

May 26, 1964

J. R. SHINE
MULTIPLE CONTACT ARRANGEMENT WITH FORCE
TRANSMITTING MECHANICAL CONNECTOR

3,134,868

Filed Oct. 9, 1961

2 Sheets-Sheet 1

FIG. 1

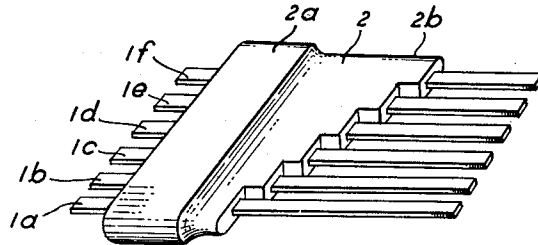


FIG. 2

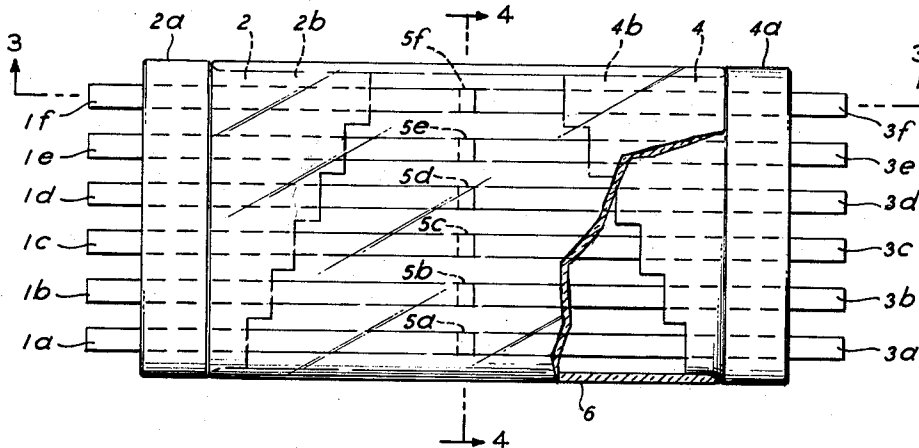
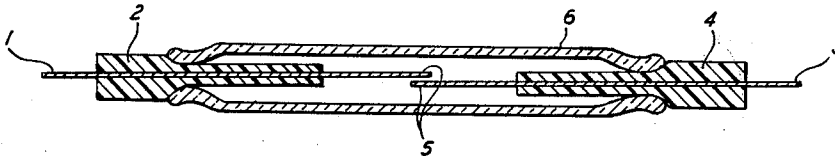


FIG. 3



INVENTOR
J. R. SHINE
BY *Delmer*
ATTORNEY

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J. R. SHINE
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FIG. 4

