

Aug. 6, 1940.

M. BOWMAN-MANIFOLD

2,210,702

TELEVISION SYSTEM

Original Filed July 3, 1933

4 Sheets-Sheet 1

Fig. 1

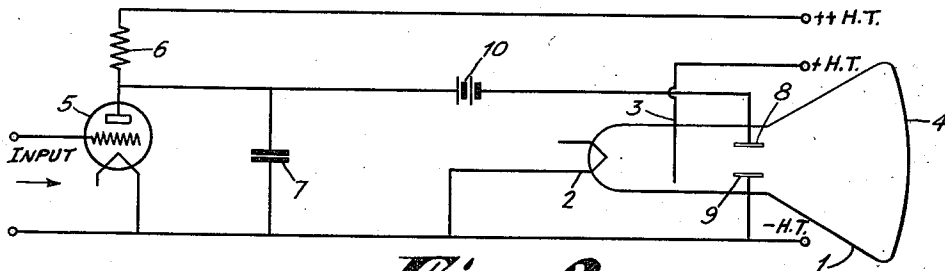


Fig. 2

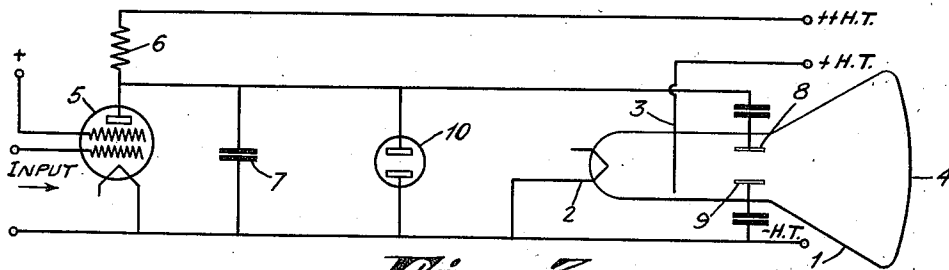


Fig. 3

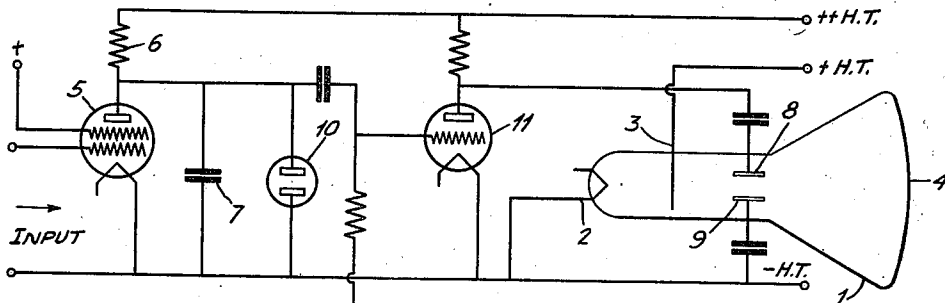
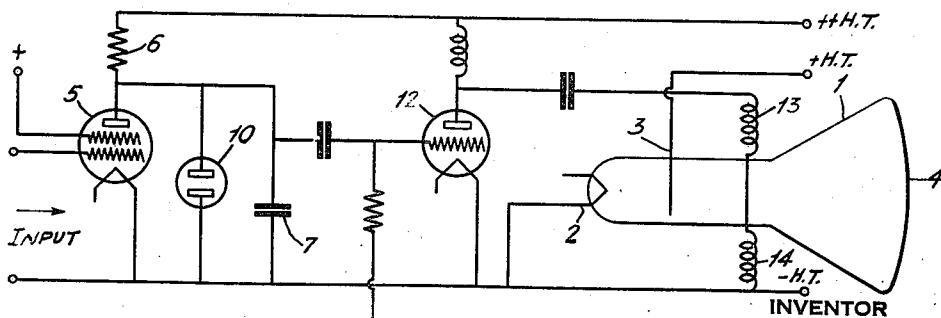


