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News and Views

War Inventions

THIS war has been referred to many times as a scientists' war. The best research workers in the country have been mobilised in an effort to outwit any possible secret weapon which the enemy may have in store for us, and in radio no less than any other field the work is going on day and night to improve our communications and defences.

The outbreak of war was the signal for thousands of well-meaning amateur inventors to flood the Services with suggestions and revolutionary ideas for winning the war out of hand. The majority of these paper schemes could unfortunately only have one useful end—to remedy the paper shortage by being pulped again. A more serious side to the matter is the amount of time which is wasted by the inventions experts in opening and examining the sackfuls of letters which reach them daily.

To those who feel the urge to rush their ideas to the Admiralty on combating the magnetic mine, or to the Air Ministry on piloting pilotless bombers, we would offer the following advice:

Each of the fighting services has an experimental establishment staffed by experts in the various branches of warfare and communications. Be sure that you understand all the aspects of a problem before you offer a hasty solution. They are always on the spot and know many things which are not apparent superficially.

Those who are not already experienced workers or research engineers should take advice before wasting money on invention or development. Hundreds of patents are filed every week which are worthless owing to lack of experience in the framing of the patent or insufficient knowledge of the problem to be solved. The genuine inventor is always welcomed by the State, but he takes care that he does not waste either his own time or anyone else's by inventing the obvious.

The Care of Television Receivers

The majority of television receiver manufacturers have generously conceded that the unexpired term of the guarantee of the set shall be allowed to stand over until the resumption of the service.

How far this guarantee will be invalidated by deterioration of the receiver remains to be seen, but it is the duty of the owner of the receiver to keep it in good condition during its enforced idleness. Several components will suffer from the common enemy of all apparatus—damp, and the receiver should be stored in a dry, warm atmosphere under cover. Several firms recommend the periodic switching on of the receiver to dry out the H.T. transformer and keep the remaining components up to trim. Electrolytic condensers are also sufferers by prolonged inaction and should be kept " formed " by the application of H.T. voltage occasionally. Cathode-ray tubes and valves have an excellent " shelf " life and should suffer no ill-effects from storage. A good rule to follow is to switch the receiver on, say, once a fortnight and allow the raster to remain on the screen for half an hour or longer. If receivers have been left in the damp for some months, trouble may appear when first switched on and in this case it is suggested that they should not be switched on until after being in a warm room or after a spell of warm weather.

The Television Service

On February 22, Major Tryon, Postmaster-General, was asked in the House of Commons by Mr. S. P. Viant whether it was his intention that television should remain suspended for the duration of the war. Major Tryon replied: " On the basis of information at present available, and after consultation with the Television Advisory Committee, I can see little prospect of the provision of a television service during the war.

" The Committee will, however, shortly meet representatives of the radio manufacturing industry to discuss the probable lines of development of television in the more distant future."

What the precise recommendations of the Advisory Committee were has not been made public, but it is generally assumed that one of the principal reasons for continuing the suspension of the service was on the grounds of expense and it would be interesting to know in what light this aspect of the matter was considered. We hope that the decision is not final for the duration of the war and that the whole position will shortly again come up for review.

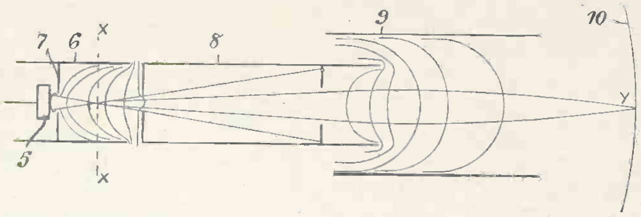


Fig. 1. Diagram showing equipotential lines and image formation with modulating electrode at zero potential.

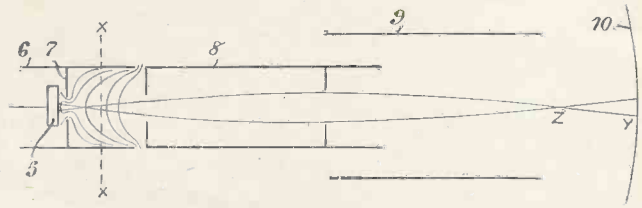


Fig. 2. The effect when modulating electrode is at —20 volts.

Maintaining Spot Focus in C.R. Tubes

UNDOUBTEDLY one of the most difficult problems in connection with the cathode-ray receiving tube is the tendency for the spot produced on the screen to change its size as the potential on the modulating electrode is varied. In other words, if the spot is correctly focused for a given beam current (i.e., brightness), it will be more or less out of focus, involving considerable increase of size for other values of current.

Many devices have been proposed with the object of overcoming this difficulty, some leading to great complexity of the electrode system within the tube; but the arrangement to be described in the present notes is very simple, and results in the additional advantage that the slope of the tube characteristic is greatly improved.

In order to understand the effect, let us first examine Figs. 1 and 2, which show a cathode-ray tube having cathode 5, cathode screen or modulating electrode 6 with apertured diaphragm 7, first anode 8, second anode 9, and reproducing screen 10. The potentials applied would normally be somewhat as follows: Cathode, zero; cathode screen, from -20 volts to zero or slightly positive: first anode, 1,000 volts positive: second anode, 5,000 volts positive.

Fig. 1 indicates the equipotential lines and the electron-optical image formation when the modulating electrode is at zero potential, Fig. 2 when it is at, say, -20 volts; comparison of the two figures shows how the correctly focused image point Y of Fig. 1 is modified by the altered potential, and becomes the defocused image area Y of Fig. 2.

Fig. 3 shows the arrangement now proposed for eliminating this dependence of spot size, on modulating potential. In this figure the electrode system is unaltered except in one respect, the new feature being that between the cathode 5 and the apertured diaphragm 7 there is interposed a grid 12, forming part of the modulating electrode, and having a very fine mesh. The interstices in this grid are so small that the equipotential surfaces close up to the cathode are very nearly flat: and although the depth of penetration of the anode field through the grid does vary to some extent with variation of the modulating potential, nevertheless, the flatness of the field in front of the cathode will be maintained and consequently the focusing action of the tube will remain consant.

In operating this tube the modulating potentials may either be applied to the modulating electrode, as described in connection with Figs. 1 and 2, or they may equally well be applied to the cathode itself, the modulating electrode being then maintained at constant potential. If the modulating potentials are applied to the modulating electrode the range should be from zero to a positive value: if to the cathode, the range should be from some negative value up to zero.

The result achieved by the arrangement of Fig. 3 may be described as a separation of the modulating and focusing actions of the cathode screen 6; and since it is essential for this purpose that the field penetration through the grid 12 shall be very small, the voltage amplification factor of the tube will be correspondingly large. Using a grid made of gauze having about 400 meshes per linear inch, an amplification factor of about 600 micro amps per volt can be obtained with the arrangement shown in Fig. 3.

It will be observed that the distance between the cathode and the grid is extremely small—0.1 mm. in the diagram. As a consequence, only a small positive voltage is required on the grid to produce the desired current, so that the velocity of the electrons is only very slightly altered, as they pass through grid, thus minimising a factor which might otherwise become a serious contributory cause of defocusing.

At the same time this permits the range of modulating potentials to be reduced: the range necessary to change from black to white on the reproducing screen may be as small as 3-5 volts, and the mean slope of the tube characteristic may be as high as 350 microamps per volt, while the current collected by the grid may be kept low by employing a mesh of relatively high transparency, say, 75 per cent.

Suitable grids may be of various types, for instance, they may be electro-deposited, or of woven mesh; and in certain cases it may be an advantage to shape them other than plane —e.g., convex or concave.

This development is reported from the E.M.I. Laboratories.

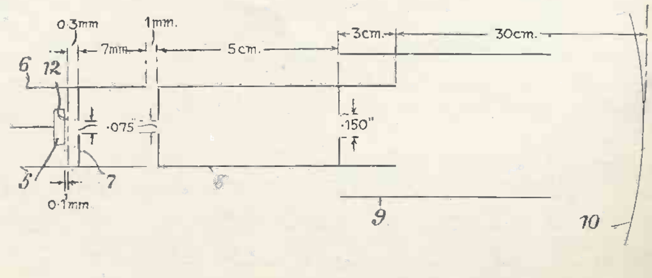


Fig. 3. Arrangement for eliminating dependence of spot size on modulating potential.

A NEW METHOD OF TELEVISION TRANSMISSION

In view of the possible developments in television which may take place during the period of the war, the following proposed scheme which would eliminate the likelihood of receivers becoming obsolete is of particular interest.

This photograph shows the DuMont television receiver which employs a 20-in cathode-ray tube with electrostatic deflection providing a picture 11½ ins. by 15 ins. for direct viewing. The instrument provides television sight, and sound on five channels and is equipped with a high-fidelity radio receiver for the broadcast and short-wave bands. Provision is made for attachment of a gramophone turntable. The chassis consists of six constituent units as follows :-

1. **Power supply.**
2. **Television radio-frequency tuner.**
3. **Video I.F. amplifier.**
4. **Television audio I.F. and high-fidelity amplifier.**
5. **Cathode-ray sweep and modulation unit.**
6. **Broadcast and short-wave tuner.**

It is designed to receive signals on the present standards of television transmission and also on the proposed DuMont standards.

LAST month brief particulars of the DuMont system of television were given which, as then stated, has the following unique features:

(1) A new type of synchronising pulse.
(2) Use of an automatic type of sweep-circuit at the receiver.
(3) Use of a long-persistence screen on the cathode-ray tube.

The object of the DuMont engineers has been to develop a television system which would meet not only the requirements of the present, but also those of the future, by providing a system of transmission which would permit the normal development of the art to proceed without the possibility of receivers becoming obsolete. Present systems definitely specify every means and method for picture transmission and there is the probability that any normal development, which it can be assumed must naturally occur in the future, cannot be incorporated in any rigidly specified system.

In adopting this independent attack upon the problem of the transmission of visual intelligence by means of radio, DuMont engineers have made a consistent attempt to limit the method of transmission to nothing more than the fundamental premise that the video signal is formed by breaking the visible image of the subject into a large number of individual half-tones, translating them into relative electrical potentials, transmitting these potentials in rapid succession through the transmitting medium, reassembling them in their proper order at the receiving end, and reconverting them to corresponding values of light and shade.

The contention is that, while the television pictures which we see to-day may appear to be quite satisfactory, they will be worthless in comparison with those which will be made possible by the co-operative development of the industry's engineering and research organisations within, say, the next ten years.

Such changes must occur, however, and DuMont engineers have made a definite attempt to limit their method for transmission as closely as possible to the basic principles outlined. This work has resulted in the adoption of the three general principles mentioned above.

Automatic Receivers

One of the improvements is the complete elimination of all controls for synchronisation of the sweep circuits at the receiver. These controls consist, usually, of a fine frequency adjustment of the sweep oscillators. Unless synchronising action is, therefore, very positive, these controls are frequently in need of adjustment. Further, should a change in scanning standards be desirable in the light of future development, these self-oscillating sweep circuits will not provide the desired flexibility without re-synchronisation adjustment. The use of an automatic type of sweep circuit at the receiver eliminates this limitation and provides in its place, a system which will cause the television receiver to follow any scanning changes in the transmitter without loss of synchronism at the receiver, and without the knowledge of the user excepting by an evident increase (or decrease, if desired) in picture detail.

