

June 29, 1954

H. M. KNAPP

2,682,584

RELAY

Filed May 24, 1952

2 Sheets-Sheet 1

FIG. 1

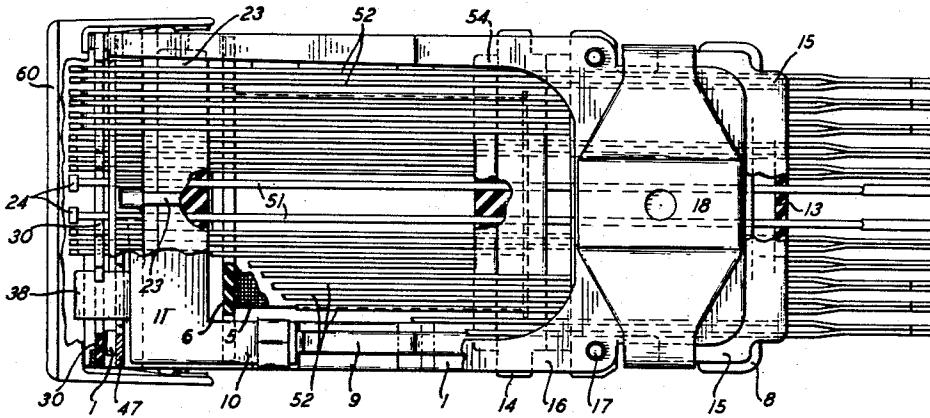


FIG. 2

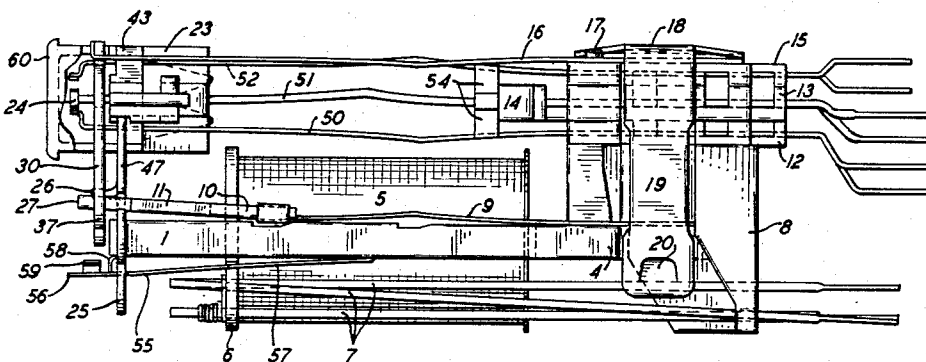
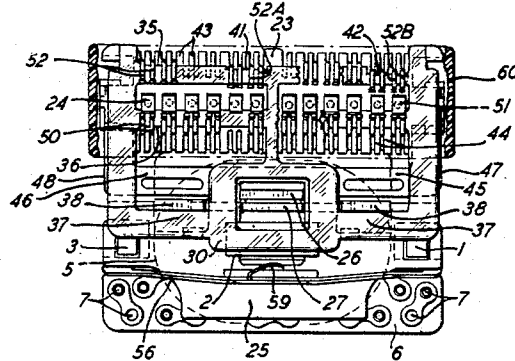


