Dec. 10, 1940. H. BÄHRING 2,224,587

METHOD OF OPERATING CATHODE RAY TUBES

Filed July 16, 1937

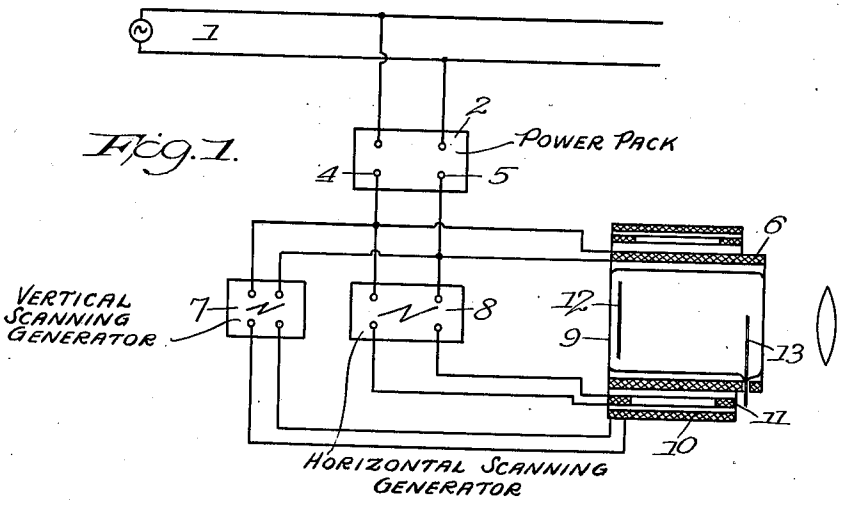


Fig. 1.

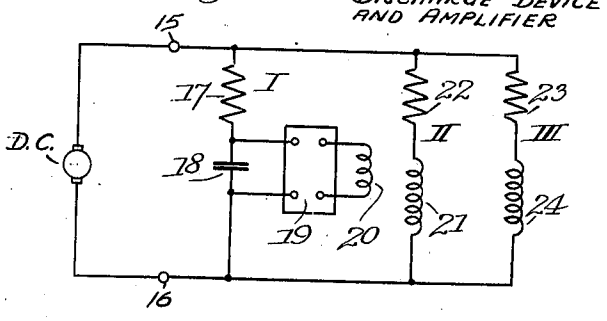


Fig. 2. DISCHARGE DEVICE AND AMPLIFIER

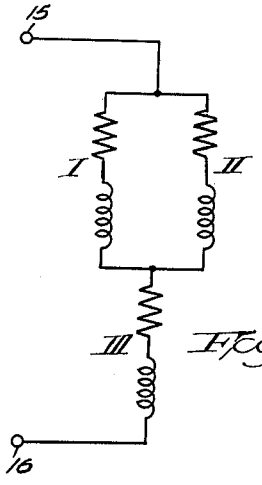


Fig. 3.

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Patented Dec. 10, 1940 2,224,587

UNITED STATES PATENT OFFICE

2,224,587

METHOD OF OPERATING CATHODE RAY TUBES

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Application July 16, 1937, Serial No. 154,093
In Germany July 13, 1936

5 Claims. (Cl. 250—27)

This invention relates to an arrangement for operating cathode ray tubes in which the deflecting field and a magnetic focusing field permeate each other. Such tubes are used, for instance, as picture analyzers for television purposes.

If a magnetic focusing field for electron optical reproduction of, for instance, a photocathode in a Farnsworth Image Dissector, permeates the deflecting fields, a rotation of the direction occurs which depends upon the intensity of the focusing field. This rotation which occurs in electrostatic as well as magnetic deflection is caused by the fact that the electrons are always influenced by the focusing field if they have a component of velocity transverse to the axis of the tube. Such a component, however, is generated in deflection and thus has an additional "secondary" deflection as a consequence. The rotation of the deflection direction causes a rotation of the entire image which approaches a limit of 90 degrees with increasing intensity of the focusing field.

When using magnetic deflection, the influence of the focusing field upon the direction of the deflection furthermore causes a distortion of the image because the "secondary" deflection does not occur linearly. The distortion is made noticeable by the fact that the coordinates of the scanning field are no longer straight.

Only if the intensity of the focusing field is of such value that the rotation of the image is approximately 90 degrees, does this distortion disappear. Thus, this is a requirement for a good image, because the intensity of the focusing field is also, on the other hand, determined by the dimensions of the tube and by the accelerating voltage for the photoelectrons, these values must also be adjusted to meet the above requirement.

Such arrangements have a certain disadvantage, in fact, the sensitivity depends upon the intensity of the focusing field; thus, if the current in the focusing coil varies, the angle of deflection also varies so that the image becomes distorted. Non-linear variations of the deflecting fields also cause a distortion when the focusing field remains constant. If variations exist they are harmonics or sub-harmonics of the scanning frequencies and standing distortion of the image occurs. Other variations cause a momentary flicker. In television transmission these variations may, for instance, cause the scanning lines to be sinusoidal instead of straight, which considerably impairs the quality of the image. Corresponding interference may also occur in oscillographs whereby incorrect curves are obtained.