Automatic synchronisation of the receiver is effected by utilising a sweep circuit which is not of the self-oscillating type. In its place is substituted a discharge circuit which is always ready to operate whenever a synchronising pulse is applied. Upon application of the synchronising pulse, this circuit gives one, and only one, single linear horizontal sweep of the luminous spot across the fluorescent screen. It is obvious that, with a circuit of this type, the number of horizontal scanning lines per frame and the number of frames are both under complete control of the transmitter. Picture detail may, therefore, be increased from time to time as the state of the art permits—and this may be done at no sacrifice in receiver operation, no obsolesence of existing equipment, and even without the knowledge of the user.

Automatic synchronisation, however, provides for flexibility as well as positive synchronisation, since the circuits which are employed at the receiver need not be of the self-oscillating type. The control panel problem is, therefore, greatly simplified

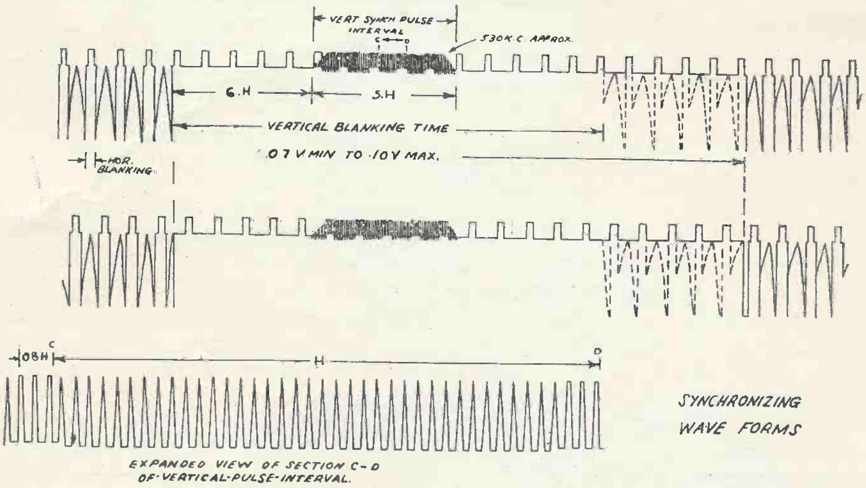
Reducing Television Band Width

for the lay-user, for there is no perplexing disintegration of the picture due to the loss of synchronism as occurs in the self-oscillating type of circuit when the sweep-frequency controls are out of adjustment.

The standard type of synchronising pulse, however, does not lend itself readily to automatic synchronising circuits. While it is possible to obtain continuous horizontal synchronisation from this type of wave, the presence of equalising pulses, plus the low-frequency components occurring during the vertical pulse interval, does not provide a pure horizontal synchronising wavetrain such as is desirable. The low-frequency components cause transients in the horizontal circuit, when it is being derived, which give rise to distortion of the scanning pattern at the top of the picture. Isolation of the vertical synchronising signal, to a degree where it is possible to utilise the pulse to drive automatic circuits, is accomplished only with considerable difficulty.

A form of synchronising signal has, therefore, been developed by DuMont engineers which has been found to offer decided advantages in the ability to isolate the horizontal and vertical components at the receiver (see diagram). The vertical synchronising pulse consists of a long train of high-frequency carrier signal which is harmonically related to the horizontal synchronising pulse. This signal is very easily eliminated from the signal applied to the horizontal tripping circuit by means of a simple wave trap. The isolated vertical synchronising signal may then be applied to the vertical sweep circuit, either directly as an R.F. signal or as a demodulated signal.

Simple changes in television receiving equipment now in existence, and having self-oscillating type sweep circuits, may be readily made to accommodate the new synchronising signal. When once this change has been made, the receiver will accept, with equal dependability, signals as they are now transmitted on 441 lines 30 frames per second (U.S.A. recommended standard). The same receiver will, further, provide the flexibility of being able to respond to transmissions utilising other frame or line frequencies which may be chosen in the future.



Wave form of synchronising signal developed for the DuMont system.

Reduced Band Width

The present U.S.A. transmission system limits the repetition rate of the pictures to sixty fields, thirty frames per second. This repetition rate makes necessary a transmission band width of 4.0 megacycles for the video signal, in order to provide a picture having detail corresponding to 441 lines. A repetition rate of 30 frames per second is necessary only to prevent flicker due to the need for a longer persistence-time of human vision. It is not necessary in order to stop motion.

Such a method of flicker elimination places the burden of this elimination on the human eye, rather than on the receiving equipment, and since transmission bandwidth is related to repetition rate, it demands a greater bandwidth than is necessary for the proper transmission of moving objects.

The problem of bandwith has always been, and probably always will be, a difficult technical and economic problem. It is difficult for the engineer since it imposes demands upon circuits which are obtained only through sacrifice and compromise. It is difficult economically because there is only a limited number of radio channels available, and whenever a channel is occupied by one station, that station monopolises all the frequencies within that band to the exclusion of all other stations within its service area. If a television station, therefore, utilises a small bandwidth, more stations can be built to serve the public. Conversely, with a given bandwidth the picture detail is determined, to a great extent, by the method of transmission.

The DuMont system, it is claimed, will permit a picture having the same detail as that provided by the standard system, but will require a video frequency-band of only 2.0 megocycles. This is accomplished by reducing the field-frequency from 60 fields per second (as proposed) to 30 fields per second. A satisfactory method for eliminating any flicker which may be caused by this method of operation is discussed later.

The present system, it is contended, imposes an undue frequency band requirement because of the necessity of transmitting pictures at a repetition rate higher than necessary to satisfactorily stop motion, and merely in order to eliminate undesirable flicker.

In tests in the DuMont laboratory the field frequency has been reduced to 45 per second without introducing any flicker, and the result has been a reduction of the bandwidth by 25 per cent. The field frequency has been further reduced to 30 per second with a corresponding reduction in bandwidth of 50 per cent. Pictures of detail corresponding to 567 lines, at a field frequency of 30 per second, with interlaced scanning, have been transmitted and have been excellent in quality, and yet the required frequency band is cut almost in half.

It is possible to transmit a picture with the same detail as provided by the R.M.A. standards with a band-

(*Continued on page* 106)

off effects from the high-frequency effects. This results in both ends of the characteristics badly scrambled in a single square wave. In such cases, however, the amplitude response is itself difficult to evaluate in terms of fidelity.

Square-wave Generator

The square-wave generator is primarily intended for audio-frequency testing. As will be noticed by reference to Fig. 3 the circuit consists essen-

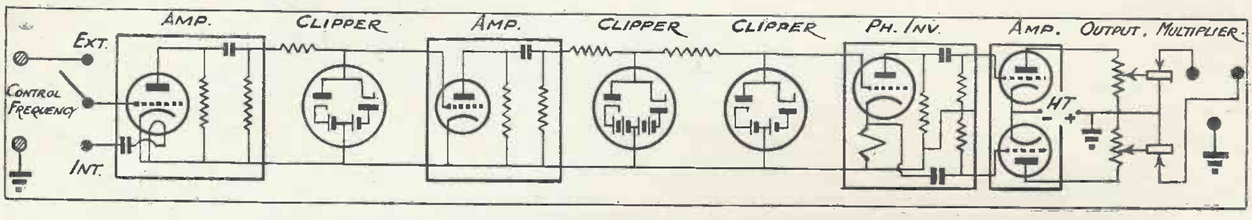


Fig. 3. Schematic circuit diagram of the Type 769-A square-wave generator.

tially of an amplifier which is so arranged that it overloads with extraordinary ease. A voltage of 2-8 volts from the power line or an external source is amplified to about 75 volts and it then has both sides of the wave clipped off by a double diode. This squared signal is re-amplified and carefully clipped by a pair of cascaded diodes. Finally, this signal is amplified and attenuated to any desired level.

The generator is not arranged for use at video frequencies but can be used to test the low-frequency response of a video amplifier and is entirely adequate for all audio-frequency use. The internal dynamics of the generator itself are roughly those which would result from an amplifier having a "flat response" from about 1/10 of a cycle to about 250 kc.

Specification

Frequency Range.—Square waves with fundamentals from approximately 10 cycles per second to 5,000 can be produced. The output circuit will pass frequencies between 0.1 cycle and 250,000 cycles.

Output Voltage.—Peak-to-peak, 150 volts on balanced output; 75 volts unbalanced. The minimum output voltage is 10 microvolts.

Attenuator.—A slide wire and a 6-step multiplier are used. The frequency characteristic (wave shape) is not affected by the attenuator setting.

Squareness of Waveform.—At low frequencies, the entire rise in voltage takes place in 0.001 cycle.

Output Impedance.—500 Ω, balanced; 250 Ω unbalanced for low-voltage output. The impedance is independent of frequency down to d-c. No condenser is used in the output. $B+$ is grounded.

External Oscillator.—An oscillator capable of delivering 6 volts, open circuit, is required to excite the square-wave generator. A 60-cycle control system is built in.

Power Supply.—105-125 volts, 50-60 cycles. The power input is 60 watts.

Mounting.—19 inch relay-rack panel.

Dimensions.—Panel, 19 by 7 inches; depth behind panel, 8½ inches.

Weight.—22 pounds.

The price of the instrument in Great Britain is £84 10s. od. This refers to the standard model, suitable for 105-125 v. 50 cycles. If a 240 v. model is required the price will be slightly higher, but Messrs. Lyons are prepared to supply a separate auto-transformer free of charge, if there is no objection to the use of a component not contained in the apparatus.

The address of Claude Lyons, Ltd., is 180 Tottenham Court Road, W.1.

"A New Method of Television" Transmission

(*Continued from page* 104)

width of only 2.0 megacycles; or a 325-line picture may be transmitted on a 1.0 megacycle band. Either of these transmissions would prove useful in providing a nation-wide television service on a carrier frequency between 20 and 30 megacycles and, with such a wide coverage, many of the present economic problems of television may possibly vanish. Further, with a wider market for television receivers, they could be made on a production basis which would eventually bring them within reach of a very large percentage of the population.

Elimination of Flicker

Flicker, at the lower picture repetition rate may be eliminated by using a cathode-ray tube which has a fluorescent screen having a persistence or afterglow characteristic which will permit an image to remain on a given screen area long after the electron beam has passed over that spot. If the afterglow persists for too long a time a certain amount of contrast will, of course, be lost in the picture, but if the persistence-versus-time characteristic be controlled, by properly controlling the treatment and chemical content of the fluorescent material, so that the luminescence, or afterglow, following fluorescence stays at a high value near to that during excitation for a period of 1/30 second and then drops rapidly to zero, no contrast will be lost and the flicker will be eliminated. Fluorescent screens possessing this persistence characteristic have been developed and flicker has been eliminated at a field-frequency of 30 per second, interlaced 2 : 1; no ill effects in either contrast or motion were observed.

The suggestions emanating from these developments are that:

(1) Transmitter and receiver shall be capable of operating at a frame frequency of either 15 or 30 per second, and a field frequency of either 30 or 60 per second, interlaced.

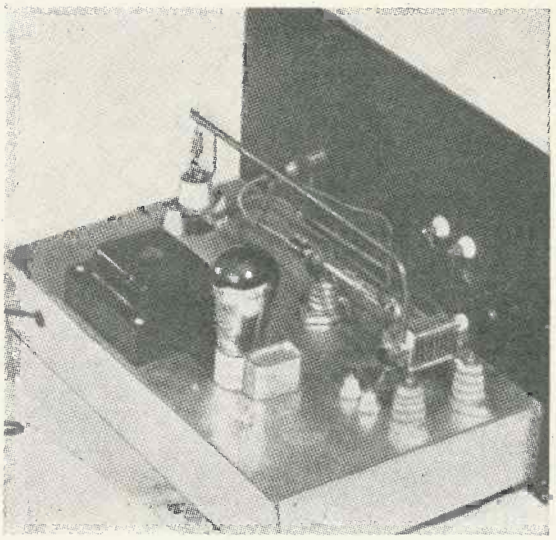
(2) Transmitter and receiver shall be capable of operating at line frequencies between 400 and 800 lines per frame (e.g., 441, 567, 625, 735).

