June 26, 1928.

1,675,311

H. SENGEBUSCH

AUTOMATIC SWITCH

Filed March 7, 1927

2 Sheets-Sheet 1

Fig: 1

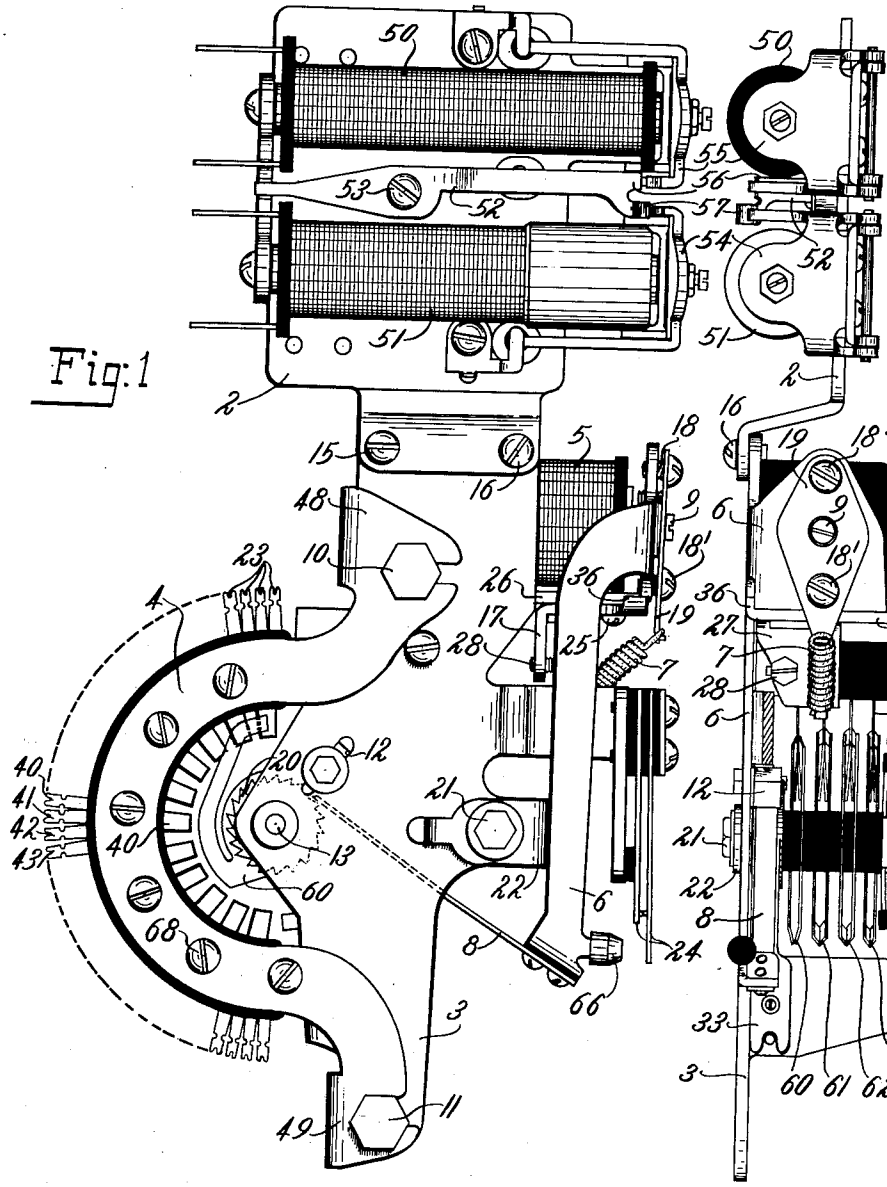

Fig: 2

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2 Sheets-Sheet 2

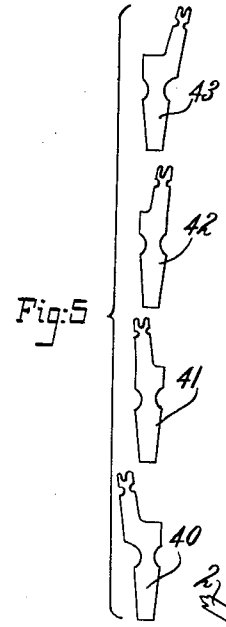


