United States Patent

Ikeuchi

[15] **3,681,725**

[45] **Aug. 1, 1972**

[54] **SATURABLE REACTOR FOR CORRECTING RASTER DISTORTION**

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[73] Assignee: **Denki Onkyo Co., Ltd.,** Tokyo, Japan

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[21] Appl. No.: **65,414**

[30] **Foreign Application Priority Data**

Aug. 25, 1969 Japan.....44/80574

[52] **U.S. Cl.**.....**335/227,** 315/27 SR

[51] **Int. Cl.**.....**H01f 7/06**

[58] **Field of Search** .....335/210, 227, 297; 315/24, 315/27, 27 SR, 27 GD

[56] **References Cited**

UNITED STATES PATENTS

3,571,606	3/1971	Kikuchi	315/27 SR
3,329,861	4/1967	Barkow et al	315/24
3,555,350	1/1971	Okuda	315/24

Primary Examiner—George Harris

Attorney—James E. Armstrong and Ronald S. Cornell

[57] **ABSTRACT**

A saturable reactor comprised of a cross-shaped core having a yoke on the center portion thereof and protrusions at right angles to the yoke and two coils wound on the yoke. Each coil of the said two coils is divided into two coil parts which are wound on the right and left yoke arms. The first pair of the said two coils is constituted so as to be identical as to the direction of the magnetic generation as is the pair of coils wound on the right and left yoke arms. The second pair of coils is constituted so as to be opposite to each other as to the direction of magnetic flux generation as is the pair of coils wound on the right and left yoke arms.

