

Feb. 2, 1954

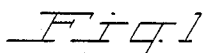
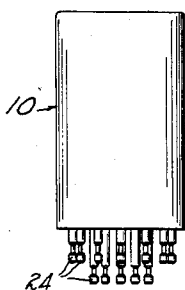
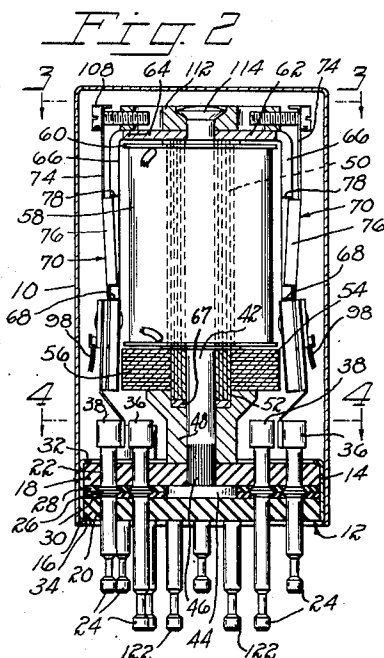
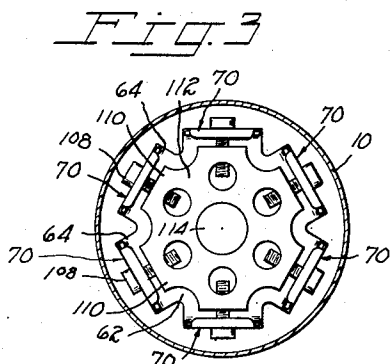
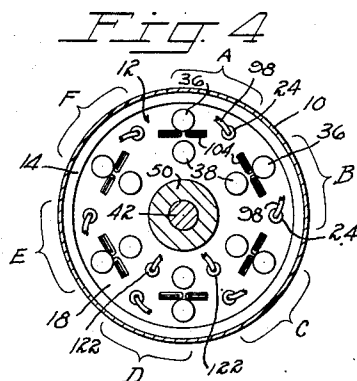
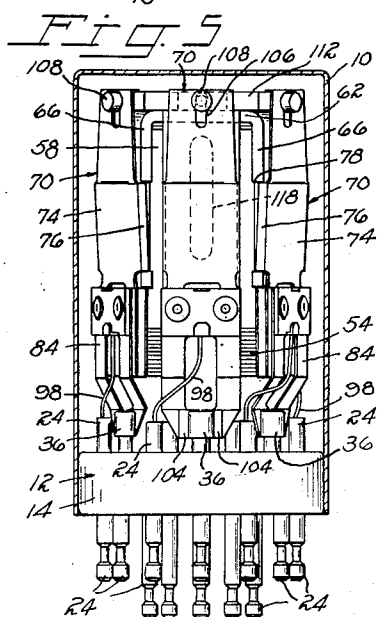
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2,668,207

ELECTROMAGNETIC RELAY OR SWITCH

Filed July 22, 1949

2 Sheets-Sheet 1



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Fig. 6

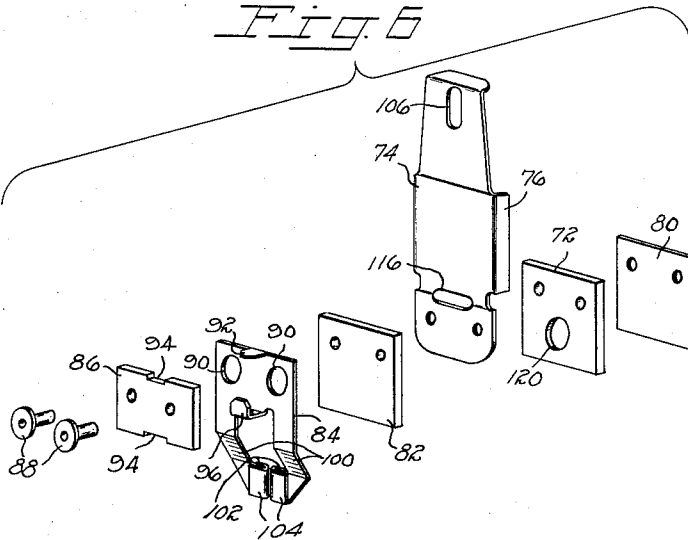
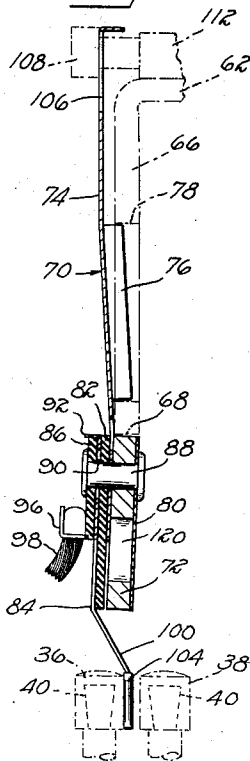


