United States Patent [19]

Kubota et al.

[11] **3,717,833**

[45] **Feb. 20, 1973**

[54] **TRANSFORMER**

[75] Inventors: **Yasuharu Kubota**, Fujisawashi, Kanagawa-ken; **Susumu Agawa**, Kamakura-shi, Kanagawa-ken, both of Japan

[73] Assignee: **Sony Corp.**, Tokyo, Japan

[22] Filed: **Aug. 23, 1971**

[21] Appl. No.: **173,979**

[30] **Foreign Application Priority Data**

Aug. 22, 1970 Japan 45/83785

[52] **U.S. Cl.** **336/69,** 336/83, 336/84

[51] **Int. Cl.** **H01r 15/04**

[58] **Field of Search**........................336/69, 70, 84, 83

[56] **References Cited**

UNITED STATES PATENTS

2,896,096	7/1959	Schwarzer	336/84 X
2,085,434	6/1937	Loftis et al.	336/84 X
2,533,920	12/1950	Crook	336/84 X
3,517,361	6/1970	Reifel et al.	336/84
3,393,388	7/1968	Young	336/84
1,624,560	4/1927	Payne	336/84 X
2,183,355	12/1939	Mavener	336/84

FOREIGN PATENTS OR APPLICATIONS

733,913	4/1943	Germany	336/84

Primary Examiner—Thomas J. Kozma
Attorney—Lewis H. Eslinger et al.

[57] **ABSTRACT**

A transformer having primary and secondary windings on a conductive non-magnetic bobbin. A pot-type core surrounds the bobbin and windings and has a central magnetic core extending axially into the bobbin and windings. Flanges on the bobbin separate the primary from the secondary, and the flanges and bobbin have a slot to limit induction current losses. The secondary is center-tapped, and the flanges and conductive, non-magnetic outer case prevent electric field coupling and suppress leakage at the center tap.

2 Claims, 19 Drawing Figures

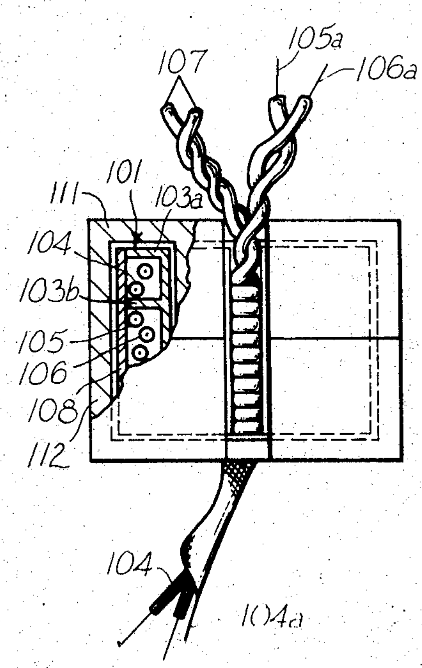
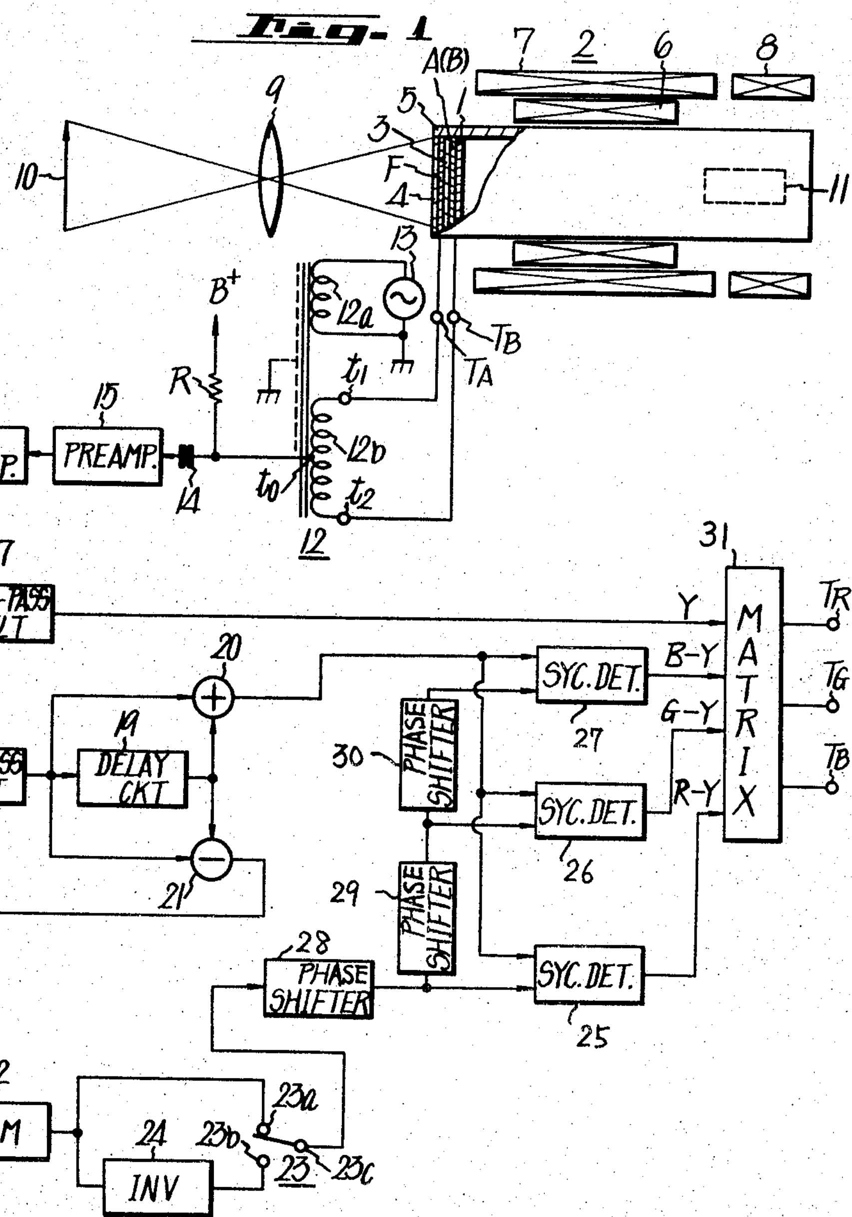