10 Claims, 14 Drawing Figures

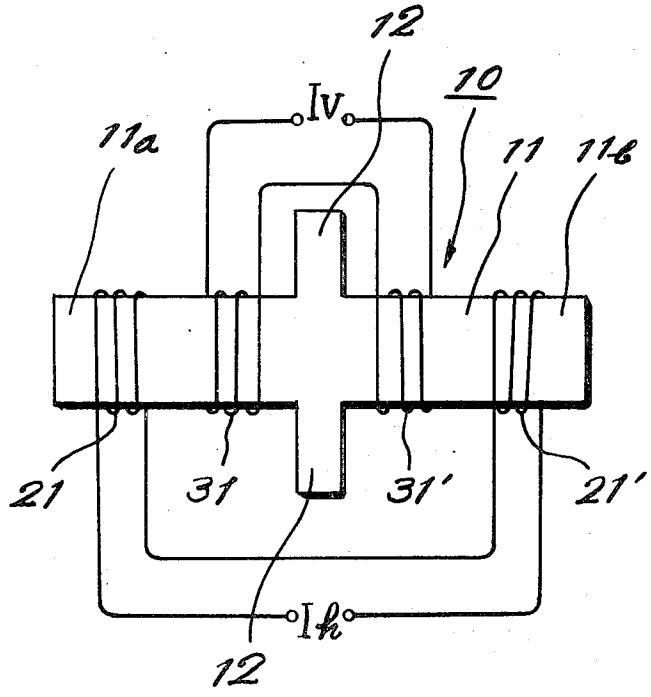


Fig. 1

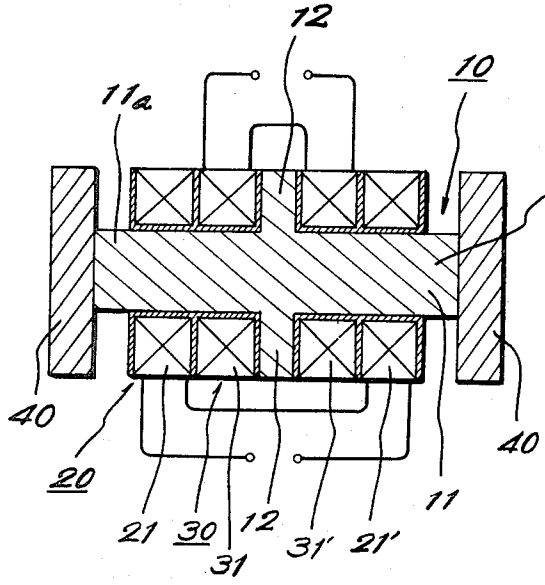


Fig. 2

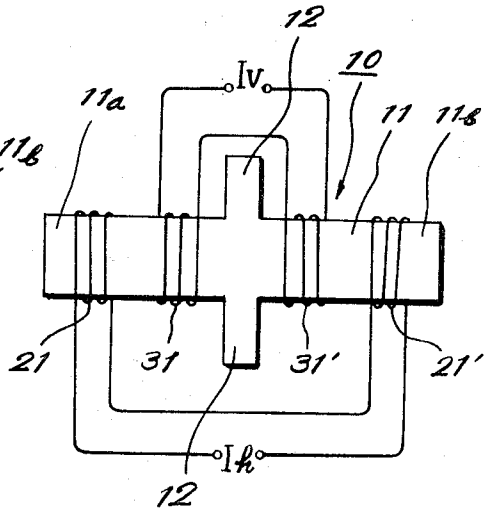


Fig. 3

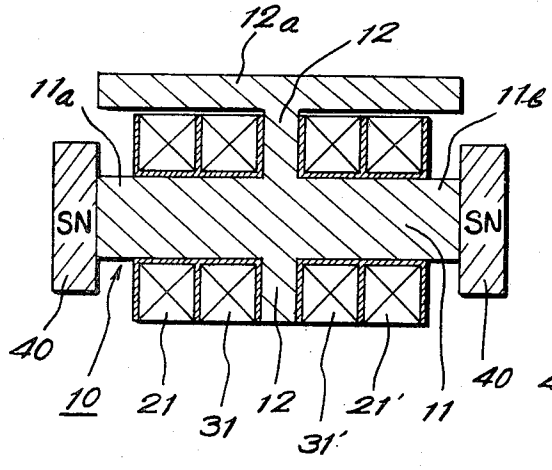


Fig. 4

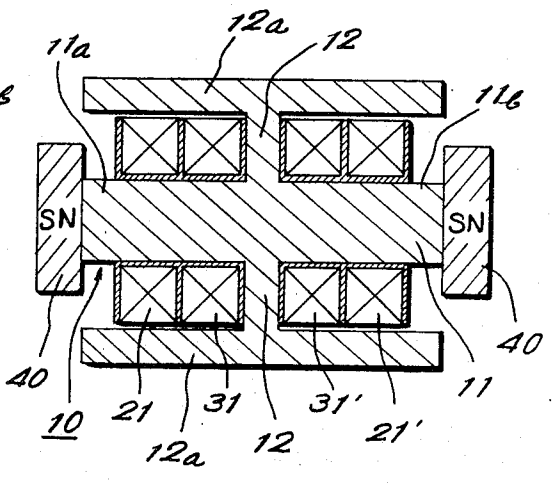