Fig. 7



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UNITED STATES PATENT OFFICE

2,668,207

ELECTROMAGNETIC RELAY OR SWITCH

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Application July 22, 1949, Serial No. 106,133

7 Claims. (Cl. 200—103)

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This invention relates to improvements in electro-magnetic relays or switches and, more particularly, but without restriction thereto, to such relays or switches which are hermetically sealed. Also, this invention readily lends itself to being embodied in very compact and so-called miniature type relay and switch arrangements of the type frequently used in various kinds of aircraft installations requiring relay devices.

It is an object of the invention to provide a multi-unit type relay in which the armature supporting means are adjustable and some of the pole pieces are so constructed that, when the coil of the solenoid is energized, the armatures respectively associated with said pole pieces will be attracted toward other pole pieces in a predetermined sequence, which sequence may be varied by suitable adjustment.

It is another object of the present invention to provide a relay type switch construction including a base which may be sealed within the open end of a cup-shaped housing which may be used to hermetically enclose the relay construction, the base directly supporting, in electrically insulated relationship, a plurality of conductor members to the inner ends of which stationary contacts are directly connected, whereby no additional conductors such as soldered flexible leads are necessary between the contacts and the conductors carried by the base for purposes of conducting current between the stationary contacts within the hermetically sealed housing and the exterior thereof.

A further object of the invention is to provide a very compact arrangement of pole pieces and an armature operated thereby, the armature carrying a movable contact assembly so constructed that it has a plurality of contact fingers which permit yieldably and wiping engagement of several movable contact members with the stationary contact to insure firm and clean electrical engagement between the contacts.

As a corollary to the foregoing object, it is a still further object of the invention to provide on the armature a longitudinally extending flexible tail which is disposed for compactness along the coil of the solenoid, the free end of the tail being adjustable toward and away from the solenoid to vary the force exerted by the flexible

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member to resist movement of the armature toward its associated pole piece.

A still further corollary to said foregoing object is the further provision of simple and unique means for mounting the armature and its flexible tail member so that the latter comprises a hinge for the armature, the tail member also including positioning means for operatively positioning the armature and its tail member relative to its supporting means so as to minimize assembly operations.

Still other objects of the invention are the construction and arrangement of the various components of the relay which results in a very compact, rugged and durable arrangement which may be hermetically sealed, if desired, and used in situations where minimum size, weight, and contact resistance are desired as well as where the relays are to be subjected to extreme limits of shock, temperature and other physical and electrical conditions. Further, the design of the components is such that the assembly thereof is greatly simplified as compared to presently used relays, whereby the cost of production is minimized.

Details of these objects and of the invention, as well as other objects thereof, are set forth in the following specification and illustrated in the accompanying drawings forming a part thereof.

In the drawings—

Figure 1 is a side elevation of a hermetically sealed multiple relay switch unit embodying the principles of the present invention.

Fig. 2 is an enlarged, longitudinal, sectional view of the relay switch shown in Fig. 1.

Fig. 3 is a sectional, plan view taken on the line 3—3 of Fig. 2.

Fig. 4 is a sectional, plan view taken on the line 4—4 of Fig. 2.

Fig. 5 is a side elevation of the construction shown in Fig. 2, except that only the housing is shown in section in Fig. 5.

Fig. 6 is an exploded, perspective view of the armature assembly illustrated otherwise in Figs. 2 and 5.

Fig. 7 is a further enlarged, longitudinal, sectional view of an armature assembly such as illustrated in Figs. 2 and 5.

Referring to the drawings, a multiple switch type relay has been illustrated for purposes of

convenience, but it is to be understood that the specific number of relay switch units illustrated herein is not restrictive since the construction is capable of operation when either a single relay switch unit or a number of such units other than the number illustrated herein are used.

