Nov. 21, 1933. J. H. PENGILLY ET AL 1,936,098

MAGNETIC SWITCH

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Fig. 1.

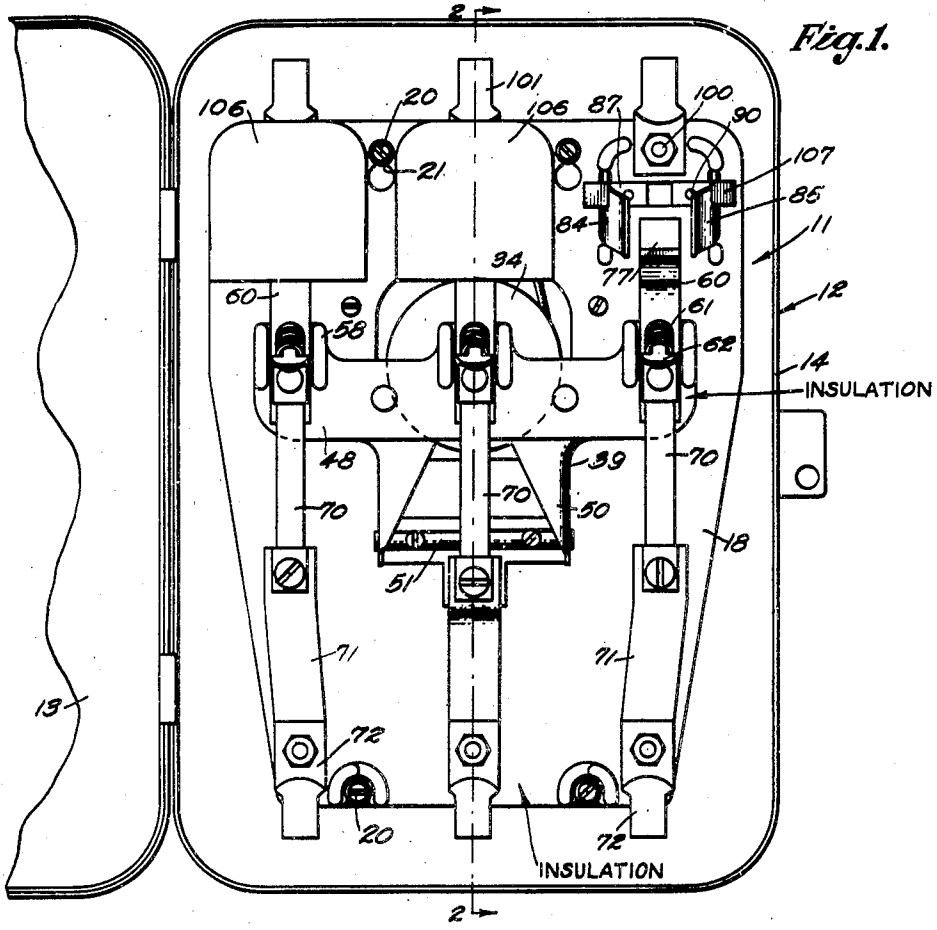
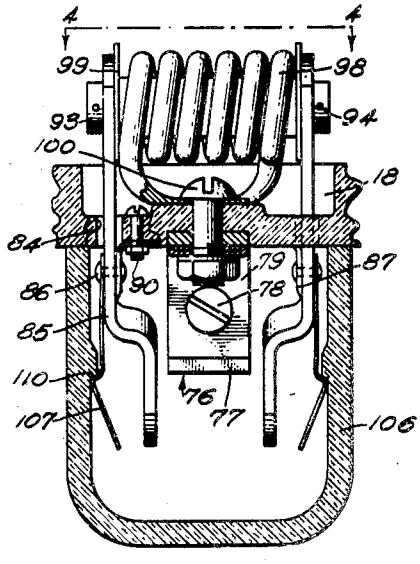


Fig. 3.



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Fig. 2.