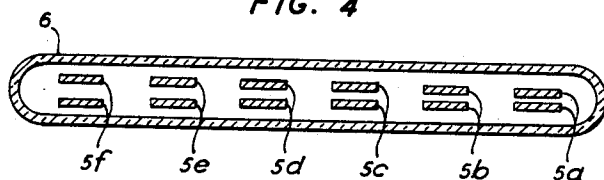


FIG. 5

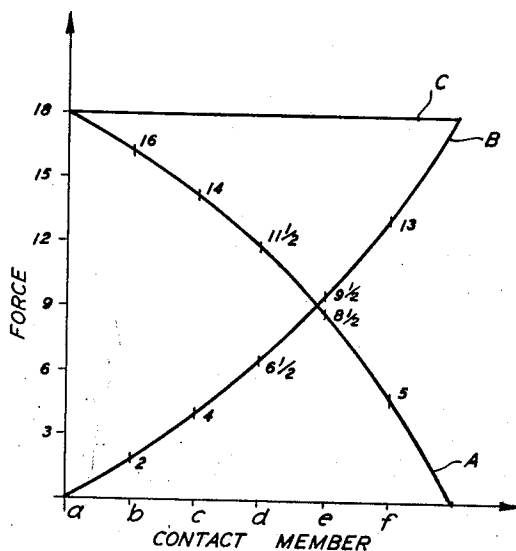
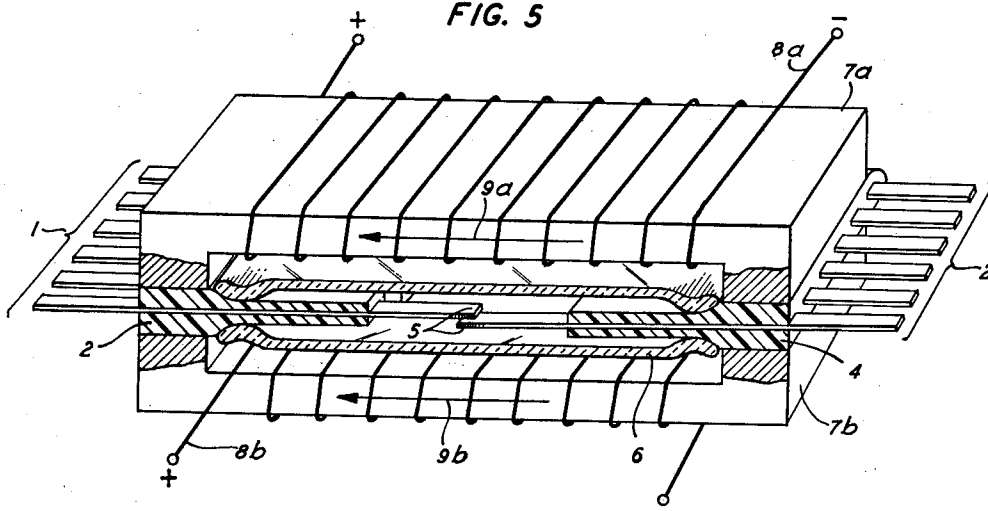


FIG. 6

INVENTOR
J. R. SHINE
BY *McTurner*
ATTORNEY

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MULTIPLE CONTACT ARRANGEMENT WITH FORCE TRANSMITTING MECHANICAL CONNECTOR

John R. Shine, Plainview, N.Y., assignor to Bell Telephone Laboratories, Incorporated, New York, N.Y., a corporation of New York

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23 Claims. (Cl. 200—87)

This invention relates to multiple contact arrangements and particularly to such arrangements utilizing means mechanically interconnecting the contacts thereof and more particularly to such arrangements utilizing such means for transmitting forces between the contacts.

Multiple contact arrangements such as the relay disclosed in U.S. Patent 2,535,400 issued on December 26, 1950 to W. B. Ellwood, have a variety of uses in switching networks for the opening and closing of multiple circuit paths. It has been found in such relays that when an operate mode was effected there was never a guaranteed certainty that all of the contacts would be operated and that a test was necessitated of all the contacts to determine the states thereof. This deficiency of the prior art was due in part to the different gap spacings resulting from the manufacture of the multiple contacts. Thus, when an operate mode was effected in such relays the pair of contacts having the narrowest gap spacing was first closed. But closure of this first pair of contacts caused a substantial portion of the magnetic flux to be shunted through its low reluctance path away from the remaining open contact pairs which had higher reluctances. As a result, an insufficient amount of flux was available to operate all of the remaining contact pairs. Thus, without increasing the energizing current being applied to the relays, there was never a guaranteed certainty that all of the contacts would be closed, and accordingly, each pair of contacts was required to be tested to determine its state.

If the amount of energizing current were increased in an effort to insure closure of all the contacts, other problems have arisen to effectively cancel any advantages resulting therefrom. For example, the stray noise level was increased and the possibility of false reoperation was increased. Even if such increase in energizing current were desirable, the states of all the contacts would have to be tested because there would still be no guaranteed certainty that closure of one contact pair would signify closure of all of the contact pairs.

Accordingly, it is an object of my invention to provide a multiple contact arrangement which substantially reduces the aforesaid deficiencies of the prior art.

It is also an object of my invention to provide a multiple contact arrangement which can be operated to guarantee closure of all its contacts and the states of which contacts can be determined without the necessity of testing all of its contacts.

It is a further object of my invention to decrease the power required to operate such an arrangement, and thereby to increase the efficiency of such an arrangement.

It is yet another object of my invention to simplify such an arrangement by decreasing the amount of material required in the actuating circuit of such an arrangement.

Still other objects of my invention, when embodied in an electrically controlled magnetic multiple contact arrangement, are to reduce electrical power requirements, to decrease magnetic material requirements and to simplify operating characteristics and requirements.

