Jan. 18, 1944. F. H. HIBBARD 2,339,404

SWITCHING MECHANISM

Filed Sept. 17, 1941 2 Sheets-Sheet 1

FIG. 1

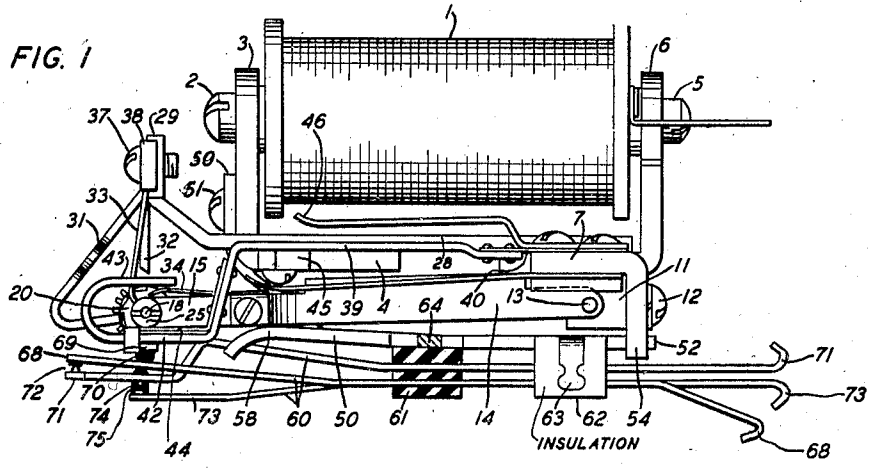

FIG. 2

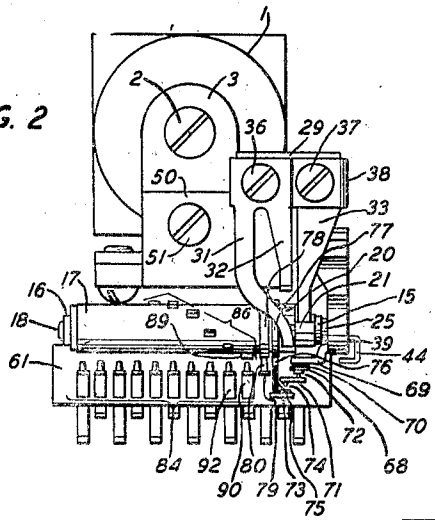

FIG. 3

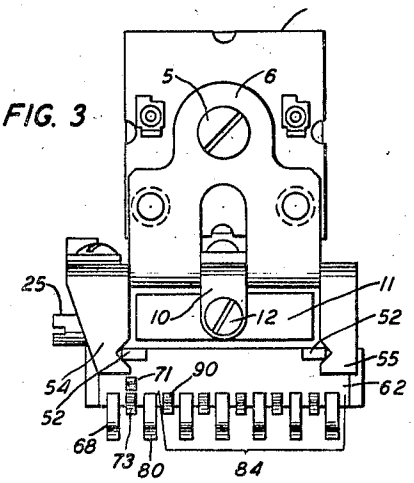

FIG. 9

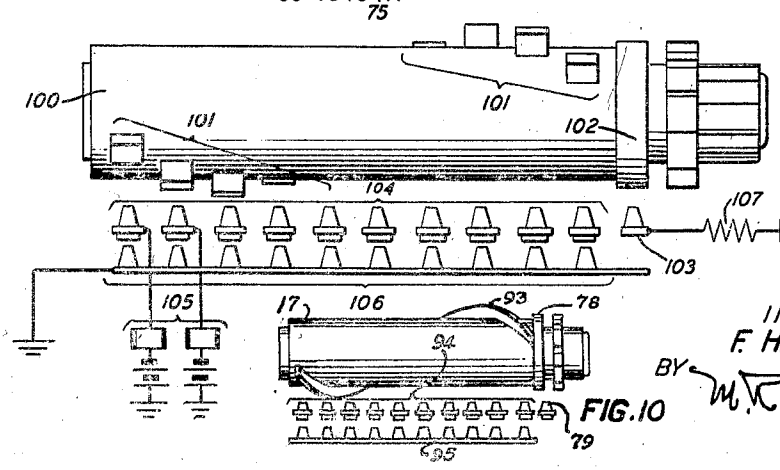