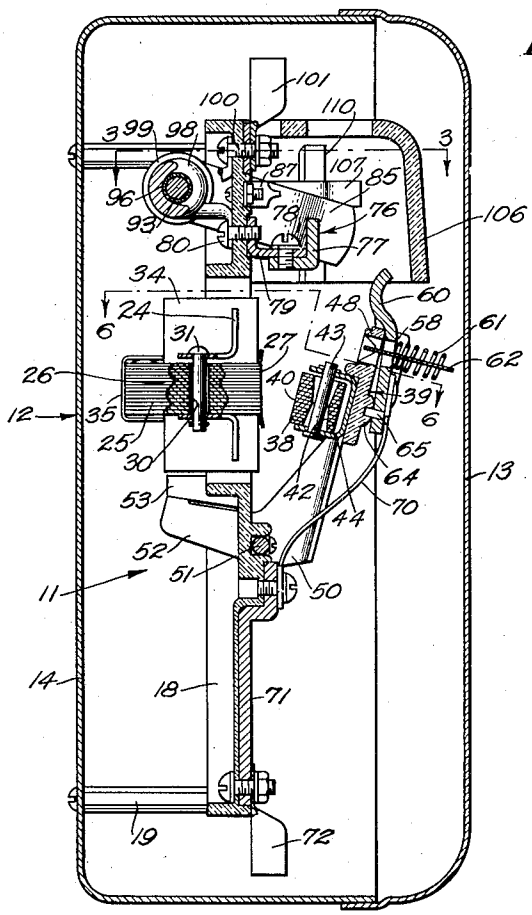


Fig. 4.

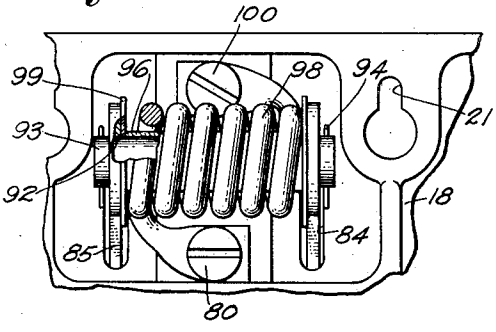
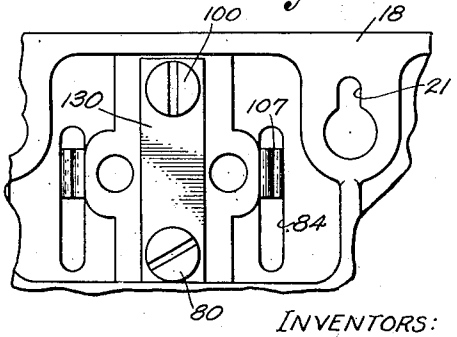


Fig. 5.



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Fig. 6.