FIG. 3



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FIG. 4

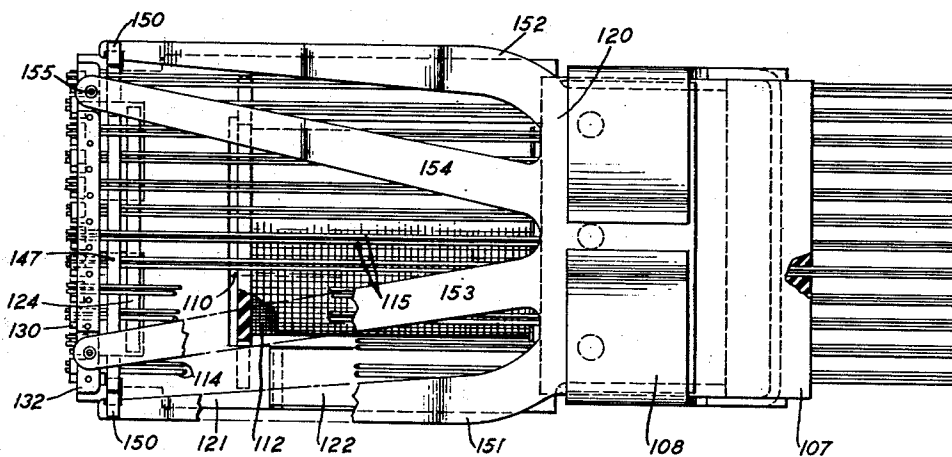


FIG. 5

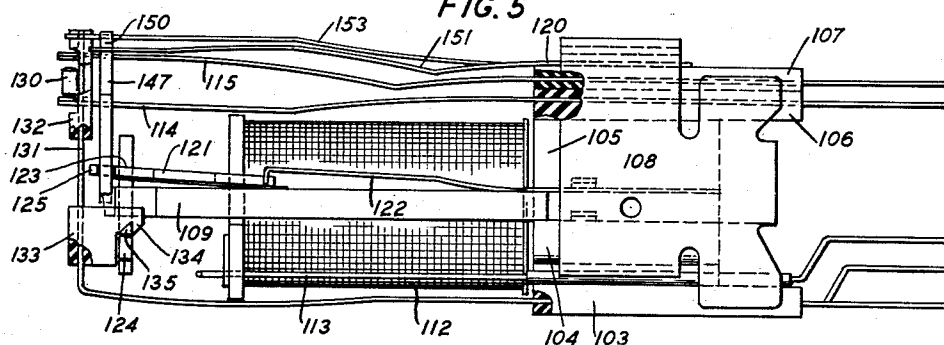
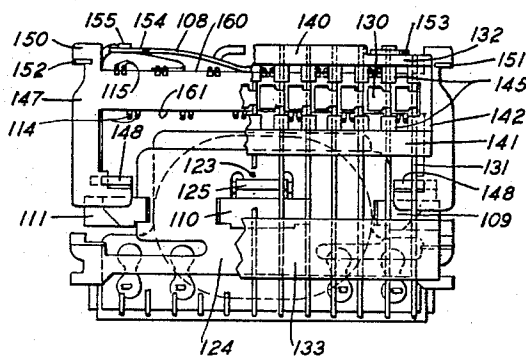


FIG. 6



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2,682,584

RELAY

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Application May 24, 1952, Serial No. 289,842

11 Claims. (Cl. 200—104)

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This invention relates to switching devices, and more particularly to switching devices for controlling a multiplicity of electrical circuits.

An object of this invention is to improve the efficiency, the compactness and the economy of manufacture and maintenance of switching devices.

A further object of this invention is to improve the facility of a switching device to transfer a first lead from a second to a third lead.

Another object of this invention is to increase the number of circuit-controlling elements of a switching device without increasing the overall dimensions of the device.

A further object of this invention is to increase the number of circuit-controlling operations which a switching device can perform.

A feature of this invention is an insulating element which not only serves accurately to fix the position of a plurality of contact elements, but also serves to guide the movement of certain other contact elements.

Another feature of this invention is the obtaining of transfer and continuity types of contact operation with but a single group of contact elements.

The principles of the invention have been exemplarily embodied in two types of electromagnetic switching devices or relays. The nature of the invention may most clearly be understood from the following detailed description of those two embodiments of the invention, when read with reference to the accompanying drawings in which:

Fig. 1 is a plan view of one preferred embodiment of the invention partially cut away to show certain details of the construction more clearly; Fig. 2 is an elevational view of the relay shown in Fig. 1;

Fig. 3 is a front-end view of the relay shown in Fig. 1;

Fig. 4 is an elevational view of a second preferred embodiment of the invention, partially cut away to show certain details of the construction more clearly;

Fig. 5 is an elevational view of the relay shown in Fig. 4; and

Fig. 6 is a front-end view of the relay shown in Fig. 4 partially cut away to show certain details more clearly.

The relay disclosed in Figs. 1 to 3 of the drawings is also disclosed, and claimed, in the patent application of H. M. Knapp and C. F. Spahn, Jr., Serial No. 289,843, filed on even date herewith.

Referring first to the embodiment of the in-

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vention disclosed in Figs. 1 to 3 of the drawings, the relay there disclosed comprises an E-shaped core having three leg portions, 1, 2 and 3 and a bridging portion 4 which serves to interconnect the leg portions 1, 2 and 3. Removably placed upon the center one of these leg portions 2 is an electromagnetic coil 5 having a front spool-head 6. The terminals of the coil 5 are connected to wires 7 which are mounted in the front spool-head 6 and extend rearwardly of the relay through apertures in a molded element of insulating material 8 and appear at the rear of the relay as terminals to which external circuits may be connected. A plurality of these terminal wires 7 are provided so that coils having multiple windings may be employed if desired.

