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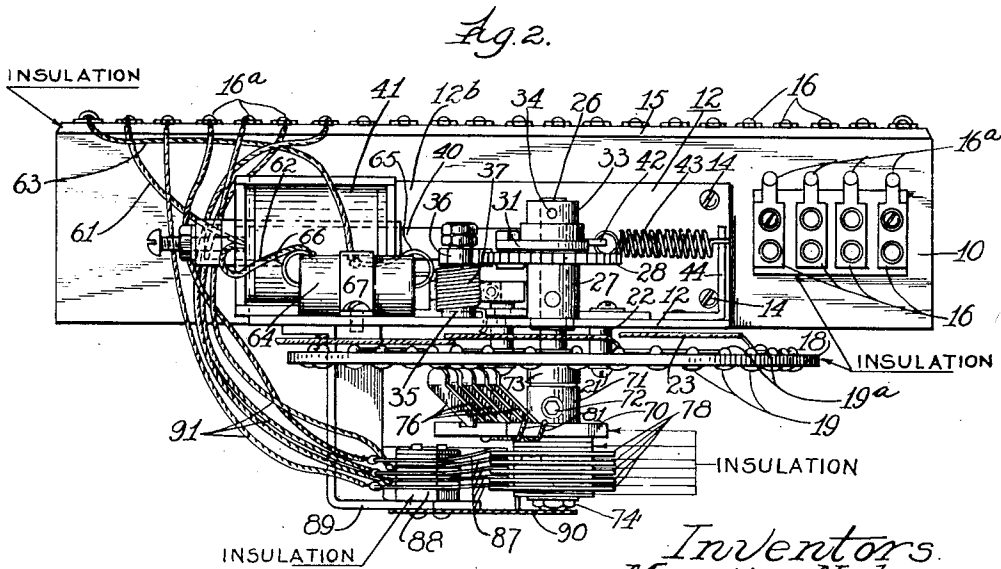
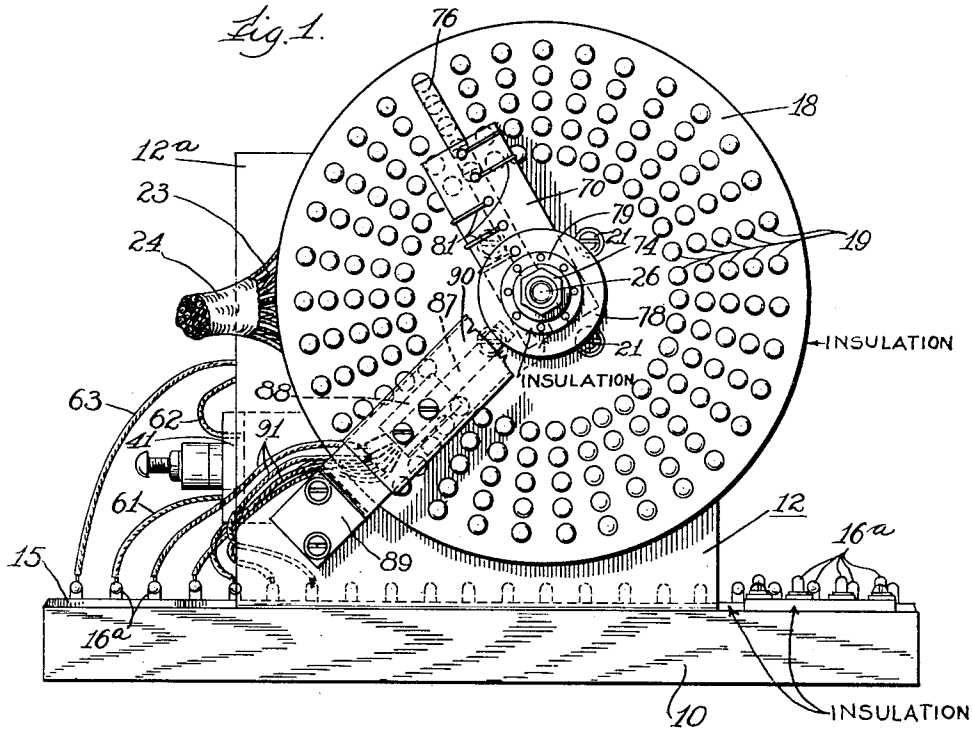
M. NELSEN ET AL

2,171,044

SWITCH

Filed March 9, 1937

3 Sheets-Sheet 1



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Aug. 29, 1939.

