade. It can also be destroyed by heat. A very important factor in the working of photographic emulsions is the effect of different coloured lights. Simple emulsions are only affected by ultra-violet and blue light and for many years were all that photographers had to work with, with the result that objects of pure red or green came out black in the monochromatic reproduction, while blue was reproduced far too light. The public accepted such photographs as they had never seen anything better. The defect was gradually remedied, principally by the effect of certain dyes on the emulsion till to-day the modern emulsions have a fairly even response to all visible colours.

A serious defect in photographic work, and one which is not realised by the vast majority of photographers, is that of halation. The term is

often used to cover defects for which it is not responsible.

When the optical image falls on the emulsion the light rays are finally mostly absorbed into the emulsion, but not immediately. Scattering takes place on the surface and during its penetration into the emulsion with the result that in such cases where the optical image has a bright area adjacent to a black one, with a sharp dividing line, the dividing line often appears somewhat blurred and close inspection shows the bright area has encroached into the dark one. While this defect is unnoticeable in most photographs, in the recording of sound for the "talkies" it produces a certain amount of poorness of quality, especially in the higher frequencies and it is interesting to note in passing how the R.C.A. has overcome it by the use of ultra-violet light, which scatters considerably less on striking the emulsion and is entirely absorbed in the thinnest of emulsions, thereby reducing halation to a minimum.

Before leaving the photographic emulsion a word about development, the process by which the silver bromide is reduced to silver. The general reaction of development is

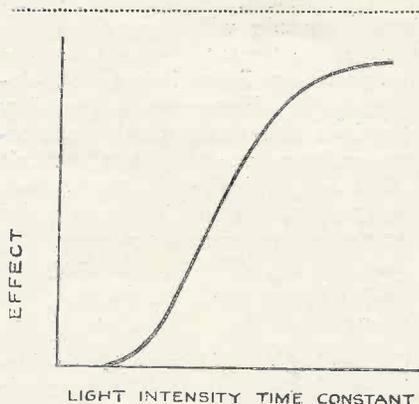
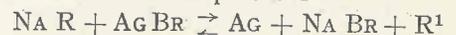


Fig. 1.—Curve showing that "effect" is a product of time and light intensity.

THE PHOTO-ELECTRIC MOSAIC AND COLOUR

The sodium salt of the reducing agent is symbolised by R while oxidation product is R' and sodium bromide. Unfortunately all commercial developers increase the grain size, that is to say, the actual silver bromide crystals during the process of development conglomerate into relatively large masses putting a limit on the fineness of detail which could be recorded if the conglomerating effect did not take place. This grain limitation is particularly noticeable if too near a cinema screen. The latest photographic research, however, is hopeful of doing away with grain, the final image, as far as films are con-

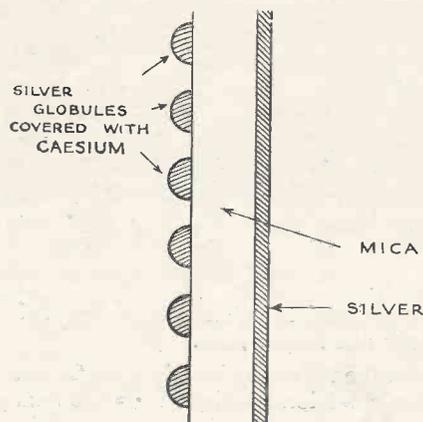


Fig. 2—Diagram showing construction of photo-electric mosaic.

cerned, being produced by a dye system.

The Television "Plate"

Now let us turn to the television equivalent of the photographic plate, the photo-electric mosaic, which in physical size as used to-day is something under 5 x 4 inches enclosed in an evacuated glass vessel.

The basis is a mica plate which is coated on both sides with metallic silver, the coating on one side, however, being considerably thicker than the other. This prepared plate is now heated and at a certain temperature the thinner of the silver surfaces undergoes a physical change, inasmuch as the silver separates into minute globules arranged in fairly regular formation while the other side remains intact. This prepared mica-silver plate is then fixed into position in its glass chamber into which caesium is distilled, and the latter,

having a particular affinity for silver, condenses on the globules, the final result being a plate of mica on one side of which are hundreds of thousands of these caesium coated silver globules and the other a piece of plain silver sectionally shown in Fig. 2. Now the electrical engineer will realise that the silver globules and silver plate with the mica between are the physical conditions for an electrical condenser so we can redraw Fig. 2 as in Fig. 3, to represent the globules as condensers.

If light falls on any of these caesium coated globules, while at the same time they are subject to a positive potential, such as the anode plate A Fig. 3, electrons will be released and drawn off on to the anode with the result that the globule condensers will become positively charged. The number of the electrons released will be proportional to the amount of light falling on the caesium, so that if twice the amount of light falls on globules 1, 2, 3, as compared with 4, 5, 6, they will in a given time assume twice the charge.

By this means we can record an optical image projected on to this plate of myriads of condensers in the form of electrical changes just as the light image produces a latent image in the photographic emulsion. Obviously if the condensers are perfect as regards insulation, on the light image being removed the image of charges should be retained indefinitely.

As in the photographic emulsion, the effect or equivalent change is a product of light and time and a point can be reached where no further changing effect will take place; to use a photographic term the plate would be over exposed. The curve of light and effect of Fig. 1 is also fairly representative of the photo-electric mosaic which may seem a strange statement when vacuum photo-cells are linear in output to incident light. However, at very low intensities of light the number of electrons released are very few per unit of time and the leakage of the globule condenser may be of such an order that the condenser never charges.

Effect of Colour

The effect of colour on photo-electric mosaics is similar to photographic emulsions, inasmuch as, the effects vary with different colours. Early

photo-cells with potassium as the active agent were most sensitive to the blue end of the spectrum, while with caesium, the most active of photo-electric elements, the greatest sensitivity is generally in the red or infra-red part of the spectrum. The cameras at Alexandra Palace appear to have become considerably less red sensitive since the test transmission periods.

The colour sensitivity is most noticeable on outdoor shots. Foliage, which is largely green to the eye, reflects large quantities of infra-red rays and if recorded on any device sensitive to that part of the spectrum appears unduly light. Actually

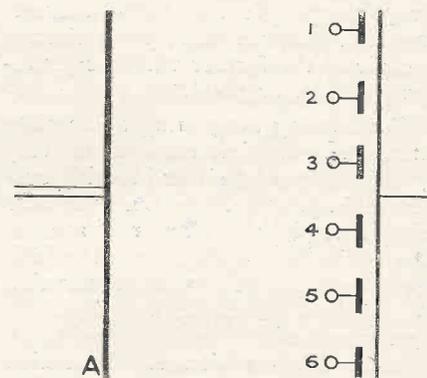


Fig. 3—Diagram showing the working principle of the photo-electric mosaic.

though most caesium photo-electric cathodes are red sensitive, by using a very thin caesium coating on silver they have even been made to peak in the blue region, and there seems little doubt that television photo-electric mosaics will eventually be as panchromatic as modern photographic emulsions.

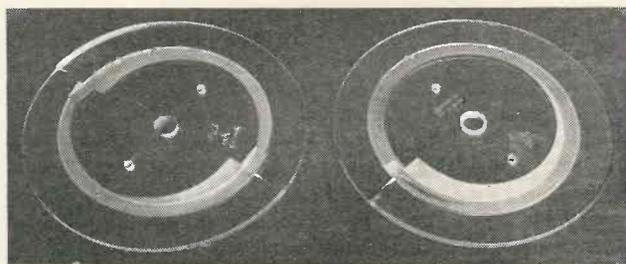
It has been pointed out that halation is due to the scattering of light at the surface and through the emulsion. In the photo-electric mosaic scattering also takes place at the surface though there is no equivalent to the passage of light through the emulsion. Unfortunately another type of halation occurs, namely, that brought about by electrical leakage from one globule condenser to another. A condition may also arise when considerable difference of potential may exist, say, between 3 and 4 (Fig. 3), 3 being so strongly positive as to attract electrons from 4, which should have gone to the anode. A little thought will

(Continued at foot of page 476)

TELEVISION HISTORY AT THE SCIENCE MUSEUM EXHIBITION

This article is supplementary to that published last month in which a general review of the exhibition at the Science Museum was given. Below, items of historical interest that are on view are dealt with.

IN last month's issue of TELEVISION AND SHORT-WAVE WORLD we gave a general account of the Exhibition of Television which was opened at the Science Museum on June 10, and which will remain open until some date yet to be announced, but which will probably be about the middle of September. We understand, however, that if the present good attendance continues in September, it is possible that it will remain open until October.



A pair of "Prismatic Discs" invented by the late C. F. Jenkins. The edges of the discs are ground to the form of a prism, the angle of which changes continuously round the periphery. They were used in the Jenkins scanning system.

In this issue, we propose to concentrate on some of the more historical objects of interest in the Exhibition, for the benefit of those who are not able to visit the Exhibition itself, and as a permanent record for future reference.

The historic Baird apparatus has often been described and illustrated before, but there were a number of other pioneers whose work, if less well known, was of considerable importance in contributing to the early development of television. The work of several of these is illustrated by exhibits in the Exhibition.

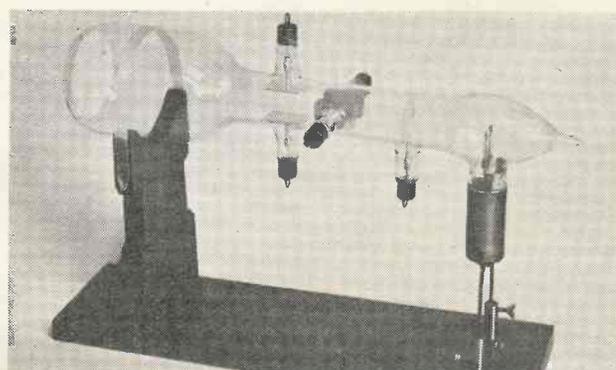
Of first importance to the pioneers of photo-telegraphy and television are the names of May and Willoughby Smith, the discoverers of the photo-sensitivity of selenium. The discovery was actually made by May, but he seems to have got so little credit for it at the time that his other names have been forgotten! The discovery, however, was communicated to the Society of Telegraph Engineers (which later became the Institution of Electrical Engineers) by his chief, W. Willoughby Smith, and a photographic copy of his communication to the Society forms an interesting exhibit.