The molded block 8 is substantially L-shaped in cross-section (the L being inverted in the showing of Fig. 2) whereby a flat surface is provided against which the upper side of the bridging member 4 of the core may rest. However, interposed between the upper surface of the bridging member 4 and this surface of the molded block 8 is a flat U-shaped spring member 9. By virtue of this construction, the bight of the U-shaped spring member 9 is clamped between the lower surface of the offset portion of the molded block 8 and the upper surface of the bridging element 4 of the core.

The two leg portions of the spring member 9 extend forwardly in spaced proximity to the outer core legs 1 and 3. The extreme forward ends of the legs of the spring member 9 are provided with extending flange portions which may be wrapped or clinched around the tip ends of the legs 10 of the armature 11 whereby the spring member 9 serves as a means for hinging the armature and for biasing that armature to its unoperated position. The clinched ends of the legs of the spring member 9 may further be attached to the legs 10 of the armature 11 by welding, if desired.

The armature 11 is essentially U shaped in appearance, the bight of the U extending across the relay so as to be capable of bridging the three legs 1, 2 and 3 of the core. The leg portions 10 of the armature 11 extend rearwardly of the relay and the tip ends of the legs 10 rest against the legs of the spring member 9, which in turn rest against the outer core legs 1 and 3. Therefore, the armature 11 is pivotally mounted, the fulcrum being approximately at the extreme ends of the legs 10 of the armature 11. The legs 10 of the armature 11 may be of any suitable length depending upon the operational requirements of

the relay. Thus, in the embodiment of the invention disclosed in Figs. 1, 2 and 3, the armature legs have been made substantially as short as possible and still provide a sufficient air-gap between the bight of the relay 11 and the central core leg 2.

It will be seen that the electromagnetic circuits of the relay include a first circuit comprising the center core leg 2, the core bridging member 4, the outer core leg 1, leg 13 and the bight of the armature 11, and an air-gap between the armature and the core. A similar path exists including core leg 3 and the other leg 13 of the armature 11. Therefore, upon energization of the coil 5, a force will be exerted tending to pivot the armature 11 to a position in which it bridges the three core legs 1, 2 and 3, i. e., the forwardmost edge of the armature 11 will tend to move downwardly to engage the core, in the showing of Fig. 2.

Three layers of contact-holding elements are provided, and in the preferred embodiments of the invention these contact-holding members are in the form of thin wires. The lowermost layer 50 and the uppermost layer 52 of wires are movable, under the control of the armature, relative to the centermost layer of wires 51. As may best be seen in Fig. 2 of the drawings, the lowermost set of these wires 50 is molded or otherwise mounted in an insulating member 12 which engages the upper edge of the molded block 8. The centermost layer of wires 51, which are preferably of heavier construction than the lower and upper layers of wires, are mounted in an intermediate block of insulating material 13 which rests on block 12. To provide the requisite rigidity, it is advantageous to provide a forward extension 14 for the block 13. The centermost layer of wires 51 are preferably mounted in the block 13 and in its forward extension 14 during the operation in which blocks 13 and 14 are molded. Similarly, the upper layer of springs 52 are molded or otherwise affixed in an upper molded block of insulating material 15 which abuts the upper surface of block 13. Abutting the upper edge of molded block 15 is an essentially U-shaped balancing spring member 16, the function of which will hereinafter be described.

In order accurately to position and retain the bridging portion 4 of the core, the molded blocks 8, 12, 13 and 15 and the balancing spring 16 in fixed position relative to one another, it is advantageous to provide corresponding projections and indentations in the several elements. For example, the balancing spring member 16 is apertured to engage projections 17 on the upper block 15. This group of elements is firmly rendered integral by means of a clamp which has a top portion 18 and two leg portions 19. The top portion 18 firmly engages the upper surface of the balancing spring member 16 and the leg portions 19 are provided with inwardly extending projections 20 which engage the edges of the undersurface of the bridging portion 4 of the core. The upper surface 18 of the clamp may be suitably deformed to provide a spring action.

The centermost layer of spring members 51 are affixed, preferably during the molding operation, in a front molded block member 23, and pass through that front molded block 23. Springs 51 are provided at their forwardmost ends with contact elements 24. As may best be seen in Fig. 3 of the drawings these contact members 24 are preferably square or rectangular blocks of metal with relatively thin layers of precious or

semi-precious contact metal at their upper and/or lower edges.