Fig: 5

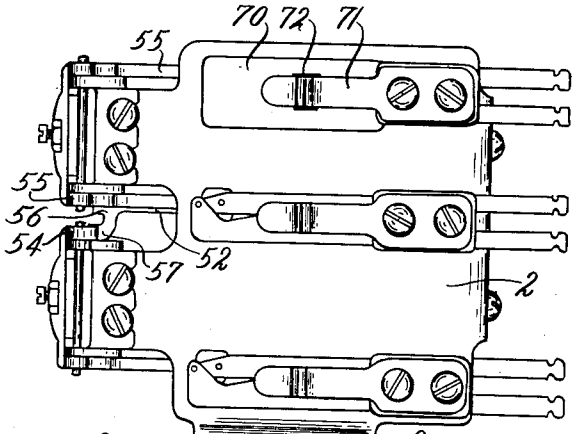


Fig: 3

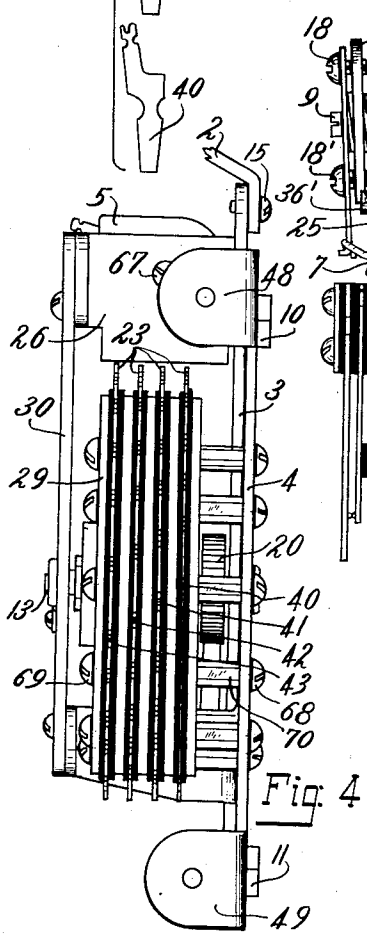
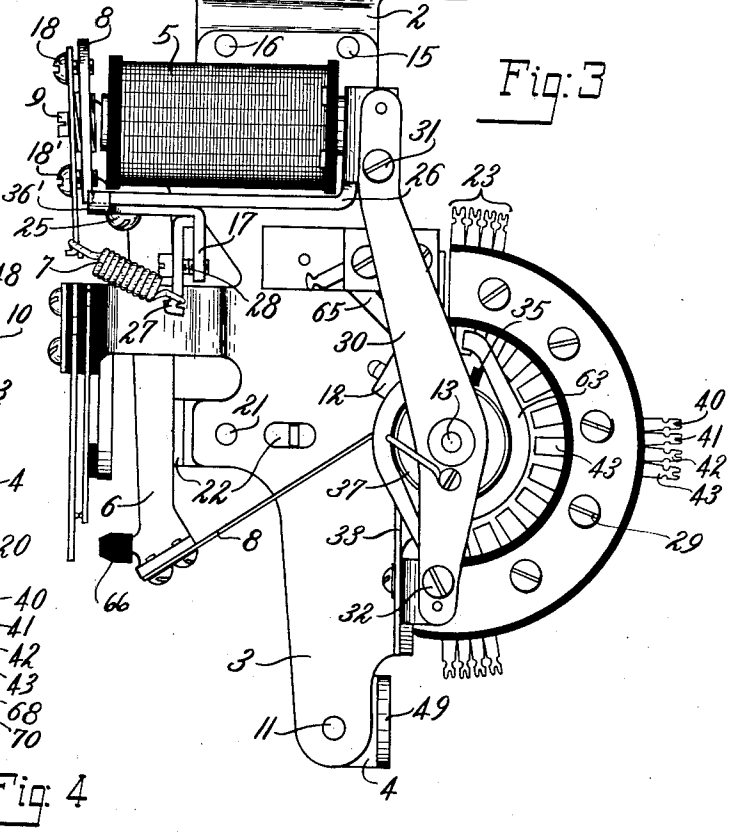


Fig: 4



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Patented June 26, 1928. 1,675,311

UNITED STATES PATENT OFFICE.

