ABSTRACT: Electrical relay circuitry for performing useful work by the selective closing of work circuits. In one form of circuitry, two independent relay magnets with associated contact groups are effective upon selective energization to reverse their respective contact groups, a third contact group being automatically reversed upon energization of either relay magnet. In another form, selective energization of the magnets reverses their respective contact groups, but the third contact group is not reversed unless both magnets are energized.
The present invention relates to relay circuitry and has particular reference to a novel arrangement of three contact groups which are mechanically connected to one another and to two relay magnets in such a manner that the contacts of the group become reversed upon energization of one of the relay magnets, the contacts of a second group become reversed upon energization of the other relay magnet, and the contacts of the third group become reversed upon energization of either magnet or, alternatively, upon energization of both magnets. Heretofore, when it has been desired to effect the partitioning of energization of three contact groups, it has been the practice to employ a relay magnet for each of the three contact groups and to energize the relay magnet for the third contact group under the control of a pair of normally open contacts in associated relation with the contact group of each of the two other relay magnets. The disadvantages of this method of selective contact group energization are manifold, one disadvantage being the need for plural relay magnets and contact group mountings. Another disadvantage of the aforementioned arrangement resides in the necessity of utilizing a large number of circuit wires, this disadvantage being particularly unsatisfactory where the pilot device, which is usually a selector switch, is mounted on the access door of a cabinet so that the numerous wires must be passed through the hinge section of the door. Additionally, in such an instance, selector switch contacts ordinarily have a low current rating and, because circuit making and breaking is effected by rotating a cam, the resultant slow contact movement is conducive toward undue arcing at the contacts.

The present invention is designed to overcome the above-noted limitations that are attendant upon the use of multiple relay arrangements and toward this end the invention contemplates the provision of a novel mechanical connection between the contact groups and in associated relation with only two relay magnets by means of which the desired selective energization of the various contact groups may be attained. As will become more readily apparent when the nature of the invention is better understood, one of the principal advantages of the invention resides in the fact that all the necessary circuit control operations may be effected under the control of a pilot device such, for example, as a selector switch, with only three wires being required for electrical connection of the switch to the two relay magnets. Another advantage resides in the fact that the contacts that are associated with the employed commercially available selector switch will have associated contacts which have an adequate current rating inasmuch as the relay magnets to which the selector switch is connected entails a low current drain. By the same token, arcing at the contacts of the selector switch is alleviated while, at the same time, fast or instant closure of the contacts that are associated with the various contact groups will be attained to energize the involved desired work circuits. Numerous other advantages of the invention will readily suggest themselves as the following description ensues.

In the accompanying two sheets of drawings, two embodiments of the invention have been shown. In these drawings:

FIG. 1 is a circuit diagram, largely schematic in its representation, illustrating one embodiment of the invention; and

FIG. 2 is a similar circuit diagram illustrating another embodiment of the invention.

In FIG. 1, three contact groups C1, C2 and C3 are shown as being operatively connected to two relay magnets RM1 and RM2 in such a manner that the contacts of the group C1 become reversed upon energization of the magnet RM1; the contacts of the group C2 become reversed upon energization of the magnet RM2; while the contacts of the group C3 becomes reversed when either magnet RM1 or RM2 becomes energized, as will become apparent when both magnets RM1 and RM2 become energized. In FIG. 2, the same three contact groups are shown as being operatively connected to the same two magnets for similar reversal of the contacts of the contact groups C1 and C2 under the control of the relay magnets RM1 and RM2, with reversal of the contacts of the contact group C3 taking place only when both magnets RM1 and RM2 are energized.

Stated otherwise, in the structure of FIG. 1, reversal of the contact group C3 takes place when either or both of the other contact groups becomes reversed. In the structure of FIG. 2, individual reversal of either contact group C1 or C2 has no effect upon the contact group C3, this latter group becoming reversed only when both contact groups C1 and C2 become reversed.

Considering now the structure shown in FIG. 1, a single fixed mounting, various portions of which are designated by the reference numeral 10, serves to support the two relay magnets RM1 and RM2. The contact group C1 is mechanically connected to the magnet RM1 for actuation thereby while the contact group C2 is similarly connected to the magnet RM2.