Fig. 1



INVENTORS
YASUHARU KUBOTA
SUSUMU TAGAWA

LEWIS H. ESLINGER
ATTORNEY

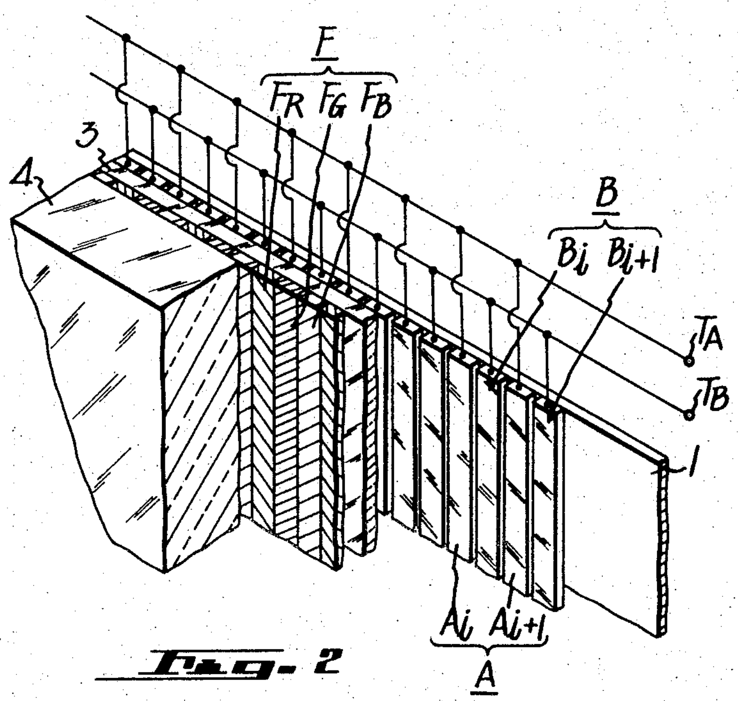
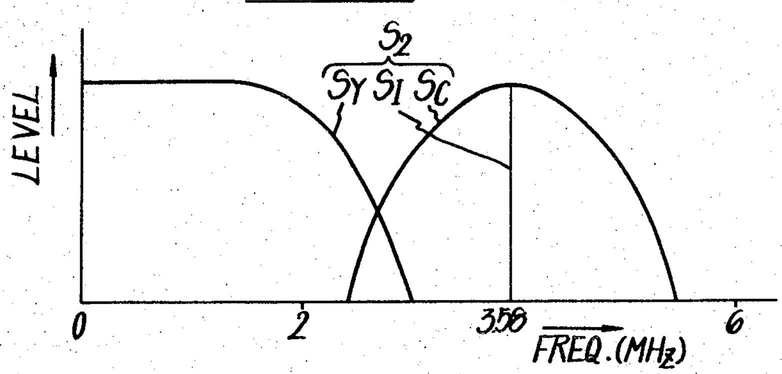


