

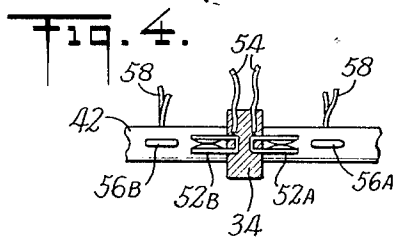
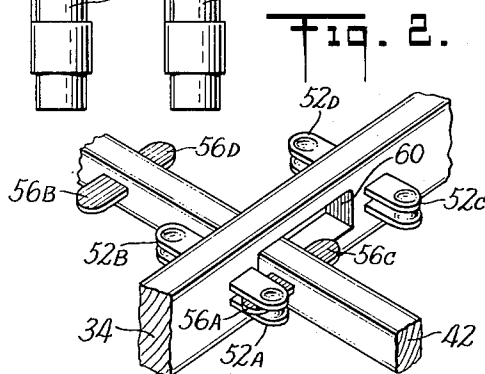
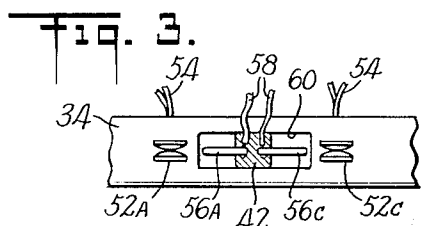
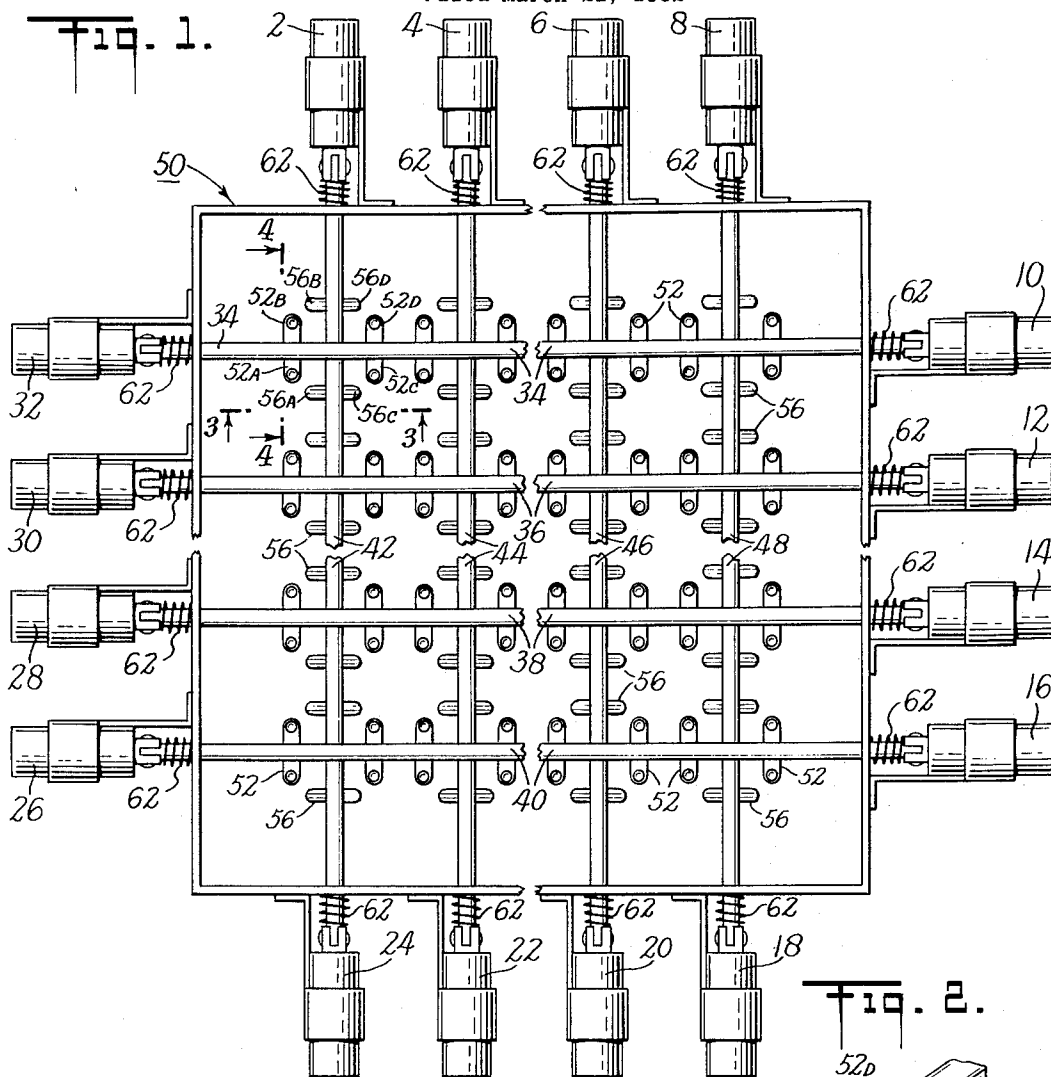
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SWITCHING DEVICE

