Jan. 13, 1942. M. G. NELSEN ET AL 2,269,856

DIRECT CURRENT IMPULSE OPERATED SELECTOR SWITCH

Filed Aug. 19, 1940 2 Sheets-Sheet 1

Fig. 1.

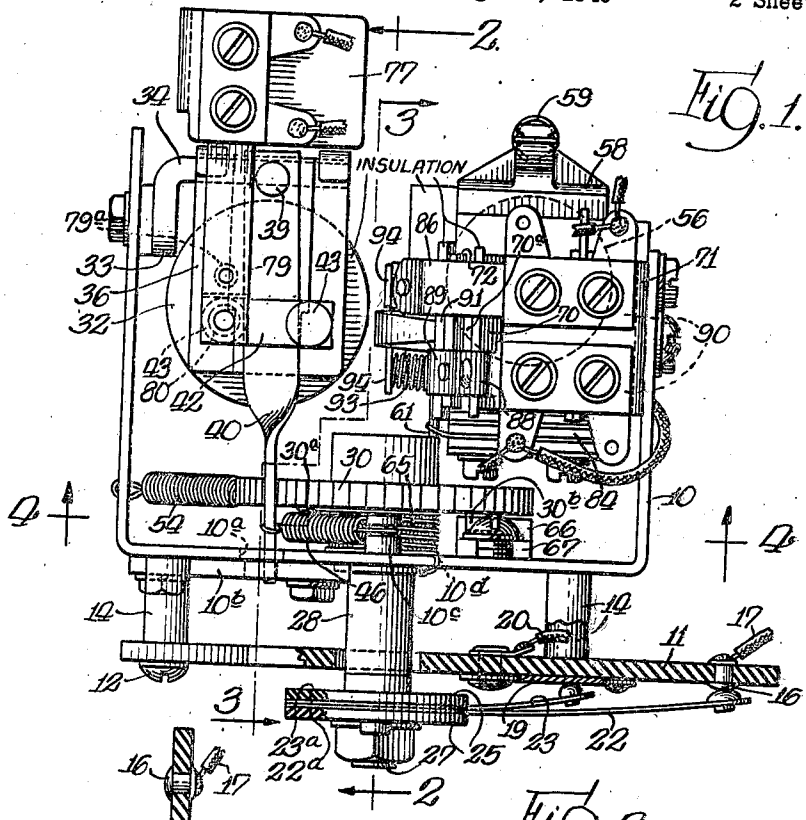
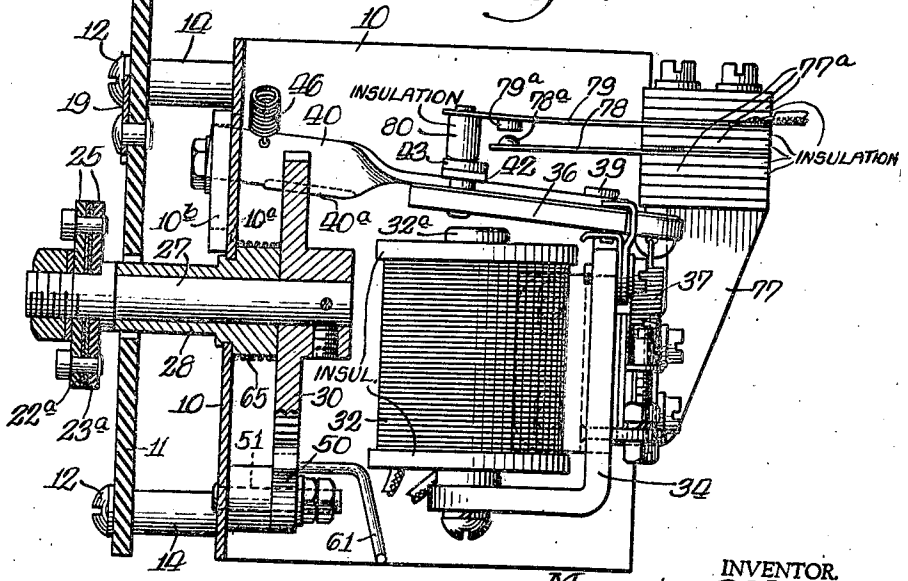


Fig. 2.



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Fig. 3.

