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C. W. KUHN ET AL
ELECTRIC CONTROL DEVICE

2,908,784

Filed Dec. 24, 1956

4 Sheets-Sheet 1

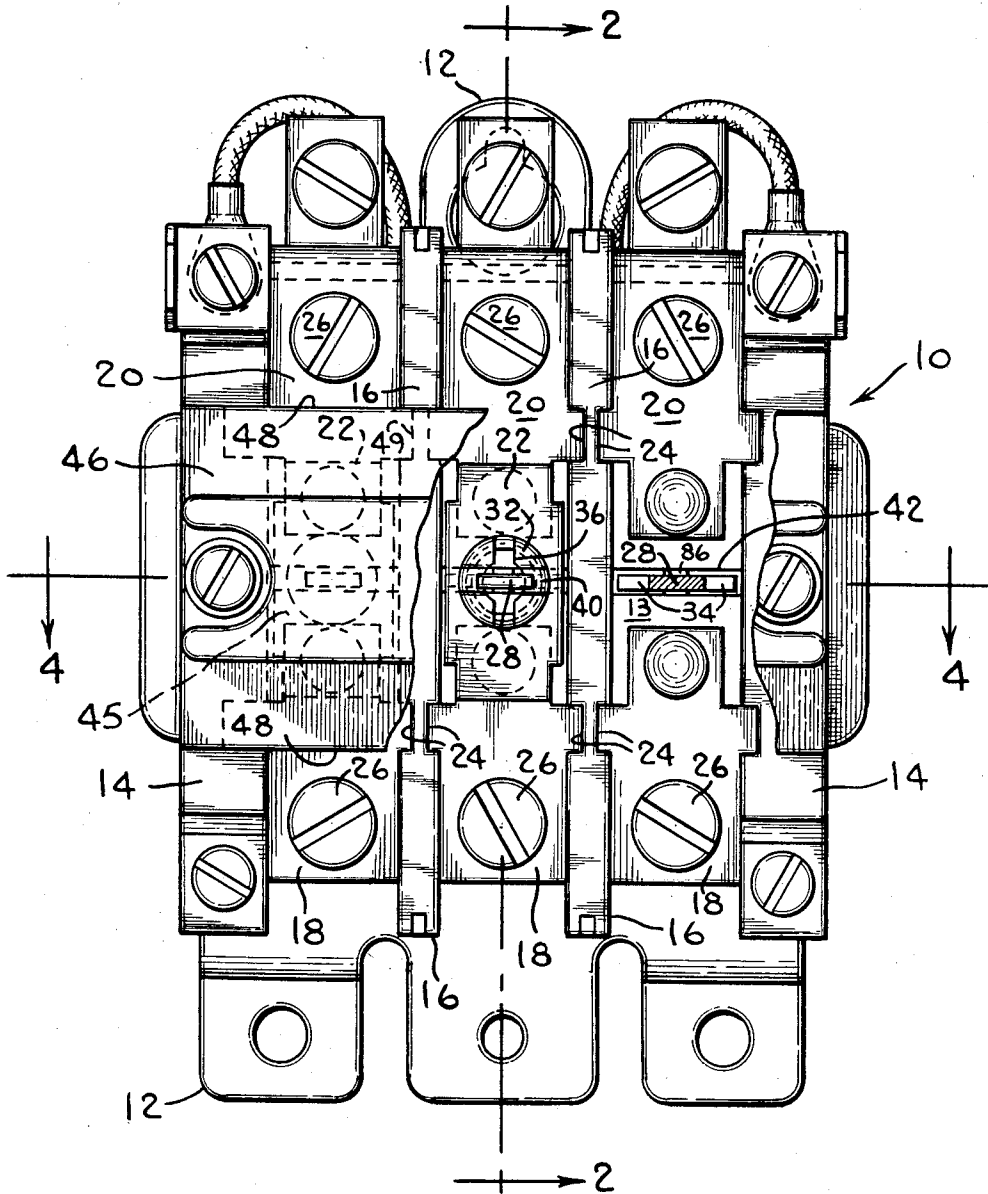