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SWITCHING DEVICE

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This invention is in the field of electrical switching apparatus, and is described in detail as embodied in an electrically-operated switch for controlling a relatively large number of circuits.

In many types of apparatus, it is desirable or necessary to control a number of electrical circuits from a remote point with a much fewer number of interconnecting leads. Such control circuits often make use of stepping relays or of complex arrangements of a number of individual relays, but if the number of circuits to be controlled is large, apparatus of this type may be quite expensive. The present invention is directed to the provision of a compact and relatively inexpensive switching arrangement suitable in many instances as a substitute for more complex control or switching arrangements.

In a preferred embodiment of the invention, a first group of electric motors is arranged to control the movement of a number of switch contacts along parallel paths and a second group of electric motors is arranged to control the movement of cooperating switch contacts along parallel paths transverse to the paths of the first group of contacts. By selecting and actuating any two of the motors, any one of a large number of electrical circuits can be selected with relatively few connecting leads. One important application of this arrangement is a decoding device for use in business machines and in other applications.

These and other features, advantages, and objects of the invention will in part be pointed out in and in part apparent from the following description considered in conjunction with the accompanying drawings, in which:

Figure 1 is a plan view diagrammatically illustrating the construction and operation of one embodiment of the invention;

Figure 2 is an enlarged perspective view of a portion of the apparatus shown in Figure 1;

Figure 3 is an enlarged partial sectional view taken along line 3—3 of Figure 1; and

Figure 4 is an enlarged partial sectional view taken along line 4—4 of Figure 1.

Figure 1 shows the essential elements of one embodiment of the invention in which sixteen small solenoids, indicated respectively by even numbers from 2 through 32, are arranged to control the longitudinal position of eight contact-supporting strips, indicated respectively by even numbers from 34 through 48. These strips are formed of insulating material such as plastic or ceramic, and are supported slidably by a square framework, generally indicated at 50.

Each of the contact-supporting members 34, 36, 38, and 40 carries sixteen bifurcated spring-clip type electrical contact members, as indicated at 52, selected ones being designated as 52A, 52B, 52C, 52D, etc. These contacts are each insulated from the others and are connected to external circuits by any suitable means, as by flexible leads indicated diagrammatically at 54 in the enlarged view of Figure 2.

Each of the contact strips 42, 44, 46, and 48 also carries

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sixteen blade type electrical contacts, as indicated at 56, selected ones being designated as 56A, 56B, 56C, 56D, etc. These contacts are insulated from each other and are mounted on the contact-supporting strips in any desired manner, for example, by molding the plastic around the metal contacts, by riveting, or by other means. Flexible leads as at 58 (see Figure 3) may be provided to connect the contacts 56 to the external circuits. These leads have not been shown in the other views, but their presence is understood.

