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KNEE-ACTION RELAY

Filed March 4, 1963

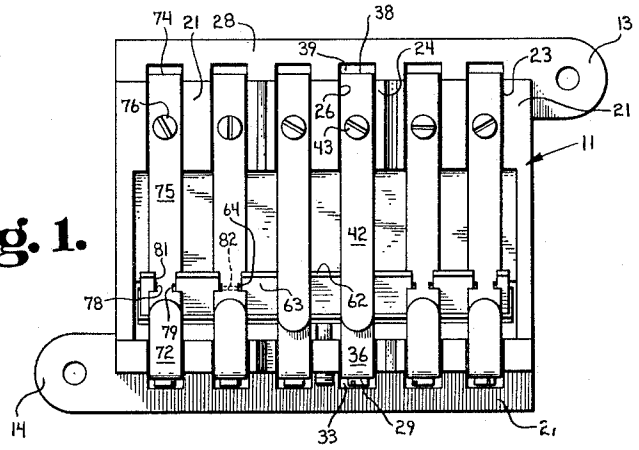


Fig. 1.

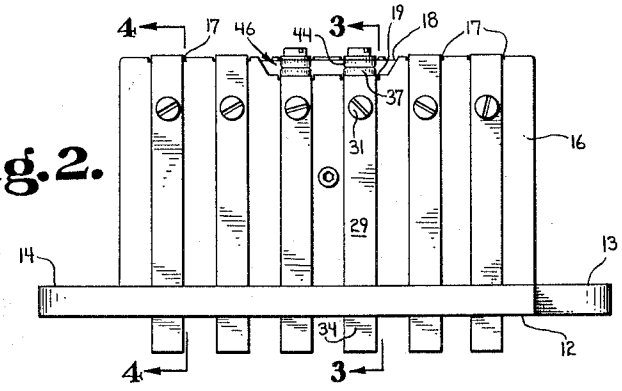


Fig. 2.

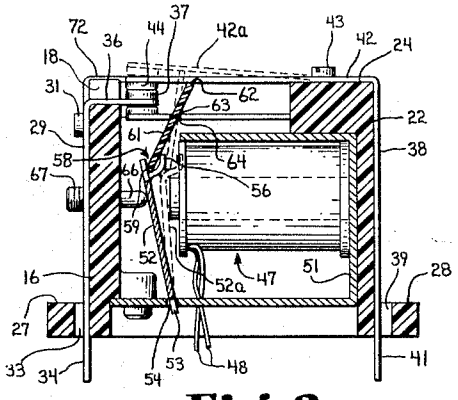


Fig. 3.

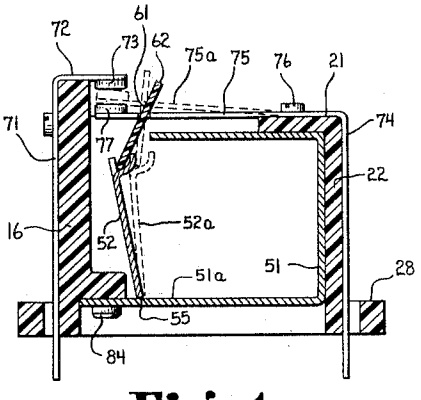


Fig. 4.

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KNEE-ACTION RELAY

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This invention relates generally to electrical relays and more particularly to a multiple contact relay having a snap type of action, plug-in features, and ease of maintenance features.

Economies can be achieved in relays where a single electromagnetic device controls action of a number of contacts. However, in relays heretofore known, removal of certain components cannot be achieved without disturbing other components. Moreover, relays heretofore known do not ordinarily have the ability to be plugged into a socket and also facilitate screw-on or solder connections. In addition, where they are of the snap action type, the required mechanism is somewhat more complicated than is desired.

It is, therefore, a general object of the present invention to provide an improved relay.

A further object is to provide a relay which can be plugged into a socket and to which a screw-on or solder connection can readily be made.

A further object is to provide a relay having a knee action which is positive and well defined and yet is accomplished with extremely simple structure.

A further object is to provide a relay achieving the foregoing objects and wherein major components can be removed without disturbing other components.

The full nature of the invention will be understood from the accompanying drawings and the following description and claims.

FIG. 1 is a top plan view of a typical embodiment of the present invention.

FIG. 2 is a front elevational view thereof.