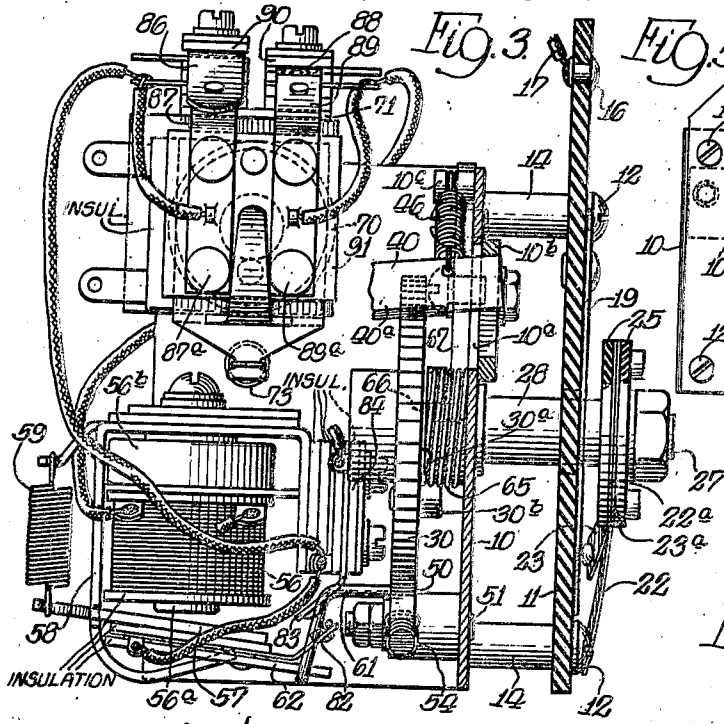


Fig. 5.

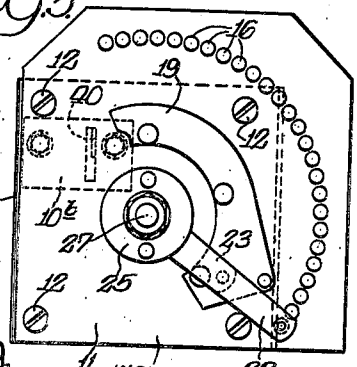


Fig. 4.

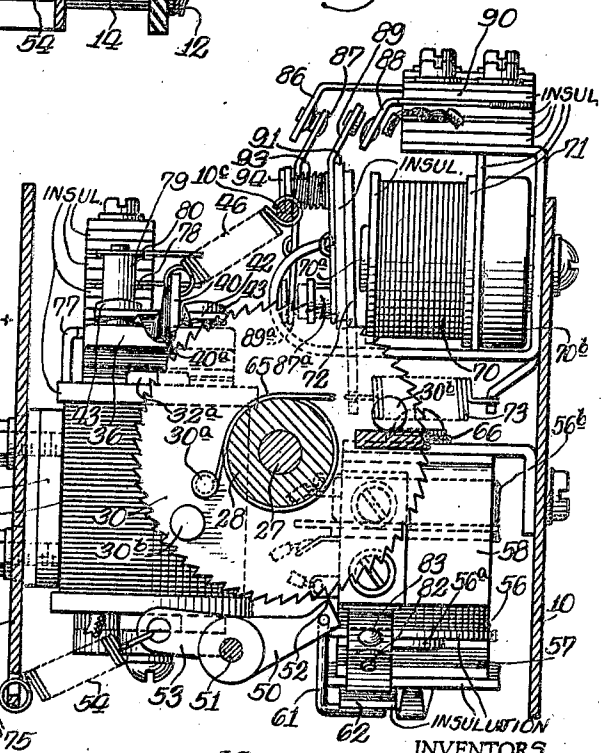
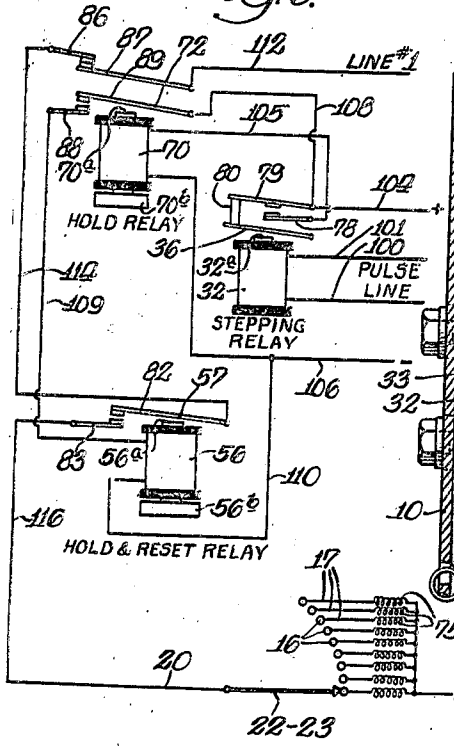


Fig. 6.



