

June 2, 1925.

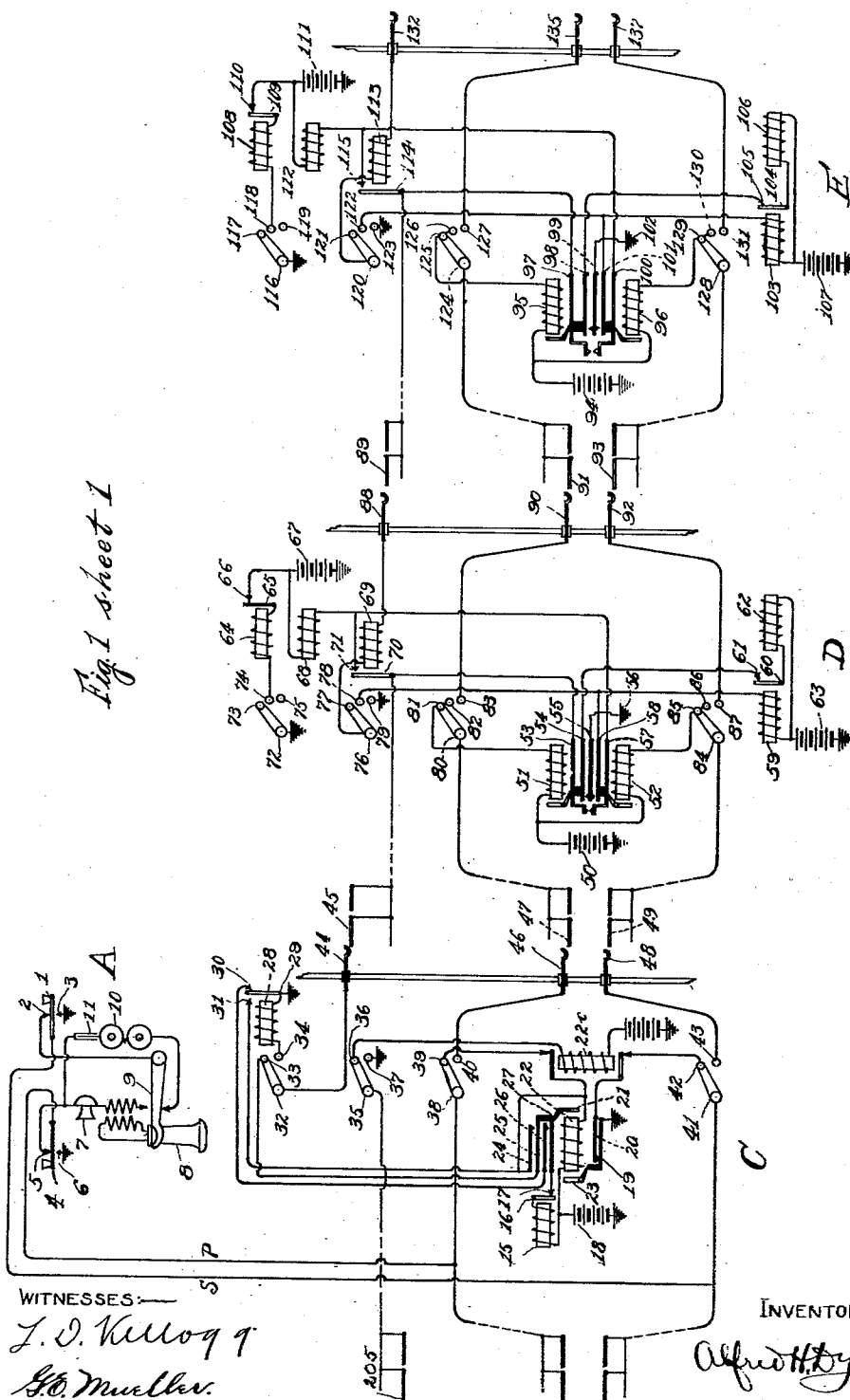
1,540,061

A. H. DYSON

TELEPHONE SYSTEM

Filed March 13, 1905

4 Sheets-Sheet 1



June 2, 1925.

1,540,061

A. H. DYSON

TELEPHONE SYSTEM

Filed March 13, 1905

4 Sheets-Sheet 2

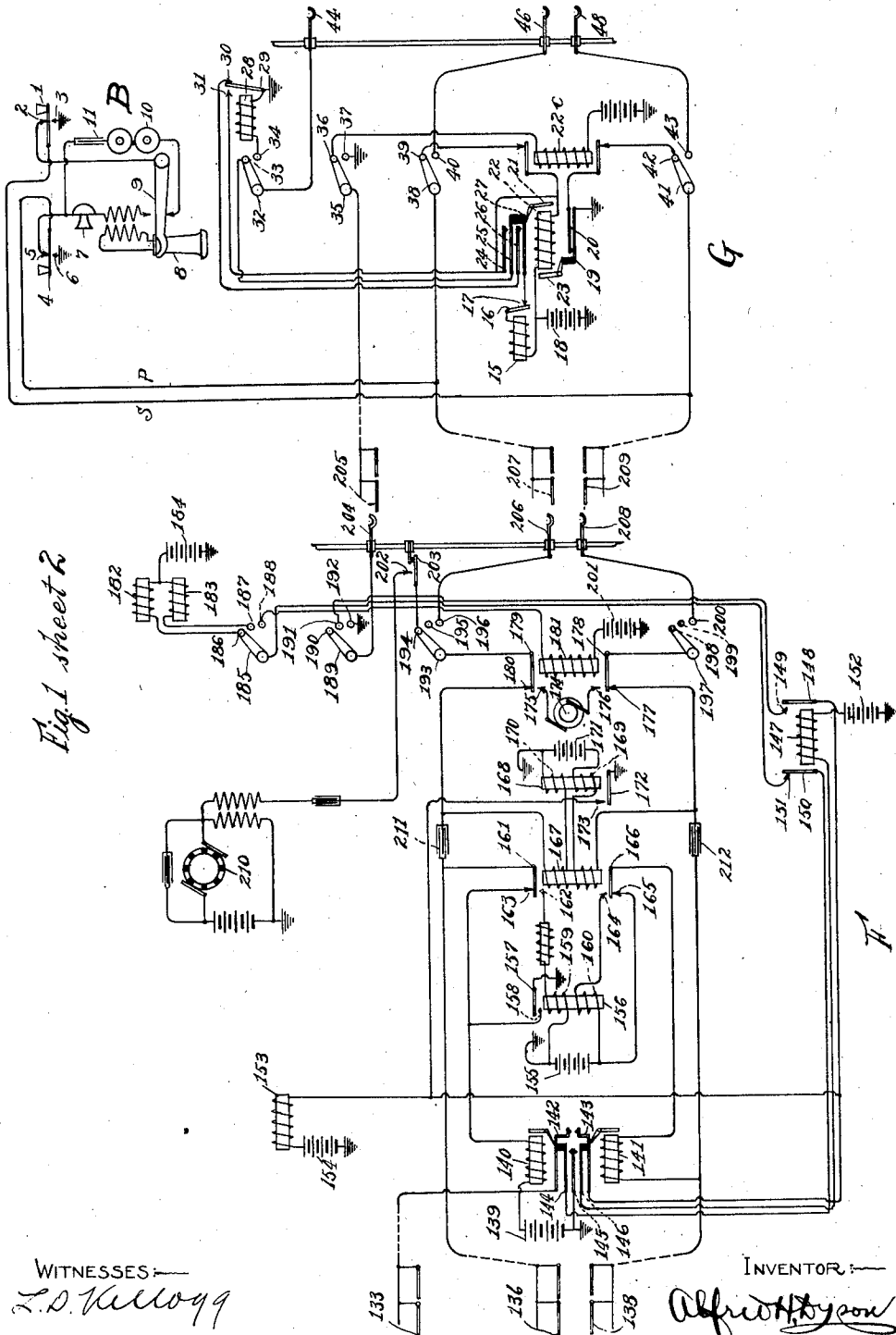


Fig. 1 sheet 2

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June 2, 1925.