In order that the centermost layer of fixed springs 51, which are integral with the front molded block 23, may be securely immobilized, a core plate 25 is provided. This core plate 25 performs a plurality of functions. It is affixed to the front ends of the core legs 1, 2 and 3 by apertures in the plate 25 securely engaging these legs. This serves not only to retain the core plate in position, but also greatly improves the economy of manufacture of the relay. The three apertures in the core plate 25 which engage the core legs 1, 2 and 3, may be accurately located at relatively small cost. When the core plate is assembled to the core, the core plate then serves accurately to position the three legs 1, 2 and 3 of the core with relation one to the other. Therefore, there is no necessity for machining the core legs to close tolerances and no necessity for maintaining the upper surfaces of the core legs 1, 2 and 3 accurately in a plane. The core plate serves to force those upper surfaces to be coplanar when the relay is assembled.

A portion 26 of the core plate 25 is bent forwardly so as to rest in proximity to a central forward extension 27 of the armature 11. This projection 26 serves as a back stop for the armature, i. e., it defines the unoperated position of the armature. By virtue of this construction the back stop is centrally located on the armature and is positioned in line with the member 30 upon which the armature's force is exerted. It has been found that if the line of the armature's output force passes through the back stop member, armature rebound is substantially obviated.

The core plate 25 is also provided with two projecting arms comprising horizontal portions 45 and 46 and vertically extending portions 47 and 48. The front molded block 23 rests against the uppermost edges of the upstanding arm portions 47 and 48, being firmly held against those portions primarily by the downward force exerted by the pretensioned single fixed springs 51 and also by the downward force exerted by the pretensioned twin springs 52. The horizontal portions 45 and 46 are apertured so that a tool may be inserted to bend the horizontal portions 45 or 46 up or down to adjust the position of the front molded block 23 and thus to adjust the position of the fixed contact elements 24 relative to the movable springs 50 and 52.

The upper and lower spring members 52 and 50, respectively, extend forwardly in approximate parallelism with one another and with the fixed springs 51, are provided with downwardly and upwardly extending offset portions, respectively, at their forwardmost ends, and terminate in precious or semiprecious metal contact elements. As may best be seen in Fig. 3 of the drawings, two upper springs 52 and two lower springs 50 are provided for each contact element 24 of each fixed spring 51 so that upon any contact closure two independent contacts engage a single fixed contact. This construction reduces the possibility of malfunctioning of the relay due to dust or other impediments.

The upper springs 52 and the lower springs 50 are controlled by a moving card 30 of insulating material. The member 30 is generally rectangular in external configuration and is suitably apertured to perform its necessary functions. The upper layer of springs 52 rest against the uppermost edge 35 of the card 30; the lowermost layer of springs 50 are engageable by an edge 36 of

the moving card 30. The card 30 is moved downwardly upon the operation of the relay by virtue of an engagement of a portion 37 of the card 30 with forwardly extending projections 38 of the armature 11.

The uppermost layer of springs 52 are bent so as to be pretensioned in a downward direction. The upper springs 52 therefore continuously exert a force downwardly on the moving card 30 so that upon the downward movement of card 30 as a result of the operation of armature 11, the upper layer of springs 52 are permitted to move downwardly to engage the fixed contact elements 24. Similarly, the lower layer of springs 50 are bent so as to be pretensioned upwardly into engagement with the fixed contact elements 24. Therefore, upon a downward movement of the moving card 30, the lower springs 50 are forcibly separated from the fixed contact elements 24. Upon the release of the relay and the return of the armature 11 and the moving card 30 to their normal positions as shown, the upper layer of springs 52 will be forced back to their normal positions, as shown, and the lower layer of springs 50 will be permitted to return to engagement with the fixed contact elements 24.

The movement of the springs 52 and 50 both upon the operation and the release of the relay is controlled not only by the moving card 30 but also by the front molded block 23. Thus, a plurality of tooth-like projections 43 are provided on the upper surface of the front molded block and the upper movable springs 52 are accurately laterally positioned and guided thereby during their movement. Similarly, a plurality of projections 44 are provided on the lower surface of the molded block 23 to guide the lower springs 50 during their movement. By virtue of this arrangement, accurate lateral engagement of the moving springs within the fixed contact elements is assured.

In certain uses of the relay the moving springs may be subjected to high-frequency vibratory chatter upon the operation or release of the relay. To avoid this condition, a shock absorbing material 54 may be affixed to the portion 14 of the molded block 13 so as to press against the moving springs 50 and 52 to damp vibrations of those springs.