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DIRECT CURRENT IMPULSE OPERATED SELECTOR SWITCH

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Application August 19, 1940, Serial No. 353,262

2 Claims. (Cl. 177—353)

The present invention relates to a selector switch device or mechanism for controlling the "make" and "break" of portions of a plurality of branches of a main electrical circuit.

More particularly, the present invention is directed to a novel, direct current operated selector switch adapted to be actuated in step-by-step fashion, by the intermittent action of an electro-magnet operated by pulsations of electrical current for selectively completing portions of one or more of a plurality of different electrical circuits, or portions of branches of a main circuit. Switches of this type also lend themselves for use in a relatively wide field in the selective and/or remote control of various types of machines and apparatus.

One of the principal objects of this invention is to provide a novel form of direct current operated selector switch of the character indicated wherein a main electrical circuit may be completed and/or broken in a timed relation.

Another object is to provide an improved switch of the character indicated for selectively completing and maintaining a main electrical circuit for a timed interval.

A further object is to provide a novel form of selector switch characterized by the provision of a direct current operated electro-magnetic timer control for effecting completion of a portion of a main electrical circuit after a timed interval, subsequent to completion of another portion of said circuit by the selector switch.

A still further object is to provide a novel form of selector switch characterized by the provision of a direct current operated electro-magnetic timing apparatus for controlling the period of completion of a main or branch portions of a main electrical circuit, selected by adjustment of the switch.

Still another object is to provide a novel selector switch of the character indicated adapted to be actuated in step-by-step fashion by pulsations of electrical current and provided with a novel arrangement of direct current operated electro-magnetic timing apparatus for controlling the period of completion of the main or branches of a main electrical circuit selected by the step-by-step adjustment of the switch.

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 plan view of the unitary selector switch embodying the present invention.

Figure 2 is a vertical sectional view through the device, taken substantially as indicated at line 2—2 of Figure 1.

Figure 3 is a staggered vertical sectional view, taken as indicated at line 3—3 on Figure 1.

Figure 4 is a transverse vertical sectional view, taken at line 4—4 on Figure 1.

Figure 5 is a front elevational view of the device showing the selector panel; and

Figure 6 is a wiring diagram including the electrical circuits for controlling the operation of the selector switch.

The switch structure illustrated in the drawings includes a main mounting frame 10, fabricated as a sheet metal stamping, of a generally U-shaped formation. Said frame serves to totally support all apparatus constituting the switch device to provide a unitary structure or assembly. Connected to the intermediate portion of the U-shaped frame 10 in spaced apart relation thereto and forwardly thereof, is a contact panel 11 of insulating material, which is connected to the frame 10 by screws 12, with spacer elements 14 interposed between said panel and the frame. Said panel is provided with an arcuate series of contacts 16, with the heads thereof exposed on the outer face of the panel and including body portions extending through the panel with their inner ends projecting to the rear side of the panel for connection to conductor wires, as indicated at 17, which wires it may be understood form portions of different electrical circuits to be selectively controlled.

Also mounted on the front face of the panel 11 is an arcuate contact strip 19, having a terminal projecting through the panel for connection to a conductor wire indicated at 20 for completing portions of the different electrical circuits including the contact buttons 16, as will hereinafter be described. Said contact buttons 16 and strip 19 are adapted to be engaged by a pair of yielding contact arms 22 and 23 respectively, as may be best seen in Figure 1 of the drawings. Said arms are formed as extensions of disc members 22a and 23a, which are disposed in engagement with each other and mounted between a pair of insulating discs 25 which in turn are fixedly mounted upon the outer end of a shaft 27, which extends through said panel 11 and is journalled in a bearing 28 which is rigidly supported on the mounting frame 10 as seen in Figure 2 of the drawings. The inner end of said shaft, within said frame, has rigidly mounted thereon a ratchet wheel 30, adapted to be moved in step-by-step fashion for moving the contact arms 22 and 23 simultaneously, in stepped fash-

ion, for sequentially engaging the respective contact buttons 16. It will be apparent that due to the arrangement of the contact arms 22 and 23, the conductor wire 20 is in series with the particular conductor wire 17 corresponding to the contact button 16, engaged by the arm 22 at a given time. In other words, when the contact arm 22 is in engagement with any one of the contact buttons 16 the portion of the electrical circuit connected through said contact button, is completed through the contact arm 23, the contact strip 19 and conductor wire 20.

