

Aug. 25, 1942.

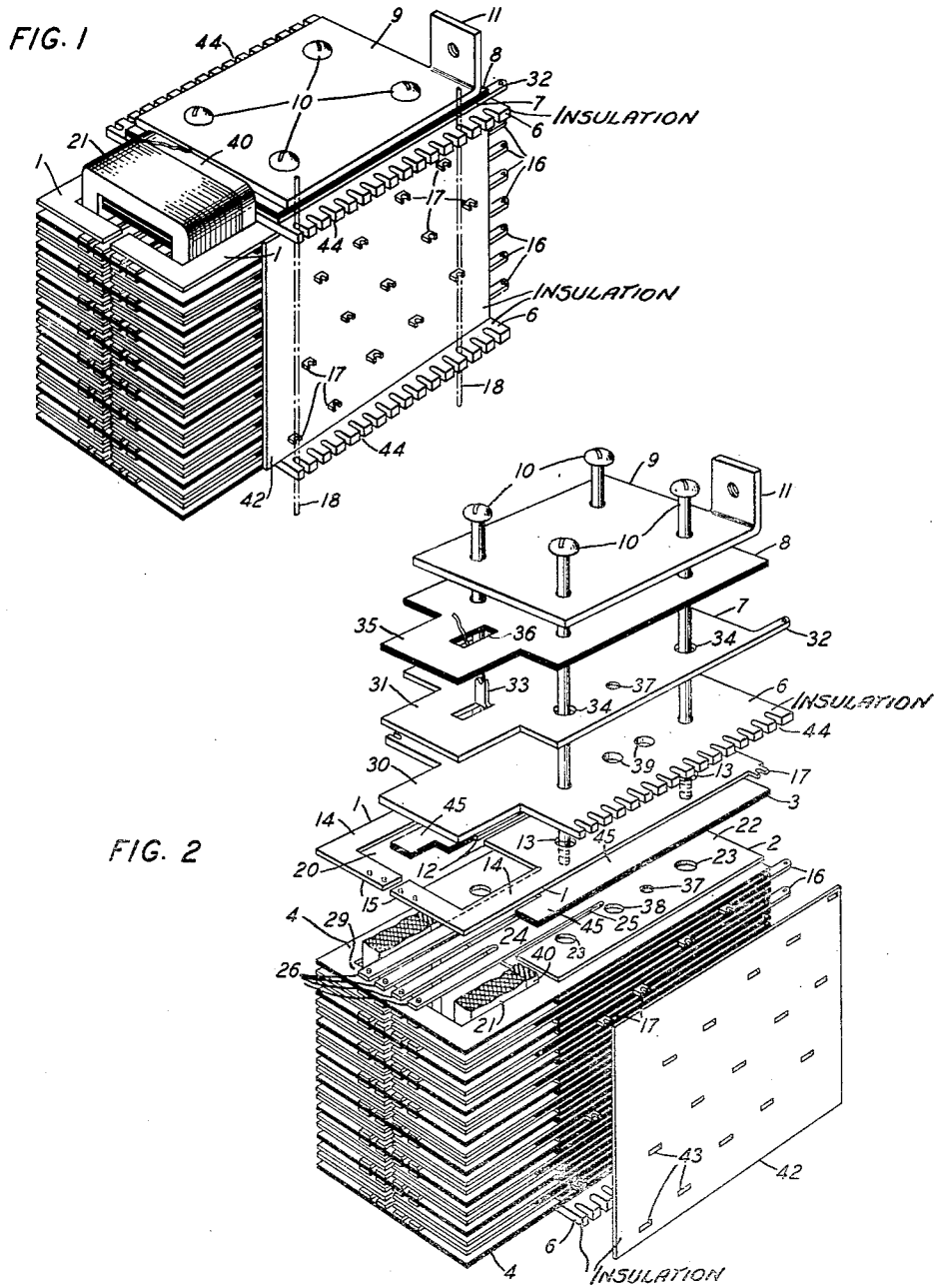
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2,293,823

