Nov. 17, 1942. H. B. BROWN 2,302,000

SWITCHING MECHANISM

Filed June 6, 1940 2 Sheets-Sheet 1

FIG. 1

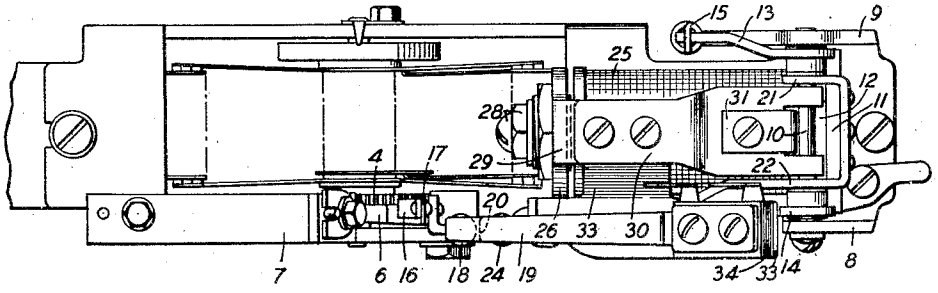


FIG. 2

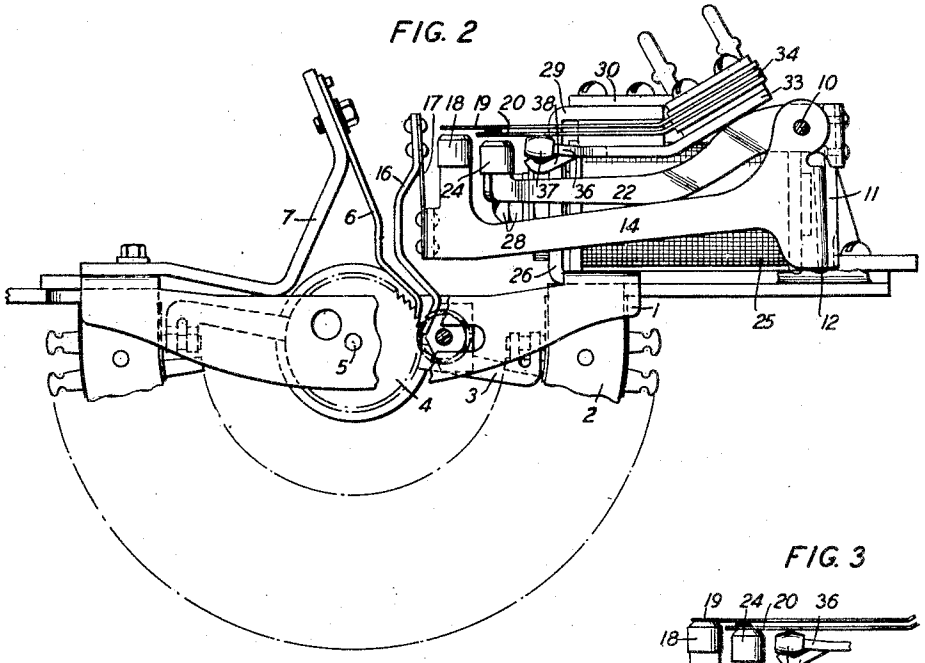


FIG. 3

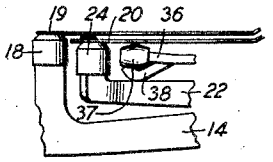
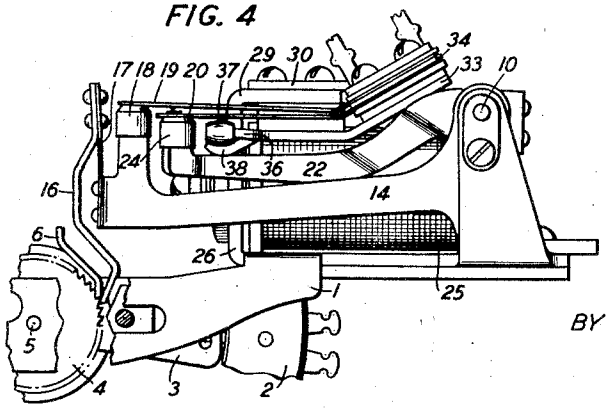