These and other objects and features of my invention are attained in a specific illustrative embodiment thereof which briefly comprises a plurality of magnetic reeds of substantially equal length and a magnetic plastic casing.

The reeds are held substantially parallel in a coplanar attitude by the casing, which provides a continuous mechanical interconnection among the reeds and which encases successively greater lengths thereof. The casing comprises a base portion from which extend successively greater lengths of reed encasing portions to successively decrease the free flexing reed length. This stepwisely varying rigidity of the casing results in a stepwisely varying rigidity or stiffness of the reeds. Accordingly, a force selectively applied to a first reed will be transmitted in part to the next adjacent second and remaining reeds. Similarly, forces selectively applied to the second and succeeding reeds will be transmitted by the casing to the next adjacent third and succeeding reeds. As a result each succeeding reed has a greater mechanical force applied thereto than the preceding reed. These transmitted forces assist the movement of the reeds. Thus, by transmitting these forces the casing assists movement of the reeds. The casing being of a magnetic material also enables a substantial magnetic coupling of the reeds to a source of magnetic flux.

In one aspect of my invention I provide two such pluralities of reeds and magnetic plastic casings and I arrange them in an overlapping manner such as to form a plurality of contact pairs each of which pairs has a gap width greater than the preceding pair. I also provide means for applying forces to the plurality of pairs of reeds by magnetically coupling the resulting assembly between two remanently magnetic members having energizable windings thereon in a manner similar to that disclosed in U.S. Patent No. 2,995,637 issued on August 8, 1961 to A. Feiner et al. To operate the plurality of pairs of reeds I apply, as in the manner disclosed in the mentioned Patent 2,995,637, short duration electronic pulses to the windings of the remanently magnetic members to establish appropriate remanent magnetization states in the magnetic members. As a result the plurality of pairs of reeds are appropriately magnetized to cause magnetic forces of attraction between respective pairs of reeds causing the reeds to tend to close. When the first pair of reeds having the narrowest gap width is closed, a substantial portion of the magnetic flux resulting from the magnetization state flows through the low reluctance path of the closed first pair of reeds. Consequently, a proportionately smaller amount of magnetic flux is available to effect closure of the next adjacent second pair of reeds having the next greater gap width. However, in accordance with the principles of my invention, a part of the force causing movement of the first pair of reeds is transmitted by the magnetic plastic casing to the second and remaining pairs of reeds thereby compensating for the decreased amount of magnetic flux and thereby assisting operation of the second and remaining pairs of reeds. Similarly, in accordance with the principles of my invention, when the second and succeeding pairs of reeds are closed, disproportionately greater amounts of magnetic flux will be shunted by the closed pairs of reeds thereby leaving a disproportionately smaller amount of magnetic flux available to operate the next adjacent pairs of reeds. The forces effecting closure of the second and succeeding pairs of reeds are, in accordance with the principles of my invention, similarly transmitted by the magnetic plastic casing in successively greater increments to the next adjacent and remaining pairs of reeds thereby compensating for the reduced flux and thereby assisting operation of the reeds. Accordingly, when the pair of reeds having the greatest gap width is closed the preceding pairs of reeds having narrower gap widths will also be closed. Thus, a testing of the state of the last pair of reeds will enable a quick determination of the states of the preceding pairs of reeds.

The plurality of pairs of operated reeds are released

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by applying, as in a manner disclosed in the mentioned Patent 2,995,637, appropriate electronic pulses to the windings of the remanently magnetic members to change the remanent magnetization states thereof and thereby to steer the magnetic flux by-passing the reeds. The respective reeds are consequently demagnetized and the natural stiffnesses of the reeds cause the mutual release of the reeds. The magnetic plastic casing mechanically assists the release of any pairs of reeds that may become stuck for any unforeseen reason.

A broad feature of my invention is a multiple contact arrangement wherein a plurality of contact members are interconnected by a mechanical means having the characteristics of stepwisely varying flexibility.

Another feature of my invention is such an arrangement wherein the mechanical means is a casing means covering stepwisely greater portions of succeeding ones of the contact members.

A further feature of my invention is such an arrangement wherein the succeeding ones of the contact members are movable successively greater distances and wherein the parts of the mechanical means connected to respective contact members have a flexibility dependent upon the movable distances associated therewith.

