

Nov. 22, 1938.

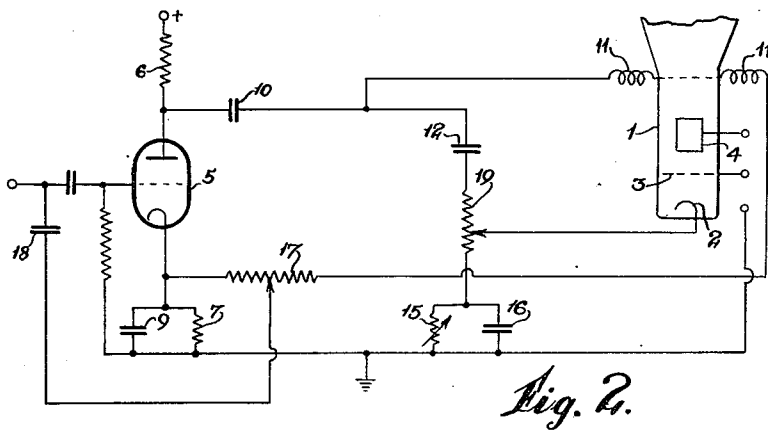
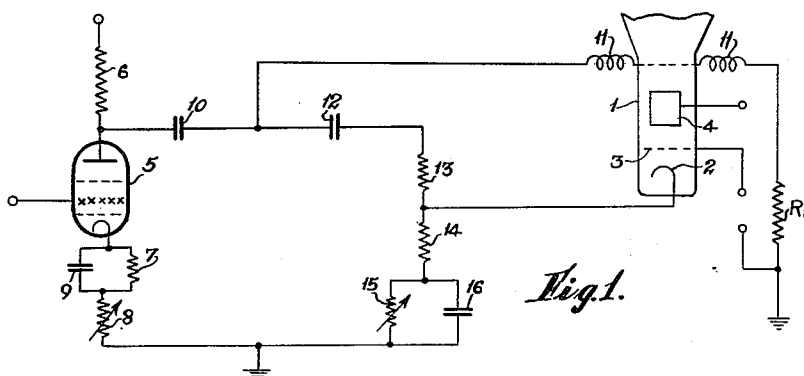
M. BOWMAN-MANIFOLD

2,137,262

TELEVISION SYSTEM

Filed Jan. 30, 1936

2 Sheets-Sheet 1



MICHAEL BOWMAN-MANIFOLD
INVENTOR

BY *Josef Oppenheimer*

ATTORNEY

Nov. 22, 1938.