The means for rotating the ratchet wheel 30 in step-by-step fashion is accomplished by the intermittent energization of an electro-magnetic relay 32 supported on one of the legs of the U-shaped frame 10 by means of a mounting bracket 33 which constitutes an extension of the field piece 34 of the relay. As may be seen in the drawing, the relay 32 is disposed with its coil in upright position, and hingedly mounted on the upper end of the upright leg of the field piece 34, is an armature 36 which is normally urged in upward direction away from the core 32*a* of the coil of the relay by means of a coil spring 37 which is connected to the outer end of the armature and to a lug extension on the leg of the field piece 34, as seen in Figure 2 of the drawings.

Pivotally mounted at 39 on a vertical axis, on top of the armature 36, adjacent said hinge connection thereof, is an actuating pawl 40, formed of a flat bar and supported directly upon the top of the armature, and extending in a direction parallel to the axis of the ratchet wheel. The forward end of said bar, beyond the armature, is twisted with respect to the main body of the bar so that the lower edge thereof is disposed adjacent to the toothed periphery of the ratchet wheel 30. Said lower edge of the bar is cut at an incline, as indicated at 40*a*, to insure proper engagement with the teeth of the ratchet wheel 30. Due to the pivotal connection 39 of the actuating pawl 40 to the armature, said pawl is permitted lateral movement with respect to the armature. To maintain the actuating pawl in proper position on the armature and for limiting its extent of lateral movement, we provide a guide in the form of a strap 42 extending over the actuating pawl, adjacent the outer end of the armature, which strap is secured to the armature by means of studs 43.

Said relay 32 is adapted to be intermittently energized by pulsations of electrical current, thus imparting a step-by-step action to the pawl 40 and ratchet wheel 30, for shifting contact arms 22 and 23 in a step-by-step manner so that arm 22 is sequentially stepped over a series of contact buttons 16. It is to be understood that said pulsations of current may be supplied directly or from a remote sending station, and in the latter case suitable receiving apparatus may be employed for use in transferring the wave impulse directly to said relay. Therefore, for convenience relay 32 may be termed a "stepping relay."

Said pawl 40 is dimensioned so that its extreme outer end projects into an opening 10*a* formed in the intermediate portion of the U-shaped mounting frame 10. Mounted on the outer face of said portion of the frame, in registration with said opening, is an adjustable guide block 10*b* having a slot or window therein for receiving the extreme end portion of the actuating pawl, as seen in Figure 3. It is to be understood that said block 10*b* is adapted to be adjusted with respect to the opening 10*a* so as to limit the extent of vertical and lateral movement of the actuating pawl, incident to the movement of the armature toward and away from the core of the relay 32. The purpose of providing for lateral movement of the actuating pawl is to permit the pawl to accommodate itself to the contour of the ratchet wheel during the vertical movement of said pawl in stepping the ratchet wheel, and thereby preclude binding of the actuating pawl and the ratchet wheel, which would otherwise occur as a result of the particular relationship of the pawl to the ratchet wheel.

To insure return of the pawl to a proper position to engage the next tooth of the ratchet wheel for successive stepping action, we provide a coil spring 46 which is connected to the outer end of the pawl and to a stud 10*c* on the intermediate portion of the main frame so that the spring is disposed in an oblique angle, tending to draw the actuating pawl in an upward and inward direction, with respect to said ratchet wheel.