FIG. 10

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SWITCHING MECHANISM

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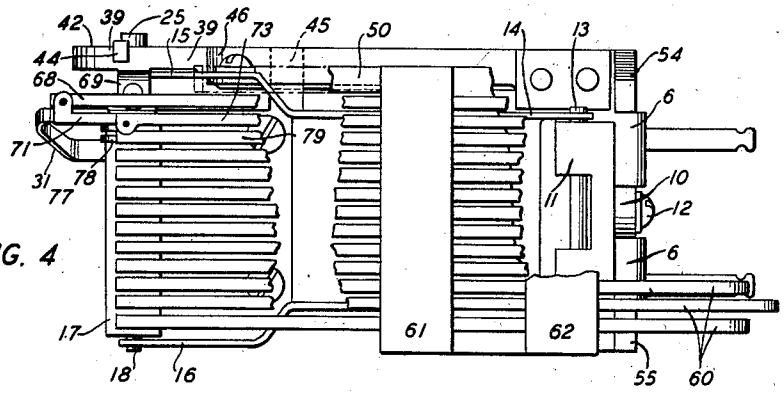


FIG. 4

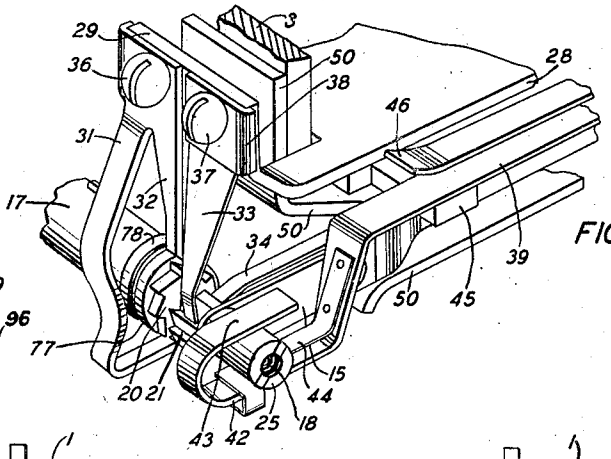
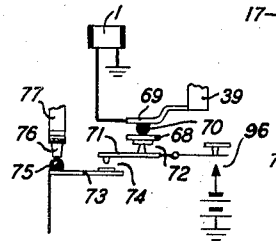