(3) The standard synchronising signals shall be as shown in the diagram reproduced.

With this modified form of synchronising signal, slightly modified receivers will accept, just as dependably, signals transmitted on 441, lines 30 frames per second, as now, and the modified receivers will be able to respond to transmissions utilising other frame or line frequencies. Field tests have also definitely shown that car interference and other types of static are less likely to interfere with receiver synchronisation as the synchronising pulse is far more positive in its action.

LOW-POWER U.H.F. DIATHERMY APPARATUS

The details of the ultra-highfrequency diathermy apparatus given below were abstracted from an article by ***William Reagh Hutchins,*** *which appeared in the January issue of "Radio," New York.*



Rear view of the miniature U.H.F. radiotherapy apparatus. The positions of the various components and the mechanical construction of the variable coupling link can be seen.

INCREASING use is now being made of ultra-short waves of from two to five metres, for therapeutic purposes, and as a result the demand for this class of apparatus is steadily growing.

The apparatus described below has ample power for most local treatments and though it has not been measured exactly the output is about 20 watts maximum. Because of the small power output apparatus of this class is doubtless safer to use than that which provides several hundred watts more commonly employed on the lower frequencies.

The circuit used for the oscillator is of the well-known split-coil feedback type, but employing linear circuit elements rather than the usual coil and condenser. Tuning is accomplished by varying the capacity of the "shorting" condenser, thus changing the effective length of the line.

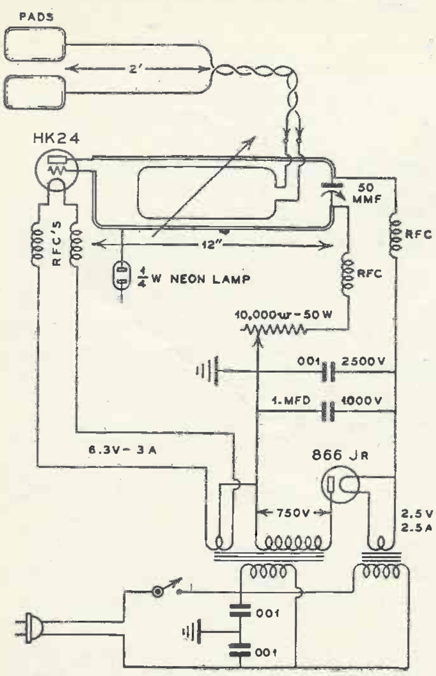
Most valves are very inefficient at the 100 Mc. frequency used, and until recently there has been no small, inexpensive valve which would be suitable. The HK24, however, is almost perfect for the purpose. No trouble was experienced with it, and it seemed impossible to make it cease oscillating by heavy loading, although of course, the overload caused it to overheat.

The grid leak was adjusted to give 20 mA. of grid current under normal conditions. The chokes in the anode and grid leads are not uniformly effective over the entire frequency range, and better efficiency could probably be obtained by pruning these somewhat. The filament chokes add to the ease of oscillation but are not very critical.

The output coupling consists of a modified variable link arrangement. A rectangular single-turn coil is pivoted in the plane of the tank circuit. It can be turned to a position almost at right angles to the tank by a knob on the panel and a flexible shaft, which is coupled to the coil shaft. The latter consists of a panel bearing coupled to a small polystyrene rod, on which the coupling coil is mounted. The two ends of the coil are brought to feed through insulators on the panel.

The pads are connected to the panel terminals by a short length of twisted pair, the last two feet of which are fanned out. This forms a roughly resonant centre-fed dipole, and the patient is placed between the pads at the ends of the radiator. Such an arrangement insures maximum voltage at the pads, and makes output adjustment simple.

The high voltage supply consists of an ordinary 375-0-375-volt, 120-mA. power transformer. The entire 750 volts is half-wave rectified by a single 866 jr. A separate filament transformer is used for the rectifier.



Circuit diagram of the HK-24 U.H.F. diathermy apparatus. A 150-mA. power transformer is used for anode supply and for the filament of the HK-24. The filament chokes consist of 55 turns of number 20 D.S.C. spaced the diameter of the wire on a ½ in. former.

A single 1μfd., 1,000-volt paper condenser is used in parallel with a .001-μfd., 2,500-volt mica for the filter. One .001-μfd. mica condenser is connected from each side of the line to ground as a precaution against R.F. power being lost in the lighting circuit.

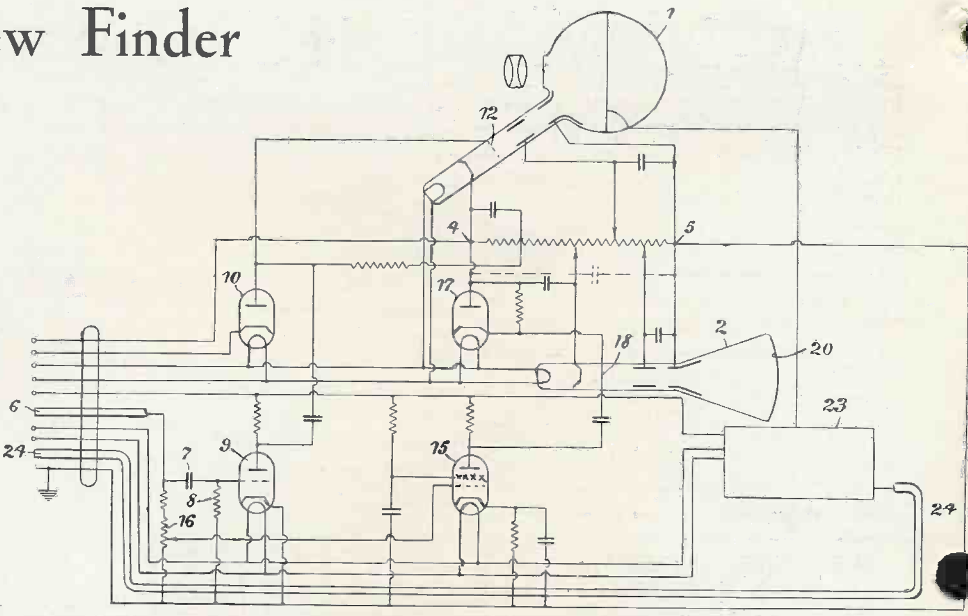
The neon-bulb indicator tied to the grid line of the tank shows when the circuit is oscillating, and also, by the amount it dims under load, indicates the relative output.

No meters are used, as their cost did not seem justified. An R.F. milliammeter in the output circuit might be useful. A plate milliammeter would probably be cheaper and would provide about as much information. Probably the chief purpose of meters in an instrument of this class is more to impress the patient than to show anything to the operator.

To operate, the filament switch is thrown on, lighting the 866 jr. After 30 seconds the anode switch is turned on, and the pads adjusted on the patient. The specific frequency is selected by the tuning knob, and the output knob is adjusted for proper excitation to the patient. The wavelength is from about 2½ to 4 metres.

No trouble was experienced at any time with this apparatus once the maximum coupling was adjusted so that the valve dissipation could not go too high.

Cathode-ray View Finder for the Emitron



Circuit diagram showing arrangement for view finder for Emitron utilising some of the conductors in the camera cable.

EMITRON cameras are generally fitted with optical view finders which form an optical image of the scene being televised on a ground-glass screen which can be viewed by the camera operator. The optical system is so arranged that the image thus seen is identical with that formed on the mosaic of the Emitron, so that the operator can adjust the focus and the field of view by observing the image which is visible to him on the ground-glass screen.

Although this arrangement is quite satisfactory in most cases, there are circumstances in which difficulties arise. If, for instance, the scene to be televised is rather inaccessible, or is to be viewew in infra red or other non-visible light, the use of the optical view finder is not likely to be very satisfactory, and an alternative method is then to be preferred.

A useful alternative method of view finding which may be used in such circumstances is a cathode-ray tube monitor fed with the picture signals derived from the Emitron and reproducing the scene viewed by the Emitron. If the location of the Emitron is rather inaccessible or inconvenient for the operator, he can control his camera by some form of remote control mechanism from a neighbouring point at which the cathode-ray monitor is installed. If, on the other hand, space is not limited, the cathode-ray monitor can be fixed to the camera itself as, for instance, when an infra-red picture is desired.

One or two practical difficulties arise in connection with the use of the cathode-ray monitor in this way. The monitor requires a number of supplies —H.T. and cathode current, deflecting currents, picture signals, etc., and these supplies may necessitate an extra camera cable with resulting complication and increase of weight which may be very undesirable, particularly in the case of relatively light weight portable equipment. These difficulties can, however, be overcome to some extent by utilising some of the conductors in the camera cable to carry some of the supplies necessary for the cathode-ray monitor, as will be seen from the following description of the arrangement shown in the drawing.

Referring to the drawing, the arrangement will be seen to consist in the Emitron 1, from which the picture signals are derived, the monitor cathode-ray tube 2 on the screen of which the picture viewed by the Emitron is reconstituted, and additional apparatus, the purpose of which will be described.

The Emitron and the montor tube are supplied with operating potentials from a common high-voltage supply and a common heater current supply. The potentiometer 4, 5 is provided to permit adjustment of the potentials on the gun electrodes of the two tubes. If the two tubes have similar physical dimensions, they may share the same scanning currents; otherwise, a separate source of scanning current for the monitor tube must be provided and can be synchronised by the voltage kicks developed across the scanning coils of the Emitron during return strokes.

Supply Lead Economy

A further economy in supply leads may be obtained by returning the picture signals derived from the mosaic of the Emitron to the monitor tube along the black-out lead for the Emitron. The Emitron signals, after application in the amplifier 23, are sent down the screened lead 24 in the camera cable to the control room, and have the Emitron black-out signals mixed with them before they are returned along the screen conductor 6 also in the camera cable. The black-out signals are arranged to be in the "blacker than black" region and the signals are returned along the conductor 6 with the black-out signals positive. The mixed picture and black-out signals are then fed to the valve 9, which serves to separate the black-out signals from the picture signals and to feed the black-out signals to the Emitron, and to the valve 15 which amplifies the mixed signals and feeds them to the control electrode 18 of the monitor tube. The presence of the picture signals on the black-out lead thus has no undesirable effect on the Emitron and, of course, the black-out signals serve a useful purpose in preventing the return strokes of the cathode-ray of the monitor tube from being seen.