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AUTOMATIC SWITCH.

Application filed March 7, 1927. Serial No. 173,243.

The present invention relates in general to automatic switching devices, and in particular to improved automatic switches which are adapted to be used in various capacities such as a line switch, a register switch, trunk finder or other uses in a telephone system.

An object of the present invention is the provision of a rotary stepping switch of simple, durable and inexpensive construction of the type wherein the wipers are advanced to normal position each time after having been operated and subsequently released.

Another object is to provide a simple and effective means for adjusting the wipers or brushes of the switch with respect to the bank contacts, so that the wipers may be maintained centered on the bank contacts.

An additional object is the elimination of the various bearings and loose pawls on the armature of the stepping magnet, thereby reducing wear and tear on these parts and the consequent noisy operation and necessary replacement.

Another object is to provide a simple and effective interlocking arrangement between the line relay and cut-off relay of this switch, when used as a line switch or terminus of an individual subscriber's line circuit.

These and other objects relating to mechanical improvements and structure tending to make such switches more easily adjustable, will be readily apparent by the following detailed description, reference being had to the accompanying drawings in which the various features of the invention are disclosed.

It may be stated that this switch discloses a mechanical structure that is adapted to be used with a circuit arrangement similar to that disclosed in a pending application of Bernard D. Willis, Serial No. 28,995.

The invention is illustrated in the accompanying drawings in which Fig. 1 is a side view of the line switch and the relays; Fig. 2 is a front view of the line switch and relays shown in Fig. 1. In order to avoid complicating the drawing unnecessarily, the bank contact assembly of the switch, and the spring combinations of the relays have been omitted in this figure. Fig. 3 is a side view of the switch and relays as seen from the opposite side of Fig. 1. Fig. 4 is a view of the bank contact assembly as seen from the right of Fig. 3, while Fig. 5 illustrates one set of bank contacts from the bank contact assembly.

Referring now particularly to Fig. 1, the reference numeral 3 indicates a sheet metal mounting plate upon which the various parts of the switch are mounted, as will be explained. The numeral 5 designates the driving magnet of the switch, which by means of its armature 6 steps the wipers 60 to 63 inclusive, over the bank contacts, one set of which are indicated by the numerals 40 to 43 inclusive. Attached to the upper end of the plate 3 by means of screws 15 and 16 is another mounting plate, indicated by the reference numeral 2. This plate serves as a mounting plate for the line relay 51 and the cut-off relay 50, and also their respective spring contact assemblies. In addition, the interlocking arrangement between these two relays is mounted on this plate.

The driving magnet 5 is fastened to the heel piece 26 by means of screw 67, as seen in Fig. 4. This heel piece 26, with the armature 6 serves to complete the magnetic circuit of the magnet 5 each time its circuit is completed. The armature 6 rests on the upper end of the heel piece 26 and is held in place by the turned up ears 36 and 36′ of the L shaped part 17; this being fastened to heel piece 26 by screw 25. One end of the armature tensioning spring 7 is fastened to a turned up portion of the part 19 and this in turn is mounted on top of the armature 6 by means of screws 18 and 18′. The other end of the spring 7 is fastened to the spring adjusting plate 27 as seen best in Fig. 3. By turning the bolt 28 into the L shaped part 17, the adjusting plate 27 is moved, and additional tension is stored in the spring 7. This bolt 28 is prevented from loosening up by a small projection of the part 27. It will thus be apparent that by turning the

bolt 28 the tension of the spring 7 may be varied to give more or less power to the stroke of the armature 6 as desired. The turned up ears 36 and 36′ prevent lateral movement of the armature 6, while the tensioning spring 7 holds the armature against the part 17, thereby forming a pivot for the armature to operate on, and providing an easy method for the removal of the same for replacement or adjustment.

The main purpose of the armature tensioning spring 7 is to provide the means for returning the armature 6 to its normal position each time it is operated, thus rotating the wipers over the bank contacts.

The iron screw 9, the head of which projects through the plate 19 is screwed into the armature 6 and serves as a means for adjusting the stroke of the armature.

