April 29, 1941. R. URTEL 2,239,865

CATHODE RAY DEFLECTING COIL

Filed Feb. 1, 1939

Fig. 1

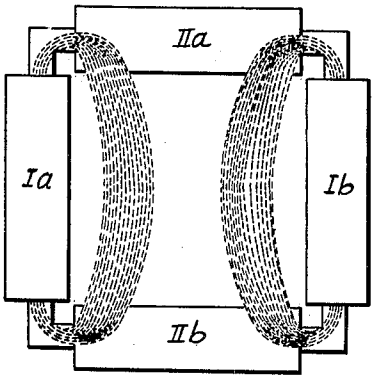


Fig. 2

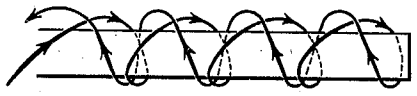


Fig. 3

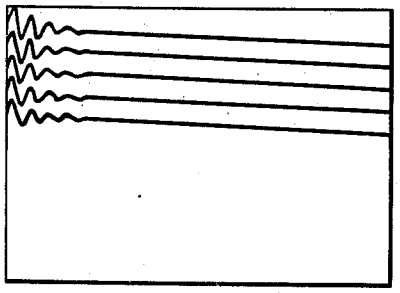


Fig. 4

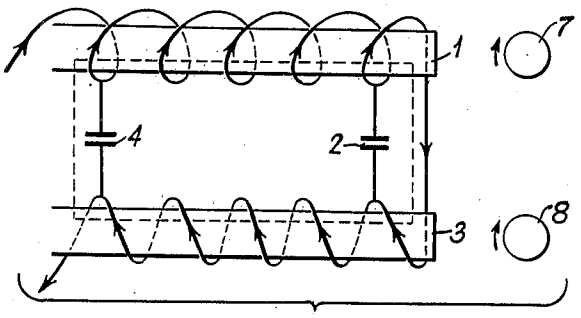


Fig. 6

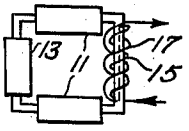
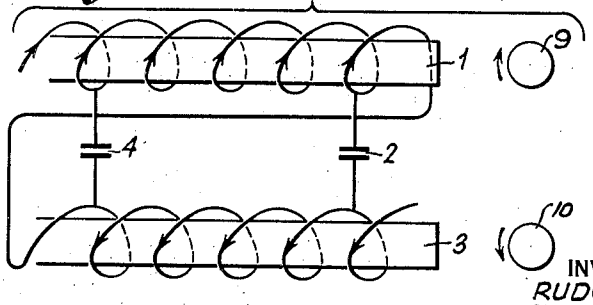


Fig. 5



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CATHODE RAY DEFLECTING COIL

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Application February 1, 1939, Serial No. 253,954
In Germany December 23, 1937

2 Claims. (Cl. 250—157)

This invention relates to methods of preparing improved magnetic coils and to improved magnetic apparatus, which apparatus is particularly adapted to be used in connection with deflection system of cathode ray tubes.

The external magnetic field by which cathode rays are deflected consists usually of a current energized coil or solenoid. The flow or path of current determines the shape of the magnetic field and of the deflection. If a cathode ray pencil or beam is to be deflected simultaneously in two directions, that is, at right angles to each other as is true of scanning systems used with television tubes, fundamentally two distinct coils are required. A considerable saving is obtained if both coils are united into a unitary structure by winding them on a single yoke. However, this introduces new problems of design and structure to eliminate distortion. The present invention is concerned with a special and novel mode of winding, as well as the recording itself, for the coils in order to eliminate distortion from such structures.

In describing the invention, reference will be made to the drawing in which

Fig. 1 shows schematically the mutually perpendicular coil system mounted on a single magnetic core,

Fig. 2 shows diagrammatically a core winding to aid in explaining the invention,

Fig. 3 shows graphically the scanning pattern produced by conventional coil structure to show the distortion which the invention overcomes,

Fig. 4 is a further diagrammatic showing of a coil structure to further explain the invention,

Fig. 5 shows diagrammatically one embodiment of the invention in which the unique winding of the coils overcomes deflection or magnetic field distortion, while Fig. 6 shows an embodiment of my invention diagrammatically.