FIG. 1

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FIG. 2

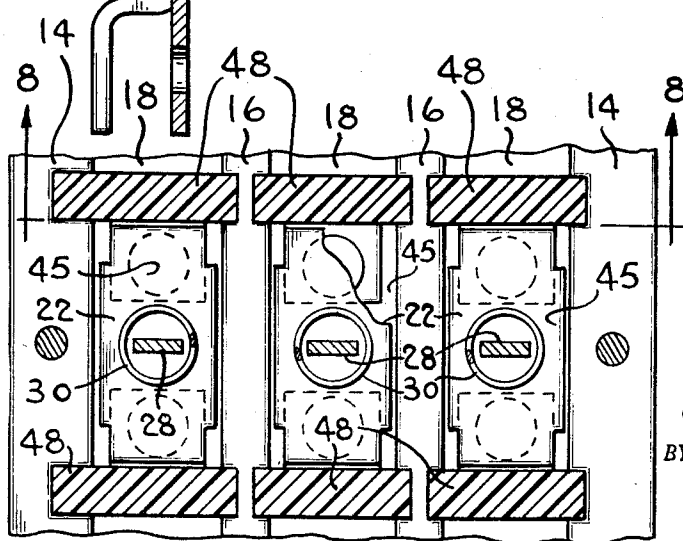
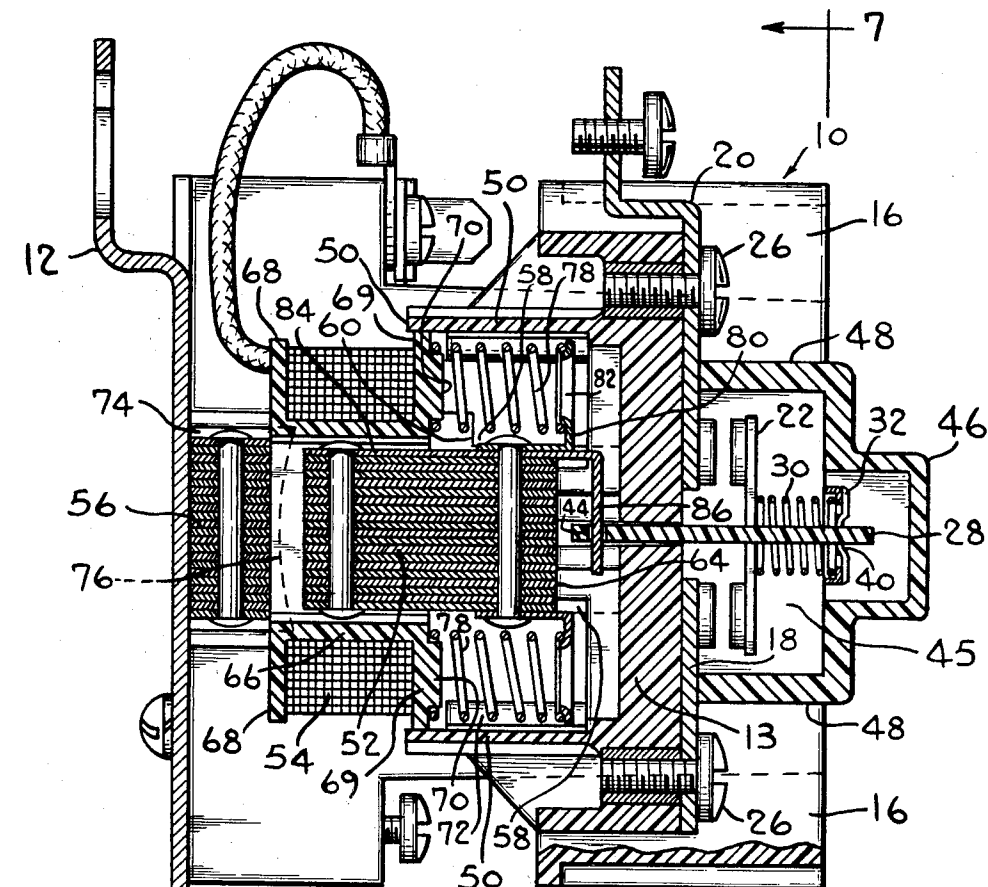