The contact-supporting members 34, 36, 38, and 40 are each provided with spaced transverse slots, as indicated at 60 in Figure 2, one at each cross-over point of the contact-supporting members, through which the contact-supporting members 42, 44, 46, and 48 extend.

Each of the contact-supporting members is supported slidably so that it can move longitudinally in either direction from its central position. The switch circuits are controlled by moving these members.

In the structure illustrated in Figure 1, any one of sixty-four separate circuits can be closed by the selected movement of two of the contact-supporting members. To illustrate the operation of the switch, assume that the contact-supporting member 34 is moved longitudinally toward the right from the position shown in Figure 1. This movement does not close any circuit contacts and no one of the one hundred twenty-eight contact leads is connected to any other contact lead. Now assume that, additionally, the contact-supporting member 42 is moved longitudinally upwardly as seen in Figure 1. These movements cause the contacts indicated at 52A and 56A to engage each other and close the corresponding circuit as shown in Figure 2, but none of the other contacts are engaged and, accordingly, only this one circuit is completed. When the solenoids are de-energized, the contact strips are returned to their "home" positions by the springs 62, or by any other suitable means.

From examination of Figure 1, it can be seen readily that if the contact-supporting member 42 were displaced in the opposite direction, that is, downwardly as viewed in Figure 1, the contacts 52B and 56B would be closed.

If the contact-supporting member 34 were moved to the left and the contact member 42 moved upwardly, the contacts 52C and 56C would be engaged, and reversing the direction of displacement of the contact-supporting member 42 will cause contacts 52D and 56D to engage each other.

Thus, at this one cross-over or junction any one of four circuits can be closed. In the device illustrated in Figure 1, there are sixteen cross-overs and sixty-four separate circuits that can be controlled by movement of the eight contact-supporting members.

The contact-supporting members can be controlled manually or in any other desired manner. In the illustrated embodiment, a solenoid is connected to each end of each of the contact-supporting members to provide the necessary switching movement. Thus, the solenoid 32, when energized, pulls the contact supporting member 34 toward the left, whereas energization of the solenoid 10 pulls the member 34 toward the right. Thus, by energizing one of the eight solenoids 10, 12, 14, 16, 26, 28, 30, and 32, connected to the contact-supporting members 34, 36, 38, and 40, and also energizing one of the group of solenoids 2, 4, 6, 8, 18, 20, 22, and 24 connected to the contact-supporting members 42, 44, 46, and 48, any one of the sixty-four circuits can be closed.

By using a common lead, all of the solenoids can be controlled from a distance by means of seventeen leads. If desired, solenoids responsive only to alternating current may be used on one end of each contact-supporting member and a D. C. responsive solenoid or relay on the other end. With this arrangement, all of the solenoids can be

controlled with no more than nine leads. Similar results can be achieved by using polarized solenoids and simple rectifier circuits.

The number of solenoids can be reduced by one-half by using polarized solenoids in which the armature can be driven in one direction with current of one polarity and in the opposite direction by current of the opposite polarity. Thus, a total of eight solenoids can be made to control the sixty-four circuits.

Although solenoids have been illustrated for supplying the motive force, other types of magnetic motors or other devices can be used for this purpose in accordance with the requirements of each particular use.

It will be apparent from Figure 1 that there is no intention to limit the size of the unit and as many contact-supporting members can be provided as are required to control the desired number of circuits. For example, a switch assembly having a total of forty contact-supporting members operated by either forty or eighty solenoids is capable of selectively operating any one of sixteen hundred separate circuits, and these solenoids can be operated from a distance over no more than forty-one leads.

Obviously, well-known devices can be used to reduce further the number of connecting leads, as for example by the use of impulse or frequency coded signals.

In the illustrated embodiment, only two components of motion have been illustrated, but other degrees of movement can be employed when the occasion indicates its desirability, for example, another motive means may be provided to move one group of contact-supporting members in a plane perpendicular to or at an angle to the plane of movement described above so as to bring another set of contacts into the operating plane, thereby doubling the number of possible circuits but requiring only one additional electromagnet or other source of motive power.