Fig. 2

Fig. 3

Fig. 5



INVENTORS
YASUHARU KUBOTA
SUSUMU TAGAWA

LEWIS H. ESLINGER
ATTORNEY

Fig. 4A

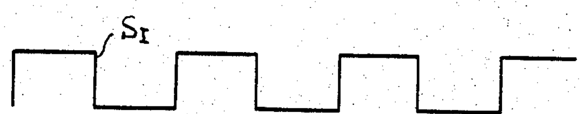


Fig. 4B

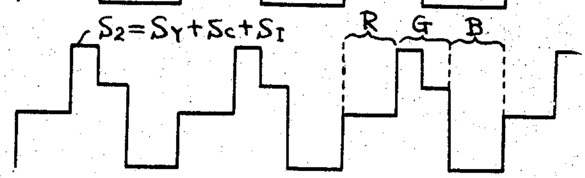


Fig. 4C

Fig. 4A'

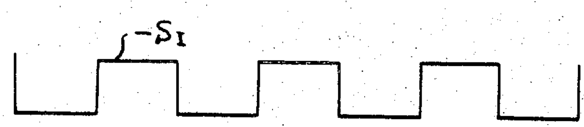


Fig. 4B'

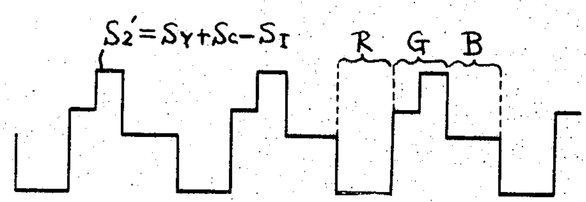


Fig. 4C'

Fig. 4D

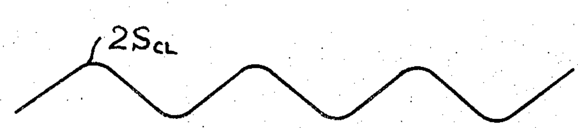
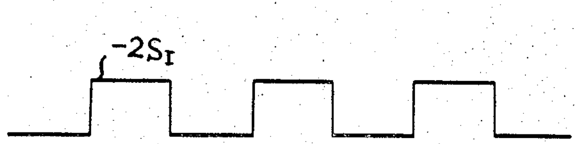