FIG. 4



INVENTOR
H. B. BROWN
BY
M. T. McKenney
ATTORNEY

Nov. 17, 1942. H. B. BROWN 2,302,000

SWITCHING MECHANISM

Filed June 6, 1940 2 Sheets-Sheet 2

FIG. 5

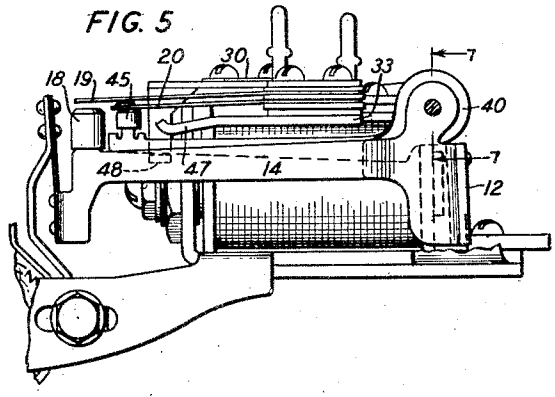


FIG. 7

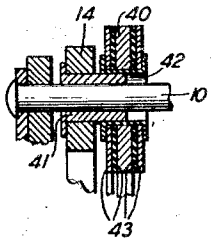


FIG. 6

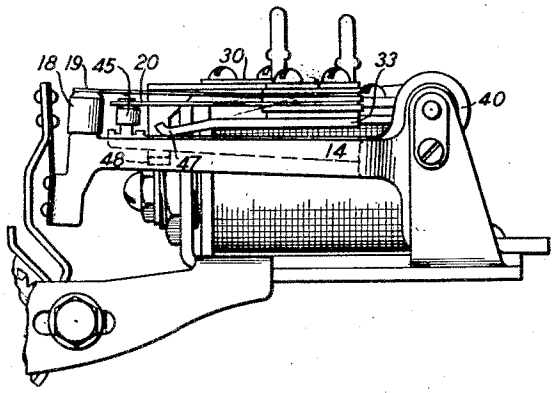


FIG. 9

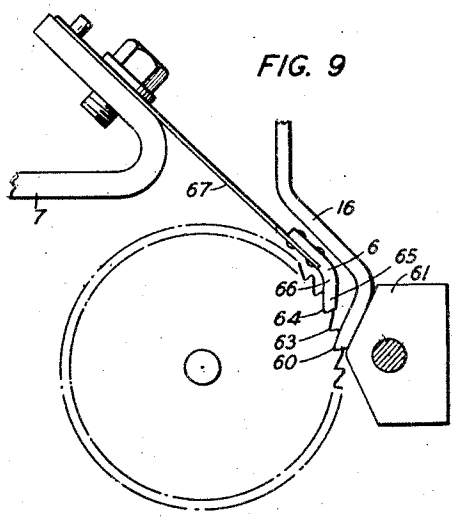
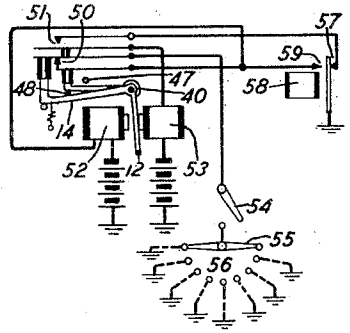


FIG. 8



INVENTOR
H. B. BROWN
BY W. T. McCarney
ATTORNEY

Patented Nov. 17, 1942

2,302,000

UNITED STATES PATENT OFFICE

2,302,000

SWITCHING MECHANISM

Henry B. Brown, Madison, N. J., assignor to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York

Application June 6, 1940, Serial No. 339,059

13 Claims. (Cl. 172—126)

This invention relates to switching mechanisms and particularly to those used in telephone systems.

An object is to provide efficient and simple means for controlling the operating characteristics of said switch mechanism.

Another object is to provide such mechanisms that are easily adjusted and readily maintained in adjusted condition.