It will be noted that in the embodiment of the invention shown in Figs. 1 to 3 which represent a relay of conventional size, there are twelve groups of contact elements, each of which groups may comprise a fixed contact element, an upper twin contact element and a lower twin contact element. By virtue of the previously described operation, it will be perceived that the upper twin contact elements, mounted on the twin wires 52, are normally separated from the fixed contact elements 24 but that upon operation of the relay these upper contact elements will be brought into contact with the fixed contact elements 24, i. e., the fixed contact elements 24 and the upper contacting elements form so-called "make" combinations. If the edge 35 of the moving card 30 be straight and parallel with the fixed elements 24, all of the upper moving springs 52 will simultaneously engage all of the fixed elements 24. However, in some uses of the relay it may be found to be desirable for selected ones of the uppermost springs 52 to engage the fixed contact elements 24 at earlier or later times than others of those upper springs 52 engage others of those fixed contact elements 24. If a slight depression such as 41 (Fig. 3) is made in the upper edge 35

of card 30, the springs 52A which engage that slight depression will obviously make contact with their associated fixed elements 24 at an earlier point in the course of the downward movement of armature 11 than will others of the moving springs 52. These contacts may be labeled "early make" contacts. Further, if an even deeper depression 42 be made in the edge 35 of the moving card 30, the springs 52B engaging that deeper depression will make contact not only prior to the time at which the normal springs 52 make contact with their associated fixed elements 24, but also prior to the time at which the "early make" contacts 52A engage their fixed elements 24. This latter group of springs 52B may be labeled "preliminary make" contacts.

It will also be perceived that by virtue of the above-described operation of the relay, the lower movable spring elements 50 are normally in contact with their associated fixed contacts 24 and that upon the operation of the relay and the consequent downward movement of armature 11 and moving card 30, this lower layer of springs 50 will "break" contact with their associated fixed elements 24. By providing similar discontinuities (not shown) in the surface 35 of the moving card 30, "early break" contacts and "preliminary break" contacts may also be provided. Conversely in both the case of "make" and "break" contacts, if the surface 35 or 36 of the card 30 be provided with areas which project upwardly or downwardly from the surfaces 35 or 36, respectively, "late make" contacts and "late break" contacts may also be provided. However, three stages of make-contact and three stages of break-contact operation are sufficient for substantially all circuit requirements.

Assuming that each upper set of twin springs 52 may be of the "normal," "early" or "preliminary" type, and that each lower set of twin contact springs 50 may also be either "normal," "early" or "preliminary," it is possible to provide for any one of fifteen different possible contact arrangements for each set of contacts. Thus, by omitting the set of lower springs 50 there may be provided a "normal make" contact set, an "early make" contact set or a "preliminary make" contact set. Similarly, by omitting the upper pair of twin springs 52, a "normal," an "early," or a "preliminary" break contact set may be provided. By using both the upper set of twin springs 52 and the lower set of twin springs 50 in conjunction with the fixed contact element 24, and by selecting whether each of the upper sets and lower sets be "normal," "early," or "preliminary," the following combinations of contact operation may, in an obvious manner, be obtained: A "break-make" combination in which both the upper and lower sets are either "normal," "early" or "preliminary"; an "early make-break," or a "preliminary make-early break," or a "preliminary make-break" combination, all normally called "continuities," in which the upper set of twin wire contacts engages the fixed contact element 24 either somewhat before or substantially before the time that the lower set of contacts separates from the fixed contact elements 24; and an "early make-break," or a "preliminary break-early make," or a "preliminary break-make" combination, all normally called "transfers," in which the lower set of twin wire contacts 50 separates from the fixed contact 24 either somewhat before or substantially before the upper set of twin wire contacts 52 engages the fixed contact element 24. Similarly,

there may be "early make-early break" or "preliminary make-preliminary break" combinations.

These diverse combinations may be obtained primarily by the "coding" of the moving card 30, i. e., by the configuration of the surfaces 35 and 36 of that card. If only make contact combinations or only break contact combinations are required, obviously either the surfaces 35 and 36 of the card 30 must be so conformed that the springs never make contact or never break contact, or else, more economically, one or more sets of springs 52 or 50 may be omitted or the contact elements may be removed therefrom.

It will be seen that the possible combinations may be extended concatenatiously by strapping the terminals of adjacent groups of contacts in the well-known fashion, whereby a plurality of complex combinations such as "make-before-break-before-make" may be obtained if circuit conditions require.

Referring again to Figs. 1 and 2 of the drawings, it will be noted that the armature 11 is subjected to a plurality of forces. The spring 9 exerts a force tending to maintain the armature in its unoperated position, as shown in the drawings. The electromagnetic flux tends to move the armature downwardly to bridge the core legs 1, 2 and 3. The moving card 30 exerts a downward force on the armature due to the fact that the moving springs 52 are pretensioned downwardly and consequently exert a force on moving card 30 in a downward direction. Balancing spring 16, which is connected to moving card 30, serves to exert an upward force on card 30 and, therefore, an upward force on armature 11. The upward force exerted by spring 16 is selected substantially to counterbalance the force exerted by the moving springs 52 and consequently the force exerted by balancing spring 16 must be varied in accordance with the degree of pretensioning of the springs 52 and the number of springs 52 which are provided.

