

Nov. 28, 1944.

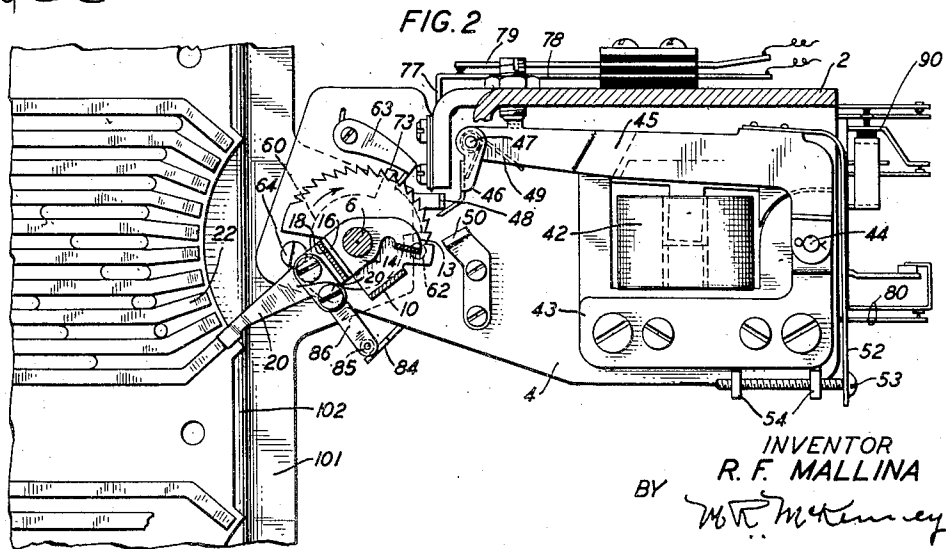
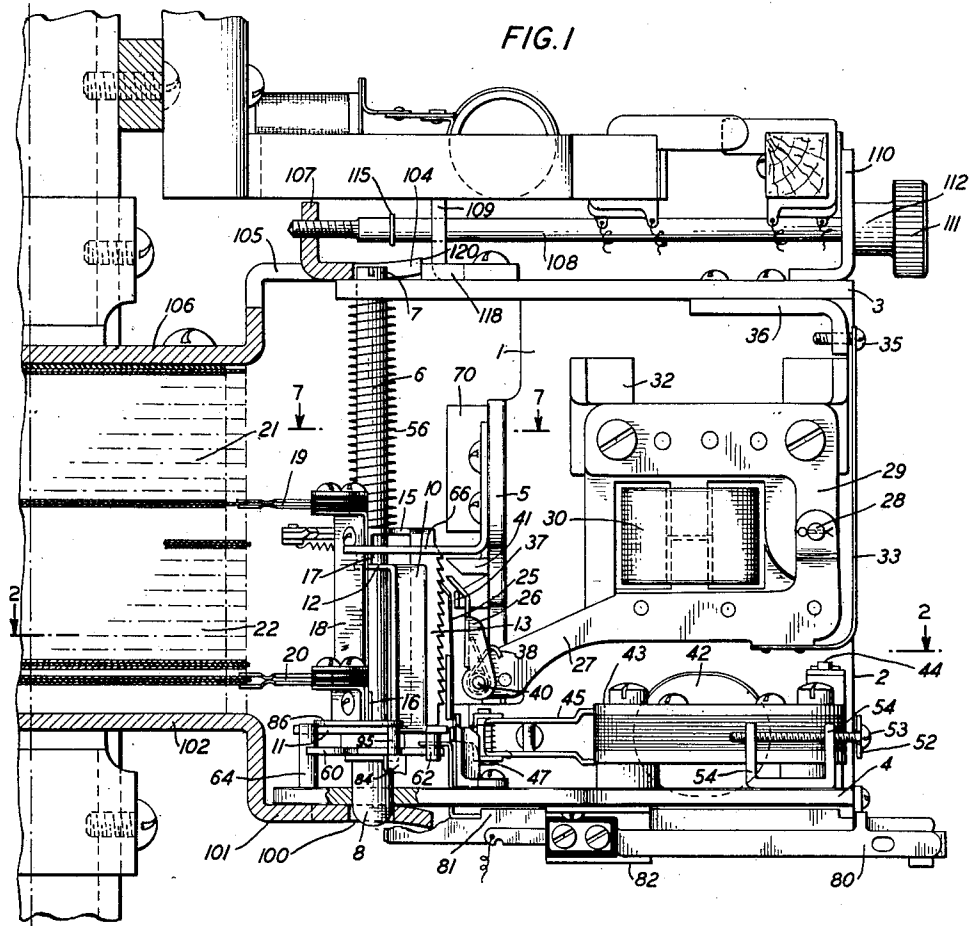
R. F. MALLINA