FIG. 5

FIG. 8



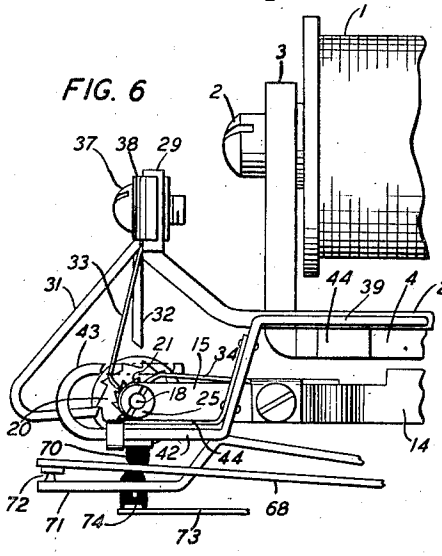


FIG. 6

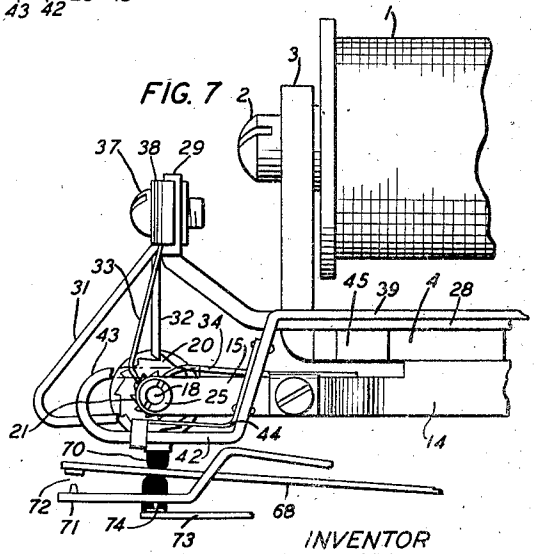


FIG. 7

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UNITED STATES PATENT OFFICE

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SWITCHING MECHANISM

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Application September 17, 1941, Serial No. 411,105

12 Claims. (Cl. 200—105)

This invention relates to switching mechanisms and particularly to mechanisms employed in the establishing of electrical connections.

An object is to simplify and improve the operating characteristics and reduce the size and cost of mechanisms of this type in which a comparatively small number of electrical connections are desired.

Heretofore such minor switching mechanisms were usually of the type in which a set of wipers are rotated in steps to establish connections to terminals in a semicircular bank.

The present invention relates to this general field of switching mechanism, and a feature thereof is an arrangement whereby a drum is provided with contacting elements arranged axially and angularly on the surface of said cylinder and a magnet having an armature on which the drum is mounted with a ratchet mechanism operated to rotate the drum one step each time the armature is operated and sets of contacts arranged so that after each return of the armature succeeding contact operating elements are effective to operate sets of contacts to establish corresponding electrical connections.

Another feature relates to a special arrangement of the ratchet mechanism whereby ratchet wheels on the drum are normally engaged by a stationary holding pawl and a stationary operating pawl to hold or lock the drum in non-operated position and whereby when the armature is operated the operating pawl rotates the drum one step and another stationary holding pawl engages a ratchet wheel in the operated position to hold the drum in the advanced position.

Another feature of the applicant's invention is an arrangement whereby in addition to the succeeding contact operating elements and the contact sets controlled thereby to establish succeeding electrical connections, a common contact plate and a feeder spring may be provided so that on each return of the drum to normal, a contact operating element does not only establish a connection to a succeeding contact set but also establishes connections between said succeeding contact set and the common contact plate and between the contact operating elements and the feeder spring and so that on each lifting of the drum the connection between the contact set and the common plate is first opened and then the connections between the associated contact operating element and the contact set and between the feeder spring and the contact operating elements are opened. An arrangement of this kind may be employed in connection with circuit arrangements for preventing sparking when succeeding electrical connections are disestablished.

The invention has been illustrated in the accompanying drawings in which

Fig. 1 shows a side view of a mechanism embodying the applicant's invention.

Fig. 2 shows a front view of this mechanism.

Fig. 3 shows a rear view.

Fig. 4 shows a bottom view.

Fig. 5 is a fragmentary perspective view of the operating mechanism as disclosed in the preceding figures.

Fig. 6 shows a side view of the operation mechanism in normal condition.

Fig. 7 shows a side view of the operating mechanism with the armature attracted by the magnet.

Fig. 8 shows a diagram of circuits that may be employed for operating this mechanism; and

Fig. 9 shows an application of this mechanism to a spark quenching arrangement in accordance with the applicant's invention.

Fig. 10 shows a modified form of the contact operating mechanism of the applicant's invention.

