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CORE CASE AND COIL ASSEMBLY

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FIG. 1

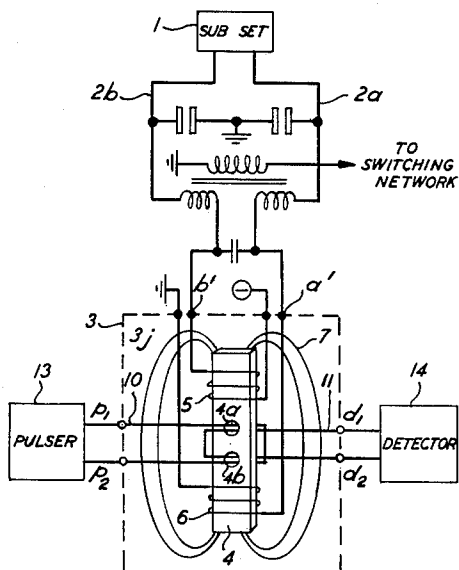


FIG. 2

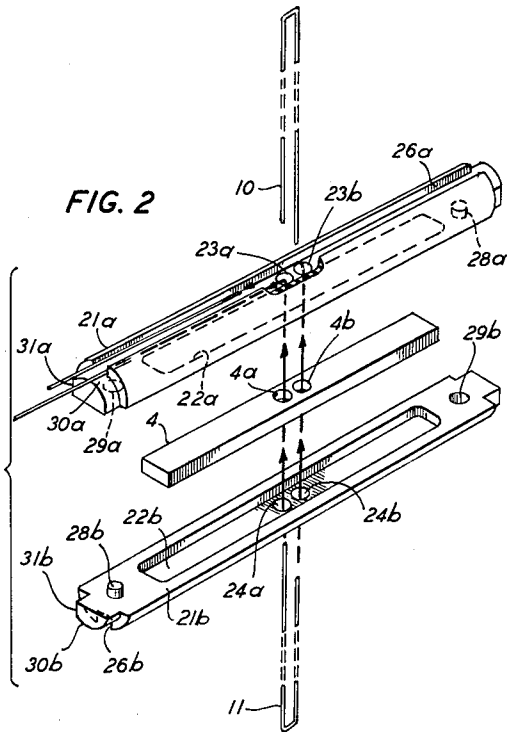
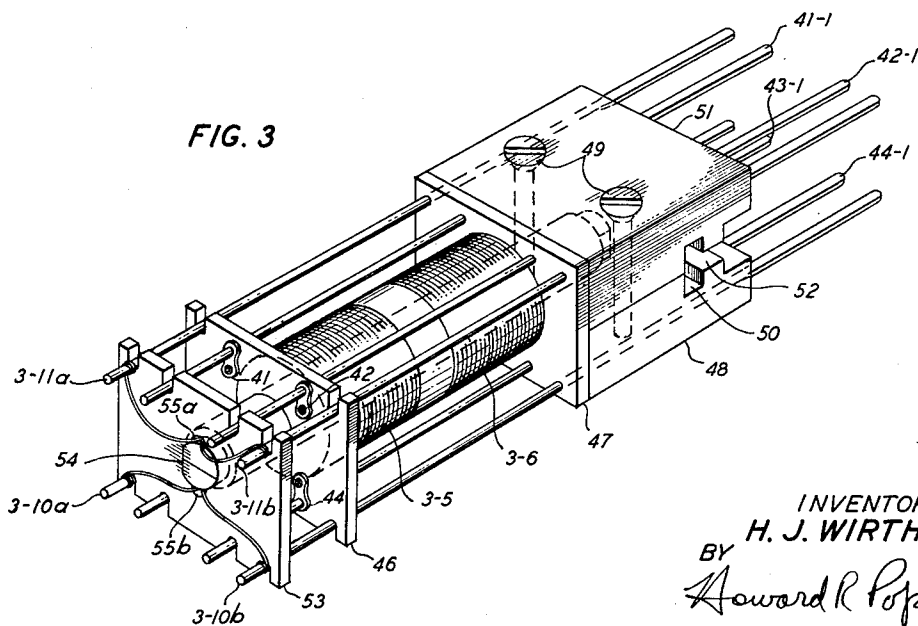