The relay switch construction illustrated herein comprises a housing 10 which is illustrated as being cup-shaped. The housing may be formed of any impervious suitable material, such as metal, so that it may retain in its interior either an evacuated or gas filled atmosphere.

Sealed within the open end of the cup-shaped housing 10 is a composite base 12. In the present illustration, the base and housing have been illustrated as circular in cross section, but it is to be understood that this shape may be varied if and as desired. The base 12 comprises a cylindrical enclosing ring or band 14 within which a pair of parallel electrical insulation plates or disks 16 and 18 are mounted in spaced relationship. Said disks may be formed, for example, from mica, and are provided with a plurality of transversely extending and aligned apertures 20 and 22, aligned pairs of said apertures receiving elongated terminal conductors 24. Said conductors are provided intermediately of their ends with annular flanges 26.

Disposed within the space between the disks 16 and 18 and on opposite sides of the flanges 26 of the conductors are a pair of flexible insulating disks 28 and 30 which are apertured similarly to the disks 16 and 18 for purposes of receiving the conductors 24. The disks 28 and 30 are not only flexible but are yieldable and may be formed of any suitable material, such as rubber, in order that, when the rigid disks 16 and 18 as well as the flexible disks 28 and 30 are disposed on opposite sides of the flanges 26 of the conductors 24 within the band 14, the rigid disks 16 and 18 may be moved toward each other so as to compress the flexible, yieldable disks 28 and 30 around the flanges 26 so as to seal the conductors 24 relative to the various laminated disks and thus prevent the passage of gas therethrough as well as electrically insulate the various conductors 24 relative to each other.

When forming the composite base 12, the various conductors 24, rigid disks 16 and 18, and flexible disks 28 and 30 are assembled in their proper relationship on opposite sides of the flanges 26 of the conductors 24 and all of said disks are compressed from opposite sides of disks 16 and 18 while assembled within the band 14. The band is preferably provided initially at one end with an annular flange 32 and, after the disks have been compressed, the other end of the band is spun or bent radially inward to provide another annular flange 34, whereby the flanges 32 and 34 serve to maintain the various disks of the base in compressed laminated condition and said disks will not only support the conductors in operative and electrically insulated condition, but also in hermetically sealed condition relative to the base as well.

The invention also contemplates mounting directly on the inner ends of certain of the conductors 24 stationary contacts 36 and 38. There is provided, in the present illustrative embodiment of the invention, a pair of stationary contacts 36 and 38 for each relay switch unit, said units being indicated A, B, C, D, E and F in Fig. 4, each unit being included within a bracket, and further details thereof are explained hereinafter.

Such direct mounting of the stationary contacts 36 and 38 results in extreme compactness and saving of space as well as the elimination of any electrical connecting means, such as short lengths of wire, which would require soldering at opposite ends to the conductors 24 and contacts 36 and 38.

Such direct connecting of the conductors and contacts is effected, for example, by providing the inner end of said certain stationary contact conductors with frusto-conical ends 40 which flare outwardly. The stationary contacts 36 and 38 are initially formed so as to be cup-shaped and are placed over the ends 40 of the conductors. The rims of the cup-shaped contacts are then swaged or otherwise shrunk so as to tightly adhere to the ends 40, whereby the contacts 36 and 38 and conductors are united in fixed relationship. The contacts 36 and 38 are preferably formed from silver or silver alloy, which material readily lends itself to being secured in the foregoing manner to the ends 40 of the conductors.

This arrangement permits the use of larger contacts than is frequently possible, particularly in small miniature relay units, whereby larger amperage loads may be imposed upon such relay switches for long periods of use of the switch without requiring replacement of such contacts through deterioration resulting from arcing. Such arrangement also affords another advantage in that, when certain portions of the exterior cylindrical surface of the contacts 36 and 38 become worn due to arcing, the contacts may be adjusted to present a new operating surface by merely rotating the conductors 24 slightly about their longitudinal axis, such rotation being effected by turning the outer ends of said conductors about their axes.

The outer end of each conductor 24 extends from the exterior side of the base 12 and said ends may be either electrically connected to a suitable circuit by inserting the ends of the conductors 24 in a jack formed to accommodate the same, or said outer end of each conductor may be connected to a circuit by merely soldering or otherwise affixing wires of the circuit directly to said outer ends.