In the switch device herein illustrated it is intended that the portion of the circuit completed by the engagement of contact arm 22 with a certain contact button 16, be maintained only for a short period of duration after which the device is readjusted to a neutral or starting position. Accordingly, we provide a check pawl 50 pivotally mounted at 51 on the inside of the front or intermediate portion of the frame 10, adjacent the lower edge. Said pawl includes a sharp, angularly formed nose 52 for engagement with the teeth of the ratchet wheel 30, and the opposite end of the pawl terminates in an arm 53 to which is connected a coil spring 54, the opposite end of which spring is connected to the lower portion of the adjacent leg of the U-shaped frame 10, as shown in the drawings. The function of the spring 54 is to normally urge the pawl 50 in a direction to cause the nose portion 52 to engage the teeth of the ratchet wheel 30, and to serve to check or hold the ratchet wheel in various, stepped positions of adjustment, but permitting further step-by-step adjustment of the ratchet wheel, by the action of the actuating pawl 40.

Said check pawl 50 is normally held out of engagement with the ratchet wheel 30, by means of a holding and reset relay 56 which is mounted on the leg of the U-shaped frame 10, opposite to that upon which the relay 32 is mounted. Said relay 56 is disposed in opposite relation to relay 32 in that its armature 57 is disposed at the lower end of the relay, and is hingedly mounted at one end on a field piece 58. Said armature 57 is normally urged in a downward direction, to the position seen in Figure 3, by means of a coil spring 59, which is connected to the heel end of the armature and to an extension lug on the field piece 58. Connected to and extending inwardly from one end of the check pawl 50 is a relatively rigid rod 61, having an angularly bent offset portion positioned to engage beneath an insulating panel 62 secured to the lower surface of the armature 57. It is to be understood that the spring 59 of the armature 57 exerts a greater force than the spring 54 of the check pawl so that the armature 57 is normally maintained, when de-energized, in the position seen in Figure 3, and due to the engagement with the rod 61 holds the check pawl 50 out of engagement with the ratchet wheel 30, as seen in Figure 4 of the drawings. As will hereinafter be described, the relay 56 is energized

during the period that the relay 32 is being energized by pulsations of electrical current for imparting a step-by-step action to the actuating pawl 40, causing step-by-step rotation of ratchet wheel 30 and contact arms 22 and 23. Relay 56 may for convenience be termed a "holding and reset relay" because of its function in operation of the circuits being controlled.

In order that the selector switch be readjusted to a neutral or starting position after each adjustment for completing a preselected circuit, the ratchet wheel 30 is yieldingly urged in a counterclockwise direction with respect to the normal direction of operation by the actuating pawl 40. For this purpose we provide a coil spring 65 surrounding a portion of the bearing 28, inside the frame 10, as seen in Figures 1 and 4 of the drawings, with one end of the spring extending through an aperture 10d in the intermediate portion of the main frame 10 and with the opposite portion of the spring anchored on a pin 30a on the adjacent face of the ratchet wheel.

It will now be apparent that as the ratchet wheel is stepped by action of the pawl 40, the spring 65 becomes tensioned so that upon release of the ratchet wheel by check pawl 50, the spring 65 tends to rotate the ratchet wheel in counterclockwise direction. In order to arrest the ratchet wheel at a normal or starting position, which corresponds also to a starting position of the contact arm 22, as seen in Figure 5 of the drawings, the ratchet wheel is provided with a nubbin 30b adapted to engage a projecting shelf portion 66 of a bracket member 67, adjustably mounted on the inner surface of the intermediate portion of the main frame 10, so that when the nubbin engages said shelf portion, the ratchet wheel will be adjusted at a neutral or starting position with the contact arm 22 likewise disposed in a neutral or starting position, as seen in Figure 5.

Mounted on the last mentioned leg of the U-shaped frame 10, immediately above relay 56, is a third relay 70 having its field piece 71 rigidly attached to leg of said frame 10. Said relay is mounted with its coil extending horizontally and is provided with an armature 72 hingedly mounted at its lower end on the field piece 71, and the upper end portion being movable toward and away from the core 70a of the coil of the relay. A spring 73 is connected to the heel end of the armature and to a lug extension of the field piece for normally urging the armature away from the core of the coil. This relay may for convenience be termed a "holding relay" and is connected in a manner to control the electrical circuit including the relay 56, as will hereinafter be described.

Associated with the respective relays 32, 56 and 70 are switch devices connected in electrical circuits in a manner for controlling the "make and break" of a main electrical circuit sought to be energized and which in the present construction corresponds to a preselected circuit of the selector switch, namely, a circuit made through one of the contact buttons 16, when engaged by the contact arm 22, due to the step-by-step actuation of the ratchet wheel as above described.