It will be apparent also that a perpendicular arrangement of the contact strips will be most convenient for a large number of applications; it may at times be advantageous to use other cross-over angles. Also at times it may be desirable to position the switch contacts in more than one plane, although a planar arrangement is the easiest to construct.

From an examination of Figure 1, it will be seen that the contact members could each be moved transversely instead of longitudinally to control the closing of selected contacts but again longitudinal movement is deemed to be more convenient.

I claim:

1. In a multiple-contact switch, apparatus comprising a first plurality of contact-supporting members, a second plurality of contact-supporting members, a supporting structure movably supporting said first members for movement in either of two directions along a first set of paths and said second members for movement in either of two directions along a second set of paths transverse to said first set of paths, each of said contact members being movable in either direction along its respective path independently of the movement of any other contact member, first and second groups of spaced insulated contact elements carried by said first plurality of contact-supporting members, third and fourth groups of spaced insulated contact elements carried by said second plurality of contact-supporting members, a separate electrical conductor connected to each of said contact members each of said contacts of said first group being arranged to engage a given contact of either said third or fourth group upon displacement of one of said first contact-supporting members in a first direction along its respective path and one of said second contact-supporting members in either direction along its respective path and each of said contacts of said second group being arranged to engage a given contact of either said third or fourth group upon displacement of one of said first contact-supporting members in a second direction along its respective path and one of said second contact-supporting members in either direction along its respective path.

2. In a multiple-contact switch, apparatus comprising a first plurality of spaced, elongated contact-supporting members, a second plurality of spaced, elongated contact-supporting members, a supporting structure movably supporting said first members for reciprocating movement along a first set of paths and said second members for reciprocating movement along a second set of paths crossing said first set of paths, each of said contact members being movable along its respective path independently of the movement of any other contact member, a first group of spaced insulated contact elements carried by said first plurality of contact-supporting members, including a set of four separate contact elements adjacent each of the areas where said first set of paths cross said second set of paths a second group of spaced insulated contact elements carried by said second plurality of contact-supporting members, including a set of four contact elements adjacent each of the areas where said second paths cross said first paths each of said contacts of said first group being arranged to engage a given contact of said second group upon displacement of their respective contact-supporting members in predetermined directions along their respective paths.

3. In a multiple-contact switch, apparatus comprising a first plurality of contact-supporting members, a second plurality of contact-supporting members, a supporting structure movably supporting said first members for limited movement along a first set of paths between "home" and either of two "contact" positions and said second members for limited movement along a second set of paths transverse to said first set of paths between "home" and either of two "contact" positions, each of said contact supporting members being movable along its respective path independently of the movement of any other contact supporting member, four groups of first and second spaced insulated contacts, the first contact of each group being carried by one of said first plurality of contact-supporting members, and the second contact of each group being carried by one of said second plurality of contact-supporting members, the first of said contacts of said first or second group being arranged to engage the second contact of said first or second group upon displacement of one of said first contact-supporting members to one of its "contact" positions and one of said second contact-supporting members to either of its "contact" positions and the first of said contacts of said third or fourth group being arranged to engage the second contact of said third or fourth group upon displacement of one of said first contact-supporting members to the other of its "contact" positions and one of said second contact-supporting members to either of its "contact" positions, said contact members being positioned so that the distance between the contacts of each group when the contact-supporting members are in their "home" positions is greater than the distance between the "contact" and "home" positions of said contact-supporting members.

4. In a multiple circuit switch, apparatus comprising a first set of contact-supporting members, a second set of contact-supporting members, a supporting structure supporting said members to form a lattice work, said first set of members extending in directions transverse to the directions of said second members and forming a plurality of spaced cross-over junctions therebetween, each of said members being movable and having "neutral" and two "displaced" positions, and a plurality of contacts distributed longitudinally along each of said members, each of said contacts being positioned near one of said junctions and arranged to move toward said junction when its supporting member is moved from its "neutral" to either of its "displaced" positions.