The discovery of the photo-sensitivity of selenium caused almost a glut of ideas, mostly wildly impractical, for systems of distant vision by means of electricity. These were, of course, doomed to failure, chiefly because selenium was not sufficiently sensitive or rapid in its response. But if selenium was useless for television, it could be used in a primitive system of photo-tele-

graphy which was invented by Shelford Bidwell, a man who devoted much thought to the subject in later years and who was indirectly responsible for Campbell Swinton's proposal in 1908. Shelford Bidwell's apparatus has been preserved and forms an interesting introduction in the Television Exhibition to the more modern inventions.

Early Scanning Apparatus

Even the earliest of the pioneers realised the necessity for some system of scanning, and it is interesting to see a copy of the original German Patent No. 30,105 granted in 1884 to Paul Nipkow for a system of distant electrical vision. It is common to regard Nipkow as the inventor of the celebrated spiral disc, and so he was, but his patent is of almost greater interest on account of the working of his receiver. For his transmitter, he proposed to use the spiral perforated disc in conjunction with a selenium cell—an impractical suggestion—but his receiver was far more ingenious. Faced with the problem of light modulation, he proposed to use a polarising prism, followed by a crossed analysing prism, the two being placed on either side



A Wehnelt cathode-ray tube of 1905. Prior to that date, an induction coil had to be used to obtain an electron beam from the cold cathode, but Wehnelt introduced a platinum strip filament which was coated with lime oxides, and the electron beam could be produced with low anode voltages.

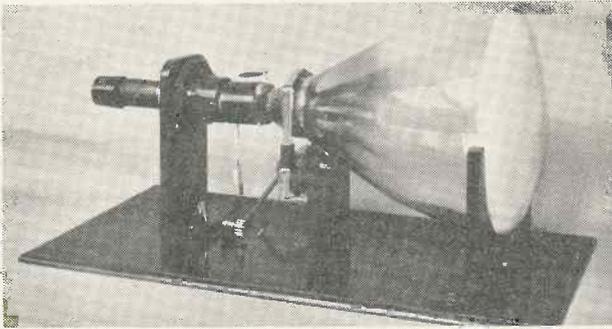
of a piece of heavy flint glass. A magnetic field was arranged to traverse the flint glass and modulation of the magnetic field caused rotation of the plane of polarisation of light passing through the combination. At the time, his whole scheme was impractical, but it is of interest to remark that Nipkow's receiver is almost identical with that used by Baird only five or six years ago. Baird, of course, used the Kerr effect, instead of the Faraday effect, but the principle is identical.

One of the prettiest devices which have ever been devised for scanning purposes was the prismatic disc

THE SCIENCE MUSEUM
TELEVISION EXHIBITION

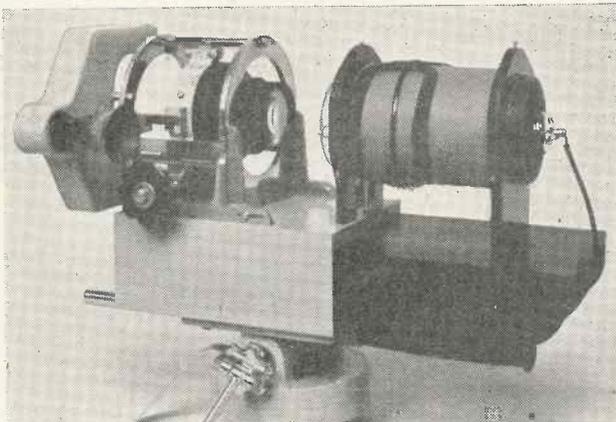
JUNE 11TH, 1937—SEPTEMBER, 1937 ADMISSION FREE
 Mondays } 10-6 Thursdays }
 Tuesdays } Fridays } 10-8
 Wednesdays }
 Sundays, 2.30-6 Saturdays }
 August Bank Holiday, 10-8

invented by C. F. Jenkins, an American, about 1917. A pair of these discs, believed to be the only pair in existence in the world, are now on exhibition at the



A large Baird cathode-ray tube having a diameter of 15 ins. It reproduces a picture 12 ins. by 10 ins. and employs magnetic focusing and scanning. With a maximum anode voltage of 6,500, a brilliant black and white picture is obtained.

Science Museum Exhibition although they were not on view when it was first opened. As the illustration shows, the discs consist of flat discs of plate glass, the periphery of which is ground to the form of a prism



A view of the Baird electron camera with the cover removed. The lens and focusing arrangements may be seen on the left while on the right is the Farnsworth image dissector tube which converts the optical image into electrical impulses.

of which the angle changes continuously round the circumference. If an object is viewed through the prismatic portion as the disc rotates, the object appears to have a linear motion in the direction of the radius, intermittent, of course, at the point where the prism angle suddenly changes.

For scanning purposes, two discs were used, one rotating at high speed to give the line scan, and the other rotating more slowly to give the frame scan. They were so arranged that the two rings overlapped each other and the scanning aperture was situated behind the prismatic peripheries at a point where they cross at

"The Television Camera"

(Continued from page 474)

show that all sorts of complications may arise if any sort of leakage takes place from globule to globule. In practice, scenes with large mosaics of black or white often appear with strange misty fog-like patches as radiated from Alexandra Palace, and

this defect is thought to be due to this reason.

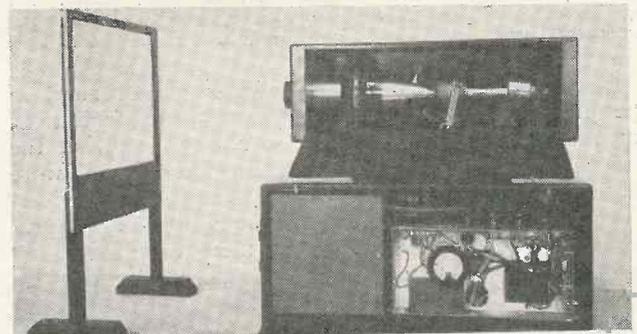
In television there is no development as in the photographic sense of the word, though the next process, namely, that of scanning, has the effect of increasing the grain just as the chemical developer does in photography. The scanning is brought

right angles. The rings were only suitable for low-definition scanning on account of the limited rotational speeds to which they could be subjected. The beauty and ingenuity of their construction, however, has to be seen to be believed and as the machine which was used to grind them has now been destroyed, these two specimens are unique.

Another interesting series of exhibits from the scanning point of view are those provided by International Television Corporation. These illustrate the development of an optical-mechanical system of reproduction, which, if certain difficulties can be overcome, may be applicable for larger screen television. A skeleton 180-line Mihaly-Traub receiver is shown, and also the scanning unit of a 405-line receiver.

Cathode-ray Tube Development

The development of cathode-ray tubes is another aspect of television which has provided scope for a special section of the Television Exhibition and it is of considerable interest to be able to witness the earliest types of Crookes tubes, dating from 1887, actually in operation. The Braun tube of 1897 and its successor, the Wehnelt tube of 1905 are of special interest since these were the first cathode-ray tubes to be of practical use for laboratory measurements, although, in an experimental form, a similar tube had been used by J. J. Thomson in his classical researches



An experimental Baird receiver which employs a projection tube for throwing an image of the cathode-ray tube onto a screen measuring 18 ins. by 14 ins. A lens having an aperture of $f/1.5$ is used.

on the electron in 1884. The Wehnelt tube shown in our illustration was the first type of cathode-ray tube to have a heated filament for the emission of the electron stream; previously, an induction coil had been necessary to provide the very high voltages required.

All the important stages in the development of the cathode-ray tube are illustrated in the Exhibition—the Johnson tube of 1921, the Bedford tube of 1930, and the von Ardenne type. Of the modern tubes, there are examples of a Cossor television tube and a Baird 15-inch tube with magnetic focusing and deflection of the electron beam.

about by discharging a relatively large number of globule condensers by systematically sweeping the mosaic with a cathode beam which discharges each group of condensers in turn, the current from the discharge producing a voltage across an external resistance. The discharge current varies according to the amount of light.

THE DESIGN OF THE PHILIPS' RECEIVER

By C. L. Richards

This is a description of an experimental receiver produced by the Philips Company

A TELEVISION receiver differs fundamentally from an ordinary radio receiver in that for the reception of television pictures a receiver must give a uniform amplification over a very wide frequency range. It is therefore not possible to use circuits with a high selectivity, so that there is a marked reduction in the amplification which can be obtained per stage. Furthermore, in receiving vision—as opposed to the reception of sound—any phase displacement which may be obtained during amplification must not alter the mutual positions of the oscillations with different frequencies from which the picture signal is built up. On the other hand, television reception is simpler than sound reception inasmuch as pronounced non-linear distortion is permissible. As a result, the carrier wave and one of the side bands are, for instance, quite sufficient for good reception. This offers the important advantage that the frequency band to be treated is only half as wide, so that the amplification in the individual stages is practically doubled.

Circuit of the Receiver

In a television receiver the wave on which the picture is modulated must be picked up, amplified and rectified; the vision signal obtained in this way must then modulate the voltage at the control electrode of a cathode-ray tube in such a way that the scanning spot on the fluorescent screen always has the same intensity as that of the corresponding point in the original picture. In addition, a scanning arrangement consisting of two saw-tooth generators is required, so that the scanning spot will cover the whole surface of the screen; a device is also needed responding to the synchronising signals picked up and thus synchronise the operation of the scanning device with that of the transmitter. Finally, the sound which is modulated on another carrier wave must also be picked up, amplified, rectified and finally passed to a loud-speaker.