Fig. 4



INVENTOR
M. BOWMAN-MANIFOLD
BY *N.S. Grover*
ATTORNEY

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M. BOWMAN-MANIFOLD

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Fig. 5

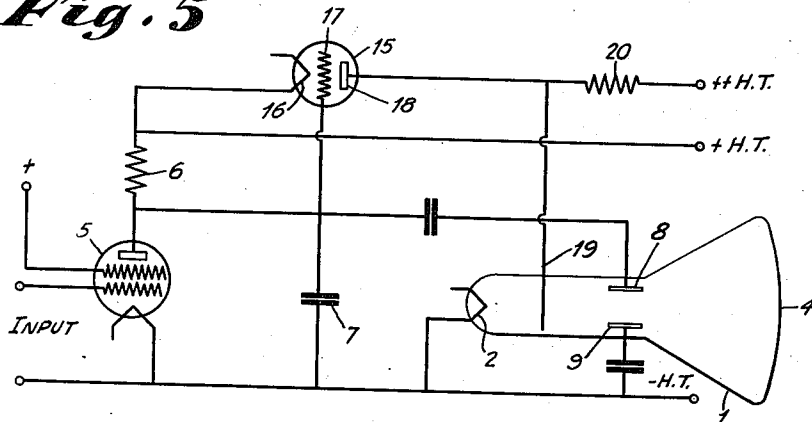


Fig. 6

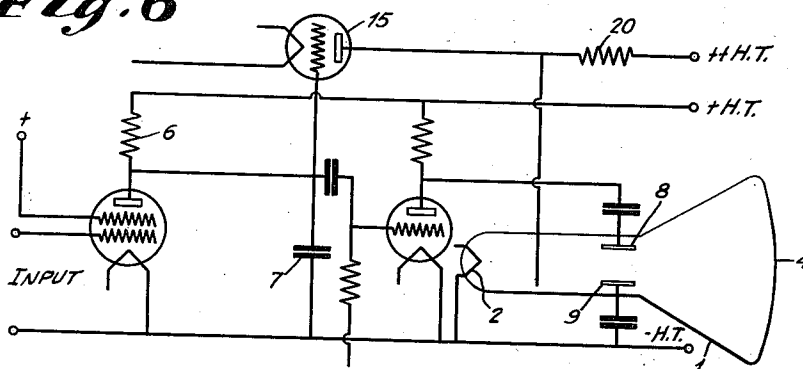
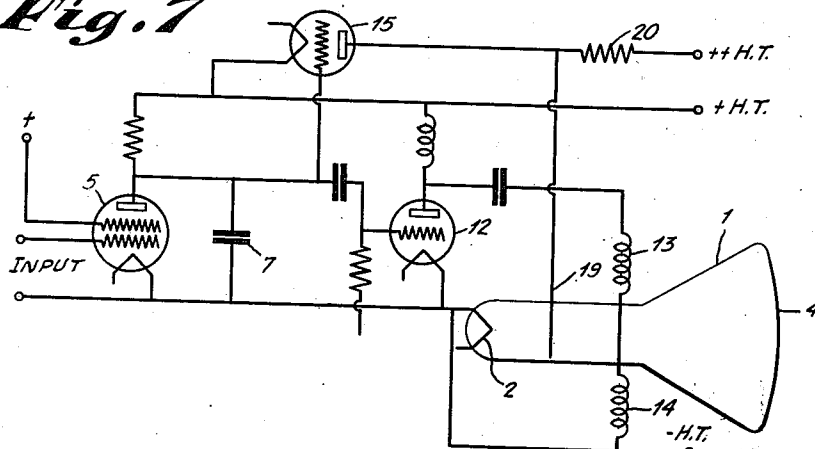


Fig. 7



INVENTOR
M. BOWMAN-MANIFOLD
BY *H. S. Grover*
ATTORNEY

Aug. 6, 1940.