Fig. 5

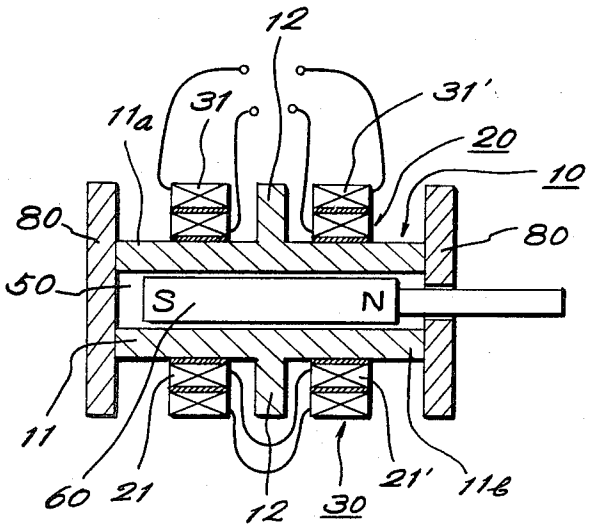


Fig. 6

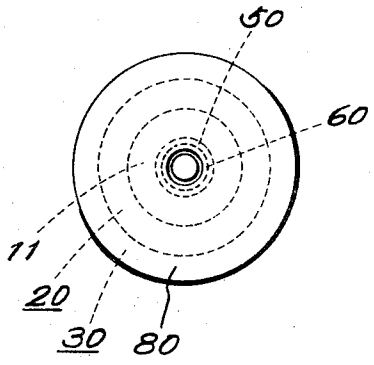


Fig. 7

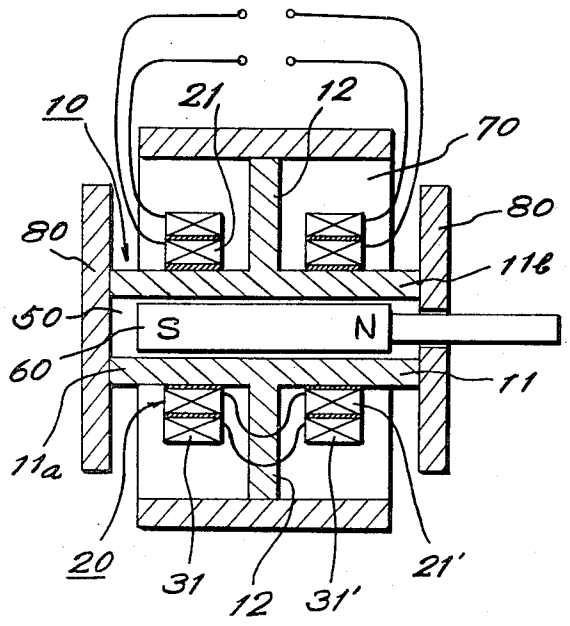


Fig. 8

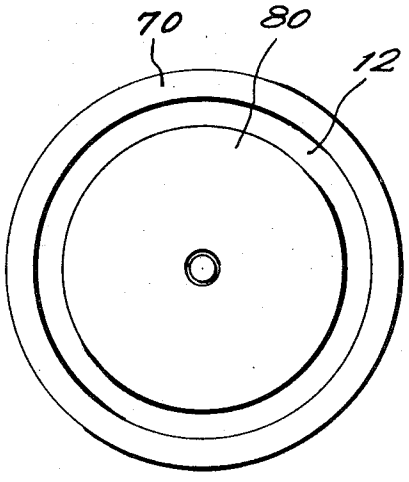


Fig. 9

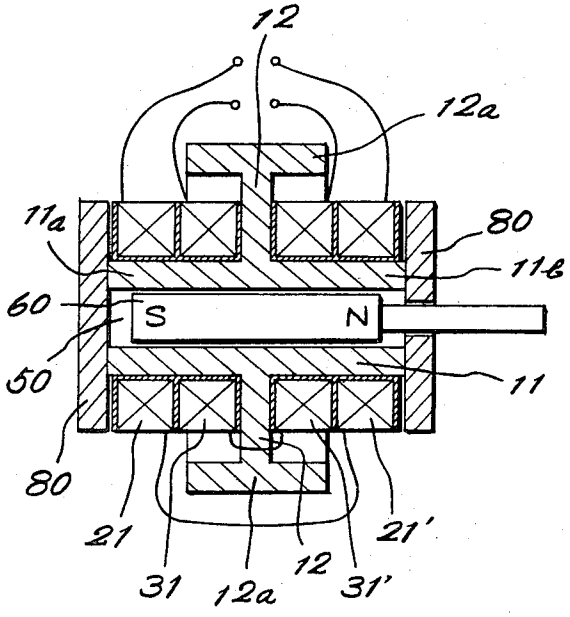


