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RELAY

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2 Sheets-Sheet 1

FIG. 1

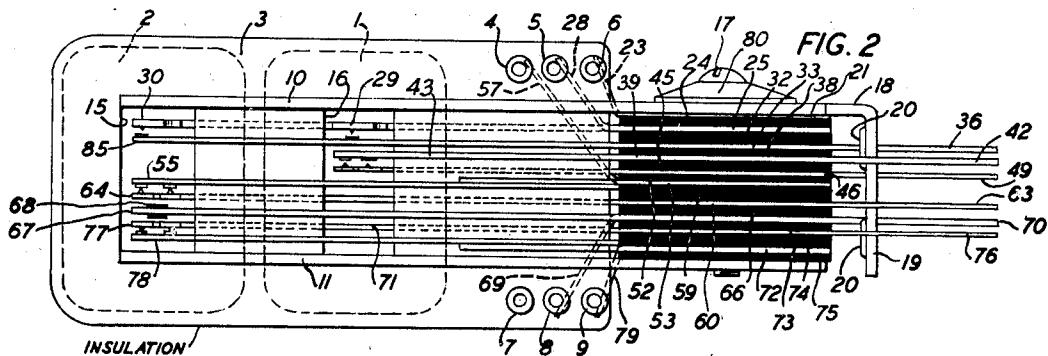
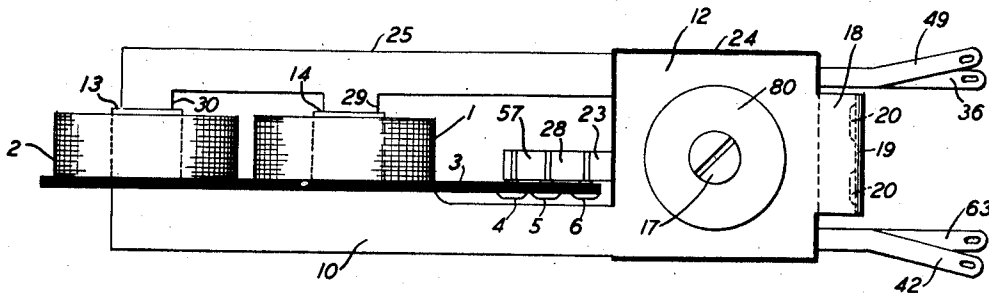
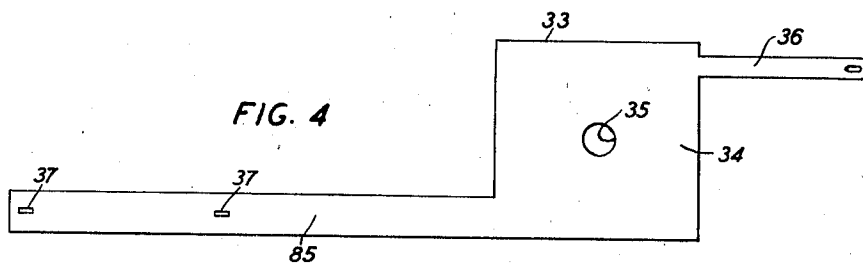
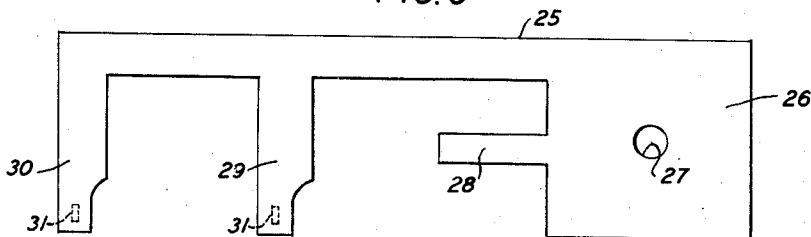


FIG. 3



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RELAY

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Application June 4, 1941, Serial No. 396,520

7 Claims. (Cl. 200—93)

This invention relates to relays, and more particularly to a combined line and cut-off relay structure of the general type disclosed in the application of Serial No. 367,341 of E. Lakatos filed November 27, 1940 in which the work circuits controlled by the relay are established by the conductive engagement of reed armatures with core or field members.