Another feature of my invention is a multiple contact arrangement wherein I provide a plurality of contacts, structural means to interconnect adjacent ones of the plurality of contacts and means for applying forces to the contacts whereby responsive to the forces applied to the contacts the structural means transmits increased amounts of forces to next adjacent ones of the contacts.

A further feature of my invention is a multiple contact arrangement wherein I provide a first bank of reeds, a second bank of reeds positioned with respect to the first bank forming thereby a plurality of pairs of contacting reeds each of the pairs of reeds having a gap width greater than the gap width of preceding pair of reeds, means for applying forces to the pairs of reeds and mechanical linkage means interconnecting the reeds of at least one bank whereby responsive to the applied forces the mechanical linkage means applies increasingly greater increments of the applied forces to adjacent ones of the pairs of reeds.

A yet further feature of my invention is such an arrangement wherein the reeds of the first and second bank of reeds are of magnetizable material and wherein the force applying means comprises a winding means inductively coupling at least the first bank for magnetizing the pairs of reeds, whereby magnetic forces are applied to the pairs of reeds to cause the mechanical linkage means to apply increasingly greater increments of forces to adjacent ones of the pairs of reeds.

Another feature of my invention is such an arrangement wherein responsive to energization of the winding, the plurality of pairs of reeds are sequentially closed, the mechanical linkage means transmits and imparts to the succeeding pairs of reeds increasingly greater increments of forces thereby compensating for the decreased amount of magnetic flux available to close the succeeding pairs of reeds resulting from closure of preceding pairs of reeds.

A still further feature of my invention is such an arrangement wherein the force applying means comprises a remanently magnetic structure to which the first and second banks of reeds are magnetically coupled and comprises winding means inductively coupled to the structure to establish particular remanent magnetization states thereby to tend to sequentially move the pairs of reeds and wherein the mechanical linkage means responsive to movement of the pairs of reeds assists in the operation of the pairs of reeds by transmitting increasing increments of mechanical forces caused by movement of the pairs of reeds to succeeding ones of the pairs of reeds.

A complete understanding of these and other objects and features of my invention may be gained from a consideration of the following detailed description and the accompanying two sheets of drawing, in which:

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FIG. 1 is a pictorial view of one embodiment illustrative of the principles of my invention;

FIG. 2 is a plan view of another embodiment of my invention which combines two assemblies of FIG. 1 in a multiple contact arrangement;

FIG. 3 is a cross section of the embodiment of FIG. 2 as viewed from the direction 3—3 in FIG. 2;

FIG. 4 is a cross section of the embodiment of FIG. 2 as viewed from the direction 4—4 in FIG. 2;

FIG. 5 is a pictorial view with a partial cross section of the embodiment of FIG. 2 combined with a magnetizing circuit utilized for operation thereof;

FIG. 6 is an illustrative diagram of the forces applied to the respective contacts of the embodiment of FIG. 2 during the operation thereof.

Referring more particularly to the drawings, in FIG. 1 there is shown a plurality of contact members 1a-1f and interconnecting these members, a body structure 2, which body structure comprises an enlarged portion 2a forming a base rigidly holding the terminal ends of the members 1a-1f and a casing 2b stepwisely encasing the free flexing ends of the members 1a-1f in the manner shown. The body structure 2 is preferably, but not essentially, of a magnetic material, such as magnetic plastic, which can effectively magnetically couple the base and casing to the plurality of contact members. The base 2a is employed herein to illustrate both a supporting structure for members 1a-1f and a reference point with respect to which the members move in response to forces applied thereto. The casing 2b, although shown to encase and solidly interconnect members 1a-1f, can also be a covering which interconnects and mechanically links the members without a solid piece therebetween. In either situation the casing 2b has its extended portions of successively greater rigidity. Thus, as will be discussed hereinafter in greater detail with respect to the operation of the embodiment of FIG. 2, forces applied to the free flexing ends of the members 1a-1f will be transmitted by the casing 2b in successively greater increments to the succeeding members. The characteristic of the casing 2b of progressively increasing rigidity can also be attained by other geometrical casing arrangements. For example, a triangular casing can be employed which varies in length from the least length covering of member 1a to the greatest length covering of member 1f.