M. BOWMAN-MANIFOLD

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Fig. 8

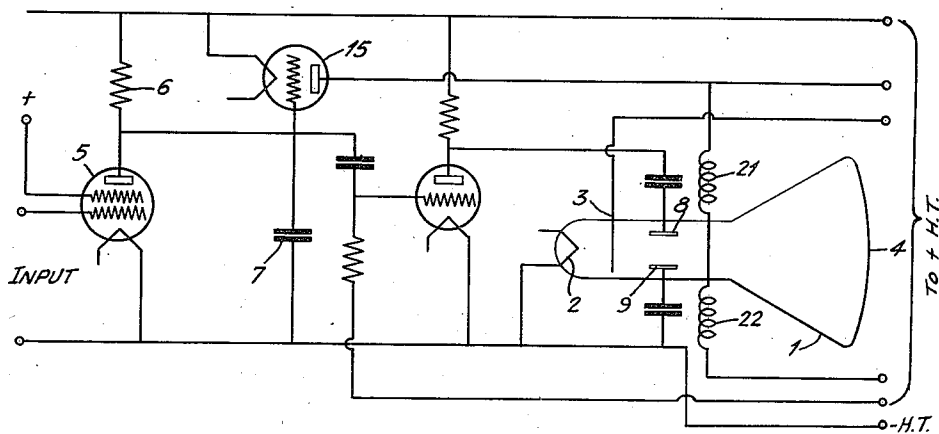
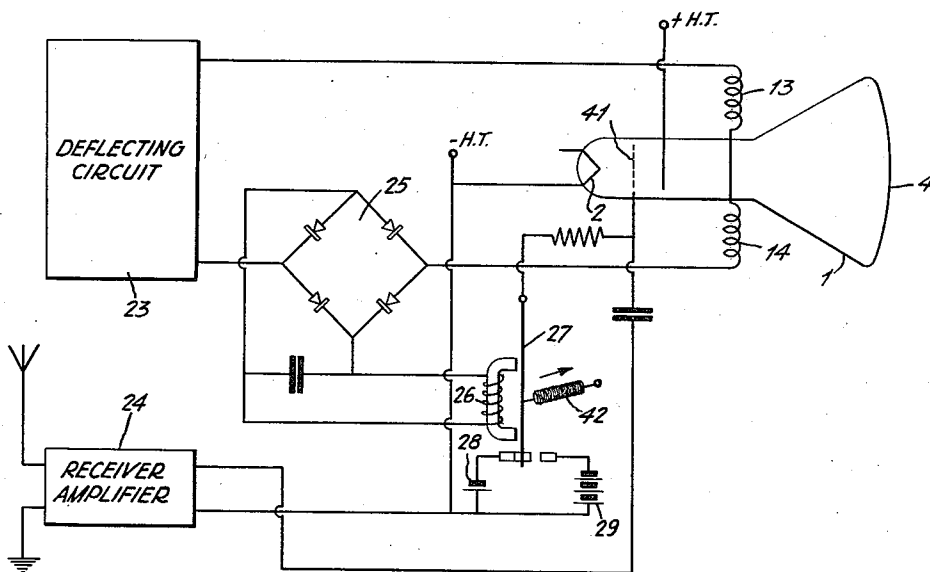


Fig. 9



INVENTOR
M. BOWMAN-MANIFOLD
BY *H. S. Sower*
ATTORNEY

2,210,702

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INVENTOR
M. BOWMAN-MANIFOLD
BY *H.S. Grover*
ATTORNEY

UNITED STATES PATENT OFFICE

2,210,702

TELEVISION SYSTEM

Michael Bowman-Manifold, Surrey, England, assignor to Electric & Musical Industries, Ltd., a corporation of Great Britain

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8 Claims. (Cl. 250—27)

The present invention relates to television systems and the like, such as systems for current or potential wave analysis, which involve the use of a cathode ray tube.

In most systems of this kind which are at present in use there is associated with the tube a deflecting circuit, sometimes called a time base device, which is adapted to keep the cathode ray in more or less continuous motion over a screen associated with the tube. In the case of a television receiving system, for example, the ray is deflected at a high speed, either by electrostatically or electromagnetically controlled deflecting fields, or a combination of both, over a fluorescent screen in close parallel lines, whilst at the same time the ray is modulated in intensity in accordance with the light and shade value of the transmitted picture.

It has been found, however, that if in such systems a failure of the deflecting circuit occurs and the ray becomes stationary on the screen, the latter is damaged by the ray and in a very short space of time may have a hole burnt in it.

Failure of the deflecting circuit may occur as a result of any one of a variety of causes.

If the deflecting circuit is maintained in oscillation by received synchronizing signals, for example, then cessation of the signals will cause the deflecting circuit to fail which in turn causes the ray to become stationary on the screen. If the deflecting circuit is self-oscillatory, then damage may occur either as a result of a failure of a member in the deflecting circuit or as a result of the deflecting circuit being switched off before the ray itself is extinguished.

It is an object of the present invention to provide means whereby damage to the screen structure, as a result of failure of the deflecting circuit, may be avoided.