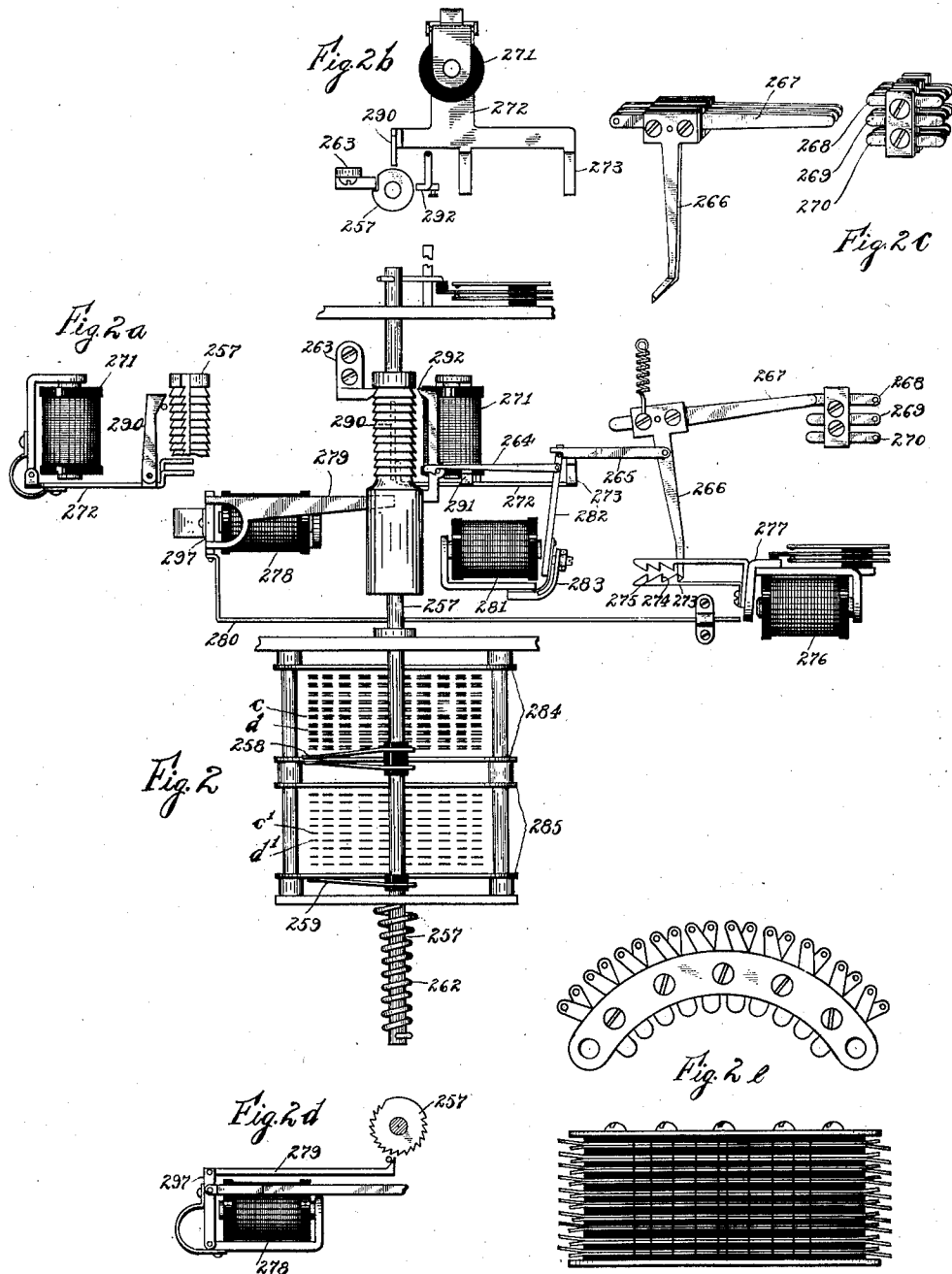
1,540,061

A. H. DYSON

TELEPHONE SYSTEM

Filed March 13, 1905

4 Sheets-Sheet 3



WITNESSES:—

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June 2, 1925.

1,540,061

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TELEPHONE SYSTEM

Filed March 13, 1905

4 Sheets-Sheet 4

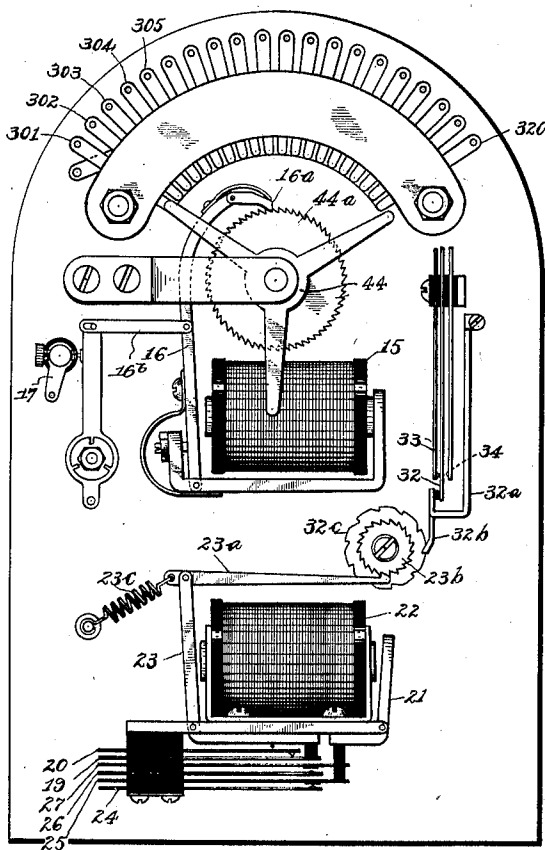


Fig. 3

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Patented June 2, 1925.

1,540,061

UNITED STATES PATENT OFFICE.

ALFRED H. DYSON, OF CHICAGO, ILLINOIS, ASSIGNOR, BY MESNE ASSIGNMENTS, TO
KELLOGG SWITCHBOARD & SUPPLY COMPANY, A CORPORATION OF ILLINOIS.

TELEPHONE SYSTEM.

Application filed March 13, 1905. Serial No. 249,804.

To all whom it may concern:

Be it known that I, ALFRED H. DYSON, a citizen of the United States, and resident of Chicago, county of Cook, and State of Illinois, have invented new and useful Improvements in Telephone Systems, of which the following is a specification.

My invention relates particularly to telephone exchange systems in which the connection of subscribers' lines is secured by automatic mechanism at the central office, actuated by means of switching mechanism at subscribers' stations.

An object of my invention is to provide a system in which the number of working parts and the number of electromagnets used for operating them may be comparatively few in number.

One means employed in the furtherance of these objects consists in a simplification of that portion of the apparatus individual to each of the subscribers' lines, which apparatuses are, in percentage systems, more numerous than any other class. Another means involves the employment of certain individual parts of the apparatus in several different capacities; notably the private or busy test circuits are also employed for restoring purposes. These and other features of my invention will be more particularly pointed out in the description and claims.

In the systems which I have had especially in mind in developing my invention, there is provided for each subscriber to an exchange a switch individual to his line, and auxiliary switches employed co-operatively with the individual switches in the establishment of connections between subscribers. In the systems to which I refer, these individual switches have ordinarily been of a type called "selector switches" and provide means whereby subscribers are enabled to select various groups of auxiliary switches, the said groups respectively being common for connection to certain groups of subscribers. This selection is determined by the subscriber by means of switching mechanism at his substation. After he has selected the group of switches desired, his individual switch thereupon automatically, or without the volition of the subscriber, operates to pick out the first idle switch of the group selected by the subscriber. It will be readily understood that a switch of this character, effecting switching movements under the

control of a subscriber and then further switching movements automatically controlled, will be complicated and expensive as compared with a switch of which it is required that one only of these operations be performed.

A feature of my invention consists in replacing selector switches, as switches individual to subscribers' lines, by simpler switches, which may be called private switches, of which is required the automatic operation above referred to only. In so doing, I place the comparatively complicated selector switches in the position of auxiliary switches. As the number of auxiliary switches may be proportional to the number of co-existing calls which it is expected will exist in an exchange, and not proportional to the number of subscribers, it will be apparent that I am, by the arrangement above mentioned, enabled to greatly reduce the number of selector switches required for a given number of subscribers.

In accomplishing this, I may increase the total number of switches required for a given number of subscribers, but taking the system as a whole, its complexity may be materially decreased, which is one of the objects of my invention. A further object is to decrease the initial cost of an automatic telephone exchange switchboard of the general type referred to, and a further object is to reduce the cost of operating and maintaining the same.

Assuming a proposed telephone exchange, of the character above referred to, for ten thousand subscribers with groups of auxiliary switches containing each switches equal in number to ten per cent of the number of subscribers, the following changes would be effected by the employment of my invention. For ten thousand individual first selector switches may be substituted ten thousand individual private switches of materially simpler construction. Nine thousand individual first selector switches may be dispensed with and one thousand may be retained and employed as auxiliary switches common for connection to all subscribers in the exchange. The ten thousand private switches of such an exchange may be conveniently divided into one hundred groups of one hundred switches each, and ten first selector switches may be associated with each of said groups in such a manner

as to be common for connection from the switches of the group (and exclusively so) with which they are associated. There would also be one thousand second selector switches arranged in groups, the switches of each group being common for connection to a group of one thousand subscribers' lines. Each first selector switch would be adapted for connection to at least a portion of each group of second selector switches. There would also be one thousand connector switches arranged in groups, the switches of each group being common for connection to the lines of one hundred subscribers. Each second selector switch would be adapted for connection to at least a portion of each group of connector switches associated with its respective one thousand lines. It is to be understood that the proportion of auxiliary switches of each class to the number of lines in the exchange and the number of classes of auxiliary switches may be varied to suit varying requirements, and the grouping of switches may be other than that outlined, without departing from the substance of my invention. I, therefore, desire not to be limited to the arrangements described.

Generally speaking, it may be said that the subscriber's private switch acts only to prepare the substation switching mechanism for effecting a connection by placing a first selector switch under its control; that the first selector switch under its control picks out a one-thousand-line group of subscribers as determined by the calling subscriber; that the second selector switch under its control picks out the desired one-hundred-line group of the selected one-thousand-line group; and that the connector switch under its control picks out the individual line of the one-hundred-line group selected.

It is in connection with such a system as this that I have elected to illustrate and describe my invention, and the system disclosed in Figure 1 may be considered as illustrating such a system.

It will be readily understood by those skilled in the art that my invention is not limited to the particular arrangement in connection with which I illustrate and describe it, but may be applied to systems of varying description. It will also be understood that it is not to be limited to the particular type of private, selector and connector switches which I have shown, but that switches of any approved character may be employed.

While I have shown in Fig. 1 a system adapted for ten thousand lines and with the subscriber's private switch adapted to connect with a first selector, it is obvious that for smaller sized exchanges the first and second selector switches may be omitted and the subscriber's private switch adapted to

directly pick out and connect with an idle connector switch by wiring the connector switches to the bank contacts of the private switch.

Referring to the drawings, Figure 1, consisting of Sheets 1 and 2, illustrates diagrammatically two telephone lines extending from substations to the exchange with telephone exchange switchboard apparatus and circuits arranged in accordance with my invention.

Figure 2 illustrates a type of automatic switch which may be employed in connection with the circuit arrangements shown at D, E and F of Figure 1. The arrangements at D, E and F differ one from the other, and the switch shown in Figure 2 is generic to all of them, mechanical features and movements of the machine being referred to in the detailed description of Figure 1, for the purpose of illustrating in concrete mechanical forms, work done by the said arrangements.

Figure 2^a, Figure 2^b, Figure 2^c, Figure 2^d and Figure 2^e illustrate details of the switching mechanism shown in Figure 2.

Figure 3 illustrates a type of automatic switch which may be employed in connection with the circuit arrangements shown at C and G in Figure 1.

