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CATHODE RAY TUBE SYSTEM

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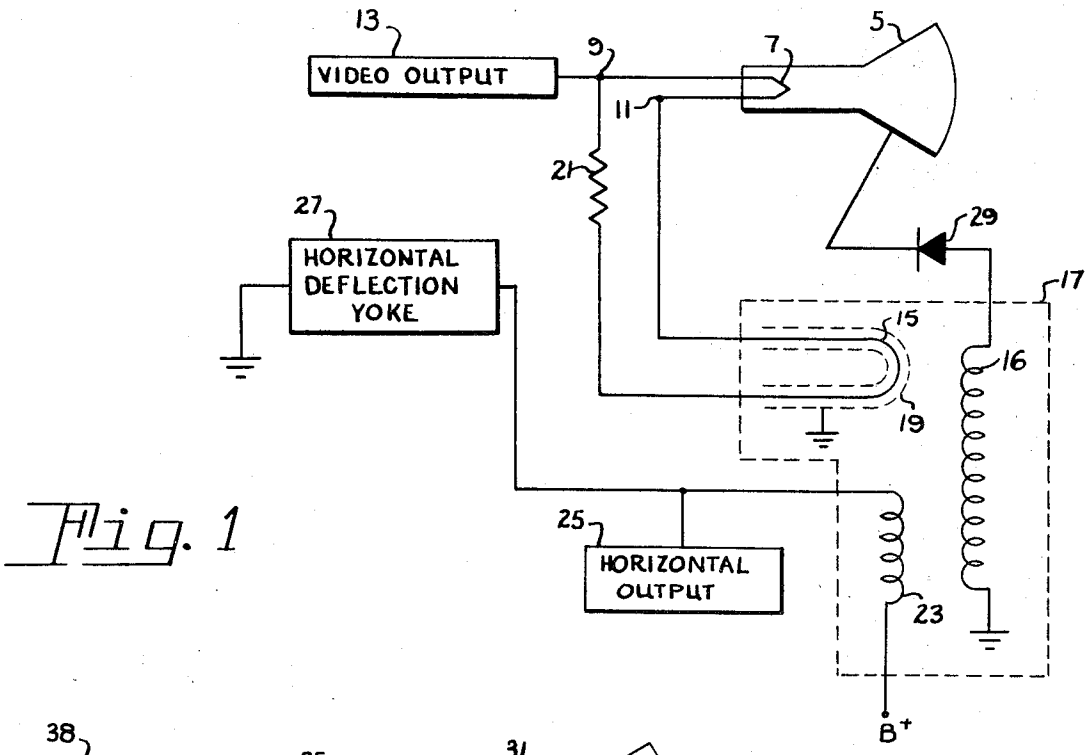