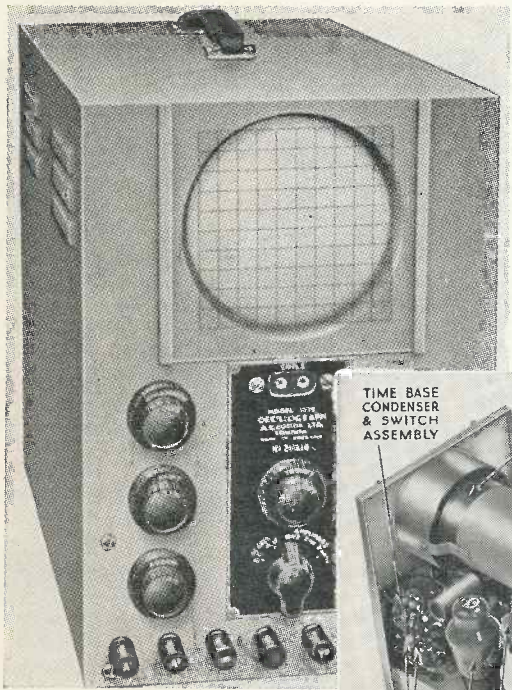
The valve 9 is provided with a grid condenser 7 and leak 8 to re-insert D.C. on the tips of the black-out signals, and the amplitude of the mixed signals is so chosen in relation to the grid base of the valve 9 that the whole of the grid base is occupied by the black-out signal and the picture signals are beyond the anode current cut-off of the valve. The potentiometer 16 is provided as a contrast adjustment for the picture on the fluorescent screen 20 of the monitor tube, and the diode 17 serves to re-establish D.C. from the tips of the black-out signals so that the background brightness of the monitor picture remains correct.

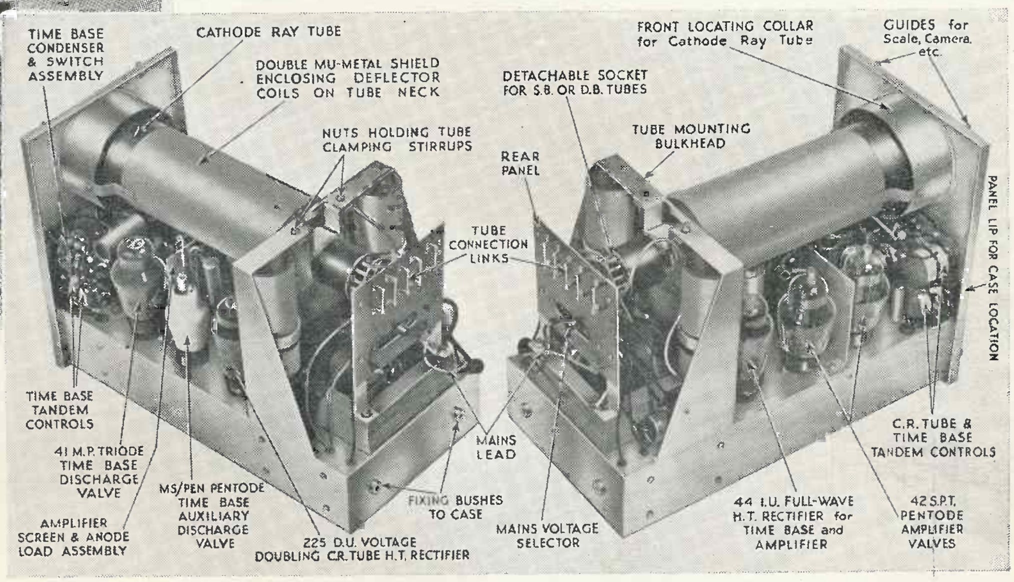
The diode 10 serves to stabilise the bias on the control electrode 12 of the Emitron during scanning, the bias on the cathode of the diode being remotely controlled from the control room to give the desired beam current. When the black-out pulse is fed from the anode of the valve 9 the diode 10 is rendered non-conducting and consequently does not interfere with the application of the black-out pulse to the Emitron.

This development is reported from the E.M.I. Research Laboratories.

THE COSSOR DOUBLE-BEAM OSCILLOSCOPE

A COMPREHENSIVE INSTRUMENT





These photographs show the exterior and interior views of the Cossor double-beam oscilloscope model 3339.

THE Cossor Oscilloscope, of which a photograph appears on this page, is claimed by its makers to be the most comprehensive instrument of its kind so far produced, irrespective of price.

This may appear to be a sweeping statement, but if its price is taken into consideration it may well be considered to be as good an investment that a research laboratory could make. The use of a double-beam tube overcomes the difficulty which so many users of oscilloscopes have to contend with—that of comparing two phenomena simultaneously without the necessity of fitting up duplicate apparatus or using complicated switching circuits, and this feature alone puts the Cossor instrument in a class by itself for adaptability and usefulness.

The instrument employs a 4½ in. diameter tube, which is ample for all ordinary work and gives good visibility at a distance. Several features have been incorporated in the design of the circuit, which have been developed by Cossor engineers, such as automatic brilliancy control at high traverse speeds, fly-back suppression, hard-valve time base, and the advantages of these are apparent when comparing its performance with simpler types of oscilloscope.

The brief specification of the instrument is as follows:

Power Rating

A.C. mains voltage ..	110, 200-250 volts.
A.C. mains frequency ..	40 to 100 c.p.s.
Power consumption ..	100 watts approx. (6 valves).
H.T. voltages	Tube 1,300 v. Amplifiers, etc., 500 v.

Dimensions (Overall)

Height	13¼ ins.	34 cms.
Width	8¾ in.	22 cms.
Length	17¼ ins.	44 cms.
Weight	40 lbs.	18 kgs.

Cathode-Ray Tube (fitted as standard)

Screen diameter ..	114 mms.
Type 3229 or Type 3209	Double-beam trapezium-corrected high-vacuum tube.
Fluorescent Screen ..	"D" type with green response.
Electron gun	Three anode type. 1st and 3rd at full H.T.
Beam Intermodulation	Normal 1%. Maximum 2%.
Sensitivity (Y axis) ..	3.1 v. D.C. 1.1 v. R.M.S. (v/mm.).

Input Impedance

	Capacity. mmF.	Resistance. Megohms
To input terminals ..	25	5.0
Direct to Tube Panel ..	14	As required
Through Amplifier ..	25	1.0
Synchronisation ..	25	2.0

Calibration

100 volts peak to peak. 35.4 volts R.M.S.

Deflector Coils

Sensitivity. 2 mms./mA. R.M.S. Maximum current. 60 mA. R.M.S.

An interior view of the instrument is shown on this page. The tube is magnetically screened with a mu-metal shield to avoid any interference from external fields or from its own power supply. The whole of the controls and terminals for connection are mounted on the front panel, and these are as follows:

Brilliancy.—The brilliancy control varies the negative bias applied to the grid of the cathode-ray tube. Clockwise rotation increases the brilliance.

Focus.—The voltage applied to the second anode of the cathode-ray tube is adjusted by means of this control. Clockwise rotation increases the voltage applied.

X. Shift.—Horizontal positioning of the beams is controlled by this potentiometer, which applies either a negative or positive voltage to the X2 deflector plate. This deflector plate is used solely for this purpose except when use is made of the link panel at the rear of the instrument.

Y Shifts.—Two Y Shift controls are provided. That controlled by the foremost knob affects the potential applied to the beam which is controlled by the Y1 deflector plate, whilst the rearmost control affects the other beam in a Y direction.

Condenser.—The condenser switch fitted enables the selection of any one of nine time base condenser capacities to be effected for rough control of velo-

News Brevities—

Commercial and Technical

THE difficulties of amplifying small direct currents for indicating instruments are well known, and a useful method of overcoming them is suggested in the January issue of our American contemporary "Electronics." A. Sear has developed a high-gain amplifier with transformer input, the primary of which is connected to the D.C. input and measured through a motor-driven interruptor. In the output circuit is a ganged switch which applies to the galvanometer or indicating meter an impulse corresponding to the voltage transient applied to the primary. The output circuit switch opens before the input interruption, and the combination thus rectifies half-wave impulses. It is possible to obtain reversal of deflection with this arrangement. A deflection of 2 divisions on a 0—1 milliammeter was produced with 0.5 microvolt input.

* * *

Neon signs are still being used for internal display purposes, and mysterious interference noises may be traced to their use. The engineers of Aerovox laboratories have recently investigated some of the more common causes of interference from these signs, and their conclusions are summarised below:

1. All interference is caused by direct radiation from the neon tubing, and none or very little is the result of kick through the A.C. line.

2. When the metal case and frame of the neon sign are not earthed, the whole unit radiates interfering signals. The field strength of such interference drops off sharply with distance from the sign, being practically zero at a distance of 6 feet.

3. Inserting R.F. chokes or condensers in the high-voltage side increases the interference, as also do faulty connections, dirty insulators, and dirty tubing.

4. Interference caused by a dirty tube can be reduced by cleaning the tube and earthing its centre point by wrapping a small piece of foil around the tube and connecting the foil to the frame of the sign.

5. Wornout or very dirty tubes may cause an interference voltage to be transferred to the A.C. line. A filter should be used in such an event.

Dr. P. Selényi of the Tungsram Research Laboratories, Hungary, has sent to "Nature" an account of a measurement of the mechanical force exerted on an electrode by a stream of electrons. The electrons were accelerated from a filament to a gold-leaf anode suspended as a pendulum. The pressures observed were 5—20 per cent. higher than calculated from the accepted value of e/m for electrons, and this difference is ascribed to radiometer effects.

The author considers that this mechanical pressure requires for its explanation a "true" as distinct from an "electro-magnetic" mass, for he points out that when a single electron approaches a metallic screen, the electro-dynamic repulsion due to induced currents depends on the conductivity of the screen, which is contrary to experience; while with a steady electron beam, conditions are stationary and no repulsion due to induced currents is to be expected.

* * *

The Columbia Broadcasting System made there alternative proposals to the Federal Communications Commission now investigating the future of television broadcasting in the United States of America. These were:

1. Fix present transmission standard on the seven lower bands immediately and definitely—"freeze" them against change—for a stated and adequate number of years. Simultaneously allow television broadcasters to proceed with scheduled programmes. If standards are fixed for a period of years, they must be fixed for a minimum of eight years, but preferably for ten years in order to protect the public and the broadcaster from a disastrous false start in television.

2. Delay both the "freezing" of standards and the launching of new programme schedules, not until ultimate standards can be set, but long enough to determine if such flexible standards can be set that any predictable change within those standards will not make wholly or largely obsolete, receiving sets designed to anticipate such changes.

3. Proceed immediately with scheduled programmes as proposed without "freezing" present standards and without setting flexible standards which ensure receiving sets against change, but let the broadcasters tell the public, actively and frequently, that this is so—that sets have no assurance of continued use—and let this go on until standards can be guaranteed for a definite period of years.

* * *

It is the opinion of the Columbia engineers that with the present standard of 441 lines (U.S.A.) it is possible to create *twice as good a picture* on the screen of a home receiving set, as the best of the pictures which have thus far been publicly available.

Present standards, it is contended, have only been made to yield barely half their full potentialities in terms of the quality of the end result, the picture which the public receives. This, they say, is not a loose generalisation, but is based on engineering concepts. By "good picture, better picture and best picture," the television engineer is referring to such factors as the degree of *detail* a picture contains, the range of *contrast* it presents from light to dark, and the completeness of *gradation*, between its lightest and darkest areas.

* * *

From estimates contained in the Federal Communications Commission's reports, it is assumed that it is conservative to estimate that a television service of public appeal, with adequate transmission to the New York population area, can be provided for less than 500,000 dollars per year per station.

In any market of over 1,000,000 population, there is room for three stations, each broadcasting a minimum of five hours of programmes weekly on a scheduled basis with over fifteen hours of programmes available to the public. This, it is thought, would constitute as much televesion as viewers could find time to view.

* * *

Radio will again supply the link between civilisation and the United States Antarctic expedition, commanded by Admiral Byrd. A series of popular programmes, arranged and sponsored by prominent U.S.A. newspapers, has been inaugurated and will reach the Byrd expedition through General Electric's powerful short-wave transmitter, WGEO, in Schenectady. These programmes will be broadcast every other Friday night, from 11.30 p.m. to 12 o'clock midnight, Eastern Standard Time. WGEO transmits on 31.48 metres and is equipped with the directional antenna designed by Dr. E. F. W. Alexanderson.