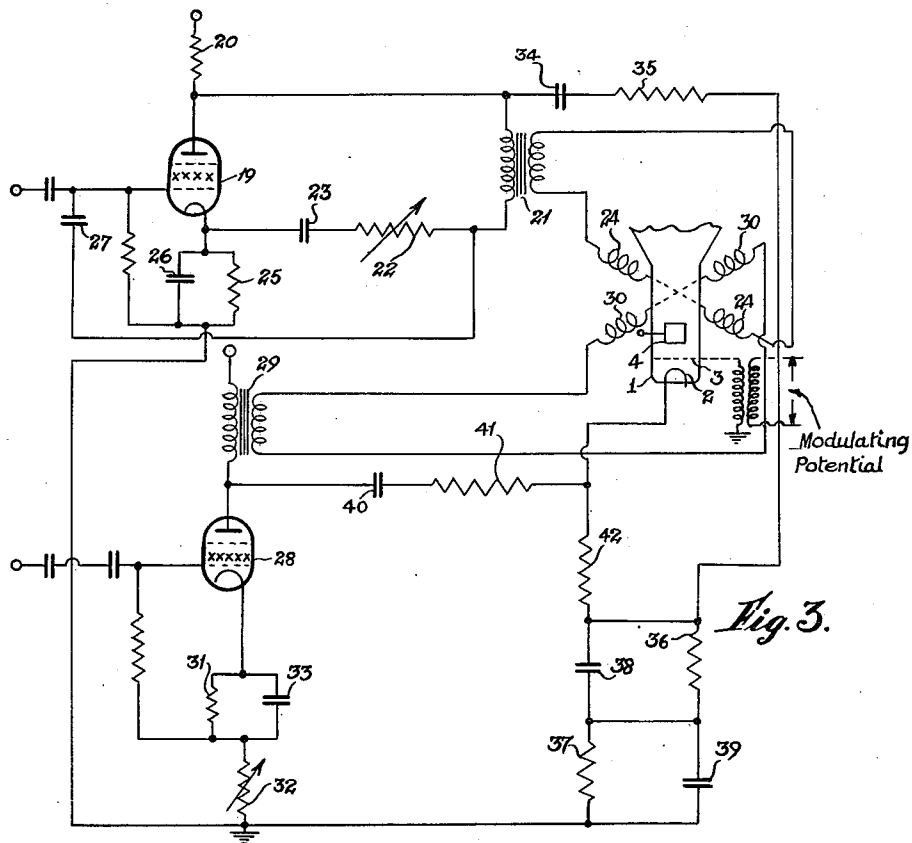
M. BOWMAN-MANIFOLD

2,137,262

TELEVISION SYSTEM

Filed Jan. 30, 1936

2 Sheets-Sheet 2



MICHAEL BOWMAN-MANIFOLD
INVENTOR

BY *Josef Oppenheimer*

ATTORNEY

UNITED STATES PATENT OFFICE

2,137,262

TELEVISION SYSTEM

Michael Bowman-Manifold, Worplesdon Station,
England, assignor to Electric & Musical Indus-
tries Limited, Middlesex, England, a British
company

Application January 30, 1936, Serial No. 61,519
In Great Britain October 16, 1934

3 Claims. (Cl. 178—7.5)

The present invention relates to television and like systems of the kind in which a cathode ray tube is employed, and in which means are employed for deflecting the cathode ray for scanning purposes.

In a known system of the kind mentioned, it has been proposed to utilize an electrical effect developed incidentally to the ray-deflecting operation substantially to cut off the ray during a predetermined period in each ray-deflecting cycle, so as to "black-out" the screen of the cathode ray tube during these periods and thus to eliminate the return lines traced out by the cathode ray on the screen. The known arrangement makes use of the potential difference which is set up across a scanning coil of the cathode ray tube when a current of saw-tooth wave-form is caused to flow in the scanning coil, this potential difference being applied to the control electrode of the tube in such a sense as to black-out the ray.

It has been found, however, that owing to the resistance of the scanning coil, the black-out due to the potential difference set up across the scanning coil may not be limited to the periods occupied by the return strokes of the cathode ray, and it is an object of the present invention to provide improved or modified apparatus for effecting black-out in systems of the kind mentioned.

A further object of the invention is to provide, in television apparatus comprising a cathode ray tube, electromagnetic deflecting means for deflecting the cathode ray of said tube and means for causing a scanning current of substantially saw-tooth wave-form to flow in said deflecting means, a black-out circuit for generating a black-out voltage which is substantially proportional to the time differential of said scanning current, and means for utilizing said black-out voltage to black-out said cathode ray.

The black-out circuit may comprise a condenser and resistance the time constant of which is substantially equal to that of the deflecting circuit.

In one arrangement, the potential difference set up across a resistance forming part of the black-out circuit is applied between the cathode of the cathode ray tube and a point of constant potential, such as earth for example, the grid of the tube being biased to a suitable operating potential relatively to earth.

Preferably, the impedance of the black-out circuit over substantially the whole of the range of frequencies fed to it is made large compared with that of the ray-deflecting circuit with which it

is associated; it will be appreciated that the presence of the black-out circuit thus has little effect upon the wave form of the scanning oscillations applied to the deflecting circuit.