Fig. 10

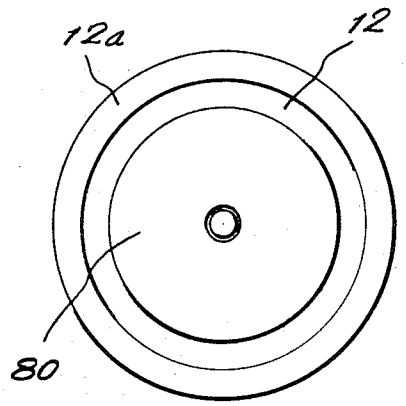


Fig 11

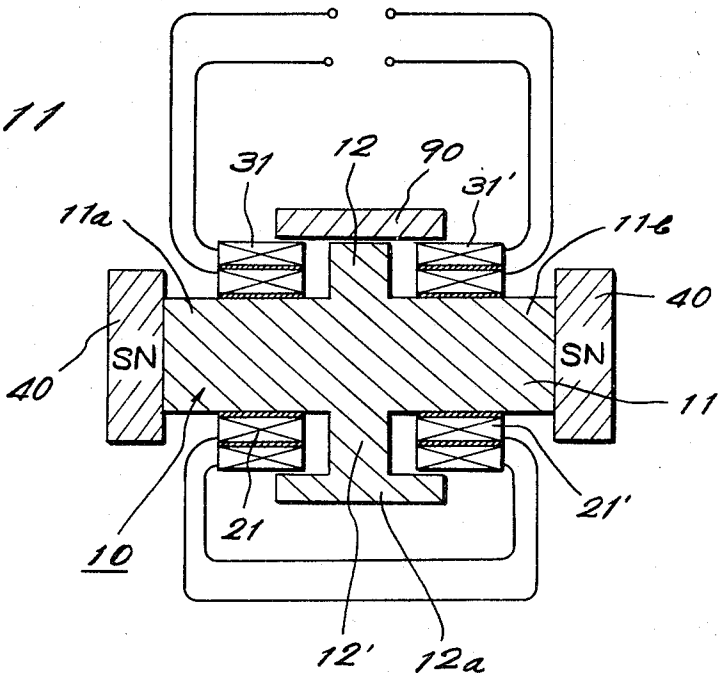


Fig. 12

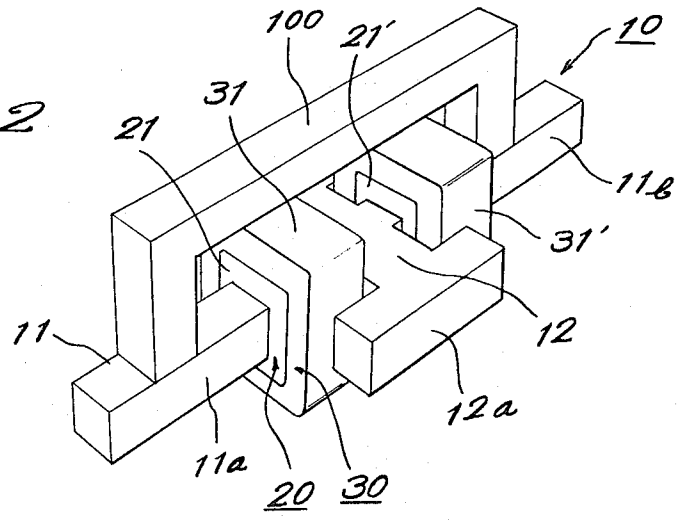


Fig. 13

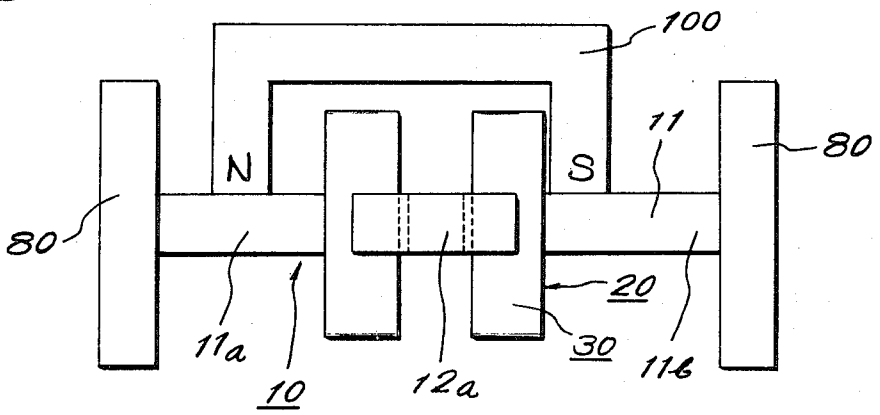
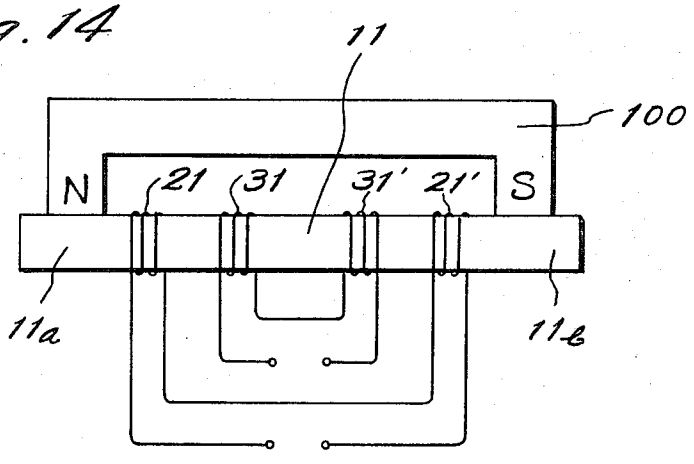


