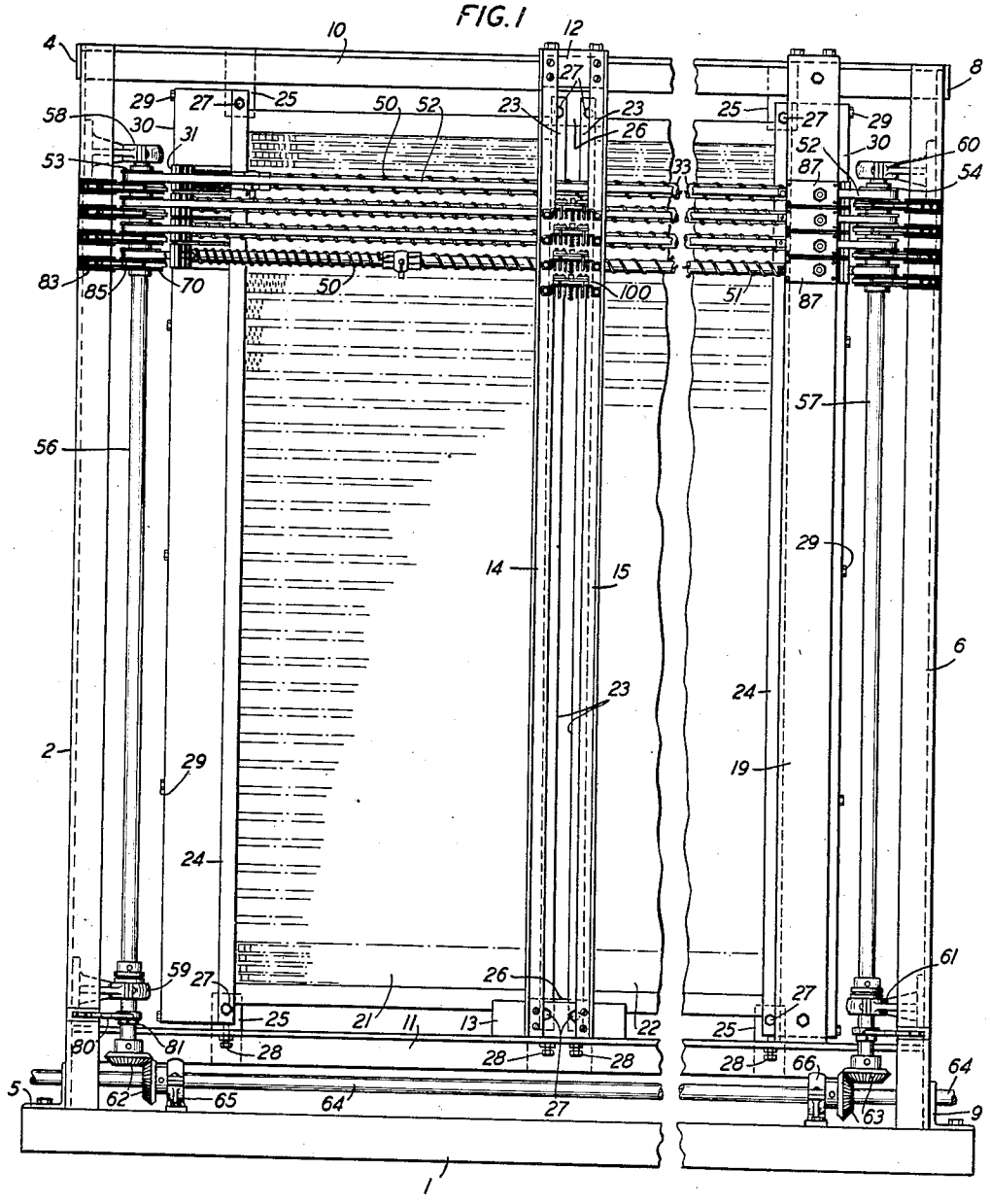
July 12, 1938. W. W. CARPENTER 2,123,228

SELECTOR SWITCH

Filed March 31, 1937 3 Sheets-Sheet 1

FIG. 1



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SELECTOR SWITCH

Filed March 31, 1937 3 Sheets-Sheet 2

FIG. 2

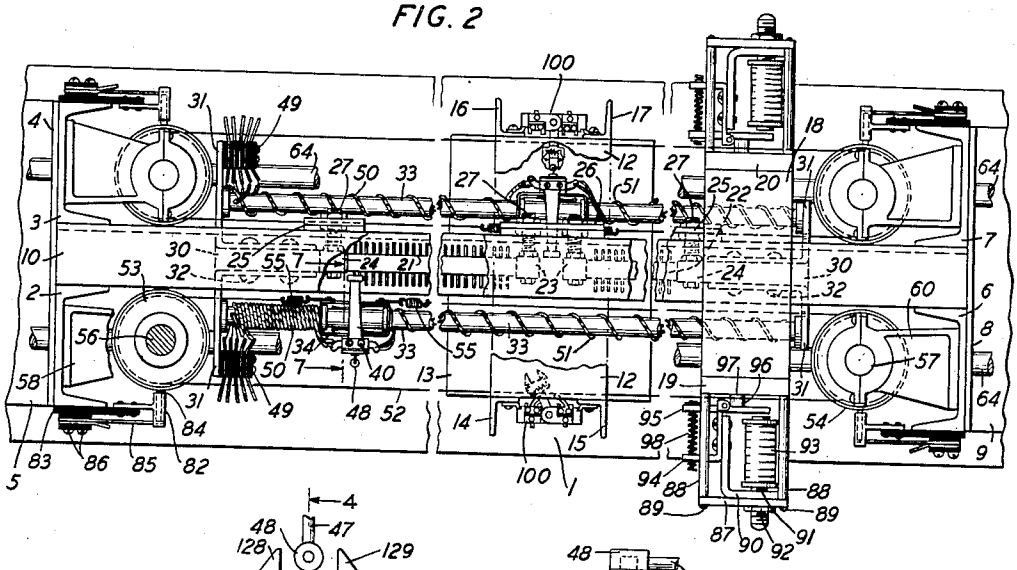


FIG. 3

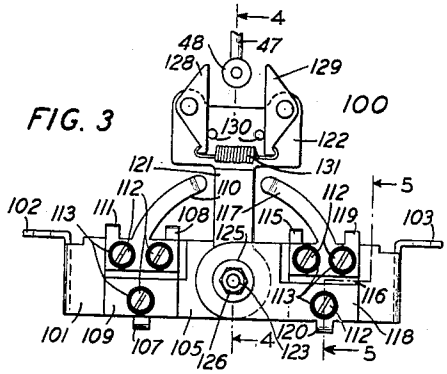


FIG. 4

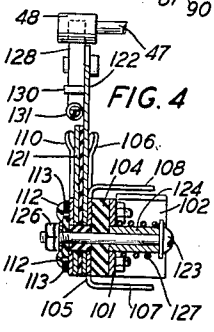


FIG. 5

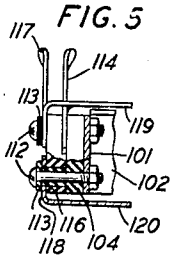


FIG. 6

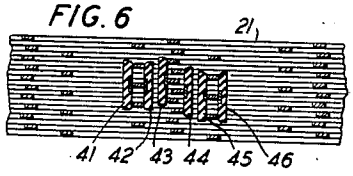


FIG. 7

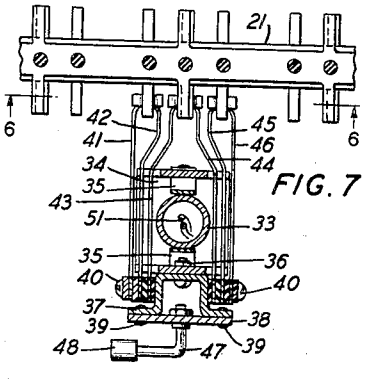
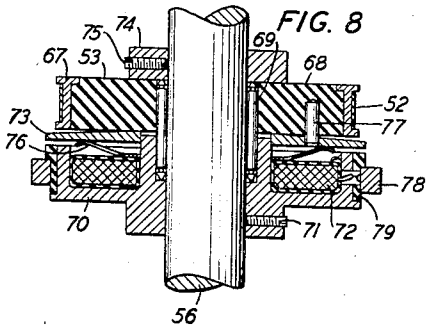