The invention will now be further described, by way of example, with reference to the accompanying drawings, in which three arrangements according to the invention are illustrated; in each of Figs. 1 and 2, there is illustrated a part of a television receiver in which means are provided for blacking out the frame return strokes, and in Fig. 3 is shown a part of a receiver in which provision is made for blacking out the return strokes of both the line and frame frequency scanning oscillations.

In each figure, there is shown part of a television receiver which comprises a cathode ray tube 1 having an indirectly heated cathode 2, a modulator or grid electrode 3 and one or more focusing electrodes 4. The fluorescent screen of the tube is not shown. In each receiver, also, two pairs of deflecting coils arranged to deflect the ray in two mutually perpendicular directions over the fluorescent screen are provided, for purposes of scanning, and two oscillation generators adapted to drive currents of substantially saw-tooth wave form through the deflecting coils are associated respectively with the two pairs of deflecting coils. The latter are indicated by 11 in Figs. 1 and 2 and by 24 and 30 in Fig. 3.

The oscillation generators, which are not illustrated, are preferably of the kind known as blocking oscillators, and one of them is arranged to generate saw-tooth oscillations at the line scanning frequency, while the other is arranged to oscillate at the frame frequency.

Referring to Fig. 1, the output of the frame frequency blocking oscillator is fed to the control grid of pentode 5 serving as an output valve. The anode of the valve 5 is connected through a coupling resistance 6 to the positive terminal of a source of anode current, and its cathode is connected through a biasing resistance 7 and a variable negative feed-back (or anti-reaction) resistance 8 in series to earth. The biasing resistance 7 is shunted by a by-pass condenser 9, and the antireaction resistance serves to provide negative feed-back for the purpose of improving the wave-form of the saw-tooth oscillations, and to provide a measure of control of the amplitude thereof.

The anode of the output valve 5 is connected to earth through a coupling condenser 10 in series with the frame deflecting coils 11 of the cathode ray tube 1, and these coils 11 are shunted

by a circuit comprising the following elements in series: a condenser 12 (of a capacity referred to hereinafter as C), two fixed resistances 13 and 14 (of values referred to as R_2 and R_3) in series and a variable biasing resistance 15 shunted by a by-pass condenser 16 of low impedance at the frame frequency. The junction point of the resistances 13 and 14 is connected to the cathode 2 of the cathode ray tube 1; the anode 4 of the tube 1 is connected to the positive terminal of a suitable source of current having its negative terminal earthed, and the resistance 14 and the variable biasing resistance 15 in series serve to bias the grid 3 of the cathode ray tube 1, with respect to the cathode thereof, to a suitable operating point.

Now the current I flowing in the deflecting coils 11 is of substantially saw-tooth wave form, and falls in the algebraic sense at a substantially constant rate to a minimum value during the scanning stroke; that is, during the scanning stroke,

$$\frac{dI}{dt}$$

is substantially constant and small, and substantially no current flows in the shunt circuit. The positive direction of current is considered as that of a current of positive charge through the coils, towards earth. However, during the return stroke

$$\frac{dI}{dt}$$

is variable and larger, and current flows during this time in the shunt circuit. It will readily be seen that the wave form of the potential set up across the resistances 13 and 14 is thus proportional to the first differential of the wave form of the current I. The potential difference across 13 and 14 is, during the forward stroke, a small constant quantity and at every return stroke is a larger pulse; this pulse, which, with the current in the scanning coils decreasing during the scanning stroke and increasing during the return stroke, is in the positive sense, is applied to the cathode 2 of the cathode ray tube 1 and serves to black-out the screen during the frame return stroke. If the current is in the opposite sense, the pulse is in the negative sense and may thus be applied to the grid of the cathode ray tube.