Heretofore driving mechanisms have been provided for selector switches and similar devices in which electromagnets are employed for stepping the switches in a step-by-step manner by the aid of self-interrupting contact springs that control the energizing and deenergizing of such stepping magnets. The means for stepping the switches is usually controlled by an armature and an operating pawl that act on a ratchet wheel to step the switch one step for each release operation of the magnet. A holding pawl may be provided to hold the ratchet wheel in an actuated position between the steps taken thereby. The energizing of the magnet may operate the armature and the operating pawl in a forward stroke to store energy in a spring and on the release of the magnet the backward stroke of the armature is controlled by the energy stored in said spring to actuate the operating pawl to advance the ratchet wheel one step or the equivalent of the distance between two adjacent teeth on the ratchet wheel. Make-and-break contact devices in the form of contact springs may be controlled by the movement of the armature to close an interrupter circuit for the operation of the magnet. This contact device is adjusted to close and open the energizing circuit at such instances as to energize and deenergize the magnet at the proper time to effect a smooth and efficient working condition of the stepping mechanism of the switch.

It is a feature of the present invention to provide a contact device of this kind in which the interrupter springs are controlled by the armature in cooperation with an operating member and adjusting stops so arranged that said stops may be adjusted to open the interrupter springs at any desired instant during the forward stroke of the armature and to close said springs at any desired instant during the backward stroke of the armature.

In the preferred form of the applicant's invention, said operating member may take the form of an auxiliary armature, acted upon by the energization of the magnet to perform its function in regard to the control of the interrupting spring.

In a modified form of the applicant's invention, the operating member may be in the form of a member in frictional engagement with the main armature to perform its function.

The invention has been illustrated in the accompanying drawings in which

Figs. 1 to 4 illustrate the preferred embodiment of the invention in which two armatures are employed.

Figs. 5 to 7 illustrate the modified form of the applicant's invention in which one armature and a friction member are employed.

Fig. 8 shows a circuit diagram in which the armatures may be actuated by two operating magnets; and,

Fig. 9 shows an arrangement of the actuating pawl and the holding pawl in relation to the ratchet wheel as arranged in accordance with the applicant's invention.

Referring now to the drawings and particularly to Figs. 1 to 4, the applicant's invention has been applied to a single motion rotary step-by-step type of switch although it is equaly applicable to any mechanism involving the rotation of a ratchet wheel. This switch may consist of a frame member 1 that may be mounted in any suitable holding rack. To this frame member 1 is secured a semicircular contact bank 2 in which groups of contacts are arranged to be engaged by brushes 3 that may be rotated by a ratchet wheel 4 mounted on the shaft 5 which in turn is mounted between two side members of the frame 1. A holding pawl 6 normally engages a tooth in the ratchet wheel 4 and is in the shape of a flexible spring mounted on a bracket 7 attached to the frame 1. The frame 1 is provided with two parallel upright members 8 and 9 between which on a shaft 10 two armatures 11 and 12 are rotatably secured. The armature 12 is provided with extensions 13 and 14 through which the pin 10 is inserted. The extension 13 is connected to one end of a spring 15, the other end of which is connected to the frame 1 to maintain the armature in normal position. The extension 14 projects toward the center of the switch and is provided at its free end with an actuating pawl 16 which is flexibly connected to the extension 14 by means of the flat spring 17. The free end of the extension 14 is also provided with an insulation stud 18 for controlling the contact spring 19 to separate it from the contact spring 20 in a manner to be hereinafter described. The armature 11 is provided with extensions 21 and 22 through which the pin 10 passes. The extension 22 extends forward toward the center of the