2,363,683

SWITCHING MECHANISM

Filed Dec. 31, 1942

4 Sheets-Sheet 1



INVENTOR  
R. F. MALLINA  
BY *McKenney*

ATTORNEY

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R. F. MALLINA

2,363,683

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FIG. 3

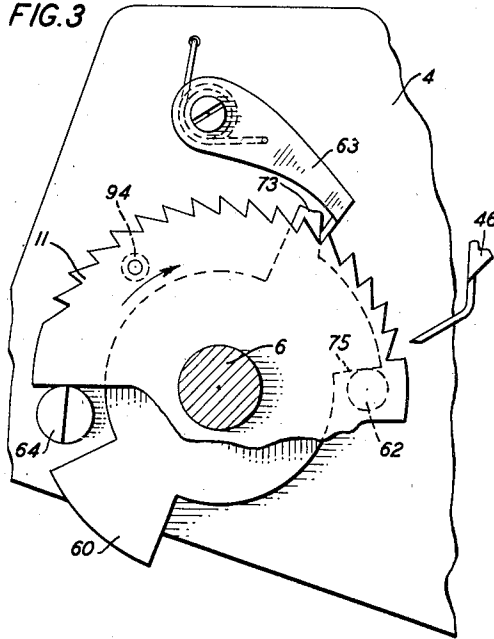


FIG. 4

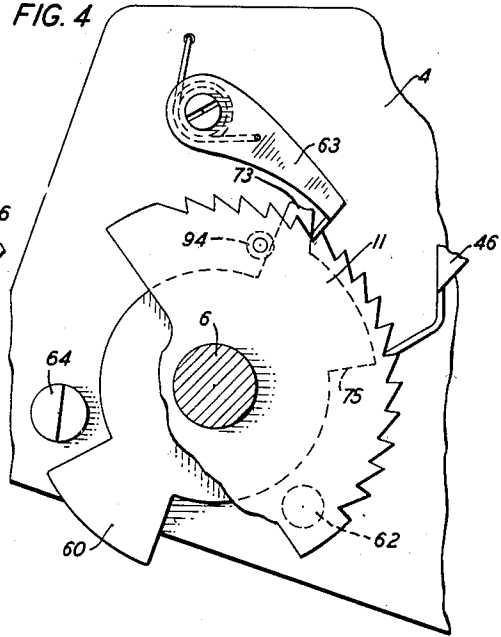


FIG. 5

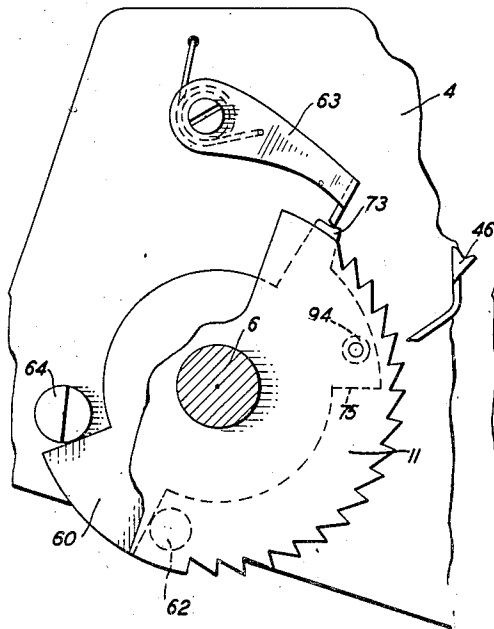
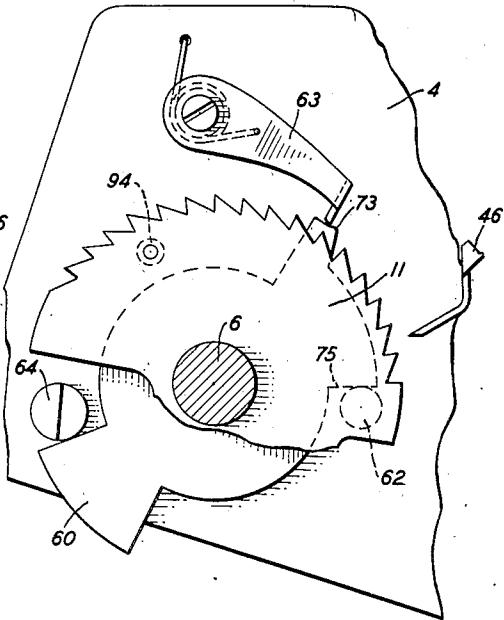


FIG. 6



INVENTOR  
R. F. MALLINA  
BY *W. C. McKinney*

ATTORNEY

Nov. 28, 1944.