It is to be understood that each of the different branch electrical circuits including the respective contact buttons 16, also include suitable mechanism adapted to be electrically energized or operated. For convenience in illustration we have shown in the wiring diagram represented in Figure 6 the branch circuit portions, connected to the respective contact buttons 16. Each branch circuit is shown as including a winding or coil indicated generally at 75, which it is to be understood, may represent any suitable form of electrically energized device adapted to be operated when the particular branch circuit is completed through its corresponding contact button and the contact arm 22.

The switch devices associated with the respective relays will now be briefly described. Mounted on a bracket 77 attached to the field piece 34 of the "stepping relay" 32 is a normally open switch including switch fingers 78 and 79 having their respective contact buttons 78a and 79a disposed in spaced apart relation as shown in Figure 2 of the drawings. It is to be understood that these switch fingers are formed of yieldable material and are normally biased to closing position. Said fingers are supported between a plurality of blocks 77a of insulating material, carried on the upper end of bracket 77. The switch finger 79 includes an outer extension projecting beyond finger 78 and is provided with a depending plug 80 of insulating material, adapted to be engaged by the stud 43 connected to the armature 36 so that when the armature is free or in the position away from the core 32a of said relay 32, as seen in Figure 2 of the drawings, said plug 80 is raised to dispose the contact button 79a of switch finger 79, out of engagement with its cooperating contact button 78a of the other switch finger.

The "hold and reset relay" 56 has associated therewith a normally open switch including contacts 82 and 83, the former being mounted on the insulating member 62 and the latter being mounted between blocks of insulating material, indicated at 84, carried on an extension of the field piece 58 as seen in Figure 3 of the drawings. It will be apparent that when the armature 57 is moved into engagement with the core 56a of said relay 56, contact 82 is brought into cooperative engagement with contact 83 to complete a portion of an electrical circuit.

The "holding relay" 70 has associated therewith two switches; one being composed of a pair of contact members 86 and 87 normally disposed in engagement with each other and the other switch including a pair of contacts 88 and 89 normally disposed in spaced apart relation as seen in Figure 4 of the drawings. The contact fingers 86 and 88 of the respective switch are mounted in blocks of insulating material 90 secured to an extension of the field piece 71 of the relay 70. The other respective switch members 87 and 89 are mounted on a panel 91 of insulating material secured to the outer surface of the armature 72. The switch fingers 87 and 89 are pivotally mounted at 87a and 89a respectively, adjacent the lower end of the insulating panel 91 and have springs 93 carried on studs 94 mounted adjacent the upper end of said panel. It will be noted that said springs are disposed in opposite relation, namely, so that contact arm 87 is urged away from the panel of insulating material, while the other spring tends to urge contact member 89 toward the panel of insulating material. By virtue of this arrangement, contact finger 87 remains in engagement with the contact finger 86 during a portion of the initial movement of the armature toward its core 70a to maintain the portion of the electrical circuit including said switch members, for a short period after contact finger 89 commences to engage and seat on its cooper-

ating finger 88, for purposes as will hereinafter be described. Furthermore, when the armature 72 starts to move away from its core, switch finger 89 remains in engagement with finger 88, to maintain the portion of the circuit including said switch fingers for a short period after switch finger 87 engages its cooperating finger 86. Each of the respective relays 56 and 70 which are adapted to be energized by direct current, have associated with their coils a copper slug, indicated at 56b and 70b respectively. The function of the copper slugs is to obtain a timing action by the induced current set up in the slugs immediately after the coils of the respective relays are deenergized.

The operation of the selector switch will now be described in conjunction with the wiring diagram illustrated in Figure 6. The "stepping relay" 32 is first energized intermittently by one or more pulsations of electrical current supplied by conductor wires 100 and 101, which pulsations are directly transmitted into mechanical movement by the armature 36, which in turn effects step-by-step ratcheting action of the ratchet wheel 30, through the actuating pawl 40, and effects step-by-step adjustment of the contact arms 22 and 23 so as to dispose contact arm 22 in registration with a proper predetermined contact button 16 of a certain branch of a main electrical circuit sought to be energized, and which circuit includes any suitable form of electrically operated or controlled mechanism, to be actuated, as diagrammatically represented in Figure 6, by a coil 75. It will be apparent that as the armature 36 moves into engagement with the core 32a of the coil of the relay 32, the plug 80 is released so that switch finger 79 is free to move downwardly to dispose its contact 79a into engagement with contact 78a of switch finger 78 and thereby complete a portion of an electrical circuit through the direct current supply conductor wires 104, 105 and 106 to energize the coil of the "holding relay" 70.

