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ELECTRO-MAGNETIC DEFLECTION COIL ARRANGEMENTS
FOR CATHODE RAY TUBES
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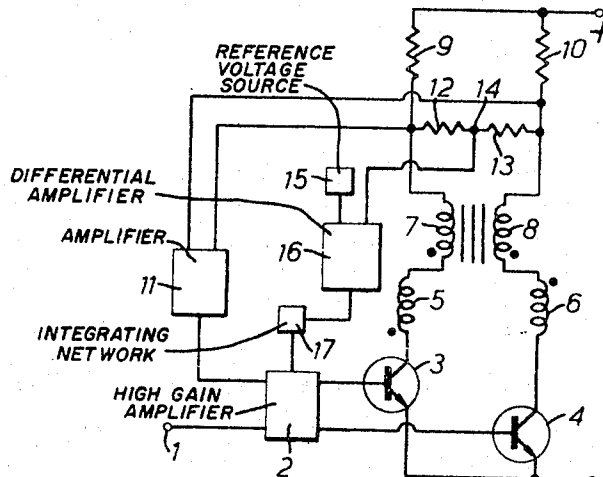


FIG. 1.
PRIOR ART

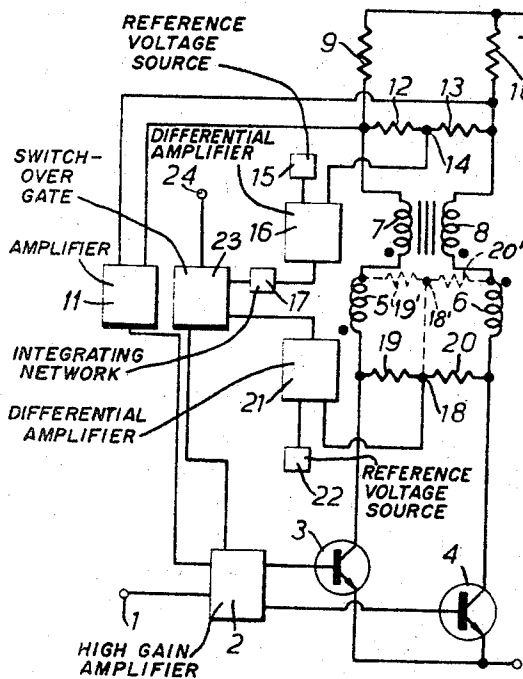


FIG. 2.

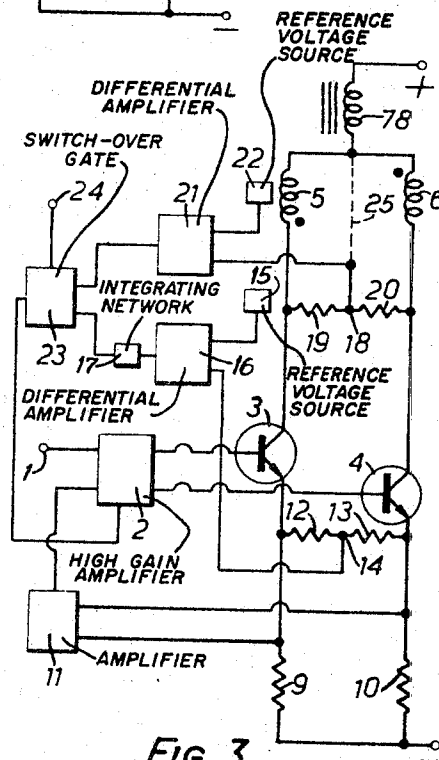


FIG. 3.

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ELECTRO-MAGNETIC DEFLECTION COIL ARRANGEMENTS FOR CATHODE RAY TUBES

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25,887/67

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6 Claims

ABSTRACT OF THE DISCLOSURE

In a cathode ray tube electro-magnetic deflection coil arrangement small symbols with high frequency components can be displayed very soon after a fast transition by providing means for developing a different in-phase feedback voltage from the centre tap of a resistance connected between the collectors of transistors used to drive the deflection coils or, where an energy recovery coil is employed, between the junction points of the recovery coil windings and the deflection coil halves. The different in-phase feedback signal is substituted for the normally employed in-phase feedback voltage by a switch-over gate controlled by an appropriate timing waveform.

This invention relates to electro-magnetic deflection coil arrangements for cathode ray tubes and is primarily intended for application to the deflection of radar display tubes. More specifically the invention relates to cathode ray tube electro-magnetic deflection coil arrangements of the kind in which fixed push-pull coils are used for deflection and differentially acting feedbacks taken from the coil circuits are employed in conjunction with an energy recovery coil and in-phase feedback for mean current.

In the accompanying drawings:

FIGURE 1 is a diagrammatic illustration of a typical previously known deflection coil arrangement of the kind referred to;

FIGURE 2 is a diagrammatic illustration of one embodiment of the invention; and,

FIGURE 3 is a diagrammatic illustration of another embodiment thereof.

In order that the invention, and the advantages which it offers, may be better understood there will first be described a typical known deflection coil arrangement of the kind referred to, which is illustrated diagrammatically in FIG. 1 of the accompanying drawings.