* * *

The General Electric Co., Ltd., has introduced a new 4-valve dry battery portable radio receiver built for use in A.R.P. shelters, train or car, and in the user's home. High efficiency is obtained by a superhet circuit incorporating frequency changer, IF amplifier, double-dioxode-triode and power output—all new 1.4 volt dry battery economy valves. The dimensions are $11\frac{1}{2}$ in. by $12\frac{1}{2}$ in. by $7\frac{3}{8}$ in. and the price is £8 18s. 6d. complete.

* * *

The British "Wireless for the Blind" Fund has received £13,381 in response to the Christmas Day appeal by an "unknown blind man" and further sums continue to arrive at the rate of about £12 a day.

* * *

This year the Academy of Motion Picture Arts and Sciences, Hollywood, are again considering awards for scientific or technical achievement. Nominations have been requested for devices, methods, formulas, discoveries, or inventions of special and outstanding value which were actually employed in the motion picture industry during 1939.

* * *

General Electric, U.S.A., has made available frequency modulation transmitters in five ratings—250 watts and 1, 3, 10 and 50 kw. The Federal Communications Commission has set aside five channels for this system of transmission.

* * *

The importance of distinguishing between a valve with a clear bulb and one with a metallised bulb is becoming increasingly appreciated. The General Electric Co., Ltd., has, therefore, decided that in certain existing, and in all new types of Osram valves of the metallised type, the suffix M shall be included in the coding.

It is not intended that this distinctive nomenclature shall apply to older type valves. It will, however, provide a safeguard in ensuring delivery of the correct finish of valves in the case of new receivers, where the new reference number indicating plain or metallised type will be specified in the manufacturers' instruction booklets.

The types involved in this change are DH63, KTW61 and X63 with plain bulbs, which will be specified as DH63M, KTW61M and X63M when required with metallised bulbs. Types Osram X73M, KTW73M, KTZ73M and DH73M are available only with metallised bulbs. There is no difference in the list price between plain and metallised valves.

* * *

Some time ago we published a description of a British television development which, in place of the fluorescent screen, employs a glass prism with a surface that totally reflects light. On the polished surface are particles of carbon or mica. The prism face is the "screen" in the television receiving tube. When it is scanned by the electron beam, the crystals are caused to move on the prism surface in proportion to the light intensity of the cathode beam. A beam of light thrown against another face of the prism is not totally reflected, but some of the light passes through the reflecting face in accordance with the movement of the crystals and enables the picture to be projected.

According to the *New York Times*, this invention has been assigned to the Radio Corporation of America and the special tubes are to be put into production.

* * *

Television programmes distributed over the G.P.O. telephone system are being worked upon by television engineers, and may be possible some time this year, according to a statement made in a paper recently read by Mr. A. G. D. West, President of the Kinematograph Society and Technical Director of Baird Television, Limited.

Plans are well forward for the submission of the scheme to the Postmaster-General and Lord Cadman, chairman of the Television Advisory Committee. Programmes would be available for all telephone subscribers on a wavelength which would not be interrupted by phone conversation, at an all-in charge amounting to a few shillings a week only.

* * *

Experiments are now being made with "odourated talkies," the object being to provide "atmosphere" in an auditorium suited to the picture being shown. Demonstrations have been given and experts have been absolutely satisfied as far as the naturalness of the odours and the quick changes are concerned. No "overlapping" at all was noticed. Doubt has been expressed whether it would be possible to inject the odours within a few seconds all over the auditorium, and then to replace them with others in a sufficiently short space of time, but this, apparently, has been accomplished.

The injection and neutralisation of odours, it is stated, are effected in some electrolytic manner, and there are over 4,000 synthetic odours available.

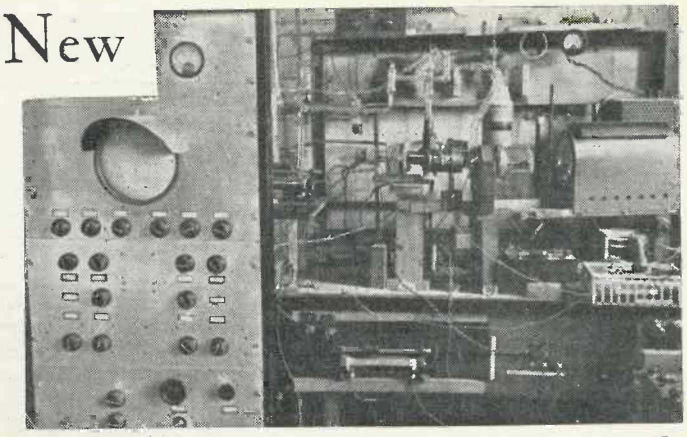
* * *

In this issue are published particulars of an ultra-short wave oscillator which has been designed for treatment of patients by diathermy. We think it desirable to utter a word of warning. The oscillators should not be used or applied to treatment of ailments in the absence of the advice of a qualified and experienced medical man. The heat developed in the tissues in most cases makes itself felt after a certain time with slight discomfort to the patient, but this may not be apparent in the case of the deeper seated organs. Irreparable harm may be done to delicate tissue by the indiscriminate use of diathermy treatment, and no radio engineer should take on himself the responsibility of advising or assisting in its use by lay persons.

* * *

There is a noticeable decrease in the number of valves now being used in American receivers and the percentage of 5-valve models has been steadily increasing. For the 1939-40 season, about 42 per cent. of all models have 5 valves, approximately 20 per cent. have 6, and 10 per cent. have 7 valves. In the 1938-39 models 38 per cent. were 5-valve sets, 18 per cent. were 6-valve, and 11 per cent. were 7-valve models. In former years, sets with as many as 25 valves were offered; the maximum number of valves in any one 1939-40 receiver is 18.

THE SKIATRON—A New Scophony Development for Large-screen Projected Pictures—*Part II*



By A. H. Rosenthal, Ph.D., F.R.A.S., A.M.I.R.E., of the Scophony Laboratories

The first part of this article, published last month, described a new development of the Scophony laboratories which makes use of electron opacity effects for television picture projection. This concluding instalment deals with synchronising, experimental procedure and the possibilities of colour television with the new system.

In certain applications of the Skiatron principle, especially where reflected instead of transmitted light is used to produce the picture, the crystal layer 9 may be heated by means of an electric current from a source 24 which is passed through a suitably arranged conductor electrode 11 and which can be controlled to maintain the layer at a constant predetermined temperature by means of a thermo couple 27, connected to control the source 24. This arrangement was illustrated in Fig. 2 of Part 1 of this article, whereas the heating method described at the end of Part I is illustrated in Fig. 2a.

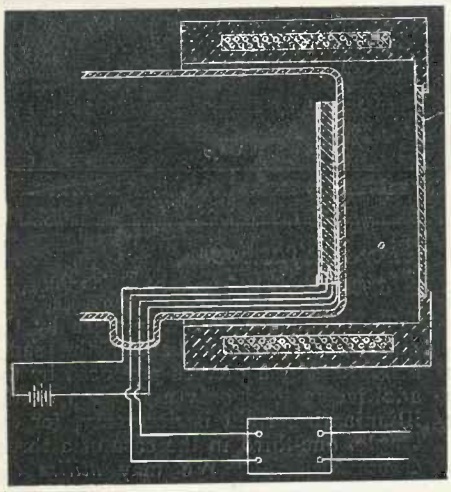
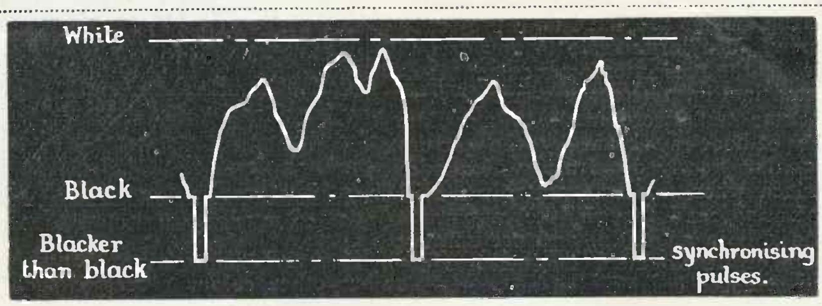
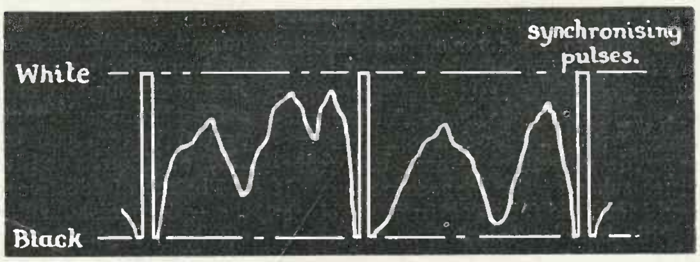


Fig. 2a. Method of maintaining even temperature.





Figs. 3a and 3b. Diagrams showing the effect of synchronising system.

Synchronising

In most television transmission systems, synchronising signals are transmitted in the intervals between successive lines and frames. In these intervals a fly-back of the cathode-ray beam occurs. These synchronising signals are usually of the "blacker-than-black" type, so that if they are applied to the control grid of a cathode-ray tube together with the picture signals, they suppress the cathode-ray beam during the fly-back (Fig. 3a). In cases where a positive control is used, that is, where an increase in the intensity of the cathode-ray beam produces an increase in the "white" value of the image screen, this method is useful. This case occurs in the ordinary fluorescent screen type of cathode-ray tube, and in the application of the present invention in which the datum level of density of the deposit corresponds to picture black.

Where, however, a negative control is used, as in the applications of the Skiatron system in which the image screen is initially transparent and the density of the deposit increases with the increase in the intensity of the scanning beam, the blacker-than-black impulse would produce a beam of increased intensity, with the result that a series of opaque lines would be traced by the cathode-ray beam during the fly-back between successive picture lines, and opaque lines across the picture would be traced during the fly-back between successive picture frames. This disadvantage can be avoided by reversing the direction of the synchronising signals applied to the control grid, so that they lie in the "white" direction and produce a reduction in the intensity of the beam (Fig. 3b).

Experimental Procedure

The difficulties of obtaining sufficiently large and suitable single crystals led to an experimental procedure somewhat different from that described above. Previous scientific investigators found that a denser deposit of colour centres can be obtained in crystals whose lattice is highly disturbed than in very regular crystals. Therefore in our further experiments we used *microcrystalline layers* of alkali halides, especially of potassium chloride and bromide. These layers

The Skiatron System and Colour Television

could be obtained by *controlled evaporation.*

The material is preferably placed in a small boat or container inside the cathode-ray tube and connected in series with a ring-shaped copper strip and the layer is formed by heating the boat with eddy currents induced in the strip by means of an external induction coil of an eddy current bombarder. Very uniform deposits of the material or a mixture of materials can be obtained in this manner.

The sensitivity of the crystalline material will depend upon the treatment during its formation. Any treatment which tends to disturb the regularity of the lattice will tend to give an increased sensitivity.

Screens obtained in this manner recorded immediately in the form of a change in opacity any alterations in the impinging electron beam. The path of the focused electron beam, moved along the screen by a magnet, appeared immediately as a sharp line of coloured deposit, and a scanning and modulated beam produced a picture of varying opacity. *No definition is lost* since the layers are only a few thousandths of a millimetre thick. All records on the screen can be projected on a projection screen on a large scale to any desired size by the projection arrangement indicated in Fig. 1 (February issue).