Fig. 1

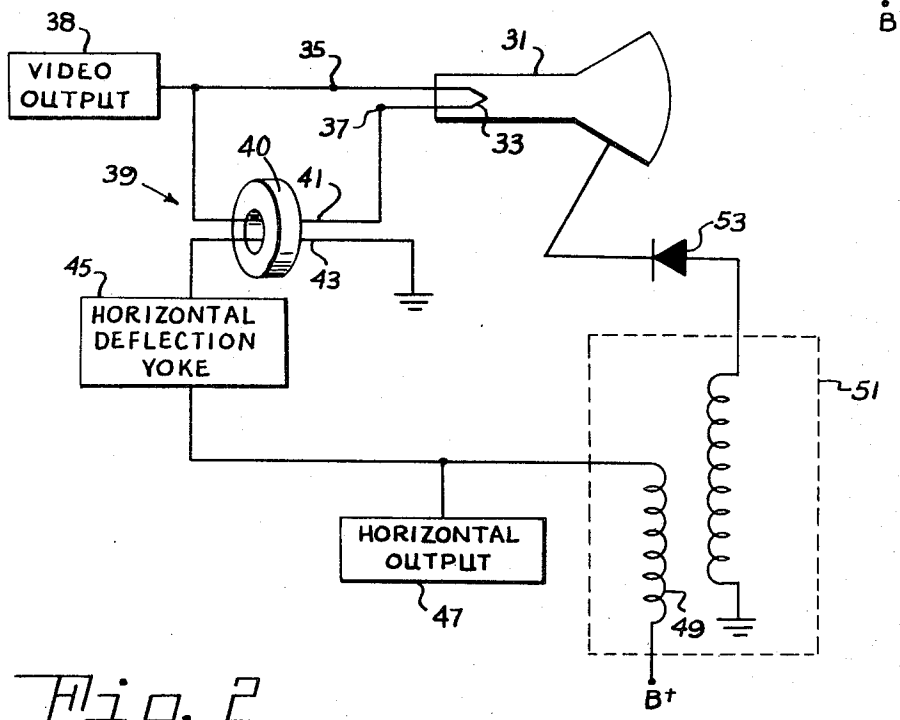



Fig. 2

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# CATHODE RAY TUBE SYSTEM

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## ABSTRACT OF THE DISCLOSURE

A "fast warm-up" cathode ray tube system includes a cathode ray tube having a directly heated cathode with a pair of terminals, a signal source, a current source, and a transformer means having a primary winding coupled intermediate the current source and a potential reference level and a secondary winding coupled to the terminals of the cathode and to the signal source.

## CROSS REFERENCE TO OTHER APPLICATIONS

A co-pending application filed Feb. 1, 1967, Ser. No. 613,150, now Pat. No. 3,441,767, in the name of Donald R. Kerstetter and entitled "Tensioned Directly Heated Cathode Having Improved Temperature Characteristics" relates to a cathode structure suitable for use in a directly heated cathode ray tube. Also, a co-pending application entitled "Resilient Means for Supporting a Directly Heated Planar Cathode" filed Feb. 1, 1967, Ser. No. 613, 722, now Pat. No. 3,440,474, in the names of Stanley L. Pawlikowski and Donald L. Say relates to supporting structure for the above cathode. Both of these applications are assigned to the assignee of the present application.

## BACKGROUND OF THE INVENTION

Presently available television receivers commonly employ a cathode ray tube system wherein the cathode of the cathode ray tube is of the indirectly-heated variety. Also, the cathode of the cathode ray tube is directly coupled to a video signal source. Moreover, such systems ordinarily have a "warm-up" or raster appearing time in the range of about six to eight seconds.

However, the ever increasing use of active solid state devices with their substantially instantaneous operational capability has stimulated interest in the provision of a cathode ray tube system wherein the "warm-up" or raster appearing time is substantially reduced. Also, it has been found that the cathode of an indirectly heated cathode ray tube has a relatively large mass rendering any reduction in "warm-up" time of such a system incremental at best.

In the prior art, it has been known that "warm-up" time or raster appearing time may be substantially reduced by a system wherein the heater of the indirectly-heated cathode ray tube is continuously operated below the normal operational temperature. Activation of the receiver causes application of normal operating potential to the indirectly heated cathode. Also, systems are known wherein a "higher-than-rated" potential is temporarily applied to the cathode of the indirectly-heated cathode ray tube upon activation of the receiver.

However, it has been found that each of the above-mentioned systems leaves something to be desired. For



example, continuously operational systems cause an undue waste of power during periods of non-operation of the receiver. Also, "higher-than-rated" systems require thermal switching and accessory components which add to the cost and reduce the reliability of the receiver. Thus, it has been found that a cathode ray tube system employing a directly heated cathode, as disclosed in U.S. Ser. Nos. 613,150 and 613,722, provides an enhanced "warm-up" or raster appearing period.

Additionally, it has been found that directly heated cathode ray tubes pose a number of problems to the circuit designer of a cathode ray tube system. For example, a winding on a power transformer would provide suitable power for a line operated receiver but would be obviously inappropriate to a battery powered receiver. Also, the well-known advantages of applying video signals to the cathode rather than the grid electrode presents a problem in a directly heated system since a D.C. power source connected to the cathode would tend to short circuit to circuit ground the video signals being applied to the cathode.