MULTICONTACT RELAY

Filed Nov. 27, 1940

2 Sheets-Sheet 1



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FIG. 3

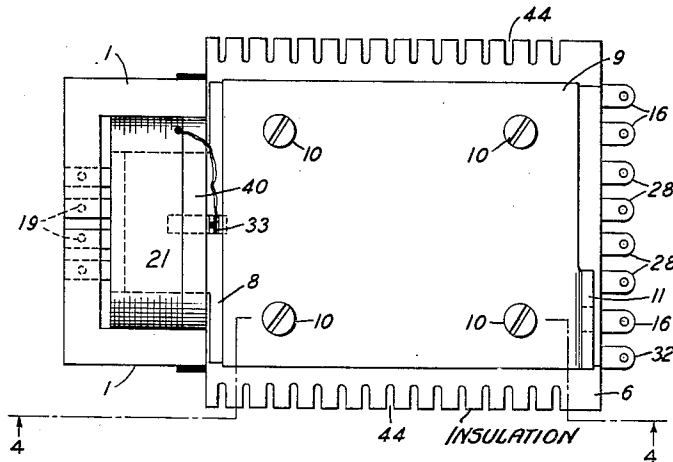


FIG. 4

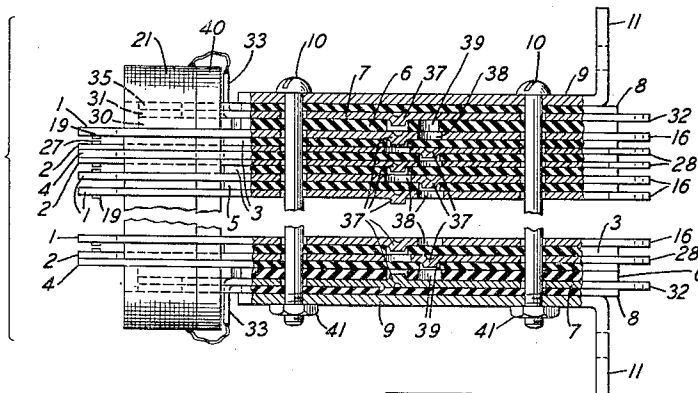
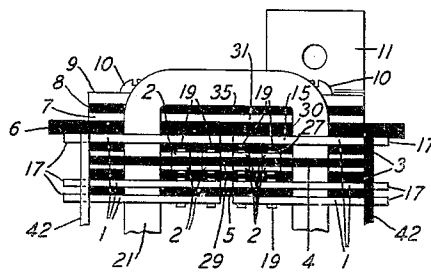


FIG. 5



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2,293,823

MULTICONTACT RELAY

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Application November 27, 1940, Serial No. 367,338

16 Claims. (Cl. 200—103)

This invention relates to relays and more particularly to a relay which is capable of simultaneously controlling a plurality of work circuits.

Multicontact relays are used extensively in telephone systems and particularly in systems of the all-relay and cross-bar types for controlling and establishing circuits. Multicontact relays which have been used extensively in such systems have been provided with a single armature which when actuated by the energization of the relay winding effects the operation of a plurality of contact springs to engage with a plurality of mate contact springs. A relay of this type has a very considerable spring load and requires an operating winding having a large number of ampere turns, thus necessitating relatively large operating and holding currents. Furthermore, if a large number of pairs of contact springs are to be operated the magnetic circuit required must comprise considerable magnetic material thus increasing the size of the relay structure and the mounting space required therefor.

As disclosed in patent No. 2,212,830 granted to us on August 27, 1940, a multicontact relay of a simpler and more efficient character requiring a much smaller mounting space was proposed. This relay comprised a plurality of magnetic circuit units each including a core lamination of magnetic material having a plurality of upwardly extending pole-pieces, an associated armature supporting spring lamination and an interposed lamination of insulating material assembled side by side with their corresponding pole-pieces in alignment and insulated from each other by further interposed spacing laminations of insulating material and provided with a common energizing coil embracing the corresponding pole-pieces of every core lamination. Each armature spring was provided with a forwardly extending spring finger to which was secured a short bar armature positioned to overlie the pole-pieces of its associated core lamination. By the energization of the energizing coil all of the armatures were attracted into conductive engagement with their associated core laminations thereby simultaneously closing a plurality of work circuits each extending from an armature spring lamination through the armature carried thereby and to the associated core lamination.

It is the object of the present invention to further simplify the structure of a relay of the type disclosed in our patent hereinbefore referred to and to further improve the operating characteristics of such relay.