5. In a multiple circuit switch, apparatus comprising a first set of substantially parallel contact-supporting members, a second set of substantially parallel contact-supporting members, a supporting structure supporting

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said members to form a lattice work, said first set of members extending in directions transverse to the directions of said second members and forming a plurality of spaced cross-over junctions therebetween, each of said members being movable back and forth along a linear path and having a "neutral" position and two "displaced" positions in opposite directions from the "neutral" positions, and a plurality of contacts distributed longitudinally along each of said members, each arranged to engage a contact of another member when their respective supporting members are moved from their "neutral" to predetermined ones of their displaced positions.

6. In a switch member for controlling a relatively large number of circuits, a switching junction comprising a first contact-supporting member, a second contact-supporting member extending transversely across said first member, said first and second members each being movable independently along first and second paths respectively from a "neutral" position in one direction to a "first" position and in the opposite direction to a "second" position, said paths extending at an angle to each other, a first plurality of insulated contacts carried by said first member, part of said contacts being on one side of the cross-over of said members and the remainder on the opposite side, and a second plurality of insulated contacts carried by said second member, part of said second plurality of contacts being on each side of the cross-over of said members, said contacts being arranged so that each contact is spaced from every other contact when said members are in their "neutral" positions, each of said contacts on said first member being arranged to engage an adjacent contact on said second member when each of said members is moved from its "neutral" position to a predetermined displaced position.

7. In a switch member for controlling a relatively large number of circuits, a switching junction comprising a first contact-supporting member, a second contact-supporting member extending transversely across said first member, said first and second members each being movable independently along first and second linear paths respectively from a "neutral" position in one direction to a "first" position and in the opposite direction to a "second" position, said paths extending at an angle to each other, first, second, third, and fourth spaced insulated contacts carried by said first member, said first and second contacts being on one side of the cross-over of said members and said third and fourth contacts on the opposite side, and fifth, sixth, seventh, and eighth spaced insulated contacts carried by said second member, said fifth and sixth contacts being on one side of the cross-over of said members and said seventh and eighth contacts being on the opposite side, each of said contacts being spaced from every other contact when either of said members is in its neutral position, said first contact being arranged to engage said sixth contact when each of said members is moved from its home position to its "first" position, said fourth contact engaging said

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seventh contact when said members are in their "second" positions, said second and eighth contacts being engaged when said first member is in its "first" position and said second member is in its "second" position, said third contact engaging said fifth contact when said first member is in its "second" position and said second member is in its "first" position.

8. In a switch member for controlling a relatively large number of circuits comprising a plurality of switching junctions formed by a plurality of spaced first contact-supporting members, and a plurality of spaced second contact-supporting members extending transversely across said first member, said first and second members each being movable independently along first and second paths respectively from a "neutral" position in one direction to a "first" position and in the opposite direction to a "second" position, said paths extending at an angle to each other, each of said junctions having associated with it: first, second, third and fourth spaced insulated contacts carried by said first member, said first and second contacts being on one side of the cross-over of said members and said third and fourth contacts on the opposite side, and fifth, sixth, seventh, and eighth spaced insulated contacts carried by said second member, said fifth and sixth contacts being on one side of the cross-over of said members and said seventh and eighth contacts being on the opposite side, each of said contacts being spaced from every other contact when either of said members is in its neutral position, said first contact being arranged to engage said sixth contact when each of said members is moved from its home position to its "first" position, said fourth contact engaging said seventh contact when said members are in their "second" positions, said second and eighth contacts being engaged when said first member is in its "first" position and said second member is in its "second" position, said third contact engaging said fifth contact when said first member is in the "second" position and said second member is in its "first" position.

9. The method of selectively closing any one of a large number of circuits comprising simultaneously displacing a first group of aligned spaced insulated contact members in either direction along a first linear path, and simultaneously displacing a second group of aligned spaced insulated contact members in either direction along a second linear path extending substantially perpendicularly to and intersecting said first path by a sufficient distance to place one of said contacts of said second group in the path of movement of said contacts of said first group, whereby to enable the closing of any one of four separate circuits at each path intersection.

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