Extending perpendicularly from the surface of base 12 from which the contacts 36 and 38 project is a mounting post or pin 42 which terminates at one end in a transverse annular flange 44 disposed within the space between the insulating disks 16 and 18. The end of said pin 42 adjacent the flange 44 is preferably straight knurled as shown at 46 so as to prevent rotation of the pin 42 relative to the base and, in addition, the friction existing between the opposite surfaces of the flange 44 and the inner surfaces of the disks 16 and 18 serves to do likewise. Surrounding said pin 42 adjacent the disk 18 is a bushing 48. Also disposed on said pin 42 is a series of nested, concentric, tubular members formed from iron or steel and comprising a core 50. If desired, the ends of said tubular members nearest the base may be disposed within a recess 52 provided in one end of the bushing 48 which centers the members of core 50 relative to pin 42.

Surrounding the end of the core 50 adjacent the bushing 48 is a set of similar, laminated, iron or steel members 54 which are provided with circumferentially spaced radial notches to provide a plurality of circumferentially spaced, radially projecting pole pieces 56. Surrounding said core 50 between the pole pieces 56 and the outer end of the core is a coil 58 mounted on a suitable

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flanged spool 50. Abutting the outer end of the core 50 and mounted adjacent the outer end of pin 42 is another pole piece member 52 provided with a series of circumferentially spaced pole arms 54 which extend radially therefrom for a short distance and are then bent substantially at a right angle so as to extend parallel to the core 50 toward the pole pieces 56. The portions of the pole arms 54 which are parallel to the core comprise pole pieces 56. A washer 57 of any suitable compressible material such as silicone rubber is disposed in the bottom of recess 52 to urge the tubular members of core 50 into firm engagement with pole piece member 52. For purposes of convenience in description, the pole pieces 56 are designated first pole pieces and pole pieces 56 are designated second pole pieces. The pole pieces 56 each terminate in an end surface 58, said end surfaces all being in common plane perpendicular to the pin 42 and said plane being spaced a short distance away from, but longitudinally aligned with, the pole pieces 56.

Each pair of longitudinally aligned pole pieces 56 and 56 is provided with an armature assembly generally designated 70 and illustrated in details in Figs. 6 and 7. Each armature assembly comprises an iron or steel armature block 72, one end of which is disposed against the end surface 58 of the first pole piece 56. The first pole pieces 56 thus serve to dispose the pivot point of the armature assemblies 70 close to the second pole pieces 56. The armature block 72 is connected for limited pivotal movement relative to said end surface 58 by means of an elongated hinge member 74. One end of said hinge member is connected to the armature block 72 and extends an appreciable distance beyond the armature in one direction so as to overlie but, at its outer end, be somewhat spaced from the first pole piece 56. The hinge member 74 may be formed from any suitable resilient material such, for example, as beryllium-copper.

Projecting in the same direction from opposite side edges of the hinge member 74 intermediate the ends thereof are a pair of parallel flanges 76 which are disposed within a pair of complementary elongated notches 78 formed in opposite side edges of the first pole piece 56, whereby said flanges 76 serve to position the armature assembly connected to the hinge member 74 relative to such first pole piece 56. The flanges 76, by being received within the elongated notches 78, will prevent longitudinal movement of the armature assembly relative to the first pole piece 56 and also prevent movement of the armature assembly relative to its first pole piece 56 in directions tangential to the coil 58.

Secured adjacent the pole piece engaging surface of each armature block 72 is a shock absorbing member 80 which is preferably formed from non-magnetic material for purposes of also reducing the tendency of residual magnetism in the armature block and pole piece 56 to cause the armature block 72 to stick to its second pole piece 56 after the coil 58 has been deenergized. Normally, the hinge member 74 holds the armature block in spaced relation to the second pole piece as indicated in Fig. 2. The hinge member 74 is secured against the opposite surface of the armature block 72, and disposed against the other surface of the armature engaging end of the hinge 74 is a small block or piece of insulating material 82, such as fiber. A resilient contact carrying member 84 is secured against said piece of insulating material 82 and another piece of

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insulating material 86 is disposed against the outer surface of flexible contact carrying member 94. The shock absorbing member 80, armature block 72, hinge member 74, insulating material 82, flexible contact carrying member 84, and second insulating material 86 are secured together in laminated relationship by providing each with a plurality of series of transversely aligned apertures which receive rivets 88, the rivets being peened at one end to secure all of these components in assembled relationship as illustrated in Fig. 7.