The time constant of the black-out circuit 12, 13, 14 is arranged to have such a value that it compensates for the resistance of the deflecting circuit. Thus if the inductance of the frame deflecting coils 11 is L and their resistance is R_1 , then the potential difference E set up between the junction point of condenser 12 and resistance 13, and earth is given by the expression

$$E = \frac{I(pL + R_1)}{R_2 + R_3 + \frac{1}{pC}} \times (R_2 + R_3)$$

where I is the current flowing in the deflecting coils, and p, which is the Heaviside operator, is identically equal to

$$\frac{d}{dt}$$

The above expression may be re-written

$$E = I p L \frac{1 + \frac{R_1}{pL}}{1 + \frac{1}{(R_2 + R_3)pC}}$$

and it will readily be seen from this that if the

time constants of the circuits comprising the deflecting coils and the elements 12, 13 and 14 respectively are made equal, that is, if

$$\frac{L}{R_1} = (R_2 + R_3)C$$

then

$$E = I p L$$

provided also that the impedance of the shunt circuit 12, 13, 14 is appreciably larger than that of the coils 11 and so has little effect on the wave form of current in coils 11.

Thus when the time constant of the black-out circuit is equal to the time constant of the deflection circuit, the compensation for the resistance of the deflecting circuit is exact.

In a practical case, it is found that with deflecting coils having an inductance of 6 henries, and a resistance of 3000 ohms, suitable values for C and $(R_2 + R_3)$ are 0.02 microfarad and 100,000 ohms respectively. The mean value of E is found to be 96 volts, and its minimum value about 24 volts. As in the case under consideration a potential difference of about 3 volts is sufficient to black out the screen under operating conditions, the value of the resistance 14 is made approximately one seventh of the value of resistance 13. The value of the resistance 14 should preferably be small compared to the reciprocal of the mutual conductance of the cathode ray tube; the mutual conductance of the tube may be about 15 microamps per volt, and in this case resistance 14 should be small compared to 66,000 ohms.

The resistance 14 may with advantage be shunted by a condenser of so small a capacity as to be without effect on the black-out action. This will serve to suppress any component of line frequency which may be developed across resistance 14, due to current in the frame scanning coils resulting from unintentional coupling with the line scanning coils, and which if not suppressed would cause vertical shadow bands across the picture. This condenser may have a capacity of 0.02 microfarad.

The value of the condenser 12 is somewhat critical, since it is found that if it is too large the picture is brighter towards the end than at the beginning, while if it is too small, the return strokes at the end of the picture are not completely blacked out.

Reference is now directed to Fig. 2, which illustrates a modification of the arrangement described above with reference to Fig. 1; like parts in Figs. 1 and 2 are given the same reference numbers. In the arrangement of Fig. 2, the anti-reaction resistance 8 of Fig. 1 is replaced by a potential divider resistance 17 connected in series between the deflecting coils 11 and the cathode of the output valve 5. A variable tapping point on the resistance 17 is connected through a condenser 18 to the control grid of the valve 5. In this arrangement, the resistance in series with the deflecting coils 11, with respect to the anode and cathode of the valve 5, is constant and independent of the position of the tapping point in the anti-reaction resistance 17. A suitable value for the resistance 17 is 5,000 ohms. If desired, this resistance may be omitted, and a feed-back coil may be wound over the scanning coil, the potential difference set up across this coil being applied in anti-regenerative sense between the control grid and cathode of the blocking oscillator valve.

The resistances 13 and 14 of Fig. 1 may if de-

sired be replaced by a fixed potentiometer resistance 19 having a variable tapping point therein connected to the cathode of the cathode ray tube, as shown in Fig. 2. The potential divider resistance 17 of Fig. 2 may be replaced by a variable

resistance, and the condenser 10 may be connected between one end of this resistance and the cathode of valve 5, while the other end of the resistance is connected to the control grid of valve 5 through condenser 18.

The scanning coils 11 may be fed through a transformer, in which case the coils 11 of Figs. 1 and 2 are replaced by the primary winding of an iron-cored transformer, and the scanning coils are connected across the secondary winding of the transformer.