In the receiver described here, a cathode-ray tube is used giving a picture measuring 25 by 18 cms. The tube operates on an anode tension of 5,000 volts. The cathode-ray is deflected in both directions by electrical means through the agency of two pairs of deflecting plates; the requisite deflection voltage being approxi-

gether with an auxiliary frequency generated by the oscillator V_3 .

Two new carrier waves are produced in the mixer valve, each with a lower frequency than the two primary carriers. Vision is modulated on one intermediate-frequency carrier wave and sound on the other. The two carriers are passed together

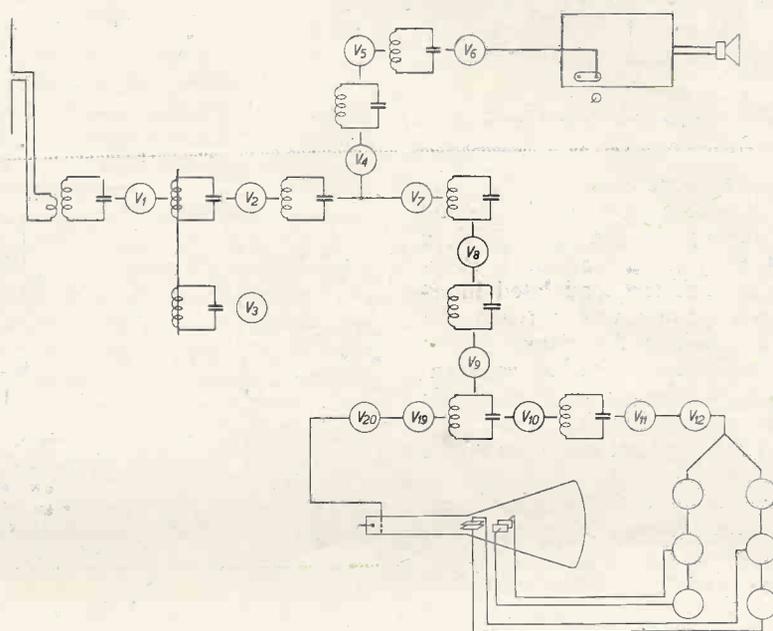


Fig. 1. Circuit diagram of receiver for vision and sound. V_1 Ultra-short wave amplifying valve for vision and sound. V_2 Mixing valve with oscillator V_3 . V_4 to V_6 Amplification and rectification of sound signals. V_7 to V_8 Amplification of vision and synchronising signals. V_9 and V_{10} Transmission of vision signals to the control electrode of cathode-ray tube. V_{11} , V_{12} Amplification of synchronising signals and transmission to saw-tooth wave generators.

mately 1,000 volts. The modulation voltage at the control electrode of the tube is approximately 30 volts.

A schematic circuit of the receiver is shown in Fig. 1. The two carrier waves for vision and sound are picked up with the same aerial and both amplified in the same frequency stage by an amplifying valve V_1 ; the frequency characteristic of this stage must naturally be sufficiently broad for this purpose.

To separate the picture and sound signals the heterodyne principle has been introduced. The two signals are passed to the mixer valve V_2 to-

to the grids of two intermediate-frequency amplifying valves V_4 and V_7 .

The anode circuit of V_4 is tuned to the sound intermediate frequency and has such a narrow frequency characteristic that the vision signals are no longer able to pass. In this connection it should be remembered that behind the mixer valve the signals are transmitted on an entirely different carrier. The intermediate-frequency carrier modulated with vision is further amplified in V_5 in the usual way and rectified in the diode V_6 , the low-frequency signal so obtained is applied to the gramophone pick-up

sockets of a standard radio receiver equipped with loudspeaker and volume control.

As already indicated, the two intermediate-frequency carriers are also passed to the grid of the amplifying valve V_7 . The circuit following this valve, as well as the two succeeding amplifying stages with the valves V_8 and V_9 , together furnish a frequency characteristic of the required type, so

the same modulation depth, so that the broken lined marked 1 and 2 will always occupy the same positions. In consequence, the values V_1 and V_2 (Fig. 3b), of the voltage at the anode of V_{20} , corresponding to the grid voltages 1 and 2 will also always be the same irrespective of the modulation of the vision signals. The control electrode of the cathode-ray tube is connected directly to the anode of

circuits in the receiver have much sharper resonance curves than those of the television receiver.

Synchronising Signals

In discussing the receiver circuits in reference to Fig. 1 it was mentioned that an intermediate-frequency carrier on which the picture and synchronising signals are modulated is obtained in the circuit behind V_9 . The carrier wave is amplified by the valve V_{10} , V_{11} is a triode with incorporated diode (Fig. 4). The incoming signal is rectified in the diode giving a picture-frequency signal at the resistance R_1 . As shown in the figure the signal is also applied at the same time to the grid of the triode. The characteristic of the triode is so chosen (Fig. 5) that the amplitudes of the vision signals all fall within those grid voltages as no anode current flows, while the

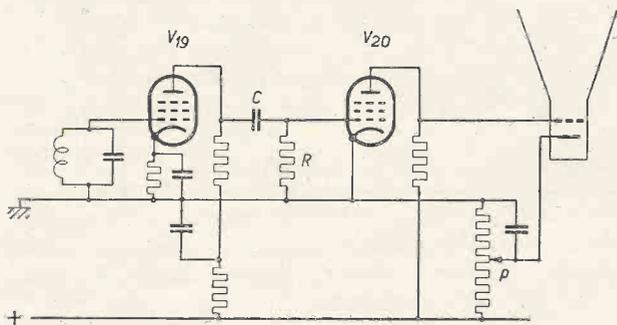


Fig. 2.—Circuits of valves V_{19} and V_{20} which apply the vision signal to the control electrode of the cathode-ray tube.

that in the anode circuit of the valve V_9 there remain only the picture and synchronising signals. Behind V_9 a separation again takes place. Passing to the left the modulated intermediate-frequency waves reach the valve V_{19} , which functions as an anode rectifier. Following rectification picture signals are obtained; they are amplified by V_{20} and finally passed to the control electrode of the cathode-ray tube.

Since this part of the circuit requires closer attention, it has been reproduced separately in Fig. 2. The picture-frequency signals furnished by the anode rectifier V_{19} are passed through a condenser C to the grid of V_{20} , this grid is connected to the cathode through a high resistance R ; as long as no signal is received the grid is at zero potential with respect to the cathode. If now the picture-frequency signal is applied to the grid, grid current will flow and produce a voltage drop in the resistance R , as a result of which the mean grid bias becomes negative. This is shown in Fig. 3a; the grid voltage adjusts itself in such a way that the peaks on the right, which in this case correspond to the base of the synchronising signal, just fall within the region in which grid current flows. For each line scanned the vision signal is of different form and in general exhibits marked fluctuations in modulation depth, as shown, e.g., for two lines in Fig. 3a. On the other hand, the synchronising signals always have

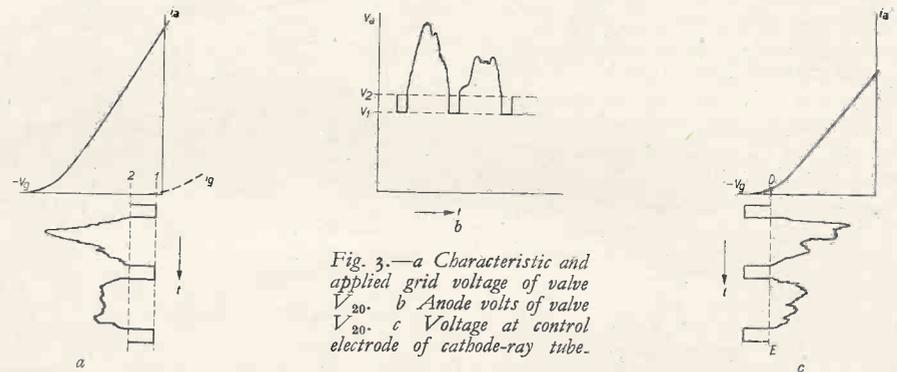


Fig. 3.—a Characteristic and applied grid voltage of valve V_{20} . b Anode volts of valve V_{20} . c Voltage at control electrode of cathode-ray tube.

V_{20} . By applying a suitable negative tension (adjusted with the potentiometer P) between the control electrode and the cathode, the picture-frequency signal can be applied to the control electrode of the cathode-ray tube in the manner shown in Fig. 3c; it is seen that the line DE corresponding to the perfectly dark picture occupies such a position that current just fails to pass through the cathode-ray tube, while modulation to the right of DE allows a beam current to pass, which is approximately proportional to the modulation and thus increases and diminishes with the brightness of the radiated picture.

Correct tuning is obtained by adjusting the oscillating circuit of the oscillator, shown next to V_3 in the circuit diagram, in such a way that the loudspeaker reproduces the sound picked up, i.e., tuning is done on the sound and not on vision, since the

opposite is the case for the synchronising signals. The anode current of the triode is thus of the form shown in Fig. 5b. It is seen that the syn-

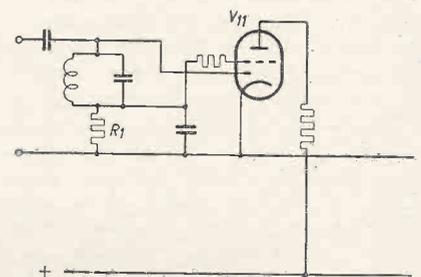


Fig. 4.—Circuits of the diode-triode V_{11} . The short line represents the diode anode. In this stage the synchronising signals are separated from the vision signals.

chronising signals are almost completely separated from the vision signals proper.