Fig. 4E

Fig. 4F



INVENTORS
YASUHARU KUBOTA
SUSUMU TAGAWA

LEWIS H. ESLINGER
ATTORNEY

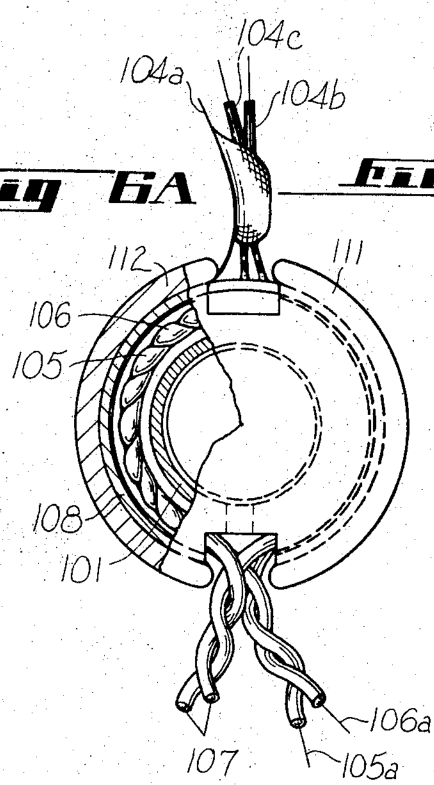


Fig 6A

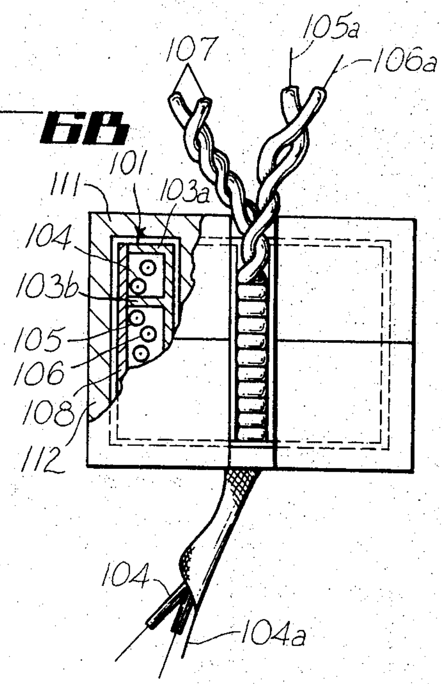


Fig 6B

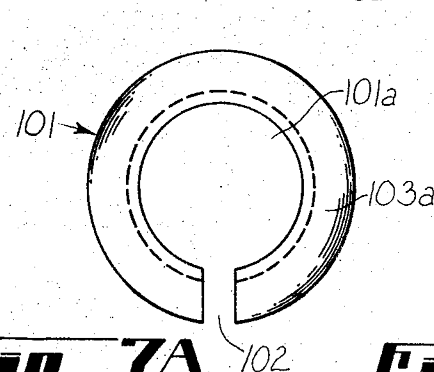


Fig 7A

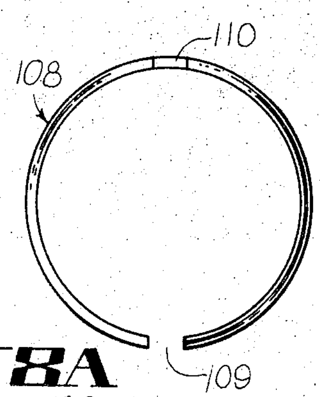


Fig 8A

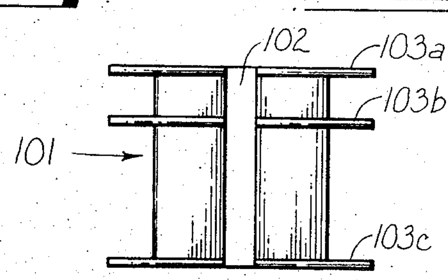


Fig 7B

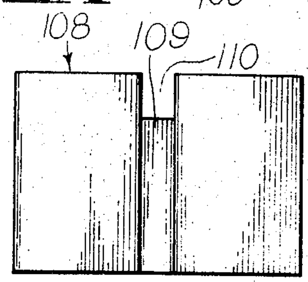


Fig 8B

INVENTORS
YASUHARU KUBOTA
SUSUMU TAGAWA
BY

TRANSFORMER

BACKGROUND OF THE INVENTION

1. Field of the Invention

This relates to the field of transformers for coupling video signals and particularly to means for shielding primary and secondary windings to prevent undesired electric field coupling therebetween.

2. Prior Art

A pickup tube of the type having a target with a multiplicity of color filters and signal plates extending transversely of the direction of line scan has been disclosed in U.S. Pat. No. 2,446,249. In this type of pickup tube the signal plates corresponding to the color filters are connected to bus bars and the respective primary color video signals are derived from three signal output terminals connected to the bus bars. However, this pickup tube is defective in that each primary color video signal is mixed with other primary color video signals due to the electrostatic capacity coupling present between the respective signal electrodes. This results in crosstalk which lowers the color purity of the color video signal.

There has been proposed a system such as disclosed in U.S. Pat. No. 3,502,799 in which a plurality of index signal images and striped color component images are optically formed on the target of a vidicon tube to produce a composite color video signal with an index. With this system, however, the ratio between the color component image area and the effective scanning area of the vidicon is decreased by an amount corresponding to the index signal images. This results in lower resolution. Further, this prior art system necessitates a complicated and expensive device for optically forming the index signal images on the target.

In U.S. application Ser. No. 72,593 entitled COLOR TELEVISION CAMERA and filed Sept. 16, 1970 in the name of Yasuharu Kubota, one of the inventors of the present case, there is described an improved color television pickup tube and system. The pickup tube described in that application has a plurality of electrodes, a color filter and a photoconductive surface and is adapted to form color separated images on the photoconductive layer. In addition, an alternating voltage is supplied to the plurality of electrodes. Accordingly, a predetermined pattern of potential changes is formed on the surface of the photoconductive layer of the pickup tube which is reproduced as an index signal. In this manner the index signal does not narrow the dynamic range of the image pickup tube and the resolution of the color video signal is not lowered.

The index signal, luminance signal and chrominance signal are not derived from each electrode but are picked up in the form of one composite signal, so that even if crosstalk exists between the electrodes, color difference signals can be readily derived from a demodulator circuit, and accordingly a color video signal of good white balance can be obtained.

Since the index signal is obtained at the output of the pickup tube by supplying an alternating voltage to the electrodes in synchronism with the line scanning period of the pickup tube, demodulation of the color video signal is easily accomplished. Further, when the color video signal is reproduced without the chrominance signal, the index signal is simply obtained by adding to the output of the image pickup a signal produced by delaying the pickup tube output by one horizontal scanning period. In this manner, there is no possibility of the index signal being mixed with the demodulated color video signal.

In the device of application Ser. No. 72,593, supra, the index signal and the chrominance signal are in the same band, and hence the bands of the luminance signal and the chrominance signal can be widened to thereby a color video signal with high resolution. In addition, since the index signal and the chrominance signal are derived from a common preamplifier and filter, no difference in the delay time between these signals is produced and, accordingly, a picture of excellent white balance can be obtained. Further, the index signal does not interfere with the chrominance signal, and hence the picture quality is not degraded.