Due to the intermittent action of "stepping relay" 32, the switch fingers 78 and 79 are continuously moved into and out of engagement with each other for making and breaking the circuit to the relay 70, and similar pulsations of current are thus imparted to the relay 70 which ordinarily would cause intermittent movement of its armature 72 in a manner similar to the armature 36 of relay 32. Such intermittent operation of relay 70, however, is precluded by the use of the copper slug 70b which by induced magnetism retains the armature 72 attracted to the core 70a of the relay 70 for a period sufficient to overlap the period between pulsations of the current supplied to said relay. Therefore, during the time that the relay 32 is being intermittently energized by pulsations of current, the armature 72 of relay 70 remains attracted to its core and during this time switch finger 87 is separated from its cooperating finger 86, and switch finger 89 is in engagement with switch finger 88. This action of relay 70 serves to hold or complete through switch fingers 88—89, a portion of an electrical circuit, during the interval that pulsations of electrical current are supplied to the coil of relay 70 incident to the make and break action of switch fingers 78 and 79, resulting from the intermittent action of relay 32 by the pulsation of the electrical current supplied to said relay 32.

As may be seen in Figure 6, the "hold and reset relay" 56 is connected in shunt relation to relay 70 when the relay 70 is energized. This shunt circuit includes a conductor wire 108, connected to the direct current supply conductor wire 104 and to the switch finger 89. When the latter switch finger is in engagement with switch finger 88 it completes the electrical circuit through conductor wire 109 through the coil of the "hold and reset relay" 56, and conductor wire 110 to the other supply conductor wire 106, for energizing said relay 56. Immediately after the relay 56 is deenergized, the copper slug 56b is built up with induced magnetism for holding the armature 56 attracted to the core of the coil of the relay 56 for a short interval period of time after opening of the shunt circuit, including said relay 56.

The devices represented by the coils 75, which may be selectively energized incident to adjustment of the selector switch, with the arm 22 engaging a predetermined contact button 16, may be energized by the same low current utilized for energizing the relays 70 and 56. Usually such devices as represented by the coils 75 often require a higher current and accordingly we have herein shown said devices connected in a separate high power circuit in which the main current supply lines are generally designated as line #1 and line #2. The circuit for the coils 75, representing devices to be selectively energized, includes a conductor wire 112 for connecting current supply line #1 to switch finger 87, and a conductor wire 114 connects switch finger 86 to the switch finger 82, associated with the relay 56, while a conductor wire 116 connects the cooperating switch finger 83 to conductor wire 20, which is connected to the contact strip 19, contact arm 23, through the contact arm 22 to a predetermined contact button 16, corresponding to the preselected circuit to be energized. Conductor wires 17, complete the circuit through the respective coils 75, to the other current supply line #2.

Normally when the selector switch is in inoperative position no current is permitted to flow through the main circuit including conductor wires 112, 114 and 116 and supply lines #1 and #2, since the switch composed of members 82 and 83 is in open position. However, after pulsations of electrical energy are imparted to the "stepping relay" 32 for effecting selective adjustment of the arm 22 with a desired contact button 16, by the action above described, the main circuit, by the separation of switch fingers 86 and 87, remains open during the period that pulsating current is supplied to relay 32. Therefore, no current is permitted to flow through the main circuit including conductor wires 112, 114 and 116, and lines #1 and #2, during the period that the contact arm 22 is moving from one contact to another.

