Aug. 24, 1943. N. A. KURMAN 2,327,533

RELAY

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Fig. 1

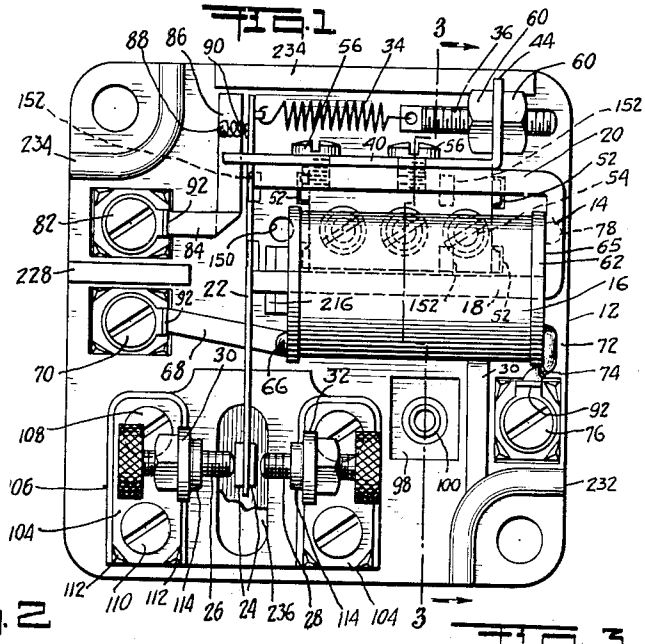


Fig. 2

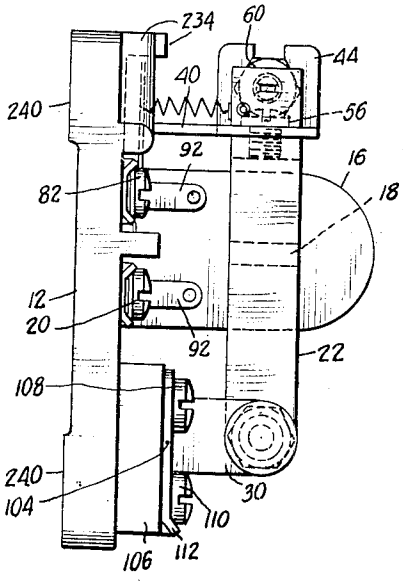


Fig. 3

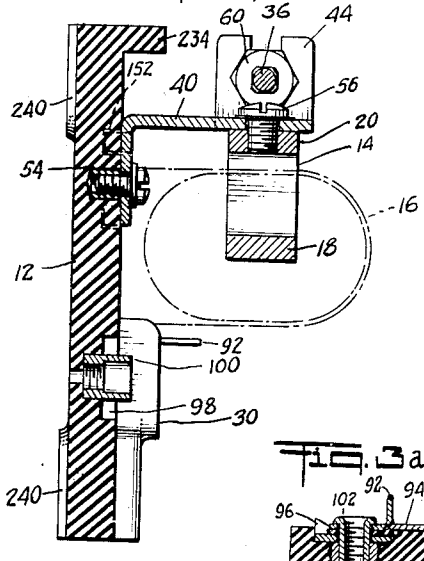
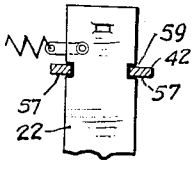