In telephone systems, and particularly in systems of the step-by-step type each subscriber's line is provided with a line relay and a cut-off relay, the two windings of the line relay being energizable in a circuit extending from the terminals of the central office battery over two pairs of normally closed contacts of the cut-off relay and the calling line loop when the calling subscriber closes the line loop at his substation to initiate a call. The line relay upon energizing is instrumental in closing two pairs of contact springs, over one pair of which a circuit is established to start an idle line finder in search of the calling line and over the other pair of which the winding of the cut-off relay is connected to the test or sleeve conductor of the calling line terminating in multipled bank terminals of all line finders having access to the calling line. When the started line finder finds the calling line and its test brush encounters the test multiple of such line, the circuit prepared by the operated line relay for the cut-off relay is completed and the cut-off relay operates to open its two pairs of normally closed contacts to thereby disconnect the windings of the line relay from the calling line loop. It also closes a third pair of contacts whereby the cut-off relay locks itself to the circuit completed over the test brush of the line finder and is thus maintained operated following the release of the line relay resulting from the disconnection of the windings thereof from the calling line loop.

Some suggestions have heretofore been made for combining the line and cut-off relays into a single unit to effect savings in manufacturing and installation costs and to effect a saving in mounting space. Since several thousands of both line and cut-off relays are required each year to meet the normal expansion of installed telephone offices and to meet the normal demand for new office installations, it is apparent that a relay structure which would perform all of the functions of both the line and cut-off relays in a reliable manner, and which could be simplified to such an extent as to effect material manufacturing, installation and maintenance costs, would be of great value.

It is therefore the object of the present invention to simplify the structural details of a combined line and cut-off relay assembly, to reduce thereby the costs of manufacture, installation and maintenance and to effect more reliable operation.

To attain this object the relay assembly in accordance with the present invention is provided with a double wound line relay coil and a cut-off relay coil disposed side by side with their axes parallel, an E-shaped core lamination having two of its arms extending through the two coils respectively and having its third and wider arm serving as a support, an L-shaped reed armature lamination, the short arm of which serves as a support and the long arm of which may be attracted into conductive engagement with the core arms of the core lamination, a C-shaped reed armature lamination, one arm of which serves as a support and the other arm of which extends through the line relay coil and is attractable into conductive engagement with the end of the long arm of an associated field lamination, two C-shaped reed armature laminations each having one arm extending through the cut-off relay coil and each having its other arm serving as a support, and two field laminations cooperating therewith and each having an end portion of permanently magnetized material whereby the associated reed armatures are normally attracted into conductive engagement with such field laminations. These laminations are clamped between clamping plates which are provided with arms extending into the coils and serving as supports therefor and the laminations are insulated from each other and from the clamping plate by interposed strips or laminations of insulating material.

The windings of the line relay coil are normally connected over the reed armature laminations extending through the cut-off relay coil and normally engaged with their associated field laminations whereby such line relay coil may be energized over a calling line loop upon the closure of such loop at the line substation. When the line relay coil becomes energized it operates the reed armature extending therethrough into engagement with its associated field lamination to establish a circuit for starting a line finder or for performing any other desired function and also magnetizes the core arm extending through such coil to attract the associated reed armature whereby the cut-off relay coil becomes connected to an operating circuit therefor which may, for example, extend to a test terminal in the bank

of a line finder having access to the calling line with which the relay assembly is associated. When the line finder finds the calling line the circuit of the cut-off relay coil becomes completed whereupon the core arm extending therethrough becomes magnetized to hold the reed armature associated therewith attracted thereto after the line relay coil later becomes deenergized and to cause the reed armatures extending therethrough to become repelled from the permanent magnet portions of the associated field laminations whereby the windings of the line relay coil become disconnected from the calling line loop and therefore deenergized to release the reed armature extending therethrough from the associated field lamination to open the line-finder start circuit.