R. F. MALLINA

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SWITCHING MECHANISM

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FIG. 7

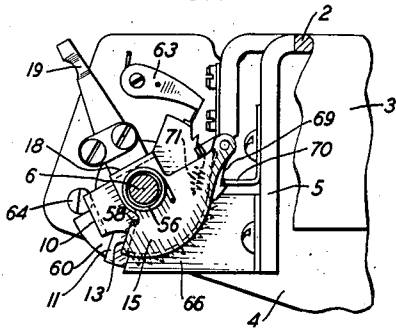


FIG. 8

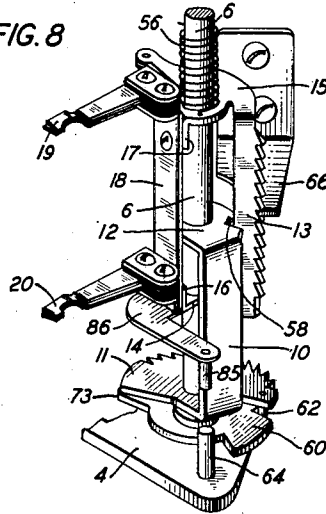


FIG. 9

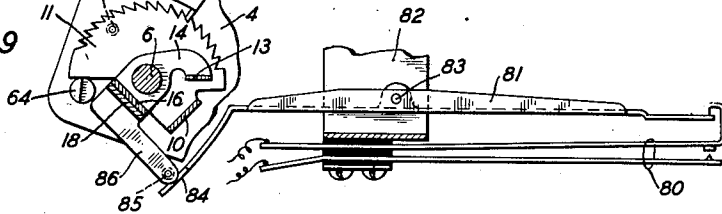


FIG. 10

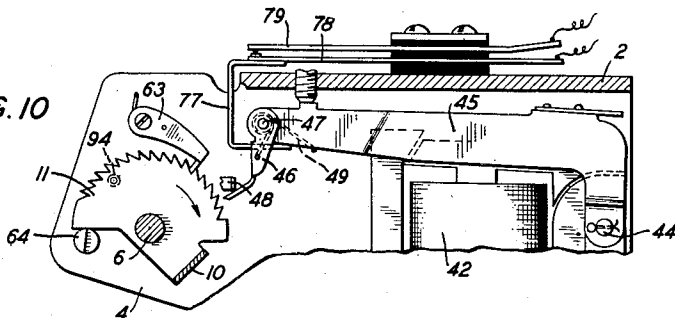
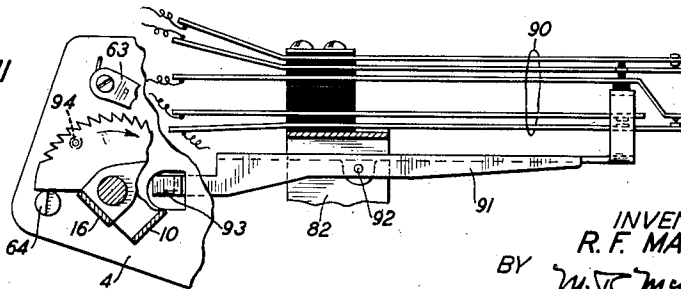