FIG. 8



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SELECTOR SWITCH

Filed March 31, 1937 3 Sheets-Sheet 3

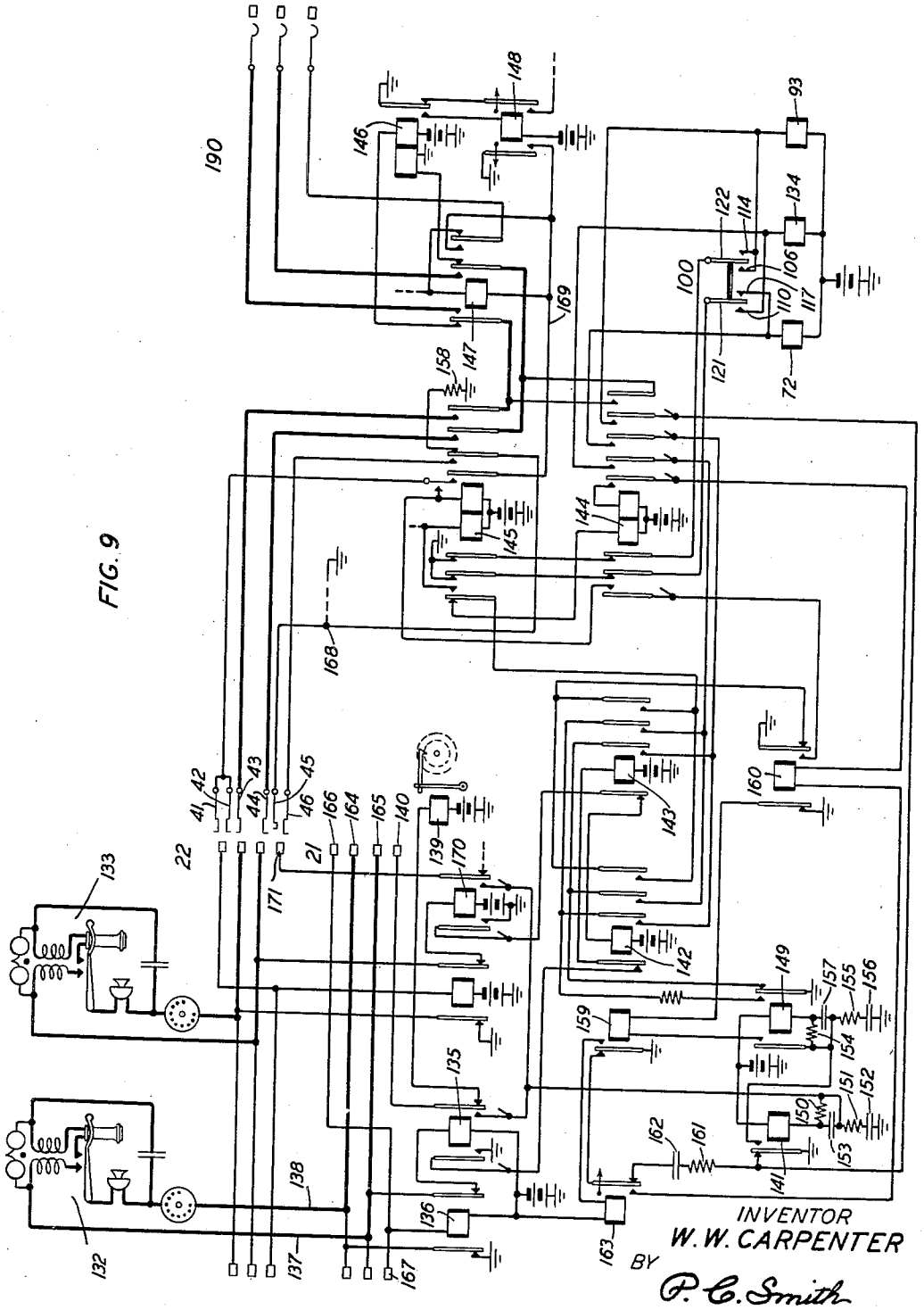

FIG. 9

Patented July 12, 1938

2,123,228

UNITED STATES PATENT OFFICE

2,123,228

SELECTOR SWITCH

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Application March 31, 1937, Serial No. 133,969

18 Claims. (Cl. 179—25)

This invention relates to selector switches applicable for use in machine switching telephone systems and more particularly to switches of the terminal hunting type having access to large groups of line or trunk terminals.

In machine switching telephone systems selector switches, either of the step-by-step or power driven panel type, are used extensively as line or trunk finders and in some systems as trunk finders at selection stages under the control of controllers or markers. Heretofore such switches have been limited in their speed of operation by their inherent physical characteristics; in the case of step-by-step type switches, by the speed at which the stepping mechanism can be operated without undue wear and vibration and in the case of power driven switches of the panel type, by the speed at which the brushes may be stopped and accurately centered by the commutators on the desired set of bank terminals.

For example, the panel type line finder now widely used, employs ten sets of brushes mounted on a single elevator rod, the ten brush sets having access to ten banks of terminals in which subscribers' lines terminate. With this construction it is necessary that the distances between the brush sets on the elevator rod and the distances between terminals in the banks be in accurate relationship thus increasing the cost of manufacture and assembly. Each line finder is also equipped with a stationary commutator with which brushes mounted on the elevator rod engage for making electrical connections between the brush sets and outside wiring and for controlling the stopping of the hunting movement of the switch when one of the brush sets engages the terminals of a calling line. Since the accurate centering of a brush set upon the terminals of a calling line is dependent upon the commutator, it is therefore essential that the commutator be constructed and assembled on the switch with its segments in accurate relationship with the terminals of the bank. Furthermore, since the total mass of the switch to be accelerated and decelerated comprises the elevator rod, the ten brush sets, the commutator brushes and the wiring between the brush sets and commutator brushes, the energy necessary for starting and stopping the movement of the switch is such that the hunting speed must be kept low or at approximately forty terminals per second. It is customary to mount the ten panel banks upon a single frame and to assemble thirty elevators on the frame on each side of the double-faced bank. A unit of this type is too large and heavy for shipment as an entirety and therefore it is necessary to partially disassemble the unit before shipment and to reassemble it at the place of installation thus further adding to the cost.

Since the central office equipment for machine switching systems is expensive it is particularly essential, therefore, that it be used with the utmost efficiency. If equipment is slow in operation, a larger amount of equipment must be installed to handle peak loads than would be the case if equipment of a faster operating type were available, thus increasing the first cost of installation and increasing the carrying charges and cost of maintenance. Furthermore, it is essential that connections shall be established between subscribers' lines and central office equipment as speedily as possible to guard against the possibility of wrong connections should subscribers start dialing within a short interval after the removal of their receivers from the switchhooks.

It is therefore the object of the present invention to provide a switch of the hunting type which may be driven at a high terminal hunting speed, which has a small mass to be accelerated and decelerated whereby small energy is required for its operation, which makes provision for the accurate centering of a brush set on a set of bank terminals which has been placed in a calling condition without the use of a centering commutator and which is economical to manufacture, assemble and maintain.

A further object of the invention is to provide a switch which may be used in any type of machine switching system where line finders, trunk finders or marker controlled selectors of the hunting type may be employed.

In accordance with the present invention these objects are attained by providing a line-finder frame capable of accommodating the customary sixty finder switch units. Two banks of the same general type as are commonly used on the well-known panel type switch frame are mounted vertically thereon side by side, each bank being provided with one hundred sets of vertically disposed multiple terminal strips, each strip having multiples for accessibility from thirty finder switch units on each side of the banks. By the provision of the two banks of one hundred terminal sets each, two hundred lines, trunks or links may be terminated thereon.

Mounted horizontally on each side of the frame in front of the thirty horizontal rows of two hundred terminal sets of the two banks are thirty finder switch units. For operating the thirty finder switch units on one side of the frame, two

oppositely rotatable vertical drive shafts are provided, one at each end of the frame. Two similar drive shafts are provided for operating the thirty switch units on the opposite side of the frame.