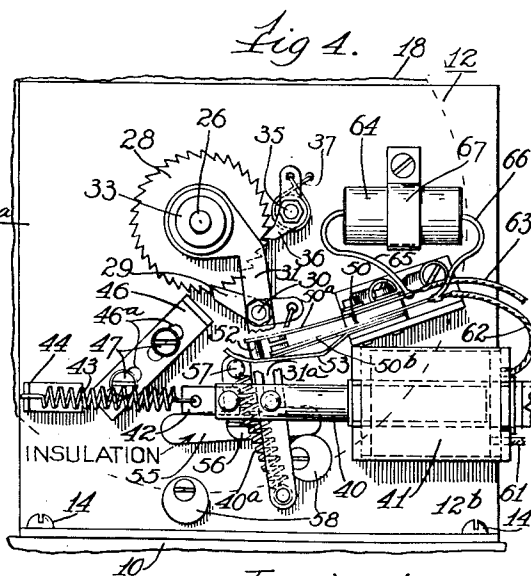
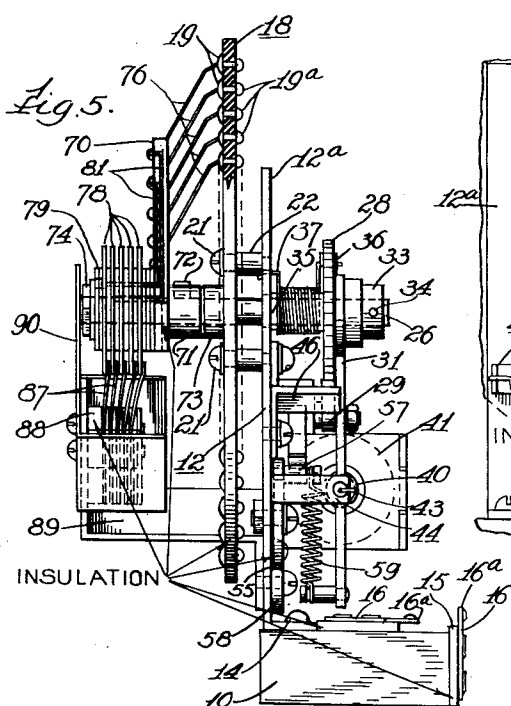
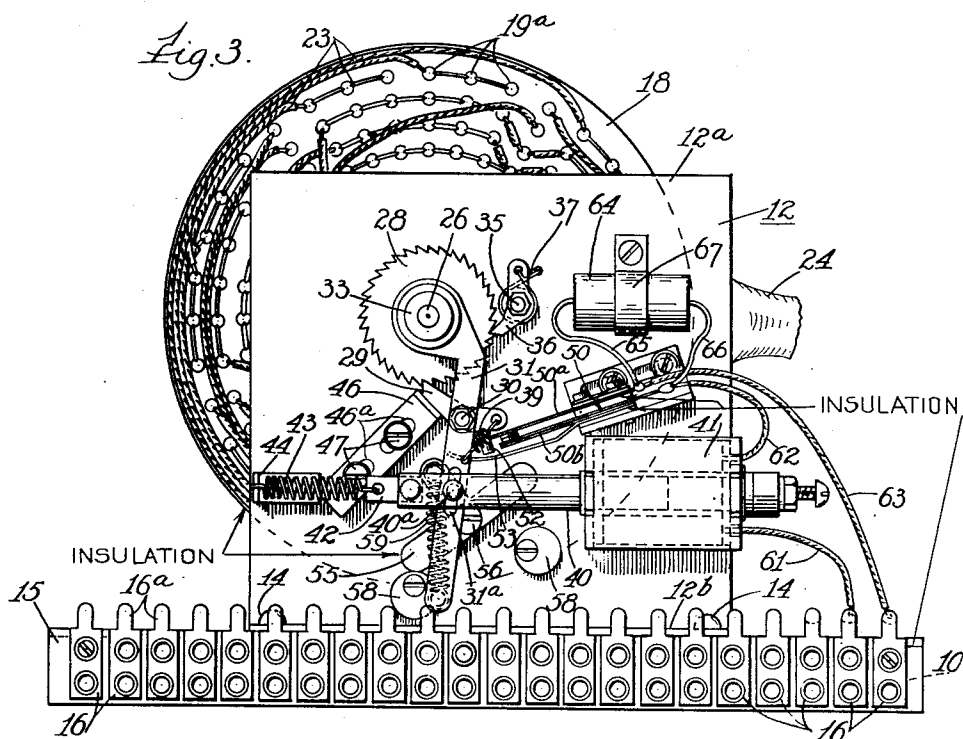
M. NELSEN ET AL