FIG. 11



INVENTOR  
R. F. MALLINA  
BY *W. T. McKenney*

ATTORNEY

**Nov. 28, 1944.**

R. F. MALLINA

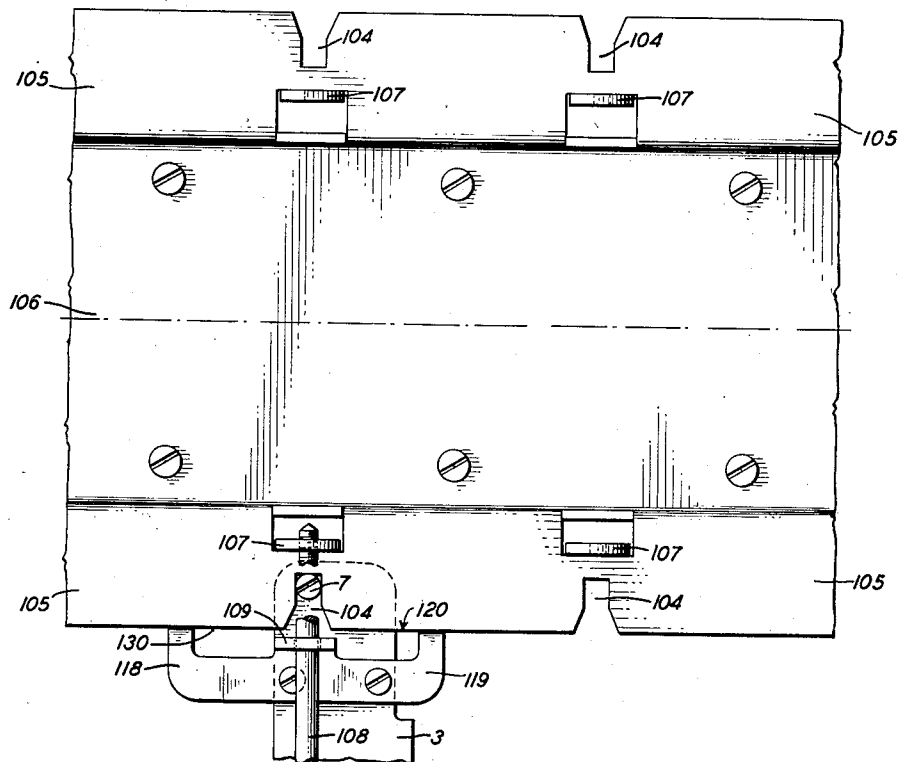
**2,363,683**

## SWITCHING MECHANISM

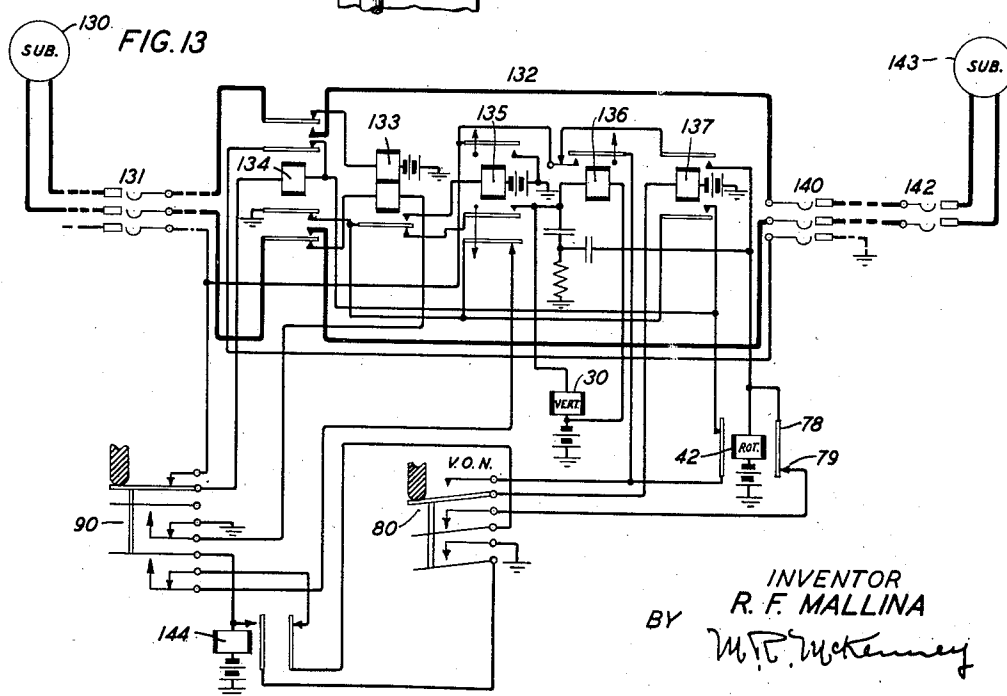
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**FIG.12**



**FIG. 13**



INVENTOR  
R. F. MALLINA  
BY *W. T. McKenney*

ATTORNEY

## UNITED STATES PATENT OFFICE

2,363,683

## SWITCHING MECHANISM

Rudolph F. Mallina, Hastings on Hudson, N. Y.,  
assignor to Bell Telephone Laboratories, Incorporated,  
New York, N. Y., a corporation of New York

Application December 31, 1942, Serial No. 470,749

7 Claims. (Cl. 179—27.52)

This invention relates to switching mechanisms and particularly to such mechanisms for use in automatic telephone systems.

It is an object of the invention to simplify the construction of switching mechanisms of this kind to reduce the size and to permit the mechanism to be operated at a high speed.

Heretofore switches have been used of the so-called step-by-step type in which wipers are arranged to contact with terminal banks by being advanced in steps in a vertical direction to select a horizontal row of terminals and then advance in steps in a rotary direction to engage a particular set of contacts in the selected row. Switches of this kind may be provided with a carriage structure in which the wipers are mounted. This carriage is mounted on a vertical shaft and provided with a toothed rack engaged by a stepping pawl operated by a magnet to raise the carriage and wipers to the desired row of terminals and provided with a ratchet wheel engaged by a stepping pawl operated by a magnet to advance the carriage and the wipers in a rotary direction. To hold the carriage in advanced vertical position a holding pawl is provided for the rack. When the rack is rotated it is held by a fixed holding plate engaging a tooth in the rack and to hold the carriage in an advanced rotated position a holding pawl is provided for engagement with the teeth in the ratchet wheel. The return of the carriage and wipers to normal may be accomplished by advancing them in the rotary direction to a last position where the rack will leave the holding plate and drop until the carriage and wipers are fully returned vertically and then having the carriage engage the rotary holding pawl to release the ratchet wheel for the return of the carriage and wipers to normal position under tension of a spring.

The present invention relates to this latter type of switching mechanism and one feature relates particularly to arrangements for releasing the carriage and wipers to normal. This arrangement is such that as the carriage is advanced to the last position in a rotary direction for release, a pawl provided on the carriage engages a vertical guide bar so that when the carriage drops this pawl and guide bar serve as a holding means for holding the carriage in this advanced rotary position until it has been completely returned vertically.

Another feature is an arrangement of a cam controlled by the ratchet wheel when rotated to the last position to disengage the holding

pawl from the ratchet wheel and thus permit the rotary release movement to begin immediately after the carriage has been fully returned in the vertical direction.

5 An advantage of this arrangement of releasing is that the carriage is freed for release rotary at the same time that it is freed for release vertically and thus as soon as the vertical release has been completed the rotary release begins which arrangement permits the return of the mechanism to normal with an increased speed.

Another feature is an arrangement of a switch of this kind in which all the moving parts, such as the carriage, wipers and operating pawls and the magnets and armatures for actuating these pawls are mounted in a bracket which may be mounted on a frame containing the terminal banks in a position where the wipers will engage the terminals accurately when operated, and securely fastened in said position merely by a single hand-operated screw. This feature is carried out by having a projection below the lower side of the bracket engaging an aperture in the frame and having the upper end of the shaft extending above the upper side of the bracket and engaging a slot in the frame to secure the carriage in its proper position in front of the frame in a vertical position and having projections on the upper member of the bracket engaging the frame on either side of the slot to prevent the bracket from turning on the shaft and having a single hand-operated screw mounted on the bracket on the upper member thereof and screwed into a hole in the frame above the slot therein to tighten and hold the bracket and its mechanism securely and accurately in place.

The invention has been illustrated in the accompanying drawings in which:

Fig. 1 shows a side view of the switching mechanism mounted on a frame containing the terminals arranged in accordance with the applicant's invention;

45 Fig. 2 is a top cross section of this mechanism and frame taken on line 2—2 of Fig. 1;

Figs. 3 to 6 are enlarged views showing various positions taken by the ratchet wheel in the operation of the mechanism;

50 Fig. 7 is a fragmentary cross section taken on line 7—7 of Fig. 1 with the carriage advanced to the last rotary position;

Fig. 8 is a fragmentary perspective of the wipers and carriage on the mounting shaft;

55 Figs. 9, 10 and 11 show various spring con-

tacts operated during the operation of the mechanism, such as vertical off-normal contacts, rotary pulsing contacts and last step rotary contacts;

Fig. 12 is a fragmentary top view of the terminal frame and a stepping mechanism; and

Fig. 13 shows a circuit diagram for operating this stepping mechanism as a selector.