The mechanical operation of the switch shown in Figure 3 is as follows: A current of comparatively small volume is first caused to pass through the winding of relay 22. This causes the attraction of its light armature 21 which closes contact between springs 27 and 26 and also between springs 25 and 24. This first flow of current does not energize the said relay sufficiently to cause the attraction of heavy armature 23. The closure of contact between springs 26 and 27 establishes a local circuit for the flow of current through the winding of magnet 15, energizing said magnet. Contact pieces 301, 302, 303, 304, etc., to 320 are of the following characters. Contact pieces 301, 303, 305, etc., designated by the odd numbers, represent terminals of ten first selector switches. Contact pieces 302, 304, etc., those designated by even numbers, have permanent local ground connections. Wiper 44 is arranged to engage at all times with one or the other of its three arms illustrated, one of the contact pieces above described. It normally rests in engagement with a contact piece, the terminal of one of the selector switches which may or may not be a busy switch. The energization of magnet 15, above referred to, attracting armature 16, causes a forward movement of pawl 16^a attached to the said armature, causing a rotary movement of circular ratchet 44^a to which wiper 44 is rigidly attached. This effects a corresponding rotary movement of the said wiper, mov-

ing it out of engagement of a contact piece, the terminal of a selector switch, and into engagement with a contact piece having a permanent local ground connection. This
 5 causes a current of greater volume than that first mentioned to flow through the winding of relay 22, attracting its armature 23, whereupon pawl 23^a, pivoted to the said armature, moves forward out of engagement with the tooth of ratchet 23^b normally engaged by the said pawl, and into engagement with an adjacent ratchet tooth. Circuits are provided, described hereinafter in connection with Figure 1 whereby as
 10 long as relay 22 is energized, magnet 15 will alternately be energized and de-energized, its armature breaking its circuit after each energization but not until the said armature has been almost fully attracted, and thereupon again closing the circuit of said magnet but not until said armature is almost fully retracted, thus securing with each energization a full stroke of pawl 16^a. One way in which this may be accomplished is indicated in Fig. 3 in which the armature 16 of magnet 15 is made up of two substantially parallel parts linked by the arm 16^b having lost motion with respect to the two sections. Each energization and
 20 de-energization of magnet 15 causes a rotary movement of ratchet 44^a and wiper 44, one or the other of the arms of the said wiper engaging successive contact pieces until one is reached which is insulated from ground. This will occur as soon as the wiper reaches a contact, the terminal of an idle selector switch, terminals of busy selector switches being characterized by a connection to ground. As soon as such idle terminal is reached by one of said arms, relay 22 is de-energized, its armature 23 is retracted by spring 23^c, and circular ratchet 23^b is moved one step from left to right by means of pawl 23^a. Ratchet 32^c, being rigidly attached to ratchet 23^b, moves a corresponding distance with a rotary motion from left to right, in such a manner that portion 32^b of lever 32^a rests upon the circumference of ratchet 32^c. This retracts lever 32^a, causing arm 32 to disengage contact point 33 and to engage contact point 34. Arm 32 remains in engagement with contact point 34 until relay 22 is again energized and de-energized, causing a further rotary movement of ratchet 23^b from left to right by means of pawl 23^a. This causes portion 32^b of lever 32^a to engage the next tooth of ratchet 32^c, thereby allowing arm 32 to disengage contact point 34 and to again engage contact point 33.

Referring to ratchet 44^a, it will be understood that a plurality of wipers may be mounted upon the said ratchet and that a plurality of rows of contact pieces may be provided for such wipers respectively, and

that each movement of ratchet 44^a may thereby be made effective to accomplish a plurality of simultaneous circuit changes.

It will also be understood that lever 32^a may be adapted to effect corresponding
 70 movements of a plurality of circuit-changing arms similar to arm 32, and each movement of the lever may be employed to effect a plurality of simultaneous circuit changes.

Referring now to Figure 2, I show a
 75 shaft 257, the upper portion of which is provided with horizontal ratchet teeth, below which are provided vertical ratchet teeth. The said shaft is adapted to be moved vertically and with a rotary motion
 80 with respect to the banks of contact points 284 and 285. Upon the shaft are rigidly mounted the pair of wipers 258 and wiper 259 which, when the shaft is raised and
 85 turned, are adapted to be placed in contact with contacts shown in banks 284 and 285 respectively.

Referring to Figure 2^a, the structure of the rows of contacts may be readily understood.

The mechanical operation of the switch is as follows: When magnet 271 is energized, its armature 272 is attracted and pawl 290, being mounted upon said armature, engages a tooth of the horizontal ratchet and raises
 95 the shaft one step up. Armature 272 is provided with arm 291 which, upon the first energization of magnet 271, raises arm 264, thereby disengaging it from the pin shown in the illustration upon dog 292 which latter thereupon moves toward the shaft and engages with its upper portion a tooth of the horizontal ratchet, maintaining shaft 257 in whatever position it may have been raised
 100 vertically by pawl 290. Armature 272 is also provided with arm 273 which, upon the first attraction of the said armature, lifts arm 265 out of engagement with the pin shown upon armature 282 of magnet 281, thereby releasing pawl 266 and rendering the said pawl movable when magnet 276 is operated. If a number of successive energizing impulses are imparted to the energizing winding of magnet 271, shaft 257 will be moved upward by the engagement of
 105 pawl 290 with the successive teeth of the ratchet it is adapted to engage, a number of steps corresponding to the energizing impulses imparted to the magnet, dog 292 maintaining the shaft in its raised position
 110 after each step.

Magnet 278 is adapted, by means of pawl 279 mounted upon armature 297, to effect a rotary movement of shaft 257 by causing the engagement of said pawl upon the energization of said magnet, with the vertical ratchet teeth of the shaft, moving wipers 258 and 259 with a rotary movement from left to right. Successive energizing impulses sent through the magnet 278 effect, by means of
 120 125 130

the said pawl 279, successive rotary movements of the shaft. The lower portion of dog 292 is adapted to engage, when the dog is disengaged as above described, the vertical ratchet teeth on the shaft and maintains the shaft in whatever rotated position it may be placed by successive energizations of magnet 278.

Referring now to magnet 276: upon its armature 277 is mounted a ratchet consisting of teeth 273, 274 and 275. When armature 277 is attracted by the energization of the magnet, the ratchet mounted thereon is drawn downward with respect to pawl 266, and upon the release of the armature the said pawl moves out of contact with tooth 273 and forward into contact with tooth 274. The said pawl being pivoted, and rigidly attached to arm 267, the said arm is thereby moved out of contact with contact point 268 upon which it normally rests, and into contact with contact point 269, and a second attraction and release of armature 277 again causes the forward movement of pawl 266, moving arm 267 into engagement with contact point 270. It will be noted that in case magnet 276 is in an unenergized condition, each successive energization of magnet 278 will cause a forward movement of pawl 266 by means of arm 280 mounted on the armature of magnet 278 and engaging armature 277 of magnet 276. Tooth 275 prevents further forward movement of pawl 266 when said pawl engages said tooth.

There being ten horizontal ratchet teeth adapted to be used for securing vertical movements of the shaft, and ten vertical ratchet teeth adapted to be used for securing rotary movements of the shaft, the pair of wipers 258 and wiper 259 may be placed in contact with any correspondingly placed contacts in banks 284 and 285 by sending suitable numbers of energizing impulses through magnets 271 and 278.

Assuming that said wipers have been placed in contact with desired contacts in the said banks, the return of the wipers to their normal position, as shown in the illustration, is secured by the energization and de-energization of magnet 281, in the following manner: The energization of the said magnet attracts its armature 282 which moves forward arm 264 pivoted upon said armature in such a manner that it engages the pin upon dog 292; at the same time, the pin upon said armature 282 engages the offset on arm 265. Upon the de-energization of magnet 281, its armature is moved away from the core of the magnet by spring 283 which operates to draw dog 292 out of contact with the ratchets of the shaft and retains it in its withdrawn position. At the same time, arm 265 is drawn backward and, being pivoted to pawl 266, returns the said pawl to its normal position, as shown in the

illustration. The withdrawal of dog 292 out of engagement with the ratchets upon shaft 257 allows the free movement of the shaft, and the torsion of spring 262 turns the shaft with a rotary motion opposite to that effected by pawl 279. When this motion has placed wipers 258 and 259 out of engagement with the last contacts to the left of banks 284 and 285, shaft 257 is moved downward by gravity and rests in its normal position shown in the illustration.

Referring to Figure 2, I show a plurality of arms associated with pawl 266 of which arm 267 is adapted to engage contact points 268, 269 and 270, the other arms being adapted to engage the other series of contact points mounted in association with those designated, respectively. This figure discloses means by which pawl 266 upon its movement may be adapted to effect a plurality of simultaneous circuit changes. It is evident that the number of circuit changes so effected may be varied as required.

Referring to Figure 1, the operation of the system is as follows: Assuming that subscriber A desires to be connected with subscriber B, whose number is assumed to be 5435, the said subscriber A removes receiver 8 from hook switch 9, thereby allowing the switch hook to engage the upper one of the two anvils associated with it. This establishes a path for the flow of current as follows: from ground at private switch C, through contact between springs 19 and 20, through contact 42—41, through limb S of the telephone line, through the substation, returning over limb P of the telephone line, through contact 38—39 and through the winding of relay 22 to battery 18. This flow of current may be, due to the resistance of the telephone line, only sufficient to energize the said relay to a degree enabling it to attract its light armature 21, heavy armature 23 remaining in its normal position shown. The attraction of armature 21 closed contact between springs 24 and 25 and also between springs 27 and 26. The closure of contact between springs 27 and 26 established a path for the flow of current as follows: from battery 18, through the winding of magnet 15, through contact 16—17, contact 27—26, contact 30—29 to ground, causing the energization of magnet 15 and the attraction of its armature 16 out of engagement with anvil 17 thereby opening the circuit of the said magnet, but not until its armature was almost fully retracted. Wipers 44, 46 and 48 normally rest in engagement with terminals of a selector switch. The energization described of magnet 15, the said magnet corresponding to the similarly designated magnet in Figure 3, caused wipers 44, 46 and 48 to rotate one step, thus bringing wiper 44 into engagement with a permanently grounded contact piece as de-

scribed in connection with Figure 3. This established a path for the flow of current as follows: from the permanent local ground connection to the said contact piece, through wiper 44, through contact 32—33, through contact 25—24, through the winding of relay 22 and to battery 18. This flow of current is over a local circuit and is of a volume sufficiently great to cause the energization of relay 22 to a degree sufficient to attract heavy armature 23. This attraction opens contact between springs 19 and 20, thereby eliminating the preexisting flow of current over the telephone line through the winding of relay 22. It also (referring to Figure 3) causes the pawl 23^a to advance a step upon ratchet 23^b, engaging the tooth of the said ratchet adjacent to that upon which it rested prior to the energization of relay 22 described.