According to the present invention a television or the like system comprises a cathode ray tube, a deflecting circuit which has no self-oscillatory properties, or at least functions normally independently of any self-oscillatory properties, but which is adapted, under the control of signals such as synchronizing signals, to generate electrical oscillations for reflecting the cathode ray over a screen associated with the tube and means adapted to render the ray innocuous to the screen on failure of said deflecting circuit.

According to a further feature of the present invention a television or the like system comprises a cathode ray tube, deflecting means for effecting the periodic deflection of the cathode ray over a screen and safety means, operative upon

failure of said deflecting means, for rendering the cathode ray innocuous to the screen.

The ray may be rendered innocuous to the screen by being suppressed entirely, reduced in intensity, deflected off the screen or kept in motion by some auxiliary deflecting means. If the last mentioned expedient be adopted damage may be avoided merely by keeping the ray in motion over the screen in a straight line.

Other features of the invention will be apparent from the accompanying description and the appended claims.

Several embodiments of the invention will be described by way of example, reference being made to the accompanying drawings.

Each figure of the drawings illustrates, diagrammatically, a television receiving system comprising a cathode ray tube and, associated with the tube, deflecting and safety circuits. The safety circuit is, in each case, adapted to function only when the deflecting circuit fails.

In the arrangement illustrated in Fig. 1 the normal deflecting circuit is so modified that it operates to deflect the cathode ray off the screen when the synchronizing signals fail;

Figs. 2, 3 and 4 illustrate arrangements in which a self-oscillatory safety circuit operates to maintain the cathode ray in motion in a straight line over the screen, on failure of the normal deflecting means.

Figs. 5, 6 and 7 illustrate arrangements in which the safety circuit operates to reduce the intensity of the ray falling on the screen; and

Fig. 8 illustrates an arrangement in which an auxiliary safety circuit deflects the ray off the screen.

The safety circuits illustrated in the above Figs. 1 to 8 inclusive are brought into operation automatically if the deflecting circuits fail owing to cessation of the synchronizing signals. As indicated earlier, however, the deflecting circuits may fail for other reasons.

Figs. 9 and 10 illustrate arrangements in which the safety circuits are automatically brought into operation if the deflecting circuit fails for any reason whatsoever. Fig. 10 illustrates a television receiver comprising a cathode ray tube, a rectifier adapted to supply the tube with current, a deflecting circuit and a safety circuit, the arrangement being such that if the rectifier and deflecting circuit are switched off simultaneously, the safety circuit operates to extinguish or reduce the intensity of the ray before it comes to rest on the screen.

Figure 11 illustrates an arrangement wherein

the sweep circuit must be operating before the electron beam can attain its full strength.

Like parts illustrated in the several figures bear the same reference numbers.

5 All of the receivers illustrated are adapted for use with a transmitter, not necessarily comprising a cathode ray tube, from which there are transmitted a carrier wave modulated in accordance with the picture elements and a series of syn-
10 chronizing impulses. The synchronizing impulses, which should be of extremely short duration compared to the intervals between them, may be transmitted upon the same or upon a different carrier wave.

15 The receiver illustrated in Fig. 1 comprises a cathode ray tube 1 having a cathode 2 and an anode 3. The picture impulses are utilized to modulate the intensity of the cathode ray whilst the synchronizing impulses are utilized to deflect
20 the ray, electrostatically, over a fluorescent screen 4 associated with the tube. In order to effect this deflection of the ray the synchronizing impulses, if necessary after separation from the picture impulses by means of electrical filters,
25 are applied to the grid circuit of a thermionic valve 5, the grid of which is biased negatively to such an extent that, whilst the valve is normally non-conductive, it becomes conductive when synchronizing impulses are received. The
30 cathodes of the valve 5 and the cathode ray tube 1 are connected together and to the negative terminal of a source of high voltage. The anode of this discharge valve 5 is connected through a high resistance 6 to a point on the voltage source
35 and the anode 3 of the cathode ray tube 1 is connected to another suitable point on the source. In shunt with the anode-filament path of the valve 5 is connected a condenser 7 which is charged through the resistance 6 at a compar-
40 atively slow uniform rate when the valve 5 is non-conductive. The condenser 7 discharges through the valve 5 when the valve is rendered conductive by the received synchronizing impulses. The
45 condenser 7 has its terminals connected respectively to two deflecting plates 8 and 9 of the cathode ray tube 1. The connections are conductive and either direct or through a biasing battery 10.