Fig. 3a

Fig. 2a



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Fig. 4

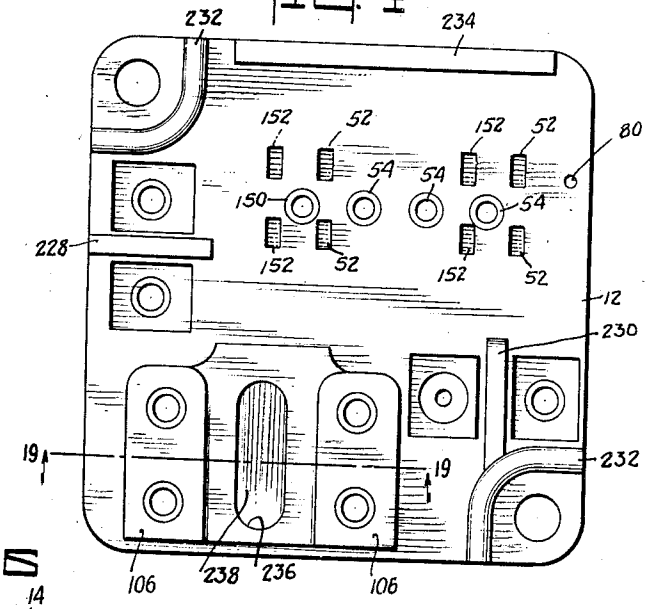


Fig. 4a

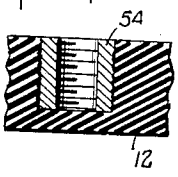


Fig. 6

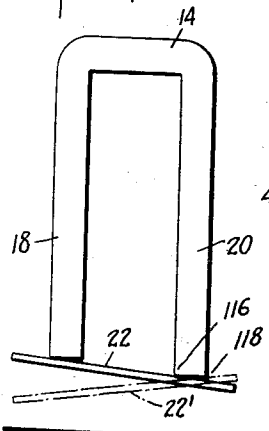


Fig. 5

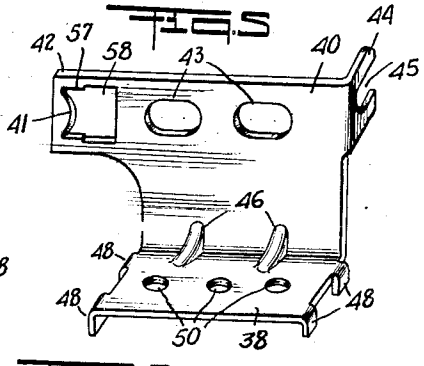


Fig. 7

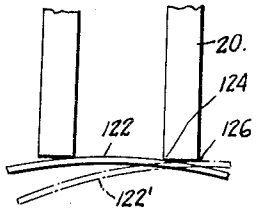


Fig. 9

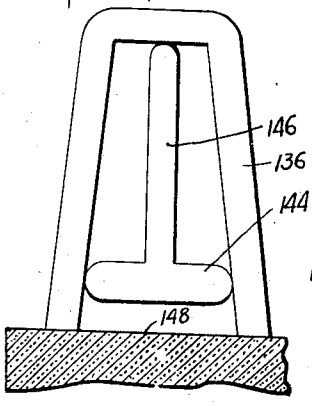


Fig. 8

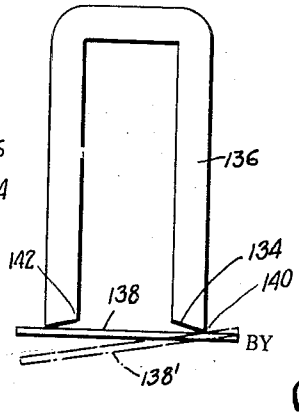
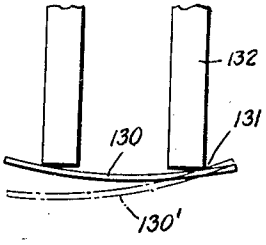


Fig. 10



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RELAY

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Fig. 11

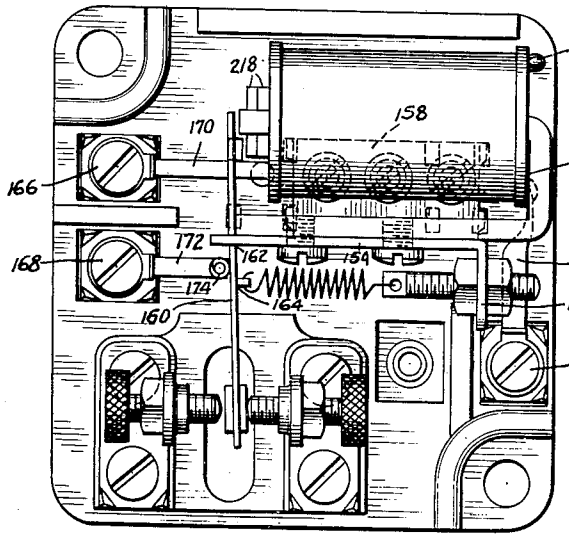


Fig. 16

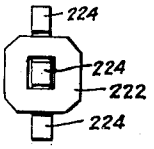


Fig. 15

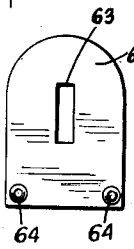


Fig. 17

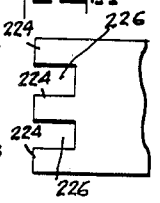


Fig. 18



Fig. 12

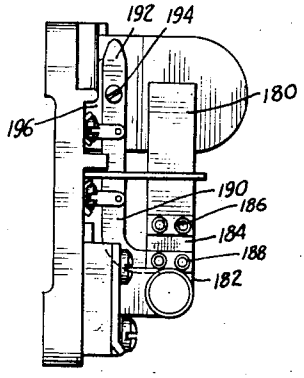


Fig. 13

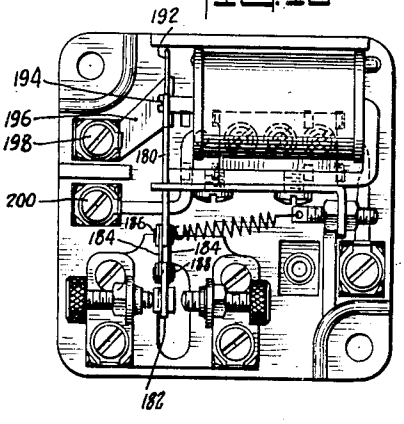


Fig. 13a

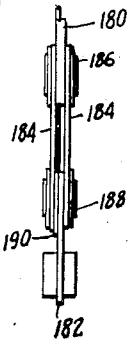


Fig. 14

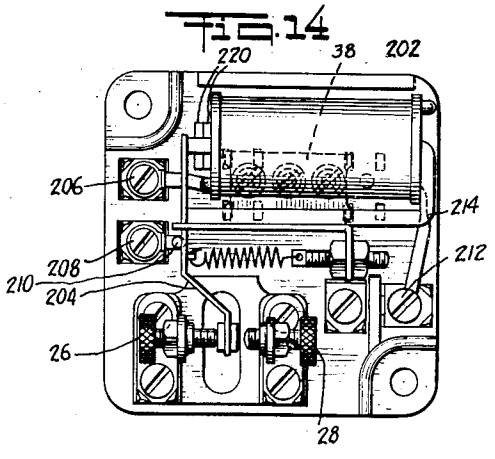
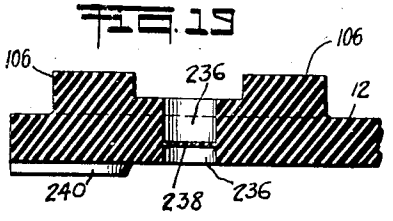


Fig. 19



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Patented Aug. 24, 1943

2,327,533

UNITED STATES PATENT OFFICE

2,327,533

RELAY

Nathan A. Kurman, Woodside, N. Y.