Each switch unit comprises a single brush set of three or more brushes mounted on a light carriage slidable on a tubular guide rod secured at its opposite ends to brackets attached to the outside edges of the faces of the bank, the outside connections to the sleeve brush being made by springs which slide on the guide rod and the outside connections to the other brushes being made by flexible insulated lead wires coiled around the rod on either side of the brush carriage. The brush set is traversed along the row of bank terminals to which it is individual by a steel tape which runs over two pulleys or flanged drums mounted for free rotation on the two vertical drive shafts, respectively. The ends of the tape are secured to the brush carriage by coiled springs which function to tension the tape and to act as shock absorbers when the movement of the tape is abruptly arrested.

Each driving pulley may be clutched to the driving shaft on which it is mounted by a magnetic clutch of the "pot" type, the core of the clutch magnet being keyed to the driving shaft and the armature of the magnet being connected to the associated pulley by a driving pin secured to the pulley and loosely engaging with the armature. Normally when the clutch magnet is not energized, the armature is held away from the periphery of the magnet core by a spring leaving a small air-gap between the core and the armature thereby eliminating friction. When the clutch magnet is energized the armature is attracted and the pulley is driven thereby in the rotational direction of the driving shaft.

To insure a quick stopping of the tape and brush carriage attached thereto a magnetically releasable brake is provided. The brake includes two cooperating brake shoes, one on either side of one traverse of the tape, one being fixed and the other secured to the armature of the brake magnet. The armature is normally operated by a spring to press the shoes together to embrace the tape, the leverage of the armature being such that the movement of the shoe attached thereto is very slight but that the braking force supplied by the spring is quite large.

The brake magnet winding is arranged to be energized simultaneously with either one of the clutch magnets of the switch unit so that when either one of the clutch magnets is energized to traverse the tape in either direction the brake magnet is energized to attract its armature to release the brake.

The brush carriage is normally positioned at the mid-point between the two banks and when started in either direction operates a double throw normalling switch positioned on a mid-portion of the switch frame. This switch is instrumental in reversing the direction of travel of the brush carriage when the connection made by the switch unit is released and for stopping the carriage in its normal position.

Since the moving parts of the switch unit have very little mass, the brush carriage may be accelerated or decelerated rapidly and the switch is therefore capable of being operated with a very small amount of power at hunting speeds far in excess of those heretofore attained. In fact, a hunting speed of 250 terminals per second is easily attainable and a hunting speed of 400 terminals per second is possible.

To insure that the brush set when traversed at these high hunting speeds shall be stopped and accurately centered on a terminal set which has been marked in a calling condition, a particularly sensitive test circuit is provided. The test circuit comprises a test relay, the winding of which is normally connected in a charging circuit extending from battery through a first and a second resistance and a first condenser to ground, the first resistance being shunted by a second condenser. The relay starts to energize, but will not operate by the charging current, but the condensers both become charged. When, however, the grounded test brush engages a marked test terminal the condensers partially discharge and the relay is energized through the first resistance. If the test brush overruns the test terminal both condensers become further charged and the charging current now holds the relay operated until the charging current decays when the relay releases. The test relay upon operating stops the movement of the brush carriage and prepares circuits for driving it in the opposite direction. If the brush set has overrun the marked terminal set then when the test relay releases the brush carriage is driven back until the test brush again engages the marked set of terminals. Since the second condenser is now fully charged it offers a low resistance shunt around the first resistance and the test relay reoperates opening the drive circuit to arrest further movement of the brush carriage.

Although in the foregoing brief description of the invention the two terminal banks have been described as mounted vertically on the frame with the switch units mounted horizontally, it will be obvious that the banks could be mounted horizontally one above the other, with the switch units mounted vertically. It should be particularly noted that the entire frame with sixty switch units mounted thereon is very compact and occupies relatively small floor space and that due to the relatively light weight of each switch unit the entire frame may be assembled and wired at the factory and shipped ready for installation. Furthermore, the replacement of any switch unit may be readily and speedily accomplished.

For a more complete understanding of the invention and the mode of its operation reference may be had to the following detailed description taken in connection with the accompanying drawings of which:

Fig. 1 is a side elevational view of a switch frame embodying the invention showing some of the switch units installed thereon;

Fig. 2 is a top plan view of the switch frame;

Fig. 3 is a plan view of the normalling switch;

Fig. 4 is a sectional view of the normalling switch as viewed along section line 4—4 of Fig. 3;

Fig. 5 is a partial sectional view of the normalling switch as viewed along section line 5—5 of Fig. 3;

Fig. 6 is a sectional view of a portion of a terminal bank and brush carriage as viewed along section line 6—6 of Fig. 7;

Fig. 7 is a top plan view of a portion of a terminal bank and brush carriage as viewed along section line 7—7 of Fig. 2;

Fig. 8 is a sectional view of one of the driving pulleys and associated magnetic clutch; and

Fig. 9 is a circuit diagram illustrating the manner in which the improved switch may be used as a line finder in a telephone system of the step-by-step type.

Referring now to the drawings, the invention

will be described in more detail. Considering first Figs. 1 and 2, the switch frame comprises a base 1 on one end of which are secured two channel-shaped uprights 2 and 3 jointed at their upper ends by the strap 4 welded or otherwise secured thereto and joined near their lower ends by the angle bar 5 welded or otherwise secured thereto and by which the uprights are secured to the base 1. Similar uprights 6 and 7 joined by the strap 8 and angle bar 9 are similarly mounted in the other end of the base 1. The upper ends of uprights 2 and 3 are also joined to the upper ends of uprights 6 and 7 by the angle bar 10 welded or otherwise secured thereto. The lower ends of the uprights 2 and 3 are similarly jointed to the lower ends of uprights 6 and 7 by angle bar 11.

Bolted to the mid-point of the upper angle bar 10 is a channel member 12 having its flanges lying parallel to the bar 10 and extending downwardly. A similar channel member 13 is bolted to the mid-point of the lower angle bar 11 having its flanges extending upwardly. Four vertically extending angle bars 14, 15, 16 and 17, two on each side of the switch frame, are attached by screws to the flanges of members 12 and 13 for supporting the normalling switches of the switch units as will be hereinafter described.

Bolted to the upper angle bar 10 near its right end is a channel member 18 having its flanges lying parallel to the bar 10 and extending downwardly. A similar channel member is bolted to the lower angle bar 11 near its right end having its flanges extending upwardly. Two vertically positioned plates 19 and 20, one on each side of the switch frame, are attached by screws to the flanges of these channel members to afford support for the brake magnets of the switch units as will be later described.

Positioned side by side between the end members of the switch frame are two panel terminal banks 21 and 22. Each bank is of the general type disclosed, for example, in Patent 1,127,741 granted February 9, 1915 to A. F. Dixon, and comprises two vertical side members 23 and 24 between which one hundred sets of multiple terminal strips and insulating separators are clamped. The banks are secured to the angle bars 10 and 11 by straps 25 and 26 which are attached to the angle bars by screws and to the side members 23 and 24 of the bank by bolts 27. Each terminal strip is provided with thirty multiple terminals extending outwardly on each side of the bank and with a soldering terminal at each end whereby accessibility is afforded to sixty selector switch units, thirty on each side of the bank. The terminal strips are arranged in sets of four, as most clearly disclosed in Figs. 6 and 7, to which the tip, ring, sleeve and metering leads of a subscriber's line may be connected as disclosed in Fig. 9, although in some instances, as for example where the switch frame is to be used for other purposes, each set might comprise three terminal strips. The corresponding sets of multiple terminals on the several sets of strips in both banks are aligned horizontally and individualized to different selector switch units. To enable the alignment of the horizontal rows of terminal sets of one bank with the corresponding horizontal rows of terminal sets of the other bank, adjusting screws 28 are provided which extend through the lower angle bar 11 and engage beneath the side members 23 and 24 of the banks.