switch and is provided at its free end with insulation stud 24 for controlling the springs 19 and 20 to be described hereinafter. The armatures 11 and 12 are acted upon by a magnet coil 25 when said coil is energized to control the above-mentioned extensions 14 and 22 on these two armatures. This coil 25 is secured through an upright extension 26 on the frame 1 by means of suitable fastening means such as the bolt and nut 28. This extension 26 on the frame 1 is continued into an extension 29 which is bent towards the right at its top above the coil 25 as shown in Figs. 1 and 2. To this extension 29 is secured a plate 30 which is bifurcated at its free end bent around the shaft 10 to localize or guide the armatures on the shaft. A plate 31 is secured to plate 30 and is bent between the two forked ends of the plate 30 and under the pin 10 for the same purpose. On the under-side of the extension 29 is secured a bracket 33 on which the springs 19 and 20 are mounted as shown at 34. This bracket 33 also extends into projections toward the center of a switch. One of these is numbered 36 and is provided with an insulating stud 37 that normally engages spring 20 to hold it in the desired position. The other extension 38 is bent downwardly and in juxtaposition to the extension 22 on armature 11 to guide the forward or upward movement of this extension when armature 11 is energized.

The operation of this switch will now be described. The contacts 19 and 20 may be connected in series with the winding of coil 25 to open and close at desired intervals to open or close the circuit for this coil. Normally the connection between contacts 19 and 20 is closed so that when the current is applied to the circuit through these contacts the coil will energize and operate the armature 12 to bring the extension 14 upward looking at Fig. 2. This will move the actuating pawl 16 into the next succeeding tooth of the ratchet wheel 4 and when the coil is deenergized, the armature 12 will be returned to normal by the springs 15 and hence the operating pawl 16 will on its return to normal rotate the ratchet wheel 4 the distance of one tooth to rotate the brushes 3 from one set of terminals to another set in the bank. The holding pawl 6 holds the ratchet wheel in the advanced position. The armature 11 is also operated by the magnet 25 when energized to bring the extension 22 upward looking at Fig. 2. When therefore the two armatures are attracted by the magnet the beginning of the forward strokes of these armatures will force the springs 19 and 20 upward without causing them to separate. However, the extension 22 on armature 11 will, after having traveled a short distance upward strike the extension 38 and thereby prevent the stud 24 from forcing the spring 20 any further in the upward direction, while armature 12 will continue to move the extension 14 and bushing 18 a still further distance upward to force spring 19 away from spring 20 to open the connection between these two springs. The adjustment of extension 38 in relation to the extension 22 may be such that the stud 24 will permit the springs 19 and 20 to separate and open the circuit for magnet 25 at any desired interval prior to the completion of the forward stroke of the armature 12 with the provision of course that the upward stroke of the extension 14 has advanced far enough to cause the driving pawl 16 to engage the next tooth. Thus by opening the circuit for magnet 25 some time prior to the completion of the forward stroke of this armature, the magnetic lines of force operating thereon will gradually diminish to permit the armature 12 to start to return to normal under control of spring 15 as soon as possible after or at the instant the forward stroke is completed. The extension 36 and insulation stud 37 may, on the other hand, be so adjusted that the closing of the connection between springs 19 and 20 will take place at a most desirable moment on the return stroke of the extension 14 so as to start the reenergization of the coil 25 in time to build up magnetic lines of force sufficiently to reattract the armature 12 as quickly as possible after it has returned to normal. It is readily seen therefore that with these adjustment means very rapid operation and release of the armatures may be obtained to secure a corresponding speedy operation of the switch.

At the time the magnet 25 begins to deenergize the spring 20 will exert a pressure on the insulation stud 24 to bring the extension 22 on armature 11 back towards normal so that the spring 20 will come to rest on the insulation stud 37 while spring 19 is still controlled by the insulation stud 18 so that the bushing 24 will not interfere with the closing period of the springs 19 and 20. Thus the opening and closing of the connection between contacts 19 and 20 will take place at the most advantageous moments to control the operation of the switch as determined by the adjustment and interrelation of the studs 18, 24 and 37 and the extension 38. It is therefore evident that extremely accurate adjustments of the mechanism in these respects may be made by simply adjusting the positions of the extensions 36 and 38.

Fig. 3 shows the extensions 14 and 22 just prior to the positions where the connection between the springs 19 and 20 will be opened. That is, extension 22 with its stud 24 has caused the spring 20 to follow spring 19 and the extension 14 and stud 18 have been operated to positions where stud 18 will cause the opening of the connection between these contacts.