In special uses of the relay, it may be desirable to have an additional force exerted on the armature tending to restore that armature to normal. If such force be required however, it is normally disadvantageous to have that force continually exerted inasmuch as such force would also oppose the movement of the armature during its operation. Buffer spring 55 is operative to exert a force to assist restoration of the armature to normal but does not impede the downward movement of the armature until after all contact operations have been completed. Buffer spring 55 is essentially U-shaped, having a cross-piece 56 and two legs 57. A projection 58 (Fig. 2) extends upwardly from the cross-piece 56 and engages the lower edge of the middle core leg 2. The extreme ends of the legs 57 of spring 55 press against the lower surfaces of the outer core legs 1 and 3, and at a point on the buffer spring 55 intermediate the projection 58 and the extreme ends of the spring legs 57, the spring legs 57 engage projections on the spoolhead 6. The projections on the spoolhead 6 are so located that the legs 57 of the buffer spring 55 are slightly deformed when the buffer spring is in position on the relay, and the resulting tension of the spring legs 57 serves to retain the buffer spring 55 in position. An additional upstanding portion 59 is provided on cross-piece 56. This portion 59 is so located that the lower edge of the moving card 30 will contact it when the relay is operated. Consequently, just prior to the completion of the operation of armature 11, the mov-

ing card 30 will engage the buffer spring 55 and bend it downwardly. When the coil 5 is deenergized the buffer spring 55 will be effective to exert an additional upward force to assist the return of the armature 11 to normal.

While the use of twin contact elements mating with single contact elements substantially obviates the possibility of malfunctioning of the relay in the presence of dust or other impurities, a contact cover 60 may be provided further to insure proper operation and also to prevent damage through mishandling. This cover is arranged to engage the front molded block 23 on all four sides to create a substantially dust-tight enclosure for the contacts. It will be noted that since the contact cover 60 engages the upper extremes of the projections 43 and the lower extremes of the projections 44 on the front molded block 23, the contact cover also serves to insure that the springs 52 and 50 will be trapped in their proper positions and yet that, upon removal of the contacts, the springs 52 and 50 may be readily displaced so that the moving card 30 may be removed and a card of different surface configuration inserted for coding purposes.

The embodiment of the invention disclosed in Figs. 4 to 6 is quite similar for the most part to the embodiment shown in Figs. 1 to 3. Consequently, except as to the differences in construction, the details of the embodiment shown in Figs. 4 and 6 will be described in a somewhat less detailed manner.

A plurality of molded insulating blocks 103 to 107 are firmly interassociated by a clamping member 108. A core member having three legs 109, 110 and 111 is clamped between insulating blocks 104 and 105, and an energizing coil 112 is mounted upon the center core leg 110. The terminals of the windings of coil 112 are connected to wires 113 which extend through apertures in insulating block 103. A lowermost set of twin wire movable contact springs 114 is molded in and extends through insulating block 106 and an upper set of twin wire contact springs 115 is molded in and extends through insulating block 107. A multifingered balancing spring 120 is clamped between the upper molded insulating block 107 and the upper portion of clamp 108. The several elements contained by clamp 108, including the balancing spring 120, the core and the molded insulating blocks 103 to 107, may have matching projections and indentations to assure permanency of registration.

A U-shaped armature 121 is mounted so that the rearwardmost tips of the legs of armature 121 engage the outer legs 109 and 111 about the core. A spring member 122 engages each of the legs of armature 121 and is clamped between the core and the fixed insulating block 105 in such a fashion that it hinges the armature 121 to the core.

The unoperated position of armature 121 is established by a back-stop element 123 on the core plate 124, a projection 125 at the front of the armature passing through an aperture in the core plate 124 so as to be engageable with the back-stop projection 123.

The fixed contact elements 130 comprise blocks of metal faced at their upper and lower surfaces with precious or semi-precious metal contacting surfaces. These fixed contact elements 130 are welded or otherwise affixed to vertically extending wires 131. As may best be seen in Fig. 5, these wires 131 are molded or otherwise affixed in a frame-like front molded

member 132, extend downwardly, are molded or otherwise affixed in a front retaining element 133 of insulating material and then extend rearwardly and are molded or otherwise affixed in insulating block 103. The front retaining element 133 is provided with projections 134 which engage extensions 135 on core plate 124. Since apertures in core plate 124 firmly engage and position the front ends of the core legs 109 to 111, the core plate is integral with the core. Therefore, since the front retaining element 133 is integral with the core plate 124, element 133 is also integral with the core. In this manner the wire springs 131 are firmly fixed in position.