Referring now to the drawings, the wipers, carriage and operating magnets and pawls are all mounted on a bracket member 1 consisting of a vertical back or side portion 2, a horizontally located top member 3, a horizontal bottom member 4 and an intermediate right angle projection 5 extending from the back member 2. On this bracket or frame between the members 3 and 4 is mounted a shaft 6 the upper end of which is secured to the member 3 by means of a screw 7. This screw extends with its head above the member 3 as is shown in Fig. 1. The lower end of the shaft is mounted in a sleeve or bushing 8 extending below the lower surface of member 4. On the shaft 6 is mounted a wiper carriage which consists of a bracket portion 9 terminating at the bottom in the horizontally located ratchet wheel 11 and at the top in the angular projection 12, through which two parts the shaft extends. Parallel with the shaft 6 is a rack 13 bent at the bottom into horizontal part 14 and at the top into a similar horizontal part 15, through which two parts the shaft 6 extends. The part 14 is provided with a right angle projection 16 and the part 15 is provided with a right angle projection 17 which projections are connected together by a bar 18. On this bar 18 is mounted an upper set of wipers 19 and a lower set of wipers 20. Wipers 19 are arranged for connection with sleeve terminals and wipers 20 with tip and ring terminals in the respective banks 21 and 22. Engaging a tooth on the rack 13 is a holding pawl 25 which is mounted on frame member 1 while a stepping pawl 26 for the rack is mounted on an armature 27 which is pivoted at 28 to the yoke piece 29 for a magnet coil 30. The yoke piece 29 is mounted on a bracket 32 secured to the member 2 and to hold the armature in its lowermost position normally a spring 33 is secured to the armature 27 and adjusted by means of a screw 35 in a bracket 36 secured to the frame member 2. Pawl 26 is normally held in engagement with a stop member 37 by means of a helical spring 38 mounted on the pivotal pin 40 and when magnet 30 is energized its armature 27 will therefore advance the pawl 26 to engage a tooth in rack 13 to raise it one step. The rack will be held in this advanced position by the holding pawl 25. To regulate the stroke of pawl 26 a back stop 41 is provided and mounted on frame member 5.

Mounted on the lower member 4 of the frame is a magnet 42 by means of the yoke piece 43. To this yoke piece is mounted on pivot 44, the armature 45 at the end of which is mounted an operating pawl 46 on a pivot 47. This pawl is held against the stop 48 by means of a helical spring 49 mounted on the pivot 47. When the armature 45 is attracted by magnet 42 pawl 46 will engage the ratchet wheel 11 and rotate it one step. To regulate the stroke of the pawl 46 a back stop 50 is provided. To maintain the armature 45 in its normal position a spring 52 is attached at one end to the armature and at the other end is engaged by the screw 53 to regulate its tension. This screw is turnable in

lugs 54 mounted on the lower frame member 4.

Surrounding the shaft 6 at its upper end is a helical spring 56 one end of which is secured to the frame member 3 at the top and at the lower end secured to the projection 15 of rack 13 so that when the rack has been lifted the spring will to some extent help in returning it to normal in the vertical direction and also when the ratchet wheel is free for rotation back to normal this spring will furnish the moving power for this purpose. The rack 13 engages a slot in the upper angular projection 12 of the bracket member 10. This slot is marked 58 in Fig. 3, the only figure in which it is clearly shown. Therefore, when the ratchet wheel 11 rotates the rack 13 will rotate with it, while being free to move in a vertical direction in the slot 58. Between the ratchet wheel 11 and the sleeve 8 is mounted a cam member 60 which normally stands in the position shown in Fig. 3, as it is held in this position by pin 62 projected downwardly from the ratchet wheel 11. Associated with the ratchet wheel 11 and mounted on the lower member 4 is a spring-tensioned holding pawl 63 normally engaging a tooth in the ratchet wheel 11.

Referring now to Figs. 1 to 8 in particular, a description will be made of the operation of the mechanism so far described. When the magnet 30 is energized the armature 27 causes pawl 26 to engage the rack 13 and raise this rack and wipers 19 and 20 one step, while the holding pawl 25 maintains the rack in this advanced position. This operation may be repeated until the desired level of terminals is reached. Then the magnet 42 is operated to cause its armature 45 and pawl 46 to engage a tooth in the ratchet wheel 11 which is then advanced one step from the normal position determined by a stop pin 64 (Fig. 3) engaging the ratchet wheel 11 in this normal position. This operation may then be repeated until the wipers have been advanced to a particular set of terminals in the selected level. The ratchet wheel 11 is held in the operated positions from tooth to tooth by means of the holding pawl 63. As stated the rack 13 rotates with the ratchet wheel 11. Thus on the first rotary step the rack 13 will leave the holding pawl 25 but a tooth in this rack will now be engaged by the holding plate 66 so as to maintain the rack and wipers in the elevated position.