In accordance with the present invention this

object is attained by the provision of a plurality of groups of magnetic circuit units each comprising a layer of two field laminations of magnetic material disposed side by side out of conductive engagement with each other, a layer of two armature laminations of magnetic material disposed side by side out of conductive engagement with each other and each having a spring tongue attractable into conductive engagement with an associated one of the field laminations, and a lamination of insulating material interposed between the layer of field laminations and the layer of armature laminations. These groups of magnetic circuit units are assembled side by side with the pole piece extensions of the field laminations and the spring tongues of the armature laminations in alignment and insulated from each other by further interposed laminations of insulating material and are clamped in their assembled position between end plates serving as mounting brackets by bolts which extend through aligned holes in the end plates, field laminations, armature laminations and insulating laminations.

In the assembly of the groups of magnetic circuit units such units are assembled in pairs back to back so that the armature laminations of pairs of adjacent units lie adjacent to each other separated by interposed laminations of insulating material which serve as back stops for the spring tongues of such laminations and the field laminations of other pairs of adjacent units lie adjacent to each other separated by interposed laminations of insulating material. During the assembly the polar extensions of the field laminations are positioned to embrace the outside of a single toroidal operating coil and the spring tongues of the armature laminations are extended through the center of the coil.

The rear ends of the core and spring laminations are provided with terminal lugs to which the conductors of work circuits may be soldered and the longitudinal edges of all field laminations are also provided with bifurcated terminal lugs extending therefrom which may be employed to multiple the corresponding field laminations of one or more relays together. To enable parallelly disposed bare multiplying wires to be laid in the slots of such lugs out of conductive engagement with each other, the lugs are staggered with respect to each other and are extended through slots similarly staggered in face plates of insulating material which plates prevent any solder dropping from the lugs during the soldering of multiple wires thereto from dropping between and short-circuiting adjacent laminations of the

units. Insulating plates having notches in their longitudinal edges for the reception of the multiplying wires are also positioned in the assembly just outside of each outside magnetic unit and brass plates which serve as supports and terminal lugs for the ends of the coil are also positioned outside of the notched guide plates and are insulated from the end plates by interposed plates of insulating material.

All elements of the proposed relay are of such form that they may be punched from sheet stock and no element with the exception of the coil supporting plates and the end plates requires a bending operation to be performed thereon. Furthermore, the assembly of two magnetic circuit units side by side in each layer reduces the over-all length of the relay by approximately one half whereby a relay capable of establishing thirty separate work circuits upon the energization of its coil has an over-all width of approximately three inches, an over-all height of two inches and a depth of three inches.

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

Fig. 1 is a perspective view of the relay;

Fig. 2 is a partially exploded perspective view of the relay more clearly disclosing the assembly elements thereof;

Fig. 3 is a side elevational view of the relay;

Fig. 4 is a partial sectional view taken along section line 4—4 of Fig. 3; and

Fig. 5 is a partial front end view of the relay.

The relay, as previously described, comprises an assembly of a plurality of magnetic circuit units, for example thirty, each comprising a field lamination 1, an armature lamination 2 and an interposed lamination 3 of insulating material such as hard rubber or fiber. To conserve mounting space and to reduce the over-all length of the relay the field laminations 1 of two units are reversely positioned in a single layer out of conductive engagement with each other and the armature laminations 2 of the same two units are reversely pointed in a single layer, the two layers of laminations being insulated from each other by a single interposed lamination 3 of insulating material as best disclosed in Figs. 2 and 5. A plurality of such layers of units are assembled side by side and with adjacent layers back to back so that the armature laminations 2 of pairs of adjacent layers are contiguous and separated from each other by spacing laminations 4 of insulating material, such as hard rubber or fiber, and that the field laminations 1 of intermediate pairs of adjacent layers are contiguous and separated from each other by spacing laminations 5 of insulating material, such as hard rubber or fiber. Outside of the field laminations 1 at one end of the assembly is positioned a multiple wiring guide plate 6 of insulating material followed by a combined coil supporting and coil terminal lug member 7 and an outside plate 8 of insulating material. A similar plate 6, member 7 and plate 8 are positioned outside of the spacing lamination 4 at the other end of the assembly and the entire assembly is then clamped between the end plates 9 by bolts 10 which extend through aligned holes in all of the assembled elements. As disclosed most clearly in Fig. 4, the bolts extend tightly through the holes in the end plates 9, in the outside insulating plates 6 and 8 and in all of the laminations 3, 4 and 5 of insulating material but the diameters of the

holes in the coil supporting and terminal lug members 7, in the field laminations 1 and in the armature laminations 2 are sufficiently larger than the diameter of the bolts so that the bolts are out of contact therewith.

