Dec. 15, 1959 P. J. H. JANSSEN 2,917,646

DEFLECTING COIL SYSTEM FOR CATHODE RAY TUBES

Filed Dec. 12, 1956

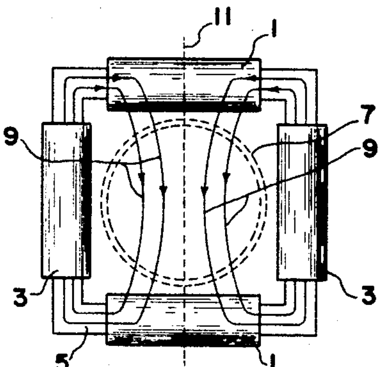
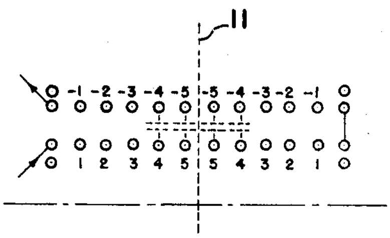


FIG. 1



PRIOR ART

FIG. 2

PRIOR ART

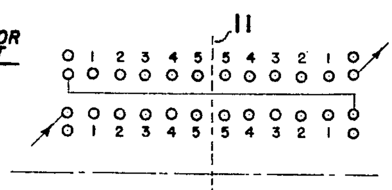
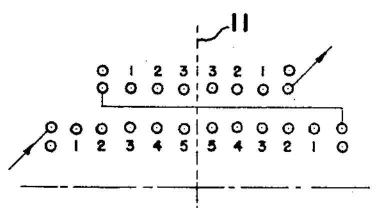


FIG. 3



PRIOR ART

FIG. 4

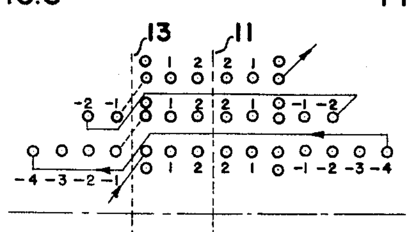


FIG. 5

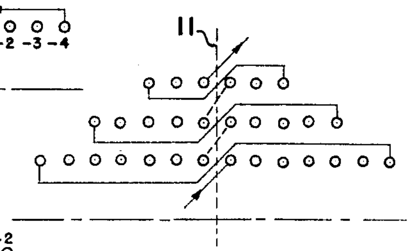


FIG. 6

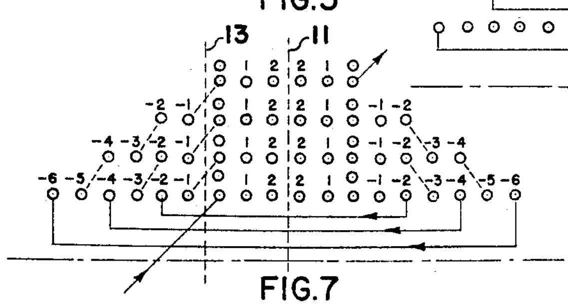
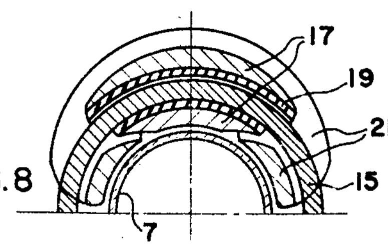


FIG. 7

FIG. 8



INVENTOR.

BY P. J. H. JANSSEN

Frank R. Jifari
AGENT

United States Patent Office

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DEFLECTING COIL SYSTEM FOR CATHODE RAY TUBES

Peter Johannes Hubertus Janssen, Eindhoven, Netherlands, assignor, by mesne assignments, to North American Philips Company, Inc., New York, N.Y., a corporation of Delaware

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Claims priority, application Netherlands January 5, 1956

9 Claims. (Cl. 313—76)

This invention relates to deflection coil systems for cathode-ray tubes having a ferromagnetic annular core the cross-section of which is embraced by the coils for the slow or vertical deflection, all the layers of these coils being wound in the same helical direction. Such a coil system is known from U.S. Patent 2,239,865. As will be described more fully hereinafter, this particular manner of winding prevents the formation of resonant circuits by each pair of successive winding layers together with the capacitance between the adjacent wires, which circuits are excited by the sawtooth line deflection field and give rise to spurious oscillations causing very undesirable distortions of the frame deflecting field, particularly if the coils are of the high-impedance type.

In the known arrangement, the axial cross-section of each of the frame deflection coils is at least approximately rectangular, that is to say, all the layers of the toroidal coil comprise the same number of turns. It is an object of the present invention to provide a deflection coil system containing frame or vertical deflection coils of a different shape, which is suitable for wide-angle deflection, the said advantage of freedom from spurious oscillations being retained. According to the invention, this is ensured in that the layers are wound with decreasing overall width in an axial direction so that a cross-section through half the coil exhibits a generally trapezoidal shape, with each layer being divided in at least two parts which succeed one another in the direction of winding. Further, each layer starts at a point situated within the axial boundary of the outermost winding layer and, after a part which begins at this point has been wound and the winding wire is returned, a preceding part is wound up to the said point.

