

Sept. 6, 1960

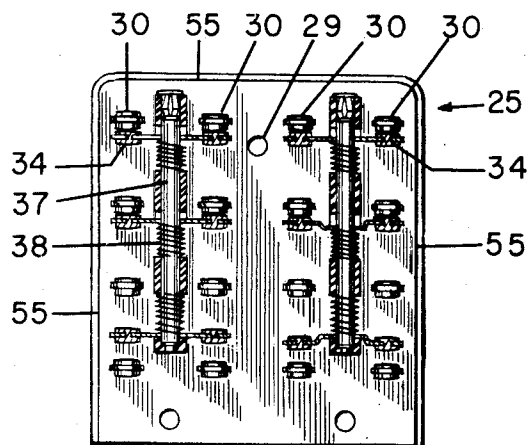
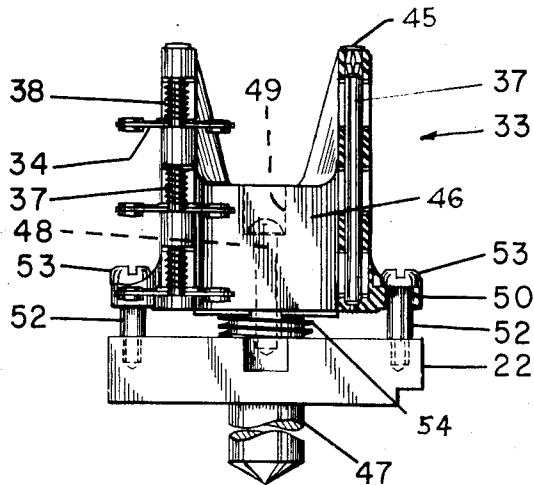
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2,951,922

ELECTRICAL CONTACTOR ASSEMBLY

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3 Sheets-Sheet 2



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3 Sheets-Sheet 3

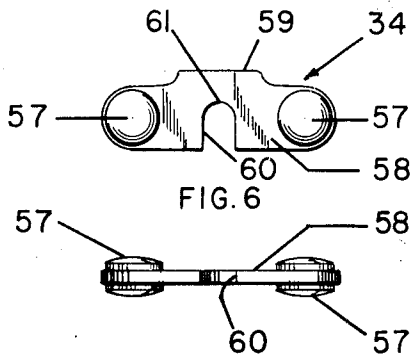


FIG. 6

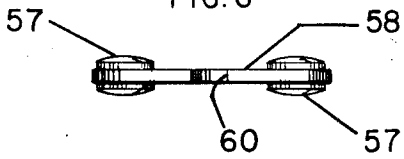


FIG. 7

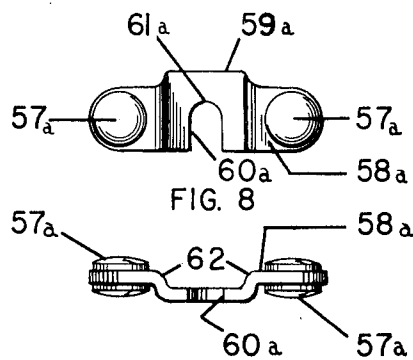


FIG. 8

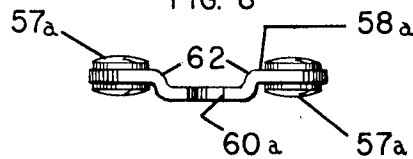


FIG. 9

FIG. 10

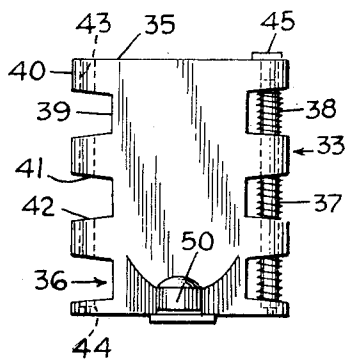
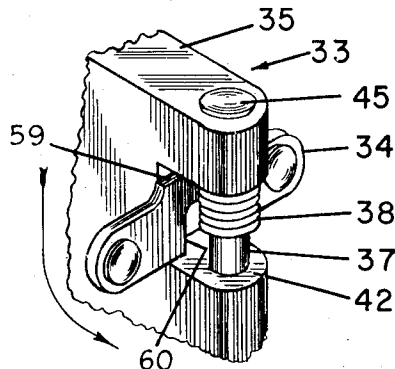