It will be seen that since the condenser 7 is
50 charged at a uniform slow rate and discharges periodically through the discharge valve 5 there is applied to the deflecting plates 8, 9 of the tube a sawtooth voltage wave. A similar voltage wave,
55 but of different frequency, if applied to another pair of deflecting plates associated with the tube with the aid of a second circuit, similar to that described, and the second pair of plates serves to deflect the ray in a direction perpendicular
60 to the first pair. The frequency of one wave is much greater than that of the other and the combined effect is to cause the ray to move over the fluorescent screen 4 in close parallel lines. For simplicity, the second pair of plates and its
65 associated deflecting circuit have not been illustrated.

If now the incoming synchronizing impulses fail owing to a fault at the transmitter, in the transmission channel or in any part of the deflecting circuit prior to the discharge valve 5,
70 the condenser 7 acquires a potential difference outside its working range owing to the fact that it cannot discharge through the discharge valve 5 which, owing to the cessation of synchronizing impulses, remains non-conductive. Because of
75 the conductive connections between the con-

denser 7 and the deflecting plates 8, 9 the potential difference applied to the plates is sufficient to deflect the ray off the screen 4 and damage to the screen is thus avoided.

Referring to Fig. 2, in which the left hand part
5 of the circuit is the same as in Fig. 1 excepting that here the valve 5 is shown as a screen grid valve, a cathode ray tube is shown at 1, having a cathode 2, an anode 3 and a fluorescent screen
10 4. A diode 10, such as a neon tube, is connected in shunt with the condenser 7 and these two members are connected in parallel with the deflecting plates 8, 9 of the tube and the anode-filament path of the discharge valve 5. The diode
15 10 has such properties that during normal operation of the deflecting circuit 5, 6, 7 substantially no current passes therethrough. As before, the condenser 7 is charged at a uniform rate through
20 a resistance 6 and discharges through the valve 5 when the latter is rendered conductive by received synchronizing signals.

On failure of the synchronizing signals, however, the potential difference across the condenser 7 and the diode 10 builds up abnormally until a
25 point is reached when the diode becomes conductive and the condenser 7 then discharges through the diode. A self-oscillatory safety circuit is thus formed and the fluctuating potential supplied from this circuit to the deflecting plates
30 8, 9 of the tube ensure that the ray is kept in motion over the screen 4.

The arrangement illustrated in Fig. 3 is the same as that illustrated in Fig. 2 with the exception that the sawtooth voltage wave developed
35 across the condenser 7 is amplified in the amplifying valve 11 before being applied across the plates 8, 9 of the tube 1.

A further modification of the arrangement of Fig. 2 is illustrated in Fig. 4. Here the sawtooth
40 voltage wave developed across the condenser 7 is utilized to generate a sawtooth current wave in the plate circuit of a thermionic valve 12, this sawtooth current wave being passed through two
45 deflecting coils 13, 14 associated with the tube 1. If the deflecting circuit fails owing to cessation or fading of the received signals, the condenser 7 builds up to the striking voltage of the diode
50 10 and automatically discharges through the diode instead of through the valve 5; thus keeping the ray in motion over the screen 4.

In the arrangement illustrated in Fig. 5, the safety circuit comprises an auxiliary thermionic
55 valve 15 which functions if the deflecting circuit fails.

The filament 16 of the auxiliary valve 15 is
60 maintained at a high positive potential relative to the filament of the discharge valve 5, being connected, preferably, to the source of anode potential of the valve 5, that is to the end of the resistance 6 remote from the anode of the valve
65 5. The grid 17 of the auxiliary valve 15 is connected to that terminal of the condenser 7 which is connected to the anode of the discharge valve 5 and thus the grid 17 of the auxiliary valve 15 is biased negatively with respect to its filament
70 16. The anode 18 of the auxiliary valve is connected to one of the electrodes 19 of the cathode ray tube 1 which control the intensity of the ray, these two electrodes being connected through a common resistance 20 to a source of positive potential higher than the positive potential of the source supplying the anode of the discharge valve 5.