Application April 13, 1942, Serial No. 438,805

13 Claims. (Cl. 175—336)

This invention relates to relays, and more particularly to sensitive relays intended for use in aircraft radio, and for keying, antenna changeover, and automatic controls of various kinds.

The primary object of my invention is to generally improve sensitive relays.

The relay employs a U-shaped pole piece having a coil assembly around one arm of the pole piece. The armature extends across the ends of the pole piece, and fulcrums on the other or outside arm of the pole piece. It is normally urged to open position by a restoring spring connected to an adjusting screw.

One specific object of my invention is to provide a simplified and sturdy mounting for the parts of the relay, and with this object in view, I provide a single sheet metal bracket, the base of which is secured to the insulation base of the relay, and the upper part of which functions, first, to hold the pole piece rigidly in position, second, to retain the armature at the ends of the pole piece, and third, to hold the adjusting screw for the spring.

The relay of the present invention is not only sensitive, but has almost "meter accuracy". For example, in a typical case, the operating specification may require the relay to act at 400 milliamperes and to "drop out" or release at 200 milliamperes. A small tolerance may be provided, the four-hundred figure being given a range, for example, of 380 to 420 milliamperes. In practice, I found that while many relays functioned satisfactorily, other relays of seemingly identical construction would tend to stick within the critical range of current, and so spoil the desired accurate response. On careful study of this problem, I found that the effective adjustment of the restoring spring is sometimes altered during operation by a shift of the effective location of the fulcrum of the armature, and a consequent change in the leverage system on which the spring works. This shift is from one edge to the other of the pole piece end. It may be caused by a slight convexity of the armature toward the poles, or by a slight inequality in the length of the poles, such that the ends, while square, do not lie in one plane, or may be caused by a slight angularity in an outward direction at the end of the fulcrum pole.

One object of the present invention is to overcome the foregoing difficulties, and to prevent any shift in the effective fulcrum without, however, appreciably increasing the reluctance or reducing the efficiency and power of the relay. This object may be readily fulfilled by a slight bending of the armature to make it slightly concave toward the poles. An alternative cure is to grind the end of the outside pole to make it slightly angular in an inward direction.

The adjustment of a sensitive relay is critical, and a shift in the location of the pole piece of only say, one-half of one-thousandth of an inch, may be sufficient to throw the relay out of adjustment. In accordance with a further feature and object of my invention, the mounting of the coil assembly on the base is preferably made independent of the mounting of the pole piece, and a slight clearance is preferably provided between the side arm of the pole piece, and the coil assembly surrounding the same, so that any change in the location of the coil assembly will not affect the position of the pole piece and the adjustment of the relay.

The relay may be made in varying types to fit different conditions. Sometimes an end pivot for the armature will be wanted, and at other times a center pivot. Sometimes the coil may be short, and at other times a greater number of turns may be wanted for a more powerful relay, thus leading to the use of a longer coil. Sometimes the entire armature is connected in the external or controlled circuit, but at other times the contact end of the armature must be insulated. Some relays are intended for A. C. and some for D. C. operation.

A further object of the invention is to simplify the provision of these different types, and to make it possible to supply the same at reasonable cost. For this purpose I have provided a single molded insulation base, which may be used in common for all types, the said base preferably being provided with a few extra holes which make it universally useful for the different relay types. Many of the metal parts are also usable for most or all of the relays.

To the accomplishment of the foregoing, and other objects which will hereinafter appear, my invention consists in the relay elements and their relation one to the other, as hereinafter are more particularly described in the specification, and sought to be defined in the claims. The specification is accompanied by drawings in which

Fig. 1 is a plan view of a typical relay embodying features of my invention;

Fig. 2 is an end elevation of the same;

Fig. 2*a* is a detail;

Fig. 3 is a section taken approximately in the plane of the line 3—3 of Fig. 1;

Fig. 3*a* is a detail;

Fig. 4 is a plan view of the molded insulation base with the parts of the relay removed;

Fig. 4a is a detail;

Fig. 5 is a perspective view showing a bracket forming a part of the relay;

Fig. 6 is a schematic drawing explanatory of one cause of fulcrum shift;

Fig. 7 schematically illustrates another cause of this difficulty;

Fig. 8 is a diagrammatic exaggerated showing of one way to avoid fulcrum shift;

Fig. 9 diagrammatically illustrates one method of grinding the ends of the pole piece;

Fig. 10 diagrammatically illustrates another method of avoiding fulcrum shift;

Fig. 11 is a plan view of a relay modified to use a center pivot;

Fig. 12 is an end elevation of a modified relay having an insulated armature;

Fig. 13 is a plan view of the same relay;

Fig. 13a is a detail drawn to enlarged scale;

Fig. 14 is a plan view of a relay having a lengthened coil;

Fig. 15 is an end elevation of the coil assembly;

Fig. 16 is an end view showing a shading coil used when the relay is to be operated by alternating current;

Fig. 17 is a side elevation of the end of the pole of such an A. C. relay;

Fig. 18 is a similar view of a pole intended for D. C. operation; and

Fig. 19 is a section through a part of the base taken approximately in the plane of the line 19—19 of Fig. 4.