The end plates 9 are provided with out-turned ears 11 which serve as mounting brackets for the attachment of the relay structure to a suitable relay or apparatus rack.

Each field lamination 1 is stamped from a sheet of suitable magnetic material into the U shape most clearly disclosed in Fig. 2 and comprises one widened arm 12 which serves as a support therefor in the assembly and which is provided with two enlarged holes 13 through which two of the clamping bolts 10 extend, a narrowed base portion 14 which, as later described, embraces the outside of the operating coil 21, and a second narrow arm 15 which serves as a pole-piece and embraces the outside end of the operating coil. The rear end of the arm 12 is provided with a rearwardly extending terminal lug 16. Alternate ones of the field laminations have their terminal lugs staggered vertically as disclosed most clearly in Fig. 3 to give greater clearance between the lugs of adjacent laminations for enabling conductors to be more readily soldered thereto and to eliminate the possibility of cross-connections between laminations. The outside edge of the arm 12 of each field lamination is also provided with an outwardly extending bifurcated terminal lug 17 in the slot of which a bare wire multiple 18 may be soldered as illustrated by the dot-dash lines of Fig. 1. As best illustrated in Fig. 1, the lugs 17 of all field laminations are placed at different positions along the edges of the laminations so that in their assembled position no two of such lugs are in alignment. The pole-piece arm 15 of the field lamination has a pair of contacts 19 welded or otherwise secured to the pole-face thereof facing the associated armature lamination 2. As previously stated, two field laminations are oppositely disposed in each layer of such laminations with the inner edges of their arms 12 and 15 out of engagement and forming a rectangular space 20 between the arms and base portions thereof through which the operating coil 21 extends.

Each armature lamination 2 is also stamped from a sheet of suitable magnetic material into the L shape most clearly disclosed in Fig. 2 and comprises a widened base portion 22 which serves as a support therefor in the assembly and which is provided with two enlarged holes 23 through which two of the clamping bolts 10 extend and a tongue or reed portion 24. To give the tongue 24 greater length and thus greater resiliency the base portion 22 is slotted as indicated at 25. The free end of the tongue portion 24 is bifurcated to form two contact-carrying sections 26 to the pole-faces of which facing the associated field lamination 1 are welded or otherwise secured contacts 27 which cooperate with the contacts 19 carried by the associated field laminations. The rear end of the base portion 22 is provided with a rearwardly extending terminal lug 28. Alternate ones of the armature laminations have their terminal lugs staggered vertically as most clearly disclosed in Fig. 3 to give greater clearance between the lugs of adjacent laminations for enabling conductors to be more readily soldered thereto and to eliminate the possibility of cross-connections between laminations. As previously stated, two armature laminations are oppositely disposed in each layer of such lamina-

tions with the inner edges of their tongue portions 24 out of conductive engagement.

Each spacing lamination 3, which is disposed between each layer of field laminations and each layer of armature laminations constituting a pair or layer of magnetic circuit units, is stamped from a sheet of suitable insulating material such as hard rubber or fiber into a substantially U shape. The central portion thereof between the arms 45 is cut away to permit the tongues 24 of the armature laminations 2 to move freely toward the associated field laminations 1 and the forward ends of the arms 45 are extended forwardly over the arms 14 of the field laminations to lend rigidity thereto. Four holes are also provided therein through which the bolts 10 pass with a snug fit.

Each spacing lamination 4, which is disposed between adjacent layers of armature laminations 2, is stamped from a sheet of suitable insulating material such as hard rubber or fiber into a rectangular shape and is provided with four holes through which the bolts 10 pass with a snug fit and with a rectangular shaped opening near its outer end through which the energizing coil 21 extends. The narrow end portion 29 of the lamination 4 lies between the ends of the tongues 24 of the armature laminations and constitutes a back stop therefor.

Each spacing lamination 5, which is disposed between adjacent layers of field laminations 1, is stamped from a sheet of suitable insulating material such as hard rubber or fiber into a rectangular shape and is provided with four holes through which the bolts 10 pass with a snug fit. The outer end of the lamination 5 extends just to the rear spoolhead 40 of the coil 21.

The multiple wiring guide plates 6 are also each stamped from a sheet of suitable insulating material, such as hard rubber or fiber, into a substantially rectangular shape with a forwardly extending tongue portion 30 which serves to support the coil 21 and with four holes through which the bolts 10 pass with a snug fit. Each longitudinal edge of each plate 6 is provided with as many slots 44 as there are layers of field laminations in the assembly or, in the relay illustrated, with fifteen such slots. These slots are evenly spaced and when the plates 6 are assembled on the bolts 10 these slots are in alignment with the slots in the bifurcated lugs 17 of the field laminations.

