

Sept. 6, 1949.

M. G. NELSEN

2,481,033

SELECTOR-STEPPER SWITCH

Filed April 17, 1944

3 Sheets-Sheet 1

Fig. 1.

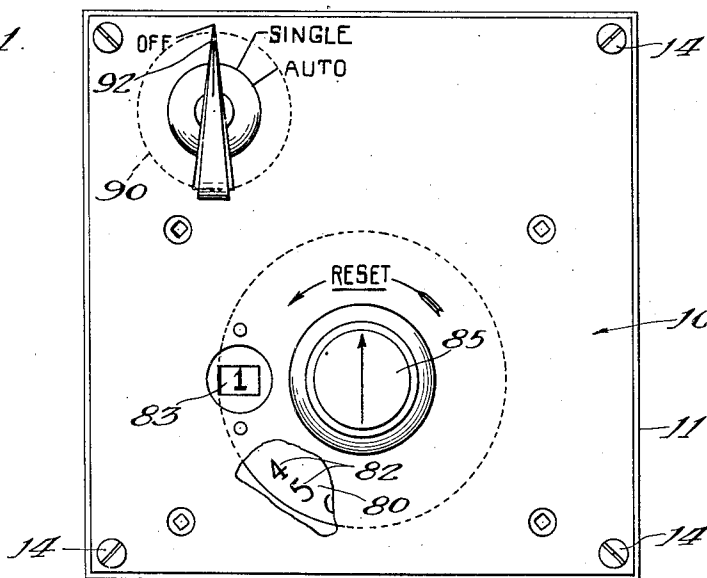
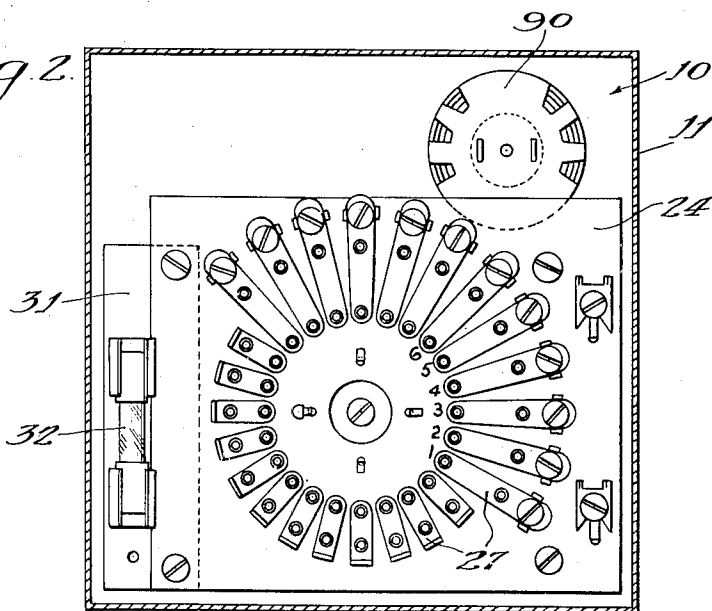


Fig. 2.



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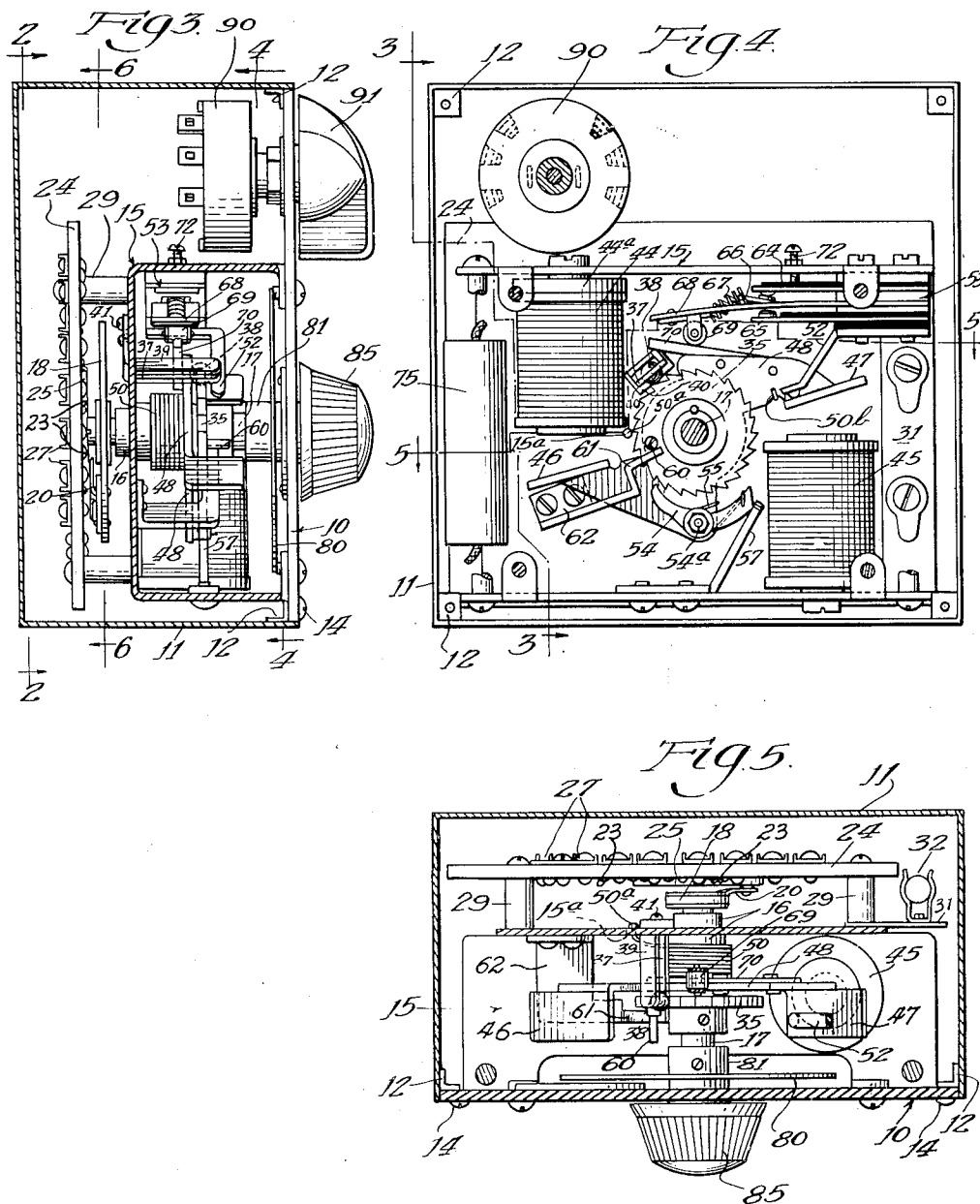
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3 Sheets-Sheet 2