As may best be seen in Fig. 6 of the drawings, the front molded member 132 is frame-like in appearance being provided with two horizontal crosspieces 140 and 141 joined by two vertical side pieces 142. The fixed, single wire springs 131 are molded in both the lower and upper crosspieces 140 and 141 and extend parallel to the side members 142. The moving twin wire springs 114 and 115 extend through individual apertures defined by the lower horizontal member 141 or the upper horizontal member 140 respectively, of the front molded member 132, by the fixed contact elements 130 and by the vertical spring wires 131. It is obviously imperative that the twin contact springs 114 and 115 not engage the wires 131 since such engagement would constitute an erroneous circuit closure. Therefore, horizontal portions 140 and 141 are provided with projecting cylinders of insulating material 145 which surround the fixed wires 131 over that portion of their lengths between the fixed contact elements 130 and the upper or lower horizontal members 140 or 141. Therefore, the vertical cylindrical projections 145 of the front molded member 132 serve to guide the twin wire springs 114 and 115 during their movement.

The movement of the twin wire moving springs 114 and 115 is further controlled by a moving card 147 which engages projections 148 (Fig. 6) of armature 121 so as to be controlled by the movement of the armature. Projections 150 at the extreme upper edge of the moving card 147 engage the outermost fingers 151 and 152 of the balancing spring 120 whereby the card 147 is maintained in proper position and is biased upwardly to assist the armature 121 to restore to its normal position. The centermost fingers 153 and 154 of the balancing spring 120 are pretensioned oppositely to the outermost fingers 151 and 152, i. e., are pretensioned downwardly. The innermost fingers 153 and 154 engage projections 155 on the upper edge of the front molded member 132 so as to assist in fixing the position of member 132.

It will be seen from the above description that upon the energization of coil 112 armature 121 will be attracted downwardly into engagement with the core whereby moving card 147 will also be moved downwardly. Since the upper set of springs 115 is pretensioned so as to tend to move downwardly, and since the lower set of twin springs 114 is pretensioned so as to tend to move upwardly into engagement with the fixed contact elements 130, upon the downward movement of card 147 the upper twin wire springs 115 will be permitted to move into contact with the fixed elements 130 and the twin wire springs 114 will be forced to disengage contact with the fixed contact elements 130. Conversely, upon the de-

energization of coil 112 and the resultant release of armature 121, moving card 147 will return upwardly whereby the lower twin wire springs 114 will be permitted to reengage the fixed contact elements 130 and the upper twin wire springs 115 will be forced to disengage the fixed contact elements 130.

Since the movement of the upper twin wire springs 115 is controlled by the surface 160 (Fig. 6) of the moving card 147 and since the movement of the lower twin wire springs 114 is controlled by the configuration of surface 161 of moving card 147, coding of the relay may be accomplished in a manner similar to that previously described with reference to the embodiment depicted in Figs. 1 to 3 of the drawings, that is, the surface 160 or 161 contacting any given pair of twin wire springs may be elevated or depressed to control the time at which that pair of springs will make or break contact with the fixed contact element 130 relative to the time at which the other twin wire contact springs will make or break contact. Consequently, any one group of springs comprising one pair of upper springs 115, one pair of lower springs 114 and one contact element 130 may be arranged to provide any of the aforesaid fifteen or more types of contact combinations including normal, early and preliminary makes and breaks, and the plural variations of transfers and continuity contacts.

It is to be understood that the above-described arrangements are but illustrative 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. In a switching device, a molded block of insulating material, means for fixing said block, a plurality of fixed wire springs molded in said block, contact elements mounted on said fixed wire springs, each of said elements having two faces, a first and a second plurality of movable wire springs, contact surfaces on said first plurality of movable wire springs engageable with one face of said contact elements, contact surfaces on said second plurality of movable wire springs engageable with the other face of said contact elements, and means for controlling the movement of said movable contact springs.

2. In a switching device, a molded block of insulating material, means for fixing said block, a plurality of fixed wire springs molded in said block, contact elements mounted on said fixed wire springs, each of said elements having two faces, a first and a second plurality of movable wire springs, a plurality of projections on said block engaging said movable wire springs, contact surfaces on said first plurality of movable wire springs engageable with one face of said contact elements, contact surfaces on said second plurality of movable wire springs engageable with the other face of said contact elements, and means for controlling the movement of said movable contact springs.