Referring now to FIGS. 2, 3, and 4, there are shown a first assembly similar to the embodiment of FIG. 1 comprising a plurality of contact members or reeds 1a-1f, interconnected by body structure 2, having base 2a and casing 2b and a second assembly similar to the embodiment of FIG. 1 comprising a plurality of contact members or reeds 3a-3f, interconnected by a body structure 4 having base 4a and casing 4b. The two assemblies are enclosed in a vitreous envelope 6, which envelope 6 is cut away to reveal its structure, and are disposed in the manner shown forming thereby a plurality of overlapping pairs of contacts 5a-5f at the free flexing ends of the reeds 1a-1f and 3a-3f.

The relative positioning of the reeds can best be seen in FIG. 3 which shows reed 1 overlapping reed 3 to form contact pair 5, and body structures 2 and 4 holding the reeds 1 and 3, respectively, and supporting the vitreous envelope 6. The vitreous envelope 6 may be of any material, preferably of glass, and is welded to the body structures 2 and 4 in a known manner, to thereby form a sealed enclosure to protect the plurality of contacts contained therein. In the embodiment shown in FIG. 2 the envelope 6 and the body structures 2 and 4 form a rigid supporting structure for the plurality of reeds and a reference point with respect to which the reeds are movable. The casings 2b and 4b are symmetrically disposed in the manner shown with the portions of the casing having the least rigidity being associated with reeds 1a and 3a and with the rigidity of the casing portions in-

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creasing until the portions of the casing associated with the reeds 1f and 3f have the greatest rigidity.

The two assemblies are preferably arranged such that the gaps between the contacting pairs 5 of the successive pairs of reeds have successively greater air gaps. This can best be seen with reference to FIG. 4 in which the contact pairs 5a-5f are shown enclosed within envelope 6. As shown, the contact pairs 5a-5f, formed by the arrangement of the two assemblies, have increasingly greater air gaps starting with the contact pair 5a having the narrowest gap and progressing to the greatest gap between the contact pair 5f. The contact gaps are related to the rigidity of the casing portions associated with the reeds thereof. Thus, as shown in FIGS. 2 and 4 taken together, the contact pair 5a having the narrowest gap is associated with the portions of the casings 2b and 4b having the least rigidity and contact pair 5f having the greatest gap is associated with the portions of the casings 2b and 4b having the greatest rigidity. The gaps in some cases may be desired to be substantially the same. While necessary in some specific aspects of my invention, the gap spacing need not be of varying width as above described in order to practice my invention in its broader aspects.

Referring now to FIG. 5, there is shown the contact arrangement of FIG. 2 positioned between and magnetically coupled to a pair of remanently magnetic members 7a and 7b. The remanent members 7a and 7b have inductively coupled thereto the respective windings 8a and 8b. A cross section is shown of the remanently magnetic members and contacting arrangement in order to clearly illustrate the structure of the entire arrangement. Superimposed upon the pair of remanently magnetic members 7a and 7b are arrows 9a and 9b, respectively, which arrows represent the suitable remanent magnetization states of the respective members. These arrows will be subsequently referred to in discussing the actuation of the contacting pairs 5. The body structures 2 and 4 are shown magnetically coupled to the remanently magnetic members 7a-7b to provide a low reluctance path for the magnetic flux used to operate the contact pairs 5. The remanently magnetic members 7a and 7b are used to supply forces to the free flexing ends of the contact members by supplying magnetic flux between the contacting pairs 5 thereby permitting magnetic attraction of the free flexing ends of the reeds. Other means of supplying forces to the free flexing ends of the reeds can be employed. For example, coil means wound around the entire arrangement of FIG. 2 can be employed in a manner known in the art, or a mechanical force applying mechanism can be effectively employed.

Having described the structure of the various embodiments of my invention, I will now discuss a theory of operation of the embodiment of FIG. 2 as illustratively actuated by the circuit shown in FIG. 5. Such a theoretical discussion is best explained with reference to the illustrative force diagram of FIG. 6, which plots force (ordinate) against the contact pairs (abscissa). It is to be understood that the values plotted on the ordinate are not related to any particular scale and are given only for purposes of illustration and explanation of one possible theoretical basis of operation. Line A represents the amount of magnetic force supplied by the magnetic flux to the contact pairs 5a-5f. Line B represents the amount of mechanical force supplied by the casings 2b and 4b to the contact pairs 5a-5f. The total of the magnetic force A and mechanical force B applied to the respective contact pairs 5a-5f is shown by the line C. This total amount of force C applied to the contact pairs is sufficient to cause closure thereof.