Some tests were made to modulate the cathode-ray beam by the picture signals received from Alexandra Palace when this transmitter was still operating, and though the apparatus was still in an initial and preliminary state of development the pictures obtained could be regarded as encouraging and the results promising, if one has in view the vast amount of research work still to be done on the physical nature of the problems concerned.

Most standard tests of performance were made and are being further continued with signals derived from specially developed electronic test transmitter tubes of the monoscope type. It would lead too far away from the object of this article—to give a qualitative account of this work—if we were to enter into a description of the various methods of quantitatively measuring the magnitudes of absorption, time constants of the deposits and other values the knowledge of which is necessary for a systematic development of these phenomena to technical perfection.

It might be of some interest to give an outline of some further proposed promising future applications of the above described methods. The name "colour centres" for the electronic combination centres forming the foundation stones of the deposits suggests immediately an application of these phenomena to "*colour television.*"

Reproduction in Colour

There have been many proposals for utilising the so-called additive method of colour reproduction in television systems. In this system the final coloured picture is obtained by superimposing a plurality of partial images, the colour of each partial image being one of the so-called primary colours of the particular colour process employed. This process is usually a three-colour process employing certain red, green and blue colours as the primary colours, but other colour processes such as a two-colour process have been proposed.

The superposition of the partial images can be effected simultaneously or successively, and they can be projected one on top of the other, or the corresponding elements or lines of the partial images can be placed side by side or interleaved respectively.

The use of additive methods possesses the serious disadvantage that the light efficiency is poor. In the average, only a small part of the incident white light is utilised in forming the colour picture; for example, in a three-colour system only one-third of the incident light is utilised.

In colour photography an alternative method, known as the subtractive method, is used. In this system the colour values are derived from the incident white light by the successive subtraction of certain portions thereof, by passing the light in succession through transparencies, each of which contains a record of one partial image in the form of a deposit having a colour which is complementary to the primary colour of, and a transparency proportional to the intensity of the partial image in question.

Thus if a three-colour process based on red, green and blue as the primary colours is employed, the complementary colour deposits in the three respective transparencies would be bluish green (minus red), magenta (minus green), and yellow (minus blue) respectively. At points corresponding to white in the final colour picture each transparency is free from any colour deposit so that the whole of the white light incident at this point passes through all the transparencies without substantial loss.

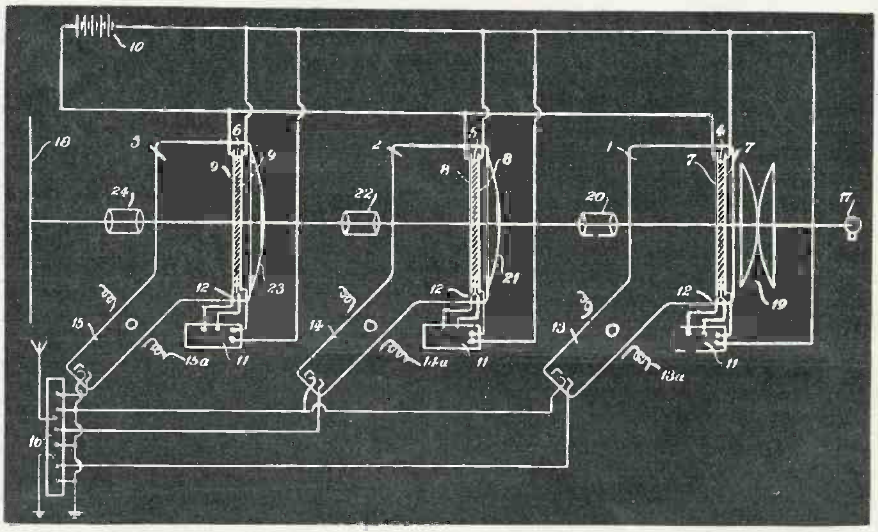


Fig. 4. Arrangement of Skiatron system for subtractive method of colour television.

The Subtractive Method

To produce a colour picture by the subtractive method having the same brightness as a picture produced by the additive method only a fraction of the illuminating light is necessary, for example, one-third in the case of a three-colour system. We may *utilise the "colour centre" screens* to obtain the *advantages of subtractive colour mixture methods for a system of colour television.* This is achieved by deriving from a transmitter by any known or suitable colour separation method sets of modulated signals each representative of the intensity of one of the primary colours of the object to be transmitted, utilising each of these sets at the receiver to produce a *corresponding fugitive colour deposit* in a transparent screen, the colour of the deposit in each screen being complementary to the primary colour represented by the corresponding set of signals, and the density of the deposit in each screen being inversely proportional to the intensity of the primary colour in the object, and passing white light through all the screens in succession on to a reproduction surface.

The transparent screens are image screens of the type described above, in which *coloured deposits are formed by impinging electron beams*. The spectral transmisson of these coloured deposits is different for different materials, and can also be varied by changing the temperature. Thus for a given alkali halide crystal the spectral absorption curves get broader and the region of maximum absorption is shifted towards the longer wavelengths with increase of temperature. Thus by a suitable choice of material and/or operating temperature screens having deposits of the colours necessary for any colour process can be obtained. For example, in a three colour process based on red, green and blue as the primary colours, suitable materials for the three screens would be the following alkali halide crystals: KBr, KI, RbCl, RbBr, for the minus red deposit, KCl, NaBr for the minus green deposit and NaCl, LiCl, KF for the minus blue deposit.

Referring to Fig. 4 three cathode-ray tubes 1, 2 and 3 are provided, each comprising a transparent image screen indicated at 4, 5 and 6 respectively. Each screen is situated in an electric field provided by pairs of transparent electrodes 7, 8 and 9, across which is maintained a potential difference by means of a source of potential 10. The screens can also be maintained at a suitable temperature by means of a thermostatic control of suitable form, which in the example shown consists of a source of current 11 for each tube which passes a current through one of the electrodes 7, 8 and 9 of each screen, the amount of the current and hence the temperature for each screen being controlled by a thermo-couple 12 in each screen. Means indicated at 13, 14, 15 are associated with the tubes for producing a scanning cathode-ray beam and the amplifying arrangement 16 is fed by signals representative of each of the primary colours of the object being transmitted.

The sense of the modulations applied to the beam is such that the density of the deposit produced is inversely proportional to the intensity of the corresponding primary colour. The three beams are caused to traverse the three screens 4, 5 and 6 in synchronism by means of scanning coils 13a, 14a and 15a.

The material and/or temperature of the screens are chosen so that the coloured deposits produced therein have the required complementary colours. White light from a suitable source 17 is projected successively through the screens 4, 5 and 6 in such a way that the screen images are superimposed in register on a reproduction surface 18. This can be done by fully illuminating the first screen with a condenser system 19 which also forms an image of the light source 17 on a first projection lens 20 situated between the first two screens 4 and 5. This projection lens forms an image of the first screen 4 on the second screen 5 in register, and the light is focused by means of a field lens 21 on to a second projection lens 22 which forms an image of the second screen (5) on the the third screen 6 in register. A field lens 23 focuses the light passing through the screen 6 into a final projection lens 24 which forms an image of the third screen 6 on the reproductive surface 18, forming thereon the final colour picture.

It will be noted that with the inverting optical system shown, the image on the screen 4 must be inverted, that on screen 5 upright and that on screen 6 inverted, so that the projection lens 24 forms an upright image of the screen 18. This can be arranged by applying the deflecting currents to the coils 13a, 14a and 15a in a suitable sense.

Low Frame Frequency

As pointed out before, the use of an image screen of this type enables one to use a *picture repetition frequency which is much lower than usual*, since the intensity is held substantially constant during the whole frame period *and no flickering occurs*; in consequence, a *considerable reduction of the frequency band width is possible*. This is of even greater importance in a colour television system since the eye is more sensitive for colour fluctuations than for monochrome fluctuations, so that in the colour television systems in which no storage of image over the picture period occurs it is necessary to transmit more than 50 partial images per second in order to avoid flickering at high intensities.

In the present system in which *a large storage of the partial images over the picture period is possible*, a picture repetition frequency of 17-20 per second would be completely satisfactory, and hence the total width of the frequency band necessary to transmit the signals would be no greater than that required to transmit the signals representing a black and white picture by methods in which no storage of the received picture takes place.

Other Applications

There are, of course, many *other applications* of electron-opacity screens, apart from television. To mention only one, such a screen may be used instead of the usual fluorescent screen together with a photo-electric cell and if desired secondary electron emissive layers in a so-called image converter. Any picture optically imaged on to the photo-electric screen and electron-optically concentrated on the electron-opacity screen by corresponding electron beams will cause thereon a picture of varying transparency which can be optically projected on a large screen by a standard light source. Such a piece of apparatus appears to be especially adapted to the presentation on a large scale of public speakers, or for other purposes of presentation of topical subjects to a large audience.

Conclusion

Returning to our starting point, the cinematographic technique, we may now say that the fugitive image produced on the colour centre screen can be regarded as the *equivalent of a photographic image on a lantern slide or a cinema film. But this pseudo photographic image lasts only for the duration of a frame scanning period, and is then replaced by the new image on the same carrier*. Thus the effect is similar to that of the intermediate-film process, but with the advantages that (1) no time is lost for processing, and (2) one frame is replaced by the next on the same carrier, no film being consumed. The interchange of the consecutive frames is brought about by the diffusion of electrons across the thickness of the crystal under the influence of the electric field.

This system of television projection, making use of the interesting electron-opacity effects in a new type of electronic projection tube, the *Skiatron*, seems to approach closely the ideal solution of the problem of large-screen television as outlined at the begining of the first part of this article. The preliminary experimental results obtained up to now justify the hope that further detailed research work will succeed in developing a method of television projection which is able to provide—analogous to cinematographic technique—*pictures of any size and brightness,* suitable both for home and theatre entertainment.

Correction

On p. 55, 3rd column, line 5, last month's issue, should read:
"*of* rhodium or platinum *or* a suitable"

There are several new developments in the manufacture of wire-wound resistors. Some have ceramic coatings which render them entirely waterproof. One producer marks the coating with a spot which changes colour when the resistor is subjected to an overload. Several other manufacturers are using fibre glass as insulation.

Photographing Television Programmes

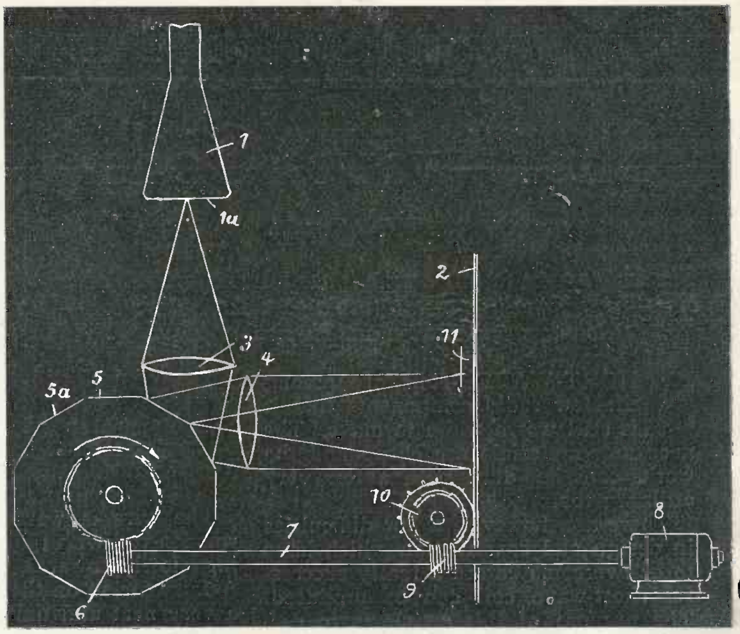


Diagram showing a successful method of photographing entire television programmes.