Referring now to the drawings, and particularly to Figs. 1 to 4, the mechanism consists of a magnet coil 1 mounted on the left side by means of the screw 2 to a return pole-piece 3 which is bent at an angle towards the right under the magnet to form an extension 4. The magnet is also mounted by means of a screw 5 to a return pole-piece 6 on the right side and which is bent towards the left under the magnet to form an extension 7. This right-hand return pole-piece has a cut-out downwardly extending portion 10 shown particularly in Fig. 3 to which a bearing block 11 of non-ferrous material is secured by means of a screw 12. Mounted on this bearing block 11 through a pin 13 is an armature 14. To the left-hand end of this armature 14, between the projections 15 and 16, is mounted a drum 17 on a pin 18. On this pin 18 and between the right-hand end of the drum and the projection 15 looking at Fig. 2 are mounted two ratchet wheels 20 and 21 secured to the drum and rotatable therewith. On the right-hand end of pin 18 is a collar 25 which is screwed onto the pin 18. Connecting and secured to the two pole-piece extensions 4 and 7 is a non-magnetic plate 28. This plate 28 extends towards the left, looking at Fig. 1, at an oblique angle and then perpendicularly upwardly to form an extension 29

to which three pawls 31, 32 and 33 are secured, the rigid pawls 31 and 32 may be formed from a common piece and secured to the extension 29 by means of screw 36, while the flexible pawl 33 is secured to extension 29 by screw 37 and bracket 38. Pawl 31 normally engages a tooth in ratchet wheel 20 and pawl 33 normally engages a tooth in ratchet wheel 21 to maintain the drum and the ratchet wheels in a fixed normal position, while pawl 32 engages a tooth in the ratchet wheel 20 each time the drum 17 is lifted, as will be described hereinafter, to step the ratchet wheels and drum one step. An additional holding pawl 34 is provided to engage ratchet wheel 21 to maintain the drum in an advanced position. This pawl is secured to projection 15 on armature 14.

Flexibly secured to the pole-piece extension 7 is an arm 39 by means of the leaf spring 40. This arm 39 extends downwardly at an oblique angle looking at the left-hand end of Fig. 1 and then horizontally to form the portion 42 after it is bent in a U-shaped formation upwardly to form the extension 43. The portions 42 and 43 of the U-shaped member 39 are located on opposite sides of the collar 25. Connected to the downwardly extending portion of arm 39 is a spring 44 bent to lie parallel with and above extension 42 to engage the collar 25 normally. Protruding from the extension 4 is a lug 45 that serves as a normal rest for member 39. Connected to the extension 7 is a backstop spring 46 that limits the upward movement of the member 39 which in turn limits the upward movement of the armature 14 when attracted by magnet 1 as the collar 25 thereon engages the extension 43. Secured to the left-hand return pole-piece 3 is a member 50 by means of a screw 51. This member 50 is also secured at its opposite end by means of two lugs 52 and 53 extending therefrom and engaging V-shaped slots in the extensions 54 and 55 that extend downwardly from the right-hand return pole-piece 6 shown particularly in Fig. 3. This member 50 has an extension 58 that engages the under side of the armature 14 and serves as a backstop for this armature.

On the member 50 is mounted a series of springs generally identified with the numeral 60. These springs are molded into two blocks of insulation material 61 and 62. Block 61 is shown in cross-section. Referring to block 62, this block is locked to the member 50 by opposite ears such as 63 extending from member 50. Block 61 is similarly locked to member 50 by ears extending from this member, one of these ears 64 being shown in cross-section. This series of springs in detail consist of the following. A spring 68 which is normally engaged by extension 69 on the member 39 but insulated from this extension 69 by an intermediate insulation insert 70. Engaging this spring 68 is another spring 71 to make electrical contact therewith at the contact points 72. Below spring 71 is another spring 73 which, however, is normally out of electrical contact with the spring 71 but capable of being connected therewith at the contact points 74. Spring 73 is provided with an insulation stud 75 which normally engages a projection 76 on an insulation disc 77 mounted on pin 18 adjacent ratchet wheel 20. Adjacent disc 77 is mounted a metal feeder ring 78 on the drum 17 with which feeder spring 79 makes electrical contact at the contact point 80. Adjacent feeder spring 79 in a horizontal row looking at Fig. 2 is a series of ten springs identified generally by the numeral 84. These springs have contact points on their free ends which may connect respectively and in succession with corresponding metal lugs 86 arranged in a helical formation around the drums 17 so that for each succeeding rotary stepping movement of the drum 17, a succeeding connection may be made between a contact spring of the group 84 and a lug of the group 86. These lugs 86 are normally connected in any suitable manner with the feeder ring 78 on the drum. In place of lugs 86 a metal band may be arranged on the insulation drum 17 in a helical formation to connect with the ring 78 as shown for example in Fig. 10. This figure shows a metal band 93 helically arranged around the cylinder 17 and connected directly with the feeder ring 78. The contacts 94 may be disposed in the same manner as the contact springs 60 in Figs. 1 to 7 and a common contact plate 95 may be arranged to contact with the contacts 94 when actuated by the band 93.