Secured to the side member 24 of each bank by lag screws 29 is a flat plate 30 to either face of which brackets 31 for supporting the tubular guide rod 33 of the selector switch unit are attached by the screws 32 as most clearly shown in Fig. 2. Slidable on each guide rod 33 is a brush carriage 34 having a rectangular frame, the ends of which slidably embrace the guide rod 33. Referring to Fig. 7 which shows the brush carriage in more detail, two spring fingers or brushes 35 are secured to the sides of the brush carriage frame and make sliding contact with the guide rod 33. Attached to the front side of the frame by bolt 36 is a channel member 37 to the out-turned flanges of which a plate 38 is secured by screws 39. Secured to the plate 38 is an angular trip rod 47 having an insulated tip 48 for a purpose to be later described.

Also secured to the flanges of channel member 37 by screws 40 are six brushes 41 to 46, inclusive. Brushes 41 and 42, which serve as sleeve brushes, engage the opposite edges of sleeve terminals of the bank, as shown in Fig. 6, and are conductively connected together at their fixed ends and through the screws 40 to the member 37 and thereby through the carriage frame and brushes 35 to the guide rod. The brush 43, which serves as a tip brush and engages the left edges of the tip terminals of the bank, as disclosed in Fig. 6, is insulated from the springs 41 and 42 and from the member 37. Brush 44 which serves as a ring brush and engages the right edges of the ring terminals of the bank and brushes 45 and 46 which serve as testing and metering brushes, respectively, and engage with the opposite edges of the metering or test terminals of the bank, as shown in Fig. 6, are insulated from each other and from the member 37. It is to be noted by reference to Fig. 6 that the contact area of the test brush 45 is narrower than the contact areas of the other brushes. Brushes 43 to 46, inclusive, are equipped with soldering lugs as most clearly disclosed in Fig. 2.

Mounted on the bracket 31 at the left end of the guide rod 33 is a terminal block 49 in which are insulatedly secured five soldering terminals to which outside wiring may be connected. One of the terminals is conductively connected to the guide rod whereby an electrical connection may be made to the sleeve brushes 41 and 42 and the other four terminals are connected by flexible insulated leads to the soldering lugs of brushes 43 to 46, inclusive. The two flexible leads which connect with brushes 43 and 44 are wound spirally around the guide rod 33 on the left side of the brush carriage 34, as indicated at 50, and the flexible leads which connect with brushes 45 and 46 extend through the tubular guide rod, are brought out through an opening in its wall near the right end thereof and are then wound spirally around the guide rod on the right side of the brush carriage and connected to the soldering lugs of brushes 45 and 46, as indicated at 51. By thus winding the leads spirally around the guide rod and providing a sliding connection from the sleeve brushes 41 and 42 to the guide rod, electrical connections from the terminals on block 49 to the brushes on the brush carriage are completed while permitting free sliding movement of the brush carriage in either direction along the guide rod.

For traversing the brush carriage along the guide rod a steel tape belt 52 is provided which runs over two driving pulleys or flanged drums 53

and 54 located adjacent to the end uprights of the switch frame. The two ends of the belt 52 are connected to the opposite ends of the brush carriage by spiral springs 55 which serve the dual purpose of tensioning the belt and of absorbing the the shock incident to starting and stopping the brush carriage. Two vertical drive shafts 56 and 57 are provided on the front side of the switch frame, the driving pulleys 53 of all thirty of the switch units mounted on the front of the frame being normally freely rotatable on shaft 56 and the driving pulleys 54 of the same switch units being normally freely rotatable on shaft 57. The shaft 56 is journaled in bearings 58 and 59 secured by screws, not shown, to the vertical upright 2 and the shaft 57 is similarly journaled in bearings 60 and 61 secured by screws, not shown, to the vertical upright 6. Corresponding drive shafts are similarly journaled in bearings secured to uprights 3 and 7 on which the driving pulleys of all thirty of the switch units mounted on the rear of the frame are normally freely rotatable.

The two vertical drive shafts 56 and 57 on the front of the frame are geared by beveled gears 62 and 63 to be rotated in opposite directions from a main horizontal power shaft 64 which is journaled in bearings 65 and 66 secured to the base 1 of the switch frame. A similar power shaft and gearing is also provided for rotating the vertical drive shafts on the rear of the switch frame.

For operatively coupling a driving pulley to the driving shaft upon which it is positioned a magnetic clutch is associated with each pulley. One of the pulleys 53 and associated clutch is illustrated in detail in Fig. 8. The pulley comprises a metal flanged rim 67 molded upon a core 68 of bakelite or other suitable insulating material. Mounted beneath the pulley is a magnetic clutch of the so-called "pot" type comprising a core 70 secured to the drive shaft 56 by the set screw 71, a magnet winding 72 enclosed within the core between the inner hub thereof and the outer peripheral pole-piece, and a disc-shaped armature 73. Interposed between the core 68 of the pulley and the shaft 56 and engaging within an annular recess in the hub of the core 70 are needle bearings 69 which enable the pulley 53 to rotate freely with respect to the shaft 56. For holding the pulley 53 and needle bearings 69 in proper relationship to the clutch, a collar 74 is secured to the shaft 56 immediately above the pulley by the set screw 75.

The armature 73, which is interposed between the pulley 53 and the pole-face of the peripheral pole-piece of the core 70, slidably engages the hub of the core 70 and is normally pressed away from the pole-face of the core by the spider spring 76 whereby a narrow air-gap is normally maintained between the armature and the pole-face of the core thereby eliminating friction between the rotating core and the armature. The armature is coupled to the pulley 53 by pin 77 embedded in the bakelite core 68 and slidably engaged in an aperture in the armature. Normally with the magnet winding 72 unenergized, the rotation of the shaft 56 and clutch core 70 carried thereby is without effect upon the pulley, but upon the energization of the winding 72 and the attraction of the armature 73 against the pole-face of the core 70, the armature is rotated with the core and through the pin 77 causes the rotation of the pulley 53.

One terminal of the winding 72 is conductively connected to the core 70 of the clutch and thereby to the shaft 56 and the other terminal is connected to a slip ring 78 which is mounted on the outer peripheral surface of the core 70 and insulated therefrom by the insulating ring 79. For conducting operating current to each clutch magnet winding a brush assembly individual to each clutch and a brush individual to each vertical drive shaft are provided as shown in Fig. 1. The brush which is individual to the shaft 56 comprises a flat spring 80 secured to the upright 2 which engages with the collar 81 secured to the shaft 56. The brush assembly which is individual to each clutch comprises, as most clearly disclosed in Fig. 2, a cylindrical brush guide 82 riveted or otherwise secured to the insulating support 83 and within which a carbon brush rod 84 engaging the slip ring 78 of the clutch is slidably positioned and a contact spring 85 which engages with the outer end of the brush 84. The spring 85 is insulatedly mounted on the support 83 and together with the support are attached to the upright 2 by screws 86.

Associated with each switch unit is a magnetically controlled brake which cooperates with the tape belt 52 thereof. The brakes of all units on the front of the switch frame are secured to the vertical plate 19 and the brakes of all units on the back of the frame are secured to the vertical plate 20. Each brake comprises an end support 87 which is held in spaced relation from the vertical plate to which the brake is secured by sleeves 88. Screws 89 which extend through the support 87 and sleeves 88 engage in threaded openings in the vertical plate, for example the plate 19. Secured to the inner side of the support 87 is an L-shaped return pole-piece 90 through which and through the support 87 the magnet core 91 is threaded. The threaded end of the core is provided with a slotted end portion by means of which the core may be turned in the threaded opening of the support 87 for adjusting the air-gap between the free end of the core and the magnet armature. For clamping the core in its adjusted position the lock nut 92 is provided. A magnet coil 93 is supported on the free end of the core 91.

Secured to the free end of the pole-piece 90 by suitable screws is an L-shaped bracket 94 provided at the end adjacent to the free end of the pole-piece with ears between which the magnet armature 95 is pivoted. One end of the armature overlies the end of the pole-piece 90 and the magnet core 91 and is provided near its pivot with a brake shoe 96 which cooperates with a brake shoe 97 attached to the plate 19. The coiled spring 98, one end of which is secured to the outer end of the armature 95 and the other end of which is secured to the free end of bracket 94, is provided for normally retracting the armature 95 and forcing the brake shoe 96 carried thereby toward the stationary brake shoe 97 to clamp the tape 52 therebetween. The position of the brake shoe 96 with respect to the pivot point of the armature, to the point of attachment of the spring 98 to the armature and to the end of the armature which overlies the end of the core 91 is so chosen that the motion of the brake shoe is very slight, in the order of a few thousandths of an inch, but that the braking effort applied thereto by the spring 98 is quite large. Since, however, the end of the armature which overlies the magnet core has considerable leverage, the magnet coil 93 when energized is quickly able to overcome the spring 98 and to disengage the brake shoe 96 from the tape 52.