For a better understanding of the invention, reference may be had to the following detailed description thereof taken in connection with the accompanying drawings in which:

Fig. 1 is a side elevational view of a relay assembly constructed in accordance with the present invention;

Fig. 2 is a top plan view of the relay disclosed in Fig. 1;

Fig. 3 shows the core lamination;

Fig. 4 shows a reed armature lamination for cooperation with the core lamination of Fig. 3;

Fig. 5 shows a coil terminal lug lamination;

Fig. 6 shows a field lamination;

Fig. 7 shows a reed armature lamination for cooperation with the field lamination of Fig. 6;

Fig. 8 shows a field lamination having an end portion of permanent magnetic material;

Fig. 9 shows a reed armature lamination for cooperation with the field lamination of Fig. 8; and

Fig. 10 illustrates the circuit application of the relay assembly.

To more clearly disclose the invention the relay illustrated has been drawn to approximately double scale.

The relay is provided with a coil assembly comprising a line relay coil 1 having two equal windings and a cut-off relay coil 2, both mounted side by side with their axes parallel on a common spoolhead or mounting plate 3 of suitable insulating material, such as fiber or hard rubber. Riveted to the plate 3, adjacent to its upper and lower edges and near the rear end thereof, are two sets of barrel rivets or studs 4, 5 and 6, and 7, 8 and 9 of conducting material to which the ends of the windings of the coils 1 and 2 are connected, the terminals of one winding of the line relay coil being connected to the studs 4 and 6, the terminals of the other winding of the line relay coil being connected to the studs 8 and 9 and the terminals of the winding of the cut-off relay coil being connected to the studs 5 and 8.

The coil assembly is supported on the arms of two clamping plates 10 and 11 which may be stamped from brass or other non-magnetic material. Each clamping plate is substantially E-shaped having one widened arm 12 and two narrower arms 13 and 14 of sufficient width to extend through the rectangular openings through the coils 1 and 2 and through the rectangular openings 15 and 16 through the coil assembly mounting plate 3 and of sufficient length to extend just beyond the outer faces of the coils. The clamping plates are each provided with a hole located centrally of its supporting arm 12 through which a clamping screw 17 is insertable as will later be described. The upper plate 10

is also provided with a rearwardly extending portion 18 which extends downwardly at right angles to form a bracket 19 by means of which the relay assembly may be supported on a relay mounting rack. To enable the assembly to be secured to the relay rack the bracket portion 19 has two embossments 20 formed therein through which threaded holes extend for the reception of screws.

Assembled between the two clamping plates 10 and 11 are a plurality of reed armature, core and field laminations of magnetic material, a ground terminal lug 21, a battery terminal and back stop member 67, and interposed strips or laminations of insulating material. The terminal lug 21 shown in detail in Fig. 5 is stamped from a nickel silver sheet and is assembled in conductive engagement with the upper mounting plate 10 and thus when the relay is mounted on the relay rack serves as the grounded terminal of the relay. This lug has a hole 22 centrally disposed therein through which the clamping screw 17 may extend and is provided with a narrow extension 23 for connection with the stud 6 of the coil assembly as best disclosed in Fig. 2.

Assembled adjacent to the terminal lug 21 is a square strip or lamination 24 of suitable insulating material, such as fiber or hard rubber, having a centrally located hole therethrough for the reception of the clamping screw 17 and which serves to insulate the lug 21 from the core lamination 25 assembled adjacent to the insulating lamination 24. The core lamination 25 is stamped from a suitable sheet of magnetic material, such as silicon steel of approximately .028 inch thickness, into the E shape best disclosed in Fig. 3. One arm 26 of the core lamination is substantially square, has a hole 27 centrally located therein for the reception of the clamping screw 17 and has a forwardly extending portion 28 for connection with the stud 5 of the coil assembly as best disclosed in Fig. 2. The other two arms 29 and 30 serve as core pole-pieces and extend through the openings through the coils 1 and 2, respectively. Each of these arms has a bar 31 of contact material welded or otherwise secured thereto.