While the springs 84 and lugs 86 have been shown for an arrangement whereby a single connection may be established at each rotary step of the drum 17 it is evident that other arrangements may be made to establish a plurality of connections at each rotary step of the drum by having, for example, different spring pile-ups at each position and controlling them by different arrangements of the lugs 86 or by having the lugs 86 of insulation material for actuating the different combinations of springs at the different positions.

The operation of this mechanism is as follows: If the magnet coil 1 is energized, the armature 14 will be attracted upwardly to rotate on its pin 13 towards the extensions 4 and 7 of the return pole-pieces 3 and 6. In moving upwardly it will move the drum 17 and the ratchet wheels 20 and 21 upwardly and thus the operating pawl 33 will rotate the drum and the ratchet wheels one step as it engages a tooth in the ratchet wheel 21. The holding pawl 31 will in this case naturally not interfere with this rotation. As the armature is fully attracted, the holding pawl 32 will engage the next tooth in the ratchet wheel 20 and prevent further rotation of the drum and ratchet wheels. Thus normally the holding pawl 31 and the operating pawl 33 will hold the drum in the normal position by engaging teeth in the ratchet wheels 20 and 21, respectively, and when the drum and ratchet wheels have been rotated one step as the armature is moved upwardly, the holding pawl 32 and the operating pawl 33 will hold the ratchet wheels and drum in the position to which they have been rotated. Thus the interaction and cooperation of these three pawls with the ratchet wheels 20 and 21 insures that the drum will always be normally in the proper position and when rotated remain in the rotated position without shifting one way or the other. As the armature 14 moves upwardly, the collar 25 will some time during its operation engage the member 43 and move the member 39 upwardly until the member 39 is stopped by the backstop 46. If then the circuit for the magnet coil 1 is opened, as will hereinafter be described, in connection with the circuit diagram shown in Fig. 8, the armature will be released and the ratchet wheel 20 will be engaged by the holding pawl 31 while the operating pawl 33, being flexible, will ride over to the next tooth while the pawl 32 will leave the tooth with which it was engaged. As the drum and armature are returned to normal

position and come to rest against the stop 58, the first lug 89 at the right-hand side looking at Fig. 2 of the group 86 makes electrical contact with the first right-hand spring 90 of the group 84 while the spring 79 will make contact with the band 78 and thus an electrical connection is established from spring 79 through band 78, lug 89 and spring 90. Then when the armature is again energized by the magnet coil 1, the drum will rotate to the next position and on its return cause the second lug of the group 86 to engage with the second spring 92 of the group 84 and thus establish a connection from spring 79, band 78, the second lug of the group 86 and spring 92. In this manner successive connections may be established through succeeding springs of the group 84 and lugs 86, band 78 and the spring 79 and after the last lug of the group 86 has been removed from making contact with the last spring in the group 84, the next operation will cause the first spring 90 to again connect with the first lug 89 and these operations may be repeated as desired.