FIG. 3



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1

2

3,139,488

CORE CASE AND COIL ASSEMBLY

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13 Claims. (Cl. 179—18)

This invention relates to electromagnetic structures and more particularly to a core case and coil assembly for adapting the mechanical and electromagnetic characteristics of a ferromagnetic supervisory element for use in a practical telephone switching system supervisory array.

The apparatus described in the copending application of J. A. Baldwin-H. F. May, Serial No. 26,758, filed May 4, 1960, for monitoring the status of telephone lines and trunks makes use of an elongated ferromagnetic element exhibiting rectangular loop hysteresis characteristics in closed magnetic flux paths and demagnetizing characteristics in open flux paths embracing the closed flux paths. One such supervisory element is required for every line circuit under surveillance, and in a typical application 10,000 such elements may be grouped in an array for the systematic and orderly observation of the condition of the telephone lines. In such an array the sense and interrogate conductors individually thread the apertures of a large number of ferromagnetic elements about which apertures the closed, remanent switching flux paths are established.

The ferrite elements exhibiting the desired switching characteristics described in the above-mentioned Baldwin-May application are advantageously manufactured from a heat-treated cadmium-magnesium-manganese ferrite. While this heat treatment optimizes the flux switching properties of the material there is a tendency, accentuated by the elongated stick-like configuration of the elements, for the heat treatment to produce permanent warping, twisting, and bending distortions. Accordingly, in any practical embodiment of the above-mentioned supervisory array, difficulty is encountered in aligning the apertures of the numerous elements so that the sense and interrogate conductors can be threaded through. The bowing and twisting also complicates the positioning of the line supervisory coils coaxially with respect to the longitudinal axis of the ferrite stick element and also with respect to the transverse apertures through which the sense and interrogate conductors must be threaded. In addition, the threading of the apertures and the connections to the supervisory windings cause a build-up of mechanical stresses which are a potential reliability hazard due to the relatively brittle nature of the ferrite elements. This latter factor, coupled with the ever present possibility that despite conventional protection devices, a power line fault or lightning strike may burn out a line supervisory element, makes it highly desirable that the supervisory elements in the array be readily accessible and amenable to individual replacement.

Accordingly, it is an object of the present invention to facilitate the individual coupling of sense and interrogate conductor circuits to the magnetic paths of a number of apertured ferromagnetic elements without regard to the dimensional distortions thereof and without subjecting the elements to mechanical stresses.

It is another object of the present invention to provide a supervisory array of individually serviceable electromagnetic circuit elements.

It is a further object of the present invention to provide an easily manufactured and assembled electromagnetic supervisory apparatus.

In accordance with the principles of the present invention, in one illustrative embodiment thereof, a hollow cylindrical core box is provided for housing the ferromag-

netic element. The core box is patterned so that the sense and interrogate conductors serve both to secure the element within as well as to fasten together the core box halves. The outer periphery of the cylindrical core box forms a mandrel about which the line supervisory coils are positioned coaxially with respect to the longitudinal axis of the ferromagnetic element and the outer surface is shaped to provide a longitudinal channel through which the ends of the sense and interrogate conductors are brought out.

According to one aspect of the present invention, it is a feature thereof that the cylindrical core box halves are stapled together by inserting preformed U-shaped sense and interrogate conductors through the apertures of the opposite core box halves in alignment with the corresponding ferrite apertures and by bending the legs of the U-shaped conductors at their point of emergence from the core box.

According to another aspect of this illustrative embodiment a recessed flange having a plurality of terminal pins is keyed to the end of the core box for effecting individual connection to each of the windings associated therewith.