Fastened to the opposite end of the armature 6 by means of a couple of screws is a resilient stepping pawl 8, the other end of which normally engages a tooth of the ratchet wheel 20. The resiliency of this stepping pawl 8 allows sufficient lateral movement to enable it to ride over the next tooth. The ratchet wheel 20 is mounted on the shaft 13, together with the wipers 60, 61, 62 and 63, suitably insulated from each other. The shaft 13 is journaled in bearings in the frame 3 at one end, and in the frame 30 at the other end.

The advantage of this type of armature and pawl connection is obvious, there being no pivots to become loose to cause the armature and pawl to get out of adjustment and to rattle.

The supporting frame 30 is fastened to the frame 3 at one end by the screw 32, and at the other end is attached to the heel piece 26 by means of screw 31. It will thus be observed that this frame 30 serves the dual purpose of providing a support for the wiper shaft 13 and also for strengthening the switch frame to prevent lateral movement.

A resilient holding pawl 33 engages the teeth of the ratchet wheel 20, and prevents backward movement of the wipers and also holds the wipers in their proper position on the bank contacts.

The wipers 60, 61, 62 and 63 are double ended so that when one end is in engagement with the first set of bank contacts, the other end is one step away from the last set of bank contacts. The wipers are constructed of S-shaped pieces of thin, resilient, hard metal in order to obtain the maximum amount of elasticity combined with maximum wearing qualities. It will be observed that the wiper 60, known as the test wiper, differs slightly from the remaining wipers. The contact edge of this wiper is slightly elongated so that, as the wiper is rotated from one bank contact to the next, it will still be in engagement with the first contact after having advanced onto the next one, After coming to rest on a certain bank contact, the wiper remains centered on this bank contact and does not touch the adjacent ones. The remaining wipers 61, 62 and 63 have their edges bent over at right angles to wiper 60 but in a manner so that these wipers do not touch adjacent contacts at the same time, as they are rotated.

Each of the wipers 60, 61, 62 and 63 has a brush, such as 63′ which serves wiper 63, in continuous contact with the wiper so that an electrical connection to the wipers may be effected.

Adjustably fastened to the frame 3 by means of a bolt is the block or stop 12, the purpose of which is to lock the stepping pawl 8 against the ratchet tooth each time after the armature 6 has been operated, in order to prevent the wipers from rotating over more than one set of bank contacts at a time. Another stop 22 is adjustably mounted on a projection of the frame 3 by means of a bolt 21. The purpose of this stop is to limit the backward stroke of the armature 6 when the wipers are rotated.

An insulated bushing 66 fastened on one end of the armature 6, operates a pair of spring contacts 24 each time the armature is attracted by the magnet 5. These springs 24 are insulated from and mounted on an extended portion of the frame 3 and are operated to interrupt the circuit of the magnet 5 each time it has energized.

The bank contact assembly is held together and fastened to the semi-circular mounting plate 4, upon which the frame 3 is mounted, and held in place by the bolts 10 and 11, in such a manner that by loosening these bolts and moving the frame 3 the wipers may be adjusted in or out with respect to the bank contacts. This is so that the bank contacts will be properly lined up for the wipers to freely rotate over them. The ends of the mounting plate 4 have portions 48 and 49 bent at right angles to the plate with a hole drilled through the center, so that bolts may be inserted; thereby providing the means by which the whole line switch assembly is mounted on a switchboard or upright.

The mounting plate 4, together with the semi-circular part 29, the clamping screws such as 68 and 69, and the extension studs such as 70, serve to clamp and secure the bank contacts, the semi-circular insulating strips and the other iron separators 29, all together as a unit so that the mechanism mounted on the frame 3 is adapted to be readily detached therefrom by turning out the bolts 10 and 11 and sliding them out of the slots provided in the plate 4.

The bank contacts 40, 41, 42, and 43 represent one particular trunk or line with which

the wipers 60, 61, 62 and 63 are adapted to make contact at the same time. The terminal ends of these bank contacts, it will be observed, are staggered with respect to each other so as to permit bare wire multipling between them and the corresponding set of bank contacts which are mounted on adjacent, similar line switches of the same switchboard. Referring to Fig. 5 the bank contact 40 is first laid down, then several strips of insulation and a separator such as 29 are placed on top of the contact, after this the contact 41 is placed on top. This same procedure is followed with the remaining bank contacts 42 and 43. From the above it will be seen that the front portion of each contact, or that part adapted to be wiped over by the wipers, lines up with respect to the next bank contact, so that all four bank contacts 40, 41, 42 and 43 are wiped over by the wipers at the same instant. The rear portion or terminal end of each bank contact is slightly offset for the purpose stated and will be best seen by referring to Fig. 4.