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SWITCH

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3 Sheets-Sheet 2



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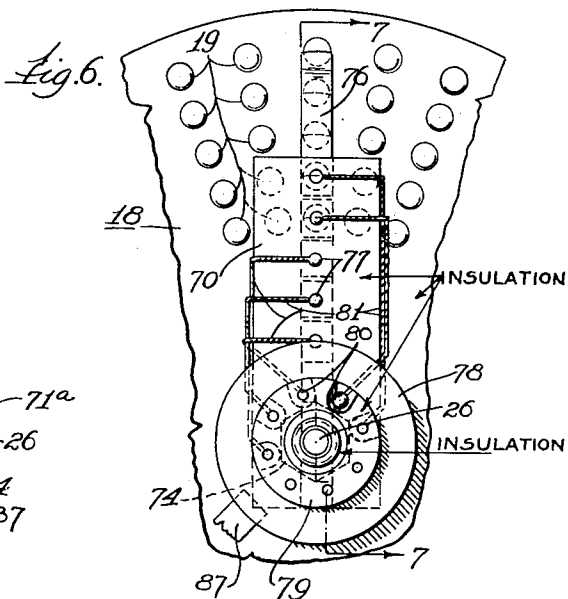
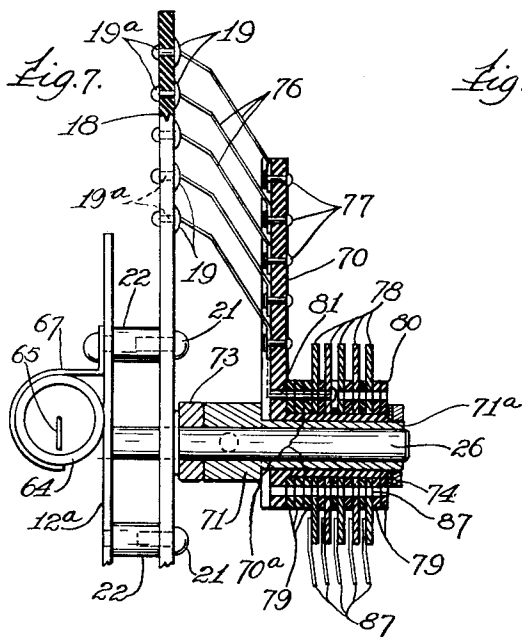
M. NELSEN ET AL

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SWITCH

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3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE

2,171,044

SWITCH

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Application March 9, 1937, Serial No. 129,930

1 Claim. (Cl. 200—11)

This invention relates to switches for electrical circuits, and more particularly to step-up switches adapted for completing in sequence, and/or simultaneously, portions of a plurality of different electrical circuits for immediate or subsequent actuation of mechanisms, or devices, or for maintaining certain circuits, while breaking others and completing portions of still other circuits. Switches of this type generally include one or more contact fingers adapted to engage in a certain sequence a series of contact buttons for completing portions of electric circuits, and wherein either the fingers or the buttons are movable for registration in the manner indicated.

Devices of the type embodying the present invention are particularly suitable for use in electrical systems where it is desired to control in a predetermined sequence the making and breaking of a plurality of different electrical circuits, such as for controlling the sequence of operation of certain mechanisms or devices, as signal or alarm systems used in conjunction with the starting or stopping of machines. For example, such a switch may be included in circuit with a timer or clock, suitable for causing operation of the switch at suitable predetermined intervals of time.

Switches of this type may also be advantageously employed in conjunction with certain amusement devices or games, such as coin-controlled "pin games". In such devices or games the switch is actuated in response to operation of coin-controlled devices, and by virtue of which portions of one or more electrical circuits may be completed. Such circuits, when completed, usually energize lamps, kicker devices and sundry other devices, and in some instances such circuits are completed by the player moving a part of the game device, such as the projection of a ball in a pocket on the surface of the game, wherein a switch is located and is closed by the weight of the ball. A subsequent operation of the coin-controlled mechanism may make all new circuit connections or may maintain some and establish portions of additional circuits.