Each contact group includes a pair of normally closed 01 contacts and a pair of normally open 02 contacts. Upon energization of either relay magnet, the contacts of the associated contact group are adapted to be reversed through the medium of the usual pivoted armature 12 and, in addition, contact-manipulating fingers 14 which are carried on the various movable contact arms 15.

The mounting 10 serves also to support a contact group C3 having a pair of normally closed 01 contacts and a pair of normally open 02 contacts, such contacts being capable of reversal under the control of contact-manipulating fingers 16 which are similar to the fingers 14 of the contact groups C1 and C2. The fingers 16 are adapted to be actuated under the control of an articulated actuator assembly 17 including a bridging thrust member in the form of a vertically sliding thrust plate 18 which is constrained to move in a linearly straight path by means of a pin and slot connection 20. A pair of springs 22 normally maintains the thrust plate 18 in a retracted position. The lower edge of the thrust plate is engageable with a pair of thrust fingers 24 which are associated with the 01 contacts of the contact groups C1 and C2.

The various contacts of the three contact groups C1, C2 and C3, may be connected in appropriate work circuits, the lead wires for which have been designated at w1 and w2 for the contacts of the contact group C1; at w3 and w4 for the contacts of the contact group C2; and at w5 and w6 for the contacts of the contact group C3.

From the above description it will be seen that, upon energization of the relay magnet RM1, the associated armature 12 and fingers 14 will cause reversal of the 01 and 02 contacts of the contact group C1 by opening the former contacts and closing the latter contacts. At the same time, the fingers 24 which are associated with the contact group C1 will shift the thrust plate 18 upwards to an advanced position wherein the fingers 16 of the contact group C3 will reverse the positions of the 01 and 02 contacts of the contact group C3 by opening the former contacts and closing the latter contacts.

In a similar manner, energization of the relay magnet RM2 will cause reversal of the 01 and 02 contacts of the contact group C2 and reversal of the 01 contacts of the latter group will, through the medium of the associated finger 24, as well as the thrust plate 18 and the fingers 16 of the contact group C3, cause reversal of the 01 and 02 contacts of the contact group C3.

Selective energization of the relay magnets RM1 and RM2 is adapted to be effected by means of a suitable pilot device such, for example, as the selector switch SS which is a three-position switch having a 1 contact connected to the relay magnet RM1, a 03 contact connected to the relay magnet RM2, and a neutral or idle 02 position. Such switch also has a pivoted selector contact arm 26. When the contact arm 26 is in electrical contact with the 01 contact of the selector switch SS, a circuit will extend from a source S, through leads 11, 13, relay magnet RM1, lead 15', 01 contact of the switch SS, contact arm 26, and lead 17' back to the source S. When the contact arm 26 is in electrical contact with the 03 contact of the
selector switch SS, a circuit will extend from the source S, through leads 11, 19, relay magnet RM2, lead 21, 03 contact of the switch SS, contact arm 26, and lead 17* back to the source S.

In the form of the invention shown in FIG. 2, the same arrangement and disposition of relay magnets RM1 and RM2 and contact groups C1, C2 and C3, obtains, but the mechanical actuating instrumentalities (i.e., the bridging actuator assembly 117) by means of which selective reversal of the contact groups C1 and C2 controls the reversal of the contact group C3 has been modified in such a manner that reversal of either contact group C1 or C2 to the exclusion of the other contact group will not affect the normal condition of the contact group C3. Only when both contact groups C1 and C2 are reversed will the contact group C3 become reversed. Additionally, because it is necessary in order to effect simultaneous reversal of the contact groups C1 and C3, to cause simultaneous energization of both relay magnets RM1 and RM2, a selector switch SS2 which will accomplish this function has been substituted for the selector switch SS of FIG. 1.

Due to the similarity between the contact-actuating instrumentalities and the selector switches of FIGS. 1 and 2 and, in order to avoid needless repetition of description, similar reference numerals but of a higher order have been applied to the corresponding parts and circuit wires or leads as between the disclosures of these two views.