It will be appreciated that the number of bank contact sets in the bank assembly need not be limited to the number shown in the drawing; but the number may be increased any desired amount by simply increasing the size of the bank or reducing the width of the bank contacts.

As this is a line switch of the type that always is returned to its normal position upon release, some means must be provided for stopping the switch when this position is reached. The set of bank contacts indicated generally by the reference numeral 23 serve partly for this purpose. When the wipers 60 to 63 inclusive, come into position on this set of contacts the circuit of the magnet 5 is opened and the wipers remain in engagement with these contacts. The interruption of the circuit of the magnet 5 is caused by the bushing 35, which is mounted on the wiper shaft 13, operating the springs 64 and 65, these contacts being in the circuit of the magnet 5.

A circular disk 37 having numerals stamped on its periphery is also mounted on the wiper shaft 13 and gives an indication of the set of bank contacts with which the wipers are in engagement with.

As has been stated before, the sheet metal plate 2 is attached to the upper end of the frame 3 by means of the screws 15 and 16. It is slightly bent at the point where it fastens to the frame so that when the relays 50 and 51 are mounted upon it, the width occupied by them will approximately correspond with the main width of the switch. As these line switches are mounted side by side on the switchboard, waste space is thereby eliminated. This plate 2 has two portions turned up at right angles to its plane for holding the relay coils 50 and 51. The rear of the plate 2 mounts the spring assemblies of the relays, while two extensions of the plate provide means for holding the brackets whereby the relay armatures 54 and 55 are pivoted. This single plate 2 is adapted to complete a path for the magnetic circuit of each or both of the relays 54 and 55 whenever the coils have been energized.

Secured to the plate 2 by means of screw 53 is the so called interlocking arrangement 52, between the line relay 51 and the cut-off relay 50. This interlocking bar is constructed of spring steel, one end resting in a groove in the turned up portion of the plate 2 to prevent lateral movement, while the other end is fork shaped. The end 56 of the fork presents a straight edge to the armature 55 and the other fork 57 is bent slightly so that when armature 54 moves down on the fork 57 it will be forced outward against the spring tension of the bar 52. The cut-off relay 50 has two legs formed on its armature which legs operate the spring combinations. This is so as to prevent an undue amount of spring combinations being mounted together in one assembly, the assemblies being divided into two parts as seen in Fig. 3. Another leg of the armature 55 is in alinement with the edge 56. The line relay 51 has only one leg on its armature 54 for operating its spring combinations. A leg of this armature 54 is adapted to slide over the bent portion 57 of the bar 52 where it moves down upon it.

As all three spring assemblies of the relays are of relatively the same height from the plate 2, the same size dust proof insulation cover 70 may be forced over them and held in position by the locking spring 71 falling into the detent 72 of the cover 70.

With the above explanation in mind the function of the interlocking arrangement will now be defined. Should the line relay 51 be energized before cut-off relay 50, the armature 54 is attracted and the spring combination operated, and the same time the leg of armature 54 will force out the bent portion 57 of the bar 52, so that when cut-off relay 50 becomes energized and attracts its armature 55, the edge 56 will not obstruct the leg of the armature and it consequently can operate all the way and move both spring assemblies of this relay. If cut-off relay 50 is energized before line relay 51, the armature 55 is attracted, but due to the edge 56 obstructing the movement of the leg of this armature it can only operate part way and consequently only part of the springs of the spring assembly will be operated.

A further brief explanation will now be given with regard to the operation of the switch in connection with the circuit of the same. A circuit adapted to operate with

this switch is disclosed in the before mentioned pending application of Bernard D. Willis, Serial No. 28,995, Fig. 2, in which the driving magnet 6', switching relay 4', and line relay 5' correspond to 5, 50 and 51 of the instant case. Wipers 23', 24' and 25' correspond to wipers 40, 41, and 42. The wiper corresponding to wiper 43 of the switch is not shown in the circuit, as this is optional and may be used for discriminating metering or other services. The bank contacts 20', 21', and 22', of Willis are represented in this case as indicated by the reference 23 and are the home position contacts. Springs 13' and cam 14' correspond to the springs 64 and 65 and the part 35.