The switch remains now in this position until it is desired to release it to normal position and a description of the operations to release the switch will now be made. When it is desired to release this connection the magnet 42 is again energized to cause the armature 45 and pawl 46 to advance the ratchet wheel 11 to a position where the wipers are placed beyond the last set of terminals in the selected row. In this case it would be at the eleventh step of the magnet and ratchet wheel. At this time the tooth in rack 13 that engages the holding plate 66 has been shifted beyond this plate as shown in Figs. 7 and 8 and is thus free to restore to its normal position in the vertical direction. However, to hold the rack and wipers in this advanced rotary position while they descend vertically two operations take place. One is that a pawl 69 on the projection 15 of the rack 13 has now passed a vertical holding plate 70, secured to the member 5 of the frame, so that the hook-shaped end of this pawl will now under tension of spring 71 engage the plate on the front side looking at Fig. 1 and hold the rack and wipers in this po-

sition. The spring 71 is attached at one end to an extension on pawl 69 and at the other end to the projection 15. The second operation that takes place is that the pin 62 on the ratchet wheel 11 will engage one edge of the cam 60 and rotate this cam in a clockwise direction until it takes the position as shown in Fig. 5 where it is stopped by pin 64. When this takes place the cam portion 73 at the opposite side of the cam will engage the holding pawl 63 and cause it to release the ratchet wheel 11. Under these circumstances therefore the ratchet wheel is now ready to return to its normal position from the rotary movement but is prevented from doing this by the pawl 69 engaging the plate 70 until the rack 13 has returned fully in its vertical direction. When this position is reached the pawl 69 will slip off the lower end of the plate 70 and thus permit the ratchet wheel 11 with rack 13 and the wipers to return to normal position under the tension of spring 6. This position is shown in Fig. 3. It will be noted as shown in Fig. 6 that just prior to the return of wheel 11 completely to the normal position the pin 62 will again engage the cam 60 at the point 75 and thus rotate the cam in the counter-clockwise direction to remove the projection 73 from the pawl 63 and thus permit this pawl to be restored at the same time as the ratchet wheel 11 is restored to normal as shown in Fig. 3. Fig. 4 shows the position of the ratchet wheel in an intermediate advanced position before it has been rotated fully to the eleventh position. Thus it will be seen that the restoring of the mechanism may take place with the least possible delay at the moment the ratchet wheel has been rotated to the eleventh position as both the rack 13 and the ratchet wheel 11 are freed from their holding means, rack 13 from the plate 66 and the ratchet wheel 11 from the holding pawl 63 so that on the return vertically of the rack the rotary return may immediately begin without having to wait for the release of the ratchet wheel 11 from its holding pawl.

The rotary magnet 42 may be operated by circuits closed through self-interrupting contacts by an arrangement of such contacts as shown in Fig. 10 particularly. That is, each time the armature 45 is operated it will engage a projection 77 extending from spring 78 to have the spring open its connection with a spring 79. Other spring contacts may also be provided, for example, vertical off-normal springs 80 as is shown in Fig. 9. These springs may be closed by a lever 81 located under member 4 of the frame and connected to a bracket 82 at a point 83. The opposite end of this lever 81 is provided with an upwardly extending projection 84 which is normally engaged by a pin 85, extending downwardly from an angular extension 86 on the member 18 of the carriage. When therefore the rack 13 is lifted this pin 85 releases the projection 84 permitting the lever 81 to rotate looking at Fig. 9 in a clockwise direction to permit the springs 80 to close, the upper one of these springs being under tension for this purpose. Then when the rack is returned to normal in the vertical direction and the ratchet wheel 11 returns it in a rotary direction, the pin 85 will engage projection 84 from the left-hand side thereof and return it to normal to open the springs 80. A somewhat similar arrangement is provided for other springs as shown in Fig. 11 which are operated on the last rotary step of the ratchet wheel 11. These springs are shown in Fig. 11 at

90 and may be operated by a lever 91 pivoted at 92 in the bracket 82. The opposite end of this lever 91 is bent upward and then towards the left into an end piece 93 looking at Fig. 11 and extends through an opening in the member 4 of the frame. This end piece 93 is engaged by pin 94 on the ratchet wheel 11 when the ratchet wheel takes the eleventh step to rotate the lever 91 to operate contacts 90.

This mechanism as hereinbefore described for operating the wipers to select a particular set of terminals and be returned to a normal position is arranged in a very compact manner inside the members 2 to 5 of frame 1. This unit may therefore be easily and speedily associated with the terminal banks 21 and 22 to accurately place the wipers in position for engagement with the terminals in these banks by a simple arrangement which will now be described. It should be noted that the sleeve 8 extends slightly below the plate 4 and may be engaged in an opening 100 in a projection 101 from the lower plate 102 of the terminal bank assembly and that the screw 7 engages the slot 104 in projection 105 on the upper plate 106 of the terminal bank assembly. This projection 105 has the angular cut-out projection or member 107 in which the screw 108 may be secured. This screw is mounted in openings in the brackets 109 and 110 and has a knob 111 at its right-hand side looking at Fig. 1 which when the screw is fully inserted in the projection 107 has its shank or hub 112 engaging the outer surface of the bracket 110. A holding ring or enlargement 115 is provided on the screw 108 to prevent it from falling out from its bearing brackets 109 and 110 when not inserted in the projection 107. It should be observed that in order to mount this mechanism on the terminal assembly between the members 101 and 105 the mechanism is first arranged so that the sleeve 8 engages in the hole 100 and then the mechanism is tilted or advanced so that the screw 7 enters the slots 104. When this is done the screw 108 is inserted in projection 107 and screwed in by turning by hand the knob 111 and tighten it to securely press the mechanism in place. This positions the shaft 6 in proper relation to the terminal banks so that one vertical step of the wipers will place them opposite the first level of terminals. To position the wipers accurately so that one step in a rotary direction will place them on a first set of terminals, members 118 and 119 are provided. These members extend in opposite directions from the bracket 109 and engage the outer edge 120 of the projection 105. By accurately positioning these members 118 and the edge 120 and accurately gauging the size of the sleeve 8 in the hole 100 as well as the width of the slot 104 and the size of the screw 7 the mechanism may therefore be accurately placed in position where the wipers will engage the terminals properly when raised and rotated.