3. In a switching device, a molded block of insulating material, means for fixing said block, a plurality of fixed wire springs molded in said block, contact elements mounted on said fixed wire springs, each of said elements having two faces, a first and a second plurality of movable wire springs, a plurality of projections on said block extending perpendicularly to said movable wire springs, each of said movable wire springs

engaging adjacent ones of said projections, contact surfaces on said first plurality of movable wire springs engageable with one face of said contact elements, contact surfaces on said second plurality of movable wire springs engageable with the other face of said contact elements, and means for controlling the movement of said movable contact springs.

4. In a switching device, a molded block of insulating material, means for fixing said block, a plurality of fixed wire springs molded in said block, contact elements mounted on said fixed wire springs, each of said elements having two faces, a first and a second plurality of movable wire springs, contact surfaces on said first plurality of movable wire springs engageable with one face of said contact elements, contact surfaces on said second plurality of movable wire springs engageable with the other face of said contact elements, and an operating card for controlling the movement of said movable wire springs, said first plurality of movable wire springs being pretensioned against said operating card, and said second plurality of movable wire springs being pretensioned against said contact elements.

5. In a switching device, a molded block of insulating material, means for fixing said block, a plurality of fixed wire springs molded in said block, contact elements mounted on said fixed wire springs, each of said elements having two faces, a first and a second plurality of movable wire springs, contact surfaces on said first plurality of movable wire springs engageable with one face of said contact elements, contact surfaces on said second plurality of movable wire springs engageable with the other face of said contact elements, and a vertically movable operating card for controlling the movement of said movable wire springs, said card having an upper surface and a lower surface, said first plurality of movable wire springs being pretensioned downwardly against the upper surface of said card, and said second plurality of movable wire springs being pretensioned upwardly against said contact elements and being engageable by the lower surface of said card.

6. In a switching device, a molded block of insulating material, means for fixing said block, a plurality of fixed single wire springs molded in said block, contact elements mounted on said fixed wire springs, each of said elements having two faces, a first and a second plurality of movable twin wire springs, a plurality of projections on said block extending perpendicularly to said movable wire springs, each of said movable wire springs engaging adjacent ones of said projections, contact surfaces on said first plurality of movable wire springs engageable with one face of said contact elements, contact surfaces on said second plurality of movable wire springs engageable with the other face of said contact elements, and a vertically movable operating card for controlling the movement of said movable wire springs, said card having an upper surface and a lower surface, said first plurality of movable wire springs being pretensioned downwardly against the upper surface of said card, and said second plurality of movable wire springs being

pretensioned upwardly against said contact elements and being engageable by the lower surface of said card.

7. In a switch, a plurality of contact springs, means for controlling the movement of said contact springs, a plurality of contact members extending perpendicularly to said contact springs and engageable therewith, and an element of insulation material molded on said contact members, said element having a first portion lying in a plane above said plurality of contact springs, a second portion lying in a plane below said plurality of contact springs, a third portion lying in a plane to one side of said plurality of contact springs, and a fourth portion lying in a plane to the other side of said plurality of contact springs.

8. In a switch, a plurality of contact springs, means for controlling the movement of said contact springs, a plurality of contact members extending perpendicularly to said contact springs and engageable therewith, and an apertured frame of insulating material molded on said contact members, said contact springs extending through the aperture in said frame.

9. In a switch, a plurality of contact springs, means for controlling the movement of said contact springs, a plurality of contact members extending perpendicularly to said contact springs, a contact element on each of said contact members extending perpendicularly to both said contact springs and said contact members, and an apertured frame of insulating material molded on said contact members, said springs extending through the aperture in said frame and engageable with individual ones of said contact elements.

10. In a switch, a plurality of groups of contact springs, means for controlling the movement of said contact springs, a plurality of contact members extending perpendicularly to said contact springs and engageable therewith, and an apertured frame of insulating material molded on said contact members, individual ones of said groups of contact springs extending through an aperture defined by said frame and by adjacent ones of said contact members.

11. In a switch, a plurality of groups of contact springs, means for controlling the movement of said contact springs, a plurality of contact members extending perpendicularly to said contact springs, a contact element on each of said contact members extending perpendicularly to both said contact springs and said contact members, and an apertured frame of insulating material molded on said contact members, individual ones of said contact springs extending through individual apertures defined by said frame, by adjacent ones of said contact members, and by individual ones of said contact elements.

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