## OBJECTS AND SUMMARY OF THE INVENTION

Therefore, it is an object of the present invention to provide an enhanced cathode ray tube system. Another object of the invention is to provide an improved cathode ray tube system with an enhanced "warm-up" or raster appearing time. A further object of the invention is to provide an improved cathode ray tube system employing a directly heated cathode ray tube coupled to both a signal source and a power source.

These and other objects are achieved in one aspect of the invention by a cathode ray tube system employing a cathode ray tube having a directly heated cathode coupled to a signal source and transformer coupled to a power source.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 illustrates one embodiment of a fast "warm-up" time cathode ray tube system; and

FIG. 2 illustrates a preferred embodiment of a fast "warm-up" time cathode ray tube system.

## DESCRIPTION OF THE PREFERRED EMBODIMENTS

For a better understanding of the present invention, together with other and further objects, advantages and capabilities thereof, reference is made to the following disclosure and appended claims in conjunction with the accompanying drawings.

Referring to the drawings, the cathode ray tube system of FIG. 1 includes a cathode ray tube **5** having a directly heated cathode **7** with a pair of external terminals **9** and **11**. One of the external terminals **9** is coupled to a video signal source **13** and a secondary winding **15** of a transformer **17** is coupled intermediate the terminal pair **9** and **11**.

The secondary winding **15** of the transformer **17** has a shield member **19** surrounding a portion thereof with the shield member **19** connected to a potential reference level such as circuit ground. Also, the secondary winding **15** may be coupled to the terminal pair **9** and **11** by way of an impedance **21** which is usually in the form of a resistor.

A primary winding 23 of the transformer 17 is coupled to a horizontal output stage 25 of a television receiver and in series connection with a horizontal deflection yoke 27 intermediate a current source B+ and a potential reference level such as circuit ground. Moreover, a winding 16 of the transformer 17 is coupled by way of a rectifier 29 to the cathode ray tube 5.

As to operation, it may first be assumed that the secondary winding 15 does not include the shield member 19. In this case, a capacitance is developed intermediate the secondary winding 15 and the transformer 17. The transformer 17 is self-resonant at about 100 kHz. and is disconnected from the load of the cathode ray tube 5 during the active scan period by a reverse bias on the rectifier 29. Thus, a relatively high-Q and high powered ringing circuit is undesirably provided in close proximity to the secondary winding 15 and coupled thereto by the above-mentioned capacitance. Moreover, the secondary winding 15 has a relatively high impedance with respect to circuit ground since the secondary winding 15 is a part of the output circuit of the video output stage 13. Thus, an undesired ringing developed in the transformer 17 is capacitance coupled to the secondary winding 15 having a relatively high impedance to circuit ground. Unfortunately, this undesired ringing signal is applied to the cathode ray tube 5 and appears thereon as alternate light and dark vertical bands.

This above-mentioned ringing difficulty may be virtually eliminated or at least greatly reduced by the inclusion of the shield member 19 surrounding a portion of the secondary winding 15. As can be seen in FIG. 1, the shield member 19 is positioned in the vicinity of the winding 16 of the transformer 17 and in surrounding relationship with the secondary winding 15 and coupled to circuit ground.

In this instance, capacitive coupling intermediate the secondary winding 15 and the transformer 17 is virtually eliminated by the shield member 19 with little or no effect upon the magnetic coupling therebetween. The reduced capacitive coupling tends to greatly reduce the previously mentioned ringing appearing on the cathode ray tube 5 as alternate light and dark vertical bands.

Additionally, it may be noted that the inclusion of the shield member 19 tends to introduce a capacitance value shunting the video output stage 13 which tends to somewhat reduce the high frequency detail of the video signal applied to the cathode ray tube 5. Moreover, it was found that it was necessary to include a resistor 21 intermediate the secondary winding 15 and the cathode 7 of the cathode ray tube 5 in order to obtain the desired steady state power to the cathode 7 from the available power source. In turn, the inclusion of the resistor 21 tended to increase the "warm-up" time of the cathode ray tube 5 from about two to about five seconds.

Alternatively, a preferred cathode ray tube system is illustrated in FIG. 2. Therein, a cathode ray tube 31 has a directly heated cathode 33 with a pair of external terminals 35 and 37 respectively. One external terminal 35 of the directly heated cathode 33 is coupled directly to a video output stage 38.