It is a feature of the present invention that a pair of supervisory windings be mounted at their hubs upon a mating dowel member containing a recess housing and apertures for communicating with an apertured elongated ferromagnetic element to thereby provide appropriate coupling of the supervisory windings and aperture-threading conductor circuits with the element.

It is another feature of the present invention that the sense and interrogate conductor circuits provide both electromechanical linkage and mechanical fastening for the components of a supervisory electromagnetic apparatus.

The foregoing and other objects and features may be more readily understood from the following detailed description and drawing, wherein:

FIG. 1 shows a monitoring apparatus and a periodically scanned array to which the core case and core assembly of the present invention is applicable;

FIG. 2 shows an exploded view of a core case and conductor subassembly for use in FIG. 1; and

FIG. 3 shows an assembled view of a specific core case and coil embodiment.

Referring now to FIG. 1, there is shown a supervisory apparatus of the type described in the above-mentioned copending application of Baldwin-May which is employed for the high-speed scanning of subscribers' lines in a telephone switching system. As described therein, each subscriber in the telephone system possesses a subset such as subset 1 which is connected to a pair of transmission lines 2a and 2b. At the central office the transmission lines 2a and 2b are connected to terminals a' and b' of periodically scanned array 3. Array 3 contains a pair of input terminals, not shown, corresponding to terminals a' and b' for each transmission line circuit of the telephone system. Each such a' and b' terminal pair is associated with a monitoring gate circuit 3j, including an elongated magnetic element 4, by means of a respective set of supervisory windings 5 and 6. Magnetic element 4 includes a pair of apertures 4a and 4b through which are threaded conductors 10 and 11. A pulser 13 is connected to the commutated terminals p1-p2 of gate 3j for a predetermined interval during the scanning of array 3 to apply alternate polarity switching signals to conductor 10. A detector 14 is similarly connected to commutated terminals d1-d2 and depending upon the current in windings 5 and 6, the relationship of the flux paths about apertures 4a, 4b to the longitudinal flux path 7, detector 14 responds to the signals induced in conductor 11 by the pulses applied to conductor 10.

While for the sake of simplicity only one transmission line circuit and one monitoring gate circuit 3j have been

3

shown, it is to be understood that conductors 10 and 11 will normally be coupled to a number of such gate circuits. For example, array 3 may comprise 10,000 gate circuits 3j arranged in a square array of 100 rows in 100 columns. In such an array, there would be conductors corresponding to conductors 10 and 11 for each of the 100 rows and such conductors would thread the apertures of each of the 100 elements 4 in a given row.

Referring now to FIG. 2 there is shown an exploded view of a magnetic element core and core case subassembly illustrative of the principles of the present invention. The core case comprises a pair of semicylindrical dowels 21a, 21b of nonmagnetic and high resistance or nonconductive material. At least one of the semicylindrical dowels, for example 21b, includes a recess portion 22b and advantageously, a similar recess 22a may be provided in dowel half 21a. The length, breadth and depth dimensions of recess 22b are made to correspond to the maximum allowable dimensions of element 4 to take into account the bowing, twisting, and warping distortions exhibited by element 4 as a result of the heat treatment process required to bring its magnetic characteristics into the range of specifications found desirable from the electromagnetic circuit viewpoint. Where dowel half 21a includes a recess 22a, the combined depth of recess 22a and 22b should be made somewhat more than the maximum allowable thickness of element 4 to allow the dowel halves to be properly faced together.

Each of the semicylindrical dowels 21a—21b includes a pair of transverse apertures 23a, 23b, 24a and 24b positioned laterally and longitudinally in dowels 21a and 21b, respectively, so as to be in alignment with apertures 4a and 4b of element 4 when element 4 is seated in recesses 22a, 22b. U-shaped conductors 10 and 11 are inserted from opposite sides of dowels 21a and 21b and taken up to draw together dowels 21a and 21b to include element 4 in the recesses 22a—22b. The free ends of each of conductors 10 and 11 are then bent over to lie in external longitudinal channels 26a, 26b of dowels 21a and 21b, respectively. When so bent over, conductors 10 and 11 maintain the dowels 21a and 21b stapled together and provide mechanical fastening for as well as electromagnetic coupling to element 4.