With the above brief comparison of the schematic diagram and the instant switch in mind, it will now be explained how this switch operates from a circuit point of view in connection with the mechanical operation.

The subscriber's line wires to which this line switch may be attached and individual thereto in the exchange, are brought to the terminals of the armature spring contacts of switching relay 50 through back contacts to ground, and through line relay 51 to battery. Upon the initiation of a call, line relay 51 energizes and attracts its armature 54. The stepping magnet 5 energizes, attracts armature 6, and as it breaks its own circuit at contacts 24 it immediately deenergizes and under action of the coil spring 7 drives the wipers 60 to 63, inclusive, one step and off the home position contacts 23. At the same time the bushing 35 moves out of engagement with springs 64 and 65. If the trunk line on whose contacts the wipers are now resting, is idle, the switching relay 50 energizes and stops further rotation. The armature 55 of this relay operates all the way as the bar 52 has been moved out of the path of this armature by the armature 54 sliding on the part 57. The line relay 51 is now deenergized and the subscriber's line circuit is switched through. In the event of an incoming call to this subscriber's line, the switching relay 50 is energized, but due to the edge 56 obstructing the full movement of the armature 55 it can only operate part way and the contact springs of relay 51 are so operated as to prevent further operation of the line switch.

Upon the release of an outgoing connection, switching relay 50 is deenergized and since the contact springs 64 and 65 have been closed, the circuit is completed for the stepping magnet 5 through these contacts to return the wipers to normal position. When the wipers have been positioned on bank contacts 23 the arm on the bushing 35 opens springs 64 and 65 and the switch remains in this position.

From the foregoing description it will be seen that a new type of line switch has been developed, combining refinements and compactness and employing a minimum number of bearings and pawls, and, in addition, wherein all parts are substantially made and readily accessible for adjustment or replacement.

Although this switch is described as used as a line switch or subscriber's individual switch, it is to be understood that by removing the plate 2 containng relays 50 and 51, by means of screws 15 and 16, the switch itself is adaptable for use in various other capacities such as registers, frequency selectors, etc.; as will be readily apparent by anyone skilled in the art. Applicant therefore does not desire to be limited to the precise structure of his disclosure but only by the scope of the appended claims.

What is considered new and what is desired to have protected by Letters Patent will be pointed out in the appended claims.

What is claimed is:

1. In a rotary stepping switch, an arc shaped bank contact assembly support, a switch frame having mounted thereon rotatable wipers and driving mechanism therefor, means comprising bolts in said frame and slots in said support for securing said support and said frame together so that the axis of the wipers is approximately in the center of said bank assembly, means on said support for mounting said support and said frame together on a switchboard as a unit, and means including said slots and bolts for adjusting said axis in a plane at right angles to said mounting means.

2. In a rotary stepping switch, a driving magnet, a heel piece member for said magnet, a holding member mounted on the end of said heel piece, said holding member having extensions projecting beyond the edge and on the sides of said heel piece, and an armature for said magnet resting on the edge of said heel piece and held in position by said holding member.

3. In a rotary stepping switch, a driving magnet, a heel piece member therefor, a holding member fastened on the end of said heel piece, said holding member projecting beyond the edge and on the sides of said heel piece, an armature for said magnet resting on the end of said heel piece, said heel piece cooperating with said holding member to form a pivot point for said armature, and means for retaining said armature on said pivot point.

4. In a rotary stepping switch, a driving magnet, a heel piece member secured thereto, an armature resting on the end of said heel piece, means for holding said armature on the end of said heel piece, said means cooperating with said heel piece to form a pivot for said armature, and means attached to said armature to prevent displacement thereof from said pivot point.

5. In a rotary switch, a driving magnet, an armature therefor, a heel piece member secured to said magnet, means for forming a pivot for said armature on said heel piece, means for holding said armature on the end of said heel piece, a rotatable wiper shaft having a ratchet wheel mounted thereon, and a resilient single piece stepping pawl rigidly fastened at one end to said armature and having the other end in operative relation to said ratchet wheel.