Referring to the drawings, and more particularly to Figs. 1 through 5, the relay comprises a molded insulation base 12, a U-shaped pole piece 14, a coil assembly 16 disposed on the inside arm 18 of the pole piece, while the free end of the outside arm 20 of the pole piece acts as a fulcrum for the armature 22 extending across the ends of the pole piece. The pole piece is preferably made of a heat-treated nickel alloy. The working end of the armature carries appropriate contact surfaces 24 which cooperate with contact screws 26 and 28, threadedly received in contact posts 30 and 32. The armature is normally pulled to open position by a pull spring 34, connected at one end to the armature, and at the other end to a threaded adjusting screw or bar 36.

A single sheet metal support bracket carries the pole piece, the armature, and the adjusting screw. The shape of this support bracket is best shown in Fig. 5, where it will be seen that it comprises a base portion 38 and an upright portion 40, the latter including an extension 42 and an outwardly bent ear 44. The bracket is rigidified by indented reenforcements 46. Auxiliary locating lugs 48 may be turned downwardly at the ends of the base 38. These are in addition to three holes 50 for screws.

Referring now to Fig. 4, the molded insulation base 12 has four recesses 52 properly located to receive the lugs 48. It is further provided with three holes 54 to receive the screws which pass through the holes 50 of the bracket. These holes 54 may be threaded to receive the screws, or the bottom of the base may have enlarged (countersunk) holes to receive nuts for the screws, or, as I prefer, small metallic bushings or inserts may be molded directly in the base, these inserts being internally threaded to receive the screws. The outside is preferably knurled to receive the insulation material molded thereabout. The top ends of these bushings do not project above the base. One of these flush bushings is shown in section in Fig. 4a of the drawings.

Reverting now to Figs. 1, 2 and 3, the outside arm 20 of the pole piece is secured directly against the upright bracket wall 40 by means of screws 56. While not shown in the drawings, thin shakeproof washers are preferably inserted beneath the heads of the screws to guard against possible loosening of the same.

The armature 22 passes freely through the large opening 58 (see Fig. 5) of the bracket, and may then be moved into the stepped or reduced portion 57. The armature is notched, as shown at 59 in Fig. 2a, to receive the stepped portion 57. As a result the armature is retained at the end of the outside arm 20 of the pole piece. It is held against downward tilting by the action of the notches 59. However, these are loose enough not to interfere with the desired slight swinging action of the armature when viewed in plan. The arcuate projection 61 (Fig. 5) is what bears against the outside of the armature, and this permits the armature to seat itself properly against the ends of the pole piece. The clearance or closeness of support of the armature against the outside pole is adjustable by reason of slots 63 (Fig. 5), the pole piece being bodily moved relative to the bracket while the armature is already in position, following which the screws 56 (Fig. 1) are tightened. A shim may be placed between the armature and the fulcrum pole when securing screws 56. The shim may be a few, say two, thousandths of an inch in thickness. When the armature thus lies against the pole piece it cannot move from step 37 (Fig. 5) to the enlarged space 58.

The spring adjusting bar 36 passes freely through the outwardly bent ear 44, previously referred to, the adjustment of this bar being fixed by oppositely tightened nuts 60. The ear is preferably slotted, as shown at 45 in Fig. 5, thereby facilitating assembly and disassembly of the relay. The threaded bar 36 is preferably flattened or squared on the outside, as is best shown in Fig. 3, the threads being left in full at the corners. This construction is convenient so that the bar may be held against rotation while adjusting the nuts 60. The slot 45 preferably fits the flat sides of the bar, thus itself preventing rotation of the bar.

The coil assembly 16 might be held in position by the pole piece. However, I prefer to provide at least a slight clearance between the inside arm of the pole piece and the inside of the coil assembly, so that any slight change in position of the coil assembly, as for example if accidentally pushed or struck, will not be accompanied by a like movement of the pole piece, for that may throw the relay out of adjustment. I therefore mount the coil assembly independently on the base of the relay. Referring to Fig. 15, the end pieces 62 of the coil assembly are shaped as shown, and the lower corners are provided with tiny metallic eyelets 64. One eyelet at each end is used for the end of the magnet wire coming out of the coil. These two eyelets are also used to locate the coil on the main base, as by soldering the same to metallic straps. A third eyelet is additionally secured by soldering the same to the head of a locating screw, so that the coil assembly is held to the base at three points. It may, of course, be held at four points by using the fourth eyelet, and another locating screw. The slot 63 (Fig. 15) is slightly larger than the pole piece

both horizontally and vertically. I also provide clearance at the end of the coil, that is, at **65** in Figs. 1 and 11.

Referring to Fig. 1, one of the holding points for the coil is the point **66**, where strap **68** extends between terminal screw **70** (or more accurately, the insert for screw **70**) and one of the eyelets on the coil assembly. This connection also serves as an electrical connection for one end of the coil. Another holding point is the point **72**, where a longitudinally twisted metal strap **74** extends between one of the eyelets and a terminal screw **76**. This acts also as an electrical connection to the other end of the coil. It will be understood that the ends of the magnet wire pass from inside the end pieces of the coil assembly, through the eyelets, to the soldered connections. The third holding point is at the numeral **78**, where a small self-threading drive screw (such as a Parker-Kalon screw) is driven into a hole in the base. This is the hole **80** shown in Fig. 4. It may be molded, or, being tiny, it may be drilled. If drilled its location is readily changed for a center pivot relay. Solder is flowed at the point **78** between the head of the screw and the immediately adjacent eyelet on the end piece **62** of the coil assembly. If desired, a short bit of wire or metal may be laid between the head of screw **78** and the eyelet, thus guiding and supporting the flow of solder therebetween.