Referring to Figure 1, it is apparent that magnet 15 will continue to be alternately energized and de-energized, each energization and de-energization causing successive rotary step-by-step movements of wipers 44, 46 and 48 until contact between springs 27 and 26 is broken. The second of such energizations causes wiper 44 to engage a contact piece, the terminal of a first selector switch. The contact pieces, terminals of first selector switches associated with private switch C of subscriber A, are multiplied to private switches other than that of subscriber A, and any of the said first selector switches may be employed by any private switch to which their terminals are multiplied, for making a call. In case the first selector switch, into engagement with a terminal of which wiper 44 was placed by the above described second energization of magnet 15, is at the time of such engagement employed by another subscriber, the terminal engaged by wiper 44 will have a local ground connection through the relay 28 of a private switch individual to the line of a subscriber other than A. In this case, the flow of current over the local circuit is continued through the winding of relay 22 from ground, through the winding of relay 28 of the private switch of the other subscriber, through contact 34—32 of the said private switch, through wiper 44 of the said switch, to a terminal of the selector switch, through the multiple of said terminal then engaged by wiper 44 of the private switch of subscriber A, through contact 32—33 of the private switch of subscriber A, through contact 25—24 and through the winding of relay 22 to battery 18, thus maintaining heavy armature 23 of the said relay in its attracted position. Magnet 15 continues to vibrate, wiper 44 engaging alternately contact pieces permanently connected to ground and contact pieces, terminals of busy selector switches, until said wiper 44 engages the terminal of a selector switch not at that

time employed in a connection. Assuming this to occur when contact piece 45 is reached, there being no ground connection at that time to the said contact piece, the local circuit through the winding of relay 22 is interrupted and the relay is de-energized. This de-energization causes both armatures 21 and 23 to resume their normal positions, opening the circuit of magnet 15 by causing spring 27 to disengage spring 26, thus preventing further operation of the said magnet and causing wiper 44 to rest in engagement with contact piece 45, wipers 46 and 48 resting in engagement with contact pieces 47 and 49. The return to normal of heavy armature 23 of relay 22 caused arm 32 to disengage contact point 33 and to engage contact point 34 by (referring to Figure 3) the retraction of pawl 23^a causing ratchet 23^b to rotate one step from left to right. Arms 35, 38 and 41, by means not shown in Figure 3, were by the aforesaid movement of ratchet 23^b moved out of engagement with contact points 36, 39 and 42 respectively, and into engagement with contact points 37, 40 and 43 respectively. The engagement of arm 32 with contact point 34 placed ground upon contact piece 45 of the first selector switch and its multiples, rendering the said switch busy with respect to all other private switches having access to it. The engagement of arm 35 with contact point 37 established a ground connection to contact point 205, rendering the line of subscriber A busy with respect to subscribers who may desire connection with his line. The engagement of arms 38 and 41 with contact points 40 and 43 opened up the circuit of relay 22 to limbs P and S of the telephone line and extended the circuits of the said limbs to wipers 46 and 48 respectively.

Subscriber A now sends, by means of key 4, five impulses of current over the following path: from ground, through contact 6—4, over limb P of the line, through contact 38—40, through contact 46—47, through contact 80—81, through the winding of relay 51 and to battery 50, causing five energizations and de-energizations of the said relay, each of which causes an impulse of current to flow over the following path: from ground 56, through contact between springs 55 and 54, through contact 61—60, through magnet 62 and to battery 63.

Referring now to Figure 2 and regarding it as illustrating first selector switch D, magnet 62 in Figure 1 corresponding to magnet 271 in Figure 2, the five impulses of current referred to caused five successive energizations and de-energizations of magnet 271 and caused the shaft of the first selector switch to be raised five steps upward in such a manner that wipers 258 and 259 are placed in positions horizontal with the fifth rows of contact pieces in banks 284 and 295 re-

spectively, designated c and c^1 . These rows of contact pieces are assumed to be terminals of second selector switches common for connection to subscribers to whom are assigned numbers from 5000 to 5999.

Subscriber A now sends, by means of key 1, one impulse of current over the following path: from ground, through contact 3—1, over limb S of the telephone line, through contact 41—43, contact 48—49, contact 84—85, through the winding of relay 52 to battery 50, causing the said relay to become energized and then de-energized. This causes an impulse of current to flow over the following path: from ground 56, through contact between springs 55 and 58, through the winding of relay 59 to battery 63, causing the energization and de-energization of the said relay. Relay 59 corresponding to relay 276 in Figure 2, pawl 266 is moved out of engagement with ratchet tooth 273 and into engagement with ratchet tooth 274. This (referring to Figure 1) accomplishes the following circuit changes: arms 72, 76, 80 and 84 disengage, respectively, contact points 73, 77, 81 and 85, and move into engagement, respectively, with contact points 74, 78, 82 and 86. The engagement of arm 72 with contact point 74 established a flow of current from ground, through contact 72—74, through the winding of magnet 64, through contact 65—66 to battery 67, causing the energization of magnet 64. Magnet 64 corresponding to magnet 278 in Figure 2, this energization caused shaft 257 in Figure 2 to be rotated one step, and placed wipers 258 and 259 in engagement with the first contact pieces at the left of rows c and c^1 , respectively. The contact pieces in rows c and c^1 are multiplied to other first selector switches, all of which have access to the second selector switches whose terminals appear in the said rows. In case the first contacts mentioned are terminals of a switch already selected by some other first selector switch, the contact piece corresponding to contact piece 89 in Figure 1 will be grounded, and a flow of current will result over the following path: from ground, through wiper 88, through relay 69, through contact 76—78, through the winding of relay 59 to battery 63, causing the said relay to be energized. The windings of relays 69 and 59 are so proportioned that this flow of current does not cause the attraction of armature 70.

The energization described of magnet 64 attracted its armature, opening its circuit at contact 65—66 and causing its de-energization. The said magnet alternately becomes energized and de-energized as long as arm 72 rests in engagement with contact point 74, each energization and de-energization causing the wipers of the switch to engage terminals of successive second selector switches. As soon as an idle second selector

switch is reached assumed to be switch E, its terminal corresponding to contact piece 89 will be free from ground connection, and the circuit above described as energizing relay 59 will be broken, causing the de-energization of the said relay 59. This effects the following circuit changes: arms 72, 76, 80 and 84 disengage respectively contact points 74, 78, 82 and 86 and engage respectively contact points 75, 79, 83 and 87. The disengagement of arm 72 from contact point 74 opened the circuit of magnet 64 and prevented further rotary movement of the shaft. The engagement of arm 76 with contact point 79 put ground on wiper 88 and contact piece 89, and its multiples, of the second selector switch picked out, rendering the said switch busy with respect to other first selector switches having access to it. In case the contact pieces at the left of rows c and c^1 are terminals of an idle switch, the engagement of arms 72, 76, 80 and 84 with contact points 75, 79, 83 and 87 is accomplished by arm 280 (Figure 2), relay 276 of said figure corresponding to relay 59 of Figure 1 remaining unenergized.

Subscriber A now sends, by means of key 4, four impulses of current from ground at the substation, through contact 90—91, contact 124—125, through the winding of relay 95 of second selector switch E to battery 94, causing four energizations and de-energizations of the said relay, resulting in four energizations and de-energizations of magnet 106. This magnet corresponding to magnet 271 in Figure 2, regarding the said figure now as illustrating second selector switch E, the shaft of the said switch is raised upward four steps, placing wipers 258 and 259 in positions horizontal with the fourth rows of contacts in banks 284 and 285, counting from below, designated d and d^1 respectively (Figure 2).

These rows of contacts are assumed to be terminals of ten connector switches common for connection to lines of subscribers to whom are allotted numbers running from 5400 to 5499. The said terminals are multiplied to second selector switches other than E, all of which thereby have access to the said connector switches.

Subscriber A now sends, by means of key 1, one impulse of current over limb S of the telephone line, through contact 92—93, contact 128—129, through the winding of relay 96 to battery 94, causing the energization of the said relay. This causes an impulse of current from ground 102 through the winding of relay 103 to battery 107, energizing and de-energizing the said relay. Relay 103 corresponding to relay 276 shown in Figure 2, the following circuit changes are accomplished by its energization and de-energization. Arms 116, 120, 124 and 128 disengage respectively contact points 117, 121, 125 and 129, and move into engagement, respectively, with contact points 118, 122, 126 and 130.

121, 125 and 129, and engage respectively contact points 118, 122, 126 and 130. The engagement of arm 116 with contact point 118 causes the energization and de-energization of magnet 108; and the said magnet corresponding to magnet 278 in Figure 2, wipers 132, 135 and 137 are thereby placed in engagement with the first contacts at the left of rows d and d^1 . In case the connector switch, whose terminals the said contacts are, is not already in use by connection being made with it by another second selector switch employing it in a connection, its contact piece corresponding to contact piece 133 in Figure 1 will be insulated from ground, and the impact of arm 280 upon armature 277 of relay 276 in Figure 2, and its withdrawal upon the de-energization of magnet 278, will cause arms 116, 120, 124 and 128 (Figure 1) to move into engagement with contact points 119, 123, 127 and 131.

In case the connector switch, whose terminals the contact pieces at the left of rows d and d^1 are, is already employed by another second selector switch, the contact piece corresponding to contact piece 133 in Figure 1 will be grounded, and a path for the flow of current will be established from ground through the winding of relay 113, through contact 120—122, through winding of relay 103 and to battery 107 energizing relay 103. The windings of relays 113 and 103 are so proportioned that this flow of current does not cause relay 113 to attract its armature. Magnet 108 will alternately become energized and de-energized, moving wipers 132, 135 and 137 into engagement with terminals of successive connector switches. As soon as terminals of an idle connector switch are reached, the circuit through relay 103 is broken, causing arms 116, 120, 124 and 128 to engage respectively contact points 119, 123, 127 and 131. The engagement of arm 116 with contact point 119 opens the circuit of magnet 108, causing wipers 132, 135 and 137 to rest in engagement with the contact pieces, the terminals of the idle connector-switch assumed to be terminals 133, 136 and 138 of connector switch F. The engagement of arm 120 with contact point 123 connects contact piece 133 and its multiples to ground, rendering the connector switch busy with respect to other second selector switches having access to it.

Subscriber A now sends, by means of key 4, three impulses of current from ground, through contacts 46—47, 90—91, 135—136, 161—163, through the winding of relay 140 and to battery 139, causing three energizations and de-energizations of relay 140. Three impulses of current are thereby caused to flow from ground, through contact 145—144, through contact 150—151, through contact 185—186, through the

winding of magnet 182 to battery 184, energizing and de-energizing the said magnet three times.