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Fig. 6

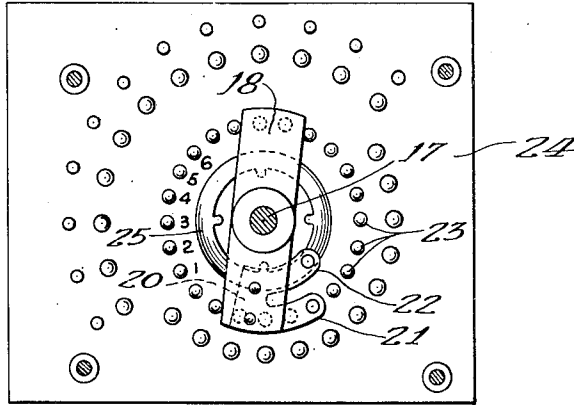
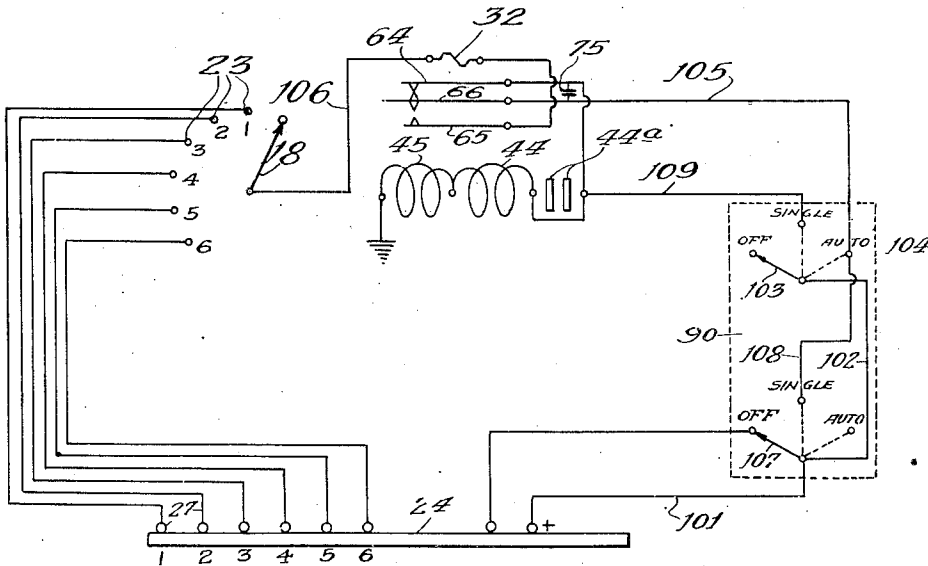


Fig. 7



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UNITED STATES PATENT OFFICE

2,481,033

SELECTOR-STEPPER SWITCH

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Application April 17, 1944, Serial No. 531,431

16 Claims. (Cl. 171-97)

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This invention relates to selector-stepper switch devices for controlling the "make" and "break" of portions of a plurality of different electrical circuits or branches of a main circuit. While for convenience reference will hereinafter be made in both the description and claims to a plurality of branch circuits, it is to be understood that such terminology shall be construed to mean either branch or independent circuits. Switch devices of this general class are adapted to a relatively wide field of use for direct or remote control of the operation of various types of devices or apparatus.

One of the objects of this invention is to provide a novel selector-stepper switch of the character indicated which is of simple, durable, compact construction, and which is positive in operation and capable of withstanding substantial shock and vibration without being inadvertently actuated.

Another object is to provide a novel selector-stepper switch of the character indicated, provided with manually adjustable means which permits the switch to function automatically to complete temporarily, in rapid sequence, portions of a plurality of different branch electrical circuits, or to cause selective and individual completion of one or more predetermined branch circuits.

A further object is to provide an improved selector-stepper switch, characterized by the provision of novel means for producing pulsating operation of electro-magnet means for actuating the selector switch in a step-by-step manner.

Still another object is to provide an improved selector-stepper switch, characterized by the provision of a pair of oppositely arranged electro-magnets, having their armatures connected together and pivoted on a common axis so as to permit obtaining maximum power of the armature movement for actuating a ratcheting mechanism, and wherein the armatures provide counter balancing for precluding faulty or inadvertent actuation of the ratcheting means due to shock or vibration.

A still further object is to provide an improved selector-stepper switch, characterized by the provision of means for visually indicating the position of adjustment of the switch, and/or to designate a particular branch circuit to be completed.

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

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Figure 1 is a front elevational view of the switch device embodying the present invention.

Figure 2 is a vertical sectional view through the rear of the switch device, taken substantially as indicated at line 2-2 on Figure 3.

Figure 3 is a staggered, vertical sectional view through the switch device, taken substantially as indicated at line 3-3 on Figure 4.

Figure 4 is a vertical sectional view through the switch device, taken substantially as indicated at line 4-4 on Figure 3.

Figure 5 is a staggered, horizontal sectional view through the switch device, taken substantially as indicated at line 5-5 on Figure 4.

Figure 6 is a sectional view showing the contact panel and contact arm, taken substantially as indicated at line 6-6 on Figure 3.

Figure 7 is a wiring diagram of the electrical circuits of the switch per se.