FIG. 4

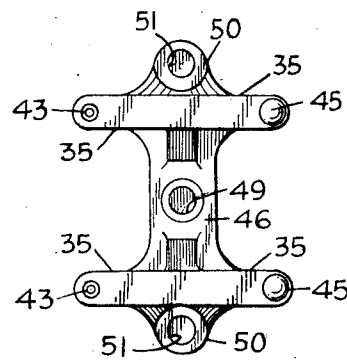


FIG. 5

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ELECTRICAL CONTACTOR ASSEMBLY

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This invention relates to a contactor assembly and particularly to a contactor assembly employed to control the opening and closing of a plurality of circuits by means of a switching device such as a solenoid.

In the past it has been possible to convert a contactor assembly from a break to a make, or a make to a break, type only by interchanging parts, reversing components, or some other rearrangement which normally required the disassembly and reassembly of at least a part of the contactor assembly and the use of several tools. Likewise, it has not been possible to freely convert the assembly from the types described above to a make-before-break type. Neither has it been possible to combine make, break, and make-before-break contacts on a single carrier so as to have an assembly for performing a plurality of switching functions of differing character, as described above, thereby providing a single contactor assembly adaptable to handle the varied requirements of several circuits with which the contactor may be associated.

It is an object of the present invention to overcome the above noted limitations and to provide a contactor assembly on which the movable contacts are resiliently supported so as to "wipe" across the face of the fixed contacts as a circuit is made.

The present invention may be described briefly as comprising a pair of supports for a plurality of fixed contacts, a novel, movable carrier for a plurality of specially constructed movable contacts for bridging selected pairs of the fixed contacts, and an actuator for moving the movable carrier in one direction, the movable carrier being supported on a spring which functions to return the carrier to its normal position when the influence of the actuator is removed. The movable carrier carries its contacts, each of which is supported by a spring, in angular relationship to the fixed contacts to be bridged. As the fixed contacts are bridged by the movable contacts the latter are cammed into a parallel plane by the former. This causes the face of the movable contacts to wipe across the face of the fixed contacts removing the film of high resistance and wiping away any dirt or dust particles which otherwise might tend to keep the fixed and movable contacts apart. The resultant compression of the spring supporting the movable contact insures continued intimate contact between the fixed and movable contacts.

In the accompanying drawings:

Figure 1 is a front view of the contactor assembly, partially in section, operatively connected to a solenoid;

Figure 2 is a side view of the movable carrier, partially in section, carrying three contacts, and shows the contactor base, the solenoid case and guide means for the movable carrier;

Figure 3, taken substantially along the line 3-3 of Fig. 1, shows one fixed support with its contacts and the relationship of the latter to the movable contacts;

Figure 4 is a front view of the movable carrier;

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Figure 5 is a top view of the movable carrier;

Figure 6 is a top view of a make or break movable contact;

Figure 7 is a side view of the contact shown in Figure 6;

Figure 8 is a top view of a make-before-break contact; and

Figure 9 is a side view of the contact shown in Fig. 8; and

Figure 10 is a perspective view of a portion of the movable carrier showing the manner of insertion of the contact on the movable carrier.

Referring now to the drawings, the improved contactor assembly is shown in Fig. 1 associated with an actuator of the solenoid type. The solenoid is supported on a base plate 10 having outwardly extending portions 11 and 12. The extended portions have slotted holes 13 and 14 therein for receiving bolts to fix the base plate 10 to a panel board, not shown. A box-like support 15 attached to the base plate 10 encloses the solenoid 16. The solenoid is attached to the base 17 of the support 15 by a tube and core stop assembly 18 which has a threaded extension 19 extending through an opening provided in the base 17. A nut 20 received on the extension 19 fixes the solenoid to the base 17. The solenoid 16 has a pair of connectors 21, 21 by means of which the solenoid may be connected into a controlling circuit.