FIG. 7

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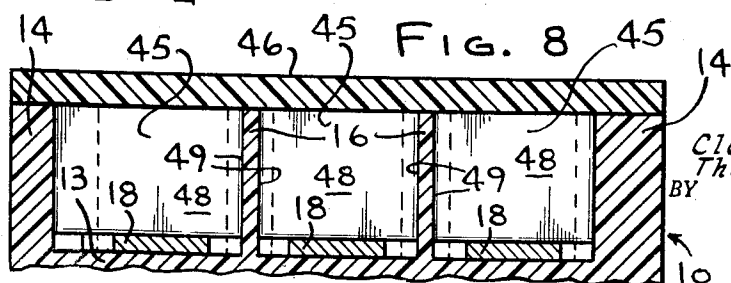
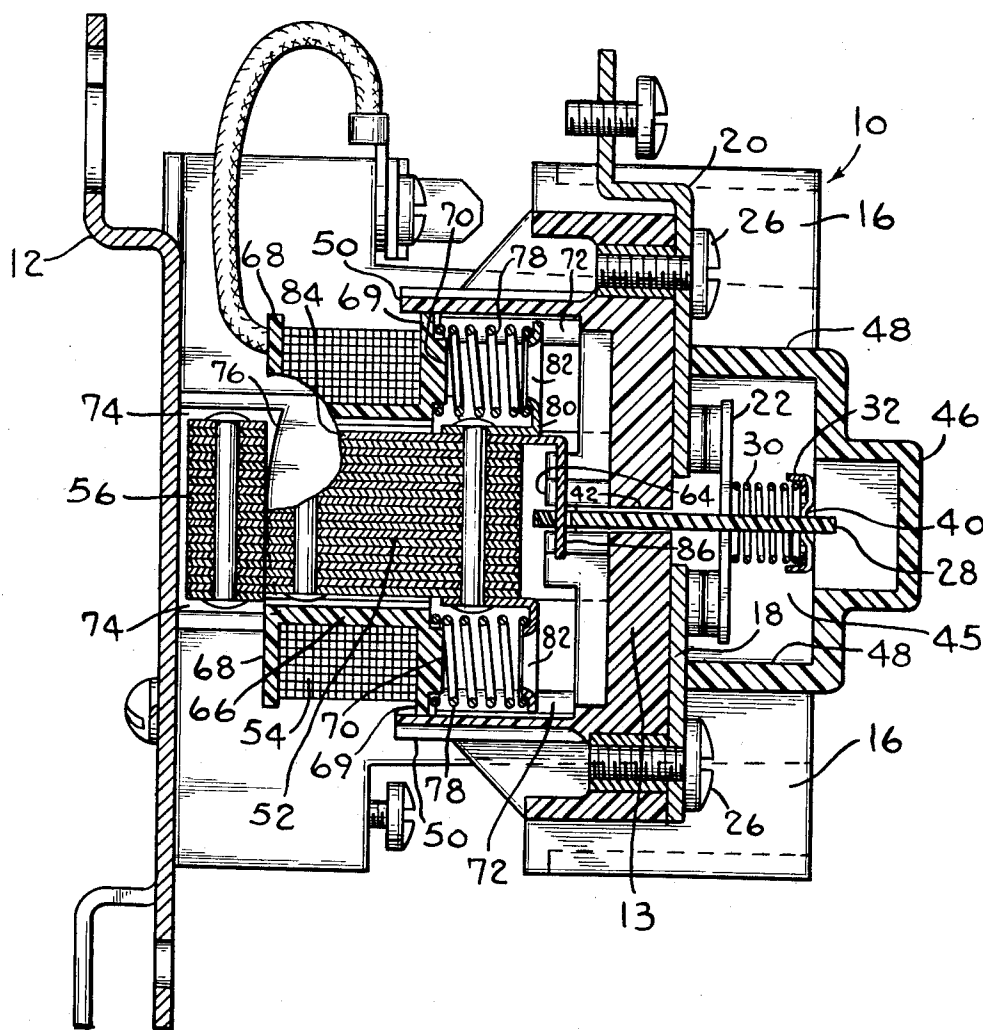
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FIG. 3



