Aug. 19, 1947. H. M. CROSBY 2,425,999

SIGNAL PORTRAYING APPARATUS

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Fig. 1.

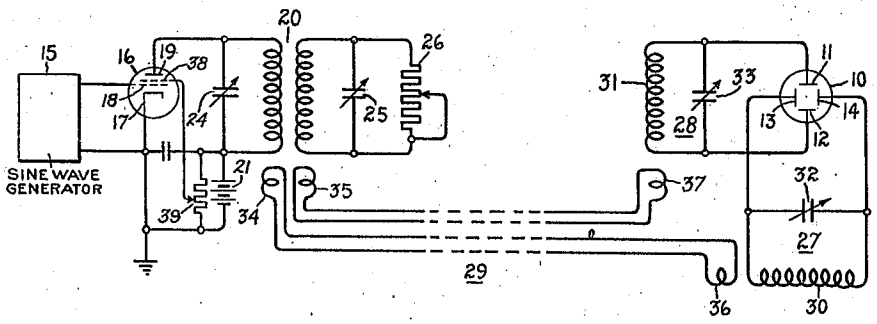
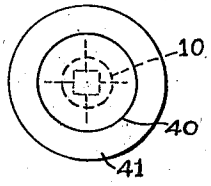


Fig. 2.



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SIGNAL PORTRAYING APPARATUS

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7 Claims. (Cl. 315—24)

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My invention relates to signal portraying apparatus of the type which employs a cathode ray electron discharge device and more particularly to such apparatus in which the cathode ray beam is deflected to form a circular trace in the absence of a signal.

Certain applications in which cathode ray tubes are employed to provide a visible indication of a signal require that the cathode ray beam be deflected to form a circular trace on the fluorescent screen of the tube so that when a signal is impressed on the tube it will produce an indication on the circular trace. The cathode ray tube is provided with deflecting members on axes at right angles and the circular trace is formed by impressing equal sinusoidal voltage or current waves which are 90° out of phase on the two axes, it being evident that when such sinusoidal waves are impressed on the members the beam will be deflected in a circular path. For example, one method which has been employed to obtain the 90° phase difference is to provide a transformer with two secondaries having voltages respectively leading and lagging the primary voltage by 45°. Temperature and humidity changes of the surrounding air affect the tuning of the secondaries and thus cause phase variations of the secondary voltages. These variations may be compensated or minimized; however, changes in the ratio of reactance to resistance or the "Q" of the inductances, are extremely difficult to compensate since they result in relatively great changes in phase. Accordingly, it is an object of my invention to provide a signal portraying apparatus employing a cathode ray electron discharge device including an improved arrangement for deflecting the cathode ray beam to provide a circular trace and which apparatus shall have greater stability over a wide range of atmospheric conditions.

It is another object of my invention to provide a signal portraying apparatus having a cathode ray electron discharge device and including an improved arrangement for producing a circular deflection of the cathode ray beam which arrangement facilitates the location of the cathode ray device at a position remote from the deflecting wave generator and which provides stable operation regardless of variation in the temperature or humidity of the ambient air.

The novel features which are believed to be characteristic of my invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and method of operation, together with further objects and advantages thereof, will best be understood by reference to the following description taken in connection with the accompanying drawing, in which Fig. 1 represents which indicates diagrammatically a circuit embodying my invention, and Fig. 2 is an end view of the cathode ray device in the circuit of Fig. 1 showing the face of the fluorescent screen.

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Referring now to the drawing, the signal portraying apparatus shown in Fig. 1 includes a cathode ray electron discharge device or tube 10 of a type well known to the art. The tube 10 includes two pairs of electrostatic beam deflecting plates arranged on axes perpendicular to the longitudinal axis of the tube and at right angles to one another, the first or vertical deflection pair comprising plates 11 and 12 and the second or horizontal deflection pair comprising plates 13 and 14. The remaining elements of the tube have been omitted as they are not necessary to an understanding of the present invention. In order to produce a circular trace on the fluorescent screen of the tube 10 sinusoidal voltages 90° out of phase and of equal magnitude are impressed on the two pairs of plates.