Reverting now specifically to FIG. 2, the modified bridging actuator 117 includes a thrust plate 118 which is constrained to move in a linearly straight path by means of a pin and slot connection 120. A spring 122 normally maintains the thrust plate 118 in a retracted position. A rocker arm 123 is pivoted medially of its ends by a pin 125 to the lower region of the plate 118 and normally has its opposite end regions loosely overlying the thrust fingers 24 of the contact groups C1 and C2. The arrangement is such that the upward displacement of either thrust finger 24 alone will merely take up the lost-motion connection which exists between the rocker arm 123 and the associated fingers 24 which it overlies but will not exert any leverage upon the pivot pin 125 so that the plate 118 will not be displaced. However, when the other thrust finger 24 is additionally upwardly displaced, the arm 123 will function in the manner of a second class lever, thus raising the pin 125, and consequently the entire thrust plate 118. The upper end of the thrust plate 118 underlies the contact-manipulating fingers 16 of the contact group C3 and, therefore, the upward displacement of the thrust plate 118 will cause reversal of the contact group C3.

Whereas the selector switch SS in the form of the invention shown in FIG. 1 is capable only of individual energization of either relay magnet RM1 or RM2 to the exclusion of the other, the selector switch SS2 employed in connection with the form of the invention shown in FIG. 2 is capable of simultaneous energization of both of these magnets. The switch SS2 is a four-position switch having a 01 contact connected to the relay magnet RM1, a 02 contact connected to the relay magnet RM2, a 03 dual-function position, and a neutral or idle 04 position. The switch SS2 also has a pivoted swinging selector contact arm 126 provided with an arcuate segment 127 capable of bridging the 01 and 02 contacts. When the contact arm 126 and segment 127 are in contact with the 1 contacts of the switch SS2, a circuit will extend from the source S, through leads 111 and 113, the relay magnet RM1, lead 115*, 01 contact of the switch SS2, contact segment 127 and arm 126, and lead 117* back to the source S, thus energizing the magnet RM1. When the contact arm 126 and segment 127 are in contact with the 02 contacts of the switch SS2, a circuit will extend from the source S, through leads 111, 119, relay magnet RM2, lead 121, segment 127 and contact arm 126, and lead 117* back to the source S, thus energizing the magnet RM2. When the switch is in its 03 position, the two local circuits previously outlined will be placed in electrical parallel due to the bridging of the 01 and 02 contacts by the contact segment 127 so that both magnets RM1 and RM2 will become energized.

It is to be distinctly understood that the invention is not to be limited to the specific forms of relay circuitry that are illustrated in the accompanying drawing or described in this specification since the disclosure herein is purely exemplary of two operative embodiments of the invention. For example, the specific form of each of the contact groups C1, C2 and C3 as illustrated herein in the text has been selected for simplification of the disclosure. Such contact groups are purchased items wherein the illustrated contact mountings, the contact arms, the contact manipulating fingers 14 and 16 (commonly referred to as push fingers) are available in bulk for assembly in the field to produce contact groups having any desired number of pairs of contacts, the individual contacts in groups may be either normally open or normally closed. The contact arms are also available in varying lengths irrespective of whether they are of the "push-open" or the "push-closed" type. The relay magnets RM1 and RM2 likewise are commercially available units which are specifically designed for cooperation with contact groups of the type illustrated herein. Therefore, no claim is made herein to any novelty as to either the contact groups C1, C2 and C3, or the relay magnets RM1 and RM2 per se, the novelty of the present invention residing rather in the specific assembly arrangement of these magnets and contact groups and in the provision of a suitable mechanical transfer connection such as the thrust plates 18 and 118 by means of which reversal of the contacts of the contact groups C1 and C2 variously is caused to effect reversal of the contacts of the contact group C3. It is obvious that, if desired, instead of employing contact groups having direct closing contacts, contact groups of the type having bridged contacts may be utilized if found to be expedient.

Finally, it should be understood that, although in the illustrated forms of the invention, each of the three contact groups includes two pairs of contacts, one contact being of the normally closed type and the other contact being of the normally open type, contact groups having a greater number of pairs of contacts, or having only a single pair of contacts may be employed. Furthermore, such contacts as are employed may be varied as desired as to their opening or their closing function, the arrangement depending, of course, upon the exigencies of the particular involved electrical installation. Therefore, only insofar as the invention is particularly pointed out in the accompanying claims is the same to be limited.