In order that the invention may be readily carried out, some embodiments thereof will now be described by way of example with reference to the accompanying drawing, in which:

Fig. 1 shows a deflecting system of a known kind,

Figs. 2 and 3 illustrate diagrammatically two known manners of winding which may be used in the system shown in Fig. 1,

Fig. 4 illustrates the operation of another coil system,

Figs. 5 and 6 illustrate diagrammatically two embodiments of the invention, while

Fig. 7 shows still a further embodiment of the invention, and

Fig. 8 is an axial cross-sectional view of one half of a coil system of the invention mounted in operating position.

The known deflection coil system shown in Fig. 1 comprises two coils **1** for the frame deflection (vertical deflection) and two coils **3** for the line deflections (horizontal), the coils being wound as toroids on an annular, in the present case square, soft-ferromagnetic core **5** so that the windings embrace the sectional are of the core (so-called toroidal windings). The core **5** surrounds the neck of a cathode ray tube **7** in the usual manner. The line deflection coils **3** periodically produce a sawtooth

magnetic deflecting field in the tube which is indicated in Fig. 1 by a number of lines of force **9**.

Fig. 1 shows that the field **9** traverses the coils *1* and can induce pulse-shaped voltages in these coils. These voltages are in opposition in the two halves of each of the coils **1** situated on both sides of the vertical median or center symmetry line **11** and compensate each other to a certain extent. Fig. 2 is a vertical axial cross-sectional view of part of the upper half of one of the coils **1** and shows the instantaneous distribution of the induced pulse voltages over the turns of the first two layers of the coil by means of figures placed above or below the turns indicating, on an arbitrary scale, the pulse voltage on each winding at the spot where the winding is intersected. For example, the numeral 1 placed above or below a turn of the coil indicates that there is induced therein due to flux from the horizontal coil system a voltage having an arbitrary magnitude of 1 and a certain polarity. The numeral 4, for example, indicates a voltage induced in the turn with a magnitude four times that represented by the numeral 1 and of the same polarity. The numeral −3, for example, denotes an induced voltage three times greater than that represented by the numeral 1 but of the opposite polarity. The starting turn of each layer is labelled 0, and the symmetry and winding sense determines the other numerals. The horizontal dash-dot line represents the center line of the coil and the bottom half is identical to the top half shown. As will be seen from Figure 2, at the ends of the layers no voltage difference is produced between two opposed turns of succeeding layers; however, due to the opposite winding sense, midway between the ends (near the symmetry line **11**) the potential difference of the sharp pulse peaks induced by the oppositely directed fields **9** can be considerable. For example, at the symmetry line **11**, the voltage difference has a magnitude of ten. These pulses give rise to spurious oscillations in the two coil halves—which are parallel connected for these oscillations—on both sides of the line **11**, the frequency of these oscillations being determined by the self-inductances of the coil halves and the capacitances (shown by broken lines) between the turns between which a potential difference is produced. These spurious oscillations give rise to very inconvenient irregularities in the form of the image lines.

These irregularities can be avoided in coils of rectangular cross-section, as described in the aforementioned Patent 2,239,865, by winding all the layers in the same helical direction, for example as a right-handed helix, the end of each layer being connected by a wire which may pass between the layers to the beginning of the next subsequent layer, as is shown in Fig. 3. In this arrangement, all the turns situated above each other are at the same potential, indicated by the same numerals, so that no spurious oscillations are produced.

Deflection coils of rectangular axial cross-section are found to produce a field which is not entirely uniform and this is a serious disadvantage particularly in the case of deflection through a large angle (for example 90°). In order to improve the uniformity use is made of saddle coils of substantially trapezoidal cross-section. In order to ensure this improved uniformity in toroidal coils, according to the invention these coils can be wound with decreasing axial width of the layers, as is shown in Fig. 4.

However from Fig. 4 it will be seen that in this event there are again produced potential differences between turns arranged directly above one another so that spurious oscillations occur in coils wound in this manner. According to a further feature of the invention, these spurious oscillations can be avoided by means of the winding shown in Fig. 5. In this winding, each layer is wound in two parts which succeed one another in the direction of winding—in the example shown from left to right—(in Fig. 5 these parts are separated by a broken line 13), starting from a point (near the broken line 13) of the layer to be wound which is situated within the axial boundary (the broken line 13) of the outermost winding layer and, after the part starting from this point has been wound and the winding wire has been returned, winding the preceding part up to the said point.