The formation of the color separated images on the photoconductive layer of the pickup tube may be accomplished by any conventional method. For example, a lens screen consisting of many lenticular lenses can be disposed on the surface of the face plate of the pickup tube and the image of a color filter consisting of a plurality of pairs of striped color filter elements and interposed between an object to be televised and the lens screen is projected by the lens screen onto the photoconductive layer and, at the same time, the image of the object being televised is caused by an objective lens to overlap on the image of the color filter. Further, it is also possible that the image of the object to be televised is focused by an objective lens onto the photoconductive layer through a color filter disposed inside of the pickup tube in close proximity to the photoconductive layer. In this case, the optical system is simple in construction and need not be adjusted, so that an inexpensive color television camera can be produced.

In the pickup tube employed in this invention its relative position to the color filter need not be adjusted with high accuracy, and hence adjustment of the pickup tube is easily accomplished.

It has been found that the transformer used for supplying index signals to the electrodes in the pickup tube in U.S. application Ser. No. 72,593, supra, may have undesirable leakage between the primary and secondary. Such leakage may cause unbalanced index signals and a deterioration of color fidelity, for example, by producing a pattern of bright and dark lines in the reproduced television picture.

Accordingly, it is a principle object of the present invention to provide an improved transformer having reduced leakage current.

A further object is to provide a transformer having a reduced leakage and capable of handling low level video signals from a television pickup tube.

Further objects will be apparent from the following specification together with the drawings.

BRIEF DESCRIPTION OF THE INVENTION

The present invention comprises a transformer having a primary and secondary winding in which the secondary has a center-tap. These windings are wound on a non-magnetic, conductive bobbin that has a flange to separate the primary from the secondary and additional flanges at the ends. The bobbin with the windings on it is enclosed in a non-magnetic, conductive shield, and the shield, the flanges, and the bobbin all have slits to prevent losses due to induction currents. Connections to the primary winding are enclosed in a conductive, braided wire shield connected to the outer case.

The wire leads of the secondary winding extend from the conductive shield case and are twisted together to equalize capacitance between these leads and ground. The other ends of the winding are joined together to form the center tap of the secondary winding, and the wire sections adjacent the center tape are twisted together so as to also have equal capacitances to ground. The entire conductive shield case with the bobbin and windings therein is enclosed within a suitable magnetic pot-type core that has a central projection that extends into the hollow bobbin and has an outer portion that completely encloses the transformer except for openings to permit the leads to pass through.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a system diagram illustrating one example of a color television camera incorporating the transformer of the present invention.

FIG. 2 is a perspective view partly in cross-section showing the principle parts of the pickup tube employed in the camera of FIG. 1.

FIGS. 3 and 4 are waveform diagrams for explaining the operation of the camera in FIGS. 1 and 2.

FIG. 5 is a graph showing one example of a frequency spectrum for a color video signal produced by the color television camera shown in FIGS. 1 and 2.

FIG. 6 is an end view of a transformer constructed according to the invention and with parts broken away to show some of the interior construction.

FIG. 7 shows the bobbin used in the transformer of FIG. 6.

FIG. 8 shows the outer shield case to be used with the bobbin in FIG. 7 in manufacturing the transformer of FIG. 6.

DETAILED DESCRIPTION OF THE INVENTION

In order to provide a suitable background for explanation of the present invention, a color video camera in which the transformer of the present invention may be used will first be described. FIG. 1 illustrates the fundamental concepts of this invention. In FIGS. 1 and 2, two sets of electrodes A ($A_1, A_2, \ldots A_i, \ldots A_n$) and B ($B_1, B_2, \ldots B_i, \ldots B_n$) are disposed adjacent the photoconductive layer 1 of a pickup tube 2. The photoconductive layer 1 is formed, for example, of materials such as antimony trisulfide, lead oxide, etc. The electrodes A and B are transparent conductive layers formed of tin oxide including antimony and they are alternately arranged in an order which may, for example, be $A_1,B_1,A_2,B_2, \ldots A_i,B_i, \ldots A_n,B_n$, the electrodes being respectively connected to terminals T_A and T_B for connection with external circuits. In this case, the electrodes are disposed so that their longitudinal directions may cross the horizontal scanning direction of an electron beam.

The electrodes A and B are disposed on one side of a glass plate 3, on the other side of which an optical filter F made up of red, green, and blue color filter elements F_R, F_G and F_B arranged in a repeating cyclic order of F_r, F_G, F_B, F_R, F_G, F_B, . . . are disposed parallel to the length of the electrodes A and B in such a manner that each triad of red, green, and blue color filter elements F_R, F_G and F_B may be opposite to each pair of adjacent electrodes A_i and B_i. So long as the electrodes A and B and the optical filter F are aligned with each other in their longitudinal directions, their relative arrangement is optional. The optical filter F is fixed to the faceplate 4.