The selector-stepper switch embodying the present invention is a unitary assembly, including a main mounting panel 10 to which the various parts of the switch mechanism are attached. The switch mechanism is adapted to be housed within a rectangular sheet metal box 11, with the panel 10 seated against mounting brackets 12, to which the panel 10 is attached by means of screws 14. Connected to the inner surface of the mounting panel 10, is a frame 15, in the form of a sheet metal stamping. Mounted in the rear wall of the frame 15, is a bushing 16, in which is journaled a shaft 17. Rigidly attached to the rear end of the shaft, protruding beyond the rearward wall of the frame 15, is a contactor arm 18 of insulating material, on the outer end of which is mounted a contactor 20, including a pair of spaced apart contact fingers 21 and 22. The finger 21 is positioned to engage a circularly arranged series of spaced apart contact buttons 23, mounted on a panel 24 of insulating material, and it may be understood that certain of the contacts are connected to conductor wires of separate, branch electrical circuits. The other contact finger 22 engages a contact ring 25, also mounted on the insulating panel 24, in surrounding, spaced apart relation to the shaft 17, as seen in Figure 6 of the drawings. Thus the fingers 21 and 22 serve to complete electrical branch circuits between the respective contact buttons 23 and the contact ring 25.

The contact buttons 23 are connected to terminals 27 carried on the opposite side of the panel 24, and the terminals are adapted to be connected by conductor wires into the various branch or separate main electrical circuits to be

controlled. As will presently be described, mechanism is provided for rotating the shaft 17 in a step-by-step manner so that the finger 21 of the contact arm moves in a step-by-step fashion to engage successively the series of contact buttons 23. The insulating panel 24 is mounted in fixed spaced apart relation to the rear wall of the frame member 15, as seen in Figures 3 and 5 of the drawings, by means of spacer studs 29.

Attached to the rear wall of the frame 15, at one edge, as may be seen in Figure 5 of the drawings, is an insulating panel 31 on which is mounted a fuse 32, to take care of possible overload of the circuits including the entire control switch.

Rigidly mounted on the shaft 17, within the frame 15, is a ratchet wheel 35, having a multiplicity of teeth spaced apart circumferentially by angular amounts corresponding to the angular spacing of the contact buttons 23. The ratchet wheel is adapted to be yieldingly retained in any position of rotative adjustment by detent means, comprising a rigid bar 37, extending parallel to the axis of the shaft 17, in close proximity to the periphery of the ratchet wheel 35, and having an aperture in which is freely movable a metal ball 38, adapted to engage and seat between adjacent teeth of the ratchet wheel. A spring finger 39 engages the top of the ball and urges the latter yieldingly into engagement with the teeth of the ratchet wheel. The bar 37 and the finger 39 project rearwardly through an opening 40 in the rear wall of the frame member and are bent at right angles for fastening by screws 41 to the rear side of the rear wall of the frame 15, as seen in Figure 3 of the drawings.

Mounted in the frame 15, on opposite sides of the shaft 17, as seen in Figure 4 of the drawings, are electro magnetic devices, arranged in opposed relation to each other. One of the magnets includes a coil 44 secured to the upper wall of the frame 15, and the other magnet includes a coil 45 secured to the lower wall of the frame 15. The corresponding operating ends of the coils are disposed in opposed relation to each other. Cooperating with said ends of the coils are armatures 46 and 47 which are connected together to constitute a single armature element 48, journaled on the bushing 16, adjacent the ratchet wheel. The two armatures and their connecting portions desirably are formed as a unitary stamping, and the armatures are so dimensioned and related to each other as to provide a counter-balancing action of one with respect to the other. The armature element 48, including both of the armatures 46 and 47, is urged in a counter-clockwise direction, as seen in the drawings, by a coil spring 50, surrounding the bushing 16, with one end of the spring as indicated at 50a anchored in an aperture 15a in the rear wall of the frame 15, while the opposite end of the spring as indicated at 50b is seated in a notch in the armature element 48, adjacent the armature 47, as seen in Figure 4 of the drawings. It is to be understood that the coil spring is initially tensioned before connection to the armature element. The armature element is arrested or limited in its outward position of adjustment with respect to the coils 44 and 45 by a stop member 52 positioned to be engaged by the armature 47, said stop member being connected to the bottom of a snap-action switch assembly, indicated generally at 53, attached to the upper wall of the frame 15.

Pivotaly mounted at 54a, on the lower portion of the armature element, is a pawl 54 for driving the ratchet wheel in a step-by-step fashion each

time the armatures are attracted to their corresponding coils. It is to be understood that each time the armatures are attracted to their coils, the pawl 54 drives the ratchet wheel 35 rotatively to the extent of a single tooth. Such movement of the ratchet wheel is imparted to the shaft 17 to effect corresponding rotative adjustment of the contactor arm 18, so as to dispose the contact finger 21 in engagement with the next adjacent contact button 23. The pawl 54 has a coil spring 55 wound around its pivot connection to yieldingly urge the pawl into engagement with the ratchet. One end of the spring is anchored around the adjacent edge of the armature element and the other end engages the tail end of the pawl, as clearly seen in Figure 4 of the drawings. Just prior to the armature element assuming the position seen in Figure 4 of the drawings, the tail end of the pawl is caused to abut against a trip arm 57, secured to the bottom wall of the frame 15, to shift the operating end of the pawl out of engagement with the teeth of the ratchet wheel.

In order to position the ratcheting mechanism and the contactor arm 18 at an initial or zero starting position, I provide a stop pin 60 on the forward face of the ratcheting wheel 35, positioned so that when the ratchet wheel is rotated it will engage a finger 61, of a bracket member 62, which in turn is mounted on the inner face of the rear wall of the frame 15. Thus if a ratcheting mechanism is operated through its entire range of movement, or in the event it is disposed at some intermediate position and it is desired to reset the ratcheting mechanism, together with the contactor arm to a zero or starting position, the shaft 17 is rotated in a counter clockwise direction until the pin 60 engages the stop finger 61. Such adjustment is permissible at all times when the electro-magnets are not being actuated.

The snap-action switch 53 is of the single pole double throw type and includes two fixed contact fingers 64 and 65, and a movable contact finger 66. The movable contact finger is interconnected by a spring toggle 67 with an actuating arm 68 which is normally biased in a downward direction so that the movable contact finger 66 is in engagement with the fixed contact finger 64. Mounted on the under side of the outer end of the actuator 68 is a roller 69 yieldingly urged into contact with a cam member 70, rigidly attached to the upper portion of the armature element 48. As the armature element rotates in clockwise direction, incident to energization of the electro-magnets, the cam 70 acting on the roller 69 causes the actuator 68 to operate the snap-action switch so as to separate the movable contact finger 66 from the fixed contact finger 64, and effecting engagement of said movable finger 66 with the stationary finger 65. It is to be understood that the switch is actuated just prior to seating of the armatures on the ends of their respective coils, and to insure proper adjustment for such action, I provide an adjusting screw 72, engaging the fixed finger 64, so as to move it upwardly or downwardly a relatively small amount to obtain the desired nicety of adjustment. It is also to be understood that the relationship of the switch to the cam is such as to permit the switch to reassume the position of adjustment, as seen in Figure 4 of the drawings, just prior to the armature 47 engaging the stop 52, after the coils are deenergized.