Positioned in the assembly for cooperation with the core lamination 25 and insulated therefrom by an interposed lamination 32 of insulating material, similar to the lamination 24, is a reed armature lamination 33. This lamination is stamped from a sheet of magnetic material, such as silicon steel of approximately .014 inch thickness, into the L shape best disclosed in Fig. 4. One arm 34 thereof is substantially square, has a hole 35 centrally located therein for the reception of the clamping screw 17 and has a rearwardly extending soldering terminal 36, and the other arm 35 thereof extends forwardly adjacent and parallel to the coil assembly plate 3 and overlying the ends of the core arms 29 and 30. Welded or otherwise secured to the face of the arm 35 adjacent to the core arms 29 and 30 are two bars 37 of contact material which are positioned to cooperate with the contact bars 31 on the core arms 29 and 30 but which are normally out of engagement therewith.

Positioned in the assembly and insulated from the field lamination 33 by an interposed insulating lamination 38, similar to the insulating lamination 24, is a field lamination 39. This lamination is stamped from a sheet of magnetic material, such as silicon steel of approximately .028 inch thickness, into the L shape best disclosed in

Fig. 6. One arm 40 thereof is substantially square, has a hole 41 centrally located therein for the reception of the clamping screw 17 and has a rearwardly extending soldering terminal 42, and the other arm 43 thereof extends forwardly adjacent and parallel to the coil assembly plate 3. Welded to one face of the arm 43 near its end, are two bars 44 of contact material.

Positioned in the assembly for cooperation with the field lamination 39 and insulated therefrom by an interposed insulating lamination 45, similar to the insulating lamination 24, is a reed armature lamination 46. This lamination is stamped from a sheet of magnetic material, such as silicon steel, of approximately .014 inch thickness, into the C shape best disclosed in Fig. 7. One arm 47 thereof is substantially square, has a hole 48 centrally located therein for the reception of the clamping screw 17 and has a rearwardly extending soldering terminal 49, and the other parallel arm 50 of which extends freely through the line relay coil 1 with its end opposite to the end of arm 43 of the field lamination 39. This arm is bifurcated and is provided near the end of each portion thus formed with a bar 51 of contact material welded or otherwise secured thereto. These contact bars are positioned for cooperation with the contact bars 44 carried by the field lamination 39 but are normally out of engagement therewith.

Positioned in the assembly and insulated from the reed armature lamination 46 by an interposed insulating lamination 52, similar to the lamination 24, is a field lamination 53. This lamination is made in two sections welded together, the rear section 54 of which is stamped from a sheet of magnetic material, such as silicon steel, of approximately .028 inch thickness, into the shape best disclosed in Fig. 8, and a pole-piece section 55 of a permanent magnet steel of approximately .028 inch thickness, such as Vicalloy. The rear section is L-shaped, the forwardly extending arm of which is welded to the magnet section 55 and the other arm of which is substantially square with a centrally located hole 56 therethrough for the reception of the clamping screw 17 and with a forwardly extending portion 57 which engages with the stud 4 carried by the coil assembly plate 3 as best disclosed in Fig. 2. The arm 54 with the magnet section 55 welded thereto extends forwardly parallel to the plate 3 and the face of the magnet section is provided near its outer end with a pair of bars 58 of contact material welded thereto.