ALTHOUGH instantaneous photographs of television pictures have been taken by photographing the fluorescent screen of the cathode-ray tube of a television receiver, very little appears to have been done in regard to the photography of a complete television programme on to film for subsequent reproduction. Such a film record would seem to have considerable value as a convenient means for repeating television programmes, and it is surprising that nothing has so far been heard of such film records.

It may be, of course, that the technical difficulties in making such films have been a hindrance. With an interlaced type of transmission, it is not easy to photograph a television picture by means of the usual intermittent motion of the camera, but very satisfactory films have been made in the E.M.I. Laboratories by using a continuous motion film camera in the way described below.

In the drawing, 1 is television signal receiving device shown as a cathode-ray tube having a screen *1a*, tube 1 being arranged to be actuated by the signals radiated by the transmitter so as to reproduce the transmitted pictures on the screen *1a*. The tube can, for example, be a standard monitoring tube for the transmitter and either a positive or negative record may be made depending upon the polarity of the image on the cathode-ray tube.

The screen of the tube 1 is imaged on the film 2 through an arrangement comprising lenses 3 and 4 between which is the mirror drum 5 having reflecting elements *5a*, the mirror drum 5 being driven through a worm gear 6 from a shaft 7 by an electric motor 8, the shaft 7 also carrying a further worm gear 9 through which a drive is transmitted to the film driving sprocket 10.

The speed at which the film is driven relative to that of the drum 5 and the number of elements *5a*, are so chosen that there is no relative motion between the image 2 of the cathode-ray tube screen *1a* and the film. With advantage the optical system may be designed so that successive images are contiguous, leaving no waste space between frames.

The actual speed of the film is such that a satisfactory exposure is obtained and the area of the film illuminated at any instant may be limited by means of a mask 11, which preferably corresponds to the picture area on the screen of the cathode-ray tube, so that each picture is only photographed once. The film speed may conveniently be 25 frames a second, the record then being suitable by projection for standard cinematograph equipment.

It is not, of course, essential to use a mirror drum to ensure that the image of the screen shall move at the same speed as the film, and other optical compensating means may equally well be used.

The apparatus shown in the drawing may also be used for scanning film. In order to do this, the film is run through the apparatus in the same way as in the making of the film. The cathode-ray tube, however, is not modulated, so that the scanned patch is of uniform brightness, and a corresponding image is formed on the film. A photo-cell is placed behind the film and receives light from this image through the film, with the result that it generates an electrical signal proportional to the point-to-point brightness of each frame of the film in turn, i.e., the desired picture signals. No sound head is shown in the diagram, but this may, of course, follow conventional practice and its optical system may be adapted for use as a recorder or a reproducer when the same apparatus is used both for making the film record and projecting the film.

It is conceivable that motion picture studios will one day replace their cameras by Emitrons and photograph their films from a monitor tube in a way similar to that which has been described. Higher standards of definition would be required, of course, but this involves no insuperable technical problem, and the increased flexibility which would result from the fading and superposition facilities afforded by television technique would be a great advantage, particularly in regard to trick shots and shots involving expensive sets.

A RECORD OF PATENTS AND PROGRESS

RECENT DEVELOPMENTS

PATENTEES

F. and Q. H. Shurley :: Degea Akt :: Standard Telephones and Cables Ltd., :: The British Thomson-Houston Co., Ltd., and D. Gabor :: The British Thomson-Houston Co., Ltd., :: Baird Television Ltd., and P. W. Willans :: Scophony Ltd., and A. H. Rosenthal :: British Electricon Ltd., W. A. Robinson and W. A. Chambers

Photo-electric Control for Colour Printing

(Patent No. 507,089.)

A PHOTO-ELECTRIC cell is used to control the operation of a machine for printing in colour on articles which are substantially circular in shape, such as bottles, tins or cans, electric lamp bulbs, or glass tumblers.

In a three-colour process, for instance, the article must pass under the printer three times in succession, and on each occasion must be carefully adjusted, to ensure that each impression is accurately aligned with the previous ones, so as to prevent blurring.

According to the invention, the bottles, etc., are carried between rotatable chucks on a pair of revolving discs. Before being presented to the printer, each article is brought, in turn, between an electric lamp and a photo-electric cell. In this position a frictional drive is applied until a predetermined opaque spot stops the passage of light. Immediately this happens a relay is operated so that the driving motor of the friction drive is stopped, a brake is applied, and the article is thus left accurately set for printing.—*F. and Q. H. Shurley.*

Bombarding the Atom

(Patent No. 508,233.)

Neutrons to be used for bombarding atoms, in order to stimulate nuclear or chemical reactions, are usually produced by subjecting beryllium with " alpha " particles or with gamma-rays of high energy, or with high-speed particles of the heavy isotope of hydrogen. All these methods require expensive apparatus. Another method which is also open to the same objection as regards expense is that of repeated secondary acceleration by means of high-frequency fields—the so-called Cyclotron process.

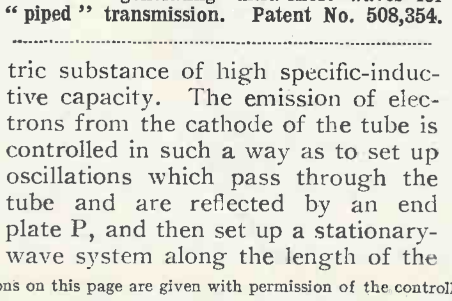
According to the invention, the energy required to activate the bombarding particles is obtained by condenser discharges through a gas of high concentration, where momentary temperatures of over ten million degrees are produced. The time-intervals are necessarily very short, but it is possible in this way to produce momentary outputs of 100,000 kilowatts and upwards. " Heavy " hydrogen is preferably used as the reagent.—*Degea Akt.*

Dielectric Guides

(Patent No. 508,354.)

It has recently been discovered that very short waves can be transmitted along a tube or " guide " made of insulating material. The energy travels along the guide in much the same way as wireless waves pass through the ether, except that they do not spread out in all directions but are " piped " inside the guide. There is no " go and return " current like that in an ordinary metallic conductor, but the transfer of energy seems to occur as a displacement current, similar to that which " passes through " a condenser.

The figure shows a method of generating ultra-high-frequency waves for transmission in this way. A cathode-ray tube T is entirely enclosed in a guide G made of dielectric substance of high specific-inductive capacity. The emission of electrons from the cathode of the tube is controlled in such a way as to set up oscillations which pass through the tube and are reflected by an end plate P, and then set up a stationary-wave system along the length of the dialectric guide. The waves may be modulated, and the signals received by a cathode-ray tube similarly arranged at the far end of the guide. —*Standard Telephones and Cables, Ltd.*

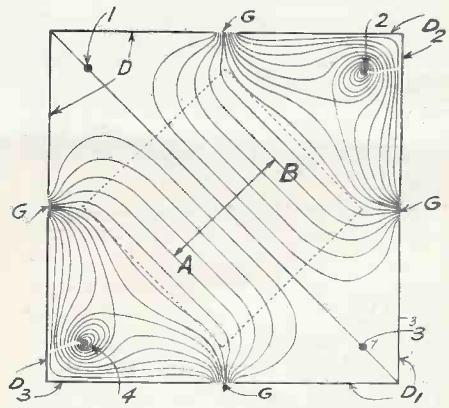


Method of generating ultra-short waves for " piped " transmission. Patent No. 508,354.

Cathode-ray Tubes

(Patent No. 508,520.)

The ordinary deflecting-plates used to control the scanning beam in a cathode-ray tube are replaced by two pairs of L-shaped plates D, D1 and D2, D3 which, when placed in position as shown, form a square in cross-section with a narrow gap G in the middle of each side.



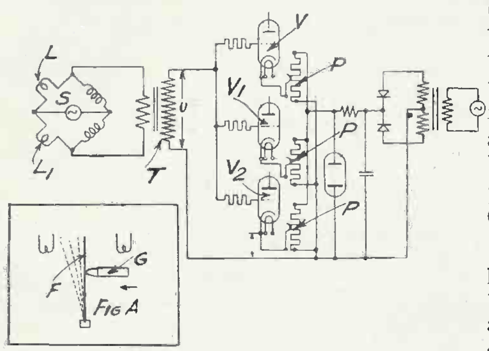
Production of uniform deflecting field in cathode-ray tube. Patent No. 508,520.

The plates D and D1 are connected with the " mean " scanning potential, whilst the plates D2 and D3 receive equal and opposite deflecting-voltages above and below the " mean " potential. In addition four " wire " electrodes 1, 2, 3, 4 are placed near each corner, as shown, and are maintained at the mean potential of the nearby deflecting-plates. The arrangement results in a deflecting-field of the form shown, the lines of force through which the electron beam is swung (in the direction A B) being both straight, and uniform in their distribution.—*The British Thomson-Houston Co., Ltd., and D. Gabor.*

Photo-electric Gauges

(Patent No. 508,616.)

The movement of a magnetic gauge G, Fig. A, bends a "feeler" or finger F, as shown in dotted lines. The finger lies in the magnetic field between two inductance coils L, L1 forming part of a Wheatstone Bridge connected across an AC source S.



Circuit for photo-electric gauge. Patent No. 508,616.

The voltage induced from the bridge into the secondary of a high-ratio transformer T is applied to the grids of three gas-discharge valves V, V1 and V2. These are arranged in parallel, and the grids are so biased from a potentiometer P that one or other of the valves is triggered off, according to the particular position of the moving member, thus automatically controlling the feed in a stepwise manner and with a high degree of accuracy.—*The British Thomson-Houston Co., Ltd.*

Synchronising Systems

(Patent No. 514,643.)

The line impulses used for scanning in television are sent out on a different carrier-wave from the framing impulses. Preferably the line impulses are radiated with the sound signals, whilst the framing impulses are combined with the vision signals, the latter being applied to modulate the carrier-wave downwards from a given datum level, whilst the synchronising impulses modulate it upwards from the same level.

The advantage of this arrangement is that the framing impulses can be conveniently used for automatic volume-control. The line impulses, too, can be more clearly separated from the sound signals, and so made immune from the effects of parasitic disturbances. — *Baird Television, Ltd., and P. W. Willans.*

"Projector" Scanning

(Patent No. 514,155.)

A cathode-ray television receiver is arranged to project the picture on to a viewing-screen placed outside the glass bulb, so that it is not restricted by the size of the tube.

The usual fluorescent screen is replaced by a "crystal" screen "sputtered" on both sides with a very thin coating of metal. Scanning by a beam of electrons then varies the transparency of the screen from point to point, so that the light projected through it from an external lamp is modulated accordingly. In this way an image of the received picture can be reproduced on a viewing-screen placed on the opposite side of the C.R. tube to the projection lamp.

The manner in which the transparency of the crystal screen is affected by the impact of the electron-beam appears to depend upon the formation of small "opacity centres," which give rise, in turn, to changes in the refractive index of the crystals as the beam moves from point to point.—*Scophony, Ltd., and A. H. Rosenthal.*

Detecting Smoke and other Impurities

(Patent No. 514,653.)

The presence of smoke in the air (as an indication of the outbreak of fire), or the presence of suspended particles or other impurities in a stream of water or other liquid, is indicated by the effect of such suspended matter on a photo-electric cell.