The selector-switch embodying the present in-

vention is adapted to be operated by direct current. In order to obtain a stepping action by the electro magnets it is necessary that the magnets operate in an intermittent or pulsating manner. This intermittent or pulsating action is accomplished by means of the snap-action switch 53. However in order to insure the maintenance of the branch circuit or circuits for a period of time sufficient to effect operation of the apparatus or devices being controlled thereby, there must be employed some form of time delaying means. For this purpose the electro magnet including the coil 44 is provided with a copper slug 44a, which functions in a well understood manner, to effect a delaying action in the release of the armatures after they have been attracted by energization of the coils.

Connected to the contact panel 24 and positioned in close proximity to the coil 44 is a condenser 75, which it may be understood is connected across the contact fingers 64 and 66 of the switch for suppressing arcing of the switch.

Mounted on the forward portion of the shaft 17, adjacent the inner wall of the main mounting panel 10 is a circular disc 80 attached to a hub 81, which in turn is rigidly connected to said shaft by a set screw. The forward face of the disc is provided with a circumferentially arranged series of numbers, as indicated 82, which are spaced apart angular amounts corresponding to the spacing of the teeth of the ratchet wheel and the angular spacing of the contacts 23 on the contact panel. The numbers of the disc 80 are located so as to be sequentially registered with a window opening 83, in the main mounting panel 10, as seen in Figure 1 of the drawings. When the mechanism is in its zero or starting position, with the pin 60 of the ratchet wheel engaging the stop member 61, the disc 80 is in position so that number 1 is disposed in registration with the window 83 as seen in Figure 1 of the drawings. As the ratchet wheel is operated in step-by-step manner to cause the contact arm to sequentially engage the series of contact buttons 23, the disc 80 is correspondingly rotated step-by-step so as to bring into corresponding registration with the window 83, the numerals corresponding with the respective contact buttons. In other words, the numerals of the disc 80, visually indicate the particular main or branch electrical circuit to be completed through the contactor arm. While in the construction illustrated, the number of the disc seen through the window 83 of the main panel 10 designates the circuit to be completed, if desired the construction may be modified so that the numeral would designate the circuit previously completed.

The extreme end of the shaft 17 projects through the main panel 10 and has rigidly attached thereto a knob 85, which for convenience, is termed a "reset knob." This knob may be manually engaged and rotated so as to readjust the ratcheting mechanism, as well as the contactor arm 18, either to a zero starting position, or to any intermediate position. For example, if it is desired, under one condition of operation of the selector-switch, to complete only a single branch electrical circuit, such as designated by the numeral 5 on the disc 80, the reset knob is rotated in the proper direction so that said numeral is disposed in registration with the window 83.

Mounted on the main panel 10 above the ratcheting mechanism is a tap switch 90, hav-

ing an operating shaft projecting through the panel and on the end of which is mounted a finger knob 91. The finger knob includes a pointer 92, and the knob is adapted to be rotated so as to dispose the tap switch in either of three positions of adjustment. In the position seen in Figure 1 of the drawings, the adjustment is such that the tap switch is in the "Off" position. When the switch finger 91 is rotated to the position indicated by the word "single," the switch then becomes adjusted so as to permit completion of only an individual branch electrical circuit and which circuit may be predetermined by adjustment of the reset knob 85 as above stated. When the finger knob 91 is adjusted to the position indicated by the word "Auto," the tap switch then is in a position of adjustment so that the ratcheting mechanism may be operated automatically to complete in rapid sequence a portion or the entire series of branch electrical circuits, by the pulsating actuation of the electro magnets. If the switch is to be operated automatically, the ratcheting mechanism is first set at the zero or a desired starting position, and the tap switch correspondingly adjusted, then the automatic operation will take place and the entire series of branch circuits will be temporarily completed in sequence.

To facilitate a clear understanding of the construction and operation of the switch embodying the present invention, reference will be made to the wiring diagram illustrated in Figure 7 of the drawings. The diagram merely represents the circuits of the selector-stepper switch per se, and it is to be understood that external auxiliary switch means, (not shown) is provided for controlling the actuation of the selector-stepper switch. Each time that the auxiliary control switch is closed the coils 44 and 45 are energized and attract the armatures to said coils, thereby actuating the ratchet wheel and contact arm 18 in a step-by-step manner and the snap switch 53, which is normally closed, and in series with the coils 44 and 45, is actuated during each attraction of the armatures to open the circuit including the coils 44 and 45, and simultaneously and temporarily completes the branch circuit through the contactor arm to the particular contact button 23 engaged by the contactor arm, for operating the apparatus controlled by the circuit.

The copper slug 44a associated with the coil 44 serves to hold the armature element in attracted position for a relatively short interval of time so as to prevent instantaneous release of the armature element under influence of the coil spring 50. The timing interval need only be a small fraction of a second, and for practical purposes it has been found satisfactory to utilize a copper slug which will permit the switch to operate, for automatically completing in sequence a series of branch circuits, at a speed at which the magnets are energized about ten times per second. When the armature element moves to its open position, the snap switch is actuated to again open the circuit to the contactor arm, and reestablish the circuit including the coils 44 and 45, so that the operation may be repeated. During such stepping movement, the indicating disc 80 is simultaneously stepped to indicate the position of adjustment of the switch after completion of each or the entire series of stepping actions. The stop pin 60 eventually contacts the underside of bracket 62 if the auxiliary switch remains closed and prevents further operation of armature 48. After actuation the selector-

switch may be manually reset by turning the knob 85 as above stated.