Each switch unit is provided with a normalling switch 100, the normalling switches of the switch units on the front of the switch frame being attached to the vertical angle bars 14 and 15 and the switches of the switch units on the back of the frame being attached to the angle bars 16 and 17. The normalling switch which is disclosed in Figs. 3 to 5, inclusive, comprises a horizontal mounting plate 101 having downwardly and outwardly extending ears 102 and 103 by means of which it may be secured by screws to the angle bars, two contact pile-ups secured thereto and insulated therefrom by the hard rubber insulating strip 104 and a switch bar pivoted on the central portion of the mounting plate between the two contact pile-ups.

The left-hand contact pile-up comprises two separate bottom contact members 105 and 106 positioned adjacent to the insulating strip 104 and out of contact with each other, the member 105 having a soldering terminal 107 and the member 106 having a soldering terminal 108. Superimposed on the members 105 and 106 is a hard rubber insulating strip 109 on the upper portion of which is superimposed the contact member 110 having the soldering terminal 111. The contact members 106 and 110 are arcuate in formation and extend parallelly toward the pivoted switch bar. For securing the members of the contact pile-up to the support 101, bolts 112 are provided which extend through the contact members and insulating strips 104 and 109 and are insulated from the contact members by insulating sleeves surrounding their shanks and by insulating washers 113 inserted beneath their heads.

The right-hand contact pile-up comprises a bottom contact member 114 positioned adjacent to the insulating strip 104 having a soldering terminal 115, an insulating strip 116 superimposed thereon and two contact members 117 and 118 superimposed on the strip 116, the member 117 having a soldering terminal 119 and the member 118 having a soldering terminal 120. The contact members 114 and 117 are arcuate in formation and extend parallelly toward the pivoted switch bar. For securing the members of the contact pile-up to the support 101, bolts 112 are provided which extend through the contact members and insulating strips 104 and 116 and are insulated from the contact members by insulating sleeves surrounding their shanks and by the insulating washers 113 inserted beneath their heads.

The pivoted switch bar is a composite member comprising two blades 121 and 122 separated from each other by an interposed strip of insulating material. The composite switch bar is pivoted on a bolt 123 which extends through the metal sleeve 124, the mounting plate 101, insulating strip 104, contact member 105, the composite switch bar, the contact member 118 and the insulating washer 125 and is held in place by the lock nuts 126. For insulating the bolt from the contact members 105 and 118 and from the blades 121 and 122, the bolt is surrounded by an insulating sleeve as most clearly shown in Fig. 4. As thus assembled the switch blade 121 is in electrical contact with the contact member 118 and the blade 122 is in electrical contact with the contact member 105, good contact therebetween being insured by the spiral spring 127 which is interposed between the head of the bolt 123 and the mounting plate 101 surrounding the sleeve 124.

Pivoted to the outer end of the switch blade 122 are two fingers 128 and 129, the inner ends of which are normally positioned against the stop pins 130 by the coiled spring 131, the ends of which are secured to the inner ends of the fingers. In the upper portion of Fig. 2 the switch unit brush carriage is shown in its normal position at the mid-point between the terminal banks in which position the insulated tip 48 of the trip rod 47 attached to the brush carriage is engaged between the fingers 128 and 129 of the switch bar of the associated normalling switch 100 and the switch bar is thus held in its neutral position, or the position disclosed in Fig. 3.

Should the brush carriage move to the left, as viewed in Fig. 3, and engage the insulating tip 48 of its trip rod 47 against the finger 128, due to the engagement of the finger against the stop pin 130 the movement of the brush carriage will rotate the switch bar about the pivot bolt 123 thereby engaging its blades 121 and 122, respectively, with the contact members 110 and 106 whereby two circuits are established, one from soldering terminal 107 of contact member 105 through switch blade 122 and contact member 106 to the soldering terminal 108 thereof and the other from soldering terminal 120 of contact member 118 through switch blade 121 and contact member 110 to soldering terminal 111. Should the brush carriage move to the right, as viewed in Fig. 3, and engage the insulating tip 48 of its trip rod 47 against the finger 129, the switch bar then will be rotated to the right thereby engaging its blades 121 and 122, respectively, with the contact members 117 and 114 whereby two circuits are established, one from soldering terminal 107 of contact member 105 through switch blade 122 and contact member 114 to the soldering terminal 115 thereof, and the other from soldering terminal 120 of contact member 118 through switch blade 121 and contact member 117 to the soldering terminal 119 thereof. The purpose of these circuits will be apparent from the following description of the application of the invention to a typical telephone system.

For the purpose of illustrating one of the many possible uses of the selector switch hereinbefore described, the switch has been shown in Fig. 9 as a line finder in a machine switching telephone system of the well-known step-by-step type. It is to be understood, however, that it could be equally well used in any type of telephone system where line, trunk or link hunting functions are to be performed.

Referring now to Fig. 9, two of the subscribers' lines 132 and 133 of a group of two hundred lines are shown terminating, respectively, in the banks 21 and 22 of a line-finder frame. The brushes 41 to 46, inclusive, clutch magnets 72 and 134, brake magnet 93 and normalling switch 100 of one of the switch units on the line-finder frame, the control relays individual thereto, the control relays common to all switch units on the frame and the brushes and some of the relays of the first selector switch 190 individual to the line-finder switch unit are also shown.

It will first be assumed that the subscriber whose line is indicated at 132 as terminating in bank 21, or the left bank of the line-finder frame, initiates a call by removing the substation receiver from the switchhook thereby establishing a circuit for the line relay 135. This circuit may be traced from battery through the winding of relay 135, the right back contact of cut-off relay 136, ring conductor 137 of the line, through the sub-

station, returning over tip conductor 138 to ground at the left back contact of relay 136. Line relay 135 thereupon operates disconnecting at its back contact the winding of the subscriber's message register magnet 139 from the metering and test terminal 140 of the bank 21, at its right front contact connecting the terminal 140 to the winding of test relay 141 which is common to all two hundred subscribers' lines which terminate in banks 21 and 22 and at its left contact establishing a circuit from ground thereover, over the back contact of group relay 142 which is common to the one hundred lines including line 133 terminating in bank 22, to battery through the winding of group relay 143 which is common to the one hundred lines including line 132 terminating in bank 21.

Group relay 143 upon operating opens at its back contact the operating circuit of group relay 142 to prevent any line in its one-hundred line group from starting a line finder at this time and at its outer right contact establishes a circuit for start relay 144 which is individual to the line-finder unit disclosed. This circuit may be traced from battery through the left winding of relay 144, the outer left back contact of start circuit relay 145 also individual to the line-finder unit disclosed, outer right contact of relay 143 to ground at the right back contact of common relay 160.

Relay 144 upon operating prepares an operating circuit over its left front contact through the right winding of relay 145, at its left back contacts disconnects ground from the switch blades 121 and 122 of the normalling switch 109, at its inner right front contact prepares a locking circuit for itself, at its next-to-inner right front contat prepares an operating circuit for the right drive clutch magnet 134 of the line-finder unit disclosed, at its middle right front contact establishes an operating circuit for the left drive clutch magnet 72, at its next-to-outer right front contact establishes an operating circuit for the brake magnet 93 and at its outer right front contact establishes a loop circuit for operating the line relay 146 of the first selector switch 190. This latter circuit may be traced from battery through the right winding of relay 146, left back contact of cut-through relay 147, outer right front contact of relay 144, inner right back contact of relay 147 to ground through the left winding of relay 146. Relay 146 operates over this circuit and establishes an obvious operating circuit for slow-to-release relay 148 thereby preparing the selector switch for subsequent operation and connecting ground to holding conductor 169.