A toroidal transformer 39 includes a core 40 and a one-turn secondary winding 41 shunting the pair of external terminals 35 and 37 of the cathode 33. The primary winding 43 of the toroidal transformer 39 is connected to circuit ground and by way of a horizontal deflection yoke 45 to a horizontal output stage 47 and via a winding 49 of a transformer means 51 to a current source B+. Also, the transformer means 49 is coupled via a rectifier 53 to the cathode ray tube 31.

Also, the toroidal transformer 39 includes a core 40 of a material having a relatively high permeability. For example, one known form of core material provided by Indiana General, Keasbey, New Jersey, and known as "0–6" has a permeability in the range of about 4700. Also, the impedance of the transformer 39 is lower than the impedance of the directly heated cathode 33 of the cathode



ray tube 31. Moreover, the deflection system has the capability of providing current through the deflection yoke 45 of an amount in the range of about 1–10 amperes.

As to operation, a signal derived from the horizontal output stage 47, current source B+ and transformer 51 includes a scan or trace period and a retrace period or flyback pulse. This signal is applied to the toroidal transformer 39 via the horizontal deflection yoke 45.

Since the toroidal transformer 39 has a primary winding 43 closely associated with circuit ground, capacitive coupling to the transformer 51 is minimized which, in turn, minimizes transference of ringing signal from the transformer 51 to the cathode ray tube 31. Also, the toroidal transformer 39 is readily located in close vicinity to the external terminals 35 and 37 of the directly heated cathode 33 providing further isolation of the secondary winding 41 and the transformer 51. Moreover, the toroidal transformer 39 serves as a low impedance source having an impedance which is always lower than the impedance of the cathode 33.

Thus, the toroidal transformer 39 presents a minimum of capacitive coupling to the video output stage 37 which, in turn, virtually eliminates ringing and reduction of high frequency detail therein. Moreover, most importantly, the toroidal transformer 39 is readily designable to provide the proper power for the directly heated cathode 33 without resorting to employment of an impedance intermediate thereto and the cathode 33. As a result, the "warm-up" or raster appearing time of the cathode ray tube 31 is reduced to about 2 seconds and the low impedance source i.e. the toroidal transformer 39, furnishes higher than rated current when the resistance of the so-called "cold" cathode 33 is relatively low, and rated current when the resistance of the cathode 33 is normal.

While there has been shown and described what is at present considered the preferred embodiments of the invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention as defined in the appended claims.

What is claimed is:

1. A "fast warm-up" cathode ray tube system comprising in combination:
   - a cathode ray tube having a directly heated cathode with a pair of terminals;
   - a signal source;
   - a current source, and
   - a transformer having a primary winding coupled to said current source and a secondary winding connected to said pair of terminals of said cathode and to said signal source.

2. The combination of claim 1, including a Faraday shield connected to a potential reference level and surrounding a portion of said secondary winding adjacent said primary winding and connected to said pair of terminals of said cathode.

3. The combination of claim 1 wherein said transformer has a primary winding connected intermediate said current source and a potential reference level and a secondary winding connected to said pair of terminals of said cathode and coupled to said signal source.

4. The combination of claim 3 including a toroidal transformer wherein said secondary winding of said toroidal transformer is in the form of a single turn of wire connected to said pair of terminals of said cathode whereby said cathode is powered from a low impedance source.

5. The combination of claim 4 wherein said secondary winding has an impedance less than the impedance of said cathode.

6. The combination of claim 4 wherein said current from said current source is of an amount in the range of about 1 to 10 amperes.

7. The combination of claim 3 wherein a horizontal deflection yoke and said primary winding of said transformer are series connected intermediate said current

source and a potential reference level whereby current at a horizontal deflection frequency flows through said primary winding of said transformer means.

**8.** The combination of claim **3** wherein said transformer means is in the form of a toroidal transformer having a core material with a permeability in the range of about 3000 to 6000.

**9.** The combination of claim **3** wherein said signal source is in the form of a video signal source.



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