6. In a rotary stepping switch, a driving magnet, a heel piece member secured thereto, an armature, means cooperating with said heel piece to form a pivot point for said armature, a rotatable wiper shaft having a ratchet wheel mounted thereon, a resilient single piece stepping pawl rigidly fastened to said armature and in operative relation to said ratchet wheel, means for energizing said magnet whereby said armature is operated, and means attached to said armature for holding it against said pivot point and for returning it to normal position whereby said wiper shaft is rotated after said magnet is deenergized.

7. In a rotary line switch, a switch frame containing power driven means for rotating a set of wipers over a bank contact assembly, a relay mounting plate removably fastened to said switch frame, relay coils, and means for energizing them, armatures and spring contact assemblies therefor, all mounted on said plate, said plate providing a means to complete a common magnetic circuit with said armatures whenever said relays are energized.

8. In a line switch, a switch frame having mounted thereon wipers and means for rotating them over sets of bank contacts, a relay mounting plate attached to said switch frame, projections thereon for mounting a line and cut-off relay, armatures and spring combinations for said relay mounted on said frame, and an interlocking spring member mounted on said frame having fork shaped projections at one end in operative relation to said relay armatures, the other end being set in a recess on said frame.

9. In combination a relay mounting plate, a line and a cut-off relay together with their respective armatures and spring combinations mounted on said mounting plate, an interlocking member mounted on said frame between said relays and having a fork shaped end in operative relation with each of said armatures, means for energizing said line relay and operating its armature to move the spring combination therefor, and to move one forked end of said interlocking member out of the path of movement of said cut-off relay armature when this relay is energized.

10. In combination, a relay mounting plate, a line and a cut-off relay together with their respective armatures and spring combinations mounted on said plate, an interlocking member mounted on said frame and having a forked shaped end in operative relation with said armatures, means for energizing said cut-off relay to attract its armature, one fork of said interlocking member permitting said armature to operate only part way and move part of the spring combination of said relay, means for restoring said cut-off relay to normal, means for energizing said line relay to attract its armature and move the other fork of said interlocking member out of the path of movement of said cut-off relay armature, and means for subsequently energizing said cut-off relay to attract its armature all the way and move the whole spring combination of this relay.

11. In a rotary stepping switch, a heel piece, a driving magnet attached thereto, a holding member fastened to said heel piece and extending beyond said heel piece, a chamfer on the end of said heel forming an angle of more than 90° between the end of the heel piece and said holding member, an armature for said magnet resting against said holding member and heel piece, a chamfer on said armature forming an angle of less than 90° between the face engaging said heel piece and the face engaging said holding member, and means including a coil spring fastened to said armature and said holding member for retaining said armature in place.

12. In a rotary stepping switch, a heel piece, a driving magnet attached thereto, a holding member fastened to said heel piece and extending beyond said heel piece, a chamfer on the end of said heel forming an angle of more than 90° between the end of the heel piece and said holding member, an armature for said magnet resting against said holding member and heel piece, a chamfer on said armature forming an angle of less than 90° between the face engaging said heel piece and the face engaging said holding member, and means including a coil spring fastened to said armature and said holding member and having tension along a line parallel to the bisector of the angle between the end of said heel piece and said holding member, for retaining said armature in place.

13. In a rotary stepping switch, a semi-circular bank of contacts containing a plurality of rows each containing a plurality of individual contacts, spaces between said individual contacts, a double end wiper assembly having a wiper for each of said rows of contacts, means for rotating said assembly to bring said wipers into engagement with successive ones of said contacts, means including the ends of certain of said wipers bent on a radius for securing an edgewise engage-

ment between said wipers and their respective contacts and for preventing said wipers from bridging from one contact to the next during rotation, and means including the ends of another of said wipers, bent on a line tangential to said rotation, for securing an edgewise engagement between that wiper and its associated contacts and for securing a bridging of that wiper from contact to contact during rotation.

In witness whereof, I hereunto subscribe my name this 3d day of March, A. D., 1927.

HANS SENGEBUSCH.