The operation above described corresponds to the adjustment of the finger piece 91 to the "automatic" position, as indicated in Figure 1 of the drawings, in which position current flows through the conductor wire 101 to the tap switch, into the conductor wire 102, through the tap switch finger 103, to the contact 104, and thence through conductor wire 105, and the movable switch finger 66, of the snap-action switch, to the switch finger 64, through the coils 44 and 45 of the magnets to ground. Thus the coils of the magnets are energized, and by the stepping action above described the snap switch is operated so that the movable switch finger 66 breaks contact with the switch finger 64, and completes contact with switch finger 65, thus breaking the circuit including the coils 44 and 45, and completing the circuit through conductor wire 106, to the contactor arm 18, and the aligned contact button 23 to energize the particular branch circuit including the contact button engaged by the contactor arm 18. Due to the holding action of the copper slug 44a, the circuit through the contactor arm 18, and the registered contact button 23, is maintained for a short interval of time, after which the coils 44 and 45 release the armature element, and cause actuation of the snap-action switch to reestablish contact between the switch fingers 66 and 64, immediately after breaking contact between switch fingers 66 and 65. It will be apparent that the stepping action may be repeated, in a cyclic manner, and by virtue of which the ratcheting mechanism functions to complete in a rapid sequence the several branch circuits, including the respective contact buttons 23.

Now when the finger knob 91 is adjusted to the position indicated at "single," only an individual branch circuit may be completed when the auxiliary or control switch is operated. This branch circuit will include the contact button 23 engaged by the contactor arm 18, in a step position of adjustment. In other words, the reset knob 85 may be so adjusted for selecting any one of the entire group of branch circuits for completion. When the auxiliary or control switch is closed, current is permitted to flow through the conductor wire 101, through the tap switch finger 107 and conductor wires 102 and 108. The conductor wire 108 merges with the conductor wire 105 which controls the snap-action switch. Current also flows from the conductor wire 102 through the tap switch finger 103 through the conductor wire 109 into the coils 44 and 45 for energizing the same. Because current flows through the path of least resistance, it will cause the electro magnets to be operated prior to the passage of current through the snap-action switch and the contactor arm and hence the snap-action switch will become actuated, incident to energization of the magnets, and current is then caused to flow through the movable switch finger 66, stationary finger 65, through the conductor wire 106 and the contactor arm 18 for completing the selected branch circuit, through the corresponding contact button engaged by the contactor arm. This individual selected circuit will remain in closed condition until the control or auxiliary switch is again opened.

For convenience in illustration, a group of the contact buttons 23 in the wiring diagram have been designated by the numerals 1 to 6 inclusive,

and their respective contact terminals have been correspondingly designated in Figures 2 and 6 of the drawings.

While I have illustrated and described a preferred embodiment of my invention, wherein I utilize a pair of electro magnets arranged with interconnected armatures so as to obtain a counter balanced relationship which permits obtaining a selector stepper device capable of withstanding substantial shock and vibration, such as for use in aircraft, it will be manifest that for certain other uses a single electromagnet might be employed, utilizing the other novel constructional features of my invention to substantial advantage. I do not, therefore, wish to be understood as limiting this invention to the precise embodiment herein disclosed, except as I may be so limited by the appended claims.

I claim as my invention:

1. A selector switch comprising a series of spaced apart contacts adapted to be connected in separate, branch electrical circuits, a mounting frame, a rotatable shaft carried on the frame, a contactor arm mounted on and rotatable with said shaft, a ratchet wheel fixedly mounted on said shaft, an electromagnet comprising a coil fixedly mounted on the frame and a cooperating armature mounted for free rotation on said shaft, a driving pawl carried on the armature and positioned to engage the teeth of the ratchet, to rotate the latter in one direction, together with the shaft and contactor arm, a predetermined angular amount, each time the armature is actuated by its coil, whereby to shift the contactor arm in a step-by-step manner to sequentially engage the contacts of the series, a detent for releasably retaining the ratchet wheel, shaft and contactor arm at each stepped position of adjustment, spring means for yieldingly urging the armature away from the coil, a stop for limiting outward movement of the armature, means for shifting the pawl out of engagement with the ratchet wheel as the armature approaches said stop, a finger knob on said shaft for manually rotating the shaft, ratchet wheel and contactor arm to dispose the latter in engagement with a predetermined contact of the series, indicia means comprising an element rotatable with the shaft for designating a particular branch circuit in correspondence with the contactor arm in engagement with a contact of the series, and a snap-action switch connected in circuit with said contacts and controlled by the armature and adapted to be closed, when the armature moves to its coil, to complete a branch circuit including the contact engaged by the contactor arm, incident to such movement of the armature.

2. A selector switch comprising a series of spaced apart contacts adapted to be connected in separate, branch electrical circuits, a mounting frame, a rotatable shaft carried on the frame, a contactor arm mounted on and rotatable with said shaft, a ratchet wheel fixedly mounted on said shaft, an electromagnet comprising a coil fixedly mounted on the frame and a cooperating armature mounted for free rotation on said shaft, a driving pawl carried on the armature and positioned to engage the teeth of the ratchet, to rotate the latter in one direction together with the shaft and contactor arm, a predetermined angular amount, each time the armature is actuated by its coil, whereby to shift the contactor arm in a step-by-step manner to sequentially engage the contacts of the series, a detent for releasably retaining the ratchet wheel, shaft and contactor arm at

each stepped position of adjustment, and a double pole snap-action switch including a set of normally open contacts adapted to be connected in a branch circuit including the contactor arm and the contact of the series engaged by said arm, a set of normally closed contacts in circuit with the coil, and an operating arm positioned to be controlled by the armature, whereby said sets of contacts are reversed incident to movement of the armature to the coil to complete the branch circuit including the contact of the series then engaged by the contactor arm.

3. A selector switch comprising a series of spaced apart contacts adapted to be connected in separate, branch electrical circuits, a mounting frame, a rotatable shaft carried on the frame, a contactor arm mounted on and rotatable with said shaft, a ratchet wheel fixedly mounted on said shaft, an electromagnet comprising a coil fixedly mounted on the frame and a cooperating armature mounted for free rotation on said shaft, a driving pawl carried on the armature and positioned to engage the teeth of the ratchet, to rotate the latter in one direction, together with the shaft and contactor arm, a predetermined angular amount, each time the armature is actuated by its coil, whereby to shift the contactor arm in a step-by-step manner to sequentially engage the contacts of the series, a detent for releasably retaining the ratchet wheel, shaft and contactor arm at each stepped position of adjustment, a double pole snap-action switch including a set of normally open contacts adapted to be connected in a branch circuit including the contactor arm and the contact of the series engaged by said arm, a set of normally closed contacts in circuit with the coil, and an operating arm positioned to be controlled by the armature, whereby said sets of contacts are reversed incident to movement of the armature to the coil to complete the branch circuit including the contact of the series then engaged by the contactor arm, and time delay means for maintaining the armature attracted to the coil for a short interval of time for maintaining said last mentioned branch circuit complete for a period of time.