FIG. 3 is a vertical section therethrough taken along the line 3—3 in FIG. 2 and illustrating a pair of the normally closed contacts thereof.

FIG. 4 is a vertical section taken along the line 4—4 in FIG. 2 and illustrating a pair of normally opened contacts thereof.

Referring now particularly to FIGS. 1, 2, and 3 of the drawings, a frame is provided in the form of a housing **11** having a base with lower surfaces **12** lying in a plane and with apertured mounting lugs **13** and **14**. The upstanding front wall **16** of the housing has an upper marginal edge with a plurality of grooves **17** therein and a depressed central portion **18**, the depression also having grooves **19** therein. The top portion **21** of the housing adjacent the upstanding rear wall **22** also has grooves **23** therein, and an elevated portion **24** with grooves **26** therein. A flange **27** extends from the front wall **16** adjacent the lower margin thereof and forms a portion of the base whereas a flange **28** extends from the lower margin of the rear wall **22** and also forms a portion of the base.

An electrically conductive terminal strip **29** is mounted by means of the screw **31** to the front wall of the housing. This strip passes through an aperture **33** in the flange **27** whereby the portion **34** projecting below the base surface **12** can function as a terminal.

The upper portion of the strip **29** is inwardly turned to provide a horizontal portion **36** received in one of the grooves **18**. A contact disc at point **37** is secured to the top of portion **36**.

A similar terminal strip **38** is disposed next to the rear wall **22** and passes through the aperture **39** in the flange **28** to provide a terminal portion **41** projecting below the base. This terminal strip **38** is L-shaped, much like the terminal strip **29** mounted to the front wall. The horizontal portion **42** thereof is received in one of the grooves **26** and may be secured to the top of the housing by the screw **43**, for example. A contact point **44** is mounted to the underside of the free end of the horizontal portion **42** and normally engages the upper face of the contact point **37** attached to the terminal strip **29**.

The structure described above provides a set of normally closed contacts. An identical set of normally closed contacts is immediately adjacent the first set and is designated by the reference numeral **46**. The function of the illustrated embodiment is to open the contacts **37** and **44** upon energization of the relay. This is accomplished by raising the contactor **44** while the contactor **37** remains stationary. The terminal strip **38** may be made of a highly conductive springy material such as beryllium copper, for example, whereby the horizontal portion thereof may be elevated to the position shown by the dotted line **42***a*. In this condition, a force is generated sufficient to return the point **44** to its normal position engaged with the contact **37** upon removal of any external elevating force from the horizontal portion **42**.

An electrical coil **47** having electrical supply wires **48** is mounted around the core **49** which is, in turn, mounted to the magnet base **51**. The core **49** and base **51** are both made of ferro-magnetic material to provide a good transmission path for any flux generated by energization of the coil **47**.

An elongate armature plate **52** of ferro-magnetic material has a plurality of lugs **53** in its lower edge which are received by apertures **54** in the magnet base **51**. The lower edges **55** between the lugs **53** rest on the upper surface **51***a* of the magnet base (FIG. 4). This armature plate, therefore, is free to rock or pivot on an axis parallel to the rear wall **22** and to the base surface **12** of the housing and is attracted toward the core **49** upon energization of the coil. It can, therefore, move from the position shown by the solid outline in FIG. 3 to the position shown by the dotted outline and designated by reference numeral **52***a*. In this position, it is limited from further travel by the armature plate **52** engaging the end of the coil **47**.

A number of offset tabs **56** may be provided along the length of the armature at the upper margin thereof. These co-operate with the plate proper to form notches **58**. The lower marginal edge **59** of an electrically nonconductive spacer plate **61** rests in and is supported by these notches. The upper marginal edge **62** of this spacer engages the underside of the horizontal portion **42** of the terminal strip **38**.

A portion **63** of the spacer passes through a lateral notch **64** of another terminal strip to be described more fully hereinafter. Horizontal translational motion of the spacer is thereby limited along a line of engagement of the rear face of the spacer with notches **64** in this and additional terminal strips. Therefore, when the coil **47** is energized, the movement of the armature toward the coil is effective to move the upper edge of the spacer upwardly to the position shown by the dotted line **62***a* whereupon the horizontal portion **42** of the terminal strip **38** is moved to the position shown by the dotted line designated **42***a* thus opening the contacts **44** and **37**.