As shown in Fig. 8, operation of the magnet coil 1 may be caused by a circuit closed, for example, through a button 96 from ground, magnet coil 1, button 96 to battery. As hereinbefore described, the collar 25 will on its upper stroke when the armature 14 is energized engage the extension 43 and move the arm 39 upwardly and thereby permit the interrupter spring 68 to leave the interrupter spring 71. This opens the connection through contacts 72 interrupting the circuits for the magnet 1. This interruption of the connection of the circuit for magnet 1 may take place at a certain desired interval during the movement of the collar 25 in the upward direction to secure the desired speed of rotation of the drum. When the magnet deenergizes due to the opening of its circuit connection through the contacts 72 the collar 25 will, of course, be moved downwardly on the release of the armature and through the engagement of spring 44 cause arm 39 to be moved downwardly which in turn presses interrupter spring 68 against interrupter spring 71 to close the interrupter circuit through the contacts 72 for a succeeding operation of the magnet. It will be noted that the spring 44 may be adjusted as to its tension so that it will prevent the arm 39 from rebounding to cause shattering of the connection through contacts 72. It should also be observed that the springs 71 and 73 may be employed as off-normal contacts to close the connection from battery through contacts 74 over springs 71 and 73. This connection is closed immediately upon the first rotary step taken by the drum 17 as then the projection 76 on ring 77 leaves the projection 75 on spring 73. In Fig. 6 the normal positions of the contact springs 68, 71 and 73 are shown and also the position of the pawl 31 engaging a tooth in ratchet wheel 20 and the operating pawl 33 engaging a tooth in ratchet wheel 21. In Fig. 7 the attracted position of the armature 14 is shown with the connections through contact point 72 between springs 68 and 71 opened and the connection through contact point 74 between springs 73 and 71 closed and with the holding pawl 32 engaging a tooth in ratchet wheel 20 and operating pawl 33 engaging a tooth in ratchet wheel 21. These two figures therefore indicate that the drum and ratchet wheels are held in normal and engaged position by the three pawls and also shows the opened and closed conditions of the contact springs 68, 71 and 73.

In Fig. 9 is shown a spark quenching arrangement that may be associated with the applicant's invention. In this case the drum 100 is similar to drum 17 with contact making lugs arranged helically such as the group 101 and the feeder ring 102 normally connected with contact spring 103. The drum 100 is shown however in raised position ready to be released and lowered to make this connection between ring 102 and spring 103. In this case these would be associated with contact spring 103, a series of springs 104 for establishing successive connections for operating relays such as 105 and others and associated with these contacts 104 is also a series of contacts 106 connected together electrically to ground. To contact 103 is connected a resistance 107, a condenser 108 and a source of current 109 in series. The operation in this case is as follows. When the drum 100 is lowered a connection is made between contact 103 and ring 102 and also between one of the lugs 101 and one of the contacts of the group 104 and this latter contact is then further lowered by further movement downwardly of the drum 100 to make contact with the associated contact in the group 106 thus establishing a circuit from battery through one of the relays 105, one of the contacts in the group 104 and in the group 106 to ground, causing the operation of this relay. When the drum 100 is then again raised, the connection between the contact in group 106 and the associated contact in group 104 is first broken to release the relay in the group 105. It should be noted that when this connection is opened, a connection will still remain for an instant from battery through the released relay, the associated contact in group 104, a lug in the group 101, ring 102, contact 103 through resistance 107, condenser 108 and battery 109. The presence of the resistance 107 and condenser 108 in this circuit quenches the spark that ordinarily might have passed between the opened contacts in the groups 106 and 104, on the opening of this connection. Then when the drum is further lifted the connection between the contact in group 104 and the lug in group 101 as well as the connection between ring 102 and contact 103 are opened. Thus a common spark quenching means comprising the resistance 107 and condenser 108 operates whenever a connection for any relay in the group 105 is opened.

What is claimed is:

1. In a switch, a frame, an operating magnet and an armature therefor mounted on said frame, a cylindrical member rotatably mounted on said armature, said armature being arranged to lift said cylinder when attracted by the magnet and return it to normal when released by said magnet, means on said frame and cylinder cooperating to rotate said cylinder one step each time it is lifted by the armature, projections on the surface of said cylinder arranged in a helical formation, a series of contact springs mounted on said frame in relation to said projections so that after each rotary step is completed and on the return of the cylinder from its lifted position on the release of the armature a different combination of contact springs is actuated by a different projection to establish a different electrical connection.