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The circuit shown in Fig. 4 is followed by the stage V_{12} , which serves for the still more complete separation of the synchronising signals from the

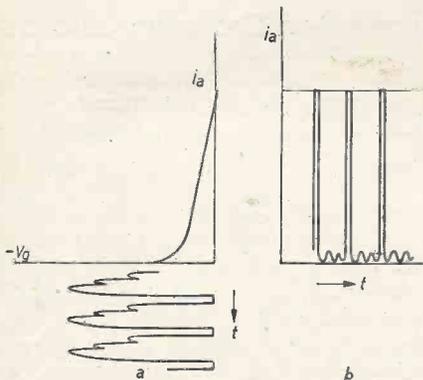


Fig. 5.—a Characteristic and applied grid voltage of the diode-triode valve V_{11} .
b Anode current of triode section of V_{11} .

vision signals. Following V_{12} are filters in which the line and picture synchronising signals can be separated from each other on the basis of their frequency difference; finally, each is applied to one of the saw-tooth wave generators for deflecting the cathode-ray.

Saw-tooth Wave Generators

In the circuit diagram the saw-tooth wave generators are represented by two groups each composed of three circuits (not specifically indicated) on the right of the cathode-ray tube. Each of the two generators

contains a condenser which is charged through a resistance and discharged by a valve (top circuit). The saw-tooth voltage of the condenser is amplified by the two amplifying valves following it, and which apply the scanning voltage to the deflection plates of the cathode-ray tube. The circuit containing the two amplifying valves is so arranged that the saw-tooth generators automatically continue in operation, even in the absence of synchronising signals. Means are also provided for improving the linearity of the saw-tooth waves. Each saw-tooth generator is actually duplicated in order to be able to employ different scanning methods, a point already indicated at the outset.

Assembly of Components

The cathode-ray tube (f in Fig. 6) is mounted horizontally in a chassis a , on which the various amplifying stages and the saw-tooth generators are also fixed.

Four control knobs serve for the adjustment of the television receiver (in the actual apparatus these are combined to a pair of twin knobs h and l), and with which the following adjustments can be made: 1, Adjustment of the amplification of the vision amplifier, permitting a variation of the amplitude of the picture-frequency signal at the control electrode of the cathode-ray tube (see Fig. 3c) and thus increasing or reducing the brightness of the picture; 2, adjustment of the potentiometer P in Fig. 2,

permitting the line DE (Fig. 3c) corresponding to a dark screen to be brought into the correct position, viz., just at the current cut-off point of the cathode-ray tube; 3, tuning of

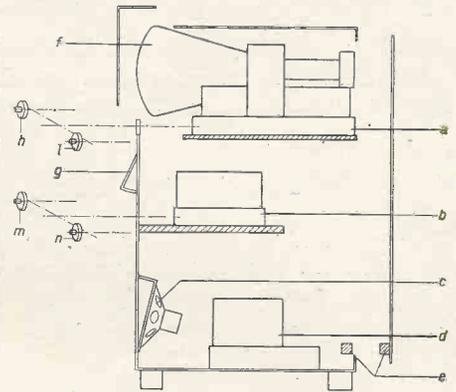


Fig. 6.—Diagrammatic section through the receiving set.
a Vision receiver. b Broadcast receiver.
c Loudspeaker. d Anode current unit.
e Safety contact. f Cathode-ray tube.
g Tuning scale of radio receiver.
Vision controls: h Picture adjustment. i Tuning and selecting of scanning method.
Radio controls: m Volume and band width. n Tuning and wave range; on and off switch; changeover for radio or television reception.

the oscillating circuit; 4, changing over from one scanning system to the other.

All high-tension leads are provided with metallic screening throughout the set; protection against high-tension shocks is also provided, the mains voltage being cut off and the high-tension condensers discharged when the cabinet is opened.

New German Standards

A decision has been reached by the German Reichpost regarding future standards for television in that country. It has been decided to employ 441 lines with 50 pictures per second, interlaced. The picture ratio is to be 5 to 6.

Delay Fuses

RADIO fuse designers have for years tried to produce a fuse which is capable of withstanding the surges which occur when switching on a radio receiver, and at the same time be rated low enough to protect the receiver against a small continuous overload. The usual faults which occur in a radio receiver result in a heavy current in only one secondary winding of the mains transformer, so that the resulting overload current in the primary of the transformer is not high enough

to blow the ordinary house fuses, nor an insensitive radio fuse, but is nevertheless high enough to cause severe overheating and even fire in the radio receiver.

What is required is a fuse of about $\frac{1}{2}$ -amp. rating, but with a delay characteristic which prevents it blowing on a short period overload reaching 1 or even 2 amps. for a fraction of a second.

Recently one of the Belling and Lee engineers hit on a bright idea. He took a non-oxidising filament of high melting point wire (nickel, to be precise), and mounted on it some tiny explosive blobs of powdered magnesium held in a suitable binder. The melting point of the nickel is some $1,500^\circ\text{C}$., but the flash point of the magnesium is only 650°C ., and on burning it instantly generates some $3,000^\circ$ or $4,000^\circ\text{C}$.. Thus an overload of appreciable duration heats the

blobs of magnesium up to their flash point, and on burning they melt the nickel filament and clear the fuse. High overloads of short duration, however, do not create sufficient heat to raise the blobs of magnesium to firing point; in fact the blob acts as a short period lagging on the wire which can actually be seen to reach red heat in between the blobs for a fraction of a second while the short overload persists.

The result is that one of these new "Mag-nickel" fuses of $\frac{1}{2}$ -amp. rating will resist the same surges as a 1 amp. conventional radio cartridge fuse, and yet will blow on a 75 per cent. overload if the overload persists for one second.

Further advantages of this new fuse are that its nickel filament is mechanically robust and does not oxidise or deteriorate after long periods of service.

A NOVEL SCHEME FOR TELEVISION IN COLOURS

By Viktor A. Babits, A.M.I.E.E., M.I.R.E., Dr. Techn. University of Technical Sciences
Budapest.

The idea of television in natural colours has engaged the attention of a number of inventors but up to the present no successful scheme has been evolved. This article is a description of a system which it is claimed can be adapted to existing methods of transmission and reception.

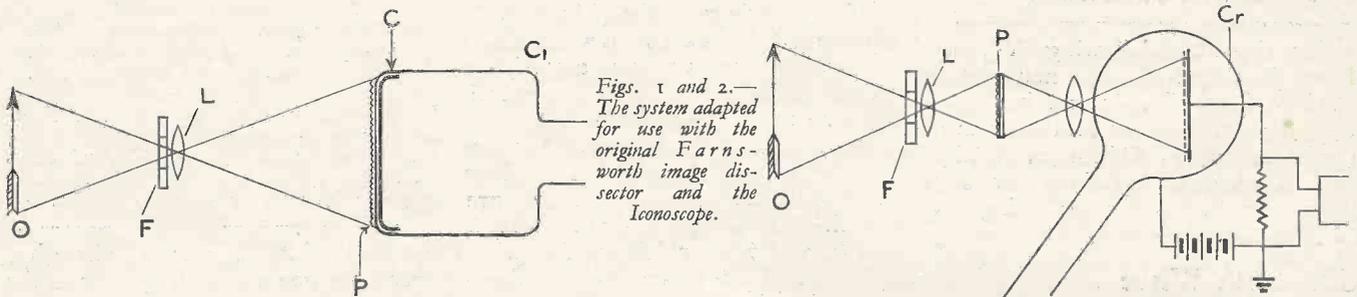
MANY suggestions have already been made, indicating how coloured television might be realised, but owing to their complication none have yet reached the stage of practical development.

The suggested system about to be described is a combination of the

is an optical filter F, of different colours placed one beside the other. This filter is composed of at least three differently coloured filters, that is red, green, and a blue.

It will be understood that each single picture line of the object O is reproduced through three differently

ceiver in Fig. 3 emits white light, then, corresponding to each picture line of the object O, three picture lines lying one under the other appear on the fluorescent screen of the receiver. If a similar prism-screen is placed on this too, reproducing the fluorescent picture by means of the



Figs. 1 and 2.—
The system adapted
for use with the
original Farnsworth
image dissector
and the
Iconoscope.

“Kodacolor” method for coloured films and the existing television systems.

The device consists of two parts: one of them being combined with the scanning apparatus, the other with the receiver where the picture is re-constituted. In Figs. 1 and 2 the combination of the device with the usual cathode-ray scanners is shown, and in Fig. 3 the combination with the apparatus for reconstructing the picture (receiver).

The principle of the system will be understood if explained in connection with Fig. 1, in which is shown diagrammatically Farnsworth’s first image dissector modified so as to make it suitable for the transmission of colour television.

In this diagram O is the coloured film or object to be transmitted by television, which object is reproduced by means of the lens L on the photo-electric layer C. In front of the glass plate with the photo-electric layer there is a prism-screen P, which is composed of cylindrical rods, and which contains exactly the same number of rows as the number of picture lines.

Again, in front of the lens L there

coloured filters on the photo-electric layer C. However, in front of the cathode the prism-screen is placed, which causes rays of different colours to be refracted at different angles. Consequently, if, for instance, to each picture line there corresponds one cylindrical rod, then each picture line, after having passed through the three differently coloured filters, is reproduced on the photo-electric cathode in three separate differently

lens L through a filter F, consisting of the same colours and being arranged in the same way as that of the scanner device, on the screen S, then on the screen S the coloured picture of the object O will appear.

The usual photo-electric cathode is not panchromatic, but a panchromatic photo-electric cathode can be produced by placing under the prism-screen, on which three differently coloured picture lines are reproduced one beneath the other, three photo-electric layers of differently selective photo effects; these layers might, for instance, consist of sodium, rubidium and caesium. The resulting effect of such photo-electric cathodes approximates the panchromatic effect.