One of the objects of this invention resides in the provision of a novel and improved form of step-up switch adapted to be operated by a solenoid connected in a main control circuit and by virtue of which said switch, each time it is operated, completes in sequence, and/or simultaneously, portions of a plurality of different electrical circuits.

Another object is to provide an improved driving mechanism for a step-up switch which is simple in construction and positive in operation.

A further object is to provide in an improved form of step-up switch having a plurality of separated rotatable contact fingers, a novel construction and arrangement of means providing circuit connections with each of said fingers.

Still another object is to provide, in a switch of the character indicated, a plurality of separated, rotatable, radially aligned contact fingers movable as a unit into registration with a plurality of individual concentric series of contact buttons.

Other objects and advantages of this invention will be apparent from the following description, taken in connection with the accompanying drawings, in which—

Figure 1 is a front elevation of the step-up switch embodying the present invention.

Figure 2 is a top plan view of the switch.

Figure 3 is a rear elevation of the switch showing the driving mechanism.

Figure 4 is a fragmentary rear elevational view showing the driving mechanism retracted, ready for re-adjustment of contact fingers.

Figure 5 is an end elevation of the switch.

Figure 6 is an enlarged, fragmentary front view of a portion of the panel containing contact buttons and the contact fingers and their mounting.

Figure 7 is a section through the contact finger assembly, taken at line 7—7 on Figure 6.

In the embodiment of our invention illustrated in the drawings the switch includes a base 10, herein shown as of rectangular form, on which is secured a support 12, preferably formed of sheet metal. Said support includes an upstanding supporting panel 12^a and a transverse foot 12^b which is secured to said block by screws indicated at 14. Mounted along the rear edge of the block is a strip of insulating material 15 carrying a bank of transversely separated contact clips 16, each having an upstanding ear 16^a, to each of which may be soldered or otherwise attached the end of a conductor wire. Mounted on the upper surface of the block, adjacent one end, is a block of insulating material 15 on which is mounted another bank of contact clips 16 having projecting ears to which the ends of conductor wires may be attached.

Mounted in front of, and in spaced relation to, the upstanding support portion 12^a is a vertically disposed circular panel of insulating material 18, the face of which is provided with a plurality of concentric series of spaced-apart contact buttons

19. Said series of buttons are herein shown as five in number, with the buttons of the respective series disposed in radial alignment. Said panel 18 is secured to the support 12^a by a plurality of screws 21, with spacer sleeves 22 mounted on the screws between the panel 18 and the support 12^a. Each contact button includes a shank 19^a extending through to the rear face of said panel 18, and to these shanks are connected conductor wires, indicated at 23. As may be seen in Figure 3, some conductor wires connect to one contact button, and others to a plurality of contact buttons of the same concentric series, while in other instances a conductor wire is connected to one or more buttons of several series of buttons. These wires are trained around the back of the panel 18 and support 12^a, and are bound together, as a cable, as by means of the sheath indicated at 24. The ends of said wires are soldered to the projections 16^a of certain of the contact clips 16, to which may be connected conductor wires leading to various mechanisms and/or devices which are to be operated upon the completion of certain electrical circuit connections through the contact buttons 19, as hereinafter described.

Extending through, and projecting laterally beyond, opposite faces of the assembled panel 18 and support 12^a is a horizontally disposed drive shaft 26, which is located centrally with respect to said concentric series of contact buttons 19. Connected to, and projecting from, the back side of the support panel 12^a is a hub 27 providing journal support for said shaft, and fixedly associated with said shaft adjacent the end of the hub is a ratchet wheel 28 for rotating said shaft. Said wheel is rotated by a driving pawl 29, pivoted at 30 on a depending arm 31, the upper end of which is journaled on the shaft. A collar 33 is secured by a pin 34 to the rear end of the shaft to confine said arm 31 in position thereon. Pivotaly mounted on a stud 35 on the back of support panel 12^a is a check pawl 36, yieldingly maintained in contact with the teeth of the ratchet wheel 28 by a coil spring 37 connected at one end to said pawl and at the other end to said support. This check pawl is constructed and positioned to prevent reverse rotation of the ratchet wheel, such as might occur by the frictional drag of the driving pawl 29 over the teeth of the ratchet wheel upon retraction of said pawl.