Referring again to FIG. 5, I actuate the plurality of contacting pairs 5a-5f by applying an appropriate pulse, positive in this case, to the plus (+) terminals of the windings 8a and 8b and grounding the minus (-) terminals. This causes a magnetic field to be established with-

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in the windings 8a and 8b sufficient to establish a remanent magnetization state in both of the remanently magnetic members 7a and 7b to be in a direction as shown by the arrows 9a and 9b, respectively. This places opposite remanent magnetic poles at the free flexing ends of the reeds 1 and 3 causing mutual attraction of the contact pairs 5a-5f. There is available a sufficient amount of magnetic flux to cause the first pair of contacts 5a having the narrowest gap (as seen in FIG. 4) to operate. The operation of the first pair of contacts 5a has two effects; first, it lowers the reluctance between the contact members 1a and 3a and second, it enables the casing to transmit part of the force caused by magnetic attraction to the remaining contact members 1b-1f and 3b-3f.

With respect to the first effect, the lowered reluctance between the members enables magnetic flux to be shunted through the closed pair of contacts 5a in an amount which leaves a disproportionately smaller amount of magnetic flux available to flow through each of the remaining pairs of contacts 5b-5f. For example, in the embodiment shown in FIG. 5 there are six pairs of reeds and contact pairs. Thus, disregarding any losses, normally one-sixth of the total flux would be available to flow through each of the contact pairs. However, due to the lowered reluctance of the closed pair of contacts 5a, more than one-sixth of the total flux is shunted therethrough and consequently less than five-sixths of the total flux is available to effect closure of the remaining pairs of contacts 5b-5f. More specifically, in terms of forces, as shown in FIG. 6 by line A, the magnetic force applied to the pair of contacts 5a is 18 units, but due to the flux shunting effect caused by operation of the pair of contacts 5a, the magnetic force available to close the second pair of contacts 5b is less, about 16 units.

With respect to the second effect, the force supplied by the magnetic flux to the first pair of contacts 5a is transmitted by the casing 2b and 4b as mechanical forces from the first pair of contact members 1a and 3a to the second and remaining pairs of contact members 1b-1f and 3b-3f. More specifically, as shown in FIG. 6 by line B, this transmitted mechanical force of two units is applied to each of the contact pairs 5b-5f. It causes the second and remaining pairs of contacts 5b-5f to move approximately the same distance moved by the first pair of contacts 5a. Thus, when this transmitted mechanical force of two units (line B) applied to contact pair 5b is added to magnetic force of 16 units (line A) applied to contact pair 5b, the total force of 18 units (line C) is sufficient to operate and does operate and the second pair of contacts 5b.

Similarly, closure of the second and remaining pairs of contacts 5b-5f shunts therethrough disproportionate amounts of magnetic flux thereby supplying decreasing amounts of magnetic forces of 14, 11½, 8½ and 5 units to the succeeding pairs of contacts 5c, 5d, 5e, and 5f, respectively, (as shown by line A of FIG. 6). Similarly, closure of the second and remaining pairs of contacts 5b-5f has a second effect. The forces caused by movement of the contact members due to the magnetic forces are transmitted by the casing 2b and 4b to the next succeeding reeds 1c-1f and 3c-3f to provide at the respective contact pairs thereof incrementally greater total mechanical forces of 4, 6½, 9½, and 13 units, respectively, (as seen in FIG. 6, line B) causing the succeeding contacts to move progressively greater distances. The total force of 18 units applied to each of the members (as seen in FIG. 6, line C) is sufficient to effect closure of all the pairs of contacts. The last pair of contacts 5f having the greatest gap is thusly closed. Because the reeds 1 and 3 are interconnected by the casings 2b and 4b, respectively, closure of the last pair of contacts 5f having the greatest gap will insure that the preceding pairs of contacts 5a-5e having narrower gaps will be closed. Accordingly, testing of the state of the pair of contacts 5f will insure with a guaranteed certainty that all of the pairs of contacts 5a-5f are closed.