Figure 2 may be regarded as illustrating a connector switch, arm 280 being in this case omitted.

Magnet 182 corresponding to magnet 271 in Figure 2, wipers 258 and 259 are raised to positions horizontal with the third rows of contacts in banks 284 and 285, counting from below, which contacts are assumed to be, counting from left to right, terminals of lines of subscribers to whom are allotted numbers from 5431 to 5440.

Subscriber A now sends, by means of key 1, one impulse of current over limb S of the line through contact 48—49, contact 92—93, contact 137—138, through the winding of relay 141, through contact 166—165 to battery 155, causing the energization and de-energization of the said relay. This causes an impulse of current to flow over the following path: from ground, through contact between springs 145 and 146, through the winding of relay 147 to battery 152, causing the energization and de-energization of the said relay. Relay 147 corresponding to relay 276 in Figure 2, the following circuit changes are accomplished by its energization and de-energization: arms 185, 189, 193 and 197 disengage respectively contact points 186, 190, 194 and 198, and engage respectively contact points 187, 191, 195 and 199.

Subscriber A now sends, by means of key 4, five impulses of current over the previously traced path, through the winding of relay 140. Arm 185 at this time resting in engagement with contact point 187, five impulses of current are thereby caused to flow through the winding of magnet 183, energizing and de-energizing the said magnet five times. Magnet 183 corresponding to magnet 278 in Figure 2, wipers 258 and 259 are moved with a rotary motion five steps from left to right until they engage the fifth pairs of contacts from the left of the third rows respectively of banks 284 and 285. These are the terminals of the line of subscriber 5435, or subscriber B. This is assumed to occur when wipers 204, 206 and 208 (Figure 1) engage respectively contact pieces 205, 207 and 209.

Subscriber A now sends, by means of key 1, one impulse of current over the previously traced path, through the winding of relay 141 to battery 155, energizing and de-energizing the said relay. Relay 147 is thereby energized and de-energized in a manner previously described. In case the line of subscriber B is already in use, contact piece 205 is connected to ground and the energization of relay 147, attracting armature 148 into engagement with anvil 149, establishes a path for the flow of current as fol-

lows: from ground, through contact 205—204, through contact 189—191, through contact 149—148, through the winding of magnet 153 to battery 154. The said magnet 153 corresponding to magnet 281 in Figure 2, the mechanism of the connector switch, upon the de-energization of magnet 153 when the de-energization of relay 147 interrupts the above described flow of current, is caused to return to normal. Subscriber A now depresses key 4, which act, under the above described circumstances, causes an impulse of current to flow over a previously traced path, through the winding of relay 140, energizing the said relay. The connector switch F having returned to normal, arm 185 now rests in engagement with contact point 186. The flow of current above described energizing relay 140, caused a flow of current from ground, through contact between springs 145 and 144, through contact 150—151, through contact 185—186, through the winding of magnet 182 to battery 184, again causing an upward movement of the shaft of the connector switch. Spring 203 is thereby caused to engage anvil 202, cutting busy back machine 210 into circuit with the line of subscriber A and causing him to receive, by means of his receiver, the characteristic busy signal. Upon receiving the same, subscriber A causes the release of second selector switch E and first selector switch D and their returns to normal in a manner hereinafter described.

In case the line of subscriber B is not in use at the time the wipers of the connector switch engage terminals of the said line, wiper 204 is connected to battery through contact 35—36 and no flow of current occurs, upon the energization of relay 147 in the manner described, through the winding of magnet 153, and the connector switch is not released. The energization and de-energization of relay 147 in this case causes arms 185, 189, 193 and 197 to disengage respectively contact points 187, 191, 195, and 199, and to engage respectively contact points 188, 192, 196 and 200. The engagement of arm 189 with contact point 192 establishes a connection from ground, through contact 192—189, through wiper 204 to contact piece 205 and its multiples, rendering the line of subscriber B busy with respect to other connector switches having access to the said line. It also caused the energization of relay 22° thereby cutting relay 22 and magnet 15 of private switch G from the talking circuit.

When subscriber A in this case depresses key 4, causing the energization of relay 140 of the connector switch, the energization of the said relay establishes a path for the flow of current from ground, through contact 145—144, through contact 150—151,

through contact 185—188, through the winding of relay 181 to battery 201, energizing the said relay and attracting its armatures 179 and 178 into engagement with anvils 175 and 176. This cuts ringing machine 174 into the metallic circuit of the line of subscriber B and causes bell 10 of subscriber B to ring. Subscriber A then releases key 4, relay 181 is de-energized and its armatures 179 and 178 resume their normal positions, as shown in Figure 1.

Subscriber B, in response to the call, removes receiver 8 from switch hook 9 which allows the hook lever to engage the upper of the two anvils shown associated with it, establishing a path for the flow of current from the grounded side of battery 171, through winding 170 of relay 168, through the upper winding, as illustrated, of relay 167, through contact 180—179, through contact 193—196, through contact 206—207, over limb P of the telephone line of subscriber B, returning over limb S of the telephone line, through contact 209—208, through contact 200—197, contact 178—177, through the lower winding of relay 167, through winding 169 of relay 168 and to the active side of battery 171. Relay 168 is differentially wound and the above described flow of current does not cause the energization of its core. The above described flow of current causes the energization of relay 167, its armatures 161 and 166 are attracted to engage anvils 162 and 164 respectively, establishing a path for the flow of current from the grounded side of battery 155, through contact 162—161, through contact 136—135, contact 91—90, contact 47—46, over limb P of the telephone line of subscriber A, through the substation, returning over limb S of the line through contact 48—49, contact 92—93, contact 137—138, through the winding of relay 141, through contact 166—164 to the active side of battery 155.

Subscribers A and B are now in conversation through condensers 211 and 212, their transmitters being energized, respectively, by currents flowing over the two paths above described.

When they have finished their conversation, subscribers A and B replace their receivers on the hook switches and depress keys 4 and 1 associated with their respective substations, thereby grounding simultaneously the two limbs of their respective telephone lines.

In case subscriber B does this first, winding 170 of relay 168 is short circuited upon the establishment of ground to limb P of the line at the substation, the balancing effect of the differential windings of the said relay is destroyed and the core of the relay is magnetized, attracting armature 172 into engagement with anvil 173. Current thereupon flows from ground, through contact 130

172—173, through magnet 153 to battery 154, causing the energization of magnet 153. Subscriber B releases keys 4 and 1, thereby removing ground from limbs P and S of the telephone line. Receiver 8 being at this time upon the switch hook, the circuit of relay 168 is opened up at the substation, the said relay is de-energized, armature 172 disengages anvil 173, thereby breaking the circuit of magnet 153 and causing its de-energization. The said magnet corresponding to magnet 281 in Figure 2, its energization and de-energization as described causes the return of the connector switch to normal. The release of keys 4 and 1 by subscriber B caused the de-energization of relay 167, the armatures 161 and 166 of the said relay thereupon resuming their normal positions, as shown in Figure 1.

Subscriber A, depressing keys 1 and 4 and replacing his receiver on the hook subsequent to similar action by subscriber B, causes simultaneous energizations of relays 140 and 141, the currents energizing the said relays passing through contacts 161—163 and 166—165 respectively. The simultaneous energizations of the said relays cause springs 142 and 143 to engage, establishing a path for the flow of current as follows: from ground, through contact 123—120 (second selector switch E), through the winding of relay 113, through contact 132—133, contact 142—143, through the winding of magnet 153 and to battery 154. This flow of current energizes relay 113, attracting armature 114 into engagement with anvil 115, establishing a path for the flow of current as follows: from ground, through contact 79—76 (first selector switch D), through the winding of relay 69, through contact 88—89, contact 114—115, through the winding of magnet 112 to battery 111, energizing relay 69 and magnet 112. The energization of relay 69 attracted armature 70 into engagement with anvil 71, establishing a path for the flow of current as follows: from ground, through relay 28 (private switch C), through contact 34—32, contact 44—45, contact 70—71, through the winding of magnet 68 and to battery 67, causing the energizations of relay 28 and magnet 68. The energization of relay 28 established a path for the flow of current as follows: from ground, through contact 29—31, through the winding of relay 22 to battery 18, energizing the said relay and causing it to attract its two armatures whereby pawl 23^a (referring to Figure 3), associated with heavy armature 23, is caused to advance one step upon ratchet 23^b, engaging a tooth of the said ratchet adjacent to the one engaged by it prior to the above described energization of relay 22.

When subscriber A releases keys 4 and 1, removing ground from the two limbs of the

telephone line, relays 140 and 141 are de-energized, opening the circuit of relay 113 at contact 142—143 and causing the de-energization of the said relay. The de-energization of relay 113 opens the circuit of magnet 112 at contact 115—114 and, similarly, the circuit of relay 69. Magnet 112 corresponding in function to magnet 281 in Figure 2, its de-energization causes the return of second selector switch E to normal. The de-energization of relay 69, due to the above described opening of its circuit, opens the circuits of magnet 68 and relay 28 at contact 71—70, thereby causing their de-energizations. The de-energization of magnet 68 (the said magnet corresponding in function to magnet 281 in Figure 2) causes the return of first selector switch D to normal. The de-energization of relay 28 allows armature 29 to disengage anvil 31, thereby de-energizing relay 22. Referring to Figure 3, the de-energization of the said relay allows armature 23 to be retracted by spring 23^c; and pawl 23^a, being thereby drawn backward, causes ratchet 23^b to be moved with a rotary motion one step from left to right. This movement brings portion 32^b of lever 32^a into engagement with a tooth upon ratchet 32^c, adjacent to that engaged by the said portion before subscriber A began the call. This engagement causes a forward movement of lever 32^a, and arm 32 disengages contact point 34 and engages contact point 33, thereby resuming its normal position. Referring now to Figure 1, the above described movement of lever 32^a, in addition to returning arm 32 to engagement with contact point 33, also returned arms 35, 38 and 41 to their normal positions (by means not shown) in engagement with contact points 36, 39 and 42 respectively.