It will be observed, therefore, that in addition to the pivotal action of the armature on the magnet base, there is pivotal action between the lower marginal edge **59** of the spacer and the notch of the armature and this action takes place on an axis parallel to the rear wall **22** and to the base surface **12**. Moreover, there is pivotal action between the upper marginal edge **62** of the spacer and the lower face of the horizontal portion of the terminal strip. If it is assumed that there is a triangle lying in the plane of the section of FIG. 3, (i.e. perpendicular to the base and rear walls of the housing) and the

corners of the triangle are defined by the three pivotal axes mentioned, then energization of the coil lengthens the side of the triangle between the lower pivotal axis and the upper pivotal axis as the axis defined by the armature notch and the lower edge of the spacer moves toward the coil.

Upon de-energization of the coil, the spring force exerted on the upper edge of the spacer by the horizontal portion of the terminal strip will return the spacer and armature to the initial position shown whereupon the travel of the armature will be stopped by the stop pin 66. This pin has a thread 67 thereon which permits calibrating adjustment of the relay.

From the foregoing description, it will be recognized that there is a knee type of action between the armature and the spacer when the coil is energized and de-energized.

Referring now to FIG. 4, the arrangement of the normally open contacts will be described. For the normally open contacts, a terminal strip 71 is mounted to the front wall 16 of the housing in the same manner as is terminal strip 29. It is generally L-shaped having a horizontal portion 72 with a contact point 73 on the underside thereof. A terminal strip 74 is mounted next to the rear wall of the housing in the same manner as is terminal strip 38. Terminal strip 74 has a horizontal portion 75 received in one of the grooves 23 in the housing and secured by the screw 76. The distal end of the horizontal portion has a contact point 77 mounted to the upper surface thereof in face-to-face vertically spaced relation to the contact point 73.

In FIG. 1, it can be observed that the horizontal portion 75 of the terminal strip has notches 78 and 79 in opposite edges thereof. An identical notch 64 in the adjacent terminal strip has been previously mentioned herein. The spacer 61 has notches 81 in the upper marginal edge thereof. These notches 81 are of a depth such that the bottom edge 82 of each of the notches 81 engages the underside of the horizontal portion of the terminal strip along a line between the lateral notches 78 and 79. Therefore, when the armature is attracted to the core 49 by energization of the magnet coil 47, the spacer is effective to raise the horizontal portion to the position designated by reference numeral 75*a* whereupon the contact points 73 and 77 are brought into engagement. The additional stress imparted to the horizontal portion during this action assists in returning the armature to its original position whenever the coil is deenergized.

Here again, there is pivotal action between the lower edge 55 of the armature and the upper face 51*a* of the magnet base. There is also pivotal action on a line between the spacer and the notch in the armature and there is pivotal action between the horizontal edge 82 of the notch 81 in the spacer and the lower face of the contact spring 75. The axes on which these pivotal actions take place are parallel. If one visualizes a triangle in the plane of the section 4–4 with these axes perpendicular to the plane of the triangle and with each axis defining a corner of the triangle, the spacer and armature define two legs of fixed length of that triangle. The third leg of the triangle increases in length as the armature is drawn toward the magnet core 49.

The screws 84 hold the magnet base in the frame. By merely removing these screws, the magnet base and the coil and core mounted thereto can be removed as a unit without disturbing the normal condition of any of the contact points. Also, by the manner of mounting the terminal strips and contact points, these items can be removal individually without interfering with the other components of the relay. The fact that the lower ends of the terminal strips project through the base flanges of the frame, facilitates the plugging of the unit into a socket if desired. At the same time, there is ample space and provision for soldering leads to the terminal strips or screwing leads onto the terminal strips at practically any location. The coil leads 48 can also be made comparatively rigid if desired for plug-in purposes.

The construction of this relay permits the use of a single magnet for the operation of a plurality of points which may be normally opened or normally closed. While the contact springs which mount normally closed contacts have an initial stress in them sufficient to securely maintain the points closed, the normally opened contact mounting springs are usually unstressed initially. Energization of the magnet increases the stress in these springs thereby generating a restoring force therein which is applied to the spacer. Therefore, when the coil is de-energized and the magnet thereby released, the armature is forced away from the core and thereby permits separation of the contact points with a snap action.