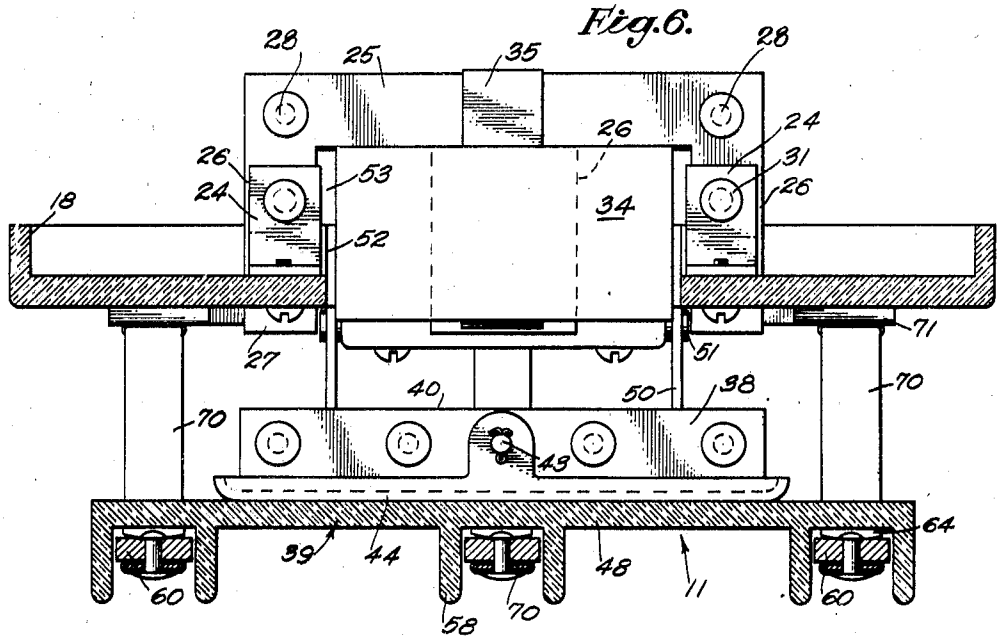
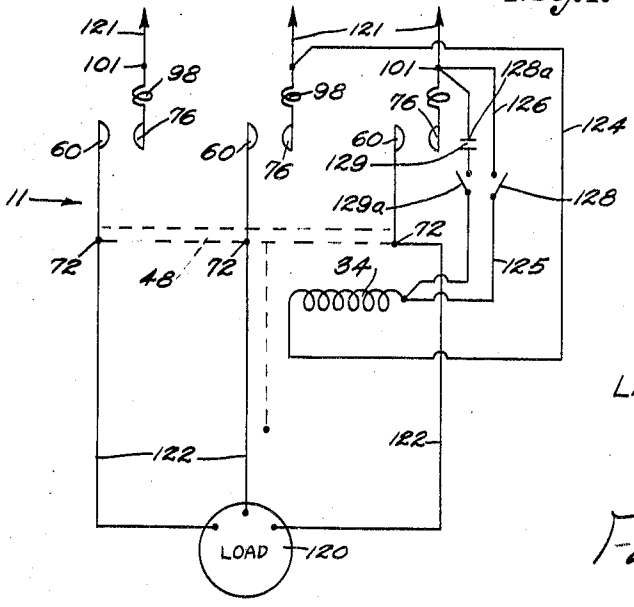


Fig. 7.



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Patented Nov. 21, 1933 1,936,098

UNITED STATES PATENT OFFICE

1,936,098

MAGNETIC SWITCH

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Application March 1, 1930. Serial No. 432,376

8 Claims. (Cl. 175—338)

Our invention relates to magnetic switches wherein the switch contacts are opened or closed by magnetic means.

When magnetic switches are operated by an alternating current, as is frequently done, a considerable amount of hum and vibrational noise is produced thereby. This is due primarily to the fluctuationg force with which the armature of the switch is attracted to a magnet frame thereof. This noise is highly objectionable especially where the switch is used in buildings such as dwellings, stores, theaters, and the like, and a number of devices have been produced for eliminating this noise. So far, these devices have been only partially successful and a large amount of noise still exists in alternating current operated magnetic switches.

It is an object of our invention to provide a magnetic switch in which the noise resulting from operation on alternating current is materially reduced, and contributing to this object, it is a further object to provide a magnetic switch in which the armature is pivoted about a central pivot point.

It is another object to provide a magnetic switch in which the magnet frame and armature are so mounted as to reduce the noise transmitted therefrom.

In magnetic switches of small size, the current rupturing capacity of the switch may be materially increased by providing arc extinguishers or blow-outs for rupturing the arcs included between the movable and stationary switch contacts when the switch is opened. When such switches are used on lightly loaded circuits, however, blow-outs are not needed and it is desirable to leave them off the switch so as to reduce the cost of manufacturing.

It is also an object to provide a magnetic switch and separate blow-outs which may or may not be incorporated in the switch structure, depending on the load of the circuit or circuits in which the switch is used.