In the present relay (Fig. 1) the armature is not insulated. It is connected in circuit from terminal screw **82** by means of a strip of metal **84**, which is folded at right angles, thus providing an extension **86** which extends parallel to and almost beneath the armature. Electrical connection is completed by means of a flexible pigtail wire **88**, the lower end of which is soldered to strip **86**, and the upper end of which is soldered to a tiny lug **90** which is eyeletted to the armature.

A conventional short upright soldering lug **92** may be provided at each of the terminal screws **70**, **76**, and **82**. These soldering lugs are detachably held beneath the heads of the screws, the latter being threadedly received in metal inserts or bushings molded into the base. The upper ends of the bushings are flanged or riveted to hold the connecting straps **68**, **74**, and **84** previously referred to, as is best shown in Fig. 3*a*, in which the enlarged apertured end of a connecting strap is indicated at **94**, while a rectangular metal washer with upturned corners is shown at **96**, the latter being useful when connecting a wire directly beneath the head of the terminal screw. They are also useful to hold the free soldering lugs **92** against rotation. The rectangular washers are received in mating rectangular recesses in the base, four of which are clearly shown in Fig. 4, and one of which is shown at **98** in Fig. 3. The section through the latter is through an insert **100**, which is not used in the particular relay here shown, and which therefore has not been riveted over on top of any other parts. When the end is riveted over, it takes the form shown at **102** in Fig. 3*a*.

The contact posts **30** and **32** are formed integrally with sheet metal base portions **104** (Figs. 1 and 2), which are disposed on top of raised blocks of insulation **106**. Each post is held by two screws **108** and **110**. Of the latter, the outer screw is also used for electrical connection to the relay, and for this purpose the corners are turned upwardly, as indicated at **112**. In some variant forms of relay (double pole, in which two contact screws are wanted on one side of the armature), I provide two contact posts, each of which is held in position by only one screw, instead of a single post being held by two screws, as here illustrated.

In order to increase the length of thread between the contact screw and the contact post, the metal of the latter is preferably extruded inwardly for a substantial distance, as is indicated at **114** in Fig. 1. In this way the effective length of the thread may be increased to about twice the thickness of the metal used for the contact post. It will be understood that the ends of the contact screws are provided with special inserts or non-pitting surfaces for long wear. Silver or other metal may be used, depending on the particular use of the relay. The same applies to the contact surfaces **24** on the end of the armature itself.

It will be understood that for any one adjustment, the effect of the pull spring **34** on the armature **22** depends on the precise location of the fulcrum on which the armature is moved. The fulcrum should not shift. Under some conditions it may do so.

Thus, referring to Fig. 6, it will be seen that when the armature is in the closed position **22**, the fulcrum is at the inside corner **116** of the outside pole **14**. When the armature is in the open position **22'** the fulcrum is at the outside corner **118** of the pole **20**. Between these two positions the armature will lie flat against the end of pole **20**. There is evidently a distinct change in the leverage on which the pull spring operates when the fulcrum shifts between corners **116** and **118**. In Fig. 6 the armature is straight, and the pole ends are square, but the fault arises because the pole ends do not lie in a common plane. The error is greatly exaggerated in this and succeeding diagrams, for the sake of clarity.

The same difficulty may arise for other reasons, for example, because of the armature being bent convexly toward the poles. This is shown in Fig. 7, in which it will be seen that the convex armature **122**, when in the closed position, turns on the inside corner **124** as a fulcrum, whereas, when in the open or broken line position **122'**, it turns on the outside corner **126** as a fulcrum. This same difficulty may arise if the end of the outside pole **20** has a slight slope outwardly (upwardly toward the outside as viewed in Fig. 7), instead of being perfectly square.

One method of curing these difficulties is to intentionally bend the armature slightly concavely toward the poles, this being illustrated at **130** in Fig. 10. It will be evident that with this change, the armature can move between the solid and broken line positions **130** and **130'**, while at all times using the outside corner **131** of the pole **132** as a fulcrum.

Another method is that illustrated in Fig. 8, in accordance with which the end **134** of the outside pole **136** is ground at an angle sloping inwardly. In such case the armature can move between the closed and open positions **138** and **138'**, while always using the outside corner **140** as a fulcrum. It is not necessary for the other pole to be ground inwardly, as shown at **142**, but in one particular method of practising my invention, it is simpler to do so. This is illustrated in Fig. 9, in which it will be seen that a spreader or jig **144** is inserted between the arms of the pole piece, thereby spreading the same slightly. A spacer arm **146** may be used to properly locate the spreader **144** relative to the ends of the pole piece. The pole piece is then held against the side of a grinding wheel, or is in any other way

rubbed against a planar grinding surface 148. Emery paper secured on a steel disc may be used. After grinding the ends, the spreader 144 is removed, permitting the poles to spring back to original parallel condition. This provides the desired slight angle at the ends.

It should be kept in mind that the changes here illustrated are very slight. For example, with a pole piece about an inch and a half in length, the ends are spread only a matter of $\frac{1}{32}$ of an inch. The angle should be kept slight, or, if the armature is bent as shown in Fig. 10, the concavity of the same should be kept very slight, in order not to appreciably increase the reluctance, or decrease the efficiency and power, of the relay.