The necessary sinusoidal deflection waves are obtained from a suitable generator 15 which has been illustrated as connected across the input circuit of an amplifier tube 16. Tube 16 is provided with the usual cathode 17, control electrode or grid 18 and anode 19, the generator 15 being connected between the cathode 17 and grid 18. The output circuit of the tube 16 is connected to the primary winding of a transformer 20, the primary winding being connected in the anode circuit in series with a suitable source of anode potential illustrated conventionally as a battery 21. Across the primary and secondary windings of the transformer are connected variable condensers 24 and 25, respectively, which are tuned to resonance at the frequency of the impressed voltage. It will be understood, therefore, that the voltages in the primary and secondary windings are 90° out of phase. A variable resistor 26 is connected across the secondary winding to provide a variable load so that the current in the secondary winding may be adjusted.

In order to impress the deflection voltages on the horizontal and vertical plates, the primary and secondary windings of the transformer 20 are coupled to tuned circuits 27 and 28, respectively, through link couplings including a low impedance four-conductor transmission line 29. The circuits 27 and 28 include inductances 30 and 31, respectively, and variable condensers 32 and 33,

respectively. Both circuits are tuned to resonance at the frequency of the deflection waves. The link couplings include windings 34 and 35 in inductive relationship with the primary and secondary windings, respectively, and windings 36 and 37 in inductive relationship with the inductances 30 and 31, respectively. The windings 34 and 35 have relatively few turns as compared with the primary and secondary windings of the transformer and, therefore, there is a stepdown of voltage from the primary and secondary windings to the link couplings. In a similar manner the windings 36 and 37 have relatively few turns as compared with the windings 30 and 31 and the voltages are thus stepped up from the link coupling to the deflection plates. It will be evident that with this stepdown arrangement, including the low impedance coils 34, 35, 36 and 37, it is feasible to employ a low impedance transmission line.

Since the distributed capacities of the interconnecting conductors of the transmission line 29 are connected across a low impedance circuit, this capacity has negligible effect on the phase of the voltages across the tuned circuit; a high overall circuit stability is thereby obtained. The arrangement of the circuit as shown in the drawing maintains the phase relationship of the two deflecting voltages substantially constant regardless of changes in the "Q" of the inductors or of changes in capacity of the connecting cable or transmission line. Any changes in tuning of the circuits caused by changes of capacity or inductance due to temperature variations may be compensated in accordance with practice well known to the art as by employing capacitors of the proper compensating type.

During the operation of the deflection circuit illustrated the primary and secondary circuits of the transformer and the circuits 27 and 28 are all tuned to the deflection frequency and the resistor 26 is adjusted to equalize the deflection voltages impressed on the horizontal and vertical deflection plates of the tube 10. A circular sweep 40 is thereby obtained on the fluorescent screen 41 of the tube as indicated in Fig. 2. Thereafter, regardless of changes in temperature or moisture content of the surrounding air, there can be substantially no change in the phase relationships of the tuned circuit and a circular trace on the fluorescent screen will thus be maintained regardless of changes in atmospheric conditions.

It is desirable that the operator of the apparatus illustrated should be able to vary the diameter of the circular trace and in order to accomplish this adjustment effectively without producing any change in the circular form of the trace, I employ a variable control of the voltage on the screen grid 38 of the tube 10. The variable voltage is obtained from a voltage dividing resistor 39 connected across the source 21. By adjusting the contact on the divider 39 full range diameter control may be obtained independently of the circularity of the sweep.

From the foregoing, it is readily apparent that I have provided a beam deflecting circuit which insures the maintenance of the circular sweep relatively independent of changes in temperature or humidity of the ambient air and furthermore, a circuit which makes it possible to employ a transmitting line or cable so that the cathode ray tube may be located at a considerable distance from the signal generating apparatus without the necessity of frequent readjustment of the tuned circuits.

While I have described one embodiment of my invention in connection with a cathode ray tube of the electrostatic deflection type, other applications will readily be apparent to those skilled in the art. I do not, therefore, desire my invention to be limited to the particular arrangement illustrated and described and I intend by the appended claims to cover all modifications which fall within the spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent in the United States is:

1. A signal portraying apparatus comprising a cathode ray electron discharge device having a fluorescent screen and including an electron beam forming means and first and second deflecting means for deflecting the beam in directions perpendicular to one another, a source of sinusoidally varying waves, a transformer having a primary winding and a secondary winding, said primary winding being connected to said source, means for tuning both said windings to the frequency of said waves, means for coupling said first and second deflecting means respectively to said primary and secondary windings, a variable load element connected across said secondary for adjusting the relative amplitudes of the waves across said primary and secondary windings so that waves of equal intensity may be impressed on both said deflecting means whereby the beam is deflected to produce a circular trace on said screen.