As is shown in Fig. 5, in this arrangement, the potential difference between turns laying above one another are avoided. It will also be evident from these figures that, if the winding starts outside the boundary of the outermost layer, for example two turns further to the left, the undesirable condition described with reference to Fig. 4 occurs with respect to the first two layers.

The line dividing the two parts of the winding and the starting point preferably are situated midway between the ends of the layer, that is to say on the line 11 as shown in Fig. 6, since the winding process can thus be simplified. In the embodiment shown diagrammatically in Fig. 7, the part first wound of each layer (with the exception of the two uppermost layers) is followed in the direction of winding and is preceded in the opposite direction by parts which are wound only after a part of the following and/or preceding layer has been provided. Thus, for example, the eight turns of the second layer which are wound first (starting from the broken line 13) are followed in the second layer by two turns which are wound after the provision of a part of the third layer and are preceded by two turns (immediately to the left of the broken line 13) wound after the provision of a few turns of the first layer and also by two turns wound after the provision of a part of the third layer (and of the first layer). Here also, the starting point lies within the axial boundary of the outermost layer i.e., at a turn lying underneath the outermost layer, and all the turns situated directly above one another are at the same voltage. Moreover, as will be noted, the symmetry relative to the center line 11 is maintained, in that the interconnected turns of the same layer of the preceding and subsequent wound portions are located the same distance from the symmetry line 11.

Fig. 8 shows a practical embodiment of a deflecting system in accordance with the invention. The ferromagnetic core 15 is circular and the (uppermost) frame deflector toroidal coil 17 is wound on a correspondingly curved insulating coil former 19, the line deflector coil 21 being designed as a saddle coil. The coil 17 may comprise 10 layers having in all 2500 turns. Since the layers are shorter on the inside of the annular core 15 than on the outside, the turns are not arranged as uniformly as is shown in Fig. 5, so that, for example, at some points on the outside the turns of a layer are interposed between the turns of the next subsequent layer. However, it has been found in practice that the desired effect is fully achieved.

What is claimed is:

1. A deflection coil system comprising a magnetic core, and a toroidal winding comprised of a plurality of layers of turns on said core, said toroidal winding having a generally trapezoidal-shaped half cross-section, the winding starting point of the inner layers being at a turn lying underneath the outermost layer and said layers being wound in the same direction such that adjacent turns in adjacent layers are substantially at the same induced potential when the system is excited.

2. A deflection coil system comprising a magnetic core, and a toroidal winding comprised of a plurality of layers of turns on said core, said toroidal winding having a generally trapezoidal-shaped half cross-section, the inner said layers commencing at a point intermediate their ends and all the layers being wound in the same direction, whereby substantially no induced potential difference exists between adjacent turns in adjacent layers when the system is excited.

3. A coil system as claimed in claim 2 wherein the starting point of the inner layers is at a turn lying underneath the outermost layer.

4. A deflection coil system comprising an annular magnetic core, and a toroidal winding comprised of a plurality of layers of turns on said core, said toroidal winding having a generally trapezoidal-shaped half cross-section, the inner said layers commencing at a turn intermediate their ends lying underneath the outermost layer and all the layers being wound in the same direction, so that the initial part of the inner layers is wound after a terminal part, and elongated conductor means interconnecting the initial and terminal parts of the thus-wound inner layers, whereby substantialy no induced potential difference exists between adjacent turns in adjacent layers when the winding system is excited.

5. A deflection coil system as set forth in claim 4 wherein the starting point of each layer is closer to the end of the layer than the beginning.

6. A deflection coil system for producing the frame scan in a cathode-ray tube comprising a magnetic core, and a toroidal winding comprised of a plurality of layers of turns on said core, said toroidal winding having a generally trapezoidal-shaped half cross-section, each of said layers being wound in the same direction and the inner layers comprising adjacent, discontinuous, wound portions with the wound portion at the end remote from the winding starting point being wound before the preceding layer portion is wound, whereby substantially no induced potential difference exists between adjacent turns in adjacent layers when the system is excited.

7. A deflection coil system as set forth in claim 6 wherein some of the inner layers are divided into three wound portions comprising center, preceding and subsequent portions and wound in that order.

8. A deflection coil system as set forth in claim 6 wherein each layer commences at its center.

9. A deflection coil system comprising a magnetic core, and a toroidal winding comprised of a plurality of layers of turns on said core, said toroidal winding having a generally trapezoidal-shaped half cross-section and each of said layers being wound in the same direction, and plural conductor means interconnecting the adjacent inner layers, each of said inner layers commencing as a winding at a turn located underneath the outermost layer.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 2,917,646 December 15, 1959

Peter Johannes Hubertus Janssen

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 1, line 69, for "sectional are" read -- sectional area --; column 4, line 24, strike out "winding".

Signed and sealed this 24th day of May 1960.

(SEAL)
Attest:

KARL H. AXLINE
Attesting Officer

ROBERT C. WATSON
Commissioner of Patents

UNITED STATES PATENT OFFICE

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