On failure of the synchronizing impulses the discharge valve 5 remains non-conductive and, as
75

before, there is developed across the condenser 7 in shunt with the discharge valve 5 an abnormally high potential difference. The positive plate of the condenser is, however, connected to the grid 17 of the auxiliary valve 15 and therefore this grid 17 becomes less negative with respect to its filament 16. Current thus passes in the plate circuit of the auxiliary valve 15 and the potential of the anode of this valve, together with that of the intensity control electrode 19, falls. In consequence the intensity of the ray reaching the fluorescent screen 4 is reduced. The electrode 19 may be such that its potential controls the intensity of the ray reaching the screen 4 mainly by control of focus, that is to say so that the total number of electrons reaching the screen is little affected or the electrode potential may affect mainly the number of electrons reaching the screen. In either case the effect is to protect the screen against damage by the ray.

The arrangement of Fig. 6 is the same as that of Fig. 5 with the exception that the sawtooth voltage wave developed across the condenser 7 is amplified in the amplifying valve 11 before being applied to the deflecting plates 8, 9 of the tube 1.

As illustrated in Fig. 7, the sawtooth voltage wave generated across the condenser 7 is utilized to generate a sawtooth current wave in the plate circuit of the valve 12, this sawtooth current being passed through a pair of deflecting coils 13, 14 associated with the tube. As in the case of Figs. 5 and 6, if the deflecting circuit fails owing to the cessation of synchronizing signals, current commences to flow in the plate circuit of the auxiliary valve 15 and the ray is thrown out of focus on the screen 4 or its total strength is reduced, or both effects occur, owing to the fall in potential of the electrode 19.

In the arrangement illustrated in Fig. 8 current flowing in the plate circuit of the auxiliary valve 15 is passed through an auxiliary pair of deflecting coils 21 and 22 which operate to deflect the ray off the screen if synchronizing signals cease.

The safety circuits so far described afford no protection for the screen if a failure occurs in the discharge valve itself or in any part of the deflecting circuit between the discharge valve 5 and the deflecting plates or coils of the tube.

Protection for such a failure may be obtained, however, in accordance with the present invention by inserting, in one of the deflecting circuits associated with the tube, a relay, or a thermionic valve or contact rectifier feeding a relay, which operates automatically on failure of the normal deflecting means to render the ray innocuous to the screen in one of the ways already mentioned.

A television receiver embodying such a safety device is illustrated in Fig. 9. In this figure 23 represents a deflecting circuit which may be of the kind illustrated in any of Figs. 2 to 8 but having no safety circuit associated with it. Received picture signals are amplified in the amplifier 24 and applied between the cathode 2 and control electrode 41 of the cathode ray tube 1. The ray is deflected over the screen 4 by means of a pair of coils 13, 14 and a copper oxide rectifier 25 is connected in series with the deflecting coils. The direct current output from the rectifier 25 is utilized to energize a relay, comprising an electromagnet 26, which brings into or out of operation a safety device. When a normal deflecting alternating current passes through the coils 13, 14 of the tube the output from the recti-

fier 25 energizes the electro-magnet 26 in such manner that its armature 27 closes an auxiliary circuit comprising a battery 28, which supplies a potential to the control electrode 41 of the cathode ray tube. The potential supplied in this way is that required for the normal operation of the tube.

If, however, the alternating current supplied to the coils of the tube fails the electromagnet 26 is not energized and the armature 27 thereof is moved by a spring 42 to close a second auxiliary circuit comprising a battery 29, which supplies a much higher negative potential to the control electrode 41 of the cathode ray tube. By this means the intensity of the cathode ray is reduced and damage avoided.

If desired, closure of the second auxiliary circuit above mentioned by the relay may cause the ray to be deflected off the screen or may close a circuit serving to keep the ray in motion over the screen. Alternatively it may change the potential of another electrode of the tube whereby the ray is thrown out of focus.

Instead of the rectifier 25 being arranged in series with the deflecting coils 13, 14 it may be arranged in parallel therewith or in series or parallel with an auxiliary coil coupled to the normal deflecting coils or plate circuit.

If the ray is normally deflected over the screen by electrostatic means a modification (illustrated in Fig. 10) of the above described form of the invention can be adopted.

The deflecting plates 8, 9 of the cathode tube 1 are connected across the grid-filament of a thermionic anode bend rectifying valve 30 and a relay comprising an electromagnet 26 is connected in the plate circuit of this valve.

When a normal alternating potential is applied to the deflecting plates 8, 9 of the tube 1, current passes in the valve 30 whereby the electromagnet 26 in the plate circuit is energized and the armature 27 thereof is caused to break a safety circuit which includes a pair of auxiliary deflecting coils 21, 22. Thus under these conditions the tube is operating normally.