2. A signal portraying apparatus comprising a cathode ray electron discharge device having a fluorescent screen and including an electron beam forming means and first and second pairs of deflecting members for deflecting the beam in directions perpendicular to one another, a source of sinusoidally varying waves, a transformer having a primary winding and a secondary winding, said primary winding being connected to said source, means for tuning both said windings to the frequency of said waves, a first tuned circuit connected between the members of said first pair of deflecting members, a second tuned circuit connected between the members of said second pair of deflecting members, said first and second tuned circuits being tuned to the frequency of said waves, and means for coupling said first and second tuned circuits respectively to said primary and secondary windings whereby the beam is deflected to produce a circular trace on said screen.

3. A signal portraying apparatus comprising a cathode ray electron discharge device having a fluorescent screen and including an electron beam forming means and first and second pairs of deflecting members for deflecting the beam in directions perpendicular to one another, a source of sinusoidally varying waves, a transformer having a primary winding and a secondary winding, said primary winding being connected to said source, means for tuning both said windings to the frequency of said waves, a first tuned circuit connected between the members of said first pair of deflecting members, a second tuned circuit connected between the members of said second pair of deflecting members, said first and second circuits being tuned to the frequency of said waves, and means for coupling said first and second tuned circuits respectively to said primary and secondary windings whereby the beam is deflected to produce a circular trace on said screen, said coupling means including a low impedance transmission line whereby said cathode ray device may be located at a point remote from said transformer.

4. A signal portraying apparatus comprising a cathode ray electron discharge device having a fluorescent screen and including an electron beam forming means and first and second pairs of deflecting members for deflecting the beam in directions perpendicular to one another, a source of sinusoidally varying waves, a transformer having a primary winding and a secondary winding, said primary winding being connected to said source, means for tuning both said windings to the frequency of said waves, a first tuned circuit connected between the members of said first pair of deflecting members, a second tuned circuit connected between the members of said second pair of deflecting members, said first and second circuits being tuned to the frequency of said waves, and means including a low impedance transmission line for providing one link coupling between said first tuned circuit and said primary winding and another link coupling between said second tuned circuit and said secondary winding whereby the beam is deflected to produce a circular trace on said screen.

5. A signal portraying apparatus comprising a cathode ray electron discharge device having a fluorescent screen and including an electron beam forming means and first and second pairs of deflecting plates for deflecting the beam in directions perpendicular to one another, a source of sinusoidally varying voltage waves, a transformer having a primary winding and a secondary winding, said primary winding being connected to said source, means for tuning both said windings to the frequency of said waves, a first tuned circuit connected across said first pair of plates, a second tuned circuit connected across said second pair of plates, said first and second tuned circuits being tuned to the frequency of said waves, and means for coupling said first and second tuned circuits respectively to said primary and secondary windings whereby sinusoidally varying deflecting voltages are impressed on said pairs of plates 90° out of phase and the beam is deflected to produce a circular trace on said screen.

6. A signal portraying apparatus comprising a cathode ray electron discharge device having a fluorescent screen and including an electron beam forming means and first and second pairs of deflecting members for deflecting the beam in directions perpendicular to one another, a source of sinusoidally varying voltage waves, a transformer having a primary winding and a secondary winding, said primary winding being connected to said source, means for tuning both said windings to the frequency of said waves, a first tuned circuit

connected across said first pair of members, a second tuned circuit connected across said second pair of members, means including a low impedance transmission line providing one link coupling between said first tuned circuit and said primary winding and another link coupling between said second tuned circuit and said secondary winding, said last mentioned means being arranged to provide a step-down of voltage between said windings and said couplings and a step-up of voltage between said couplings and said tuned circuit, and means providing a variable load for said secondary winding for equalizing the voltages across said pairs of members whereby the beam is deflected to produce a circular trace on said screen.

7. A signal portraying apparatus comprising a cathode ray electron discharge device having a fluorescent screen and including electron beam forming means, a first and second deflecting means for deflecting the beam in directions perpendicular to one another, a source of sinusoidally varying waves, a transformer having a primary winding and a secondary winding, means including an electron discharge device having an anode and a cathode and control and screen electrodes for connecting said primary winding to said source, means for tuning both said windings to the frequency of said waves, means for coupling said first and second deflecting means respectively to said primary and secondary windings whereby the beam is deflected to produce a circular trace on said screen, and means for impressing a variable voltage on said screen electrode for adjusting the diameter of the circular trace independently of the circularity thereof.

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