In order that the contact carrying member 94 may be electrically insulated from the assembly, the apertures 90 therein which receive the rivets 88 are larger than the diameter of the stems of the rivets so as to prevent electrical engagement between said rivets and the perimeters of said apertures. However, the contact carrying member 84 is provided at one end with a laterally extending finger 92 which is received in one of a pair of notches 94 provided in opposed edges of the second piece of insulating material 86 and, parallel to but spaced from the finger 92, there is another finger 96 which is received in the other notch 94, whereby the contact carrying member 84 will at all times be aligned relative to the armature assembly in such a manner as to prevent engagement between the perimeters of its apertures 90 and the rivets 88. The finger 96 also provides means to which one end of a flexible electrical conductor 98 may be connected, as is clearly shown in Figs. 2, 5 and 7.

The contact carrying member 94 is provided with a pair of substantially parallel flexible fingers 100 which are provided on their outer ends with projections 102 which extend toward each other, there being a space between the outer ends of the projections, however. Secured to each projection 102 is one of a pair of movable contacts 104 which may be formed, for example, by bending small pieces of silver or silver alloy into U-formations around said projections, as illustrated in Figs. 4 and 6, so as to be fixed to said extensions. From the various figures, and particularly Fig. 7, it will be seen that each pair of movable contacts 104 is movable between engaging positions with a pair of the spaced fixed contacts 36 and 38 and engagement between said fixed and movable contacts takes place substantially along a straight line parallel to the longitudinal axis of the terminal conductors 24. Due to the resiliency of the fingers 100 and the fact that the extent of movement of the armature blocks 72 is greater than that required to merely move the movable contacts 104 into contacting engagement with the fixed contacts 36 or 38, said movable contacts will be moved by each armature into firm engagement with the fixed contacts 36 or 38 and in such a way that the projections 102 which support the movable contacts 104 will be flexed along axes coaxial with the main axes of the armature assembly so as to produce a wiping engagement between the movable contacts 104 and the fixed contacts 36 or 38.

The end of each hinge member 74 remote from the armature block 72 is provided with a slot 106, said slot receiving a screw 108 which is threaded into one of a plurality of projections 110 which extend radially from a collar 112 mounted adjacent the outer end of pole piece member 82 and secured thereagainst by a head 114 comprising an enlarged outer end on mounting pin 42. Said head 114 thus serves to maintain in assembled relationship all of the above-described

elements and components surrounding the pin 42 and supported thereby in fixed relationship to the base 12.

The flexibility with which each hinge member 74 supports its armature block 72 relative to the free end of its first pole piece 66 is determined by the size of an opening 116 formed in each hinge member, as clearly shown in Fig. 6, and the size of said opening may be varied to suit desired operating conditions. Also, the amount of flux required to saturate the pole pieces 66 and the armature blocks 72 is determined, respectively, by forming apertures 118 and 120 therein. The sizes of the apertures 118 and 120 in said first pole pieces and armature blocks may be varied and the adjusting screws 108 associated with each armature assembly may also be regulated to vary the tension exerted by hinge member 74 so that, when the coil 58 is energized, the armature blocks 72 of the various relay switch units will operate in a predetermined sequence so as to cause, for example, the movable contacts 104 of each armature assembly to move in such sequence from engagement with fixed contact 36 into engagement with fixed contact 38 of its relay unit. If current of sufficient magnitude is supplied to said coil 58, the engagement of all of the armature blocks 72 with their respective second pole pieces 56 will be very rapid and substantially simultaneous. However, the engagement of the armature blocks with their respective pole pieces 56 can nevertheless be made to occur in accordance with a predetermined sequence if the adjustment means described above have been regulated to produce a predetermined desired sequence.

Each relay unit in the exemplary construction of the invention illustrated herein comprises three terminal conductors 24, as will be seen especially from Fig. 4, wherein the conductors of each unit are included within a bracket adjacent the periphery of the casing 10 shown in said figure. Two of said terminal conductors of each unit are disposed parallel to each other and slightly spaced apart in a direction radial to the pin 42. The inner ends of each of said terminal conductors carry, respectively, the fixed contacts 36 and 38. The third terminal conductor 24 has connected to its inner end one end of the flexible conductor 98 which is secured at its other end to the finger 96 of movable contact carrying member 84. Also supported by the base 12 is a pair of additional terminal conductors 122 to which the ends of the coil leads are respectively connected.