Cooperating with this field lamination and insulated therefrom by an interposed insulating lamination 59 similar to the lamination 24, is a reed armature lamination 60. This lamination is stamped from a sheet of magnetic material, such as silicon steel, of approximately .014 inch thickness, into the C shape best disclosed in Fig. 9. One arm 61 thereof is substantially square, has a hole 62 centrally located therein for the reception of the clamping screw 17 and has a rearwardly extending soldering terminal 63, and the other parallel bifurcated arm 64 of which extends freely through the cut-off relay coil 2 with the contact bars 65 thereof normally engaged with the contact bars 58 of the field lamination 53. Due to the magnetization of the permanent magnet section 55 of the field lamination 53 the end of the armature 64 is attracted to engage its contact bars 65 with the contact bars 58 with the necessary back contact pressure.

Positioned in the assembly and insulated from the reed armature 60 by an interposed insulating lamination 66, similar to the lamination 24, is a back stop member 67 of substantially the same shape as the field lamination 53 disclosed in Fig. 8. The stop member may be stamped from a sheet of silicon steel of approximately .028 inch thickness and has a forwardly extending arm portion in the end of which a stud 68 of insulating material is secured and against one end of which the bifurcated end of armature arm 64 is moved when the coil 2 is energized and which thus serves to limit the movement of the end of the armature arm. The rear portion of the stop member is substantially square, having a centrally located hole therein for receiving the clamping screw 17, having a forwardly extending portion 69 for connection with the stud 8 of the coil assembly plate 3 and having a rearwardly extending soldering terminal 70.

Positioned between the back stop member 67 and the clamping plate 11 are another reed armature lamination 71, similar to the armature lamination 60, and an associated field lamination 72 similar to the field lamination 53. These laminations are insulated from the back stop member 67, from each other and from the clamping plate 11 by interposed insulating laminations 73, 74 and 75, similar to the insulating lamination 24. The rear portions of the laminations 71 and 72 and the insulating laminations 73, 74 and 75 are provided with holes centrally located therein for the reception of a clamping screw 17. The armature lamination 71 is provided with a rearwardly extending soldering terminal 76 and with the bifurcated arm 77 which extends freely through the cut-off relay coil 2 and is normally attracted toward the permanent magnet end 78 of the field lamination 72 to engage its contact bars with the contact bars carried by such field lamination. When the coil 2 is energized the bifurcated arm 77 of the armature lamination is moved into engagement with an end of stud 68 which thereby serves to limit the movement of the end of the armature arm. The base portion of the field lamination 72 is provided with a forwardly extending portion 79 which may be connected to the stud 9 carried by the coil mounting plate 3.

After all of the laminations have been assembled between the clamping plates 10 and 11, the screw 17 is inserted through the aligned holes in the clamping plate 10 and in all of the laminations into a threaded hole in the lower clamping plate 11 and then tightened. Preferably a dished spring washer 80 is inserted between the head of the clamping screw 17 and the outer face of the upper clamping plate 10. To insure that the shank of screw 17 will not engage the edges of the holes in the core, armature and field laminations and thus interconnect them, the shank of the screw is surrounded by the usual sleeve of insulating material. After the assembly is completed the extensions 23, 28, 57, 69, and 79 of the laminations 22, 25, 53, 67 and 72, respectively, may be connected in any desired manner as by soldering to the studs 6, 5, 4, 8 and 9, respectively, thus completing all of the internal wiring between the line and cut-off relay portions of the assembly.

Fig. 10 illustrates the improved relay assembly applied to a line circuit of a step-by-step dialing system in which the substation of the line is schematically shown by the circle 81 and a line finder having access to the calling line terminals

is schematically indicated at 82. When the relay assembly is installed on the line, the tip and ring conductors are connected to the soldering terminals 63 and 76 of the armature laminations 60 and 71, the sleeve terminal 83 of the line appearing on the line-finder bank is connected to the soldering terminal 36 of the armature lamination 33, the conductors of the line-finder start circuit are connected to the soldering terminals 42 and 49 of the field lamination 39 and of the armature lamination 46, the central office ground bus-bar is connected through the relay rack to the lamination 21 and thence to the line relay coil terminal stud 6 and the battery bus-bar is connected to the soldering terminal 70 of the back stop member 67.