Each dowel half advantageously includes a cone-shaped projection 28a, 28b and a mating cone-shaped depression 29a, 29b for further aiding the alignment of the dowel halves 21a, 21b. The ends of the dowel halves are furnished with a reduced diameter section 30a, 30b having a pair of aligning flats 31a, 31b thereon. When the dowel halves 21a, 21b are put together, the flats 31a, 31b form a key by means of which the dowel assembly may be oriented. Similarly, the U-shaped conductors 10 and 11 may be formed prior to assembly with one leg thereof somewhat longer than the other so that when positioned in channels 26a and 26b, respectively, the particular one of the apertures 24a, 24b through which each of the legs is threaded may readily be determined. Thus, in FIG. 2 it is apparent by inspection of the ends of conductor 11 that the shorter one thereof threads aperture 23b while the longer one thereof threads aperture 23a.

Referring now to FIG. 3, there is shown a gate circuit unit suitable for use in a terminal supervisory array of the type heretofore described. The subassembly of FIG. 2 is positioned as a mandrel within the hubs of the supervisory windings 3—5 and 3—6, the ends of which windings are connected to terminal tabs 41 through 44 respectively of insulating flange 46. Pins 41—1 through 44—1 provide electrical connections to their respective terminal tabs and are brought through insulating end flange 47 and mounting block 48 to provide mechanical rigidity and support to the assembly.

Advantageously pins 41—1 through 44—1 may be pre-molded in each of the halves of mounting block 48 whose halves may be advantageously brought together by means of screws or rivets 49. When so fastened together, the

4

halves of mounting block 48 describe a transverse channel 50 in which may be placed a captive nut by means of which the end face 51 of mounting block 48 may be secured to a mounting plate (not shown). The shank of the mounting bolt (not shown) obtains access to the captive nut in channel 50 by means of transverse channel 52.

A third insulator end flange 53 having a flat 54 is keyed onto the reduced diameter portion 30a—30b of the subassembly of FIG. 2. The recesses 55a, 55b of end flange 53 are in alignment with the channels 26a, 26b of the subassembly of 52 and permit the ends of conductors 10 and 11 to be brought out to pins 3—11a, 3—11b, 3—10a and 3—10b, respectively. As mentioned above, by providing U-shaped conductors 10 and 11 with legs of unequal length the sense in which these conductors link apertures 4a, 4b is readily indicated and as a convenience in assembly, the convention may advantageously be adopted that the longer of the legs be connected to the left end pins 3—11a and 3—10a, respectively.

In summary, it is seen that the longitudinally-channeled, transversely-apertured core box 21a, 21b provides means for positioning the elongated magnetic member 4 within the hub of the supervisory winding 3—5, 3—6 while enabling the sense and interrogate conductors 10, 11 to be coupled to member 4 without subjecting its critical inter-aperture portion to unnecessary mechanical stresses. While the core box illustrated in the drawing is shown as separate from insulating flanges 46, 47 the core box and end flanges may with equally advantageous results be fabricated of one piece with the windings 3—5, 3—6 being wound directly on the core box as a spool.

It is to be understood that the above-described arrangements are illustrative of the application of the principles of the invention. Numerous other arrangements may be devised by those skilled in the art without departing from the spirit and scope of the invention.