The air or water under test is passed through an observation chamber in which the filament of an incandescent lamp is brought to a "latent" focus by a pair of lenses acting in conjunction with a spherical reflector, both optical systems being arranged at right-angles to each other. When suspended matter is present, its diffusion effect renders the "latent" image visible or luminous, and the resulting spot of light is projected on to a photo-electric cell. This in turn operates a valve-amplifier to sound an alarm, or activate any other form of indicator. —*British Electricon, Ltd.; W. A. Robinson, and W. A. Chambers.*

Summary of other Patents

(Patent No. 505,601.)

Preventing chromatic aberration when focusing a stream of electrons. —*Zeiss Ikon Akt.*

(Patent No. 506,661.)

Electron-multiplier arranged as a quiescent push-pull amplifier.—*Marconi's Wireless Telegraph Co., Ltd.*

(Patent No. 507,122.)

Preparing and coating the sensitive cathode of a photo-electric cell. —*Electrical Research Products, Inc.*

(Patent No. 507,144.)

Optical projector suitable for use either with a standard cinema film or for handling television signals.—*Kolster-Brandes, Ltd., and C. N. Smyth.*

(Patent No. 507,235.)

Photo-electric control for an apparatus designed to copy or reproduce three-dimensional objects.—*L. Mellersh-Jackson.*

(Patent No. 509,034.)

Preparing and coating coiled filaments suitable for use as cathodes in gas-filled discharge tubes.—*British Thomson-Houston Co., Ltd.*

(Patent No. 509,090.)

Discharge tube with two intersecting electron streams, suitable for use as an amplifier or "mixer" valve in a superhet receiver.—*N. V. Philips Gloeilampenfabrieken.*

(Patent No. 509,102.)

Arrangement of the control magnets in a magnetron valve for generating ultra-short waves.—*Electricitats Ges. Sanitas.*

(Patent No. 509,260.)

Photo-electric control for adjusting the speed of the shutter, or the lens aperture, of a camera.—*I. G. Farbenindustrie Akt.-Ges.*

(Patent No. 512,327.)

Non-reactive circuit for coupling the output from a photo-electric cell to an amplifier.—*Baird Television, Ltd., and P. E. A. R. Terry.*

(Patent No. 512,903.)

Television transmitter using an image-storing screen made of alkali-halide crystals which develop special "sensitive" centres. — *Scophony, Limited, and A. H. Rosenthal.*

(Patent No. 513,486.)

Television system based on the use of two crossed grids of wires, which take the place of the usual fluorescent screen and are connected to a picture-reproducing screen mounted outside the cathode-ray tube.—*F. A. Lindemann.*

(Patent No. 514,021.)

Natural colour system of television in which signals representing "brightness" alternate with signals representing "colour." — *K. H. Kerber.*

(Patent No. 514,153.)

Photo-electric cell arrangement for counting the revolutions of the impeller blade of a ship's log, or other flow-meter.—*B. Cherhikeeff.*

"Communal Distribution"

(*Continued from page* 139)

arise from the incorporation of two shunt accepter paths. Attenuation, therefore, arises by a shunt diversion of the current through the network and if the shunt-diverted current is limited over a certain range of frequencies the attenuation of the network will likewise be limited. In Fig. 3 the limiting is effected by the common shunt path resistance R′ and the level at which the limiting of attenuation occurs can be adjusted by varying the value of this resistance.

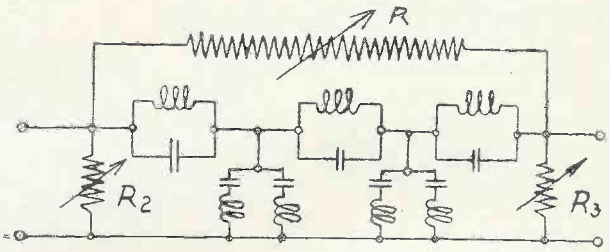


Fig. 4. Circuit for prevention of distortion of side bands due to attenuation.

As a point of mere interest and having no bearing on interference from a local transmitter it is worth noting that related to the band-rejector level-attenuation networks discussed, band-pass networks with level admittance in the pass band can be constructed by connecting a sharply cutting filter in series with a network of less trans-admittance having the purpose of smoothing the pass-region of the characteristic of the filter. This constitutes the inverse application of the principle underlying the networks that have been discussed in detail and by means of which, or by networks constructed on similar lines, it will have been evident, a very satisfactory solution to the problem of producing a filter with rapid cut combined with level attenuation is obtainable, and consequently to that of realising the advantage offered in relation to an overpowering local transmitter by a communal receiving system.

Recording Sound on Steel Wire

By Ronald L. Mansi, M.R.C.S., L.R.C.P., D.M.R.E. (Camb.)

In the two preceding issues details of the design of apparatus of a simple character for recording sound on steel wire were given. The article below gives instructians for recording, playing back and wiping out.

On *no account anchor the wire securely to the drum*, otherwise if the end of the wire is reached inadvertently without stopping the machine much damage may result. The best plan is as follows. Drill a fine hole about 1/32 in. diameter in the extreme bottom or well of the groove and direct the drill sideways so that it emerges a short distance below the groove out on to the face of the drum (see Fig. 6). Thread the wire through the hole and with a pair of round nose pliers bend ⅛ in. at the end to an angle of about 40°. This is all that is necessary to hold the wire for winding and the following few turns soon bind it in place. With this arrangement, should the wire come to the end with the machine still running, it easily clicks out of the hole and goes through the head without doing any damage.

If tin plate rims are used let a few turns wind on the drum first before recording so that the following turns will not be in direct contact with the metal of the rim. One layer of wire will be ample and not strictly necessary.

Always start and stop the motor slowly. It is more convenient, when a recording or play back is finished, to lift the lid and as the resistance is slid to the "off" position, to stop the free drum with moderate pressure of the finger. This saves waiting for the drum to slow down without overrunning the driven drum, which usually stops rapidly with the motor. Although the brake bands assist considerably in this respect, it is not desirable to have them too tight for several reasons, and in any case this manœuvre is only necessary at the end of a run.

See that the pressure on the wire is adjusted correctly as given in the previous instructions, and in this connection, if there is a noticeable falling off of volume or quality, all other factors being correct, immediately suspect the "head." The fault will be either of the following two points:—

(1) Since the spring pressure necessary on the core is only enough to move the core about one-third the thickness of the wire, if the wire has only worn a shallow groove in the core it may not be touching the chisel edge, all the spring action having been taken up. A fraction of a turn on the fine adjust-

ment will immediately cure this trouble.

(2) The wire may have grooved the chisel edges so deeply that they (the chisel edges) touch each other. In this case it will be necessary to bring the wire to bear on a new portion of the chisel edges as previously described.

Playing Back

For playing back it is usual to have the lid of the machine closed, to prevent any mechanical noises interfering with the reproduction. The machine, however, is very silent in operation and this may not be found necessary. If the lid is closed, the speed can be soon judged by the sound and quality of the reproduced voice. This is a very useful point if the machine is constructed without a speedometer. For recording, if an insensitive microphone like the one described is used, it is not necessary to have the lid closed, and so an accurate constant check on the speed can be kept. However, with a well-charged battery and the resistance once set, the speed remains remarkably constant.

It is advisable not to use more current than is necessary for wiping out the recording as this will introduce background noise. To find the correct point on the variable resistance dial proceed as follows.

Run a long length of wire with a recording at normal strength on it through the head. At definite intervals decrease the resistance by degrees which are carefully noted on the dial. With a speedometer these points are easily checked with the corresponding points on the wire, but if no speedometer is fitted, time with a watch.

On playing back, the different sections will be heard with decreasing volume starting from the beginning. When that section is reached in which the recording becomes just inaudible, note the corresponding setting on the resistance dial and retain it for wiping out.

It may be found that when the wire has worn a fairly deep groove in the pole pieces, a little more current may be necessary for wiping out, since all the magnetic lines of force do not now go through the wire.

Wiping Out

It will be found convenient to wipe out a recording when winding backwards so as to finish with a clean wire immediately ready for another recording. This will also provide a good opportunity for oiling the felt pads, since all the attention can be given to the head as no recording controls, etc., have to be watched. It is especially necessary to oil at this time as the cores bear with additional pressure on the wire due to the relatively stronger magnetic attraction caused by the wipe out current flowing in the coils.

As it is rarely desired to listen to the recording when winding backwards, considerable wear on the pole pieces can be saved by slipping a thin wooden distance piece in the space between the two phosphor bronze springs. It should be a fraction longer than the normal distance to hold the pole pieces a short distance away from the wire; this prevents unnecessary wear. Of course, it must be removed when recording or playing back.

If, for the several reasons already mentioned, background noise should be present, it can very simply be rendered non-obtrusive as follows. A small, fairly powerful bar magnet (not horseshoe) is slowly brought up towards the head when playing back, along a line which is a continuation of the long axis of the electro-magnets. At a distance of three inches or so (depending on the strength of the magnet used) from the head, a point is soon found where the background noise disappears, although it reappears on either side of this point. If the noise increases at all points, reverse the magnet and repeat the procedure.

This pole will remain the constant one to be used, since the majority of such background noises are due to

(*Continued on next page*)

"Recording Sound on Steel Wire"

(*Continued from page* 143)

faults in wiping out, the polarity of which current, however, remains constant. Note that it is only necessary to do this to one side of the head. This is due to the fact that the background noise is probably due to unbalanced magnetic characteristics and the one-sided extra field balances it up. If shields are used on the head the magnet will have to be brought closer than it would be if no shields are used.

It is not necessary to open the lid during this operation. The writer merely rests the magnet on a matchbox and pushes it up close to the case in the direction described above. Besides being very effective this method has the virtue of simplicity, but at the time of writing a small electro-magnet, close to the head and controlled by a variable resistance, is being devised with the same object in view.

It is most important that all such form of magnetic control, etc., be removed far from the head when recording, otherwise the recording will be spoiled. Only control the background on the play back and do not bring the magnet too close to the head otherwise the recording will be wiped out.

It will be seen, as was mentioned earlier, that this method is merely a form of background control on the play back, and in no way analogous to the method, used in some machines, of altering the magnetic characteristic or "threshold" of the wire when recording. It might be argued that since it wipes out the background on the play back, it should do so when recording. Nevertheless one trial should convince the sceptic as he will be greeted with a thunderous background in the play back after doing this impossible to eradicate. In most cases, however, if all the points mentioned have been carefully observed, such background control measures will be found unnecessary.

This brings the article to a close, and although the description may have seemed a little involved, upon consideration it will be seen that a large section has been taken up with a description of the principles and alternative methods possible, but the actual construction is quite straightforward.

Network Television Demonstrated in U.S.A.

Network television was demonstrated successfully to the Federal Communications Commission in Schenectady last month by General Electric engineers. The first demonstration of its kind in history, in which a programme transmitted from New York was clearly received in Schenectady homes, 142 miles away, was made possible by the use of General Electric's new relay station working in conjunction with its main transmitter on the Helderberg Mountains.

By the use of the new relaying equipment, located 1.2 miles from the main transmitter on the Helderberg Mountains, 12 miles from Schenectady, television broadcasts from New York City will become available to Capital District residents within the range of the company's station W2XB.

The programmes transmitted from New York City are received at the relay station on the 44-50 megacycle band by means of a 400-ft. rhombic antenna supported by four 128-ft. towers.

By means of a low-power 10-watt transmitter the picture part of the programmes is then relayed on a carrier wave of 156-162 megacycles from a small transmitting antenna to the main Helderberg station.