It will be understood, of course, that more or fewer sets of points than illustrated can be used if desired. A base plate can be used and a dust cover or hermetically sealed housing can be employed if desired. Moreover, the coil can be potted if required for use in high humidity areas.

Therefore, while the invention has been disclosed and described in some detail in the drawings and foregoing description, they are to be considered as illustrative and not restrictive in character, as other modifications may readily suggest themselves to persons skilled in this art and within the broad scope of the invention, reference being had to the appended claims.

The invention claimed is:

1. A relay comprising: a frame, electromagnetic means mounted on said frame, a first contactor fixed to said frame, a spring having a portion secured to said frame and having a free portion, a second contactor mounted to said free portion of said spring, an armature pivotally mounted to said frame, a rigid spacer pivotally mounted to said spring, said armature and spacer being pivotally mounted together and disposed with the pivot axes at the corners of a triangle lying in a plane perpendicular to said axes, said armature lying in the magnetic field of said magnetic means and being operable when said means are electrically energized to move two of said pivot axes and increase the length of one side of said triangle to change the relative positions of said contactors and develop a restoring force in said spring.

2. A relay comprising: a frame, an electromagnetic device mounted to said frame; a first contactor mounted to said frame; a second contactor; a spring mounted to said frame and resiliently supporting said second contactor in engageable relationship to said first contactor; an armature member and a spacer member pivotally engaged together, one of said members being pivotally engaged with said frame and the other of said members being pivotally engaged with said spring, said one member maintaining a fixed distance between its points of pivotal engagement with said frame and with said other member, and said other maintaining a fixed distance between its points of pivotal engagement with said spring and with said one member, the pivot axes of the pivotal engagements being parallel and intersecting corners of a triangle lying in a plane perpendicular to said axes, said members thereby establishing the pivotal legs of fixed length in said triangle, said spring being flexible in a direction generally transverse to the direction of the third leg of the triangle and allowing the third leg to change in length to move said second contactor generally parallel to said third leg to engage said first contactor said armature member being disposed in the magnetic field of said electromagnetic device and movable by said device in a direction generally perpendicular to the direction of said third leg when said device is energized to change the relationship between said contactors and develop a restoring force in said spring, the angles between the legs of said triangle being such that the mechanical advantage of said device for changing the length of said third leg

greatly exceeds the mechanical advantage of said spring for changing the length of said third leg.

3. The relay of claim 2 further comprising: a first electrical conductor extending from said first contactor to a first terminal projecting in a predetermined direction from said frame; and a second electrical conductor connected to said spring and extending to a second terminal projecting from said frame in a direction parallel to said first terminal.

4. The relay of claim 2 wherein said contactors are removable from said frame independently of said electromagnetic device.

5. The relay of claim 2 further comprising an adjustable armature rest mounted in said frame.

6. A relay comprising: a frame; electromagnetic means mounted on said frame; a first contactor mounted to said frame; a spring mounted to said frame; a second contactor mounted to said spring and resiliently supported by said spring in engageable relationship to said first contactor; an armature member and a spacer member pivotally mounted together, one of said members being pivotally mounted to said frame and the other of said members being pivotally engaged with said spring, thereby providing three parallel pivotal axes intersecting corners of a triangle lying in a plane perpendicular to said axes, said armature member and spacer member forming legs of fixed length in the triangle intersecting at the point of pivotal mounting of said members together and forming an obtuse included angle in the triangle at said point, and said armature being disposed in the magnetic field of said electromagnetic means and movable when said means are energized to pivot said armature and spacer and change the angle of intersection between said legs thereby establishing a knee action at said intersection to increase the length of a third leg of said triangle extending between the points of pivotal engagement of said one member with said frame and said other member with said spring, thereby to change the mechanical condition of said spring and engage said second contactor with said first contactor.

7. The relay of claim 6 wherein an adjustable stop is provided in said frame to locate said armature when said electromagnetic means are de-energized, said spring normally exerts a bias in the direction of said third leg and biases said armature member and spacer member to hold one of said members against said stop when said electromagnetic means are de-energized, the orientation of said armature member being such that said electromagnetic means, when energized, acts on said armature member in a direction generally perpendicular to said third leg, whereby a relatively small amount of energy generated by said electromagnetic means is effective to engage and maintain engagement between said second contactor and said first contactor.

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