With all of the contact pairs in an operated state a released state is effected by applying appropriate pulses, in this case a positive pulse, and a negative pulse, respectively, to the plus (+) terminals of the windings 9a and 9b, with the minus (-) terminals thereof grounded. This causes the remanent magnetization of the remanently magnetic member 7b to be reverse of arrow 9b and the remanent magnetization of the member 7a to be the same as arrow 9a as shown in FIG. 5. This removes the remanent magnetic poles from the respective reeds 1 and 3 thereby permitting their natural stiffness to cause release of the contact pairs. The casings 2b and 4b are not detrimental to the release of the reeds but may be helpful thereto by providing a degree of stiffness to the reeds and by transmitting forces between the various reeds permitting thereby release of any stuck reeds.

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

What is claimed is:

1. A multiple contact arrangement comprising a plurality of contact members and mechanical means having portions thereof interconnecting adjacent ones of said plurality of contact members, said mechanical means being in addition to said contact members and having at different said portions the characteristic of stepwise varying rigidity.

2. The invention defined in claim 1 further comprising means for applying forces to said contacts, and wherein responsive to said forces said mechanical means transmits in stepwise increments portions of said forces to others of said contact members.

3. The invention defined in claim 2 wherein said contact members are movable and wherein said contact members comprise magnetic material and wherein said force applying means comprises means for magnetizing said contact members whereby responsive to said magnetization said contact members will move permitting the transmission of stepwisely increasing incremental forces by said mechanical means to adjacent said others of said contact members.

4. The invention defined in claim 3 wherein said contact members are movable stepwisely varying distances and wherein said portions of said mechanical means associated with said contact members have their said characteristic rigidity dependent upon said movable distances of said contact members.

5. A mutiple contact arrangement comprising a first plurality of contacts and structural means having parts thereof mechanically linking said first plurality of contacts, said structural means being in addition to said contacts and having at different said parts the characteristics of stepwise varying flexibility dependent upon the characteristics of the particular contacts associated with said parts.

6. The invention defined in claim 5 wherein said parts of said structural means comprise means encasing said plurality of contacts in stepwisely greater degrees.

7. The invention defined in claim 6 further comprising operating means for selectively applying forces to respective ones of said first plurality of contacts, and wherein said encasing means responsive to said forces stepwisely transmits increasing amounts of said forces to succeeding ones of said contacts.

8. The invention defined in claim 7 further comprising a second plurality of contacts positioned relative to first plurality of contacts defining thereby a plurality of pairs of contacts, each of said pairs of contacts having a gap width wider than the preceding pair of contacts, and wherein said degree of encasing of said contacts depends upon the gap width associated therewith.

9. The invention defined in claim 8 wherein said first and second plurality of contacts are of magnetizable mate-

rial and wherein said operating means comprises winding means for generating magnetic forces between said first and second plurality of contacts tending thereby to sequentially operate said pairs of contacts, and wherein said encasing means responsive to said magnetizing forces sequentially transmits increased increments of said forces to adjacent pairs of contacts thereby assisting the sequential operation of said pairs of contacts.

10. A multiple contact arrangement comprising a plurality of contact members, means for applying forces to said members and mechanical means having portions thereof interconnecting adjacent ones of said contact members, said mechanical means being in addition to said contact members and having a different said portions the characteristic of varied rigidity whereby said forces applied to said members will be transmitted incrementally to next adjacent ones of said contact members.

11. The invention defined in claim 10 wherein succeeding ones of said contact members are movable successively greater distances, and wherein said portions of said mechanical means comprise a casing means covering different lengths of the contact members dependent upon the said movable distances associated therewith.

12. The invention defined in claim 11 wherein said contact members comprise magnetizable material, and wherein said force applying means includes means for magnetizing said members thereby causing a magnetic force, said magnetic force tending to move said members, and wherein said mechanical means in response to said tendency of movement of said members applies to next adjacent members successively greater amounts of said forces.

13. A multiple contact arrangement comprising a first plurality of contact members and a second plurality of contact members arranged in overlapping relationships forming thereby a plurality of pairs of overlapping contact members, each succeeding pair of said plurality of overlapping contact members having a greater gap than the preceding pair, operating means for appropriately magnetizing said plurality of overlapping contact members thereby tending to cause substantial attraction of ones of said pairs of overlapping contact members in an order dependent upon the width of the said gaps, and mechanical means having portions thereof interconnecting each of said first plurality, said mechanical means being in addition to said first plurality and having at different said portions the characteristic of varying rigidity whereby responsive to the movement of said ones of said pairs of contact members said mechanical means will apply successively greater mechanical forces to succeeding ones of said pairs of contact members to thereby urge said succeeding pairs of contact members into engagement.