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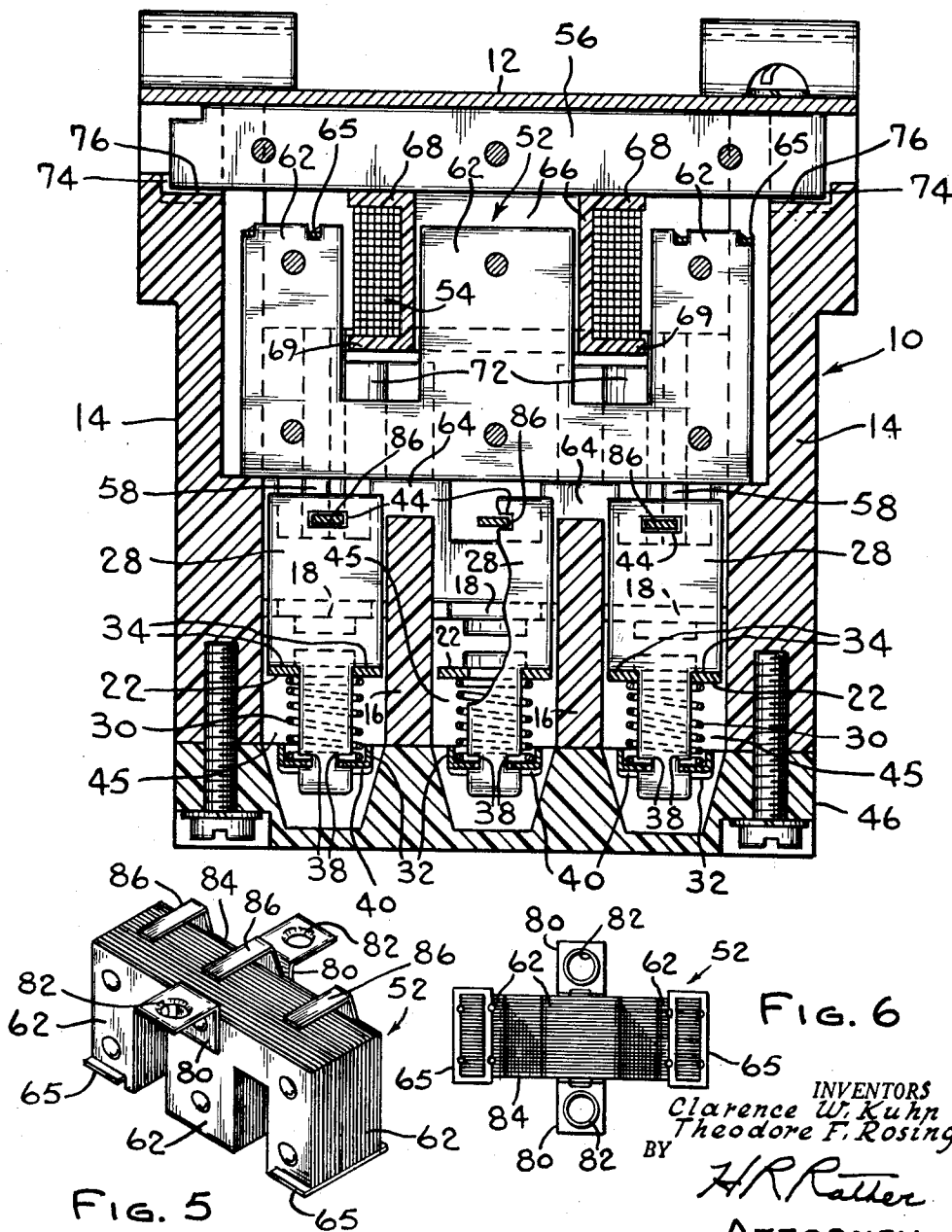
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FIG. 4



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ELECTRIC CONTROL DEVICE

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7 Claims. (Cl. 200—104)

This invention relates generally to electric control devices and more particularly to electromagnetically actuated switches which are suitable for use as contactors or relays.

It is an object of this invention to provide an electric control device with high performance characteristics which is more economical to manufacture than prior art devices.

Another object of this invention is to provide an electromagnetically actuated switch which requires a low amount of operating power.

Another object of this invention is to provide an electromagnetically actuated switch which has a high resistance to short circuiting.