Fig. 14



SATURABLE REACTOR FOR CORRECTING RASTER DISTORTION

BACKGROUND OF THE INVENTION

The present invention relates to a reactor for controlling or modifying "pincushion" type distortion in cathode ray tube displays. It is particularly well suited for use in conjunction with color display tubes.

Pincushion type distortion of cathode ray tube displays has long been recognized. In black-and-white displays, this type of distortion is corrected to a considerable extent through the use of permanent magnets, which are so shaped and fixed in positions relative to the cathode as to produce an appropriate magnetic biasing effect on the cathode ray beam. In the case of color display tubes, which are based on the use of shadow mask or similar principles, however, fixed correcting magnets cannot be used.

One approach, which has been adopted in connection with the correction of pincushion distortion in color displays involves modulation or variation of one of the sweep currents in such a manner as to produce the desired results.

In the arrangement for correction of raster distortion occurring in the vertical direction (e.g., top and bottom pincushion distortion), the cyclically varying vertical scanning current must be modulated at a higher horizontal rate, such as by adding a horizontal rate correction current alternated parabolically to the vertical deflection current.

In the arrangement for the correction of raster distortion occurring in the horizontal direction (e.g., side pincushion distortion), the cyclically varying horizontal scanning must be varied at a lower vertical rate, since the magnitude of a horizontal scanning must be varied at a lower vertical rate, since the magnitude of a horizontal scanning current is parabolical.

It has further been suggested in the prior art that this modulation be accomplished electromagnetically using a combination of magnetic and electrical circuitry which works on the principle of magnetic saturability.

In general, nominal correction can be produced by this means. There are many kinds of saturable reactor device and circuit connections for correcting pincushion distortion such as those described in U.S. Pats. No. 2,906,919, No. 3,346,765, and No. 3,444,422.

The existing reactor, as seen in the aforementioned U.S. patents, is composed of a core that mutually couples the two ends of three parallel yokes, a coil is shunt-wound on the two yokes on both sides of the said core in opposite winding direction and is connected in series, and another coil is wound on the center of the said core. Since the vertical deflection current has been applied to one of the above-mentioned coils and the horizontal deflection current has been applied to the other coil, the device has disadvantages as described herein.

In the manufacture of a reactor, coils are fitted to respective yokes of an E-shaped core, and I-shaped cores are coupled on the free ends of the yokes of the E-shaped core in order to magnetically couple the yokes. Using this process, the manufacturing process has been time-consuming, making it unsuited to mass-production. Magnetic flux leakage has been small, since the yokes formed a closed magnetic path. However, since current magnetic flux density in the closed magnetic path varied markedly depending on the infinitesimal differences in the gaps in the magnetic path, the characteristics of individual products lost uniformity because of disparity in the gap arising in the coupled part of the E-shaped core and the I-shaped core.

The present invention offers saturable reactors extremely easy to assemble and manufacture and with uniform quality of individual products.