When the prism-screen cannot be placed on, or in the immediate neighbourhood of the photo-electric layer, as, for instance, in the case of the Iconoscope (Fig. 2), then the images of the spectra of the picture lines can be reproduced on the plane side of the prism-screen, and then by means of a second lens system on the photo-electric layer. A similar solution can also be applied in the case of Farnsworth’s recent image dissector.

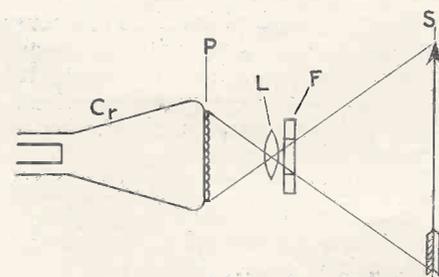


Fig. 3.—A modified arrangement for use with the
Iconoscope.

coloured picture lines, situated one beneath the other.

If the photo-electric layer of the scanner were panchromatic, and the fluorescent screen of the picture re-

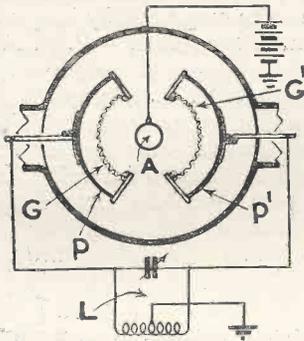
RECENT TELEVISION DEVELOPMENTS

A RECORD OF PATENTS AND PROGRESS *Specially Compiled for this Journal*

Patentees:—Farnsworth Television Inc. :: Marconi's Wireless Telegraph Co., Ltd., and G. Baldwin :: Radio-Akt. D. S. Loewe :: C. Lorenz Akt. :: I. Shoenberg

Electron Multipliers (Patent No. 463,514.)

As shown in cross-section an electron-multiplier is fitted with two perforated grids G, G₁, which are arranged on opposite sides of a central anode A, and a pair of collector electrodes P, P₁ are set out-



Electron multiplier. Patent No. 463,514

side the grids and connected across an external turned circuit L. When a ray of light strikes the photo-sensitive surface of one of the grids, it releases electrons which are attracted towards the positive voltage on the anode A, but pass right across to the opposite grid.

Here they produce more electrons by secondary emission, which are in turn accelerated back towards the positive anode and past it on to the second grid. This to-and-fro process is repeated until a surging crowd of electrons fills the space between the two grids. Some of the electrons pass out through the perforations in the grid, and are collected by the electrodes P, P₁. These build up oscillating currents in the output circuit L, the oscillations being maintained because the grids G, G₁ are in phase-opposition across the circuit.—Farnsworth Television Inc.

Time-base Circuits (Patent No. 463,625.)

The control-grid and anode circuits of a screen-grid valve are back-

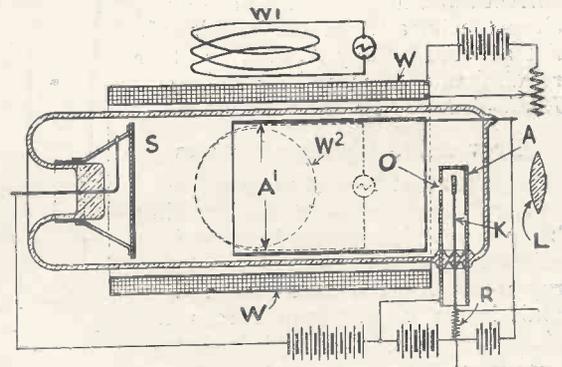
coupled to produce oscillations. The resulting grid current is used to charge up a condenser in the grid-cathode circuit so that it periodically blocks the valve, until discharged through a resistance. The result is to produce saw-toothed voltage variations, suitable for scanning, across the plates of the condenser.

Synchronising impulses are applied to the screening grid, and one of the advantages of the circuit is that these will be effective even if of comparatively small amplitude. A second set of square-topped voltages are automatically generated at the terminal of the screen grid, and are used to suppress the cathode-ray stream during the "flyback" stroke in scanning.—Marconi's Wireless Telegraph Co., Ltd., and G. Baldwin.

Television Transmitters (Patent No. 463,829.)

A picture to be televised is projected through a lens L on to a photo-electric screen S, and the electrons emitted from the latter are focused by an external winding W and swept to and fro across a scan-

Television transmitter.
Patent No. 463,829



ning aperture O in the anode A, so that they fall on to a collecting electrode K, and create signal currents in a resistance R. The scanning movement of the electron stream across the aperture is controlled by windings W₁, W₂ set at right angles to each other.

Any slow-moving electrons due to

secondary emission from the electrodes are collected by an anode A₁ which is biased to a high potential. This prevents them from mixing with the high-speed electrons forming the main stream, where they would tend to produce distortion.—Farnsworth Television Incorporated.

Preventing Distortion (Patent No. 463,967.)

It is found that pictures transmitted from the Iconoscope camera are liable to appear too dark in certain parts and too light in others. For instance, one corner of the picture may look too black, whilst the opposite corner shows too faintly. This is partly due to a peculiarity of the Iconoscope tube, and partly to the alternating component of the light used for illuminating the object in the transmitting studio.

According to the invention the trouble is overcome by superposing a suitable saw-toothed oscillation on the picture-signals produced at the output of the Iconoscope transmitter tube.—Marconi's Wireless Telegraph Co., Ltd.

Television Systems (Patent No. 464,483.)

A picture from a film F is projected by an arc lamp A through lenses L and an obturating disc D on to a slot S in the main scanning disc D₁, from which the light passes on to a photo-electric cell P. The slot S has the usual length of one complete scanning

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line, but is several lines wide. The usual synchronising signal is derived from a white margin on the film F and is projected on to the same photo-electric cell P through reflecting prisms M. The object of the arrangement is to ensure that the synchronis-

Television Transmitters
(Patent No. 464,692.)

In the Iconoscope type of transmitter the picture to be televised is focused on to a mosaic electrode, which is composed of a great number of tiny photo-electric cells. The pic-

straight, so that the electron stream would strike it everywhere at right angles. But this can only be done by projecting the picture obliquely through the optical system.

The invention relates to a lens system for securing the desired result, and for applying the necessary corrections to ensure a uniform distribution of the light from the picture before it is scanned.—*I. Shoenberg.*

Summary of other Television Patents

(Patent No. 463,642.)

Method of fixing or mounting the fluorescent screen of a cathode-ray tube.—*Ferranti, Ltd., and M. K. Taylor.*

(Patent No. 463,896.)

Cathode-ray receiver with the fluorescent screen set at an angle to the scanning screen, so as to allow the picture to be magnified by lenses from the front of the screen.—*P. T. Farnsworth.*

(Patent No. 463,971.)

Television receiver in which the synchronising signals appear across the cathode circuit of a valve, in reversed polarity to the picture signals in the anode circuit of the same valve.—*Baird Television, Ltd., and L. R. Merdler.*

(Patent No. 463,973.)

Television receiver with a common source of supply for the anode of the amplifier valve, the control grid of the C.R. tube, and the winding used for focusing the electron stream.—*Baird Television, Ltd., and L. R. Merdler.*

(Patent No. 464,049.)

Rotating-disc method of interlaced scanning from a cinema film having vertical and horizontal marginal strips.—*Radio-Akt. D. S. Loewe.*

(Patent No. 464,141.)

Generating saw-toothed scanning oscillations with a shortened "fly-back" stroke.—*Ferranti, Ltd., and J. C. Wilson.*

(Patent No. 464,286.)

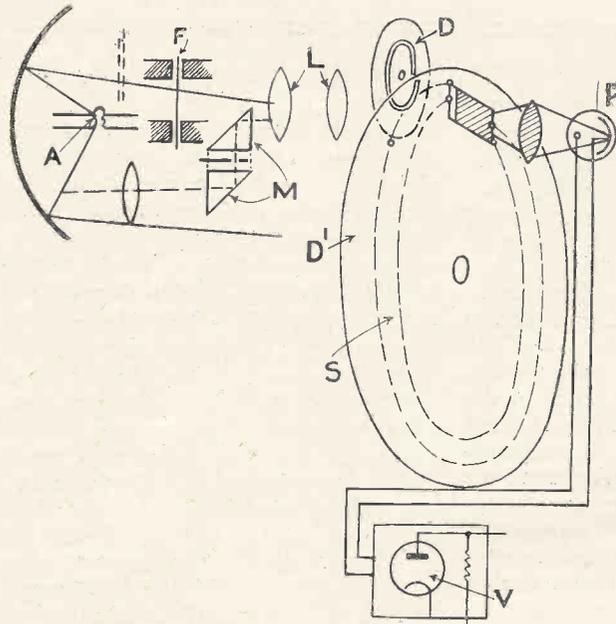
Combined sound and picture receiver having a common local oscillator and frequency-changer for both carrier waves.—*Marconi's Wireless Telegraph Co., Ltd.*

(Patent No. 464,492.)

Method of automatically regulating the degree of amplification in a television receiver, so as to compensate for fading.—*Radio-Akt. D. S. Loewe.*

(Patent No. 464,637.)

Correcting the disturbance caused by external and internal stray fields on the electron stream of a cathode-ray tube.—*Fernseh Akt.*



Scheme for keeping the intensity and amplitude of the synchronising impulses constant.
Patent No. 464,483

ing impulses reduce the current in the last valve V of the amplifier to zero.