14. The invention defined in claim 13 wherein portions of said mechanical means comprise a plastic casing covering the nonoverlapping ends of said succeeding contact members in successively greater lengths.

15. A multiple contact arrangement comprising a plurality of pairs of contacts, means for applying particular amounts of forces to said contacts, and structural means in addition to said contacts and having portions thereof interconnecting particular ones of said contacts whereby forces applied by said force applying means to said pairs of contacts will be transmitted in successively greater increments by said structural means to others of said pairs of contacts.

16. The invention defined in claim 15 wherein said plurality of pairs of contacts comprises a first plurality and a second plurality of contacts positioned such that each of said pairs of contacts formed thereby have a different spacing between the contacts thereof, and wherein said structural means mechanically interconnects at least each of said first plurality of contacts and has at different said portions the characteristics of varying rigidity.

17. A multiple contact arrangement comprising a plurality of resilient contact members, and mechanical

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means additional to said contact members and interconnecting said members so as to impart different stiffnesses to different prescribed members and so as to impart mechanical interdependency to selected pairs of members.

18. The invention defined in claim 17 wherein said mechanical means comprises means common to said members for supporting said members, means individual to each member for imparting a prescribed stiffness thereto, and means interconnecting said common means with said individual means of selected pairs of members.

19. The invention defined in claim 18 wherein said individual means impart successively greater stiffnesses from member to member throughout the said plurality thereof.

20. The invention defined in claim 19 wherein said interconnecting means interconnects said common means with pairs of members having different stiffnesses.

21. A multiple contact arrangement comprising a plurality of elongated resilient contact members of substantially equal physical size and composition and a mold encasing said members and supporting said members in substantially coplanar and longitudinally coextensive relationship, said mold comprising a base portion common to said members and encasing substantially equal lengths of said members near one set of ends thereof, contact portions for said members extending from said base portion toward the other ends of said members and encasing successively greater lengths of successive prescribed members, and connecting portions extending from said base portion toward the said other ends of said members and interconnecting contact portions of adjacent members throughout the lengths of the shorter contact portions.

22. A multiple contact arrangement comprising a plurality of pairs of magnetic reed contact members magnetically arranged in parallel; means for applying magnetizing force in common to said reed contact members to effect sequential closure thereof; and mechanical coupling means interconnecting said reed contact members for providing a mechanical force to assist closure of succeeding open contact members to compensate for loss of magnetic force due to shunting of magnetic flux by the preceding closed contact members.

23. A multiple contact arrangement comprising a first assembly including a first plurality of reeds, first body

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means interconnecting said first plurality of reeds, said first body means including a first base for said first plurality of reeds and a first casing extending from said base covering progressively greater lengths of said first plurality of reeds; a second assembly including a second plurality of reeds, second body means interconnecting said second plurality of reeds, said second body means including a second base for said second plurality of reeds and a second casing extending from said base covering progressively greater lengths of said second plurality of reeds, said first and second assemblies arranged to define of said first and second plurality of reeds a plurality of pairs of contacts, each of said pairs of contacts having a gap spacing greater than the gap spacing of the preceding pair of contacts, envelope means enclosing said plurality of pairs of contacts, and enclosing said first and second casings of said first and second assemblies; magnetizable means; means for magnetically coupling said first and second assemblies to said magnetizable means; and means including said magnetizable means energizable whereby flux produced in said magnetizable means is applied to said first and second body means and therethrough to said first and second plurality of reeds and said plurality of pairs of contacts thereby to effect movement thereof and tending to effect closure thereof in the order of the said gap spacings associated therewith and whereby responsive to said movement of said first and second plurality of reeds and said pairs of contacts said first and second casings cooperatively transmit forces caused by said movement from one of said first and second plurality of reeds associated with said moved contact pairs to the next adjacent ones of said first and second plurality of reeds thereby to assist closure of adjacent plurality of pairs of contacts associated therewith.

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