The members 7 serve both as coil supports and coil terminal lugs and are each stamped from a sheet of brass into a substantially rectangular shape with a forwardly extending tongue portion 31 which serves as a support for the coil 21 with a rearwardly extending soldering terminal 32 and with an ear 33 struck up at right angles therefrom near the base of the tongue portion 31 which serves as a soldering terminal to which one end of the winding of coil 21 may be attached. Each member is also provided with enlarged holes 34 through which the bolts 10 freely pass.

The outside spacing plates 8 are each stamped from a sheet of insulating material such as hard rubber or fiber into a substantially rectangular shape with a forwardly extending tongue portion 35 which serves to support the coil 21, with a rectangular opening 36 through which the terminal ear 33 of the adjacent member 7 may pass and with four holes through which the bolts 10 pass with a snug fit.

To assist in the assembly of the several elements of the relay the coil supporting members 7, field laminations 1 and armature laminations 2 are provided with cylindrical embossments 37,

as best disclosed in Fig. 4, which fit snugly into the holes 39 in the adjacent insulating laminations. To insure that an embossment 37 may not protrude sufficiently through the hole in the adjacent insulating lamination as to engage the armature or field lamination which is positioned adjacent to the opposite face of the insulating lamination, enlarged holes such as 38 are provided in such armature or field laminations positioned in alignment with such embossments. Thus each field or armature lamination is provided with an embossment 37 and with an enlarged hole 38, the positions of such embossment and hole being reversed in each successive field and armature lamination of the assembly.

In assembling the various elements of the relay the coil 21 is first placed in a suitable assembly jig with its axis extending horizontally and its longest faces extending vertically. An end plate 9, insulating plate 8, coil supporting member 7 and multiple wiring guide plate 6 are next assembled in the order named with the terminal lug 33 of the element 7 extending outwardly through the hole 36 in the plate 8 and with the embossment 37 of the member 7 engaged in a hole 39 in the plate 6 and with the tongue portions 35, 31 and 30 extending into the coil 21. A spacing lamination 4 is next assembled on the plate 6 with the coil 21 extending upwardly through the rectangular opening in the outer end thereof. Two armature laminations 2 are next positioned back to back on the lamination 4 with their tongues 24 extending through the coil 21 and resting on the upper face of the end portion 29 of the spacing lamination 4 and with their embossments 37 engaged in holes 39 in the lamination 4. A spacing lamination 3 is next positioned upon the armature laminations 2 followed by two oppositely disposed field laminations 1 each with its base portion 14 and outside arm 15 embracing the outer edge and outer face of the coil 21 and with its embossment engaged in a hole 39 in the spacing lamination 3. A spacing lamination 5 is then positioned on the two field laminations 1 followed by another pair of field laminations 1 with their embossments 37 engaged in holes 39 in the spacing lamination 5. In a similar manner the different laminations are assembled until the last pair of field laminations 1 has been placed in position whereupon the second guide plate 6, coil supporting member 7, insulating plate 8 and end plate 9 are assembled with their tongue portions 30, 31 and 35 inserted into the coil 21. The clamping bolts 10 are then inserted through the aligned holes in the assembly members and the entire assembly is then clamped together by placing the nuts 41 on the ends of the bolts and tightening such nuts.

After the assembly has thus been clamped between the end plates 9, the slotted face plates 42 of insulating material are then placed in position with the lugs 17 of the field laminations 1 extending through the slot 43 therein. With the plates 42 in position the accidental short-circuiting of two adjacent laminations when multiplying wires, such as 18, are soldered into the slots of such lugs is avoided.

To complete the relay assembly the ends of the winding of coil 21 are soldered to the out-turned terminal ears 33 of the supporting plates 7.

If it is found desirable to multiple together two or more of the relays hereinbefore described, which are mounted side by side on a relay mounting rack, it is only necessary to lay thirty bare wires in the aligned slots 44 of the guide plates 6

of all of such relays and to solder such wires into the slots of the aligned lugs 17.