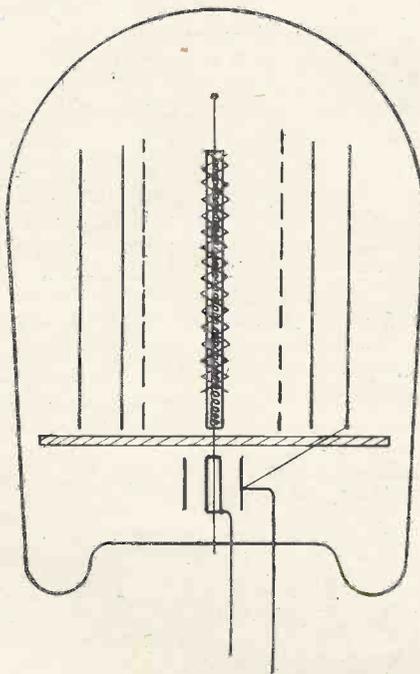
This keeps the intensity and amplitude of the synchronising impulses constant, in spite of other fluctuations, because both are definitely determined by the cessation of current from the amplifier V. Also it ensures correct reproduction of the half-tones, since the linearity of the amplifier is not affected by any A.V.C. or other regulation that may be required.—*Radio-Akt D. S. Loewe.*

Preventing Flyback Streaks

(Patent No. 464,610.)

The flyback stroke of the scanning beam should, if possible, be kept right off the fluorescent screen of a cathode-ray receiver, as it tends to produce undesirable bright lines across the picture.

According to the invention a resistance is inserted in series with the main condenser of the time-base oscillator, and the voltage induced across it, when the condenser discharges, is applied to the grid of one of the amplifying valves in the set. This results in a momentary blockage of the valve, which produces the desired effect by making the flyback stroke invisible.—*C. Lorenz Akt.*



Patent No. 464,483

ture is, of course, projected on to the side of the electrode which faces the electron stream used for scanning, and this, in turn, means that the electrode must be set across or at an angle to the stream.

On the other hand it would be much simpler, from the point of view of scanning, if the electrode could be set

STUDIO & SCREEN

A MONTHLY CAUSERIE on Television Personalities and Topics

by **K. P. HUNT**
Editor of "Radio Pictorial"

DEMURE, charming Elizabeth Cowell, standing nonchalantly in a corridor outside the studio at Alexandra Palace the other day, spoke to me with a definitely reprov- ing look in her fascinating dark eyes.

"You got me wrong," she said, or words to that effect.

"Why on earth do you persist in calling me 'Betty'? Will you please understand that I don't like it."

It is quite true that on various occasions in these notes I have referred to this delightful young lady, who is well known, of course, as the announcer-hostess at Alexandra Palace, by the name "Betty," but I have always done so with no suspicion of her dislike for the name.

"Gee! Call me 'Lizzy' if you like. Call me anything, but not 'Betty,'" she went on, following me up and down the corridor. "Any- way, what's wrong with 'Eliza- beth'?"

"You must be crazy," she con- tinued. "If you call me 'Betty,' why don't you call Jasmine Bligh, 'Jazzy'?"

"'Jazzy,'" I whispered, prick- ing up my ears, "not a bad name, either."

"You dare call her 'Jazzy' and see what she says."

Of course, I would never be so naughty.

Poor Jasmine, at the time of writ- ing these notes, is in the Isle of Wight recovering from an operation for tonsillitis. Leslie Mitchell, the other announcer, is also away on a well earned holiday. Where he has gone nobody knows. All I could gather was that letters will not be for- warded. Fans, please note!

* * *

The occasion of meeting Elizabeth again was a visit to Alexandra Palace. It is some while since I was there, and I was greatly impressed by the changes which I noticed on every side. I was fortunate in being able to see part of the broadcast of "Derby Day," the comic opera by A. P. Herbert, which was being played by a distinguished cast, including Frank Drew, George Baker, Tessa Deane,

Esther Coleman, Gordon Little and others who are well known to ordin- ary listeners.

I had not realised how little make- up was now necessary in television, and many of the actors and actresses were so slightly made-up that it was hardly noticeable. I observed a



Photograph taken at Brighton of Miss Elizabeth Cowell as seen in a television receiver by Mr. E. Westhead.

policeman, for instance, who took part in this delightful production, who did not appear to be made up at all.

* * *

At one end of the studio, under- neath the control window behind which producer Stephen Thomas directed operations, sat the orchestra conducted by Alfred Reynolds him- self. Alfred evidently was enjoying himself immensely. He wore a pair of trousers and a shirt, but not much more, and swayed about as he con-



Vera Lennox of the Television Follies.

ducted, evidently living in his own creation. Members of the orchestra, most of whom were also working minus waistcoats and jackets, res- ponded in a marvellous manner to the inspiration of the conductor and, generally speaking, I was much im- pressed by the precision, clean defini- tion and slickness of this orchestra. It does great credit not only to the individual members but to Hyam ("Bumps") Greenbaum who, by the way, was on holiday at the time in the south of France.

Despite the great heat in the studio, the orchestra seemed to work with a noticeable easiness and perfect unity.

In front of the orchestra was a row of seats where we were sitting, and between these and the other end of the studio the players were acting their parts and being televised. At the far end, in the middle, the scenery represented the Inn, and on the two sides were two other scenes.

The Emitron cameras surveyed these three sides of the square formed by the scenery, and at any given moment the action was proceeding in front of one of them. While the scene in front of one side of the studio was being shot, the players were assembling in front of one of the others in readiness for the fading in of the next.

I began to wonder how the players knew exactly when to begin, as there seemed to be so many scenes shot by the different cameras, all cleverly dovetailed into one another. So far as I could see there were no indicator lights or anything of that sort. They simply had to watch the cameraman who gave them the signal when to start and stop by raising his finger. During the time the action was pro- ceeding in front of any one scenery piece, the camera-man moved for- ward or backwards in order to get closer up or further away, as was required. He observes the scene on a fairly large focusing screen on the left side of the camera, which shows the figures upside down in the same way as the focusing screen of an ordinary camera.

What amazed me about this show was that in spite of the complication of the continuous changes from one scene to another, all the artists seemed to know exactly what was happening or when it was due to happen, in quite a miraculously detailed manner. They went through the whole thing apparently seeing and hearing nothing other than what they were doing, and quite oblivious to



Dennis van Thal, composer, pianist, conductor. Pianist in the Television Follies.

the fact that there were a few spectators.

Anyone would think from looking at them that they had rehearsed their parts hundreds of times, until it was absolutely second nature, and on inquiring into this I found that it was not very far from the truth. The direction of the whole programme, of course, was entirely in the hands of Stephen Thomas, who, from his control gallery, not only could see everything that was going on, but was in communication with the cameramen all the time. These assistants wear headphones and are told precisely when the various changes are taking place. A cameraman's job at Alexandra Palace is no sinecure, for a slight delay or misunderstanding on their part could upset everything.

* * *

As readers of these notes know, I have always expressed great admiration for Stephen Thomas, and I came away from Alexandra Palace on this occasion with my admiration for his work, energy and capacity for detail, considerably heightened. He has done a tremendous number of programmes within the last three or four months, and I hear that he often spends whole Sundays of his spare time in perfecting his productions and frequently goes to the homes of the

artists for private rehearsals of their parts.

I had a little chat with Stephen after the show, but found, as usual, that he does not like talking about himself. The upshot of the conversation, however, was that I realised that here is a man who simply cannot produce a show unless he has put his very best into it. Call it artistic conscience, if you like. Stephen Thomas has a great future in television. See if I am right.

* * *

Mr. D. H. Munro, the popular productions manager, was also away on holiday, but he did not go to Aberdeen, as I prophesied last month. I heard that he was motoring across Europe instead. The human dynamo found it very difficult at the last moment to tear himself from work, and I was secretly informed that he popped in again two days after he was supposed to have gone, and gave a spot of work to somebody.

* * *

I have not yet drawn attention to the new Television Follies, which was formed about a month ago, and which already has done some remarkably good work. At the time of writing, I think they have made four appearances, and so far as I can gather they are making a study of the television presentation of a concert party, for, as regular viewers know, they perform as pierrots. The six members are Michael North, an extremely accomplished pianist, who also used to be in the "Co-optimists" with Davy Burnaby; Pat Denny, Dennis van Thal, George Benson, Vera Lennox and Richard Murdoch. Gordon Crier, a newly-appointed Studio Manager, whom I have already mentioned in these columns, produces the show.

Gordon wears a dark blue shirt and a somewhat blasé manner. In his spare moments he is a song writer, and that he has secretly written a song called: "Television Lady," which has been set to music by Michael North.

I managed to get the words of this intriguing little ditty.

Here they are:—

TELEVISION LADY

Words by Michael Crier

Music by Michael North

I'm a very ordinary viewer

But there are fewer

Are quite so keen

Rain or shine

Sharp at nine
I'm switching on my new machine
Though I like the plays
And the talks and cabarets
I've seen
I can do without them
For the nicest thing about them
Comes between.

Television Lady
In your little screen
Do you ever wonder
What a smile from you can mean
Once I went to viewing-rooms
Now I have my own
So when I come home at night
We two can be alone
Television Lady
If I had my choice
I'd look in to nothing
But your picture and your voice
All I ask of Science
When my busy day is through



Michael North, another member of the Television Follies who has written the music for Television Lady.

Television Lady,
Is the sight and sound of you.

Verse Couplet.

When you softly murmur
"Good-night—that's the end"
I love ever'y little look
Every tilt and bend.

"Television Lady" is going to be put over to Radiolympia, and so far as I can see is likely to be a big hit in the B.B.C.'s television programmes. Incidentally, Gordon told me that he has not yet done anything about getting the song published. What a chance for one of the enterprising magnates of Tin Pan Alley!

The Magic Eye

Many Practical Applications

Most modern receivers include the Magic Eye visual tuner which was originally designed by the R.C.A. Company. This tuner has many other practical applications of interest to the experimenter. The information in this article was supplied by courtesy of Messrs R. C. A., Harrison, N.J.