Another object is to provide a magnetic switch with blow-outs having certain novel features of construction which allow the blow-outs to be omitted or included as desired without changing the appearance of the front of the switch, and which give improved results.

Further objects and advantages will be made evident in the following description of a preferred form of our invention.

In the drawings,

Fig. 1 is a front elevational view of a switch embodying our invention, showing the switch in open position.

Fig. 2 is a vertical sectional view taken on the line 2—2 of Fig. 1.

Fig. 3 is an enlarged sectional view taken on the line 3—3 of Fig. 2, showing the blow-out means of our invention.

Fig. 4 is an elevational view taken as indicated by the line 4—4 of Fig. 3.

Fig. 5 is an elevational view taken the same as Fig. 4 with the blow-out means removed.

Fig. 6 is a sectional view taken on the line 6—6 of Fig. 2, showing the magnet frame and armature of the switch.

Fig. 7 is a wiring diagram of the switch.

Referring particularly to Figs. 1 and 2, we show a switch 11 embodying our invention, which is preferably enclosed in an enclosing case 12 having a cover 13 hinged to a box portion 14 of the enclosing case 12 so that the cover 13 may be opened to permit access to the switch 11. The switch 11 includes a base 18 which is supported in the enclosing case 12 on a plurality of supports 19 secured to the enclosing case 12 and having screws 20 which engage slotted openings 21 in the base 18 in such a manner as to permit removal of the base 18 without removing the screws 20 from the supports 19.

As best shown in Figs. 2 and 6, secured to opposite sides of the base 18 are angle clips or brackets 24 arranged in pairs and providing arms forming supporting members for a laminated E-shaped magnet frame 25 having legs 26 which provide contacting faces 27 on the forward ends thereof. This magnet frame includes a plurality of laminations clamped together as by rivets 28 shown in Fig. 6. The magnet frame 25 provides openings 30 therein, through which openings 30 pins 31, secured to the brackets 24, are passed. The openings 30 preferably have a greater diameter than the diameter of the pins 31 and the space between the arms of the brackets 24 is greater than the thickness of the magnet frame 25, so that the magnet frame 25 is loosely mounted on the base 18.

Adapted to be received on the central one of the legs 26 is a cylindrical magnet coil 34. As best shown in Figs. 2 and 6, the magnet coil is held in position by a bent attachment member 35 which passes through the central opening in the coil 34 and around the magnet frame 25, the ends of the attachment member 35 being bent to engage the coil 34.

Positioned in front of the magnet frame 25, so as to be attracted thereby when the coil 34 is en-

ergized from a suitable source of electric power, is an armature 38 which is movably supported by a frame 39 pivoted to the base 18 so that a contacting face 40 of the armature 38 may be magnetically pulled adjustably into engagement with the contacting faces 27 on the legs 26. As clearly shown in Fig. 2, formed in the central part of the armature 38 is a double conical opening 42 which has its smallest diameter at the center of the armature 38. Passing through the opening 42 is a pin 43 carried by a supporting member 44 included in the frame 39. The pin 43 preferably has a slightly smaller diameter than the smallest diameter of the opening 42 so that the armature 38 is free to universally pivot on the pin 43 about the axis of the pin 43 and about a horizontal axis perpendicular to the pin 43. This permits the armature 38 to pivot on the pin 43 and assume a position such that the contacting face 40 of the armature 38 may closely engage the contacting faces 27 of the legs 26 on the magnet frame 25. We have found that with the magnet frame 25 and the armature 38 mounted in this manner, very little noise is transmitted from the enclosing case 12 when the coil 34 is energized from a source of alternating current, for the reason that the armature 38 adjustably and tightly engages the ends of the legs 26 of the magnet frame in such a manner that the magnetic field is nearly perfectly closed.