SUMMARY

In accordance with the invention there is provided a saturable reactor for correcting raster distortion comprised of a cross-shaped magnetic core having a yoke on the center portion thereof and protrusions being provided at right angles thereto, and two coils wound on the said yoke, each coil of the said two coils being divided into two parts and the divided coils wound on the respective arms formed on both sides of the said protrusions, the first coil being so constituted that the magnetic fluxes generated in the two divided coil parts assume the same direction when an electric current is caused to flow therethrough, while the said second coil is so constituted that the magnetic fluxes will be generated in opposite directions in the two divided coil parts when an electric current is caused to flow therethrough.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention is illustrated in detail in the accompanying drawings in which:

FIG. 1 is a longitudinal section of the reactor of the present invention.

FIG. 2 is a circuit diagram of the reactor shown in FIG. 1.

FIG. 3, 4, and 5 are longitudinal sections of front views of other embodiments of the reactor of the present invention.

FIG. 6 is a side view of the reactor shown in FIG. 5.

FIG. 7 is a longitudinal section of the front view of another embodiment of the reactor of the present invention.

FIG. 8 is a side view of the reactor shown in FIG. 7.

FIG. 9 is a longitudinal section of the front view of the reactor of the present invention.

FIG. 10 is a side view of the reactor shown in FIG. 9.

FIG. 11 is a longitudinal section of the front view of another embodiment of the reactor of the present invention.

FIG. 12 is an isometric of another embodiment of the reactor of the present invention.

FIG. 13 is a front view of the reactor shown in FIG. 12.

FIG. 14 is a circuit diagram of the reactor shown in FIG. 13.

DETAILED DESCRIPTION

Referring to FIGS. 1 and 2 of the drawings, the reactor of the invention is composed of a cross-shaped core 10, a first coil 20 and a second coil 30 wound around the said core and fixed permanent magnets 40 for magnetic biasing, which are attached to the core mentioned above.

The core 10 of the reactor of the invention is a cross-shaped core which is composed of a piston-shaped

yoke 11 and a protrusion 12 provided on the middle of the yoke 11 so as to be at right angles to each other. On the right and left sides of the protrusion 12, the yoke 11 forms arms 11*a* and 11*b* partitioned off by protrusion 12.

Of the two coils mentioned above, the first coil 20 is divided into two serially connected coil parts 21, 21', and each coil part 21, 21' is separately wound around the left and right arms 11*a*, 11*b* of the yoke 11 mentioned above, the windings being in the same direction.

Of the two coils mentioned above, the second coil 30 is divided into two serially connected coil parts 31, 31', and each coil part 31, 31' is separately wound around the left and right arms 11*a*, 11*b* of the yoke 11 mentioned above on which the first coil is wound, the windings being in mutually opposite directions.

The first coil 20 and the second coil 30 are identical in use to those of the conventional reactor in that vertical deflection current is caused to flow through one and the horizontal deflection current is caused to flow through the other. This differs depending on whether the vertical distortion of the raster is to be corrected or the horizontal distortion is to be corrected. In other words, it differs according to the circuit to be connected to the reactor. And such circuits are already publicly known through prior techniques, such as are detailed in the aforementioned U.S. patents.

Such being the reactor of this invention, flow of horizontal deflection current Ih through the first coil 20 of vertical deflection current Iv through the second coil 30 induces and superimposes the reverse correction current waveform of the horizontal deflection cycle on the vertical deflection current Iv. At the same time, since core 10 is magnetically biased by the permanent magnet 40, the amplitude of the aforementioned reverse correction current waveform becomes large at the beginning and the end of the vertical scanning period and small at the center thereof. Also, since the coil parts 31, 31' of the second coil 30 are wound so as to be in mutually reverse phases, the phase of the correction current waveform becomes reversed at the beginning and the end of the vertical scanning period.

When the basic waves only of the reverse correction current are taken out with a tuning circuit, sine wave current of forward correction, i.e., correction current of waveform that can be substituted for the approximately parabolic current, is obtained. This allows correction of the vertical raster distortion. Since the operation and application of the reactor described in the foregoing are already publicly known through prior techniques, detailed descriptions will be omitted.

As has been clarified by the foregoing descriptions and diagrams, the reactor related to the present invention uses the cross-shaped core 10, for the reason that it offers the advantage of easy fitting of the first coil 20 and the second coil 30 on the arms 11*a* and 11*b* of the yoke 11. Also, as the magnetic path is of the open type, it offers the advantage of the absence of any effect on the characteristics of individual products even when there are slight differences in the gaps between the arms of yoke 11.