Referring now to Fig. 11, I there show a modification in which the relay employs a center pivot instead of an end pivot. For this purpose a bracket 154 is used, which is similar to that previously employed, except that it is reversed as to transverse dimension, that is, if the bracket of Fig. 5 is considered to be right-hand, then the bracket 154 for the center pivot relay is left-hand. Specifically, the relative disposition of the ear 156 (Fig. 11) and the base 158 is reversed compared to the arrangement in Fig. 5. The shape of the brackets, before bending, is the same. A single cutting die may be used for both. Only the bending die is different. The pole piece is the same, and the same screws, inserts, and slots in the base are used to mount the bracket 154. The pole piece is inverted, the bracket being secured, as before, to the outside pole (meaning outside the coil), said outside pole having two tapped holes to receive the two screws shown. The location of the inserts in the base is so selected, as will be seen by comparison of Figs. 1 and 11, that the coil is moved inwardly in Fig. 1 to make room for the pivot and adjusting spring mechanism at the outside of the coil, whereas in Fig. 11, the coil is moved outwardly, thus providing increased room for the pivot and adjusting spring mechanism on the other side of the coil. This desired result is obtained because the screws which hold the bracket to the base are displaced from the center line of the coil, and the amount of that displacement is selected to obtain the desired shift in coil position. In the specific example here illustrated, the screws are located halfway between the arms of the pole piece.

In Fig. 11 the armature 160 differs from that previously described in being shorter, and notched at the point 162 to fit in the bracket, and in similarly changing the location of the loop 164 struck therefrom, which loop receives one end of the restoring spring. Also the functions of the terminal screws 166 and 168 are reversed, the screw 166 having a connection 170 to the eyelet and coil end of the coil assembly, and the screw 168 having a connection 172 to a flexible pigtail wire 174 leading to the armature, and connected thereto at its upper end by means of a small eyelet. The connection 176 between terminal 178 and the other end of the coil and its eyelet, is appropriately lengthened. The location of drive screw 179 for a soldered holding connection to a third corner eyelet of the coil assembly is also changed. In other respects the relay is unchanged. As before, the coil is mounted independently of the pole piece, and a slight clearance (say 20 thousandths of an inch) is provided therebetween.

Another modified relay is shown in Figs. 12 and 13. This relay resembles that shown in Fig. 11 in having a center pivot, but it differs in insulating the armature from the external circuits controlled by the relay.

Referring to Figs. 12, 13, and 13*a*, the armature consists of an inner portion 180, and an end portion 182, the latter being connected to the part 180 by thin pieces of mica 184, these being eyeletted by means of four eyelets, two passing through the part 180 as shown at 186 in Fig. 13*a*, and the other two passing through the part 182 as shown at 188 in Fig. 13*a*. In this way the end portion 182 is insulated from the armature 180 of the relay. There remains, however, the problem of connecting the end portion to an external circuit. This is done by means of a generally L-shaped piece of very thin, flexible, resilient material, best shown at 190 in Fig. 12. One end is connected to the end portion 182 of the armature (within the mica) by means of the eyelets 188 previously referred to. The remote end 192 of the long arm of the L-shaped piece of metal is connected by means of a screw 194 to a connecting member 196 extending from terminal screw 198 to a point beneath the long arm 192. It will be evident that because of the length and flexibility of the L-shaped connecting part 190, there is no appreciable resistance to movement at the contact end of the armature.

It will be understood that the relay of Fig. 1 may also be changed to use pieces of mica to insulate the end of the armature, as shown in Fig. 13*a*, and that in such case the functions of the terminal screws 70 and 82 in Fig. 1 will remain the same as there shown, or the same as shown for the terminal screws 198 and 200 in Fig. 13. This is reversed from the functions of the terminal screws 166 and 168 in Fig. 11.

Fig. 14 shows still another modified form of relay using a coil assembly 202 which is substantially longer than that used in the relays previously described. The relay of Fig. 14 happens to be a center pivot relay like those shown in Figs. 11 and 13, the essential change being that the pole piece and coil assembly have been lengthened. The support bracket is unchanged. The reason the same support bracket may be used, may be explained with reference to Fig. 4 showing the insulation base. Referring to Fig. 4, it will be noted that in additon to the three holes 54, a fourth hole 150 is provided, the spacing between all of the holes being equal. Moreover, in addition to the four rectangular recesses 52, four additional recesses 152 are provided, these being spaced from the recesses 52 by the same amount that the holes are spaced from one another. It will thus be evident that the support bracket may be moved and secured to the base by means of the hole 150 and two of the holes 54, the right-hand hole 54 not being used. At the same time, the recesses 152 will receive the downwardly turned lugs 43 (Fig. 5), the other recesses 52 remaining idle.

Reverting now to Fig. 14, it will be seen that the base of the bracket, shown in dotted lines at 38, is in the left-hand instead of the right-hand position. The coil assembly 202 may therefore be lengthened by the amount of this leftward movement of the bracket. Inasmuch as the position of the contact posts and their screws 26 and 28 has not been changed, the relative displacement of the parts of the relay is taken care of by bending or offsetting the ends of the armature, as shown at 204.

As in the case of Fig. 11, the terminal screw 206 is connected to one end of the coil, the ter-

minal screw 108 is connected to the armature by means of a flexible pigtail wire 210, and the terminal screw 212 is connected to the other end of the coil by means of connecting strap 214.

It should be understood that the lengthened coil may also be used with an end pivot instead of a center pivot. In other words, the bracket of Fig. 1 may be moved leftward in the same manner as has just been described, in order to accommodate a longer coil assembly. The armature is then bent or offset, as described in connection with Fig. 14.