2. In a switch, a frame, an operating magnet and an armature therefor mounted on said frame, a cylindrical member rotatably mounted on said armature, a ratchet mechanism connected to said cylinder, a pawl mechanism permanently fixed to said frame and located in relation to the ratchet

mechanism so that each time the ratchet mechanism and cylinder are lifted in response to the operation of the armature the pawl mechanism will rotate the ratchet mechanism and the cylinder one step, a series of metallic projections on the surface of said cylinder, a series of spring contacts mounted on said frame and so located in relation to the projections on the cylinder that each time the cylinder is returned to its normal position after having been lifted and rotated an electrical connection is established between a succeeding spring contact and a succeeding projection.

3. In a switch, a frame, an operating magnet and an armature therefor mounted on said frame, a drum rotatably mounted on said armature, ratchet wheels mounted on said drum, a pawl mechanism fixed on said frame and located so that on each energization and deenergization of said magnet for attracting and releasing the armature the ratchet wheels are engaged by said pawl mechanism to be rotated with the drum one step, a metal band arranged in a helical formation and attached to the surface of the drum, a feeder ring on said drum connected to said band, a feeder spring and a series of select springs mounted on said frame and associated with the band and feeder ring so that on each release of the armature the feeder ring will contact with the feeder spring and the band will contact with a different select spring to establish an electrical connection between the feeder spring, the feeder ring, the band and said select spring.

4. In a switch, a frame, an operating magnet and an armature therefor mounted on said frame, a drum rotatably mounted on said armature, ratchet wheels attached to said drum, a pawl mechanism fixed on said frame and so located that on the lifting from the normal position of the armature by the energization of the magnet said ratchet wheels are engaged by said pawl mechanism to rotate the drum one step, metallic members projecting from the surface of said drum, a series of contact springs mounted on said frame and associated with said members so that after each rotation of the drum one step a different combination of contact springs are electrically connected through a different member on the return of the drum from its lifted position.

5. In a selector switch, a frame, an operating magnet and an armature therefor mounted on said frame, a drum rotatably mounted on said armature for movement of said drum from a normal position to a lifted position when the armature is attracted by said magnet, two ratchet wheels attached to said drum, two stationary holding pawls mounted on said frame and associated with one of said ratchet wheels, a stationary operating pawl mounted on said frame and associated with the other ratchet wheel, said pawls being so located in relation to said ratchet wheels that when the drum and ratchet wheels are in normal position one of said two holding pawls engages the associated ratchet wheel to hold said ratchet wheels and drum in a fixed position and so that when the drum and ratchet wheels are actuated to their lifted position said operating pawl rotates the drum and ratchet wheels by engaging a tooth in the associated ratchet wheel and causes said other holding pawl to engage the associated ratchet wheel to hold said wheels and drum in said lifted and rotated position, projections on said drum, pairs of contacts mounted on said frame and associated with said projections so that after each rotation of said drum and on the subsequent lowering of the drum to a normal position a different projection causes electrical connections to be established between a different pair of contacts.

6. In a switch, a frame, an operating magnet and an armature therefor mounted on said frame, a drum rotatably mounted on said armature for movement of said drum from an unoperated position to a lifted actuated position each time the magnet is energized, two ratchet wheels attached to said drum, each of said ratchet wheels having its teeth cut in opposition to those of the other ratchet wheel, two stationary holding pawls mounted on said frame and associated with one of said ratchet wheels, one of said pawls holding the ratchet wheels and the drum in non-actuated position and the other holding said ratchet wheels and drum when in actuated lifted position, a stationary operating pawl mounted on said frame and associated with the other ratchet wheel for the rotation of said ratchet wheels and drum one step for each actuation of the armature to lift the ratchet wheels and drum toward said operating pawl, a series of projections on said drum, a series of contacts mounted on said frame and associated with said projections so that after each lifting and rotating of said drum and on the subsequent release of the armature said projections cause electrical connections to be established between different combinations of the contacts.