Having thus described the invention what I claim as new and desire to secure by Letters Patent is:

1. Electrical relay circuitry comprising in combination, a first relay magnet, a first contact group having at least one pair of movable contacts, a second relay magnet, a second contact group associated therewith and likewise having at least one pair of movable contacts, a third contact group also having at least one pair of movable contacts, means effective upon energization of the first relay magnet for reversing the position of the contact of the first contact group, means effective upon energization of the second relay magnet for reversing the position of the contacts of the second contact group, means common to a contact of the first contact group and a contact of the second contact group establishing a mechanical connection between each of said two latter contacts and a contact of the third contact group whereby reversal of either of said two latter contacts will effect reversal of said latter contact of the third group, and means for selectively energizing said relay magnets each to the exclusion of the other.

2. Electrical relay circuitry comprising, in combination, a first relay magnet, a first contact group having at least one pair of movable contacts, a second relay magnet, a second contact group associated therewith and likewise having at least one pair of movable contacts, a third contact group also having at least one pair of movable contacts, means effective upon energization of the first relay magnet for reversing the position of the contacts of the first contact group, means effective upon energization of the second relay magnet for reversing the position of the contacts of the second contact group, means common to a contact of the first contact group and a contact of the second contact group establishing a mechanical connection...
between each of said two latter contacts and a contact of the third contact group whereby reversal of either of said two latter contacts will effect reversal of said latter contact of the third group, said mechanical connection comprising a first movable actuating arm on said contact of the first contact group, a second movable actuating arm on said contact of the second contact group, and a third movable actuating arm on said contact of the third contact group, said first and second actuating arms effectively bearing against said third actuating arm for independently translating movement thereto, and means for selectively energizing said relay magnets each to the exclusion of the other.

3. Electrical relay circuitry as set forth in claim 2 and wherein the mechanical connection comprises a thrust member making bridging contact with said first and second actuating arms and in engagement with the third actuating arm.

4. Electrical relay circuitry comprising in combination, a first relay magnet, a first contact group having at least one pair of movable contacts, a second relay magnet, a second contact group associated therewith and likewise having at least one pair of movable contacts, a third contact group also having at least one pair of movable contacts, means effective upon energization of the first relay magnet for reversing the position of the contacts of the first contact group, means effective upon energization of the second relay magnet for reversing the position of the contacts of the second contact group, means establishing a mechanical lost-motion connection between a contact of the first contact group and a contact of the third contact group, means establishing a mechanical lost-motion connection between a contact of the second contact group and said contact of the third contact group, said contacts of the first and second contact groups each being effective upon exclusive reversal thereof to take up both of said lost-motion connections, and being effective upon simultaneous reversal thereof to effect reversal of the contact of the third contact group, a thrust member capable of shifting movement between a retracted position and an advanced position, said thrust member, when in its advanced position, being engageable with said contact of the third contact group for reversing the latter, and a lever pivoted medially of its ends to said thrust member and having its end portions positioned in the paths of movement of the actuating arms associated with the contacts of the first and second contact groups, and means for selectively energizing said relay magnets both individually and collectively.

5. Electrical relay circuitry comprising, in combination, a first relay magnet, a first contact group having at least one pair of movable contacts, a second relay magnet, a second contact group associated therewith and likewise having at least one pair of movable contacts, a third contact group also having at least one pair of movable contacts, means effective upon energization of the first relay magnet for reversing the position of the contacts of the first contact group, means effective upon energization of the second relay magnet for reversing the position of the contacts of the second contact group, means establishing a mechanical lost-motion connection between a contact of the first contact group and a contact of the third contact group, means establishing a mechanical lost-motion connection between a contact of the first contact group and a contact of the third contact group, means establishing a mechanical lost-motion connection between a contact of the second contact group and said contact of the third contact group, said contacts of the first and second contact groups each being effective upon exclusive reversal thereof to take up both of said lost-motion connections, and being effective upon simultaneous reversal thereof to effect reversal of the contact of the third contact group, a thrust member capable of shifting movement between a retracted position and an advanced position, said thrust member, when in its advanced position, being engageable with said contact of the third contact group for reversing the latter, and a lever pivoted medially of its ends to said thrust member and having its end portions positioned in the paths of movement of the actuating arms associated with the contacts of the first and second contact groups, and means for selectively energizing said relay magnets both individually and collectively.