All apparatus, used in establishing the connection between subscribers A and B, has now been returned to normal. It will be noted that wipers 44, 46 and 48 of private switch C rest in engagement with contact pieces 45, 47 and 49 of the first selector switch used in establishing the connection. It may be said that the normal or idle position of a subscriber's private switch is one in which the wipers of the switch rest in engagement with contact pieces, the terminals of the first selector switch last used.

In case subscriber A depresses keys 4 and 1 and replaces receiver 8 in advance of subscriber B, the release operations are accomplished in the following manner: The grounding of limb P of the telephone line of subscriber A causes winding 159 of relay 156 of connector switch F to be short circuited; and the said relay being differentially wound, the energizing effect of its two windings is unbalanced, its core is magnetized and armature 157 is attracted into

engagement with anvil 158, establishing a path for the flow of current from ground, through contact 157—158, through the winding of relay 140 to battery 139, energizing relay 140. Relay 141 being at this time energized, spring 142 engages spring 143, establishing a path for the flow of current from ground, through contact 123—120 of second selector switch E, through relay 113, contact 132—133, contact 142—143, through the winding of magnet 153 to battery 154, energizing magnet 153 and relay 113. The circuit conditions arising from the energization of relay 113 have been described in connection with the release operation in the case in which subscriber B caused the release of the connector switch, and need not be further described, the release of the second selector switch E, first connector switch D and private switch C occurring when subscriber A releases keys 4 and 1 in the manner before given. The release of keys 4 and 1 by subscriber A in the present case causes the de-energization of magnet 153, which causes the return of the connector switch F to normal.

It will be noted that subscriber B controls only the release of the connector switch associated with his line, while subscriber A is enabled to accomplish the release of all the apparatus used by him in calling subscriber B, including the connector switch.

The plurality of batteries in Figure 1 may be a single battery.

When in the claims I use the term "selector switch" without a qualifying term, for example, such as "first" or "second," I use the term broadly. In such use, the term is to be understood to include the idea of connector switch as well as the idea of first and second selector switches. Generally speaking, a "selector switch" may be defined as a switch adapted to be operated by a calling subscriber to extend the conversational circuit of his telephone line to the line of a called subscriber, or to extend the said circuit to a switch or group of switches common for connection to a desired limited group of subscribers' lines. When in the claims I refer to a switch without specifying "selector switch" or "connector switch," the idea of switches of these characters is excluded.

When in the claims I use the term "connection to," the idea of direction is intended to be conveyed. "Connection to" implies to called subscribers.

"Connection from" conversely means from calling subscribers.

When in the claims I use the term "isolate," as of a switch, I mean that the switch is isolated or rendered busy with respect to other switches with which it is associated and which have access to it.

When in the claims I use the term "busy

circuit," as of a switch, I mean a circuit extending from the said switch to another switch associated with the first, and rendering the said other switch busy with respect to other switches adapted to be placed in electrical engagement with it.

When I use the term "trunk release circuit," I refer to a circuit extending between two switches in electrical engagement, including apparatus for causing the return of a switch to its normal position.

I claim:—

1. An automatic telephone system including a plurality of subscribers' lines connecting substations with the central office, an equal plurality of automatic switches, each switch individual to one of said lines, a smaller plurality of selector switches associated with said automatic switches, each of said selector switches being common for connection to and connection from each of said telephone lines, switching mechanism associated with the line of a calling subscriber adapted to perform a preliminary switching operation for causing the automatic switch of said line to bring said line into operative relation with an idle one of said selector switches, and a central source of current and bridges adapted to supply talking current to subscribers' lines therefrom when connected.

2. An automatic telephone system including a plurality of subscribers' lines connecting substations with the central office, an equal plurality of automatic switches, each switch individual to one of said lines, a smaller plurality of selector switches associated with said automatic switches, each of said selector switches being common for connection to and connection from each of said telephone lines, switching mechanism associated with the line of a calling subscriber adapted to perform a preliminary switching operation for causing the automatic switch of said line to bring said line into operative relation with an idle one of said selector switches, means for isolating said selector switch when said relation is established and a central source of current and bridges adapted to supply talking current therefrom to subscribers' lines when connected.

3. An automatic telephone system including a plurality of subscribers' lines connecting substations with the central office, an equal plurality of automatic switches, each switch individual to one of said lines, a smaller plurality of selector switches associated with said automatic switches, each of said selector switches being common for connection to and connection from each of said telephone lines, switching mechanism associated with the line of a calling subscriber adapted to perform a preliminary switching operation for causing the automatic switch of said line to bring said line into operative

relation with an idle one of said selector switches, means for isolating said selector switch when said relation is established, switching devices comprised in said mechanism controlled by the subscriber for directing switching movements of a selector switch when said relation exists in establishing a desired conversational circuit, and a central source of current and bridges adapted to supply talking current to subscribers' lines therefrom when connected.

4. An automatic telephone system including subscribers' lines a series of groups of automatic switches at the central office, each switch individual to a subscriber's line, selector switches less in number than the total number of automatic switches, each common for connection to all subscribers in the exchange, a grouping thereof into divisions equal in number to said groups of automatic switches, each division being individual for connection from the lines of a single group of automatic switches and its switches being common for connections from the lines of the switches of said group, switching mechanism associated with the line of a calling subscriber adapted to perform a preliminary switching operation for causing the automatic switch of said line to bring said line into operative relation with an idle one of said selector switches, and a central source of current and branches adapted to supply talking current to subscribers' lines therefrom when connected.

5. An automatic telephone system including subscribers' lines, a series of groups of automatic switches at the central office, each switch individual to a subscriber's line, selector switches less in number than the total number of automatic switches, each common for connection to all subscribers in the exchange, a grouping thereof into divisions equal in number to said groups of automatic switches, each division being individual for connection from the lines of a single group of automatic switches and its switches being common for connections from the lines of the switches of said group, switching mechanism associated with the line of a calling subscriber adapted to perform a preliminary switching operation for causing the automatic switch of said line to bring said line into operative relation with an idle one of said selector switches, means for isolating said selector switch when said relation is established, and a central source of current and bridges adapted to supply talking current to subscribers' lines therefrom when connected.

6. An automatic telephone system including subscribers' lines a series of groups of automatic switches at the central office, each switch individual to a subscriber's line, selector switches less in number than the total number of automatic switches, each

common for connection to all subscribers in the exchange, a grouping thereof into divisions equal in number to said groups of automatic switches, each division being individual for connection from the lines of a single group of automatic switches and its switches being common for connections from the lines of the switches of said group, switching mechanism associated with the line of a calling subscriber adapted to perform a preliminary switching operation for causing the automatic switch of said line to bring said line into operative relation with an idle one of said selector switches, means for isolating said selector switch when said relation is established, switching devices comprised in said mechanism controlled by the subscriber for directing switching movements of a selector switch when said relation exists in establishing a desired conversational circuit, and a central source of current and bridges adapted to supply talking current to subscribers' lines therefrom when connected.

7. An automatic telephone system including two telephone lines connected for conversation, a central source of current associated therewith, supplying current for talking purposes, a private switch and a selector switch associated with said lines at the central office, contact-pieces included in said switches forming part of the talking circuit of the lines, an additional contact-piece for each of said switches forming part of a trunk release circuit for its respective switch, and apparatus for returning the switches to their normal positions when conversation is finished.

8. An automatic telephone system including two telephone lines connected for conversation, a central source of current associated therewith, supplying current for talking purposes, a private switch and a selector switch associated with said lines at the central office, contact-pieces included in said switches forming part of the talking circuit of the lines, and an additional contact-piece for each of said switches forming part of a trunk release circuit for its respective switch.

9. An automatic telephone system including two telephone lines connected for conversation, a central source of current associated therewith, supplying current for talking purposes, a private switch, a first selector switch, a second selector switch and a connector switch associated with said lines, contact-pieces included in each of said switches forming part of the talking circuit, additional contact-pieces for said private switch, said first selector switch and said second selector switch one for each, forming parts of trunk release circuits for the respective switches, and apparatus for returning each of said switches to its normal position when conversation is finished.

10. An automatic telephone system including two telephone lines connected for conversation, a central source of current associated therewith, supplying current for talking purposes, a private switch, a first selector switch, a second selector switch and a connector switch associated with said lines, contact-pieces included in each of said switches forming part of the talking circuit, and trunk release circuits extending between said switches insulated from the talking circuit for returning to their normal positions said private switch, said first selector switch and said second selector switch.

11. An automatic telephone system including two telephone lines connected for conversation, a central source of current associated therewith supplying current for talking purposes, a private switch, a first selector switch, a second selector switch and a connector switch associated with said lines, contact pieces included in each of said switches forming part of the talking circuit, and combined trunk release and busy circuits, extending between said switches, for said private switch, said first selector switch and said second selector switch.

12. An automatic telephone system including subscribers' lines, a series of groups of automatic switches at the central office, each switch individual to a subscriber's line, selector switches less in number than the total number of automatic switches, each common for connection to all subscribers in the exchange, switching mechanism associated with the line of a calling subscriber adapted to perform a preliminary switching operation for causing the automatic switch of said line to bring said line into operative relation with an idle one of said selector switches, and a central source of current and branches adapted to supply talking current to subscribers' lines therefrom when connected.

13. An automatic telephone system including subscribers' lines, a series of groups of automatic switches at the central office, each switch individual to a subscriber's line, selector switches less in number than the total number of automatic switches, each common for connection to all subscribers in the exchange, switching mechanism associated with the line of a calling subscriber adapted to perform a preliminary switching operation for causing the automatic switch of said line to bring said line into operative relation with an idle one of said selector switches, means for isolating said selector switch when said relation is established, and a central source of current and bridges adapted to supply talking current to subscribers' lines therefrom when connected.

14. An automatic telephone system including subscribers' lines, a series of groups of automatic switches at the central office,

each switch individual to a subscriber's line, selector switches less in number than the total number of automatic switches, each common for connection to all subscribers in the exchange, switching mechanism associated with the line of a calling subscriber adapted to perform a preliminary switching operation for causing the automatic switch of said line to bring said line into operative relation with an idle one of said selector switches, means for isolating said selector switch when said relation is established, switching devices comprised in said mechanism controlled by the subscriber for directing switching movements of a selector switch when said relation exists in establishing a desired conversational circuit, and a central source of current and bridges adapted to supply talking current to subscribers' lines therefrom when connected.