It will be apparent that whenever the common energizing coil 21 is energized, all of the polar ends of the field laminations 1 will be magnetized with the same magnetic polarity and the ends of the armature tongues will be magnetized with an opposite polarity whereby all of the tongues will be attracted into conductive engagement with their associated field laminations. Thus a plurality of magnetic circuit paths are established each extending from the base portion 12 of a field lamination 1 across a rear air-gap through the interposed insulating spacer 3 to the base portion 22 of the associated armature lamination 2 through the spring tongue 24 thereof extending through the coil 21, across the air-gap between the free end of such tongue and the polar end of the field lamination 1, then returning through the outer arm 15 and base portion 14 of such field lamination. As soon as the tongue has become attracted into conductive engagement with the polar end of the field lamination the armature and field laminations become conductively joined to establish a work circuit. Thus if as assumed the relay has thirty of such magnetic circuit units, thirty work circuits will be simultaneously established through the energization of the common energizing coil.

What is claimed is:

1. In a relay, a plurality of magnetic circuit units each comprising a field lamination of magnetic material, an armature lamination of magnetic material having a spring tongue attractable into conductive engagement with the associated field lamination and a lamination of insulating material interposed between said field lamination and said armature lamination, laminations of insulating material interposed between adjacent units and an energizing coil common to all of said units and surrounding all of the spring tongues thereof and operative upon its energization to cause the establishment of a separate circuit path from the field lamination to the armature lamination of each of said units.

2. In a relay, a U-shaped field lamination of magnetic material, one arm of which serves as a support and the other arm of which serves as a pole-piece, an L-shaped armature lamination of magnetic material, one arm of which serves as a support and is superimposed upon the supporting arm of said field lamination and the other arm of which extends as a spring tongue parallel to the base portion of said field lamination with its end overlying the end of the pole-piece arm of said field lamination, a lamination of insulating material interposed between the supporting arms of said field and armature laminations, end plates serving as mounting brackets between which said laminations are insulatedly clamped and a coil surrounding a portion of one of said laminations energizable to cause the attraction of the spring tongue of said armature lamination into conductive engagement with the pole-piece arm of said field lamination.

3. In a relay, a U-shaped field lamination of magnetic material, one arm of which serves as a support and the other arm of which serves as a pole-piece, an L-shaped armature lamination of magnetic material, one arm of which serves as a support and is superimposed upon the supporting arm of said field lamination and the other arm of which extends as a spring tongue parallel to the base portion of said field lamination with its end overlying the end of the pole-piece arm of

said field lamination, a lamination of insulating material interposed between the supporting arms of said field and armature laminations, end plates serving as mounting brackets between which said laminations are insulatedly clamped, and a coil surrounding the spring tongue of said armature lamination energizable to cause the attraction of said spring tongue into conductive engagement with the pole-piece arm of said field lamination.

4. In a relay, a flat field lamination of magnetic material, a flat armature lamination of magnetic material having a spring tongue attractable into conductive engagement with said field lamination, a lamination of insulating material interposed between said field and armature laminations, two coil supporting plates between which said field and armature laminations are insulatedly disposed, each of said plates having a tongue struck up therefrom serving as a coil terminal lug, end plates serving as mounting brackets between which said laminations and said coil supporting plates are insulatedly clamped, and a coil supported on said supporting plates and operative upon its energization to cause the attraction of said spring tongue into engagement with said field lamination.

5. In a relay, a plurality of magnetic circuit units, each comprising a U-shaped field lamination of magnetic material, one arm of which serves as a support and the other arm of which serves as a pole-piece, an L-shaped armature lamination of magnetic material, one arm of which serves as a support and is superimposed upon the supporting arm of said field lamination and the other arm of which extends as a spring tongue parallel to the base portion of said field lamination with its end overlying the end of the pole-piece arm of said field lamination, laminations of insulating material interposed between adjacent units and an energizing coil common to all of said units operative upon its energization to cause the establishment of a separate circuit path from the field lamination to the armature lamination of each of said units.

6. In a relay, a plurality of magnetic circuit units, each comprising a U-shaped field lamination of magnetic material, one arm of which serves as a support and the other arm of which serves as a pole-piece, an L-shaped armature lamination of magnetic material, one arm of which serves as a support and is superimposed upon the supporting arm of said field lamination and the other arm of which extends as a spring tongue parallel to the base portion of said field lamination with its end overlying the end of the pole-piece arm of said field lamination and an interposed lamination of insulating material, coil supporting plates each having a tongue struck up therefrom serving as a coil terminal lug, laminations of insulating material interposed between said units and between the outer ones of said units and said supporting plates, end plates serving as mounting brackets, laminations of insulating material disposed between said end plates and said supporting plates, clamping means for clamping the aforesaid elements together and a coil supported on said supporting plates and operative upon its energization to cause the attraction of the spring tongue of each unit into conductive engagement with the field lamination associated therewith.