According to the invention all these disadvantages are eliminated by such an arrangement of the circuit that variations of the deflecting and focusing fields caused by variations of voltages are of the same phase and equal in percentage. The simplest way to realize this idea consists in supplying all fields from one common voltage source, as, for instance, a common power pack. It has been found that a perfect compensation of all variations and interferences can be obtained in this manner. The compensation is based upon the fact that the angle of deflection increases with increasing intensity of the deflecting field, and that it decreases with increasing intensity of the focusing field. If the rotation of the picture is 90 degrees, both effects compensate each other. For electrostatic deflection perfect compensation is also obtained for periodical intermediate values.

This invention has the advantage that only one power pack with little filtering is required, whereas so far each one of the power packs had to be extremely carefully filtered.

Different circuits may be used for the realization of the invention. The choice is partly dependent on whether the amplitude of the Kipp oscillations depends upon the voltage applied to the corresponding Kipp circuit or on the current. In the first case the Kipp circuit and the focusing coil are connected in parallel, whereas in the second case a parallel as well as series connection is possible. In the case of parallel connection it is advisable to make the time constants of all branches equal.

The variations of the focusing field will naturally also influence the sharpness of the image. However, it has been found that this influence is slight and does not disturb the reproduced image in any manner.

The object of the invention may be more clearly understood from the drawing, of which Figs. 1 to 3 show several embodiments.

In Fig. 1 a power pack 2 is connected to the power supply 1. Direct current is taken from the points 4 and 5 of the power pack. A Farnsworth image dissector, indicated at 9, contains a photocathode 12 and an anode 13. A focusing coil 6 covers the entire length of the tube and secures electron optical reproduction. Deflecting coils 10 and 11 are provided through which saw-tooth currents flow which are taken from the Kipp circuits 7 and 8 and which produce deflecting fields perpendicular to each

other. According to the invention the focusing coil 6 as well as the Kipp circuits 7 and 8 are all connected to the output of the same power pack 2.

Fig. 2 shows a similar circuit. The branches indicated by I and II each contain a Kipp circuit. The insufficiently filtered direct-current voltage is applied to the circuit I at the points 15 and 16. The Kipp condenser 18 is slowly charged through a resistor 17 so that only a very small current flows. Block 19 schematically indicates an arrangement which consists of a discharge device for the condenser 18 and of an amplifier, the output of which is connected with the picture frequency deflecting coil 20. The arrangement 19 corresponds to a very high resistance during the charge period, which is long compared with the discharge period and can thus be omitted for this time in the consideration. The time constant of this branch is thus equal to the product CR of the condenser 18 and the resistor 17. The branch indicated by II represents an equivalent circuit for the line scanning arrangement in which the amplitude may be proportional to the current through the branch. The branch indicated by III is an equivalent circuit for the focusing coil. In both cases, the ohmic resistance of the branch is indicated by 22 and 23, respectively, and the inductance by 21 and 24, respectively. In order to accomplish the compensation of variations or interferences completely and especially independently of the frequency, it is advisable to make the time constants of the three branches equal; that means that

$$CR=\frac{L_2}{R_2}=\frac{L_3}{R_3}$$

whereby L_2, R_2, and so forth, indicate the inductance and resistance, respectively, of the corresponding branches II and III.

Fig. 3 shows a third embodiment in which the Kipp circuits I and II, which are indicated by equivalent circuits, are connected in parallel and then in series with the focusing coil circuit III, which is also indicated by an equivalent circuit. In this case the operation of both Kipp circuits is dependent on the passing current. A similar arrangement is also possible in which, however, one of the two Kipp circuits operates according to the applied voltage.

In all cases the deflection can be produced by electrostatic as well as electromagnetic means. The invention is, of course, applicable also to television receiver tubes and oscillograph tubes.

Having thus described my invention, I claim:

1. In combination with a cathode ray tube, an electromagnetic focusing circuit, a deflecting circuit operable to influence an electron in directions normal to each other, and a common power supply for said focusing and deflecting circuits, said circuits having approximately equal time constants.

2. Apparatus substantially as set forth in claim 1, wherein said focussing circuit and said deflecting circuit are connected in parallel.

3. Apparatus substantially as set forth in claim 1, wherein said focusing circuit and said deflecting circuit are connected in parallel.

4. Apparatus substantially as described in claim 1 having a series connection between said focusing circuit, said deflecting circuit and said common power supply.

5. In combination with a cathode ray tube, a cathode ray beam focusing circuit and a pair of deflecting circuits, all operable to influence an electron in directions normal to each other, said focusing circuit and said deflecting circuits having time constants approximately equal to each other and being energized from a single power supply source.

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