As best shown in Figs. 1 and 2, the frame 39 carries an insulating bar 48, and has a pair of legs or pivot members 50 extending downwardly therefrom. The pivot members 50 are pivoted on a shaft 51 secured horizontally to the base 18. Formed on the pivot members 50 are arms or extensions 52 which engage stops 53 formed on the base 18 so as to limit the outward movement of the armature 38 and the spacing thereof from the magnet frame 25 when the coil 34 is de-energized.

As clearly shown in Figs. 1 and 2, formed on the insulating bar 48, are pairs of guides 58 for positioning movable contact fingers 60 which are resiliently held in contact with the insulating bar 48 by compression springs 61 compressed against the fingers 60 by keys 62 passing through openings in the fingers 60 and detachably engaging elongated openings in the insulating bar 48. Formed on the insulating bar 48 are raised pivots 64 providing pins 65 which fit in openings in the lower ends of the contact fingers 60 and provide for pivoting the contact fingers 60 on the insulating bar 48 when the fingers 60 are moved to compress the springs 61.

Connected to the movable contact fingers 60 are flexible leads 70 which connect also to conductors 71 secured to the base 18. The conductors 71 are provided with terminal lugs 72 to which a load may be connected by suitable wires.

As best shown in Fig. 2, secured to the base 18 are a plurality of stationary contact fingers 76 which are positioned so as to be engaged by the movable contact fingers 60 and establish an electrical circuit therebetween when the coil 34 is energized and the switch 11 closed. The stationary contact fingers 76 include removable tips 77 which are secured by screws 78 to brackets 79 attached to the base 18 by screws 80.

As clearly shown in Figs. 1, 2 and 3, extending through openings 84 in the base 18 at either side of the stationary contact fingers 76 are magnetic conductors 85 which are secured by rivets 86 to brackets 87 attached to the base 18 by screws 90. The magnetic conductors 85 extend forward of the base 18 to a position at either side of the space included between the stationary and movable contact fingers 76 and 60 when the switch 11 is opened. The magnetic conductors 85 also extend to the rear of the base 18 where they are provided with openings 92 therein. Passing through the openings 92 in the pairs of magnetic conductors 85 are cores 93 which are secured in place by pins 94. Wound around insulating sleeves 96 on the cores 93 are blow-out coils 98. Positioned between the ends of the blow-out coils 98 and the sides of the magnetic conductors 85 are insulating washers 99.

As best shown in Figs. 2 and 4, one of the terminals of each of the blow-out coils 98 is connected by one of the screws 80 to one of the stationary contacts 76. The other terminals of the blow-out coils 98 are connected by bolts 100 to terminal lugs 101 which may connect to a source of electrical current. The blow-out coils 98 are thus connected in the circuit with the movable and stationary contact fingers 60 and 76 so that they are energized by the current flowing through the contact fingers 60 and 76. The blow-out coils 98 magnetize the magnetic conductors 85, which magnetic conductors 85 produce magnetic fields between the forward ends thereof. These magnetic fields produced by the magnetic conductors 85 react on the arcs included in the circuits between the movable and stationary contacts 60 and 76 when the switch 11 is opened. The blow-out coils 98 are preferably connected so that the directions of the magnetic fields are such that the arcs are blown upward and are quickly extinguished.

As clearly shown in Figs. 2 and 3, in order to confine the arcs and to assist in quickly extinguishing them, arc chutes 106 enclose the movable and stationary contact fingers 60 and 76 and the magnetic conductors 85. The arc chutes 106 are secured in place by spring arms 107 secured by the rivets 86 to the magnetic conductors 85 and engaging ledges 110 formed in the arc chutes 106.

In Fig. 7 we show one method of connecting the switch 11 when using it to supply three phase current to a load 120. In this case the terminal lugs 101 are connected by suitable conductors 121 to a source of electrical energy and the terminal lugs 72 are connected by conductors 122 to the load 120. One terminal of the coil 34 is connected by a conductor 124 to one of the terminal lugs 101 and the other terminal of the coil 34 is connected by conductors 125 and 126 through a control switch 128 to another of the terminal lugs 101.