The support 15 is surmounted by the contactor assembly. A base member 22 for the contactor assembly is fixed to the top 23 of the support 15 by a plurality of screws such as the one designated by the reference numeral 24. To opposite sides of the base 22 a pair of supports 25, 25 are attached by the screws 26. The spaced apart relationship between the supports 25, 25 is maintained by the base 22 at the lower end of the said supports 25, and by the cross-bar 27 near their upper ends. Opposite ends of the cross bar 27 are joined to the supports 25 by a screw, such as that shown at 28, inserted through an appropriately placed, counter-sunk hole 29 provided in each of the supports 25.

The supports 25 carry the fixed contacts 30, arranged in pairs (see Fig. 3), their leads 31 being imbedded in the supports 25. The leads 31 terminate at their outer end 32 in terminals by means of which the contactor assembly may be connected into the circuits which it controls.

Positioned equidistance between the two supports 25 and above the base member 22 is a movable carrier 33. It carries a plurality of contacts 34, in a manner to be described, for bridging a pair of the fixed contacts 30. The movable carrier 33, as viewed in Figure 5, is preferably but not necessarily H-shaped in horizontal cross-section, the four legs 35 (Fig. 5) of the carrier serving to support, at their extremities, one or more of the said contacts 34. The contacts 34 are carried by the carrier 33 in one or more recesses 36 spaced apart vertically on each of the legs 35. The contacts are retained in place by cooperation of the back wall 39 of the recess 36, the configuration of the contact plate (Figs. 6 and 8), the rod 37, and the helical spring 38, as will be discussed in detail subsequently.

The recesses 36 are formed in the shape of an equilateral trapezoid (Fig. 4), the back wall 39 of each recess being parallel to the vertical face 40 of the legs 35. The non-parallel walls 41, 42 of the trapezoidal recess are angled inwardly from the face 40 to intersect the back wall 39 of the recess, the upper wall 41 being angled downwardly and the lower wall 42 being angled upwardly, each at the same pre-determined angle to the horizontal. The purpose of angling the upper and lower walls

of the recesses is to carry the movable contacts 34 in angular relationship to the fixed contacts 30 when the two sets of contacts are not engaged. This angular relationship permits the "wiping" action of the movable contact across the face of the fixed contact when a circuit is completed. It has been determined that angling the plane of the upper and lower walls 41, 42 at an angle of approximately four degrees to the horizontal provides a properly shaped recess for achieving the above "wiping" action.

The contacts 34 are resiliently held in position by the helical springs 38 which are in turn retained by the rods 37. The latter are inserted in a vertical hole 43 provided near the extremity of each leg 35 and abut the shoulder 44 provided near the lower end of the hole 43 by reducing the diameter of the hole at this point. The rods 37 are not as long as the holes 43 are deep, and the rods 37 are secured in place by the cap-retainers 45. It will be noted that the holes 43 intercept the non-parallel walls 41, 42 of the recesses 36 (Fig. 1).

The rods 37 are fabricated from nylon or other suitable dielectric material, as is the movable carrier 33. The rods 37 are inserted through the helical springs 38 which have previously been compressed so as to be insertable between the walls 41, 42 of the recesses 36 in axial alignment with the bore of the holes 43. When thus retained, the coiled springs exert an expansive force against the walls 41, 42 of the recesses 36 and, when inserted, against the movable contacts 34.