Fig. 4 shows the relation of these extensions where the connection between the contacts 19 and 20 have been opened and it should be noted in this figure that the extension 22 now rests against the extension 38 and will therefore not advance the contact 20 any further to permit the contact 19 to be actuated on by the insulation stud 18 to cause the opening of the connection between these contacts.

The same operations of the contacts 19 and 20 during the functioning of the switch mechanism may be accomplished in a somewhat different manner as illustrated in Figs. 5, 6 and 7. In this embodiment of the applicant's invention in place of the armature 11 and extension 22 with its insulation stud 24, a separate member 40 is mounted on the pin 10 as follows. A bushing 41 is mounted on pin 10 and on this bushing is mounted the extension 14. To this bushing is also secured another bushing 42 enclosing two pairs of friction discs 43 and between these pairs on the bushing 42 is rotatably mounted the separate member 40. Thus this member 40 is frictionally engaged to participate in the movements of extension 14. The member 40 is provided at its free end with the insulation bushing 45 normally engaging the spring 20 and is resting normally against the stop member 43 which may be secured to the plate 30 and is substituted for the extension 36 and the insulation bushing 37. Otherwise this structure is practically identical

with the one disclosed in Figs. 1 to 4. While this pictured arrangement is the preferred form of the applicant's invention, other forms may be employed such as levers or members similar to member 45 having a straight sliding connection with the structure. In the case disclosed, of course, on the operation of armature 12, the member 40 will travel with this armature and the bushing 45 will maintain the connection between the springs 19 and 20 until it is stopped by the extension 47 on bracket 33 which takes place just after the operating pawl falls into the next tooth when the bushing 18 will separate the springs 19 and 20. On the deenergization of the magnet 25, the extension 14 will, of course, begin to return to normal but the connection between contacts 19 and 20 will be maintained open until member 40, controlling spring 20 through bushing 45, strikes the stop member 48. Thus the same opening and closing required of the connections between contacts 19 and 20 may be secured by merely adjusting the extension 47 to engage the member 40 at the proper time on the upward movement during the forward stroke of the armature 12 and adjusting the stop member 48 to stop the return movement of the member 40 at the proper moment during the return travel of the armature 12.

A somewhat different arrangement of the control circuits for these mechanisms may be provided as disclosed in Fig. 8. The armature 12 may, for example, be arranged with its extension 14 and member 40 as shown in the modified form disclosed in Figs. 5 to 7, with the exception that in place of the springs 19 and 20, the contacts 50 and 51 are provided and instead of a single magnet 25, two magnets 52 and 53 are provided to operate the armature 12 in one direction or the other. The switch may be operated either by a self-interruption if used as a hunting switch or by an outside pulsing relay. In the first case a switch 54 may be closed to connect the magnet to a brush 55 operating on terminals in the bank 56 of the switch. If then a ground is found on a terminal of the bank indicating that the corresponding connection is busy, a circuit will be completed from battery, winding of coil 52, contacts 50, switch 54, brush 55, the busy terminal of bank 56 to ground causing the operation of coil 52. The operation of coil 52 acts on armature 12 to cause the extension 14 thereof to open the connection between contacts 50 as controlled by the member 40 and stop 47 and to close a connection between contacts 51 at the end of the stroke. The circuit for coil 52 is thereby opened and a circuit for coil 53 is closed from battery through the winding of this coil, contacts 51 to ground at contacts 57 of the pulsing relay 58 causing the operation of coil 53 to return the armature 12 to the normal position and advance brush 55 to the next contact on bank 56. Then when contacts 50 are again closed, if the ground is found on the next contact of bank 56, the above-mentioned operations are repeated. If no ground is found the switch will stop with the brushes 57 on the next contact of bank 56. In case the switch is to be operated from the outside by a pulsing relay such as 58, the first step will be taken by the operation of the pulsing relay 58 and this closes a circuit for the coil 52 from battery through the winding of each coil, contact 59 of pulsing relay 58 to ground. The contacts 50 are not used in this connection. When the armature is operated in this manner, extension 14 closes eventually the connection at contacts 51 and when pulsing relay 58 releases, the above-mentioned circuit for magnet 53 is closed at contacts 57 of the pulsing relay and these operations are repeated to alternately operate coils 52 and 53 under control of a pulsing relay 58 to advance the switch to any desired position.