From the broad aspects of this invention, the first and second objects are accomplished by connecting each movable bridging contactor to a single movable armature by separately adjustable linkage. This permits a uniform adjustment for each bridging contactor and shortens the required armature travel. Smaller capacity and cheaper electromagnets can be used with less operating power requirements.

The third object is obtained by completely enclosing each contact assembly in its own pocket.

A switch having these characteristics is hereinafter described and shown in detail in the drawings, in which:

Fig. 1 is a view in front elevation of a switch embodying the invention with parts broken away and shown in section;

Fig. 2 is a sectional view taken on line 2—2 of Fig. 1, showing the electromagnet de-energized and the switch open;

Fig. 3 is a sectional view also taken on line 2—2 of Fig. 1 and showing the electromagnet energized and the switch closed;

Fig. 4 is a sectional view taken on line 4—4 of Fig. 1; Fig. 5 is a perspective view of the movable armature and adjustable linkage;

Fig. 6 is a bottom view of such armature;

Fig. 7 is a fragmentary sectional view taken on the line 7—7 of Fig. 2; and

Fig. 8 is a fragmentary sectional view taken on line 8—8 of Fig. 7.

The switch shown in the drawings is designed for handling up to 20 amperes at 250 volts A.C. with three poles. The rating of the switch may be varied and it may be furnished in 2, 3 or 4 pole versions within the scope of this invention. The induction coil is generally designed for 24 volts at 60 cycles A.C. The elements of the switch are contained within or mounted on an insulating housing 10, the novel characteristics of which will be described in detail in connection with the description of the switch elements. This housing has many characteristics well known to those skilled in this art which are designed to prevent voltage leakage and flash-over and provide for proper heat dissipation and the like. These will not be described in detail except where not apparent. When the switch is fully assembled, a mount-

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ing plate 12 is secured to the rear of the housing to hold the parts in place and provide means for mounting the switch to a panel in the position shown in Fig. 1.

The contact assemblies of each pole are mounted on the outside of a dividing wall 13 between sides 14 and are separated by partitions 16. Each such contact assembly includes a pair of fixed contacts 18 and 20 and a bridging contactor 22. All contacts include silver composition contacting portions mounted in a standard manner. The fixed contacts 20 may have additional offset extensions with terminal screws. All of the fixed contacts are located by interfitting tongue and grooves indicated at 24 and are rigidly secured by screws 26 threadedly engaged with inserts molded into the housing at appropriate places. These screws may also act as terminal screws. The bridging contactor 22 is part of a movable contactor assembly which consists of a flat insulating plunger 23, the bridging contactor 22, a compression spring 30 and a locking cup 32. The plunger is narrowed to form shoulders 34 at the base of a tongue. The contactor 22, being provided with a rectangular shaped opening, loosely rides on such tongue and is resiliently urged against such shoulders by the compression spring. The spring and contactor are removably held on such tongue by the locking cup 32. The locking cup has a non-circular opening 36 adapted in one position to slide on to the tongue. However, when the cup is rotated the sides of such opening will enter indentations 38 in the tongue and hold the cup on the tongue with the spring under compression. To make sure that the cup will not rotate from the locked position during normal operation, the cup may have depressions 40 into which the edge of the indentations 38 seat. However, the cup may be unlocked by forcibly rotating it until the non-circular opening aligns with the tongue. The insulating plungers 23 are slidably mounted in rectangular openings 42 on the dividing wall 13 and their inner ends project to the rear side of such wall and have small openings 44 by which they are connected to the electromagnetic operating means as hereinafter described. An enclosed pocket 45 for each of the contact assemblies is completed and closed by a cover 46 having sides 48 which snugly fit between adjacent ones of the sides 14 and partitions 16; the ends of the sides 48 resting on the fixed contacts 18 and 20 to hold the contacts in place when screws 26 are loosened. The sides 48 have slots 49 which accommodate the reduced sections of the partitions 16 between the grooves 24. This creates a cornered or tortuous path between adjacent pockets. These pockets confine any ionization due to arcing and thus increases the resistance to short circuiting.