4. A selector switch comprising a series of spaced apart contacts adapted to be connected in separate, branch electrical circuits, a mounting frame, a rotatable shaft carried on the frame, a contactor arm mounted on and rotatable with said shaft, a ratchet wheel fixedly mounted on said shaft, an electromagnet comprising a coil fixedly mounted on the frame and a cooperating armature mounted for free rotation on said shaft, a driving pawl carried on the armature and positioned to engage the teeth of the ratchet, to rotate the latter in one direction, together with the shaft and contactor arm, a predetermined angular amount, each time the armature is actuated by its coil, whereby to shift the contactor arm in a step-by-step manner to sequentially engage the contacts of the series, a detent for releasably retaining the ratchet wheel, shaft and contactor arm at each stepped position of adjustment, a double pole snap-action switch including a set of normally open contacts adapted to be connected in a branch circuit including the conductor arm and the contact of the series engaged by said arm, a set of normally closed contacts in circuit with the coil, and an operating arm positioned to be controlled by the armature, whereby said sets of contacts are reversed incident to movement of the armature to the coil to complete the branch circuit including the contact of the series

then engaged by the contactor arm, time delay means for maintaining the armature attracted to the coil for a short interval of time for maintaining said last mentioned branch circuit complete for a period of time, and a manually adjustable control switch connected in circuit with said coil and snap switch and adapted in one position of operative adjustment to effect a pulsing operation of the electro magnet for automatically completing in rapid sequence the branch circuits including a group of the contacts of the series.

5. A selector switch comprising a series of spaced apart contacts adapted to be connected in separate, branch electrical circuits, a mounting frame, a rotatable shaft carried on the frame, a contactor arm mounted on and rotatable with said shaft, a ratchet wheel fixedly mounted on said shaft, an electromagnet comprising a coil fixedly mounted on the frame and a cooperating armature mounted for free rotation on said shaft, a driving pawl carried on the armature and positioned to engage the teeth of the ratchet, to rotate the latter in one direction, together with the shaft and contactor arm, a predetermined angular amount, each time the armature is actuated by its coil, whereby to shift the contactor arm in a step-by-step manner to sequentially engage the contacts of the series, indicia means comprising an element rotatable with the shaft for designating a particular branch circuit in correspondence with the contactor arm in engagement with a contact of the series, a double pole snap-action switch including a set of normally open contacts adapted to be connected in a branch circuit including the contactor arm and the contact of the series engaged by said arm, a set of normally closed contacts in circuit with the coil, and an operating arm positioned to be controlled by the armature, whereby said sets of contacts are reversed incident to movement of the armature to the coil to complete the branch circuit including the contact of the series then engaged by the contactor arm, time delay means for maintaining the armature attracted to the coil for a short interval of time for maintaining said last mentioned branch circuit complete for a period of time, a manually adjustable control switch connected in circuit with said coil and snap switch and adapted in one position of operative adjustment to effect a pulsing operation of the electromagnet for automatically completing in rapid sequence the branch circuits including a group of the contacts of the series, and adapted in another position of adjustment for completing an individual branch circuit corresponding to the particular contact of the series engaged by the contactor arm immediately after actuation of the magnet.

6. A selector switch comprising a series of spaced apart contacts adapted to be connected in separate, branch electrical circuits, a mounting frame, a rotatable shaft carried on the frame, a contactor arm mounted on and rotatable with said shaft, a ratchet wheel fixedly mounted on said shaft, manual means on said shaft to rotate said shaft, ratchet wheel, and contactor arm to dispose the latter in engagement with a predetermined contact of said series, a pair of electromagnets comprising coils fixedly mounted on the frame and disposed on opposite sides of the shaft with their corresponding operating ends disposed in opposed relation to each other, and armatures for said coils arranged at opposite sides of the shaft, said armatures being connected together and mounted for free rotation on the shaft, and a driving pawl carried on the armatures and po-

sitioned to engage the teeth of the ratchet, to rotate the latter in one direction, together with the shaft and contactor arm, a predetermined angular amount each time the armatures are actuated by their coils, whereby to shift the contactor arm in a step-by-step manner to sequentially engage the contacts of the series.

7. A selector switch comprising a series of spaced apart contacts adapted to be connected in separate, branch electrical circuits, a mounting frame, a rotatable shaft carried on the frame, a contactor arm mounted on and rotatable with said shaft, a ratchet wheel fixedly mounted on said shaft, a pair of electromagnets comprising coils fixedly mounted on the frame and disposed on opposite sides of the shaft with their corresponding operating ends disposed in opposed relation to each other, and armatures for said coils arranged at opposite sides of the shaft, said armatures being connected together and mounted for free rotation on the shaft, a driving pawl carried on the armatures and positioned to engage the teeth of the ratchet, to rotate the latter in one direction, together with the shaft and contactor arm, a predetermined angular amount, each time the armatures are actuated by their coils, whereby to shift the contactor arm in a step-by-step manner to sequentially engage the contacts of the series, a detent for releasably retaining the ratchet wheel, shaft and contactor arm at each stepped position of adjustment, spring means for yieldingly urging the armatures away from their coils, a stop for limiting outward movement of the armatures, means for shifting the pawl out of engagement with the ratchet wheel as the armatures approach said stop, and a finger knob on said shaft for manually rotating the shaft, ratchet wheel and contactor arm to dispose the latter in engagement with a predetermined contact of the series.