The applicant's invention relating to the actuation of the operating pawl 16 and the holding pawl 6 has been illustrated in the enlarged Fig. 9. It should be noted that the operating pawl 16 may normally engage a first tooth 60 and rest against the stop member 61 and when the operating pawl 16 is to be withdrawn on its forward stroke, it should normally engage a second tooth 63 so that on the return stroke, the ratchet will be advanced one step equal to the distance between these two teeth. However, in case the operating pawl is withdrawn, so that it will not come to rest in the second tooth 63 but be drawn beyond this point to a position, for example, opposite the third tooth 64, the pawl 16 will be prevented from dropping into this tooth by the fact that the holding pawl 6 is engaged in this third tooth and is so constructed that the operating pawl merely rides up over the outer surface 65 of the holding pawl 6 and so that on its return stroke it will glide over this surface and back into the second tooth 63. Thus the holding pawl is so located and constructed so that the operating pawl regardless of whether its stroke extends beyond the second tooth or not, the holding pawl will prevent the operating pawl from advancing the ratchet wheel more than one step for each operation. The holding pawl may be so constructed as those in this Fig. 9 as to consist of a section 66 engaging the tooth 64 and a flexible spring 67 connecting this section and the bracket 7. This is of no importance as far as the action of the holding pawl is concerned in relation to the operating pawl but merely shows a modified form.

What is claimed is:

1. In a step-by-step switch, means including a motor magnet and an armature controlled thereby for operating said switch, interrupter spring contacts, a delay contact controlling device for said interrupter springs, comprising an operating member integral with the armature and an operating member controlled by the magnet, said operating members arranged to act independently on said interrupter springs to open said springs when the armature is near the end of its forward stroke and to allow said springs to close when the armature is near the end of its backward stroke.

2. In a step-by-step switch, means including a motor magnet and an armature controlled thereby for operating said switch, interrupter spring contacts, two operating members cooperating with said armature and magnet to act independently on said interrupter springs to open them at a desired instant during the forward stroke of the armature and to close them at a desired instant during the backward stroke of the armature.

3. In a step-by-step switch, means including a motor magnet and an armature controlled thereby for operating said switch, interrupter spring contacts, an operating member and an adjusting means for said operating member and interrupter spring contacts, said adjusting means being associated with the operating member and the interrupter spring contacts so that on the forward stroke of the armature said interrupter springs

are opened by the operating member and the armature at any instant during the travel of the armature as determined by the position of said adjusting means and so that on the backward stroke of the armature said interrupter springs are closed at any instant during the travel of the armature depending on the position of said adjusting means.

4. In a step-by-step switch, means including a motor magnet and an armature controlled thereby for operating said switch on the backward stroke of the armature, interrupter spring contacts, an operating member and an adjusting means for said operating member and interrupter springs, said adjusting means being associated with the armature and interrupter springs so that the independent setting of the adjusting means will cause the interrupter springs to open and close at any corresponding instance during the travel of the armature in its forward or backward stroke.

5. In a step-by-step switch, means including a motor magnet, a circuit therefor, a main armature and an auxiliary armature for operating said switch, a circuit interrupter controlled by said armatures for opening and closing the circuit of the motor magnet, means for adjusting said auxiliary armature and said circuit interrupter in relation to the main armature so that the main armature will open the interrupter springs at any desired instant during the forward stroke under control of said motor magnet and close the circuit interrupter at any desired instant during its backward stroke.

6. In a step-by-step switch, means including a motor magnet, a circuit therefor, a main armature and an auxiliary armature for operating said switch, interrupter springs for said circuit, a single member adjustable to regulate the auxiliary armature stroke and the position of the circuit interrupters in relation to the main armature to cause the main armature to open the interrupter springs at a desired instance during the forward stroke and to close them at any desired instance during the backward stroke.