THE visual indicator valves known as the R.C.A. 6E5 or British Mazda type AC/ME originally designed for tuning indicators in receivers, both have characteristics which make them suitable for use in many types of

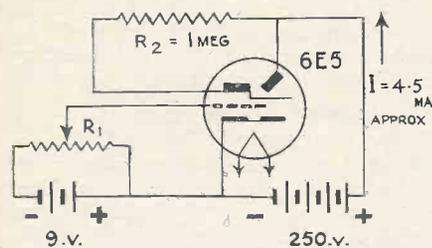


Fig. 1.—The basic circuit of the tuning indicator.

electronic devices where an indication of voltage or current, maxima or minima, is desired.

In addition to indications of maxima or minima, the tuning indicator can be utilized for quantitative measurements in devices which require calibration or which operate on the voltage balancing principle of the slide-back valve voltmeter.

The 6E5 essentially consists of a high- μ triode above which is located a cone-shape fluorescent target and a blade-like ray-control electrode; the latter is internally connected to the triode anode. The simple circuit in Fig. 1 illustrates the operation of the indicator. With zero bias on the triode grid the fluorescent pattern caused by electrons striking the coated target have a shadow sector of about 100 degrees as shown in Fig. 2. The electronic shadow is cast on the target because the ray-control electrode is at negative potential with respect to the target; the bias on the ray-control is caused by the IR drop across the anode resistor R2 when triode-anode current exists.

When the triode grid-bias is changed from zero to a negative value by means of R1 the triode-anode current decreases, the voltage drop across R2 decreases, the ray-control electrode becomes less negative with respect to the target, and the shadow sector closes to a smaller angle. With 6 or 8 volts of negative bias on the triode grid all anode current through R2 is cut off and the shadow sector is reduced to a narrow, dark line, as illustrated by the second part of Fig. 2. Slightly more bias on the triode grid may cause the pattern completely to close or even to over-close; in the latter case the dark

line may change into a narrow luminous line having greater brightness than the remainder of the pattern.

A Voltage Indicator

Because the variations of the fluorescent pattern on the target are controlled by the negative bias on the triode grid, it is apparent that the 6E5 is a voltage indicating device which draws substantially no power and can be used across high-impedance circuits with little or no loading effect. The actual variations of shadow angle, anode current and target current with respect to grid voltage, are shown in the average control characteristics in Fig. 3.

The Indicator in a Valve Voltmeter

One of the most useful applications of the 6E5 is that of balance indicator in a

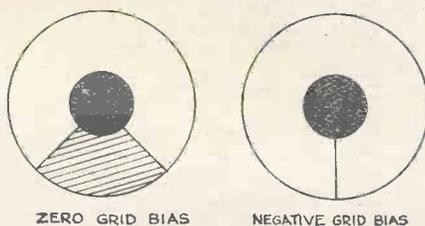


Fig. 2.—The patterns obtained on the indicator as explained in the text.

slide-back type valve voltmeter. An instrument of this type having a voltage range of 200 volts is shown in Fig. 4. Refer to this circuit and assume that the input terminals A and B are shorted and that the movable arm of slide-back potentiometer R7 is at the positive voltage end of its range, at which setting

d-c voltmeter V will read zero. The anode current of the triode-connected input-coupling valve (6J7, 6C6, 57 or Acorn 954) is practically cut off due to the biasing action of the 2-megohm cathode resistor, R1.

As it requires approximately 14 volts to obtain approximate cut-off of the 6J7 anode current, the cathode end of R1 is at a potential of positive 14 volts with respect to the lower, or negative, end of R6. The zero setting potentiometer R5 is next adjusted so that the potential of the 6E5 cathode is approximately 21 volts positive with respect to the negative end of R6. This 21 volts in series opposition to the 14 volt drop across R1 places a net voltage of -7 volts on the grid of the 6E5 with respect to its own cathode. So the pattern on the target will close to a narrow dark line which is the correct initial setting for all valve voltmeter measurements.

If the test prods are applied across any d-c or peak a-c voltage of suitable value—0.5 to 200 volts—which it is desired to measure, the anode current flowing through R1 will increase by an amount substantially proportional to the d-c or peak a-c voltage applied. The action is similar to that of a diode-rectifier except that practically no power is drawn by the negative-grid input circuit. In the case of a-c voltages rectification occurs on the positive half cycle and the large condenser C1—shunted across R1—holds the d-c voltage developed across R1 at practically the peak value of the a-c wave.

Because of the 2-megohm circuit across which it is shunted, condenser C1 must be of a high quality, low-leakage type; a good paper condenser is satisfactory. The capacity value of C1 depends on the lowest frequency a-c voltage that might be measured. A value of

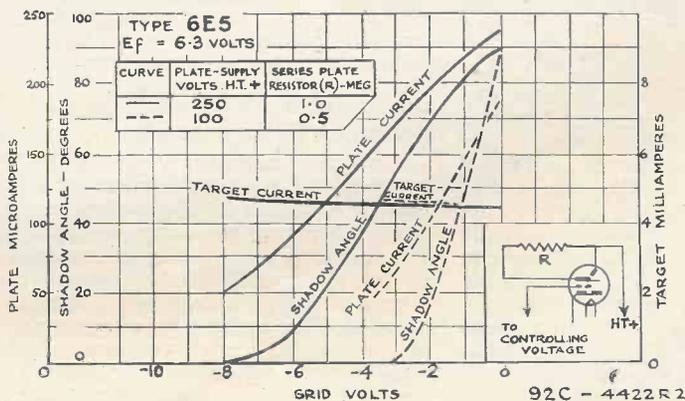


Fig. 3.—Average control characteristics.

A Valve Voltmeter :: Testing

4-mfd. is suitable for frequencies of 50 cycles per second or higher. In the case of d-c voltages, terminal A of the valve voltmeter is always connected to the positive side of the input voltage.

meter reading of 0.6 and 1.75 volts respectively. This percentage error is naturally smaller for larger values of a-c voltage, so that the higher a-c readings are quite accurate.

the 10 to the 200 volt range. The switch must be thrown to the low-voltage scale and the 500-ohm potentiometer adjusted to zero in order to make the initial zero setting with R₅, even when a voltage higher than 10 volts is to be measured; the switch is thrown back to the 200 volt scale after the zero setting is made with R₅.

The mounting of the input valve is quite important. Where RF voltages are to be measured the capacitance of the input circuit must be kept as low as possible. The well-known "goose-neck" probe construction is recommended for this reason. If very many R.F. measurements are contemplated a 954 acorn valve connected as a triode should be used in place of the 6J7 for the loading introduced by the 954 is relatively small.

Application of the 6E5 Valve Voltmeter

Because the valve voltmeter described has a considerable voltage range, does not draw any current, and can be used across a high-impedance and high-frequency circuits, it has a multitude of uses.

The A.V.C. circuit of a refractory super-het receiver can easily be checked. Prod A is connected to the cathode of one of the controlled R.F. or I.F. stages and prod B to the earth side of the R.F. or I.F. transformer secondary. The A.V.C. bias variation can be accurately measured either on a signal or with a test oscillator. The 6E5 will at the same time serve as a resonance indicator or as an alignment meter because the A.V.C. voltage varies as the different circuits are adjusted.

Valve screen and anode voltages can be checked with precision even though a very large series resistance is included in the circuit. The true anode voltage at the anode end of a resistance-coupled low-frequency amplifier can quickly be determined even if the anode load has a value of 500,000 ohms. If the L.F. valve is correctly biased the voltage at the anode will usually be about one-half of the supply voltage.

The operation of radio frequency or I.F. stages can be roughly checked by measurement of the R.F. voltage across the transformer secondary. The test lead from prod A should be short and have a

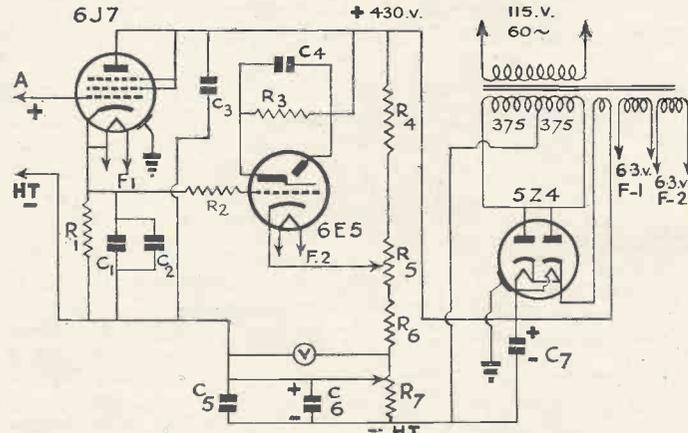


Fig. 4.—This meter has a range of 200 volts.

To complete the explanation of the valve voltmeter operation, assume that a d-c voltage of 10 volts is applied to the input terminals. The IR drop across R₁ will be 14 plus 10, or 24 volts. This places a voltage of 24-21, or plus 3 volts on the grid of the 6E5, causing the shadow sector to open. The slide-back control R₇ then has to be moved forward towards its negative end until voltmeter, V, indicates 10 volts before the original -7 volts of bias is again restored to the grid of the 6E5. So when the voltage introduced into the circuit by R₇ is adjusted just to cancel the unknown input voltage, the pattern of the 6E5 is then functioning as a voltage-balance indicator.

The use of a protected resistor, R₂, in the grid circuit of the 6E5 is important because any input voltage exceeding 7 volts will drive the grid of the 6E5 positive. The IR drop across R₂ developed by the 6E5 grid current automatically biases the valve so that the grid current cannot reach a value high enough to be harmful.