8. A selector switch comprising a series of spaced apart contacts adapted to be connected in separate, branch electrical circuits, a mounting frame, a rotatable shaft carried on the frame, a contactor arm mounted on and rotatable with said shaft, a ratchet wheel fixedly mounted on said shaft, manual means on said shaft to rotate said shaft, ratchet wheel, and contactor arm to dispose the latter in engagement with a predetermined contact of said series, a pair of electromagnets comprising coils fixedly mounted on the frame and disposed on opposite sides of the shaft with their corresponding operating ends disposed in opposite relation to each other, and armatures for said coils arranged at opposite sides of the shaft, said armatures being connected together and mounted for free rotation on the shaft, a driving pawl carried on the armatures and positioned to engage the teeth of the ratchet, to rotate the latter in one direction, together with the shaft and contactor arm, a predetermined angular amount, each time the armatures are actuated by their coils, whereby to shift the contactor arm in a step-by-step manner to sequentially engage the contacts of the series, and indicia means comprising an element rotatable with the shaft for designating a particular branch circuit in correspondence with the contactor arm in engagement with a contact of the series.

9. A selector switch comprising a series of spaced apart contacts adapted to be connected in separate, branch electrical circuits, a mounting frame, a rotatable shaft carried on the frame, a contactor arm mounted on and rotatable with said shaft, a ratchet wheel fixedly mounted on

said shaft, a pair of electromagnets comprising coils fixedly mounted on the frame and disposed on opposite sides of the shaft with their corresponding operating ends disposed in opposed relation to each other, and armatures for said coils arranged at opposite sides of the shaft, said armatures being connected together and mounted for free rotation on the shaft, a driving pawl carried on the armatures and positioned to engage the teeth of the ratchet, to rotate the latter in one direction, together with the shaft and contactor arm, a predetermined angular amount, each time the armatures are actuated by their coils, whereby to shift the contactor arm in a step-by-step manner to sequentially engage the contacts of the series, a detent for releasably retaining the ratchet wheel, shaft and contactor arm at each stepped position of adjustment, spring means for yieldingly urging the armatures away from their coils, a stop for limiting outward movement of the armatures, means for shifting the pawl out of engagement with the ratchet wheel as the armatures approach said stop, a finger knob on said shaft for manually rotating the shaft, ratchet wheel and contactor arm to dispose the latter in engagement with a predetermined contact of the series, and indicia means comprising an element rotatable with the shaft for designating a particular branch circuit in correspondence with the contactor arm in engagement with a contact of the series.

10. A selector switch comprising a series of spaced apart contacts adapted to be connected in separate, branch electrical circuits, a mounting frame, a rotatable shaft carried on the frame, a contactor arm mounted on and rotatable with said shaft, a ratchet wheel fixedly mounted on said shaft, a pair of electromagnets comprising coils fixedly mounted on the frame and disposed on opposite sides of the shaft with their corresponding operating ends disposed in opposed relation to each other, and armatures for said coils arranged at opposite sides of the shaft, said armatures being connected together and mounted for free rotation on the shaft, a driving pawl carried on the armatures and positioned to engage the teeth of the ratchet, to rotate the latter in one direction, together with the shaft and contactor arm, a predetermined angular amount, each time the armatures are actuated by their coils, whereby to shift the contactor arm in a step-by-step manner to sequentially engage the contacts of the series, a detent for releasably retaining the ratchet wheel, shaft and contactor arm at each stepped position of adjustment, spring means for yieldingly urging the armatures away from their coils, a stop for limiting outward movement of the armatures, means for shifting the pawl out of engagement with the ratchet wheel as the armatures approach said stop, a finger knob on said shaft for manually rotating the shaft, ratchet wheel and contactor arm to dispose the latter in engagement with a predetermined contact of the series, indicia means comprising an element rotatable with the shaft for designating a particular branch circuit in correspondence with the contactor arm in engagement with a contact of the series, and a snap-action switch connected in circuit with said contacts and controlled by the armatures and adapted to be closed, when the armatures move to their coils, to complete a branch circuit including the contact engaged by the contactor arm, incident to such movement of the armatures.

11. A selector switch comprising a series of

spaced apart contacts adapted to be connected in separate, branch electrical circuits, a mounting frame, a rotatable shaft carried on the frame, a contactor arm mounted on and rotatable with said shaft, a ratchet wheel fixedly mounted on said shaft, a pair of electromagnets comprising coils fixedly mounted on the frame and disposed on opposite sides of the shaft with their corresponding operating ends disposed in opposed relation to each other, and armatures for said coils arranged at opposite sides of the shaft, said armatures being connected together and mounted for free rotation on the shaft, a driving pawl carried on the armatures and positioned to engage the teeth of the ratchet, to rotate the latter in one direction, together with the shaft and contactor arm, a predetermined angular amount, each time the armatures are actuated by their coils, whereby to shift the contactor arm in a step-by-step manner to sequentially engage the contacts of the series, a detent for releasably retaining the ratchet wheel, shaft and contactor arm at each stepped position of adjustment, and a double pole snap-action switch including a set of normally open contacts adapted to be connected in a branch circuit including the contactor arm and the contact of the series engaged by said arm, a set of normally closed contacts in circuit with the coils, and an operating arm positioned to be controlled by the armatures, whereby said sets of contacts are reversed incident to movement of the armatures to their coils to complete the branch circuit including the contact of the series then engaged by the contactor arm.

12. A selector switch comprising a series of spaced apart contacts adapted to be connected in separate, branch electrical circuits, a mounting frame, a rotatable shaft carried on the frame, a contactor arm mounted on and rotatable with said shaft, a ratchet wheel fixedly mounted on said shaft, a pair of electromagnets comprising coils fixedly mounted on the frame and disposed on opposite sides of the shaft with their corresponding operating ends disposed in opposed relation to each other, and armatures for said coils arranged at opposite sides of the shaft, said armatures being connected together and mounted for free rotation on the shaft, a driving pawl carried on the armatures and positioned to engage the teeth of the ratchet, to rotate the latter in one direction, together with the shaft and contactor arm, a predetermined angular amount, each time the armatures are actuated by their coils, whereby to shift the contactor arm in a step-by-step manner to sequentially engage the contacts of the series, a detent for releasably retaining the ratchet wheel, shaft and contactor arm at each stepped position of adjustment, a double pole snap-action switch including a set of normally open contacts adapted to be connected in a branch circuit including the contactor arm and the contact of the series engaged by said arm, a set of normally closed contacts in circuit with the coils, and an operating arm positioned to be controlled by the armatures, whereby said sets of contacts are reversed incident to movement of the armatures to their coils to complete the branch circuit including the contact of the series then engaged by the contactor arm, and time delay means for maintaining the armatures attracted to their coils for a short interval of time for maintaining said last mentioned branch circuit complete for a period of time.