It will be observed that when the control switch 128 is closed, the electric current may flow through the conductor 124, the coil 34, the conductor 125, the control switch 128, and the conductor 126 so as to energize the coil 34. This magnetizes the magnet frame 25 and attracts the armature 38 which moves the frame 39 to close the switch 11, thus establishing an electric circuit between the source of supply and the load 120, and closing the contacts 128*a* of a holding circuit 129. When the control switch 129*a* in the holding circuit 129 is opened, the coil 34 is de-energized and the switch 11 opens, due to the action of gravity. When the movable and stationary contact fingers 60 and 76 separate, the arcs formed therebetween are quickly blown out in a manner already explained.

In case the switch 11 is to be used on light loads, the arcs between the contact fingers 60 and 76 are small and can be readily extinguished

by the separation of the contact fingers 60 and 76 without the use of the blow-out means. Therefore, when the switch is to be used for light loads, it is desirable to omit the blow-out coils 98, magnetic conductors 85, and associated apparatus in order to cheapen the cost of manufacture of the switch 11. The blow-out coils 98, magnetic conductors 85, and associated apparatus may be removed from the switch 11 by removing the screws 80 and 90 and the bolts 100. As best shown in Fig. 5, an electric circuit is then established between the stationary contacts 76 and the terminal lugs 101 by means of conducting strips 130 secured in place by the screws 80 and bolts 100.

It will be noted that when the blow-out means is removed, the appearance of the switch 11 from the front of the base 18 is unchanged. This is made possible due to the fact that the parts which may be removed are normally hidden from view. The blow-out coils 98, cores 93, etc. are positioned to the rear of the base and the only parts extending to the front of the base, namely the magnetic conductors 85, are covered by the arc chutes 106. Thus it is possible to furnish the switch with or without blow-outs and without detracting from the appearance of the switch. It will also be noted that the method of attaching the blow-out coils 98 and associated apparatus permits them to be quickly added to or removed from the assembly of parts constituting the switch 11.

Our switch is particularly adapted for use on alternating current. The magnet frame 25 is loosely mounted on the base 18 and the arm is pivoted about a single central pivot to the frame 39. We have found that this construction provides a quieter operating switch than when the magnet frame 25 and armature 38 are rigidly secured to the base 18 and frame 39, respectively. The reasonable explanation for this is that this construction allows the magnet frame 25 and armature 38 to move relative to each other so that the contacting faces 27 and 40 may adjust themselves freely to closest possible engagement. The varying attraction forces between the magnet frame 25 and armature 38 due to current alternations thus do not produce any relative motion between these parts.

Another probable explanation is that the loose mounting of the magnet frame 25 and armature 38 does not permit of transmitting from the magnet frame 25 or armature 38 to the base 18 a material amount of any noise which might be developed in the magnet frame 25 or armature 38 due to the coil 34 being energized by an alternating current. Thus the base 18 does not function as a sounding board for any noise generated in the magnetic parts. This type of mounting of the magnet frame 25 is particularly advantageous inasmuch as it permits this magnet frame to be free from strains which would be set up therein by the conventional type of mounting wherein the magnet is secured rigidly with respect to the base. We have found that if strains in the magnet frame 25 can be eliminated, quiet operation will be obtained. The form of mounting means shown herein is very effective in this regard. It is also found that the pivoting of the armature 38 about a single central point so that the armature 38 is rotatable about two axes is of advantage in reducing noise.

It should be understood that the blow-out coils 98 may be wound so that they may be connected in series with the contact fingers 60 and 76 as is shown in the drawings, or may be wound so that they may be connected in shunt across the contacts, in a well known manner.

It should be understood that we are not limited to the particular form of the elements shown, as various modifications may be made without departing from the spirit of the invention, and we desire our invention to be limited only by the appended claims taken in conjunction with this disclosure and interpreted in their broadest scope.