Any of the relays may be designed for either A. C. or D. C. operation. When designed for D. C. operation, it is unnecessary to employ shading coils such as are indicated at 216 in Fig. 1, at 218 in Fig. 11, and at 220 in Fig. 14. These shade coils are simply stamped loops of copper or other conductive metal, which are forced into slots 226 in the end of the pole piece, best shown in elevation in Fig. 17. The shade coils are pressed into the slots, and may be generally rectangular in outline, as is indicated at 222 in Fig. 16. Fig. 16 is an end view of the pole, showing how the copper loop 222 is fitted into two slots in the end of the pole piece, so that they are held between three tenon-like projections 224. In the case of a D. C. relay, the end of the pole piece need not be slotted, it being left whole as shown in Fig. 18.

Considering the molded insulation base itself, it may be pointed out that a raised wall 228 (Fig. 1 and Fig. 4) is disposed between one pair of terminals, while a raised wall 230 is disposed between the other pair of terminals, thereby guarding against accidental short circuit between the leads going to these terminals. Moreover, raised walls 232 are provided around the corner mounting screws, thereby protecting against accidental contact between a lead wire and the head of a mounting screw, which in turn might short circuit to the metal chassis on which the relay is mounted. There is also a wall 234 extending along one edge, this being primarily to increase the strength and rigidity of the base.

A relatively large opening 236 is provided through the base in the space between the contact posts. As is best shown in Fig. 19, this hole is initially blind, it being closed by a very thin fin 238 of insulation formed integrally with the base. The web or fin 238 is thin enough to be broken away, if it is desired to use the passage 236. The passage 236 is used in the event that the relay is to be fully covered by means of a dustproof cover. In such case the lead wires are brought in from beneath the base, through the passage 236, and from there radiate outwardly to the different terminal screws. In most cases the relay is not enclosed, and there is no need to push the web 238 out of the base. The web is kept very thin, particularly at its connection to the base, so that the hole will be smooth or can be smoothed when the web is broken away.

The bottom of the base has feet at the corners, as will be seen at 240 in Figs. 2 and 3. These prevent rocking of the base, and give it a firm foundation, despite possibility of slight warping of the chassis on which the base is mounted. This in turn guards against distortion of the base when it is mounted in position, which in turn will help prevent a change in the relation of the working parts of the relay, with possible need for readjustment. The feet also make it possible for lead wires to run beneath the base to the passage 236 previously referred to, in the event that the relay is covered.

The raised pedestals of insulation 106 for the contact posts 30 and 32 are desirable mechanically because they shorten and therefore stiffen and rigidify the contact posts, and are desirable electrically because they increase the length of surface path between the contact posts and the other terminals on the base, thereby improving the insulation therebetween.

It is believed that the construction and method of assembly and use of my improved relay, as well as the many advantages thereof, will be apparent from the foregoing detailed description thereof. It will also be apparent that, while I have shown and described my invention in several preferred forms, many changes and modifications may be made in the structure disclosed, without departing from the spirit of the invention as sought to be defined in the following claims.

I claim:

1. A relay comprising an insulation base, a U-shaped pole piece, an armature extending across the ends of said pole piece, a coil on one arm of said pole piece, a spring and adjusting screw for normally pulling the armature away from the coil, and a single bracket bent out of sheet metal for supporting the pole piece and holding the adjusting screw, said bracket having a base portion secured to the insulation base, an upright portion secured to the outside arm of the pole piece, and an outwardly bent ear receiving the adjusting screw.

2. A relay comprising an insulation base, a U-shaped pole piece, an armature extending across the ends of said pole piece, a coil on one arm of said pole piece, a spring and adjusting screw for normally pulling the armature away from the coil, and a single bracket bent out of sheet metal for supporting the pole piece and holding the adjusting screw, said bracket having a base portion secured to the insulation base, an upright portion secured to the outside arm of the pole piece, and an outwardly bent ear receiving the adjusting screw, said adjusting screw being flattened at opposite sides and having two nuts thereon, and said ear being slotted with an open ended slot dimensioned to non-rotatably receive said screw with the nuts on opposite sides of the ear.

3. A relay comprising an insulation base, a U-shaped pole piece, an armature extending across the ends of said pole piece, a coil on one arm of said pole piece, the end of the other arm of said pole piece acting as a fulcrum for the armature, and a single bracket bent out of sheet metal for supporting the pole piece and retaining the armature in position, said bracket having a base portion secured to the insulation base, and having an upright portion secured to the outside arm of the pole piece, the upright portion including an extension with an opening therethrough for receiving the armature, said extension being immediately adjacent the fulcrum acting pole piece, said armature being notched to mate with the top and bottom edges of the aforesaid opening.

4. A relay comprising a molded insulation base, a U-shaped pole piece, an armature extending across the ends of said pole piece, the end of the other arm of said pole piece acting as a fulcrum for the armature, and a single bracket bent out of sheet metal for supporting the pole piece and the armature, said bracket having a base portion secured to the insulation base, and an upright

portion secured to the outside arm of the pole piece, the upright portion including an extension with an opening therethrough for receiving the armature in order to retain the same at the outside end of the pole piece, said extension being immediately adjacent the fulcrum acting pole piece, said armature being notched to mate with the top and bottom edges of the aforesaid opening, the outer edge of the opening being convexly curved to permit the armature to seat itself on the pole end.

5. A relay comprising an insulation base, a U-shaped pole piece, an armature extending across the ends of said pole piece, a coil on one arm of said pole piece, the end of the other arm of said pole piece acting as a fulcrum for the armature, and a single bracket bent out of sheet metal for supporting the pole piece and the armature, said bracket having a base portion secured to the insulation base and an upright portion secured to the outside arm of the pole piece, the upright portion including an extension with a stepped opening therethrough for receiving the armature in order to retain the same at the outside end of the pole piece, said extension being immediately adjacent the fulcrum acting pole piece, said armature being notched to mate with the small part of the stepped opening in the extension, the large part of the stepped opening being large enough to receive the unnotched part of the armature.