What is claimed is:

1. A ferromagnetic assembly comprising an elongated ferromagnetic element having a pair of transverse apertures, a nonmagnetic body having a well whose dimensions of length and breadth are substantially the same as, and whose depth is substantially one-half as great as the corresponding dimensions of said ferromagnetic element, said nonmagnetic body having a pair of apertures communicating transversely with said well, a second nonmagnetic body exhibiting characteristics substantially corresponding to said first body, and means for encasing said ferromagnetic element in the enclosure formed by facing together the wells of each said nonmagnetic body, said means including a pair of oppositely-oriented conductive staples inserted through said apertures of said nonmagnetic bodies and threading the apertures of said magnetic element.

2. A ferromagnetic assembly in accordance with claim 1 wherein said staples are inserted through opposite ends of the apertures of said nonmagnetic bodies.

3. A ferromagnetic assembly in accordance with claim 2 wherein said nonmagnetic bodies each have longitudinal grooves on their external surfaces, said grooves intersecting said outer ends of said apertures.

4. A ferromagnetic assembly in accordance with claim 3 wherein the legs of said staples are of unequal length and are positioned in said grooves.

5. In an electromagnetic apparatus comprising an integral ferromagnetic member defining a first and at least a second magnetic path embraced by said first path and including at least one winding having a hollow core, said winding being coaxial to said ferromagnetic member for selectively magnetizing said first path, said ferromagnetic member being inserted in the hollow portion of said core, a pair of insulating flanges at opposite ends of said core, a plurality of conductive bars extending between said flanges, and conductor means threading said core and said second magnetic path of said ferromagnetic member, said

5

conductor means and said winding being connected to individual ones of said conductive bars.

6. In an electromagnetic apparatus according to claim 5 the combination wherein said conductive bars protrude through at least one of said nonconductive flanges for effecting connection with said winding and said conductor means.

7. In an electromagnetic apparatus according to claim 6 the combination wherein said hollow core of said winding includes a longitudinal channel for said conductor means.

8. A ferromagnetic terminal apparatus comprising an elongated ferromagnetic member having a pair of transverse apertures, a pair of nonmagnetic apertured casings enclosing said member, said casings each having an exterior longitudinal channel intersecting its respective aperture, and at least one U-shaped conductor having its mid-portion in one said channel and its legs threaded through said apertures and extended along the other said channel.

9. A ferromagnetic terminal apparatus in accordance with claim 8 including a second U-shaped conductor having its legs extending through said apertures in sense opposite to that of said one U-shaped conductor.

10. A ferromagnetic terminal apparatus in accordance with claim 9 further comprising a terminal bearing mounting flange keyed to one end of said casings, an insulating flange keyed to the other end of said casings and a plurality of conductive bars extending between said flanges for effecting connection with said U-shaped conductor.

11. A line supervisory element comprising an elongated ferromagnetic element having a pair of transverse apertures, a pair of nonmagnetic apertured casing members enclosing said member, said casing members each having

6

an exterior longitudinal channel intersecting its apertures, a pair of U-shaped conductors extending through said apertures in opposite directions, said conductors being bent into said channels mechanically to lock said casing members together, coil means around said casing members to determine the magnetic coupling between said conductors, pulsing means connected to one of said conductors, and detector means connected to the other of said conductors.

12. In a telephone system, a line supervisory element comprising an elongated ferromagnetic member having a pair of transverse apertures therein and defining a first magnetic path and a second magnetic path embraced by said first path, a pair of nonmagnetic apertured casing members enclosing said ferromagnetic member, a pair of line supervisory windings positioned on said casing members coaxially with respect to the longitudinal axis of said ferromagnetic member for selectively magnetizing said first path, a pair of insulating flanges at opposite ends of said casing members, a pair of U-shaped conductors extending through said apertures in said casing members and said ferromagnetic members from opposite directions physically to lock said casings together, pulser means connected to one of said conductors, detector means connected to the other of said conductors, and conductor bars extending between said flanges and connecting said pulser and detector means to said conductors.

13. In a telephone system, a line supervisory element in accordance with claim 12 wherein said casing members have external longitudinal channels, said U-shaped conductors being bent over and extending in said channels through said windings to said conductor bars.

No references cited.