13. A selector switch comprising a series of

spaced apart contacts adapted to be connected in separate, branch electrical circuits, a mounting frame, a rotatable shaft carried on the frame, a contactor arm mounted on and rotatable with said shaft, a ratchet wheel fixedly mounted on said shaft, a pair of electromagnets comprising coils fixedly mounted on the frame and disposed on opposite sides of the shaft with their corresponding operating ends disposed in opposed relation to each other, and armatures for said coils arranged at opposite sides of the shaft, said armatures being connected together and mounted for free rotation on the shaft, a driving pawl carried on the armatures and positioned to engage the teeth of the ratchet, to rotate the latter in one direction, together with the shaft and contactor arm, a predetermined angular amount, each time the armatures are actuated by their coils, whereby to shift the contactor arm in a step-by-step manner to sequentially engage the contacts of the series, a detent for releasably retaining the ratchet wheel, shaft and contactor arm at each stepped position of adjustment, a double pole snap-action switch including a set of normally open contacts adapted to be connected in a branch circuit including the contactor arm and the contact of the series engaged by said arm, a set of normally closed contacts in circuit with the coils, and an operating arm positioned to be controlled by the armatures, whereby said sets of contacts are reversed incident to movement of the armatures to their coils to complete the branch circuit including the contact of the series then engaged by the contactor arm, time delay means for maintaining the armatures attracted to their coils for a short interval of time for maintaining said last mentioned branch circuit complete for a period of time, and a manually adjustable control switch connected in circuit with said coils and snap switch and adapted in one position of operative adjustment to effect a pulsing operation of the electromagnets for automatically completing in rapid sequence the branch circuits including a group of the contacts of the series.

14. A selector switch comprising a series of spaced apart contacts adapted to be connected in separate, branch electrical circuits, a mounting frame, a rotatable shaft carried on the frame, a contactor arm mounted on and rotatable with said shaft, a ratchet wheel fixedly mounted on said shaft, a pair of electromagnets comprising coils fixedly mounted on the frame and disposed on opposite sides of the shaft with their corresponding operating ends disposed in opposed relation to each other, and armatures for said coils arranged at opposite sides of the shaft, said armatures being connected together and mounted for free rotation on the shaft, a driving pawl carried on the armatures and positioned to engage the teeth of the ratchet, to rotate the latter in one direction, together with the shaft and contactor arm, a predetermined angular amount, each time the armatures are actuated by their coils, whereby to shift the contactor arm in a step-by-step manner to sequentially engage the contacts of the series, indicia means comprising an element rotatable with the shaft for designating a particular branch circuit in correspondence with the contactor arm in engagement with a contact of the series, a double pole snap-action switch including a set of normally open contacts adapted to be connected in a branch circuit including the contactor arm and the contact of the series engaged by said arm, a set of normally

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closed contacts in circuit with the coils, and an operating arm positioned to be controlled by the armatures, whereby said sets of contacts are reversed incident to movement of the armatures to their coils to complete the branch circuit including the contact of the series then engaged by the contactor arm, time delay means for maintaining the armatures attracted to their coils for a short interval of time for maintaining said last mentioned branch circuit complete for a period of time, a manually adjustable control switch connected in circuit with said coils and snap switch and adapted in one position of operative adjustment to effect a pulsing operation of the electro magnets for automatically completing in rapid sequence the branch circuits including a group of the contacts of the series, and adapted in another position of adjustment for completing an individual branch circuit corresponding to the particular contact of the series engaged by the contactor arm immediately after actuation of the magnets.

15. A selector switch comprising a series of spaced apart contacts adapted to be connected in separate, branch electrical circuits, a mounting frame, a rotatable shaft carried on the frame, a contactor arm mounted on and rotatable with said shaft, a ratchet wheel fixedly mounted on said shaft, an electromagnet comprising a coil fixedly mounted on the frame and a cooperating armature mounted for free rotation on said shaft, a driving pawl carried on the armature and positioned to engage the teeth of the ratchet, to rotate the latter in one direction, together with the shaft and contactor arm, a predetermined angular amount, each time the armature is actuated by its coil, whereby to shift the contactor arm in a step-by-step manner to sequentially engage the contacts of the series, and a double pole snap-action switch including a set of normally open contacts adapted to be connected in a branch circuit including the contactor arm and the contact of the series engaged by said arm, a set of normally closed contacts in circuit with the coil, and an operating arm positioned to be controlled by the armature, whereby said sets of contacts are reversed incident to movement of the armature to the coil to complete the branch circuit including the contact of the series then engaged by the contactor arm.

16. A selector switch comprising a series of spaced apart contacts adapted to be connected in separate, branch electrical circuits, a mounting frame, a rotatable shaft carried on the frame, a contactor arm mounted on and rotatable with said shaft, a ratchet wheel fixedly mounted on

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said shaft, an electromagnet comprising a coil fixedly mounted on the frame and a cooperating armature mounted for free rotation on said shaft, a driving pawl carried on the armature and positioned to engage the teeth of the ratchet, to rotate the latter in one direction, together with the shaft and contactor arm, a predetermined angular amount, each time the armature is actuated by its coil, whereby to shift the contactor arm in a step-by-step manner to sequentially engage the contacts of the series, a double pole snap-action switch including a set of normally open contacts adapted to be connected in a branch circuit including the contactor arm and the contact of the series engaged by said arm, a set of normally closed contacts in circuit with the coil, and an operating arm positioned to be controlled by the armature, whereby said sets of contacts are reversed incident to movement of the armature to the coil to complete the branch circuit including the contact of the series then engaged by the contactor arm, a manually adjustable control switch connected in circuit with said coil and snap switch and adapted in one position of operative adjustment to effect a pulsing operation of the electro magnet for automatically completing in rapid sequence the branch circuits including a group of the contacts of the series, and adapted in another position of adjustment for completing an individual branch circuit corresponding to the particular contact of the series engaged by the contactor arm immediately after actuation of the magnet.

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