Referring to Fig. 1, two coil pairs I and II are wound upon a quadrangular yoke in such a way that like coils are placed opposite each other. Coils I*a* and I*b* cause a horizontal (line) deflection, coils II*a* and II*b* a vertical (or picture) deflection. Coils II*a* and II*b* are wound in layers such that in one layer the turns follow one another from right to left, and in the adjacent layer from left to right, as indicated in Fig. 2. The scanning pattern furnished by this deflector means is full of disturbances, distortions, and faults. It looks roughly as indicated in Fig. 3. The beginnings of the lines are distorted by superposed oscillations. Since these deviations of the pencil occur in a vertical sense, they can be due only to magnetic fields set up in coil pair II. Now, these oscillations arise in the following way. Suppose the position of the turns extending to the right and to the left-hand side not sketched in superposition (as in Fig. 2), but each layer separately (Fig. 4). Between the layers is always a small capacity, and since the coil itself is an inductance, small oscillatory circuits are present. The force-lines of the coils I penetrate and cross the coils II particularly at the ends (indicated by dots in Fig. 1), and the said small oscillation circuits are shock excited by the rapid changes in the coil pair I. The current in coils I is of sawtooth form, namely, slow rise and very rapid decline. It is especially the high frequencies which are contained in the sharp collapse of the field that excite the small oscillation circuits inside the coils II, and it is for this reason that the disturbing actions happen at the beginnings of the lines.

To further examine these disturbing oscillations, imagine two neighboring layers wound upon two different cores rather than on one as indicated in Fig. 4. The cores are again shown alongside with the direction of winding of the coil wire in side elevation. One of the above-mentioned small oscillation circuits is shown by dots in Fig. 4. It consists of the series connection of inductance **1**, capacity **2**, inductance **3** and capacity **4**. For this circuit the inductances **1** and **3** are in series; they are traversed in the same sense of winding though in different directions and the oscillation currents set up fields in the same direction as indicated by the circles **7** and **8**. Thus, for this circuit L is relatively large, with a constant and small C, in other words, low damping.

To suppress the disturbing oscillations, it is necessary to endow the small oscillation circuits with high damping. To this end, according to the invention, the winding of coils II is arranged by layers in such a way that the turns, in all positions, spiral either a right-hand screw or a left-hand screw or helix. In the case of Figs. 2 and 4 the turns alternate in right- and left-hand spirals around the core. In the invention, however, each layer starts for instance, left and ends right, the wire is brought back over a short distance to the left-hand edge where the turns of the following layer begin. This mode of winding could be called a sawtooth winding. What results are the conditions pictured in Fig. 5. Inductances **1** and **3** in the small oscillation circuits are now traversed in different winding sense

(as indicated by the arrows on the turns). The inductances nearly neutralize each other; the residual inductance is vanishingly small in contrast to what it was before. For the deflection current of the coil throughout all layers the winding sense is the same; it is only for the currents of the small oscillation circuits referred to that the inductances are neutralized as indicated by the direction circles **9, 10**. As a result the natural period of these tiny oscillation circuits has been raised considerably; in the second place, as a result of the small relationship L/C the damping of these circuits is very high. In fact, practical experience has proved that the deflection means Fig. 1 works satisfactorily when coils II are thus wound. In Fig. 6 I have shown the completed coil structure diagrammatically with only one of the coils indicated as to its winding, following the subject matter of the invention. It will be noted that the coils of the pair **11—11** are opposite each other, while the line deflection coil **13** is opposite a similar coil in which the two winding layers **15** and **17** are shown superimposed upon each other. It will be noted that the lower layer **15** commences at the left-hand side, as does the superimposed layer **17**, the end of layer **15** being returned behind the core to commence at the left-hand side of the core.

What I claim is:

1. A deflecting coil system comprising a symmetrical closed magnetic core, a plurality of pairs of electrical conductor coils positioned upon said core, one of said pair having coils opposite to each other and each coil having a plurality of layers composed of consecutive turns, each of said layers commencing from the same end and being wound in the same direction.

2. A cathode ray deflecting system comprising a symmetrical closed magnetic core, a plurality of pairs of electrical conductor coils positioned upon said core, the coils of each pair being opposite to each other and having a plurality of layers composed of consecutive turns, all layers of each coil commencing from the same end and being wound in the same direction, and means to connect the opposed coils of each pair in series whereby the total inductance is rendered negligible.

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