7. In a switching mechanism, a frame, an operating magnet mounted thereon, sets of contacting means mounted on said frame for establishing electrical connections, a contact element arranged in a helix, means mounted on said frame and controlled by said magnet when energized for lifting said element bodily from a normal position to an actuated position, means mounted on said frame and associated with said element for rotating said element on its axis one step in response to each lifting movement of said element, said element being so arranged in relation to the sets of contacting means that after each rotary step and on the return from its lifted to its normal position it actuates directly without friction on a succeeding set of contacting means to establish an electrical connection.

8. In a switching mechanism, a frame, an operating magnet mounted on said frame, sets of contacting elements mounted on said frame for establishing electrical connections, a drum, contact operating elements arranged in a helix on said drum, a ratchet wheel mechanism associated with said drum, means mounted on said frame and attached to said drum for lifting said drum and ratchet mechanism from a normal position on the operation of said magnet, and lowering them to the normal position on the release of said magnet, a stationary pawl mechanism on said frame arranged in relation to said ratchet wheel mechanism so that on the lifting of the drum and ratchet mechanism they are rotated one step and held in the advanced position and on the lowering of the drum and ratchet mechanism they are held in said advanced position, said helical arrangement of the contact operating elements on said drum being such that a succeeding contact operating element engages directly and without friction a succeeding set of contacting elements to close an electrical connection each time the drum has been rotated and is lowered to the normal position.

9. In a switch, a frame, an operating magnet and an armature therefor mounted on said frame,

a drum mounted for rotating on said armature, a band arranged helically on said drum, said armature being arranged to lift the drum a certain distance when attracted by the magnet and restore it to a normal position when the armature is released, means associated with the drum and frame operative on the lifting of the drum for rotating it a certain distance, and a series of contacts mounted on said frame and arranged so that a different contact establishes an electrical connection with the band on each return of the drum to normal position.

10. In a switch, a frame, an operating magnet and an armature therefor mounted on said frame, a drum mounted for rotation on its axis on said armature, a band arranged in a helix on the surface of said drum, means associated with said drum and said frame operative when the armature is attracted by said magnet for rotating said drum on its axis, said drum being mounted on the armature so that it is lifted when the armature is attracted by the magnet in a direction perpendicular to its axis and lowered in the opposite direction perpendicular to its axis on the release of the armature, and sets of contacts mounted on said frame so that on each lowering of the drum said band engages a different set of contacts to establish electrical connections.

11. In a switch, a frame, an operating magnet and an armature therefor mounted on said frame, a drum rotatably mounted on said armature, a metal band arranged in a helix around said drum, means operative in response to the attraction of the armature by the magnet for lifting said drum from a normal to an actuated position and for rotating the drum one step each time it is lifted, a series of contact springs mounted on said frame in a row parallel to the axis of said drum, a common contact plate mounted on said frame, a feeder ring on said drum electrically connected to said band, a feeder spring mounted on said frame, said band contact springs, common plate, feeder ring and feeder spring being so located in relation to each other that on each return of the drum to normal from its lifted position an electrical connection will be closed between the feeder spring and feeder ring through the band and a succeeding contact spring to the common plate and so that on each lifting of the drum from the normal position, said electrical connection will first be opened between the contact spring and the common plate then between the contact spring and the band, and last between the feeder spring and the feeder ring.

12. In a switch, a frame, an operating magnet and an armature therefor mounted on said frame, a cylindrical member rotatably mounted on said armature so that when the armature is actuated by the magnet said member is lifted from a normal position to an actuated position, means associated with said member and means associated with said frame cooperating during each lifting of the member for rotating it one step, projections arranged axially and angularly on the surface of said member, contact elements mounted on said frame, said projections and contact elements being so located in relation to each other after each rotary step and on the return of the member from its lifted position that a certain combination of connections is established by said projections between corresponding contact elements to establish corresponding electrical connections.

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