The driving pawl 29 is yieldingly maintained in proper relation to the teeth of the ratchet wheel by a coil spring 39 connected to said pawl and to said depending arm 31. The lower portion of said arm is connected to a reciprocating armature 40 of a solenoid 41 mounted on the back of the support panel 12^a. The end of the armature is slotted to accommodate the arm, and is provided with a transversely extending pin 40^a extending through a vertically elongated slot 31^a of the arm to provide a driving connection therebetween, and permitting freedom of movement of the arm 31 as it is swung about the axis of the shaft 26. The outer or free end of the armature 40 carries a pivot link 42, to which one end of a coil spring 43 is connected, the other end being connected to a bracket 44, connected to the support panel 12^a. When the solenoid is energized the armature 40 is retracted, tensioning the spring 43, which serves to withdraw the armature when the solenoid is de-energized by breaking of its electric circuit. It will be manifest that each time the armature is retracted the

arm 31 is swung to the position seen in Figure 4, positioning the pawl 29 in registration with the next tooth of the ratchet wheel 28, so that when the armature is returned to initial position by spring 43 the pawl 29 drives the ratchet wheel. To properly position the pawl at the end of its stroke, which, in turn, limits the outward movement of the armature, a stop bracket 46 is provided on said support panel 12^a. Said bracket is provided with a pair of slots 46^a through which extend anchoring screws 47 to permit exact adjustment of the stop for arresting the pawl 29 at a proper position.

Connected in series with the solenoid circuit is a normally closed switch 50 carried on a bracket 51 secured to the rear of the panel support 12^a. Said switch includes a pair of yieldable switch arms 50^a and 50^b, the arm 50^a extending beyond the end of the other arm and carrying a small plug 52 of insulating material which is positioned to be engaged by a resilient arm 53 connected to the switch 50. This switch is opened to break the solenoid circuit when the armature 40 has been retracted, so that the armature and arm 31 are returned to initial position by spring 43, and causing the pawl 29 to rotate the ratchet wheel 28. The switch is opened by a snap-toggle device comprising an inverted T-shaped lever 55, of insulating material, pivoted at 56 on said support 12^a. Connected to the end of the leg of said member is a projection 57 adapted, when the device is swung about its pivot, to engage the resilient arm 53 which, in turn, causes the switch arm 50^a to move out of engagement with the arm 50^b, breaking the solenoid electric circuit. The opposite ends of the cross-member of the lever 55 are adapted to alternately engage stop blocks 58, carried on support 12^a for limiting the amount of swing of the lever about its pivot. To insure accurate and proper opening of the switch the stop blocks are formed of circular outline and are eccentrically mounted for insuring arresting the lever 55 at proper positions. Connected to the projection 57 is a coil spring 59, the opposite end of which is connected to the lower end of the depending arm 31, and the parts are so positioned in relation to each other that the spring which serves as the means for swinging the lever 55 is disposed at either side of the pivot 56 and is tensioned by the movement of the arm 31 when actuated by the solenoid armature, so that as it passes beyond the pivot the spring rapidly returns the lever 55 to its other position of adjustment.

It is to be understood that the solenoid is connected in a separate main electrical control circuit, independent of the circuits completed through contact buttons 19. As for example, when the device is employed in connection with games or amusement devices of the character above indicated, the solenoid may be connected in an electric circuit that is established by the actuation of a main control device, such as the coin-operated mechanism. In the device, as herein illustrated, the solenoid is provided with current conductor wires 61 and 62, the latter being connected to switch arm 50^b of switch 50, while the other switch arm 50^a is connected to a conductor wire 63, whereby the switch and solenoid are connected in a series circuit. The free ends of conductors 61 and 63 are connected to contact clips 16, as may be seen in the drawings. To take the load off of the contact points of the switch arms 50^a and 50^b, and to prolong their life, a condenser 64 is connected in

parallel circuit with said switch arms, by conductor wires 65 and 66. For convenience said condenser is mounted by means of a clip 67 to the support 12^a above said switch 50.