The rate of change of current in an electro-magnetic deflection coil is, of course, limited by the power supply voltage available and this consideration tends to lead to a compromise between the conflicting requirements of providing required sufficiently fast changes of ray position and keeping to an acceptably low level the power dissipation in the driving elements, commonly transistors, used for driving coils. The use of energy recovery coils—sometimes double wound with a winding in series with each half of a push-pull coil which provides one co-ordinate of deflection, sometimes single wound with a single winding in series with both halves of the push-pull deflection coil—is a well known expedient for providing boost voltage for fast transitions. It is also well known to develop feedback voltages in the circuits of the halves of a push-pull deflection coil and to feed these back to differential amplifiers incorporated in the circuits leading to the power amplifying driving elements. FIG. 1 shows a known arrangement in which both these expedients are

adopted. FIG. 1 shows the circuitry for producing deflection in only one direction.

Referring to FIG. 1, deflection signals from a source not shown are applied from terminal 1 as one input to a high gain differential amplifier 2 the second input to which is obtained as will later be described. The amplifier has two outputs in phase opposition—in-phase and anti-phase—and these are applied to the bases of the two power amplifier transistors 3 and 4 which are the driving elements for the phase and anti-phase halves 5 and 6 of a deflection coil. The series circuit for each of these coil halves includes also one winding 7 or 8 of a double wound energy recovery or booster coil and one resistor 9 or 10 across which voltage for feedback is developed.

The voltages developed across the resistors 9 and 10 are fed back to the two inputs of a second differential amplifier 11 the output from which constitutes the second input to the amplifier 2.

With this arrangement as so far described the difference between the two feedback signals developed in resistors 9 and 10 is produced by the amplifier 11 and this difference is compared with the input signal at 1 in the high gain differential amplifier 2. Again, as so far described, the amplifying arrangement is purely differential in action and the feedback circuits do not restrict at all the mean output current. Because of this there are provided the two additional resistors 12 and 13, connected as shown, which provide at their junction point 14 a voltage dependent on the output current. This is compared with a reference voltage from a source 15 in a third differential amplifier 16 to produce a further voltage which is fed back via an integrating network 17 of long time constant to the amplifier 2. The exact characteristics of this third feedback circuit are unimportant because of the differential nature of the deflection system.

Ignore for the moment the action of the energy recovery coil 7, 8, and suppose the coil halves 5 and 6 to be directly in series with the resistors 9 and 10. Suppose that, on the assumption that the recovery coil windings are shorted out, a change of deflection coil current is demanded. Because of the coil inductance the rate of change of coil current is limited and cannot change instantaneously as the feed back due to resistors 9 and 10 to turn one of the transistors 3 or 4 fully "on" and the other fully "off." The supply voltage (minus voltage drop in the resistors and in the transistor which happens to be "on") appears across one half of the deflection coil, and due to its tight coupling with the other half, across that half also. The total end-to-end voltage across the deflection coil is thus limited to a value somewhat below twice the supply voltage and the rate of change of deflection coil current is therefore also limited.

Consider now the effect of the energy recovery coil 7, 8. By effectively isolating the effective "centre" of the whole deflection coil from the supply the energy recovery coil, by reason of its high inductance, prevents instantaneous change of the total current and opposes reduction of current by providing a high voltage to which said "centre" rises, while the collector of the transistor which happens to be "off" rises to approximately twice this voltage because of the tight coupling between the two halves of the deflection coil. Accordingly the provision of the energy recovery coil as shown ensures that the maximum rate of change of deflection coil current is limited, not by the supply voltage (which may itself be limited by considerations of power dissipation) but only by the safe voltage limits of the transistors, for the "boost" voltage provided by the energy recovery coil cannot be permitted to be high enough to damage the driving transistors. The great advantage of the energy recovery coil is, therefore,

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that it enables fast deflections to be achieved without requiring the provision of inconveniently high supply voltage.

The known arrangement of FIG. 1 is, however, still not completely satisfactory because the mean deflection coil current has to be restored to the original value as required by the in-phase feed back loop which takes feed back voltage from point 14. This restoration results in the production of an inverse voltage across the energy recovery coil, and, because this inverse voltage is limited by the saturation voltages of the driving transistors, it will persist for a relatively long time and the original conditions will not be restored until said inverse voltage has sufficiently decayed. So long as the inverse voltage persists, therefore, it produces a reduction in the effective power voltage and this reduces the rate of change of current available for small signals. A further defect is that the bandwidth of practical driving transistors tends to reduce rather drastically with reduction in the collector voltage. The known circuit of FIG. 1 has therefore the serious practical disadvantage that it will not enable small symbols with high frequency components to be displayed immediately after a fast transition. It is, indeed, usual in those many cases in which this ability is required, to provide an auxiliary deflection coil for dealing with such small symbols—an expensive and inconvenient matter. The present invention seeks to overcome these defects and disadvantages and according to this invention in its broadest aspect this object is achieved by providing means for developing a different in-phase feed back signal and means for substituting this in-phase feed back signal for the normally employed in-phase feed back signal at times when small fast symbols are to be displayed.