The left drive clutch magnet 72 and the brake magnet 93 now operate simultaneously, the circuit for magnet 72 extending from battery through the magnet winding, the middle right front contact of relay 144, the inner right front contact of relay 143 to ground at the back contact of common relay 149, and the circuit for magnet 93 extending from battery through the magnet winding, the next-to-outer right front contact of relay 144 to ground at the back contact of common test relay 141. With magnet 93 operated, the brake shoe 96 carried by its armature is withdrawn from the driving tape 52 of the line-finder switch unit and with clutch magnet 72 energized the driving pulley 53 is coupled to the vertical driving shaft 56 whereby the tape 52 is driven in such a direction as to move the brush carriage 34 of the switch unit toward the left in a hunting movement over a horizontal row of sets of terminals of the bank 21 to which the switch unit has access.

Upon the initial movement of the brush carriage from its normal position between the two banks of terminals, the trip rod 47 carried thereby moves the switch blades 121 and 122 of the normalling switch 109 to the left in which position the blade 121 engages terminal 110 and blade 122 engages terminal 106 for a purpose to be later described. As the brush carriage advances, the brushes 41 to 46 carried thereby successively engage the sets of bank terminals of the one hundred lines including line 132 which appear in the left bank 21.

For arresting the movement of the brush carriage when the test brush 45 thereof encounters the test terminal of a calling line the fast operating test relay 141 is provided whose winding is normally connected in a series circuit from battery through the 1000-ohm resistance 150, the 100-ohm resistance 151 and a first condenser 152 to ground, the resistance 150 being shunted by a second condenser 153. Condensers 152 and 153 are thus normally fully charged over this circuit. When now in the advance of the brush carriage the narrow test brush 45 engages the test terminal 140 of the calling line to which the winding of the test relay 141 has been connected, as previously described, a circuit is established from ground through resistance 158, the right back contact of relay 145, test brush 45, terminal 140, right front contact of relay 135, resistance 150 and winding of relay 141 to battery. Relay 141 will tend to operate over this circuit, but may not have time to fully operate if the brush carriage is then traveling at high speed since the test brush 45 may overrun the test terminal 140 and make a passing contact therewith for only a small fraction of a second. For example, if the brush carriage is moving at a testing speed of three hundred terminals per second, the engagement of test brush 45 with terminal 140 may be for only approximately .0013 second. This time is not sufficient to operate relay 141 for releasing the brake magnet 93 and for stopping the brush set on the calling line terminal set. Condensers 152 and 153 and resistances 150 and 151 are therefore provided to insure a positive and uniform circuit for operating the test relay while without them the relay would not have time to operate either due to the testing speed of the test brush 45, or due to the vibration of the test brush on the test terminal.

When therefore the test brush 45 momentarily engages the test terminal 140 a discharge path for condenser 152 is established from ground through resistance 158 applied over the test brush, through resistance 151 and condenser 152 to ground, over which path condenser 152 discharges sufficiently so that when the test brush overruns and leaves the test terminal 140 sufficient current will flow from battery through the winding of relay 141, condenser 153 which is now charged and offers a low resistance, resistance 151 and condenser 152 to ground to cause the operation of test relay 141. Relay 141 will now remain operated until condenser 152 becomes fully charged at which time due to the decay of the charging current, relay 141 will release.

As soon as relay 141 operates it opens at its back contact the operating circuit of brake magnet 93 which immediately releases clamping the moving tape 52 of the finder switch unit between the brake shoes 96 and 97 to immediately

arrest the movement of the tape. Magnet 93 is made slightly slow to release at this time by the removal of the shunt from the circuit extending through resistance 161, condenser 162, back contact of relay 163 and the back contact of relay 159 to ground. At substantially the same instant the energization of test relay 141 establishes an operating circuit for relay 149 extending from ground over its front contact, through resistance 154 and the winding of relay 149 to battery. Relay 149 upon operating opens at its back contact the operating circuit of the left drive clutch magnet 72 and locks itself in a circuit extending from battery through its winding, resistance 154 and its own left contact, winding of relay 159 to ground at the left back contact of relay 163. Relay 159 does not, however, operate in this locking circuit since its winding is shunted by ground applied over the front contact of relay 141 so long as relay 141 remains operated.

To insure that relay 149 will operate and lock even though its operating circuit is momentarily opened due to the vibration of the front contact of test relay 141, resistances 154 and 155 and condensers 156 and 157 are provided, the condensers being normally charged over a path extending from battery through the winding of relay 149, condenser 157, resistance 155, condenser 156 to ground. Should the front contact of relay 141 chatter upon closing, a momentary closure thereof while of insufficient duration to cause relay 149 to operate and lock, will cause condenser 156 to discharge sufficiently over the discharge path traced from ground over the front contact of relay 141 through resistance 155 and condenser 156 to ground so that if the front contact of relay 141 should then momentarily open due to chatter, sufficient current will flow from battery through the winding of relay 149, condenser 157 which is now charged and offers a low resistance, resistance 155 and condenser 156 to ground to cause the operation of relay 149 which will then lock as previously described.

As soon as relay 149 operates it completes the operating circuit for the right drive clutch magnet 134 which may be traced from battery, winding of magnet 134, next-to-inner right front contact of relay 144, middle right front contact of relay 143 to ground at the right front contact of relay 149. Upon the release of test relay 141 as previously described, ground is removed from the operating circuit of relay 149 and from one terminal of the winding of relay 159 and relay 159 now operates in the locking circuit of relay 149 in turn establishing an obvious operating circuit for slow-to-release relay 163. At its back contact relay 141 again establishes the previously traced operating circuit for brake magnet 93. With brake magnet 93 and the right drive clutch magnet 134 both operated, the brush carriage is now driven toward the right thus moving the test brush 45 back upon the test terminal 140 of the calling line at which time, since the brush carriage has not had time to attain a high speed, an operating circuit for test relay 141 is established from ground applied to the test brush through resistance 158, thence over test terminal 140, condenser 153 which being fully charged offers a low resistance to the flow of current in parallel with resistance 150, winding of relay 141 to battery. Relay 141 now operates to open the circuit of the brake magnet 93 and since with relay 163 operated the circuit through resistance 161 and condenser 162 is ineffective, magnet 93 releases quickly to arrest the movement of the brush carriage with the brushes thereof in engagement with the terminal set of the calling line 132.

Relay 141 upon operating now shunts down relay 159 which immediately releases and opens the circuit of relay 163. Before slow-to-release relay 163 has time to release, with relay 159 released, an operating circuit is established for relay 160 which may be traced from ground at the back contact of relay 159, front contact of relay 163, winding of relay 160, inner right front contact and right winding of relay 144 to battery. Relay 160 now operates opening at its right back contact the initial operating circuit of relay 144, opening at its left back contact the locking circuit of relay 149 which, however, is now maintained operated under the control of relay 141, and at its right front contact establishes the operating circuit of start circuit relay 145. The circuit of relay 145 may be traced from battery through its right winding, the outer left front contact of relay 144 to ground at the right front contact of relay 160. Relay 145 upon operating locks over its inner right front contacts to ground at the left contact of relay 148. When relay 163 finally releases, after a predetermined interval following the release of relay 159, the circuit through the winding of relay 160 and locking winding of relay 144 is opened and relays 160 and 144 now both release since the initial operating circuit of relay 144 has now been opened through the operation of relay 145. With relay 144 now released the circuit of clutch magnet 134 is now opened.

With start circuit relay 145 operated the tip and ring conductors 138 and 137 of the calling line are extended over terminals 164 and 165, brushes 43 and 44, outer right front contacts of relay 145, back contacts of cut-through relay 147 to the windings of relay 146 for holding relays 146 and 148 operated, and a circuit is established for operating the cut-off relay 136 of the calling line which may be traced from ground at the left contact of relay 148, conductor 169, inner right front contact of relay 145, brushes 41 and 42 in multiple, sleeve terminal 166 to battery through the winding of cut-off relay 136. This same ground is also applied to the test multiples 167 of the calling line appearing in the banks of all connector switches having access to the line to mark the line busy to such connector switches. Relay 145 at its outer left front contact also extends the start wire extending from the contacts of group relays 142 and 143 so that if any other line in the two-hundred line group of subscribers' lines is calling, the start relay of another available line-finder unit, corresponding to relay 144, may be operated to start such other line-finder unit. At its right back contact relay 145 also opens the circuit of test relay 141 which releases and in turn releases relay 149 and at its next-to-inner right front contact relay 145 connects the test brush 45 and metering brush 46 together preparatory to the control of metering.