5 In the construction herein shown the contact buttons 19 of the respective series are spaced apart an angular amount equal to the angular amount of movement of the ratchet wheel 28 each time it is driven by the pawl 29, due to
10 operation of the solenoid 41. Supported on said shaft 26 in front of the panel 18 is a radially extending arm 70 of insulating material, having an integral hub 70^a journaled on a hub 71^a of a collar 71, secured on the shaft by a set screw
15 72 with a collar 73 interposed between the collar and the panel 18. The end of the hub 71^a extends beyond insulating hub 70^a, and is threaded to receive a nut 74. The face of the arm 70 adjacent the panel is provided with a longitudinal
20 groove in which are mounted, in radially spaced apart insulated relation, the ends of a plurality of radially spaced and aligned resilient contact fingers 76, one for each concentric series of contact buttons. Said fingers are secured
25 to the arm by fastening members, such as rivets 77, which project to the outer face of the arm. The free ends of said fingers are adapted to align with a contact button of a respective series. Mounted on the hub 70^a of said arm is a
30 plurality of current-conducting collector rings 78, one for each finger 76, said rings being axially spaced apart by washers 79 of insulating material. Similar washers are also provided at opposite ends of said series of rings, and the outer
35 washer and the end of hub 70^a are engaged by the nut 74 to firmly clamp the parts in assembled relation, and thereby provide a friction drive for said arm carrying the contact fingers 76. Said arm, collector rings and washers, are provided with a plurality of circumferentially spaced apart apertures, disposed in
40 alignment to form ducts 80, through which extend the respective conductor wires 81. Said conductor wires 81 are connected to the rivets 77, associated with the respective contact fingers 76, the ends of which conductor wires are connected to the respective collector rings 78.

Associated with each of the respective collector rings is a resilient pick-up finger 87, the
45 ends of which fingers are maintained in yielding contact with the rings at any angular position of adjustment thereof. The opposite ends of each pick-up finger are mounted in insulated relation in a laminated block 88 of insulating
50 material, which is secured to a bracket 89 connected to the support 12^a, as seen in the drawings. The pick-up fingers are enclosed in a shield 90 connected to the bracket 89. Connected to the respective pick-up fingers are current conductor wires 91, the opposite ends of which are
55 connected to contact clips 16, as seen in the drawings.

It will now be apparent that each time the solenoid 41 is energized the driving mechanism
60 above described causes the arm 70 to rotate an

angular amount to dispose all of the contact fingers 76 in registration with the next successive contact button 19 of the respective series. As above described, such re-adjustment of the contact fingers with a new set of buttons may
5 break one or more previously established portions of different electrical circuits for actuating devices, or mechanisms, or such re-adjustment may complete portions of some, or all, new and different circuits through the engaged contact
10 buttons.

Obviously, the number of contact fingers, rings and pick-up fingers, as well as the number and arrangement of the contact buttons, may be varied to suit the particular requirements of such
15 a step-up switch. It will be apparent that by virtue of our novel switch construction it is possible to automatically complete, in sequence, and/or simultaneously, portions of a plurality of different electrical circuits in a simple, positive and expeditious manner, by merely completing a main control circuit which includes
20 the solenoid 41.

Although we have herein shown and described a preferred embodiment of our invention, manifestly it is capable of modification and re-arrangement without departing from the spirit and scope thereof. We do not, therefore, wish to be understood as limiting this invention to the precise embodiment herein disclosed, except as
25 it may be so limited in the appended claim.

We claim:

In combination, a support, a panel member carried by the support and having a plurality of concentric series of spaced-apart insulated contact buttons on one face, conductor wires connected to said buttons, a shaft extending through the support and panel member, an arm member of insulating material mounted on said shaft, a contact finger for each series of buttons, said
35 fingers being mounted on said arm and having their free ends adapted to engage said buttons, a plurality of axially spaced-apart current collector rings mounted on the shaft, means insulating said rings from each other and from
40 the shaft, electrical conductors connecting each finger with one of said rings, said rings and insulating means therefor being secured to said arm member to form a unitary assembly, said assembly being provided with a plurality of axially
45 aligned openings to form ducts through which said last-mentioned conductors extend for connection to the respective rings, pick-up fingers carried on the support and engageable with the respective rings, means insulating said pick-up
50 fingers from each other and the support, and electrical conductors connected to the respective pick-up fingers for completing portions of certain electrical circuits through the engaged contact buttons, one of said members being shiftable
55 about the axis of the shaft for aligning said contact fingers with other contact buttons.

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