Said different in-phase feed back signal may be developed in various different ways. Preferably it is taken from a centre tap on a resistance connected between the collectors of the driving transistors. Where, however, a double wound energy recovery coil is employed (as in FIG. 1) said different in-phase feed back signal could be taken from a centre tap on a resistance connected between the junction points of the energy recovery coil windings with the deflection coil halves. Again where a single winding energy recovery coil is employed, said different feed back voltage could be taken from the junction point of that coil with the deflection coil halves.

Preferably the said different in-phase feed back voltage and the normally employed in-phase feed back voltage are substituted for one another by means of a switch-over gate controlled by an appropriate timing waveform. In the case of a so-called "marked raw radar" display with symbol markings, recovery to the original conditions can be arranged to take place during the time of the radar trace. It is thus possible to reduce the power supply voltage and yet to provide an increased effective voltage during symbol time. In the case of a so-called "synthetic" display there is no suitable time for recovery and in such a case the effective power supply voltage is set to a value a little below that of the actual power supply voltage.

One embodiment of the invention is shown in FIG. 2 of the accompanying drawings in which the same references indicate the same parts as in FIG. 1. As will be seen, FIG. 2 differs from FIG. 1 in that an in-phase feed back voltage, different from the normal one derived from point 14 can be substituted for said normal one at the appropriate times. This different in-phase feed back voltage is derived from the point 18 between two equal resistors 19 and 20 in series between the collectors of the transistors 3 and 4. This voltage is fed to a further differential amplifier 21 where it is compared with a reference voltage from a source 22. The said different in-phase voltage, which is the output from the amplifier 21 is substituted, at the appropriate times, for the normal in-phase feed back voltage by means of a switch-over gate or switch 23 the operation of which is controlled by an appropriate

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timing waveform obtained in any convenient suitable manner and applied to the terminal 24.

FIG. 3 shows another embodiment. In this figure the same references are used for the same parts as in FIG. 2. In FIG. 3, which, it is thought, will be found largely self-explanatory, the elements in the series circuits which include the deflection coil halves 5 and 6 are in a different order, as compared with FIG. 2 but the main difference is that a single winding energy recovery coil 78 is substituted for the double-wound coil of FIG. 2.

Obviously many circuit modifications are possible. For example, in FIG. 2 the resistances 19 and 20, with their centre tap 18, could be deleted and resistances 19' and 20' with their centre tap 18' as shown in dotted lines used to monitor the voltage between the junction points of the deflecting coil halves with the energy recovery coil windings instead of, as shown in solid lines, monitoring the voltage between the junction points of said halves with the transistor collectors. Again, as in FIG. 3, the resistances 19, 20 could be dispensed with and the voltage constituting one input to the amplifier 21 could be taken directly from the junction point of the coil 78 with the deflection coil halves via a lead 25 shown as a dotted line.

A convenient way of describing the action of circuits in accordance with this invention is by considering the energy stored in the energy recovery coil. In the case of a marked raw radar display with symbol markings energy is taken from this coil during fast transition times and more energy is taken during symbol times. The energy is replaced during radar time. In the case of a synthetic display the energy removed during fast transitions is replaced during symbol times. In both cases fast transitions and maximum symbol presentation are obtained with a minimum of power dissipation.

We claim:

1. A cathode ray tube electro-magnetic deflection coil arrangement wherein first and second push-pull coils are used for deflection, differentially acting feedbacks are provided from a first point and a second point in a circuit for supplying current to said first and second push-pull coils respectively, and an additional feedback signal is provided from an electrical centre point resistively connected to one terminal of a current supply source forming part of said circuit for supplying current, the improvement comprising means for developing a different additional feedback signal from an electrical centre point connected to said one terminal at least partially via an inductive circuit which forms part of said circuit for supplying current, and means for selectively substituting said different additional feedback signal for said additional feedback signal whereby small fast symbols may be displayed when said different additional feedback signal is used.

2. An arrangement as defined in claim 1 including driving transistors, collectors therefor, and a resistance connected between said collectors, and wherein said different additional feedback signal is taken from a centre tap on said resistance connected between the collectors of said driving transistors, the collectors being connected to said first and said second push-pull coils.

3. An arrangement as claimed in claim 1 including a double energy coil comprising two windings, said windings being respectively connected to junction points with respective said first and said second push-pull coils, and wherein said different additional feedback signal is taken from a centre tap on a resistance connected between said junction points.

4. An arrangement as claimed in claim 1 including a single winding energy recovery coil connected to a junction point with both of said first and said second push-pull coils and wherein said different additional feedback signal is taken from said junction point.

5. An arrangement as claimed in claim 1 wherein said means for substituting said different additional feedback

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signal for said additional feedback signal comprise a switch-over gate controlled by a timing wave.

6. A marked raw radar display with symbol markings having therein the arrangement claimed in claim 1 and wherein means are provided for replacing energy in an energy recovery coil means during radar trace time.

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No reference cited.

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