The cross member 46 of the H-shaped movable carrier 33 and the core 47 of the solenoid 16 are joined together by a bolt 48 inserted through a hole 49 in the cross member 46 and threaded into the upper end of the core 47. The cross member 46 is shorter vertically than the legs 35, as clearly shown in Fig. 2, so that the cross bar 27 joining the supports 25 does not interfere with vertical movement of the movable carrier 33. A pair of guide lugs 50, 50 are formed at the base of the movable carrier 33 and are provided with holes 51, 51 each of which receives a guide pin 52. The guide pins 52 are threaded into the base member 23 so that their enlarged heads 53 are a fixed distance from the base member 23 and cooperate with the guide lugs 50, 50 to provide a limit to the upward travel of the movable carrier 33. Downward travel of the carrier 33 is limited by the core 47 striking the core stop assembly 18. The movable carrier 33 is supported by a helical spring 54 inserted between the base of the carrier 33 and the base member 22 and encircling the core 47. The spring 54 normally maintains the carrier 33 in its uppermost position with the lugs 50 against the heads 53 of the guide pins 52.

The supports 25, 25 are formed with a shoulder 55 around three sides of their inner edge for receiving and supporting a transparent dust cover 56 through which the contacts can be observed.

The specially constructed contacts 34 carried on the movable carrier 33 may be of the make-break type shown in Figs. 6 and 7 or of the make-before-break type illustrated in Figs. 8 and 9. The only difference between the two contacts is the offset provided in the central portion of the make-before-break contact as will be readily noted by comparison of Figs. 7 and 9.

The make-break type of contact shown in Figs. 6 and 7 has a pair of contact points 57, 57 carried at the extremities of a bridging plate 58. The contact points 57, 57 have identical configurations both above and below the bridging plate so that they may be carried either at the top or the bottom of the leg recesses 36 as will be made clear presently. The bridging plate 58 has an extension 59 formed on its one side, the outside edge of which extension is parallel to a line drawn through the center of the pair of contact points 57, 57. Intermediate the contact points 57, 57 on the side of the bridging plate 58 opposite the extension 59, a slot 60 extends perpendicularly inwardly of this edge of the bridging

plate 58. The slot 60 is provided to receive the rod 37 and is semi-circular in shape at its inner end 61 so as to fit around the rod 37. The inner end 61 of the slot 60 is spaced from the outer edge of the extension 59 a distance which corresponds to the distance between the back wall 39 of the leg recesses 36 and the rods 37 so that the contacts 34 fit in the recess between the back recess wall 39 and rod 37 with only enough clearance to permit limited movement of the contact 34 in the leg recess.

As mentioned above, the make-before-break contact shown in Figs. 8 and 9 is identical to the make-break contact except for the offset 62 in the bridging plate. The exponent "a" has been added to the reference numerals used on the previously described make-break contact to point out identical parts without the need of repeating the description.

In Fig. 10, a portion of one of the legs 35, including one leg recess 36, is shown to illustrate the manner and ease of installation or removal of the contacts 34 on the carrier 33. The contact 34 is shown in position as it will be inserted between the back wall 39 of the leg recess 36 and the rod 37 preparatory to being rotated into position on the carrier under the spring 38, which is here shown compressed. After rotation of the contact 34 in the direction indicated by the arrow, release of the spring permits it to expand and to bear against the bridging plate 58 so as to resiliently hold the contact 34 in position adjacent an angled recess wall. Reversal of the above procedure, obviously, removes the contact. If it is desired to insert the contact at the top of a leg recess, the contact 34 is inserted between the back wall 39 and the rod with the extension 59 at the bottom of the recess. Rotation of the contact 34 in a direction opposite to that shown then positions the contact on the carrier. The contacts 34 may be readily grasped by the human hand permitting arrangement or re-arrangement of the contacts on the movable carrier 33 without the need for tools.

The make-before-break contact may be inserted and removed in the same manner as described above. The offset portion 62 extends towards the center of the recess 36 whether the contact is installed at the top or the bottom of the recess so that the make-before-break characteristic is not nullified by installation in an upside-down position.