6. A relay comprising an insulation base, a U-shaped pole piece, an armature extending across the ends of said pole piece, a coil on one arm of said pole piece, a spring and adjusting screw for normally pulling the armature away from the coil, and a single bracket bent out of sheet metal for supporting the pole piece, the armature, and the adjusting screw, said bracket having a base portion secured to the insulation base, an upright portion secured to the outside arm of the pole piece, and an outwardly bent ear receiving the spring adjusting screw, the upright portion including an extension with means for retaining the armature at the ends of the pole piece, said extension being immediately adjacent the fulcrum acting pole piece.

7. A relay comprising an insulation base, a U-shaped pole piece, an armature extending across the ends of said pole piece, a coil on one arm of said pole piece, the end of the other arm of said pole piece acting as a fulcrum for the armature, a spring and adjusting screw for normally pulling the armature away from the coil, and a single bracket bent out of sheet metal for supporting the pole piece, the armature, and the adjusting screw, said bracket having a base portion secured to the insulation base, an upright portion secured to the outside arm of the pole piece, and an outwardly bent ear receiving the spring adjusting screw, the upright portion including an extension with an opening therethrough for receiving the armature in order to retain the same at the outside end of the pole piece, said extension being immediately adjacent the fulcrum acting pole piece, said armature being notched to mate with the top and bottom edges of the aforesaid opening, the outer edge of the opening being convexly curved to permit the armature to seat itself on the pole ends.

8. A relay comprising an insulation base, a U-shaped pole piece, an armature extending across the ends of said pole piece, a coil on one arm of said pole piece, the end of the other arm of said pole piece acting as a fulcrum for the armature, a spring and adjusting screw for normally pulling the armature away from the coil, and a single bracket bent out of sheet metal for supporting the pole piece, the armature, and the adjusting screw, said bracket having a base portion secured to the insulation base, an upright portion secured to the outside arm of the pole piece, and an outwardly bent ear receiving the spring adjusting screw, the upright portion including an extension with a stepped opening therethrough for receiving the armature in order to retain the same at the outside end of the pole piece, said extension being immediately adjacent the fulcrum acting pole piece, said armature being notched to mate with the small part of the stepped opening in the extension, the large part of the stepped opening being large enough to receive the unnotched part of the armature.

9. A sensitive relay comprising a U-shaped pole piece, an armature extending across the ends of said pole piece, a coil on one arm of said pole piece, the end of the other arm of said pole piece acting as a fulcrum for the armature, and a spring and adjusting screw for normally pulling the armature away from the coil, said armature being very slightly bent concavely toward said pole piece, in order to obviate possibility of fulcrum shift during movement of the armature.

10. A sensitive relay comprising an insulation base, a U-shaped pole piece, an armature extending across the ends of said pole piece, a coil on one arm of said pole piece, means for supporting the pole piece on the base, independent means for supporting the coil assembly on the base, the passage through the coil assembly being slightly larger than the arm of the pole piece to provide a slight clearance therebetween.

11. A sensitive relay comprising an insulation base, a U-shaped pole piece, an armature extending across the ends of said pole piece, a coil assembly around one arm of said pole piece, said coil assembly including insulation ends having eyelets or metal parts at the lower corners thereof, means for supporting the pole piece, the passage through the coil assembly being slightly larger than the inside arm of the pole piece to provide a slight clearance therebetween permitting independent support and positioning of the pole piece and the coil assembly, said coil assembly being held on the base by means of connection straps soldered to the aforesaid eyelets.

12. A sensitive relay comprising an insulation base, a U-shaped pole piece, an armature extending across the ends of said pole piece, a coil on one arm of said pole piece, a spring and adjusting screw for normally pulling the armature away from the coil, and a single bracket bent out of sheet metal for supporting the pole piece, the armature, and the adjusting screw, said bracket having a base portion secured to the insulation base, an upright portion secured to the outside arm of the pole piece, and an outwardly bent ear receiving the adjusting screw, the upright portion including an extension with an opening therethrough for receiving the armature in order to retain the same at the outside pole end, the passage through the coil assembly being slightly larger than the inside pole to provide a slight clearance therebetween permitting independent support and positioning of the pole piece and the coil assembly, said coil assembly including end pieces which extend downwardly to the base, and means independent of the pole piece and bracket for holding the coil assembly on the base.

13. A sensitive relay comprising an insulation

base, a U-shaped pole piece, an armature extending across the ends of said pole piece, a coil on one arm of said pole piece, the end of the other arm of said pole piece acting as a fulcrum for the armature, a spring and adjusting screw for normally pulling the armature away from the coil, and a single bracket bent out of sheet metal for supporting the pole piece, the armature, and the adjusting screw, said bracket having a base portion secured to the insulation base, an upright portion secured to the outside arm of the pole piece, and an outwardly bent ear receiving the adjusting screw, the upright portion including an extension with an opening therethrough for receiving the armature in order to retain the same at the outside pole end, the passage through the coil assembly being slightly larger than the inside arm of the pole piece to provide a slight clearance therebetween permitting independent support and positioning of the pole piece and the coil assembly, said coil assembly including end pieces which extend downwardly to the base and which have small eyelets therethrough, said coil assembly being held on the base by means of connection straps soldered to said eyelets, two of said straps extending to terminal screws and acting as connections for the coil winding.

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