7. In a step-by-step switch, means including a motor magnet and an armature controlled thereby for operating said switch on the backward stroke of the armature, interrupter spring contacts, a delayed contact controlling means for said interrupter springs comprising an operating member integral with said armature and actuated thereby, an operating member separate from said first-mentioned operating member and actuated by said magnet and an adjustable stop member, said three members cooperating with each other and the interrupter springs to open said springs when the armature is near the end of its forward stroke and to close said springs when the armature is near the end of its backward stroke.

8. In a step-by-step switch, means including a motor magnet and an armature controlled thereby for operating said switch, interrupter spring contacts, an operating member integral with said armature, stop members, an operating member controlled by said stop members and said armature, said two operating members and stop members cooperating with said interrupter springs to open them at any desired instant during the forward stroke of said armature and to close them at any desired instant during the backward stroke of said armature.

9. In a step-by-step switch, means including a motor magnet, an armature controlled thereby and a return spring for said armature for operating said switch on the backward stroke of the armature, interrupter spring contacts, a projection on said armature, an operating member frictionally associated with said armature and adjusting means for adjusting the movement of said operating member, said interrupter springs being in position to be acted upon by said projection and the operating member for the opening and closing of said interrupter spring contacts to take place during the movement of the armature as determined by the position of the adjusting means.

10. In a step-by-step switch, means including a motor magnet and an armature controlled thereby for operating said switch, interrupter spring contacts, an operating member integral with said armature, a friction member frictionally associated with said armature to move with the armature on its forward and backward stroke, a stop member to adjust the forward stroke of said friction member, a stop member to adjust the backward stroke of said friction member, said operating member and friction member being associated with the interrupter springs to control the open period thereof by the operating member as determined by the forward position of the friction member controlled by the position of the first-mentioned stop member and controlled to cause the closing of the interrupter spring by the operating member as determined by the position of the friction member controlled by the position of the said second-mentioned stop member.

11. In a step-by-step switch, means including a motor magnet and an armature controlled thereby for operating said switch on the backward stroke of the armature, interrupter spring contacts, an operating member controlled by said armature for opening said interrupter springs during the forward stroke of said armature and for closing said interrupter springs on the backward stroke of said armature and a delay device cooperating with said interrupter springs and comprising a stop member and an operating member, said last-mentioned operating member being controlled partially by the energization of said magnet and partially by said stop member for delaying the opening of said interrupter springs for an interval after the beginning of the forward stroke of said first-mentioned operating member and controlled partially by the deenergization of said magnet and partially by said stop member for delaying the closing of said interrupter springs for an interval after the beginning of the backward stroke of said first-mentioned operating member.

12. In a step-by-step switch, means including a motor magnet and an armature controlled thereby for operating said switch on the backward stroke of the armature, interrupter spring contacts, an operating member controlled by said armature for opening said interrupter springs during the forward stroke of said armature and for closing said interrupter springs during the backward stroke of said armature and a delay device cooperating with said interrupter springs and comprising a stop member, an armature, and an operating member controlled by said armature, said last-mentioned operating member being controlled partially by the associated armature when attracted by the energization of the magnet and partially by the stop member for delaying the opening of said interrupter springs for an interval after the beginning of the for-

ward stroke of said first-mentioned operating member and controlled partially by the associated armature when released on the deenergization of the magnet and partially by said stop member for delaying the closing of said interrupter springs for an interval after the beginning of the backward stroke of said first-mentioned operating member.

13. In a step-by-step switch, means including a motor magnet and an armature controlled thereby for operating said switch on the backward stroke of the armature, interrupter spring contacts, an operating member controlled by said armature for opening said interrupter springs during the forward stroke of said armature and for closing said interrupter springs during the backard stroke of said armature and a delay device cooperating with said interrupter springs comprising two stop members and an operating member, said last-mentioned operating member being frictionally mounted on said armature and partially controlled by the forward stroke of said armature and partially by one of said stop members for delaying the opening of said interrupter springs for an interval after the beginning of the forward stroke of said armature and controlled partially by said armature and partially by the other of said stop members for delaying the closing of said interrupter springs for an interval after the beginning of the backward stroke of said armature.

HENRY B. BROWN.