15. A telephone system including a telephone line, a progressive switch, line contacts for said line upon said switch, selectors having multiple contacts upon said switch, mechanism for performing a preliminary switching operation at the substation when said line is used as a calling line, to cause line contacts of said line to register with multiple contacts of an idle selector whereby said line is operatively connected with said selector, and release means for said line effective to disconnect the same from said selector without altering the operative position of said progressive switch.

16. A telephone system including a telephone line, selector switches associated therewith, multiple terminals of said selector switches, an automatic switch, means for operating mechanism of said automatic switch to cause it to connect said line with terminals of an idle selector, together with means for freeing said line from said selector when disconnection is desired without altering the selective position of said automatic switch.

17. A telephone system including a telephone line, a selector switch, an automatic selective switch having contacts connected with said selector continuing said telephone line to said selector, other telephone lines, a test circuit for said selector maintained in a peculiar electrical condition while said line is connected with said selector to prevent connection of said other lines with said selector, and means for restoring said test circuit to its normal condition when disconnection of said line from said selector is desired without changing the selective position of said automatic switch.

18. A telephone system including a telephone line, a selector switch associated therewith, a selective automatic switch having contacts individual to said line, multiple contacts of said selector switch at said automatic switch, mechanism for causing con-

tacts of said line to register with multiple contacts of said selector, such registering being controlled by the idle or busy condition of said selector, a magnet for freeing said line from said selector when disconnection is desired, and means for operating said magnet to free said line without altering the selective position of said automatic switch as at the time of release.

19. A telephone system including a telephone line, a progressive switch, line contacts for said line upon said switch, selectors having multiple contacts upon said switch, mechanism for performing a preliminary switching operation at the substation when said line is used as a calling line, to cause line contacts of said line to register with multiple contacts of an idle selector whereby said line is operatively connected with said selector, mechanism at the substation of said line for transmitting directive currents to adjust said selector in establishing a desired connection, mechanism for restoring said selector to normal controlled from the substation, and a trunk release circuit extending to said progressive switch responsive to said mechanism effective to disconnect said line from said selector without altering the operative position of said progressive switch.

20. In a telephone exchange system provided with selector switches of various classes at the exchange including connector switches adapted to cooperate with calling devices at the substations in establishing desired connections, the combination with two subscribers' lines connected for conversation, of a selector switch of each class, contact pieces in each of said switches forming part of the conversational circuit, an additional contact piece included in each of said switches other than the connector switch preventing intrusion upon the conversational circuit, release circuits including said additional contact pieces, a differential relay at the exchange, and means for energizing said relay from the calling substation to operate said release circuits.

21. In a telephone exchange system provided with selector switches of various classes at the exchange, including connector switches adapted to co-operate with calling devices at the substations in establishing desired connections, the combination with two subscribers' lines connected for conversation, of a selector switch of each class, contact pieces in each of said switches forming part of the conversational circuit, an additional contact piece included in each of said switches, other than the connector switch, preventing intrusion upon the conversational circuit, release circuits including said additional contact pieces, an electromagnet at the exchange having a winding through which talking current is supplied to the calling line, and means for altering the elec-

trical condition of said winding when disconnection is desired to cause operation of said release circuits.

22. In a telephone exchange system provided with selector switches of various classes at the exchange, including connector switches adapted to co-operate with calling devices at the substations in establishing desired connections, the combination with a subscriber's line, of a first selector switch adapted to be operated under substation control, second selector switches, multiple terminals of said second selector switches, wipers included in said first selector switch adapted to engage said terminals, a part of said wipers being for conversational use, a test wiper enabling said first selector to select and isolate an idle second selector, means for causing a flow of current over said wiper when disconnection is desired, release mechanism at the exchange operated responsive to said flow, and means at the exchange for supplying talking current to the subscriber's line.

23. A telephone system including a calling line and a called line switched for conversation at the exchange, a selector included in the conversational circuit, a contact of said selector preventing intrusion, a differential relay at the exchange having windings through which talking current is supplied to the calling line, said windings neutralizing one another during conversation, means controlled at the calling substation for unbalancing said windings when disconnection is desired, and mechanism responsive to the unbalancing of said windings to cause a current flow over said contact to restore said selector.

24. A telephone system including a calling subscriber's line and a called subscriber's line switched to connection at the exchange, a selector included in the connection at the exchange, a private wiper for said selector preventing intrusion, a central source of current, a differential relay at the exchange having windings connected to opposite poles of said source, the other ends of said windings being connected together via the calling substation, a switch controlled at the calling substation for causing a preponderating current flow in one winding of said relay when disconnection is desired, an electromagnet for restoring said selector, and means for energizing said magnet responsive to said preponderating flow over a circuit including said private wiper.

25. A telephone system including a pair of connected subscribers' lines, a plurality of selective switches at the exchange connecting said lines, talking contacts included in said switches through which the conversational circuit extends, contacts included in some of said switches not forming part of the conversational circuit with means con-

trolled by said contacts for preventing intrusion upon the connection, a relay at the exchange controllable responsive to circuit changes produced at the calling substation, means controlled by said relay for altering the connections of said last-mentioned contacts to release the switches, and a battery at the exchange for supplying talking current to the calling substation through said relay.

26. A telephone system including a pair of connected telephone lines, a plurality of selective switches at the exchange through which the conversational circuit extends, a multiple private or test contact for one of said switches for preventing intrusion upon the conversational circuit, means for altering the electrical condition of said contact to restore to normal one of said switches, and a central source of operating and talking current located at the exchange.

27. A telephone system including a telephone line, a selective switch at the exchange connected with said line, a second selective switch connected with said first switch, contacts of said switches forming part of a talking circuit, an additional contact piece for said first switch in connection with a contact of said second switch serving to protect the talking circuit from intrusion, means for altering the electrical condition of said contact piece when disconnection is desired, release mechanism for restoring a selective switch responsive to said altered electrical condition, and a battery at the central exchange for supplying talking current to said talking circuit.

28. A telephone system including a telephone line, a selective switch at the exchange connected with said line, a second selective switch connected with said first switch, contacts of said switches forming part of a talking circuit, an additional contact piece for said first switch in connection with a contact of said second switch serving to protect the talking circuit from intrusion, a release relay, means responsive to a switch at the substation of said line for altering the operative condition of said relay when disconnection is desired, switching mechanism controlled by said relay for affecting the electrical condition of said contact piece on alteration of said operative condition as described, release apparatus responsive to the electrical condition of said contact piece for restoring a selective switch, and a battery at the exchange for supplying talking current to said talking circuit.

29. A telephone system including a telephone line, a selective switch at the exchange connected with said line, a second selective switch connected with said first switch, contacts of said switches forming part of a talking circuit, an additional contact piece for said first switch in connection with a contact

of said second switch serving to protect the talking circuit from intrusion, a central source of current, a relay at the exchange through which talking current from said source is supplied to the transmitter of said line, means responsive to a switch at the substation of said line for altering the operative condition of said relay when disconnection is desired, switching mechanism controlled by said relay for affecting the electrical condition of said contact piece on alteration of said operative condition as described, and release apparatus responsive to the electrical condition of said contact piece for restoring a selective switch.

30. A telephone system including telephone lines, relatively movable switch contacts through which a talking circuit between calling and called lines may be completed, means, including a testing contact independent of the contacts included in the talking circuit for determining said talking circuit, means for restoring said switch contacts to normal including a circuit through said testing contact, and a centralized source of operating and talking current.

31. A telephone system including telephone lines, relatively movable switch contacts through which a talking circuit between calling and called lines may be completed, means, including a testing contact separate from the contacts included in the talking circuit for determining the relative movement of said contacts, a circuit through said testing contact for restoring said switch contacts to normal, means for controlling said circuit, and a centralized source of operating and talking current.

32. A telephone system including telephone lines, interconnecting link-circuits and a "selector" switch for extending the talking circuit of a calling line to an idle link-circuit, said "selector" switch including a test contact for use in selecting the idle link-circuit, said test contact being separate from the contacts included in the talking circuit, means for restoring said switch to normal including a circuit extending through said testing contact, and a source of current located at the central exchange for supplying talking current to said calling line.

33. A telephone system including telephone lines, interconnecting link-circuits, a plurality of interconnecting automatic switch mechanisms for uniting calling and called lines by link-circuits into a talking circuit, testing contacts associated with certain of said switch mechanisms for use in determining the link-circuits to be included in said talking circuit, means for releasing one of said switch mechanisms, means in one of said switch mechanisms for supplying talking current to said talking circuit, a circuit including a testing contact, and means

operated by said releasing means over said circuit to release another of said switch mechanisms.

34. A telephone system including telephone lines, interconnecting link-circuits, a plurality of selective switch mechanisms for uniting a calling and a called line by link-circuits into a talking circuit, a testing contact associated with one of said mechanisms for selecting a link-circuit to be included in said talking circuits, a circuit for releasing one of said switch mechanisms including said testing contact, and means for controlling said circuit, said means including a relay through which talking current is supplied to said talking circuit.

35. A telephone system including telephone lines, interconnecting link-circuits, a plurality of selective switch mechanisms for uniting a calling and a called line by link-circuits into a talking circuit, a private contact separate from said talking circuit associated with one of said switch mechanisms, a connection device for contact therewith to place a busy potential upon said contact to protect the talking circuit from intrusion, a release circuit for one of said switching mechanisms including said private contact, and apparatus for altering the potential of said private contact when disconnection is desired to render said release circuit effective, said apparatus including a relay through which talking current is supplied to said talking circuit.

36. A telephone system including telephone lines; interconnecting link-circuits; "selector" and "connector" switches for uniting calling and called lines by certain of said link-circuits into a talking circuit, said "selector" and "connector" switches being provided with testing contacts for use in determining the talking circuit, and means for releasing said "selector" switch including a circuit through its testing contact in response to the release of said "connector" switch; and means for releasing the latter, said means including a battery serially connected through the windings of a relay to the two sides of said talking circuit.

37. A telephone system including a telephone line, a non-numerical non-restoring selective switch at the exchange connected with said line, a second selective switch connected with said first switch, contacts of said switches forming part of a talking circuit, an additional contact piece for said first switch in connection with a contact of said second switch serving to protect the talking circuit from intrusion, a release relay, means for altering the operative condition of said relay when disconnection is desired, and release apparatus responsive to an altered electrical condition of said contact piece produced responsive to said relay for restoring a selective switch.