The pickup tube 2 has enclosed therein the photoconductive layer 1, the electrodes A and B, the glass plate 3, the optical filter F, and the faceplate 4 mounted on one side of the tube envelope 5. About the image tube 2 there are mounted a deflection coil 6, a focusing coil 7, and an alignment coil 8. Reference numeral 9 indicates an image lens, by means of which the image of an object 10 to be televised is focused on to the photoconductive layer 1 through the faceplate 4. Reference numeral 11 designates an electron gun for emitting an electron beam.

The operating circuit for the tube 2 includes a transformer 12 that consists of a primary winding 12*a* and a secondary winding 12*b* having a mid tap t_0. The terminals t_1 and t_2 of the secondary winding 12b are respectively connected to the terminals T_A and T_B of the image pickup tube 2. The primary winding 12*a* is connected to a signal source 13 which produces an alternating signal S_1, shown in FIG. 3, that is synchronized with the line scanning period of the image pickup tube 2. This alternating signal S_1 has a rectangular waveform with a pulse width equal to a horizontal scanning period H of the electron beam, namely a pulse width of, for example, 63.5 microseconds and a frequency of 7.875 KHz, which is one-half of the horizontal scanning frequency. The midpoint t_o of the secondary winding 12*b* of the transformer 12 is connected to the input of a preamplifier 15 through a capacitor 14 and is supplied with a DC bias voltage of 10 to 50V from a power source B+ through a resistor R.

With such an arrangement, the electrodes A and B are alternately supplied with voltages higher and lower than the DC bias voltage for every horizontal scanning period, so that a striped potential pattern corresponding to the electrodes A and B is formed on the surface of the photoconductive layer 1. Accordingly, when the image pickup tube 2 is not exposed to light, a signal S_I corresponding to the rectangular waveform illustrated in FIG. 4A is derived at the midpoint t_o of the secondary winding 12*b* in a scanning period H_i due to electron beam scanning. When a DC bias voltage of, for example, 30V is supplied to the midpoint t_o of the secondary winding 12*b* and an alternating voltage of 0.5V is impressed between the terminal T_A and T_B, a current flowing across the resistor R varies by 0.05 microamperes, which can be used as an index signal. The frequency of this index signal S_I is optionally determined with reference to the width and interval of the electrodes A and B and one horizontal scanning period of the electron beam, and can for example be 3.58 MHz. When the image of the object 10 is focused on the photoconductive layer 1, signals corresponding to the light intensity of the filtered red, green, and blue components are produced on the photoconductive layer 1 in overlapping relation with the index signal S_I to produce a composite signal S_2 such as illustrated in FIG. 4B, in which the reference characters R, G, and B respectively designate portions of the composite signal S_2 corresponding to the red, green, and blue color components. The composite signal S_2 is the sum of the luminance signal S_Y, the chrominance signal S_C and the index signal S_I, namely $S_2=S_Y+S_C+S_I$. The frequency spectrum of the composite signal S_2, as illustrated in FIG. 5, is determined by the width of the electrodes A and B, the width of the optical filter F, and the horizontal scanning period. That is, the composite signal S_2 in its entirety is in a bandwidth of 6 MHz and the luminance and chrominance signals S_Y and S_C are respectively arranged in the lower and higher bands. It is preferred to minimize overlapping of the luminance and chrominance signals S_Y and S_C and, if desired, it is possible to dispose a lenticular lens or the like in front of the image pickup tube **2**. This optically lowers resolution and narrows the luminance signal band.

In the next horizontal scanning period H_{i+1} the voltage (the alternating signal) applied to the electrodes A and B is reversed in phase, in which case an index $-S_I$ is produced such as depicted in FIG. **4A'** which is opposite in phase to the index signal S_I shown in FIG. **4A**. Accordingly, a composite signal S_2' is derived at the input side of the preamplifier **15** as shown in FIG. **4B'**, namely $S_2'=S_Y+S_C-S_I$.

Such a composite signal S_2 (or S_2') is first supplied to the preamplifier **15** to be amplified and is then supplied to the process amplifier **16** for waveform shaping and/or gamma correction. Thereafter, the signal is applied to a low-pass filter **17** and a bandpass filter **18**, respectively. As a result, the luminance signal S_Y and a signal $S_3=S_{CL}+S_{IL}$ such as shown in FIG. **4C** (or a signal $S_3'=S_{CL}-S_{IL}$ such as depicted in FIG. **4C'**) are respectively derived from the low-pass filter **17** and the bandpass filter **18** separately from each other. S_{CL} and S_{IL} are low frequency components or fundamental components of the chrominance signal S_L and the index signal S_I respectively.

The separation of the index signal S_I and the chrominance signal SC will hereinbelow be described. Since the repetitive frequencies of the index signals S_I and the chrominance signal S_C are equal to each other, the separation of these signals is achieved in the following manner without using a filter.