Referring now to Fig. 3, the output from a frame-frequency saw-tooth generator (not shown) is applied to the control grid of pentode valve 19 which serves as an output valve; the anode of this valve is connected through resistance 20 to the positive terminal of a source of anode current, and through the primary winding of a transformer 21, an anti-reaction resistance 22 and a condenser 23 in series to its cathode. The frame-deflecting coils 24 of the cathode ray tube 1 are connected across the secondary winding of transformer 21. The cathode of valve 19 is connected to earth through a biasing resistance 25 shunted by by-pass condenser 26, and the end of resistance 22 remote from the cathode of valve 19 is connected through a condenser 27 to the control grid of valve 19.

The output of a line frequency saw-tooth generator (not shown) is fed to the control grid of a line frequency output valve 28, the anode circuit of which includes the primary winding of a transformer 29 having the line-deflecting coils 30 of tube 1 connected across its secondary winding and a source of anode current having its negative terminal earthed. The cathode of the valve 28 is connected to earth through a biasing resistance 31 and a variable feed-back resistance 32 in series, resistance 31 being shunted by a by-pass condenser 33.

The anode of valve 19 is connected to earth through condenser 34, and resistances 35, 36 and 37 in series, resistances 36 and 37 being shunted by by-pass condensers 38 and 39 respectively. The anode of valve 28 is connected through condenser 40, and resistances 41 and 42 in series to the junction point of resistances 35 and 36, and the junction point of resistances 41 and 42 is connected to the cathode 2 of the cathode ray tube 1, the control grid 3 of which is earthed through a source of modulating potential.

Currents are set up in the network comprising elements 34 to 42 which are proportional to the first differentials of the line and frame scanning currents, and the complex potential difference set up across resistances 36 and 42 is applied between

the cathode 2 of the tube 1 and the control grid 3 thereof which serves to black out the ray during both the line and frame return strokes. The value of the capacity of condenser 38 is so chosen that substantially no potential difference at the line frequency is set up across resistance 36.

Suitable values for certain of the components of the arrangement of Fig. 3 are as follows:—

Condenser 34,	0.02 microfarad	10
Condenser 38,	0.02 microfarad	
Resistance 35,	100,000 ohms	
Resistance 36,	7,500 ohms	
Resistance 41,	100,000 ohms	
Resistance 42,	2,500 ohms	15

Resistance 37 serves, together with resistances 36 and 42, as biasing resistance for the tube 1, and may be given any desired suitable value. Condensers 26, 33 and 39, which serve as by-pass condensers, are all given values such that they form a path of very small impedance across their associated biasing resistances for all frequencies with which the arrangement is required to deal.

It will be noted that in the arrangements described, black-out potentials are generated, and are applied to influence the cathode ray, in such a way as not to affect the operation of the scanning oscillation generators; stability of operation of the latter is thus ensured.

The invention is not limited to the embodiments described, and many modifications within the scope of the appended claims will occur to those versed in the art.

I claim:

1. In television apparatus including a cathode ray tube, electromagnetic deflecting means for deflecting the cathode ray developed within said tube, means for causing the scanning current of substantially sawtooth wave form to flow in said deflecting means, a black-out circuit for generating a black-out voltage which is substantially proportional to the time differential of said scanning current comprising a condenser and a resistance in series, and having a time constant substantially equal to that of said deflecting circuit, and means for utilizing said black-out voltage to black-out said cathode ray.

2. Television apparatus according to claim 1 wherein the impedance of said black-out circuit over substantially the whole of the range of frequencies fed to it is large compared with the impedance of said deflecting means.

3. Television apparatus according to claim 1 wherein there is provided a transformer having primary and secondary windings, means for impressing the scanning current in said primary winding, and means connecting the deflecting means in shunt with said secondary winding.

MICHAEL BOWMAN-MANIFOLD.