From the foregoing, it will be seen that the arrangement of the armature assemblies is such that, when the coil 58 is deenergized, the inherent resilient force of the hinge members 74 is such that it will hold the armature block 72 attached thereto in spaced relation to its associated second pole piece 56, whereby the movable contacts 104 will engage the radially outermost fixed contact 36 of its relay unit. When the coil 58 is energized, the armature blocks 72 are moved in predetermined sequence into engagement with the second pole pieces 56 and thus cause the movable contacts 104 carried thereby into engagement with the radially innermost fixed contact 38 of their respective relay unit.

It will also be seen from the foregoing that the arrangement of the various components of each relay unit and also of the disposition of the relay units in circumferentially spaced relationship around the core and coil of the solenoid assembly results in an extremely compact arrangement

accommodating either a single relay unit or a substantial number of such relay units, as desired. Further, by directly attaching the fixed contacts 36 and 38 directly to the inner ends of their terminal conductors 24, which are immediately adjacent the inner surface of the base 12, further compactness of arrangement is afforded while providing sufficient space to permit the utilization of relatively large stationary contacts, whereby relatively large amperage loads may be accommodated. The arrangement embodied in the relay comprising the present invention is such that it may be readily used with either D. C. or A. C. and embodiments of the invention which have been constructed and used successfully have employed as high as 400 cycle A. C. If A. C. is used in conjunction with relay units such as illustrated and described herein, it is preferable to utilize a shading coil relative to the second pole pieces 56, but this may be readily accomplished for example, by substituting several copper laminates 54 for several of the iron ones. Also, using fixed contacts 36 and 38 which have substantially cylindrical outer surfaces permits the rotation of said contacts about their axes to present unused operating surface portions to the movable contacts 104 without requiring replacement of the fixed contacts 36 and 38. Still further, the shape of the perimeter of the base 12 is such that the band 14 thereof may be readily sealed within the open end of cup-shaped housing 10 by soldering or otherwise, where it is desired that the interior of the housing is to be provided with either an evacuated atmosphere or filled with inert gas to reduce arcing between the fixed and movable contacts. Still another advantage of the present construction lies in the fact that the entire assembly comprises relatively few movable parts, thus minimizing wear between said parts.

While the invention has been illustrated and described in its preferred embodiment and has included certain details, it should be understood that the invention is not to be limited to the precise details herein illustrated and described since the same may be carried out in other ways, falling within the scope of the invention as claimed.

I claim:

1. A multiple relay comprising in combination, a core, a coil surrounding said core, a pole member connected to one end of said core and having a series of pole arms circumferentially spaced around said coil, a series of pole pieces corresponding in number to said pole arms projecting radially from the other end of said core and spaced at their ends from said pole arms, an elongated flexible member extending along each pole arm and at one end engaging and projecting beyond the end thereof, the other end of said member being spaced from said pole arm, an armature connected to the projecting end of each flexible member and pivotally supported thereby relative to the end of said pole arm for movement to and from engagement with one of said pole pieces, a movable contact carried by each armature, and a screw associated with said other end of each flexible member and adjustable to vary the tension exerted by said arm to resist movement of the armature thereon toward its pole piece, whereby said armatures may be regulated to move into engagement with said pole pieces in a predetermined sequence when said coil is energized.

2. In a multiple relay, the combination of a base, electrical insulating means carried by said base, a magnet core supported by and extending

perpendicularly from said base, a coil surrounding said core, a plurality of first pole pieces connected to said core and extending radially from the outer end thereof and then bent to extend toward said base in parallel relation to each other and said core, a plurality of second pole pieces corresponding in number to said first pole pieces and aligned therewith axially of said core, said second pole pieces extending radially from said core adjacent the end of the coil nearest said base, an elongated flexible member overlying the portion of each first pole piece parallel to the core and extending beyond the free end thereof, an armature fixed to the extending portion of each flexible member and supported thereby adjacent the free end of said first pole piece for limited pivotal movement toward and from said second pole piece axially aligned therewith, a housing connected to said base and enclosing the components of said multiple relay, a group of three terminal conductors extending through the insulating means of said base for each pair of aligned first and second pole pieces, a stationary contact fixed directly to the inner end of two of each group of said conductors and spaced from each other, a contact carried by each armature and disposed between said fixed contacts for movement by said armature between positions of engagement with said fixed contacts when said coil is energized and deenergized, and means electrically connecting the inner end of said other conductor of each group and the movable contact associated therewith.