7. In a relay, a plurality of magnetic circuit units, each comprising a U-shaped field lamination of magnetic material, one arm of which serves as a support and the other arm of which

serves as a pole-piece, an L-shaped armature lamination of magnetic material, one arm of which serves as a support and is superimposed upon the supporting arm of said field lamination and the other arm of which extends as a spring tongue parallel to the base portion of said field lamination with its end overlying the end of the pole-piece arm of said field lamination and an interposed lamination of insulating material, coil supporting plates each having a tongue struck up therefrom serving as a coil terminal lug, laminations of insulating material interposed between said units and between the outer ones of said units and said supporting plates, end plates serving as mounting brackets, laminations of insulating material disposed between said end plates and said supporting plates, clamping means for clamping all of the aforesaid members together and a coil supported on said supporting plates through which the spring tongues of all of said units extend and operable upon its energization to cause the attraction of the spring tongue of each unit into conductive engagement with the field lamination associated therewith.

8. In a relay, a plurality of magnetic circuit units, each comprising a field lamination of magnetic material, an armature lamination of magnetic material and an interposed lamination of insulating material, each of said field laminations having a bifurcated terminal lug extending from one edge thereof, the terminal lugs of different ones of said field laminations being disposed at different points along the edges thereof, whereby no two of said lugs are in alignment, laminations of insulating material interposed between adjacent units, multiple wire guide plates of insulating material disposed outside of the outer ones of said units, each of said plates having notches in a longitudinal edge thereof aligned respectively with the slots of said bifurcated terminal lugs, end plates serving as mounting brackets, clamping means for clamping said units together and to said end plates, and an energizing coil common to all of said units and operative upon its energization to cause the establishment of a separate circuit path from the field lamination to the armature lamination of each of said units.

9. In a relay, a plurality of magnetic circuit units, each comprising a field lamination of magnetic material, an armature lamination of magnetic material and an interposed lamination of insulating material, each of said field laminations having a bifurcated terminal lug extending from one edge thereof, the terminal lugs of different ones of said field lamination being disposed at different points along the edges thereof, whereby no two of said lugs are in alignment, laminations of insulating material interposed between adjacent units, multiple wire guide plates of insulating material disposed outside of the outer ones of said units, each of said plates having notches in a longitudinal edge thereof aligned respectively with the slots of said bifurcated terminal lugs, end plates serving as mounting brackets, clamping means for clamping all of the aforesaid elements together, a face plate of insulating material having slots therein through which said terminal lugs extend and an energizing coil common to all of said units and operative upon its energization to cause the establishment of a separate circuit path from the field lamination to the armature lamination of each of said units.

10. In a relay, a plurality of groups of magnetic circuit units, each comprising a layer of field laminations of magnetic material disposed side by side out of conductive engagement with

each other, a layer of armature laminations of magnetic material disposed side by side out of conductive engagement with each other and each having a spring tongue attractable into conductive engagement with an associated one of said field laminations, and a lamination of insulating material interposed between the layer of field laminations and the layer of armature laminations, laminations of insulating material interposed between adjacent groups of units, and an energizing coil common to all units and operative upon its energization to cause the establishment of a separate circuit path from each field lamination to the armature lamination associated therewith.

11. In a relay, a plurality of groups of magnetic circuit units, each comprising a layer of field laminations of magnetic material disposed side by side out of conductive engagement with each other, a layer of armature laminations of magnetic material disposed side by side out of conductive engagement with each other and each having a spring tongue attractable into conductive engagement with an associated one of said field laminations, and a lamination of insulating material interposed between the layer of field laminations and the layer of armature laminations, laminations of insulating material interposed between adjacent groups of units, and an energizing coil common to all of said units surrounding all of the spring tongues thereof and operative upon its energization to cause the establishment of a separate circuit path from each field lamination to the associated armature lamination.