The electromagnetic means for operating the contact assemblies is on the inner side of the dividing wall 13 between the sides 14; there being protecting walls 50 extending between the sides 14 to form a recess in which part of such means is located. The electromagnetic means consists of a movable armature 52, an induction coil 54, and a magnet frame 56.

The movable armature 52 is loosely slidably mounted between guides 58 extending from the protecting walls 50, the upper one of which is notched at 60 to facilitate assembly. In comparison with the magnet frame 56, the movable armature has much greater mass. It has three spaced legs 62 which are as long as the coil 54 with the center leg operating within the central opening of the coil. The outer (toward the right as viewed in Figs. 2 and 3) stroke of the movable armature is limited by engaging projections 64 on the dividing wall 13. Its inner or contact closing stroke is limited by engaging the magnet frame 56. As is standard practice, shading coils 65 may be employed on the armature 52.

The induction coil 54 is wound bobbin style on a mold-

ed insulating frame 66 having an open core loosely receiving the center one of legs 62, an inner end plate 68 and an outer end plate 69 having spring centering projections 70. The coil is loosely mounted with its outer end plate 69 within and laterally guided by the protecting walls 50 and guides 58 at the ends thereof. Projections 72 formed between the protective walls 50 and guides 58 have ends which engage the end plate 69 to limit its outer movement. The coil is held on the seat thus formed by magnet frame 56 engaging the end plate 68 and can move slightly in all directions to adjust for variable manufacturing dimensions and to prevent any frictional locking between the movable armature and such coil. The coil has leads 73 which are secured to conveniently placed terminals. The windings of the coil are not enclosed by any part of the housing and free circulation of air thereabout is obtained to dissipate the heat of the coil.

The magnet frame 56 has its ends positioned in recesses 74 formed in the sides 14 and seats against convexly curved bottoms 76 (see Fig. 3) when the electromagnet is energized. This permits the magnet frame to rock and establish a flat surface to surface engagement with ends of the armature legs 62 to eliminate chattering and other objectionable noise and the necessity of maintaining costly close tolerances in manufacture.

It has been found preferable to resiliently return the armature 52 to switch open position and thus permit the switch to be used in any position. This is accomplished by coiled compression springs 78 seated on the spring centering projections 70 and on brackets 80 attached to the armature, such brackets also having spring centering projection 82. The springs 78 are within the protecting walls 50 and at times may be guided thereby. Springs 78 are so selected that upon de-energization of coil 54 they will overcome inertia and friction of the armature and contact assemblies and move the latter to open circuit position.

The contact assemblies are each connected to the movable armature 52 by an adjustable linkage which allows each contact assembly to be independently adjusted. Each contact assembly has its spring 30 which will be compressed after the bridging contactor 22 engages the fixed contacts 18 and 20 as the movable armature 52 moves into face contact with the magnet frame 56. As the silver composition contacting portions wear, good contact will still be obtained by the action of the springs 30 allowing the necessary overtravel to provide such wear allowance (say .053 to .059 inch). Since it is good practice to have contact pressures in the neighborhood of 7¼ oz. to 8¼ oz., it requires considerable force from the electromagnetic operating means to compress such springs prior to the closing of the magnetic gap. If the wear allowance range is maintained with close tolerance the electromagnetic force is lessened and smaller coil capacity is required. To provide for such small wear allowance range tolerance each contact assembly is preferably individually adjustable. To accomplish this a side plate 84 having a deformable finger 86 for each contact assembly is secured to the movable armature 52. These fingers are offset from the end of armature 52 and slidably fit in the openings 44 of the plungers 28. When such armature is held against movement each plunger can be separately moved to bend its finger to the position affording the desired wear allowance.

To set the contacts for a wear allowance within the range from .053 - .059 inch, a gage having a thickness of .053 inch is placed between the movable armature 52 and the magnet frame 56. Coil 54 is energized to lock the armature. The deformable fingers 86, having been roughly set so that there is no contact between bridging contactors 22 and fixed contacts 20 under these conditions, are each separately bent by pushing each bridging contactor into contact with the stationary contacts. The point at which contact is made can be accurately determined by a test lamp connected across the fixed contacts.