The cut-off relay 136 upon operating disconnects the winding of line relay 135 from the calling line whereupon relay 135 releases reconnecting the message register magnet 139 to the terminal 140, opening at its right front contact a second point in the operating circuit of test relay 141 and at its left contact opening the operating circuit of group relay 143 which will now release if no other line in the same one-hundred line group of lines in which the calling

line 132 is located is at the time in a calling condition. The common control relays 141, 149, 159, 169 and 163 are now released and in condition to control another line-finder switch unit for establishing a connection with another calling line.

The calling line being now operatively connected with the first selector switch 190, the calling subscriber may proceed to operate his substation dial to directively set up a connection to a desired subscriber's line, cut-through relay 147 operating in the usual manner after the operation of the selector switch 190 to cut the talking circuit through to the succeeding selector switch and to disconnect the windings of relay 146, which relay thereupon releases in turn releasing relay 148. Locking ground for relay 145 and for maintaining cut-off relay 136 operated is thereafter supplied in the usual manner from the succeeding selector switch over a front contact of cut-through relay 147 and conductor 169. If the call is successfully made, metering ground is connected as indicated at 168 in the usual manner thereby establishing a circuit from such ground to brush 45 and in parallel over the next-to-inner right front contact of relay 145 to brush 46, thence over terminal 140 and the back contact of line relay 135 to battery through the message register magnet 139.

When the established connection is no longer required and the subscribers restore their receivers to their switchhooks, the selector switches employed in establishing the connection are restored in the usual manner and holding ground is removed from conductor 169 thereby releasing cut-off relay 136 of the calling line and releasing relay 145. With both relays 145 and 144 released, ground is connected over the back contacts thereof to switch blades 121 and 122 of the normalling switch 100. It will be recalled that the blades of this switch were moved to the left by the movement of the brush carriage to the left. Therefore, a circuit is now established from ground over the middle left back contact of relay 145, the outer left back contact of relay 144, switch blade 121, contact terminal 110 and winding of right drive clutch magnet 134 to battery and a second circuit is established from ground over the inner left back contact of relay 145, the inner left back contact of relay 144, switch blade 122, contact terminal 106 and winding of brake magnet 93 to battery. Magnets 134 and 93 now operate, magnet 93 releasing the brake shoe 96 from the tape 52 and magnet 134 causing the tape 52 to be driven in such a direction as to move the brush carriage toward the right. When the trip rod 47 engages the finger 128 carried by the switch bar 122 of the normalling switch, it rotates it away from the associated stop pin 130 against the tension of spring 131 and snaps over it into engagement with the finger 129 and since the finger 129 is prevented from pivoting by its associated stop pin 130, the switch blades 121 and 122 are moved by the continued movement of the brush carriage into their neutral position. As soon as the switch blades become disengaged from the contact terminals 110 and 106, the circuits of magnets 134 and 93 are opened thereby arresting the further movement of the brush carriage. The brush carriage is now in its normal position midway between the two terminal banks as disclosed in Fig. 2.

It will now be assumed that the subscriber whose line 133 is disclosed as terminating in the right terminal bank 22 initiates a call thereby operating line relay 170 to mark the test terminal 171 with calling potential and to operate the group relay 142. The circuit of relay 142 may be traced from ground at the left contact of relay 176, back contact of group relay 143, winding of group relay 142 to battery. In response to the operation of group relay 142, relay 144 is operated in the manner previously described and operating circuits are established thereby for the brake magnet 93 and the right drive clutch magnet 134. The operating circuit of magnet 93 is the same as previously traced. The operating circuit for magnet 134 may be traced from battery through the winding of magnet 134, next-to-inner right front contact of relay 144, middle right front contact of relay 142 to ground at the back contact of relay 149.

Upon the energization of magnets 93 and 134 the brush carriage is driven to the right for hunting in the right terminal bank 22, the initial movement of the brush carriage moving the switch blades 121 and 122 of the normalling switch 100 to the right into engagement respectively with contact terminals 117 and 114. The circuits now function in the manner previously described except that the test relay 141 is now controlled to stop and center the brushes 41 to 46, inclusive, on the terminal set of the calling line 133 due to the engagement of the test brush 45 with the test terminal 171. In this case, however, in the event that the brushes overrun the terminal set, the operation of relay 149 causes the operation of the left drive clutch magnet 72 to drive the brush carriage back to the terminal set over a circuit extending from battery, winding of magnet 72, middle right front contact of relay 144, inner right front contact of group relay 142 to ground at the right front contact of relay 149.

When ground is removed from holding conductor 169 upon the termination of the connection and relay 145 releases, with relay 144 at that time released and the switch blades 121 and 122 in their right operated positions, circuits are established for the brake magnet 93 and the left drive clutch magnet 72 to drive the brush carriage toward the right into its normal position. The circuit of brake magnet 93 may be traced from battery, winding of magnet 93, contact terminal 114, switch blade 122, inner left back contacts of relays 144 and 145 to ground and the circuit of clutch magnet 72 may be traced from battery through the winding of magnet 72, contact terminal 117, switch blade 121, outer left back contact of relay 144 and middle left back contact of relay 145 to ground. When the brush carriage reaches its normal position the switch blades 121 and 122 of the normalling switch are moved into their neutral position arresting the further movement of the brush carriage.

What is claimed is:

1. In a telephone system, a selector switch having a bank of terminals and a brush set cooperating therewith, means for advancing said brush set in a hunting movement over said bank of terminals, testing means for arresting the hunting movement of said brush set when it engages a marked terminal of said bank, and means controlled by said testing means for reversing the direction of movement of said brush set to return it to said marked terminal in the event said brush set overruns said terminal in its hunting movement.

2. In a telephone system, a selector switch

having two banks of terminals and a brush set cooperating therewith normally positioned midway between said banks, means for advancing said brush set in a hunting movement over either one of said banks, testing means for arresting the hunting movement of said brush set when it engages a marked terminal of a bank, and means for reversing the direction of movement of said brush set in the event said brush set overruns said terminal in its hunting movement.

3. In a telephone system, a selector switch having a bank of terminals and a brush set cooperating therewith, means for advancing said brush set in a hunting movement over said bank of terminals, testing means for arresting the hunting movement of said brush set when it engages a marked terminal of said bank, means controlled by said testing means for reversing the direction of movement of said brush set to return it to said marked terminal in the event said brush set overruns said terminal in its hunting movement, and means controlled by said testing means for arresting the return movement of said brush set when it again engages the marked terminal of said bank.

4. In a telephone system, a selector switch having a panel bank of terminals and a brush set cooperating therewith, a belt for traversing said brush set across said bank, means for driving said belt in one direction to traverse said brush set in a hunting movement over said bank of terminals or in the reverse direction to return said brush set towards its normal position, testing means for arresting the hunting movement of said brush set when it engages a marked terminal of said bank and means operated by said testing means for controlling said driving means to reverse the direction of movement of said belt to return said brush set to said marked terminal in the event said brush set overruns said terminal in its hunting movement.

5. In a telephone system, a selector switch having a panel bank of terminals and a brush set cooperating therewith, a belt for traversing said brush set across said bank, a pair of driving pulleys over which said belt runs, means for driving one of said pulleys to traverse said belt in one direction to move the brush set in a hunting movement, means for driving the other of said pulleys to traverse said belt in the opposite direction to move said brush set in a return movement toward its normal position, testing means for arresting the hunting movement of said brush set when it engages a marked terminal of said bank, and means operated by said testing means for disabling said first driving means and for rendering said second driving means effective to return said brush set to said marked terminal in the event said brush set overruns said terminal in its hunting movement.