Of course, in the open magnetic path, such as is the case with the reactor of the present invention, the magnetic flux leakage becomes large, but this disadvantage can easily be eliminated by providing a magnetic shield for the outer casing of the reactor.

Consequently, the reactor of this invention offers the benefits of allowing mass production in a simple and facile manner and of uniform characteristics of individual products.

FIG. 3 and FIG. 4 show reactors where the protrusion 12 of core 10 has an extension or extensions 12*a* arranged in parallel with yoke 11.

Extensions 12*a* are provided to narrow the gap on the magnetic path, reducing the leakage flux. This means has advantages in that it makes possible not only an increase in the amount of the flux current, but also makes shielding of the flux easy.

Extensions 12*a* related to one embodiment according to the present invention may be equipped on only one end of the protrusion 12, as illustrated in FIG. 3, or may be equipped on both ends of protrusion 12, as illustrated in FIG. 4. When protrusion 12 is flange-shaped, it offers an advantage in that protrusion 12 can be made large in area.

FIG. 5 and FIG. 6 show a reactor in which an axially extending cavity 50 is provided at the center of the yoke 11 of core 10. A piston-shaped bar permanent magnet 60, for a magnetic bias, magnetized in the axial direction is slidably positioned within cavity 50. so as to be

The said reactor enables changing the magnetic bias of the right and left arms 11*a* and 11*b* by sliding the bar permanent magnet 60, so that a raster distortion asymmetric in the top and bottom of the raster can be corrected by making the amplitude of a parabolic correcting current asymmetric for the former and latter halves of a vertical scanning period.

It is known from the statement so far that the cores illustrated in FIGS. 1, 3, and 4 may be used for core 10. When the core shown in FIG. 1 is used, the leakage flux can be reduced by constituting the said core as mentioned below.

FIG. 7 and FIG. 8 illustrate the reactor cylindrical magnetic core 70 which is mounted on the cross-shaped core 10 so that the inside surface of core 70 will contact the ends of the yoke protrusions. It is desirable for the said reactor that yoke protrusion 12 is flange-shaped because cylindrical core 70 is mounted on the core 10 in parallel with yoke 11.

This type of reactor mentioned above also offers the advantage that the magnetic resistances between the arms 11*a* and 11*b* of the yoke and cylindrical core 70 can be relatively increased or decreased by sliding the cylindrical core 70 along yoke 11.

FIG. 9 and FIG. 10 show a reactor in which a permanent bar magnet 60 is inserted into the core 10 illustrated in FIGS. 5 or 7.

The operating characteristics of the reactor related to the above-mentioned embodiment will be clearly known from the statement so far.

Consequently, it is desirable for the reactors shown in FIGS. 5, 7, and 9 that a core strip 80 is mounted on both ends of the core 10 of each reactor. This means offers the advantages that the gap between the yoke arms 11*a* and 11*b* of the yoke 11 and the yoke protrusion 12 can not only be made narrower, but also coils 20 and 30 can be held with core strip 80.

However, since the reactor according to this invention is devised so as to eliminate the characteristic change due to small variation of the gap with the open magnetic path formed in the magnetic circuit, it is

necessary for a reactor of type in FIG. 7 to determine the size of core strip **80** and the length of cylindrical core **70** so that the gap between is not too narrow.

FIG. **11** illustrates a reactor in which a core strip **90** is mounted on protrusion **12** of core **10**.

Core **10**, according to the embodiment of FIG. **11**, is not flange-shaped usually, so that a pair of protrusions **12** and **12'** are stuck out in opposite directions to each other on the middle of the yoke **11**.

Core strip **90** is arranged on one protrusion **12** so as to be in parallel with the said yoke **11** and is attached to on the protrusion **12** so as to slide along the yoke in parallel.