We claim as our invention:

1. In combination: a base; an armature; means for movably mounting said armature with respect to said base; a magnet frame adapted to be magnetized to attract said armature, said magnet frame including a plurality of laminations and a clamping means for securing said laminations together; and a stress-free mounting means for mounting said magnet frame with respect to said base to eliminate stresses in said magnet frame and prevent any distortion thereof through the action of said mounting means.

2. In combination: an armature; a magnet frame adapted to be magnetized to attract said armature, said magnet frame comprising a plurality of laminations and means for rigidly clamping said laminations together; a supporting means for said magnet frame; and means for loosely retaining said magnet frame with respect to said supporting means whereby universal movement for a limited distance can take place between said magnet frame and said supporting means during the operation of said switch structure.

3. In combination: a base; an armature movable relative to said base from an open position to a closed position; a magnet frame including a pair of contacting faces with which opposite ends of said armature contact; means for loosely mounting said magnet frame as a unit with respect to said base; and coil means associated with said magnet frame and positioned to exert a pull on the central portion of said armature when said coil means is energized.

4. In combination: a base; a magnet frame providing a pair of contacting faces spaced from each other and formed of a plurality of laminations rigidly clamped together; a supporting means secured to said base; interconnecting means extending between said magnet frame and said supporting means and loosely mounting said magnet frame to permit universal movement thereof with respect to said supporting means and said base for a limited distance; an armature movable into and from contact with said engaging faces; and a coil for magnetizing said magnet frame and thereby moving said armature into engagement with said contacting faces.

5. In combination: a base; a magnet frame formed of a plurality of laminations rigidly clamped together, said frame providing an opening therethrough; supporting means mounted on said base and including a pair of arms extending on opposite sides of said magnet frame but spaced a distance apart greater than the thickness of said magnet frame whereby said magnet frame fits loosely therebetween, each of said arms including an opening; a pin extending through said openings of said arms and through said opening of said magnet frame and being smaller than at least one of said openings whereby said magnet frame is universally mounted with respect to said supporting means for a limited movement; an armature movably mounted with respect to said

base to engage said magnet frame; and coil means for moving said armature into contact with said magnet frame.

6. In combination: a base; a magnet frame formed of a plurality of laminations rigidly clamped together; means for loosely mounting said magnet frame with respect to said base to permit universal movement of said magnet frame with respect to said base for a limited distance; an armature; means for loosely mounting said armature with respect to said base to permit universal movement of said armature with respect to said magnet frame for a limited distance; and coil means for magnetizing said magnet frame to draw said armature into contact therewith.

7. In combination: a base; an E-shaped magnet frame comprising a plurality of laminations clamped together, said magnet frame including a pair of openings therethrough and providing a plurality of legs the ends of which comprise contacting faces; supporting means mounted on said base and spaced a distance apart slightly greater than the thickness of said magnet frame, said magnet frame being positioned between said supporting means to fit loosely therebetween; a pair of pins of smaller diameter than said openings of said magnet frame and extending therethrough, said pins being secured to said supporting means whereby said magnet frame is loosely mounted on said pins; an armature movably mounted with respect to said base and engageable with said contacting faces; and a coil around the center of said legs to magnetize said magnet frame to move said armature into engagement with said contacting faces.

8. A switch structure of the character described, including: a base; an armature providing a contacting face and providing an opening therein; a magnet frame providing two auxiliary contacting faces spaced from each other in a given direction and lying in a given plane, said magnet frame being adapted to be electrically magnetized to attract said armature and produce engagement between said contacting face and said auxiliary contacting faces; a movable member moved by said armature and pivoted with respect to said base on an axis lying in a plane parallel to the plane of said two auxiliary contacting faces; and a single pin carried by said movable member and fitting loosely in said opening in said armature so as to universally pivot said armature with respect to said movable member, said pin lying in a plane intermediate said two auxiliary contacting faces which plane extends at right angles to the axis about which said movable member pivots.

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