6. In a telephone system, a selector switch having a panel bank of terminals and a brush set cooperating therewith, a belt for traversing said brush set across said bank, a pair of driving pulleys over which said belt runs, said pulleys being normally loosely journaled respectively on two oppositely rotating driving shafts, a first magnetic clutch operative to connect one of said pulleys to its driving shaft to traverse said belt in one direction to move said brush set in a hunting movement, a second magnetic clutch operative to connect the other of said pulleys to its driving shaft to traverse said belt in the opposite direction to move said brush set in a return movement towards its normal position, testing means for arresting the hunting movement of said brush set when it engages a marked terminal of said bank, and means operated by said testing means for disabling said first magnetic clutch and for rendering said second magnetic clutch effective to return said brush set to said marked terminal in the event said brush set overruns said terminal in its hunting movement.

7. In a telephone system, a selector switch having two panel banks of terminals and a brush set cooperating therewith normally positioned midway between said banks, a belt for traversing said brush set across said banks, means for driving said belt, control means for causing said belt to be driven in one direction to move said brush set in a hunting movement over one of said banks, control means for causing said belt to be driven in the opposite direction to move said brush set in a hunting movement over the other of said banks, means operative in accordance with the bank in which a marked terminal is located for determining which one of said control means shall be effective, testing means for arresting the hunting movement of said brush set when it engages a marked terminal in either bank, and means operated by said testing means for disabling the control means then effective and for rendering the other control means effective to return said brush set to said marked terminal in the event said brush set overruns said terminal in its hunting movement.

8. In a telephone system, a selector switch having two panel banks of terminals and a brush set cooperating therewith normally positioned midway between said banks, a belt for traversing said brush set across said banks, a pair of driving pulleys over which said belt runs, means for driving one of said pulleys to traverse said belt in one direction to move said brush set in a hunting movement over one of said banks, means for driving the other of said pulleys to traverse said belt in the opposite direction to move said brush set in a hunting movement over the other of said banks, means operative in accordance with the bank in which a marked terminal is located for determining which one of said driving means shall be effective, testing means for arresting the hunting movement of said brush set when it engages a marked terminal in either bank, and means operated by said testing means for disabling the driving means then effective and for rendering the other driving means effective to return said brush set to said marked terminal in the event said brush set overruns said terminal in its hunting movement.

9. In a telephone system, a selector switch having two panel banks of terminals and a brush set cooperating therewith normally positioned midway between said banks, means for advancing said brush set in a hunting movement over either one of said banks, means operative in accordance with the bank in which a marked terminal is located for determining the direction in which said brush set is advanced, testing means for arresting the hunting movement of said brush set when it engages a marked terminal in either bank, means for reversing the movement of said brush set in the event it overruns said terminal in its hunting movement, a normalling switch controlled by the movement of said brush set in either direction from its normal position, and means including said nor-

malling switch to cause the return of said brush set to its normal position.

10. In a telephone system, a selector switch having two panel banks of terminals and a brush set cooperating therewith normally positioned midway between said banks, means for advancing said brush set in a hunting movement over either of said banks, means operative in accordance with the bank in which a marked terminal is located for determining the direction in which said brush set is advanced, testing means for arresting the hunting movement of said brush set when it engages a marked terminal in either bank, means for reversing the movement of said brush set in the event it overruns said terminal in its hunting movement, a double-throw normalling switch engageable by said brush set when said brush set is in its normal position and movable into either of its operated positions by the movement of said brush set in either direction from its normal position, and circuits controlled by said normalling switch to cause the return of said brush set to its normal position.

11. In a telephone system, a selector switch having a panel bank of terminals and a brush set cooperating therewith, a belt for traversing said brush set across said bank, means for driving said belt in one direction to traverse said brush set in a hunting movement over said bank of terminals or in the reverse direction to return said brush set toward its normal position, a test relay operable when said brush set engages a marked terminal during its hunting movement, an electromagnetically controlled brake engageable with said belt and operable upon the operation of said test relay to stop the movement of said belt and said brush set, and a relay operable upon the operation of said test relay for reversing the direction of movement of said belt to return said brush set to said marked terminal in the event said brush set overruns said terminal in its hunting movement.

12. In a telephone system, a selector switch having two panel banks of terminals and a brush set cooperating therewith normally positioned midway between said banks, a belt for traversing said brush set across said banks, means for driving said belt, control means for causing said belt to be driven in one direction to move said brush set in a hunting movement over one of said banks, control means for causing said belt to be driven in the opposite direction to move said brush set in a hunting movement over the other of said banks, means operative in accordance with the bank in which a marked terminal is located for determining which one of said control means shall be effective, a test relay operable when said brush set engages a marked terminal in either bank during its hunting movement, an electromagnetically controlled brake engageable with said belt and operable upon the operation of said test relay to stop the movement of said belt and said brush set, and a relay operable upon the operation of said test relay for disabling the control means then effective and for rendering the other means effective to return said brush set to said marked terminal in the event said brush set overruns said terminal in its hunting movement.

13. In a telephone system, a selector switch having two panel banks of terminals and a brush set cooperating therewith normally positioned midway between said banks, a belt for traversing said brush set across said banks, means for driving said belt, control means for causing said belt to be driven in one direction to move said brush set in a hunting movement over one of said banks, control means for causing said belt to be driven in the opposite direction to move said brush set in a hunting movement over the other of said banks, two groups of lines terminating respectively in said two banks, a line relay for each of said lines operable when said line is in a calling condition, a group relay common to each group of lines and operable when the line relay of any line of its group is operated, circuits controlled by said group relays for determining which one of said control means shall be effective, and a test relay associable with the test terminal of any line of said group by the operation of the line relay of said line for arresting the hunting movement of said brush set when it engages the test terminal of said calling line.

14. In a telephone system, a selector switch having a bank of terminals and a brush set cooperating therewith, means for advancing said brush set in a hunting movement over said bank of terminals, an electrostatically controlled test relay for arresting the hunting movement of said brush set when it engages a marked terminal of said bank, and means controlled by said relay for reversing the direction of movement of said brush set to return it to said marked terminal in the event said brush set overruns said terminal in its hunting movement.

15. In a telephone system, a selector switch having a bank of terminals and a brush set cooperating therewith, means for advancing said brush set in a hunting movement over said bank of terminals, a test relay for arresting the hunting movement of said brush set when it engages a marked terminal of said bank, a condenser for sensitizing said relay, and means controlled by said relay for reversing the direction of movement of said brush set to return it to said marked terminal in the event said brush set overruns said terminal in its hunting movement.

16. In a telephone system, a selector switch having a bank of terminal sets each including a test terminal and a brush set including a test brush cooperating therewith, means for advancing said brush set in a hunting movement over said bank of terminals, a test relay, means for associating said test relay with any test terminal to mark said terminal as calling, a condenser, a resistance, a charging path for said condenser extending through said resistance and the winding of said test relay over which said condenser is normally fully charged, a discharge path for said condenser and an operating path for said relay effective when said test brush engages the test terminal to which said relay is connected over which path said condenser partially discharges and said relay tends to operate if said test brush makes only a momentary contact with said test terminal, said condenser recharging over said charging path in the event said test brush overruns said test terminal whereby said relay operates over said charging path, and means controlled by said relay for arresting the hunting movement of said brush set and for returning it to said test terminal.

17. In a telephone system, a selector switch having a terminal bank and a brush set cooperating therewith, means for advancing said brush set in a hunting movement over said bank of terminals, an electrostatically controlled test relay for arresting the hunting movement of said brush set when it engages a marked terminal of said bank, a relay controlled by said test relay for

reversing the direction of movement of said brush set to return it to said marked terminal in the event said brush set overruns said terminal in its hunting movement, and electrostatic means for insuring the operation of said reversing relay.

18. In a telephone system, a selector switch having a terminal bank and a brush set cooperating therewith, means for advancing said brush set in a hunting movement over said bank of terminals, a test relay for arresting the hunting movement of said brush set when it engages a marked terminal of said bank, a relay for reversing the direction of movement of said brush set to return it to said marked terminal in the event said brush set overruns said terminal in its hunting movement, a condenser, a resistance, a charging path for said condenser extending through said resistance and said reversing relay over which said condenser is normally fully charged, and a discharge path for said condenser and an operating path for said reversing relay closed over the contacts of said test relay upon the operation thereof over which said condenser partly discharges and said reversing relay operates if the contacts of said test relay momentarily open.

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