12. In a relay, a plurality of pairs of magnetic circuit units, each comprising a layer of two field laminations of magnetic material reversely disposed side by side out of conductive engagement with each other, a layer of two armature laminations of magnetic material reversely disposed side by side out of conductive engagement with each other and each having a spring tongue attractable into conductive engagement with an associated one of said field laminations, and a lamination of insulating material interposed between the layer of field laminations and the layer of armature laminations, laminations of insulating material interposed between adjacent pairs of units and an energizing coil common to all of said units surrounding all of the spring tongues thereof and operative upon its energization to cause the establishment of a separate circuit path from each field lamination to the associated armature lamination.

13. In a relay, a plurality of pairs of magnetic circuit units, each comprising a layer of two U-shaped field laminations of magnetic material disposed side by side with their bases parallel and with their arms extending inwardly toward each other but out of conductive engagement, a layer of two L-shaped armature laminations of magnetic material disposed side by side with their long arms serving as spring tongues positioned adjacent to but out of contact with each other and with their free ends overlying the ends of the outer arms of the associated field laminations, and a lamination of insulating material interposed between the layer of field laminations and the layer of armature laminations, laminations of insulating material interposed between adjacent pairs of units, and an energizing coil common to all of said units and operative upon its energization to cause the establishment of a separate circuit path from each field lamination to the associated armature lamination.

14. In a relay, a plurality of pairs of magnetic circuit units, each comprising a layer of two U-shaped field laminations of magnetic material disposed side by side with their bases parallel and with their arms extending inwardly toward each other but out of conductive engagement, the inner arm of each lamination serving as a support and the outer arm serving as a pole-piece, a layer of two L-shaped armature laminations of magnetic material disposed side by side with their long arms positioned adjacent to but out of contact with each other, the short arm of each armature lamination serving as a support and the long arm serving as a spring tongue the outer end of which is attractable into conductive engagement with the pole-piece arm of the associated field lamination, and a lamination of insulating material interposed between the layer of field laminations and the layer of armature laminations, laminations of insulating material interposed between adjacent pairs of units, and an energizing coil supported within the space enclosed between the bases and arms of said field laminations and through which said spring tongues all extend and operative upon its energization to cause the establishment of a separate circuit path from each field lamination to the armature lamination associated therewith.

15. In a relay, a plurality of pairs of magnetic circuit units, each comprising a layer of two U-shaped field laminations of magnetic material disposed side by side with their bases parallel and with their arms extending inwardly toward each other but out of conductive engagement, the inner arm of each lamination serving as a support and the outer arm serving as a pole-piece, a layer of two L-shaped armature laminations of magnetic material disposed side by side with their long arms positioned adjacent to but out of contact with each other, the short arm of each armature lamination serving as a support and the long arm serving as a spring tongue the outer end of which is attractable into conductive engagement with the pole-piece arm of the associated field lamination, and a lamination of insulating material interposed between the layer of field laminations and the layer of armature laminations, coil supporting plates each having a tongue portion insertable through an operating coil and an ear struck up therefrom serving as a coil terminal lug, end plates serving

as mounting brackets, laminations of insulating material interposed between adjacent pairs of units, between the outer pairs of units and said supporting plates and between said supporting plates and said end plates, clamping means for clamping said aforementioned elements together, and an energizing coil mounted on the tongues of said supporting plates within the space enclosed between the bases and arms of said field laminations and through which said spring tongues all extend and operative upon its energization to cause the establishment of a separate circuit path from each field lamination to the armature lamination associated therewith.

16. In a relay, a plurality of pairs of magnetic circuit units, each comprising a layer of two field laminations of magnetic material reversely disposed side by side out of conductive engagement with each other, a layer of two armature laminations of magnetic material reversely disposed side by side out of conductive engagement with each other and each having a spring tongue attractable into conductive engagement with an associated one of said field laminations, and a lamination of insulating material interposed between the layer of field laminations and the layer of armature laminations, each of said field laminations having a bifurcated terminal lug extending outwardly from the outer longitudinal edge thereof, the terminal lugs of different pairs of said field laminations being disposed at different points along the edges thereof whereby no two of said lugs on the same side of the relay are in alignment, laminations of insulating material interposed between adjacent pairs of units, multiple wire guide plates of insulating material disposed outside of the outer ones of said units, each of said plates having notches in the longitudinal edges thereof aligned respectively with the slots of said bifurcated terminal lugs, end plates serving as mounting brackets, clamping means for clamping all of the aforesaid elements together, face plates of insulating material having slots therein through which said terminal lugs extend, and an energizing coil common to all of said units and operative upon its energization to cause the establishment of a separate circuit path from each field lamination to the associated armature lamination.

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