If now the deflecting alternating potential fails, the plate current in the rectifying valve 30 ceases, the electromagnet 26 is not energized and its armature is urged by spring 42 to close the safety circuit including the coils 21, 22. The coils are disposed one on either side of the cathode tube, and a source of direct current (not shown) may be connected in series with the coils. When this safety circuit is closed the field set up by the coils deflects the cathode ray off the fluorescent screen.

In switching off any of the receivers described above, the high tension supply for the cathode ray tube should be switched off before the deflecting circuits are switched off, otherwise the ray will come to rest on the screen before being extinguished and so damage the screen.

A difficulty arises if it be desired to control the current supplies for the tube and the deflecting circuits by one switch because, in general, the time constant of the rectifier supplying the tube is greater than the time constant of the rectifier supplying the deflecting circuit so that, on switching off, the ray comes to rest before being extinguished. The arrangement illustrated in Fig. 11 is designed to overcome this difficulty.

The anode 3 and focusing electrode 31 of a cathode ray tube 1 are supplied with current from a source of alternating current 32 through a rectifier 33, a smoothing condenser 34 being ar-

ranged as shown. The cathode 2 of the cathode ray tube is connected to an intermediate point of the potentiometer resistance 35 so that it is positively biased, with respect to earth, from its own high tension supply.

The control grid 41 of the tube, to which received picture signals are applied through a condenser 36, is connected, through a resistance 43, to an intermediate point of a potentiometer resistance 37, current for this potentiometer being derived from a rectifier 44 which also supplies a deflecting circuit 23 with current. A sawtooth voltage or current wave is generated in the deflecting circuit 23 which is used to deflect the ray over the screen 4 of the tube 1.

The rectified current from the rectifier 44 passes to the circuit 23 through a smoothing circuit comprising two condensers 38 and 39 and an inductance 40, energy being supplied to the rectifier 44 from the same source (for example the power supply mains) as supplies the rectifier 33.

The grid bias of the tube 1 is thus derived partly from the rectifier 33 supplying the tube and partly from the rectifier 44 supplying the deflecting circuit, negative bias being derived from the first rectifier and positive bias from the second. The two bias voltages are arranged such that the resultant bias produces a ray of the desired average intensity.

The time constants of the bias circuit cooperating with rectifier 33 is made considerably greater than the time constant of the bias circuit of the rectifier 44.

Consequently, if the source 32 be switched off, although the ray may come to rest before the anode-cathode potential of the tube falls to zero, nevertheless the positive grid bias of the tube falls to zero at a higher rate than does the negative grid bias, so that the resultant negative grid bias tends to remain high in the initial period immediately after switching off. The intensity of the ray is thus immediately reduced to a low value which may be zero. If it is not zero then after the immediate reduction to a low value the intensity thereafter falls to zero at the same rate as the anode-cathode potential of the ray falls to zero.

If desired, instead of biasing the cathode ray tube in this way, the tube may be provided with an auxiliary pair of deflecting coils or plates, energized through the tube rectifier 33. In this case, the supplies to the normal and auxiliary coils or plates are adjusted until with the auxiliary deflecting means alone in operation the spot is deflected off the screen and with both the auxiliary and the normal deflecting means in circuit (but with no oscillatory component in the normal deflecting circuit) the spot takes up a central position on the screen. On failure of the normal deflecting circuit, due to switching off or for any other reason, the ray is deflected off the screen by the auxiliary deflecting means energized from the tube rectifier 33.

If desired, an auxiliary coil may be mounted coaxially upon the tube and current supplied thereto from the rectifier 33. The arrangement is then made such that with the auxiliary coil operative, as well as the normal electromagnetic or electrostatic focusing means, the spot is in focus but on interruption of current through the auxiliary coil the spot goes out of focus.

In connection with this invention it should be understood that the invention is intended to cover conditions of starting the operation of the

system and that the protective means herein disclosed are so operative that the cathode ray beam is not turned on or otherwise rendered effective upon the screen until the deflection circuits are functioning properly.