In this embodiment according to this invention, since it is possible to change the gap between arm **11***a* and protrusion **12** and the gap between arm **11***b* and protrusion **12** by sliding the said core strip **90**, the magnetic bias prints of arms **11***a* and **11***b* can be changed. Therefore, a fixed permanent magnet **40**, as illustrated in FIG. **1**, is often used as the bias magnet. In this case, a bar magnet as illustrated in FIG. **5** may be used for a particular purpose.

FIG. **12** to FIG. **14** show a reactor in which a U-shaped permanent magnet **100** is placed on the said core **10** to be used as the bias magnet.

Permanent magnet **100** having magnetic poles at both ends is mounted on core **10** in such a manner that both magnetic poles are attached to the external surface of core **10** so that the magnetic poles may be placed on the external surfaces of the arms on the free ends outside the winding parts of coils **20** and **30**. That is, coils **20** and **30** are positioned in the space of the U-shaped permanent magnet.

The reactor relating to the above-mentioned embodiment is devised so that permanent magnet **100** can be slid to bring one magnet pole S close to the coils **20** and **30**, thus enabling it to separate the other magnet pole N from the coils; therefore, the magnetic bias points of the arms **11***a* and **11***b* be asymmetrically changed and, also, both arms **11***a* and **11***b* can be identical in the magnetic bias point by making equal the distances between both magnetic poles and the coils.

Consequently, the reactor according to the above-mentioned embodiment, like the reactor shown in FIG. **5**, can be used for correcting the vertical distortion of the raster whether it is symmetrical or not.

While a few embodiments of this invention have been illustrated and described in detail, it is particularly understood that this invention is not limited thereto or thereby. For example, the reactor shown in FIG. **12** may use the cores shown in FIGS. **3** and **4**, or the core shown in FIG. **1** may be mounted with the cylindrical core shown in FIG. **7**.

What is claimed is:

1. A saturable reactor for correcting raster distortion comprised of a cross-shaped magnetic core consisting essentially of a central yoke portion and a divider portion in the form of a protrusion intersecting the central portion at a right angle and extending to the opposite side thereof, thereby dividing the central yoke portion into separate arm portions and forming a magnetic core which is cross-shaped when viewed in cross-section, and two coils wound on the yoke portion, each of said coils being subdivided into two parts and the thus divided coils being wound on the respective arm portions formed on both sides of the protrusion, the first coil being so constituted that the magnetic fluxes generated in the two divided coil parts assume the same direction when an electric current is caused to flow therethrough, while the said second coil is so constituted that the magnetic fluxes will be generated in opposite directions in the two divided coil parts when an electric current is caused to flow therethrough, and wherein the core is so structured that the cross-sectional dimensions are identical along its entire length, with no projections appurtenant to the respective ends thereof.

2. A saturable reactor for correcting raster distortion according to claim **1**, wherein at least one end of the protrusion is extended in a direction parallel to the central yoke.

3. A saturable reactor for correcting raster distortion according to claim **1**, wherein the protrusion consists of two oppositely positioned projections.

4. A saturable reactor for correcting raster distortion according to claim **1**, wherein the protrusion consists of a continuous disc surrounding the yoke portion.

5. A saturable reactor for correcting raster distortion according to claim **1**, wherein a cylindrical core is mounted on the cross-shaped core with the inside wall of the cylindrical core in slidable contact with said divider portion of the cross-shaped core.

6. A saturable reactor for correcting raster distortion according to claim **2**, wherein the protrusion is extended by attaching thereto core strips in parallel with the central yoke.

7. A saturable reactor for correcting raster distortion according to claim **1**, wherein a U-shaped permanent magnet having magnetic poles at both ends is mounted on the cross-shaped core so that the said magnetic poles contact the right and left arm portions of the yoke respectively, and wherein the coils are positioned within the magnetic poles.

8. A saturable reactor for correcting raster distortion according to claim **1**, wherein permanent magnets for bias are mounted on both ends of the yoke.

9. A saturable reactor for correcting raster distortion according to claim **1**, wherein a cavity is provided in the center of the yoke in the axial direction thereof and a permanent bar magnet magnetized in the axial direction thereof is movably inserted into the cavity.

10. A saturable reactor for correcting raster distortion according to claim **9**, wherein core strips are placed on both ends of the yoke.

* * * * *