Reference numeral **19** indicates a delay circuit such as, for example, an ultrasonic delay line, by means of which the signal $S_3=S_{CL}+S_{IL}$ (or $S_3'=S_{CL}-S_{IL}$) derived from the bandpass filter **18** is delayed by one horizontal scanning period 1H. Reference numeral **20** designates an adder circuit and reference numeral **21**, a subtraction circuit. The signals $S_3=S_{CL}+S_{IL}$ (or $S_3'=S_{CL}-S_{IL}$) in a certain horizontal scanning period H_i and the signal $S_3'=S_{CL}-S_{IL}$ (or $S_3=S_{CL}+S_{IL}$) in the subsequent horizontal scanning period H_{i+1}, which are derived from the delay circuit **19** and the bandpass filter **18** are supplied to the adder circuit **20** to be added together, providing as an output a chrominance signal $2S_{CL}$ such as depicted in FIG. **4D**. In this case, the content of chrominance signals in adjacent horizontal scanning periods are so similar that they can be regarded as substantially the same. Further, it is also possible to delay the signal from the bandpass filter **18** by three or five horizontal scanning periods due to their similarity.

These signals $S_3=S_{CL}+S_{IL}$ (or $S_3'=S_{CL}-S_{IL}$) and $S_3'=S_{CL}-S_{IL}$ (or $S_3=S_{CL}+S_{IL}$) in the horizontal scanning periods H_i and $H_i^{+}{}_1$ are applied to the subtraction circuit **21** to achieve a subtraction $(S_{CL}-S_{IL})-(S_{CL}+S_{IL})$ or $(S_{CL}+S_{IL})-(S_{CL}-S_{IL})$ to derive therefrom an index signal $-2S'_{IL}$ (or $2S'_{IL}$, though not shown) such as depicted in FIG. 4E. The resulting index signal $-2S'_{IL}$ (or $2S'_{IL}$) is fed to a limiter circuit **22** to render its amplitude uniform forming an index signal $-2S_I$ (or $2S_I$) as depicted in FIG. 4F.

The index signal $-2S_I$ (or $2S_I$) thus obtained is reversed in phase at every horizontal scanning period, so that the signal $-2S_I$ is corrected in phase in the following manner. Reference numeral **23** designates a change-over switch (an electronic switch in practice), reference numerals **23***a* and **23***b*, its fixed contacts, and reference numeral 23C, its movable contact. The output side of the limiter **22** is directly connected to one fixed contact **23***a* of the change-over switch **23** and to the other fixed contact **23***b* through an inverter **24**. The change-over switch **23** is constructed such that the movable contact **23***c* makes contact with the fixed contacts **23***a* and **23***b* alternately for every horizontal scanning period in synchronism with the alternately signal S_I impressed on the primary winding **12***a* of the transformer **12** to thereby derive the index signal $2S_I$ from the movable contact **23***c* at all times.

The chrominance signal S_{CL} derived from the adder circuit **20** is supplied to synchronous detectors **25**, **26**, and **27**, respectively. The index signal S_{IL} is supplied to the synchronous detector **25** through a phase shifter **28** which adjusts the phase of the index signal to the axis of the red signal in order to produce a color difference signal R—Y at the output of the detector **25**. In a similar manner, the output signal from the phase shifter **28** is supplied to the synchronous detector **26** through a phase shifter **29** to produce a color difference signal G—Y at the output of the detector **26** and the output signal from the phase shifter **29** is supplied to the synchronous detector **27** through the phase shifter **30** to produce a color difference signal B—Y at the output of the detector **27**. The phase shifters **29** and **30** change the phase of the input signals by 120° respectively. These color difference signals and the luminance signal S_Y are applied to a matrix circuit **31** to derive color signals S_R, S_G and S_B at its terminals T_R, T_G and T_B respectively. The color signals thus obtained may be suitably processed to produce color television signals for the NTSC system and other various systems.

It has been found that the transformer **12** in the system shown in FIG. **1** is a critical component in the satisfactory operation of the system. Leakage signals appearing at the midpoint t_o of the secondary winding **12***b* may be the result of leakage from the primary winding **12***a*. We have found that the leakage is apparently primarily caused by capacity between the primary and secondary windings and by a difference of the capacity to ground between the two sections of the secondary windings. The leakage signal present at the midpoint t_o tends to produce unbalanced index signals during each horizontal scan. As a result, the index signal tends to remain in the reproduced chrominance signal S_{CL}, which causes a deterioration of color fidelity. This deterioration may show up as alternate bright and dark lines in the reproduced color picture.

The transformer shown in FIGS. **6–8** is provided, in accordance with the present invention, to overcome the foregoing problems related to the transformer **12** of FIG. 1.