As shown in Fig. 12 in particular, the arrangement of these operating mechanisms in relation to the terminal banks may be such that a plurality of mechanisms may be mounted in rows on opposite sides of the bank assembly, that is, the terminals may be duplicated in rows on opposite sides in the frame members 106 and 102 which may extend to accommodate a considerable number of switching mechanisms.

In Fig. 13 a circuit arrangement has been shown for telephone systems in which applicant's switch may be incorporated and the part of the circuit in which the mechanism serves as a selec-

tor has been shown in detail. A description of this circuit will now be made.

A calling subscriber's station indicated at 130 terminates in a line finder 131 which may be operated in any well-known manner to establish a connection to the selector circuit 132. When this connection is established, a circuit is completed for the operation of relay 133 from battery through the upper winding of this relay, contacts of relay 134, over the tip conductor, line finder 131 and the subscriber's loop back over the ring conductor, line finder, contacts of relay 134 and the lower winding of relay 133 to ground at the eleventh step contacts 90. Relay 133 closes an obvious energizing circuit for relay 135 and the subscriber may now dial the first digit of the desired number and thereby cause the repeated operation and release of relay 133. Relay 135 remains operated during this pulsing. On the first release of relay 133, a circuit is completed for the vertical magnet 30 from battery through the winding of this magnet, contacts of relays 135, 133 and 134 to ground. Relay 136 is also operated from battery through the winding of this relay, contacts of relays 135, 133 and 134 to ground. Relay 136 remains operated during the pulsing. After the first step of the vertical magnet, the vertical off-normal contacts 80 are closed and a circuit is completed for the operation of relay 137 from battery, winding of this relay, vertical off-normal contacts 80, contacts of relays 136 and 135 to ground. Relay 137 is locked over a circuit from battery through the winding of this relay, vertical off-normal contacts 80, contacts of the rotary magnet 42, contacts of relays 137 and 134 to ground. When this digit has been dialed and relay 136 releases as well as the vertical magnet 30, a circuit is completed for the rotary magnet 42 from battery, winding of this magnet, contact of relays 137, 136, 135 to ground. The rotary magnet opens the locking circuit for relay 137 which now releases causing the release of the rotary magnet 42. If the brushes 140 of the selector land on terminals of a busy connector circuit which has been indicated diagrammatically at 142, a ground will be present on the sleeve terminal of the connector. Thus a circuit will be completed for the reoperation of the relay 137 from battery through the winding of this relay, vertical off-normal contacts 80, contacts of rotary magnet 42, contacts of relay 134 to this ground on the sleeve terminal. Relay 137 closes a circuit for the rotary magnet which now operates and causes the release of relay 137 which releases the rotary magnet 42 and the brushes 140 are then stepped to the terminals of the next connector. These operations are repeated until an idle connector circuit is found when relay 134 will operate from battery, winding of relay 137, vertical off-normal contacts 80, contacts of magnet 42, winding of relay 134, contacts of the eleventh step rotary contact 90 to ground at contacts of relay 135 or on the sleeve to the line finder 131. Relay 137 does not operate in this circuit. Relay 134 in operating, opens the circuit for relay 133 and connects the tip and ring conductors through to the connector. Relay 133 releases and causes the release of relay 135. The connection is now extended over the connector 142 to the called subscriber's line indicated at 143 and conversation between the subscribers 130 and 143 may now take place. When the calling subscriber hangs up to release the connection, the ground on the sleeve of the line finder 131 is removed and relay 134 is released.

On the release of this relay the release of the selector will be initiated by a circuit for the rotary magnet 42 from battery, the winding of this magnet and the self-interrupting contacts 78 and 79, vertical off-normal contacts 80, contacts of relay 144, eleventh step rotary contacts 90, contacts of relays 135 and 134 to ground. The rotary magnet 42 will not alternately operate and release due to the self-interrupting contacts 78 and 79 opening and closing its circuit. When the rotary magnet has advanced the wipers and the rack 13 to the eleventh position, the contacts 90 will be actuated. These contacts then will close a circuit for the relay 144 from battery through the winding of this relay, contacts 90, contacts of relays 135 and 134 to ground. This relay 144 will then lock over an obvious circuit through the vertical off-normal contacts 80. The contacts 90 as well as the contacts of relay 144 are now opened to open the circuit for the rotary magnet 42 so as to discontinue the operation of this magnet and in accordance with the description heretofore made, the rack and wipers will return to the normal position vertically and when in this position the vertical off-normal contacts 80 will be restored opening the locking circuit for relay 144 which is released. The contacts 90 will, of course, be restored to normal position when the rotary return of the ratchet wheel 11 begins.