When the subscriber at substation 81 initiates a call and closes his line loop, a circuit is established from battery over member 67, stud 8, right winding of line relay coil 1, stud 9, field lamination 72, the arm 78 of which is normally engaged with the arm 77 of the armature lamination 71, thence over the line loop, returning over the armature lamination 60, the arm 64 of which is normally engaged with the arm 55 of the field lamination 53, stud 4, thence through the left winding of the line relay coil 1, stud 6 to ground over the terminal lamination 21. The coil 1 is thereupon energized to magnetize the core arm 29 of the field lamination 25 to thereby attract the arm 85 of the armature lamination 33 into engagement therewith and to magnetize the arm 50 of the armature lamination 46 whereby it becomes attracted into engagement with the pole-piece arm 43 of the field lamination 49. The engagement of the contacts of the arms 43 and 50 establishes the line-finder start circuit to start an idle line finder and the engagement of the contacts of arm 30 with the contacts of arm 85 prepares a circuit for the cut-off relay coil extending from the battery bus-bar over member 67, stud 8, through the winding of cut-off relay coil 2, stud 5, the arm 29 of the core lamination 25 now in engagement with the arm 85 of the armature lamination 33, to the sleeve terminal 83.

If it be assumed that the line finder 82 is started, when its test brush 84 encounters the terminal 83 of the calling line the circuit thus traced for the cut-off relay coil will be completed, whereupon the cut-off relay coil will magnetize the core arm 30 of the core lamination 25, in the same sense as the line relay coil has magnetized the core arm 29, to hold the arm 85 of the armature lamination 33 firmly in contact therewith and will so magnetize the arms 64 and 77 of the armature laminations 60 and 71 that they will be repelled from the permanent magnet ends 55 and 78 of the field laminations 53 and 72, to thereby disconnect the windings of the line relay coil 1 from the calling line loop. The line relay coil will thereupon be deenergized to release the arm 50 of armature lamination 46 from engagement with the arm 43 of the field lamination 49 to open the line-finder start circuit and to thus arrest the hunting movement of the line finder 82 and to discontinue the magnetic attraction between the core arm 29 of the core lamination 25 and the armature arm 85 of the armature lamination 33. Relay coil 2 is, however, maintained locked to its operating circuit by the continued engagement of the arm 30 of the core lamination with the arm 85 of the armature lamination 25.

What is claimed is:

1. In a relay assembly, a core lamination having a pair of pole arms extending at right angles therefrom, a first relay coil surrounding one of said arms, a second relay coil surrounding the other of said arms, an armature lamination having a reed portion cooperating with said arms, a field lamination, a second armature lamination having a reed portion extending freely through said second relay coil and cooperating with said field lamination, two additional field laminations, two armature laminations having reed portions extending freely through said first relay coil and cooperating respectively with said additional field laminations, insulating laminations interposed between adjacent ones of said other laminations and contacts on said field and core laminations and on the reeds which cooperate therewith.

2. In a relay assembly, a core lamination having a pair of pole arms extending at right angles therefrom, a first relay coil surrounding one of said arms, a second relay coil surrounding the other of said arms, an armature lamination having a reed portion cooperating with said arms, a field lamination, a second armature lamination having a reed portion extending freely through said second relay coil and cooperating with said field lamination, two additional field laminations each having a permanently magnetized pole-piece, two armature laminations having reed portions extending freely through said first relay coil and normally attracted into conductive engagement with the pole-pieces of said additional field laminations and repellable therefrom upon the energization of said first relay coil, insulating laminations interposed between adjacent ones of said other laminations and contacts on said field and core laminations and on the reeds which cooperate therewith.