Due to the fact that relay 56 functions as a "hold and reset relay," which as above mentioned is energized during the time that the pulsations of current are being supplied to relay 32, the check pawl 50 is freed by the armature 57 moving out of engagement with the rod 61 so that said pawl 50, operatively engages the teeth of the ratchet wheel 30 and maintains the same in stepped positions of adjustment. Just as soon as pulsations of current cease to be supplied to relay 32, the switch members 78 and 79 are again opened by the armature 36 engaging plug 80 so as to break the circuit which supplies pulsating current to the relay 70. However, the relay 70, due to the copper slug 70b, causes the armature 72 to remain attracted to its core for a short in-

terval of time after opening of said circuit, due to induced magnetism in the slug, and during which interval current is still permitted to flow through the coil of relay 56 for maintaining said relay fully energized. After the armature 72 is permitted to move away from the core of the relay 70, upon dissipation of the induced magnetism in the copper slug 70b, the main electrical circuit may be energized to complete a preselected branch circuit including a coil 75 by re-engagement of switch fingers 86 and 87, just prior to separation of switch fingers 88 and 89, as above described, and current is then permitted to flow through said main circuit for a short interval of time. Said main circuit is maintained completed for the short interval of time by reason of the induced magnetism in the copper slug 56b of relay 56, by virtue of which the armature 57 is held in attracted position, with the switch fingers 82 and 83 in closed relation. After the induced magnetism in the copper slug 56b is dissipated, the armature 57 is permitted to move away from the coil of said relay 56, and thereby moves switch finger 82 out of engagement with switch finger 83, breaking the main electrical circuit. Such movement of the armature 57 again causes the rod 61 to move the check pawl 50 out of engagement with the ratchet wheel 30 so as to permit said ratchet wheel, under influence of spring 65, to return to neutral or starting position, simultaneously returning the selector contact arm 22 to a neutral or starting position.

By virtue of the construction described, it will be apparent that there will be no arcing as a result of contact arm 22 moving from one contact button to another since no current flows through the main electrical circuit, including the branch circuits, until the selector arm is arrested for a predetermined period of time in engagement with a predetermined contact button of a preselected circuit, after which period of time current is permitted to flow through such circuit for only a limited period of time, and the circuits are then broken and assume the normal inoperative condition.

Although we have herein shown and described a preferred embodiment of our invention, manifestly it is capable of modification and rearrangement of parts 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 it may be so limited by the appended claims.

We claim as our invention:

1. In a direct current operated selector switch, the combination of a plurality of contacts connected in separate branches of a main electrical circuit, a movable contact arm, means including ratcheting mechanism connected to said arm, and electro-magnetic means adapted to be intermittently energized by impulses of electric current for actuating said ratcheting mechanism for shifting said arm in step-by-step fashion into engagement with a predetermined contact for completing a portion of a preselected branch circuit, spring means tending to return said ratcheting means and contact arm to a starting position, switch means adapted to be connected in the main electrical circuit, direct current operated time delay electro-magnetic means for controlling the switch means, said time delay means being subject to control by said impulse operated magnetic means, for causing completion of said preselected branch circuit after the lapse of a timed interval, subsequent to engagement of the predetermined contact by said arm, a second direct current operated time delay electro-magnetic means, subject to control by said first time delay means, for controlling said switch means to cause opening of said branch circuit after the lapse of a timed interval, and means controlled by the last mentioned time delay electro-magnetic means while the latter is energized for holding said ratcheting means and contact arm in stepped positions of adjustment.

2. In a direct current operated selector switch, the combination of a plurality of contacts connected in separate branches of a main electrical circuit, a movable contact arm, means including an electro-magnet adapted to be intermittently energized by impulses of electrical current for shifting said arm in step-by-step fashion into engagement with a predetermined contact for completing a portion of a preselected branch circuit, a normally closed switch and a normally open switch connected in the main electrical circuit, direct current operated time delay electro-magnetic means for controlling said closed switch, a normally open switch connected in the circuit of said time delay magnetic means and positioned to be controlled by said impulse operated electro-magnet, a second direct current operated time delay electro-magnetic means for controlling the normally open switch of the main circuit, said last mentioned time delay means being connected in shunt relation to the first mentioned time delay means, and a normally open switch in said shunt circuit positioned to be controlled by said first mentioned time delay electro-magnetic means, whereby the first time delay means serves to effect energization of said preselected branch circuit after the lapse of a timed interval, subsequent to engagement of said predetermined contact by said arm, and the second time delay means serves to break said branch circuit after the lapse of a timed interval, said normally closed switch of the main circuit and said normally open switch in the shunt circuit being constructed and correlated in a manner to effect closing of one prior to effectively opening of the other to positively obtain said sequential timing of completion and breaking of said preselected branch circuit, in addition to the timing by said time delay electro-magnetic means.

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