3. In a relay, the combination of a base, a magnet core supported by and extending perpendicularly from said base, a coil surrounding said core, a pole arm connected to the outer end of said core and extending parallel thereto toward said base adjacent the outer surface of said coil, a pole piece extending radially from said core adjacent the end of said coil nearest said base, an elongated flexible member extending along said pole arm and at one end engaging and projecting beyond the end thereof, the other end of said member being spaced from the other end of said pole arm, an armature connected to the projecting end of said flexible member and supported thereby adjacent the free end of said pole arm for pivotal movement toward and away from said pole piece, means engaging the spaced end of said flexible member and operable to vary the spacing thereof from said pole arm, a fixed contact supported by said base and extending toward said armature, and a contact carried by said armature and movable thereby to and from engagement with said fixed contact.

4. In a relay, the combination of a base, a magnet core supported by and extending perpendicularly from said base, a coil surrounding said core, a pole arm connected to the outer end of said core and extending parallel thereto toward said base adjacent the outer surface of said coil, said pole arm having along and intermediate the ends of opposed edges thereof an elongated notch, a pole piece extending radially from said core adjacent the end of said coil nearest said base, an elongated flexible member extending along said pole arm and at one end engaging and projecting beyond the end thereof, the other end of said member being spaced laterally from the other end of said pole arm and secured against movement in a direction away from said pole arm, a flange extending from each of the opposite edges of said flexible member and disposed respectively in the notches in the opposed edges

of said pole arm to position said member relative to said arm, an armature connected to the projecting end of said flexible member and supported thereby adjacent the free end of said pole arm for pivotal movement toward and away from said pole piece, a fixed contact supported by said base, and a contact carried by said armature and movable thereby to and from engagement with said fixed contact.

5. In a relay, the combination of a solenoid assembly including an adjustable flexible member supporting an armature for movement relative to the poles of the solenoid when the solenoid is energized, a pair of parallel flexible fingers extending from said flexible member, a movable contact fixed to each finger, said contacts being slightly spaced from each other in a direction transverse to said fingers, and a stationary contact wider than the space between said movable contacts and engageable by said movable contacts when said solenoid assembly is energized, such movement of said movable contacts being slightly greater than necessary to effect contacting engagement between said movable and stationary contacts, whereby upon engagement of said fixed and movable contacts said fingers are flexed to cause said movable contacts to engage said stationary contact with a yieldable wiping action.

6. In a relay, the combination of a solenoid assembly including an adjustable flexible member supporting an armature for movement relative to the poles of the solenoid when the solenoid is energized, a pair of spaced parallel flexible fingers extending from the flexible member, flexible projections extending transversely toward each other from the outer ends of said fingers, a contact fixed to the end of each projection and movable therewith when actuated by said armature, said movable contacts being slightly spaced from each other and extending in a direction substantially parallel to said fingers, and a stationary contact wider than the space between said movable contacts and engageable by said movable contacts when said armature is moved by said solenoid assembly, said fixed contact having a cylindrical external surface substantially axially parallel to said arms and the movement of said movable contacts by said armature being slightly greater than necessary to effect contacting engagement between said movable and stationary contacts, whereby upon engagement between said fixed and movable contacts said projections are flexed and cause said movable contacts to engage said stationary contact in parallel relationship with a yieldable wiping action.

7. In a relay, the combination of a housing having an opening, a base connected to and closing said opening in said housing, electrical insulating means carried by said base, a solenoid assembly fixed to said base and including an adjustable flexible member carrying an armature for pivotal movement relative to the poles of the solenoid when the solenoid is energized, a pair of cylindrical terminal conductors extending through the insulating means of said base and supported thereby, a stationary contact having a cylindrical external surface coaxial with and fixed directly to the inner end of one of said conductors, a contact carried by the flexible member and movable therewith relative to said fixed contact when said solenoid is energized, said movable contact being substantially parallel to the cylindrical surface of said

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fixed contact when in engagement therewith and said terminal conductor supporting said stationary contact being rotatable relative to said base to permit presenting to said movable contact an unused portion of the external surface of said stationary contact, and electrical conducting means extending between the inner end of said other conductor and said contact on said armature.

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