The fixed contacts 30 are arranged in pairs so that when bridged by one of the movable contacts 34 a circuit is completed. To accomplish this result, the fixed contacts 30 making up a pair are arranged one on either side of and an equal distance from the center line of the movable contact-carrying leg 35 associated with that pair of fixed contacts. This distance must be equal, obviously, to the distance from the center of the slot 60 to the contact points 57, 57 of the movable contact. The pairs of fixed contacts are vertically aligned in the plate assemblies. One more pair of fixed contacts is provided opposite each leg of the movable carrier than that leg has recesses, i.e., if the leg has three recesses, four pairs of fixed contacts will be provided, as illustrated in the drawings. The additional pair of fixed contacts, in combination with the interchangeable, movable contacts, makes possible the flexibility and versatility of the invention herein described.

In order that the flexibility attributed to the invention may be achieved, the vertical spacing of the fixed contact pairs and of the leg recesses must be determined so that each leg recess may be associated with either one of two pairs of fixed contacts, the one pair of fixed contacts being above the recess and the other pair below the recess. In the preferred embodiment illustrated in Figs. 1 and 3, it is desired that a closed circuit be established across the top pair of fixed contacts when the movable carrier is in its uppermost position and is carrying a movable contact at the top of the leg recess as-

sociated with this pair of fixed contacts. It is also desired that a closed circuit be established across the next lower pair of fixed contacts when the movable carrier is in its lowermost position and is carrying a movable contact at the bottom of the leg recess. Thus, the fixed contact pairs are spaced a sufficient distance above and below the leg recess so that, under the conditions indicated, the horizontal plane through the fixed contact points and their leads is paralleled by the horizontal plane through the movable contact points and the contact plate that carries them. In addition, it is desired that the plane coinciding with the top of the movable contact plate 55 intersect the junction of the top wall and the back wall of the leg recess when a circuit is completed across the top pair of fixed contacts, and that the plane coinciding with the bottom of the movable contact plate 55 intersect the junction of the bottom wall and the back wall of the leg recess when a circuit is completed across the bottom pair of fixed contacts. Further, the bottom pair of fixed contacts, in relation to any given leg recess, serves as the top pair of fixed contacts for the next lower recess on the same leg. By thus spacing the pairs of fixed contacts in vertical column and the leg recesses on their respective legs to accomplish the above results, the claimed versatility of the contactor assembly is achieved.

As is shown in Fig. 1, when the movable contacts are not bridging a pair of fixed contacts they lie in a plane parallel to the top or bottom wall of the recess. As previously described, the planes of the top and bottom walls are tilted from the horizontal through an equal arcuate distance. When the movable contact carrier is moved from its one extreme position toward its other extreme position so as to close a circuit, the movable contact meets the pair of fixed contacts before the movable carrier has reached its extreme position and before the planes of the two sets of contacts have paralleled themselves as desired and described in the paragraph above. As the contact carrier continues to its extreme position, the fixed contacts, acting against the movable contacts, urge the latter into the desired parallel relationship. The faces of each of the contact points being generally semi-elliptical in configuration, the camming action between the fixed contacts and movable contacts results in a "wiping" of the faces of the movable contacts across the faces of the corresponding pair of fixed contacts. Such action tends to remove dust or other foreign matter that might otherwise be entrapped between the two sets of contacts thereby providing a better electrical connection by eliminating minute air gaps between the two. Elimination of the air gap also lessens the likelihood of arcing across the contacts thereby insuring longer contact life.

The make-before-break contacts illustrated in Figures 7 and 8 must be inserted in pairs on the movable carrier, one of the pair being positioned at the top of a leg recess and the other at the bottom of a leg recess. The make-before-break contact, whether at the top or bottom of a recess, must be positioned with the offset 62 towards the center of the leg recess in which it is inserted, as was previously discussed. Positioned in this way, the offset 62 permits the movable carrier to travel a short distance from its one extreme position toward its other extreme position before a completed circuit is broken. But before the completed circuit is broken, the opposing make-before-break contact completes its circuit because the offset of this contact allows the contact to bridge the fixed contacts before the movable carrier has completed its travel from one extreme position to its other extreme position. The dwell period during which both circuits are completed to give the make-before-break characteristic to the contact may be varied by varying the extent of the offset 62. Obviously there are certain practical limits beyond which the offset may not extend because it is desired that one circuit be completed before the other

circuit is broken, but it is not desired that both circuits be continuously energized.