Accuracy of the Valve Voltmeter

In general the accuracy of this type of instrument depends upon the care with which the fluorescent pattern is adjusted before and after the unknown voltage is applied as well as upon the accuracy of the d-c voltmeter V. D-c voltages between 25 and 200 volts can be read to 1 volt or better, depending on the readability of the voltage scale on V. Between 0.5 and 10 d-c volts the accuracy is plus or minus 0.1 to 0.2 volts. A-c voltages will give readings which are in error by a fairly constant value of 0.8 to 1.3 volts on the low side of the correct value. This error is apparently due to the reaction of the negative half cycle on the static value of the 6J7 anode current. For example a peak a-c voltage of 1.4 and 2.8 volts gave a

The error on low a-c voltages is not disturbing as the instrument can readily be calibrated for these voltages by means of a variable a-c source of known voltage. The calibration can be made

APPLICATIONS OF THE VISUAL TUNER

- 1—Tuning Indicator
- 2—Valve Voltmeter
- 3—Negative Peak Over-Modulation Indicator
- 4—Tuning Indicator in Non-A.V.C. Receivers
- 5—A Null Indicator
- 6—Modulation Meter
- 7—Anode Voltage Measurements in R.C. Coupled Circuits
- 8—Ripple Voltage in Radio Receivers
- 9—Peak Anode Current of Mercury Vapour Rectifiers
- 10—Audio Frequency Output Meter
- 11—Stage Gain Meter
- 12—For Measuring Transformer Ratios
- 13—A.V.C. Voltage Measurement
- 14—I.F. Transformer Alignment

in terms of either or peak values. It is important to remember, however, that the voltage indicated by V is invariably of terms of either d-c or *peak* a-c. If the a-c input voltage has reasonably good wave form the peak a-c readings can easily be changed to values by multiplying them by the factor 0.707.

Other Valve Voltmeter Considerations

A voltage calibration of slide-back potentiometer R₇ can be made if it is desired to eliminate d-c voltmeter V from the circuit. This arrangement will not, of course, provide as good accuracy as with a d-c voltmeter having several voltage scales. If many measurements are to be made in the low voltage range of 1-10 volts a 500 ohm potentiometer should be placed in series with R₇ as shown in Fig. 5. A single-pole double-throw switch is required to change from

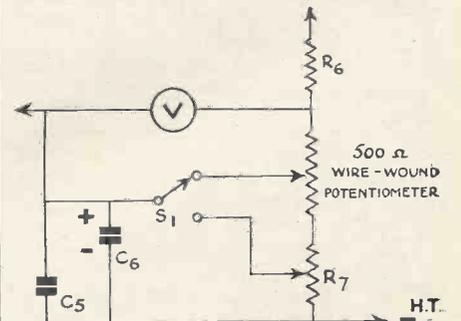


Fig. 5.—A slide-back valve voltmeter for low voltage readings.

High Power on 7 M.C.

By J. E. Hunter, G6HU

IS it not time something was done regarding the indiscriminate use of high power on the above band? Nowadays about every other station is using 50 watts, and recently I heard one say he was using 100 watts, whilst the "king of the band" is G5?? with 250 watts, but in fairness to him I must admit his visits to the 40-metre fraternity are very rare, something we certainly appreciate.

It is my firm contention that were a power limit imposed on this band the same as 1.7 mc. it would be more advantageous for all hams. Something will have to be done before long or heaven knows where we shall all end up—possibly in asylums.

I have repeatedly proved that a low power transmitter in conjunction with an efficient antenna does the job equally as well and often better than the QRO outfit. It is a well-known fact that during a QSO it is possible to reduce the input to a very negligible percentage of the original and still get the same QRK reports. The greatest distance workable on 7 mc. under normal conditions is about 500 miles and very often less, therefore in view of this fact, is there any satisfaction gained by getting an R9 report with 50/100 watts? Apart from the fact that almost every transmitter within 20-30 kc. either side is temporarily put out of action.

As far as I am concerned, it is absolutely futile to try any QSO's on Sundays, my frequency is 7,020 kc. and if anyone doubts my statement; try listening! One recent Sunday I called 24 times and had two contacts and both went up in smoke due to QRM.

Now, what about a try at co-operation and endeavour to make the band workable and fit to carry out tests. I, personally, dare not try a test on the air or bang goes the contact.

In conclusion, I shall always be pleased to make a contact with a high power station—if he can hear me.

The Pye Teleceiver

The following details of the circuit arrangements of Pye model 4044 Teleceiver are of interest.

There are five chassis units. The vision unit incorporates eight valves. The double time base and sync.

GALPINS ELECTRICAL STORES

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TELE: LEE
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TERMS CASH WITH
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ROTARY CONVERTORS, 12 v. D.C. input, 200 v. 40 m/A. D.C. output, for Car Radio, 2 H.T. tappings, complete with full smoothing equipment, new and unused, highly suitable for transmitting H.T. Very compact, price, 42/6.

CINEMA AMPLIFIER complete, less valves (valves obtainable), U.D.O., 200 watts, all sound and in good working order, £17 10s. C/F.

HIGH VOLTAGE TRANSFORMER, mains input 200/250 v., 50 cycles, single phase; output 2,000-0-2,000 v., 250 m/A., 11 v., 2½ a., and 4 v., 4a., price, £3 15s.

HIGH VOLTAGE CHOKE, 4,000 v. working, 200 watt, 40 henry, price, 35/-.

HIGH VOLTAGE CONDENSERS, capacity 4 m.f., 4,000 v. working, price, 20/-.

200 WATT, Speech Transformers, variable impedance secondary, large size, weight approx. 45 lbs., price, 30/-.

3½-IN. DIAL Milliamp Meters by high-grade makers, Moving Coil, 0-50 m/A. or 0-200 m/A., 12/6 each, and 0-3 m/A., 15/- each.

INTERVALVE TRANSFORMER with output smoothing choke, large size from 200 watt amplifier, weight approx. 45 lbs., price, 30/-.

CENTURY REPULSION INDUCTION Motors, ¼ h.p., 200/230 v., 50 cycle, single phase, as new, a real bargain, to clear at 42/6 each.

INDUCTION MOTORS, new and unused, A.C. 200/230 v., 50 cycle, single phase, approx. ¼ h.p., ball bearing, speed 1,450 r.p.m., silent running, no radio interference, only 22/6 each.

A.C. MOTOR, 2½ h.p., 200/20 v. 50, 1 ph. induction, direct coupled to 110 v. 10 a., Dynamo on iron bedplate, complete with starter, £10, or separate, Motor and starter, £7 10s.; Dynamo, £4.

DYNAMOS, all fully guaranteed for lighting or charging. 12 volt 8 amp., 15/-; 12 v. 12 a., 17/6; 20 v. 5 a., 25/-; 20 v. 8 a., 32/6; 35 volt 6 a., 27/6; 25 volt 25/35 amp., four pole, compound wound, slow speed, as new, 30/-; 100 v. 10 a., 70/-; 50/75 v. 6 a., 70/-. Carriage forward.

CHARGING RESISTANCES or Shunt Regulators. Stud, switcharm type, 12/6 each, to suit your requirements.

C.A.V. AUTOMATIC CHARGING CUT-OUTS, suit any voltage, 7/6 each.

MOVING COIL and MOVING IRON Switchboard Meters. By well-known makers. Various readings, volts and amps., 12/6 and 15/- each.

WESTINGHOUSE H.T. RECTIFIERS, output 500 volts, 250 m/A., as new, 20/- each.

MOVING COIL METER MOVEMENTS for recalibrating into multirange, all-test Meter, 2½-in. dial, by well-known makers, 5/- each.

EX-G.P.O. MAGNETIC RELAYS, working current approx. 2 m/A., 7/6 each; post 6d. "Sullivan" Moving Coil Relay, in perfect working order, new condition, 45/-.

ELECTRIC LIGHT CHECK METER, Kilowatt hour, type 200/250 volts, 50 cycles, single phase, for subletting garages, etc., in new condition, 6/-; post 1/-.

SHILLING SLOT ELECTRIC LIGHT CHECK METERS, 200/250 v., 50 cycles, 5 and 10 amp., 17/6 C/F.

ROTARY CONVERTORS, 1,500 watts, 110 v. D.C. input, 110 v. A.C., 50 cycles, single-phase output, 90/-.

MERCURY VAPOUR LAMPS for 200/230 v. D.C., as new. List £17 10s., price to clear, £3 10s.

TWO INCH SPARK Coils, 17/6; X-RAY Tubes, 12/6, new, 17/6.

NEW TWIN FLEX, 14/36, rubber and braided, red, 36 yds. 4/- or 144 yd. coil, 12/6. Post free.

separator unit also incorporates eight valves. The valves for the line control are "hard" and for the frame control "soft" valves are used.

The sound channel feeding to the gramophone portion of the T.10 employs five valves. The T.10 broadcast chassis is the standard Pye production, five valves and rectifier.

The power pack and tube unit incorporate three rectifiers and a cathode-ray tube. Two of the rectifiers supply the 450 volts for the vision channel and time base, whilst the other supplies the 4,000 volts for the cathode-ray tube.

The line deflection is electrostatic and the frame deflection is magnetic. The tube is modulated on shield and first anode.

New Store for Short-wave Amateurs

MOST of our readers are aware of the huge stocks of components of every kind handled by G2NO, H. R. Adams, and W1JYN, Ted McElroy, who have been responsible for the American import business of Eves Radio. These two well-known amateurs have now joined an equally well-known London store of Webb's Radio, and between them they are to form the largest company in this country devoted to the requirements of amateur short-wave transmitters and short-wave listeners.

Full stocks of American receivers and complete transmitters are being carried, while almost any American component will be available on demand.

In addition, those amateurs who so badly want a multi-valve American receiver, will be interested to know that special hire purchase terms of a very easy kind will be available on transmitting and receiving equipment.

This amalgamation of two famous houses is very good news, for it ensures that constructors will no longer be held up for deliveries of components, receivers or valves. In addition, Webb's Stores, in 14 Soho Street, W., will become a meeting place for amateurs visiting London.

Full information about this merger can be found elsewhere in this issue by reference to the advertisement of Messrs. Eves Radio. Amateurs can obtain components by post or by 'phoning Gerrard 2089.

Further information on the components to be stocked by Webb's Radio will be found in our September issue.