What is claimed is:

1. In a switching mechanism, a brush carriage mechanism, means for operating said carriage to lift it and then rotate it to a desired position including a horizontal stationary member engaged by said carriage to retain it in its lifted position during its subsequent rotary movement and a pawl engaging said carriage to retain it in its rotated position, means operative in response to the rotation of said carriage to a certain advanced position for releasing said carriage from the stationary member and the rotary retaining pawl simultaneously to return it from the lifted position and then immediately to return it from the rotated position, said means including a vertical stationary member and a pawl engaging it to guide the carriage during the vertical return movement and a cam operative to free the carriage from the rotary retaining pawl.

2. In a switching mechanism, a vertical shaft, a ratchet wheel mounted on said shaft, a brush carriage mounted on said shaft and arranged to rotate with said ratchet wheel but being free to move longitudinally upon said shaft and having a vertically located toothed bar, means for moving said carriage vertically in steps through the medium of said toothed bar, means for moving said carriage in a rotary movement in steps through the medium of said ratchet wheel, means for holding said carriage in the position to which it has been moved vertically during the subsequent rotary movement and through the medium of said toothed bar, means for holding said carriage in the position to which it has been moved in a rotary direction through the medium of said ratchet wheel, means operative by said ratchet wheel when advanced to a certain position for releasing said ratchet wheel from said holding means, means operated by said carriage when rotated to said certain position for preventing it from rotating back to normal, said carriage being arranged when advanced to said certain position for freeing the toothed bar from the means that held it in its vertical advanced position and thus return it to its vertical normal position and on its return to said position freeing itself from



the means that held it in said certain position in the rotary direction and thus return it to its rotary normal position.

3. In a switching device, a brush carriage including a vertical toothed bar and a horizontal ratchet wheel, means for operating said carriage to lift it through the toothed bar and rotate it through the ratchet wheel, a horizontal plate engaging said toothed bar when the carriage is being rotated to retain the carriage in its lifted position, a retaining pawl engaging said ratchet wheel to retain the carriage in its rotated position, a pawl on said carriage and a stationary vertical rib cooperating when the carriage has been rotated to a certain advanced position where the toothed bar is freed from the horizontal plate for guiding said carriage on its return to normal in a vertical direction, a cam controlled when the carriage has been rotated to said certain advanced position for freeing the ratchet wheel from said retaining pawl, to permit the carriage to return to normal position in the rotary direction after it has returned in its vertical direction.

4. In a switching mechanism, a bank of terminals, an upper and a lower mounting plate for said bank, a frame, a brush carriage in said frame, means in said frame for advancing said brush carriage to cause its brushes to engage terminals in said bank, a projection on said frame engaging an aperture in said lower mounting plate, a projection on said frame engaging a slot in said upper mounting plate, a screw having a knob and mounted in said frame so that said screw when rotated by said knob may be secured into a threaded hole in the upper mounting plate to hold the frame securely to the mounting plate, and a guide member on said frame to accurately place the frame in position on the mounting plates so that the brushes of said carriage are placed in position to accurately engage the terminals in said bank when said carriage is moved.

5. In a switching mechanism, a bank of terminals, an upper and a lower mounting plate for said bank, a frame, a brush carriage in said frame, means in said frame for actuating said brush carriage to cause its brushes to engage terminals in said bank, means for mounting said frame in position between said plates to accurately place the brushes of said carriage to correctly engage the terminals of said bank when the carriage is moved, said means including a projection on the frame engaging an opening in one of said plates and another projection on said frame engaging in a slot in the other plate and a single hand-operated screw to secure the frame to the plates.

6. In a switching device, a brush carriage in-

cluding a vertical toothed bar and a horizontal ratchet wheel, a spring for holding said carriage in a normal position, means for operating said carriage to lift it through the toothed bar and rotate it through the ratchet wheel against the tension of said spring, a horizontal plate engaging said toothed bar when the carriage is being rotated to retain the carriage in its lifted position, a retaining pawl engaging said ratchet wheel to retain the carriage in its rotated position, a pawl on said carriage and a stationary vertical rib cooperating when the carriage has been rotated to a certain advanced position where the toothed bar is freed from the horizontal plate for guiding said carriage on its return to a normal position in a vertical direction under tension of said spring, a cam operated by the ratchet wheel when advanced to said certain position to disengage said retaining pawl for freeing said ratchet wheel so that when the carriage has been returned to its normal position in the vertical direction, the carriage will be free to return to its normal position in the rotary direction under tension of said spring.

7. In a switching mechanism, a frame comprising an upper and a lower mounting plate, said plates being located in parallel relation to each other, terminals mounted between said plates and arranged in groups so as to protrude for contacting purposes on opposite sides of said plates, a series of switch frames, each being located between said mounting plates and of the same width as the distance between these plates, each switch frame being located opposite a particular group of terminals, a carriage with wipers mounted on each switch frame and means in each switch frame for actuating said carriage to cause the associated wipers to engage the associated group of terminals, means for mounting each switch frame in position on said plate so as to accurately place the wipers when moved in engagement with the associated terminals, said mounting means comprising a lower projection on said switch frame fitting tightly in an opening in the lower plate and a similar upper projection on said switch frame fitting tightly in a slot in said upper plate, a screw mounted on the upper side of the switch frame arranged to be screwed into said upper plate to securely fasten the switch frame to said plates and guide members on the sides of said switch frame engaging the upper plate, said projections, opening, slot and guide members being so fitted and cooperating that the wipers when moved will accurately engage the associated terminals.

RUDOLPH F. MALLINA.