With a contactor assembly as described it is apparent that the contacts 34 may be freely interchanged in a leg recess or between recesses to serve the circuits associated with the assembly should it be necessary to modify the said circuits. Likewise, such a contactor assembly provides a standard or universal type which, by the simple expedient of arranging the movable contacts, may be applied to a wide range and variety of switching needs.

We claim:

1. In an electrical contactor, a group of permanently fixed contacts arranged in paired columns upon a pair of oppositely disposed supports; a group of movable contacts adapted to bridge selected pairs of said fixed contacts; a carrier for said movable contacts positioned between said oppositely disposed supports and movable longitudinally of said paired columns between an upper and a lower extreme position defined by limiting means, said carrier having a plurality of contact-carrying recesses provided in each of a plurality of carrier legs individually positioned in longitudinal alignment with and adjacent to one of the said paired columns of fixed contacts, said recesses being formed in the vertical faces of said legs opposite said paired columns with a back wall parallel to said vertical face and upper and lower walls intersecting said back wall and said vertical face; and means in each of the said recesses and on each of the said movable contacts cooperating with said back recess wall for removably interlocking said movable contacts on said carrier adjacent one of said upper or lower walls, each of the said recesses being so dimensioned longitudinally and positioned relative to one another, to said fixed contact pairs, and to said limiting means that any two longitudinally adjacent recesses may be associated with a single pair of fixed contacts so that a movable contact carried adjacent the upper wall of the lower of the two adjacent recesses bridges said single fixed contact pair when said carrier is in its upper extreme position and a movable contact carried adjacent the lower wall of the upper of the two adjacent recesses bridges the same single fixed contact pair when said carrier is in its lower extreme position.

2. In an electrical contactor assembly, the combination of claim 1 characterized in that each of said paired columns of permanently fixed contacts have a number of fixed contact pairs greater by one than the number of contact-carrying recesses provided in the adjacently positioned carrier leg, the said recesses and fixed contact pairs being equally spaced along said carrier legs and in said paired columns, respectively.

3. In an electrical contactor assembly the combination of claim 2 wherein said upper and lower recess walls are angled inwardly downwardly and upwardly, respectively, from said vertical face to intersect said back wall and are so positioned in relation to said limiting means and to said pairs of fixed contacts that the contact points of said movable contacts being carried into bridging engagement with a pair of fixed contacts are wiped across the points of the fixed contact pair in a camming action which pivots the movable contact away from the adjacent angled recess wall into a plane parallel to the plane through the pair of bridged contacts as the carrier reaches one of the said extreme positions.

4. In an electrical contactor assembly, the combination of claim 1 wherein said interlocking means include a helical spring retained in each contact-carrying recess between the upper and lower recess walls by a rod of dielectric material provided in each carrier leg, said rod being substantially coextensive with said carrier leg and positioned in said leg so as to intersect the angled upper and lower recess walls a predetermined and equal distance from the back recess walls, and a movable contact bridging plate having an extension along its one side and a slot for receiving said rod cut perpendicularly inwardly

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from its opposite side to such a depth that the distance between the outer edge of said extension and the inner end of said slot is substantially equal to the said predetermined distance between said rod and said back recess walls.

5 5. In an electrical contactor assembly, the combination of claim 4 characterized in that said extension and said slot are centrally positioned on a plane bridging plate intermediate the contact points carried at either extremity of said plane bridging plate.

10 6. In an electrical contactor assembly, the combination of claim 4 characterized in that said extension and said

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slot are centrally positioned on a portion of said bridging plate offset from the plane through the contact points carried at either extremity of said bridging plate.

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