Having now described the invention, what is claimed and desired to protect by Letters Patent is the following:

1. A television receiving system comprising a cathode ray tube having a viewing screen and means including an anode for forming a beam of electrons, means to supply said anode with positive voltage, a deflecting circuit adapted to operate normally independently of any self-oscillatory properties, means operative under the control of synchronizing signals received from a distant point for controlling the generation of oscillations in said deflecting circuit for deflecting the formed beam of electrons over said viewing screen, and anode voltage reducing means interlocked with said deflecting circuit and the anode, and operative upon the failure of normal operation due to the absence of synchronizing signals of the deflecting circuit to reduce the velocity of the beam of electrons to a value other than zero which will not harm said viewing screen.

2. In a cathode ray system, a cathode ray tube having an anode, a luminescent observation screen and a source of positive voltage connected to said anode to generate an electron beam, means to receive synchronizing signals, deflecting means normally operative under the control of the received synchronizing signals to cause the generated electron beam to traverse the screen, and anode voltage reducing means interconnected with the deflecting means and the anode to reduce the intensity of the beam to a value other than zero which will not harm the screen in the absence of received synchronizing signals.

3. In a cathode ray system, a cathode ray tube having an anode, a luminescent observation screen and a source of positive voltage connected to said anode to generate an electron beam, means to receive synchronizing signals, deflecting means normally operative under the control of the received synchronizing signals to cause the generated electron beam to traverse the screen, means to control the deflecting means in accordance with the received synchronizing signals, and anode voltage reducing means interconnected with the deflecting means and the anode to reduce the intensity of the beam to a value other than zero which will not harm the screen in the absence of synchronizing signals.

4. In combination, a cathode ray tube having a cathode, an anode and a fluorescent screen and adapted to generate a beam of electrons, means including a resistor connected to the anode for maintaining the anode at a positive potential with respect to the cathode by a predetermined amount, deflecting means normally operative to cause the generated beam to traverse the screen, means connected to the deflecting means for controlling the traversal of the beam, discharge path means connected to the connection point of the anode and the resistor, and means connected to the deflecting means to render the discharge path conducting upon failure of the deflecting circuit to cause traversal of the beam, whereby the positive potential of the anode is reduced.

5. In a cathode ray tube system, a cathode ray tube having a luminescent observation screen, an anode and an electron source from which an

electron beam is generated, a source of voltage for supplying said anode with positive potential, deflecting means to cause the electron beam to traverse the screen periodically, means to supply
5 synchronizing signals to the deflecting means to control the periodic traversal of the screen by the electron beam, and auxiliary anode voltage reducing means operative in the absence of synchronizing signals for reducing positive potential on said anode to protect the observation
10 screen.

6. In a cathode ray tube system, a cathode ray tube having a luminescent observation screen, an anode and an electron source from which an
15 electron beam is generated, a source of voltage for supplying said anode with positive potential, deflecting means to cause the electron beam to traverse the screen periodically, means to supply synchronizing signals to the deflecting means to
20 control the periodic traversal of the screen by the electron beam, auxiliary anode voltage reducing means connected to the synchronizing means for reducing the positive potential on the anode in the absence of synchronizing signals,
25 whereby the intensity of the beam is reduced to a value other than zero.

7. In a cathode ray tube system wherein a cathode ray tube is provided with a luminescent observation screen, an electron source from
30 which an electron beam is generated and projected toward the screen, and an anode supplied

with positive potential, the method of operation for protecting said screen which comprises the steps of normally deflecting the electron beam periodically across said screen, supplying syn-
5 chronizing signals to control the periodicity of deflection of the beam, and reducing the positive potential of said anode in the absence of synchronizing signals, whereby the velocity of the electron beam is rendered impotent to the screen.

8. Oscillographic apparatus comprising a cath-
10 ode ray tube having a cathode, an anode and a viewing screen and wherein is developed a cathode ray for impinging upon the viewing screen, means for effecting the periodic deflection of the cathode ray over the viewing screen of said tube, 15
a thermionic valve having a cathode, grid and anode, a circuit connected between the grid and cathode of said valve, a second circuit connected between the anode and cathode of said valve,
20 means for electrically coupling the circuit connected between the grid and cathode of said valve to said deflection means, said second circuit being electrically independent of said de-
flecting means, and an electrical connection be-
25 tween the anode of said thermionic tube and the anode of said cathode ray tube, whereby the effect of the cathode ray impinging upon said screen is controlled in accordance with the current flowing through said thermionic tube.

MICHAEL BOWMAN-MANIFOLD.

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