3. In a relay assembly, a core lamination having a pair of pole arms extending at right angles therefrom, a first relay coil surrounding one of said arms, a second relay coil surrounding the other of said arms, an armature lamination having a reed portion attractable to either of said arms upon the energization of the associated coil, a field lamination, a second armature lamination having a reed portion extending freely through said second relay coil and attractable to said field lamination upon the energization of said second relay coil, two additional field laminations each having a permanently magnetized pole-piece, two armature laminations having reed portions extending freely through said first relay coil and normally attracted into conductive engagement with the pole-pieces of said additional field laminations and repellable therefrom upon the energization of said first relay coil, insulating laminations interposed between adjacent ones of said other laminations and contacts on said field and core laminations and on the reeds which cooperate therewith.

4. In a relay assembly, two clamping plates each having two coil supporting arms extending at right angles therefrom, a first relay coil and a second relay coil supported on said arms, a core lamination having a pair of pole arms extending at right angles therefrom through said coils, an armature lamination having a reed portion attractable to either of said core arms upon the energization of the associated coil, a field lamination, a second armature lamination having a reed portion extending freely through said second relay coil and attractable to said field lami-

nation upon the energization of said second relay coil, two additional field laminations each having a permanently magnetized pole-piece, two armature laminations having reed portions extending freely through said first relay coil and normally attracted into conductive engagement with the pole-pieces of said additional field laminations and repellable therefrom upon the energization of said first relay coil, insulating laminations interposed between adjacent ones of said other laminations, means for clamping all of said laminations between said clamping plates and contacts on said field and core laminations and on the reeds which cooperate therewith.

5. In a relay assembly, two clamping plates each having two coil supporting arms extending at right angles therefrom, a coil assembly supported on said arms comprising a spoolhead and a first relay coil and a second relay coil secured thereto and surrounding the arms of said plates, a core lamination having a pair of pole arms extending at right angles therefrom through said coils, an armature lamination having a reed portion attractable to either of said core arms upon the energization of the associated coil, a field lamination, a second armature lamination having a reed portion extending freely through said second relay coil and attractable to said field lamination upon the energization of said second relay coil, two additional field laminations each having a permanently magnetized pole-piece, two armature laminations having reed portions extending freely through said first relay coil and normally attracted into conductive engagement with the pole-pieces of said additional field laminations and repellable therefrom upon the energization of said first relay coil, insulating laminations interposed between adjacent ones of said other laminations, means for clamping all of said laminations between said clamping plates, and contacts on said field and core laminations and on the reeds which cooperate therewith.

6. In a relay assembly, two clamping plates each having two coil supporting arms extending at right angles therefrom, a coil assembly supported on said arms comprising an insulating mounting plate, a first relay coil and a second

relay coil secured thereto and surrounding the arms of said clamping plates and studs secured to said mounting plate and to which the terminals of the windings of said coils are connected, a core lamination having a pair of pole arms extending at right angles therefrom through said coils and having an extension engaged with one of said studs, an armature lamination having a reed portion attractable to either of said core arms upon the energization of the associated coil, a field lamination, a second armature lamination having a reed portion extending freely through said second relay coil and attractable to said field lamination upon the energization of said second relay coil, two additional field laminations each having a permanently magnetized pole-piece and an extension engaged with another of said studs, two armature laminations having reed portions extending freely through said first relay coil and normally attracted into conductive engagement with the pole-pieces of said additional field laminations and repellable therefrom upon the energization of said first relay coil, a back-stop lamination interposed between said latter armature laminations and having an extension engaged with another of said studs, insulating laminations interposed between adjacent ones of said other laminations, means for clamping all of said laminations between said clamping plates, and contacts on said field and core laminations and on the reeds which cooperate therewith.

7. In a relay assembly, a core lamination having a pair of parallelly disposed pole arms extending therefrom, a first relay coil surrounding one of said arms, a second relay coil surrounding the other of said arms, an armature lamination having a reed portion cooperating with the polar ends of both of said arms and attractable to either of said arms upon the energization of the associated coil, cooperating contacts on said arms and on said reed portion, an insulating lamination interposed between said other laminations and means to clamp said laminations together.

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