FIG. 7A shows a top view of a bobbin **101** and FIG. 7B shows a side view of this bobbin, which forms the first component in the construction of the transformer. The bobbin is basically a hollow tube of non-magnetic highly conductive metal, such as copper, aluminum, gold, silver, and the like, and has a center hole **101***a*. In order to minimize induction currents, the bobbin tube has a slot **102** that extends the entire length of the tube. Extending laterally from the tube are three flanges **103***a*–**103***c*, which are preferably of the same type of metal as the cylindrical part of the bobbin and are electrically and mechanically affixed thereto.

The other components of the transformer are shown in FIGS. 6A and 6B. A primary winding **104**, which may consist typically of four turns, is wound on the bobbin in the space between the flanges **103***a* and **103***b*. The bobbin acts as a shield for the winding but an additional metal shield of tinned braided copper wire **104***a* is connected to the bobbin and surrounds the lead wires **104***b* and **104***c* of the primary **104**.

The secondary windings, which may consist of one turn each, are indicated by reference numerals **105** and **106** and are placed in the bobbin region between the flanges **103***b* and **103***c*. The secondary windings have terminal wires **105***a* and **106***a*, respectively, and these are twisted together outside of the transformer to equalize the capacitance to ground of this part of the transformer. The other ends of the windings **105** and **106** are also twisted together and connected to form the midpoint **107**. Thus, all parts of the connections to the windings **105** and **106** are either shielded by the bobbin **101** or, where they are external to the transformer, are twisted to equalize the capacitance to ground.

The bobbin **101** and the primary winding **104** and the secondary windings **105** and **106** are enclosed within a C-shaped conductive metal shield case **108** shown in FIGS. 8A and 8B. This shield may be of the same type of metal as that of the flanges and is both electrically and mechanically joined to the flanges to form a complete shield around the windings except for a limited slot **109**, which is aligned with the slot **102** in the completed transformer. The shield case **108** also has a notch **110** at one end thereof diametrically opposite the slot **109**. The depth of the notch **110** is substantially equal to the distance between the flanges **103***a* and **103***b* so that the end terminals **104***b* and **104***c* of the primary winding **104** can be pulled through this slot to allow connections to be made. The ends **105***a* and **106***a* and the midpoint **107** of the secondary are pulled through the slot **109** on the opposite side of the transformer. Preferably the shield case **108** is soldered to the flanges **103***a*–**103***c* and the metal shield **104***a* of the primary winding **104** is soldered to the shield case **108** to form a complete shield for the transformer and its connections.

Two pot-core sections **111** and **112** fit around the transformer. These pot-cores are made of suitable ferrite material and comprise cylindrical portions closed at one end and having a hollow inner part big enough to accept the bobbin **101** and the shield case **108**. At the center of each of the pot-core sections **111** and **112** is a central post that extends into the hole **101***a* in the bobbin to improve the magnetic coupling. The core sections **111** and **112** are bonded to each other at their peripheral portions and at the center portion with an adhesive.

Because of the enclosed configuration of this transformer, the electric field from the primary winding **104** does not couple with the secondary windings **105** and **106** and, therefore, any leakage signal at the midpoint **107** is suppressed. This cooperates with the equalization of the capacitances to ground of the winding ends **105***a* and **106***a* of the secondary to produce a uniform index signal at every scanning line of the camera system shown in FIG. **1**. One additional advantage of the pot-core sections **111** and **112** is to prevent any influence from magnetic leakage flux from the outside, such as flux from the deflection yoke of the vidicon tube **1**. The cores also prevent leakage flux from the transformer to the vidicon.

What is claimed is:

1. A transformer comprising:

A. A bobbin of non-magnetic conductive metal comprising:
   1. a plurality of flanges, each having a generally radial slot, and
   2. a hollow hub having a longitudinal slot aligned with the slots in said flanges;

B. A primary winding wound on said hub between first and second ones of said flanges;

C. A secondary winding located between said first flange and a third one of said flanges and having a center tap, said secondary winding being wound on said hub, said first one of said flanges being located between said primary and secondary windings;

D. A non-magnetic conductive metal case surrounding said bobbin and conductively connected to said flanges to suppress an electric field from said windings and having a longitudinal slot extending the length thereof and aligned with said slots in said flanges, the ends of said secondary winding being twisted together outside of said case to provide equal capacitances to ground from both ends of said secondary winding;

E. A magnetic core comprising:
   1. a post extending in said hollow hub, and
   2. an outer portion surrounding said bobbin and non-magnetic conductive metal case; and

F. A flexible shield encircling the ends of said primary winding outside of said metal case, one end of said shield being electrically connected to said case and the other end of said braid being connected to ground.

2. The transformer of claim 1 in which said case has an additional notch diametrically opposite said slot in said case and extending into one end thereof a distance substantially equal to the distance between said first and second flanges, said ends of said primary winding extending through said notch and said ends and center tap of said secondary winding extending through said slot in said case.

* * * * *