After this adjusting operation is completed the .053 inch gage is removed and a .059 inch gage is inserted in its place and the coil 54 is again energized. If the test lamp fails to light then the contact assembly so tested is properly adjusted and falls within the desired range. However, if the lamp lights, such contact assembly is too tight and the fingers 86 should be bent by slightly pulling the plunger 28 of such assembly. A recheck of this assembly with the .053 gage must then be made.

The assembly of the switch may be accomplished by placing the plungers 28 in the openings 42 of the dividing wall with the openings 44 lying beneath the notches 60. The armature 52 is then slid in between the walls 50 while raised in the notches 60 until the fingers 86 are aligned with the openings 44. The armature may then be lowered to normal position and moved into engagement with the projections 64. The bridging contactors 22, springs 30 and cups 32 can now be assembled. Thereafter the return springs 78, coil 54, magnet frame 56 and mounting plate 12 are assembled in that order. No fastenings are required except for the mounting plate 12 which holds the parts in operating position.

When the coil 54 is energized the parts move from the positions shown in Fig. 2 to the positions shown in Fig. 3. During such movement the contacts are engaged and the springs 30 and 78 compressed. The relatively light magnet frame 56 freely rocks on the convex surfaces 76 and makes flush contact with the armature 52. The positioning of the coil 54 by reason of the magnetic field is substantially neutralized and only the light force of springs 78 urges the coil toward the magnet frame. Hence, all parts are easily aligned and maximum holding force developed while enjoying quiet operation.

The momentum imparted to the heavy armature 52 carries it through the critical oscillatory point near its engagement with the magnet frame.

We claim:

1. In an electromagnetically actuated switch having a plurality of fixed contacts, movable contacts cooperable with said fixed contacts, and a single movable armature for simultaneously actuating said movable contacts, separately adjustable linkage between and positively interconnecting said armature and each movable contact to provide individual adjustment between each cooperating pair of contacts.

2. Separately adjustable linkage between a movable armature and each movable contact of an electromagnetically actuated switch, comprising bendable fingers secured to said armature for each movable contact, said fingers having portions transversely positioned relative to the path of actuating movement of said armature, and insulating plungers engaged with said portions and secured to said contacts, said contacts being separately adjusted relative to said armature by a bend imposed on said fingers.

3. An electric control device comprising in combination, an insulating support, pairs of stationary contacts mounted on said support, a movable armature guided by said support, bridging contactors for said pairs of stationary contacts, plungers connecting said armature to said bridging contactors, means for resiliently mounting said contactors on said plungers to provide a wear allowance for said contacts, adjusting means between said plungers and said armature to adjust said wear allowance, and an electromagnetic coil on said support to actuate said armature.

4. An electric control device according to claim 3 in which said adjusting means includes a plurality of deformable fingers fastened to said armature and engaged with said plungers, said fingers being bent to varying degrees to make the wear allowance uniform for each set of cooperative contacts.

5. In an electromagnetically actuated switch having a plurality of contact assemblies including fixed contacts and movable contacts cooperable with said fixed contacts,

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a single movable armature for simultaneously actuating said contact assemblies, separately adjustable linkage between said armature and each movable contact to provide individual adjustment for each contact assembly, and means for enclosing each of said contact assemblies in a separate chamber to increase resistance to short circuiting, said means including a dividing wall between said contact assemblies and said armature having an opening therein, said linkage extending through said opening.

6. An electromagnetically operated switch comprising an insulating support having sides interconnected by a dividing wall, a partition cooperating with said sides and dividing wall to form spaces on one side of said wall, a contact assembly mounted in each space, a movable armature carried on the other side of said wall, said dividing wall having openings, insulating plungers extending through said openings for connecting said armature to said contact assemblies, and a cover of insulating material with side walls cooperating with said sides and partition to enclose each of said contact assemblies in a separate chamber to increase resistance to short circuiting.

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7. An electromagnetically operated switch according to claim 6 in which said sides and partition have grooves, said side walls of said cover are slotted to provide ends fitting in said grooves to form a tortuous path between adjacent chambers to further increase resistance to short circuiting, said contact assemblies include terminal portions extending from said spaces with tongues engaged in said grooves, and the ends of the side walls of said said cover rest on said portions to hold said terminal portions in place.

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