38. A telephone system including telephone lines, a calling telephone line, selective switching mechanisms at the exchange for use in interconnecting lines, less in number than the number of lines, a progressive switch at the exchange, multiple contacts of said mechanisms at said switch, contacts individual to said calling line at said progressive switch, mechanism responsive to the removal of the receiver of said calling line to electrically connect said individual contacts and multiple contacts of an idle switching mechanism, and apparatus effective, when disconnection is desired, to operatively dissociate said line from said mechanism while maintaining said switch in its antecedent progressive position.

39. An automatic telephone system including telephone lines, a calling telephone line, selectors at the exchange for use in interconnecting lines, less in number than the number of lines, a progressive switch at the exchange, multiple contacts of selectors at said switch, contacts individual to said calling line at said progressive switch, mechanism responsive to a preliminary impulse transmitted over said calling line to electrically connect said individual contacts and multiple contacts of an idle selector, whereby said calling line is operatively associated with said selector, means for electromagnetically adjusting said selector in establishing connection from said line to a called line, and a release circuit including a circuit controlling electromagnet for operatively dissociating said line from said selector while maintaining said switch in its antecedent progressive position.

40. An automatic telephone system including telephone lines, a calling telephone line, selectors at the exchange for use in interconnecting lines, less in number than the number of lines, a progressive switch at the exchange, multiple contacts of selectors at said switch, contacts individual to said calling line at said progressive switch, mechanism responsive to a preliminary impulse transmitted over said calling line to electrically connect said individual contacts and multiple contacts of an idle selector, whereby said calling line is operatively associated with said selector, a release circuit including a circuit controlling electromagnet for operatively dissociating said line from said selector while maintaining said switch in its antecedent progressive position, a multiple contact of said selector included in said release circuit, and means for causing a current flow from said selector responsive to mechanism actuated by currents over said calling line to operate said release circuit.

41. An automatic telephone system including telephone lines, a calling telephone line, selectors at the exchange for use in interconnecting lines, less in number than the

number of lines, a progressive switch at the exchange, multiple contacts of selectors at said switch, contacts individual to said calling line at said progressive switch, mechanism responsive to a preliminary impulse transmitted over said calling line to electrically connect said individual contacts to multiple contacts of an idle selector, whereby said calling line is operatively associated with said selector, a release circuit including a circuit controlling electromagnet for operatively dissociating said line from said selector while maintaining said switch in its antecedent progressive position, a multiple contact of said selector included in said release circuit, electromagnetic mechanism for causing an alteration of the electrical condition of said contact to render said circuit effective, and switching means at the substation of said line for controlling said electromagnetic mechanism.

42. An automatic telephone system including telephone lines, a calling telephone line, selectors at the exchange for use in interconnecting lines, less in number than the number of lines, a progressive switch at the exchange, multiple contacts of selectors at said switch, contacts individual to said calling line at said progressive switch, mechanism responsive to a preliminary impulse transmitted over said calling line to electrically connect said individual contacts to multiple contacts of an idle selector, whereby said calling line is operatively associated with said selector, means for electromagnetically adjusting said selector in establishing connection from said line to a called line, a connector for subsequent operation responsive to said means, to connect directly with the called line, and a central source of current and branches for supplying talking current to subscribers' lines therefrom when connected.

43. An automatic telephone system including telephone lines, a calling telephone line, selectors at the exchange for use in interconnecting lines, less in number than the number of lines, a progressive switch at the exchange, multiple contacts of selectors at said switch, contacts individual to said calling line at said progressive switch, mechanism responsive to a preliminary impulse transmitted over said calling line to electrically connect said individual contacts to multiple contacts of an idle selector, whereby said calling line is operatively associated with said selector, mechanism effective, when disconnection is desired, to operatively dissociate said line from said selector while maintaining said switch in its antecedent progressive position, and a central source of current and branches for supplying talking current to subscribers' lines therefrom when connected.

44. An automatic telephone system includ-

ing telephone lines, a calling telephone line, selectors at the exchange for use in interconnecting lines, less in number than the number of lines, a progressive switch at the exchange, multiple contacts of selectors at said switch, contacts individual to said calling line at said progressive switch, mechanism responsive to a preliminary impulse transmitted over said calling line to electrically connect said individual contacts to multiple contacts of an idle selector, whereby said calling line is operatively associated with said selector, means for electromagnetically adjusting said selector in establishing connection from said line to a called line, a connector for subsequent operation responsive to said means, to connect directly with the called line, a contact for said selector serving to protect the talking circuit when established against intrusion, means for altering the electrical condition of said contact for restoring purposes, an electromagnet for said selector responsive to the altered electrical condition of said contact to restore said selector, and release means for said calling line to operatively dissociate said line from said selector while maintaining said progressive switch in its antecedent progressive position.

45. An automatic telephone system including telephone lines, a calling telephone line, selectors at the exchange for use in interconnecting lines, less in number than the number of lines, a progressive switch at the exchange, multiple contacts of selectors at said switch, contacts individual to said calling line at said progressive switch, mechanism responsive to a preliminary impulse transmitted over said calling line to electrically connect said individual contacts to multiple contacts of an idle selector, whereby said calling line is operatively associated with said selector, means for electromagnetically adjusting said selector in establishing connection from said line to a called line, a connector for subsequent operation responsive to said means, to connect directly with the called line, a contact for said selector serving to protect the talking circuit when established against intrusion, a trunk release circuit at the exchange, means for altering the electrical condition of said contact to render said circuit effective when disconnection is desired, and release means for said calling line to operatively dissociate said line from said selector while maintaining said switch in its antecedent progressive position.

46. An automatic telephone system including telephone lines, a calling telephone line, selectors at the exchange for use in interconnecting lines, less in number than the number of lines, a progressive switch at the exchange, multiple contacts of selectors at said switch, contacts individual to said calling

line at said progressive switch, mechanism responsive to a preliminary impulse transmitted over said calling line to electrically connect said individual contacts to multiple contacts of an idle selector, whereby said calling line is operatively associated with said selector, and a central source of current and branches for supplying talking current to subscribers' lines therefrom when connected.

47. An automatic telephone system including subscribers' lines, a series of individual automatic switches at the central office, selector switches less in number than the total number of lines, switching mechanism associated with the line of a calling subscriber at the substation adapted to perform a preliminary switching operation for causing the automatic switch of said line to bring said line into operative relation with an idle one of said selector switches, and a central source of current and branches adapted to supply talking current to subscribers' lines therefrom when connected.

48. An automatic telephone system including subscribers' lines, a series of individual automatic switches at the central office, selector switches less in number than the total number of lines, switching mechanism associated with the line of a calling subscriber at the substation adapted to perform a preliminary switching operation for causing the automatic switch of said line to bring said line into operative relation with an idle one of said selector switches, means for isolating said selector switch when said relation is established, and a central source of current and bridges adapted to supply talking current to subscribers' lines therefrom when connected.

49. A telephone system including a pair of connected telephone lines, a pair of selectively operable selective switches having switch contacts through which the talking circuit extends, electromagnets for controlling the restoration of said switches respectively when disconnection is desired, a circuit extending between said switches including a wiper contact of one of said switches and separate from the talking circuit having connections to said electromagnets, electromagnetic means controllable over the talking circuit for operating said other circuit to restore said switches, and means at the exchange for supplying said talking circuit with talking current.

50. A telephone system including a pair of connected telephone lines, a pair of selective switches at the exchange through which the talking circuit extends, electromagnetic release means for said switches, respectively, a circuit extending between said switches including a wiper contact of one of said switches and separate from the talking circuit connected to said means

of both said switches, means for operating said circuit to simultaneously alter the electrical conditions of said means when disconnection is desired, and means at the exchange for supplying said talking circuit with talking current.

51. A telephone system including telephone lines, a selective switch at the exchange for directive operation in interconnecting said lines, auxiliary selective switches for interchangeable connection with said first switch, an electro-magnetic release means for said first switch, similar means for each of said other switches, apparatus for interconnecting the release means of said first switch with the release means of any one of said other switches connected with said first switch over a circuit separate from the talking circuit including a wiper contact of one of said switches, means for controlling the electrical condition of said interconnecting circuit to operate the release means of the connected switches when disconnection is desired, and means at the exchange for supplying said lines with talking current.

52. A telephone system including telephone lines, link-circuits at the exchange, selective switches including non-numerical switches for connecting together idle ones of said circuits in connecting said lines for conversation, traveling contacts of said switches included in the completed talking circuit, electromagnetic release means for said switches respectively, additional traveling contacts of the switches forming the completed talking circuit not included in the talking circuit, connections for each of said last-mentioned contacts for placing the release means of its respective switch in electrical connection with the release means of an adjacent selective switch, means for altering the electrical condition of the additional contact of a switch when disconnection is desired to operate the release means of said switch and the adjacent switch, and means at the exchange for supplying said lines with talking current.

53. A telephone system including a telephone line, a selective switch mechanism, contacts individual to said line at said mechanism, selectors having multiple contacts at said mechanism, means for causing contacts of said line to be connected with multiple contacts of an idle selector, and means for opening the connection from said line to said selector, without altering the selective position of said mechanism as at the time of such opening.

54. A telephone system including a telephone line, a selective switch mechanism, selectors having multiple contacts at said mechanism, means for causing said mechanism to select contacts of an idle selector, apparatus for connecting the limbs of said

telephone line to the selected contacts, and release means for terminating the connections of said limbs with said contacts without altering the selective position of said mechanism as at the time of release.

55. A telephone system including a telephone line, a selective switch mechanism, selectors having multiple contacts at said mechanism, means for causing said mechanism to select contacts of an idle selector, apparatus for connecting the limbs of said telephone line to the selected contacts, release means for terminating the connections of said limbs with said contacts without altering the selective position of said mechanism as at the time of release, and a trunk release circuit for operating said release means.

56. A telephone system including a telephone line, a selective switch mechanism, selectors having multiple contacts at said mechanism, means for causing said mechanism to select contacts of an idle selector, apparatus for connecting the limbs of said telephone line to the selected contacts, release means for terminating the connections of said limbs with said contacts without altering the selective position of said mechanism as at the time of release, a trunk release circuit for operating said release means, and a central source for furnishing current necessary for switching and talking.

57. A telephone system including a telephone line, a switch for said line at the exchange, a magnet for controlling said switch, means for energizing and de-energizing said magnet, said switch serving on a first de-energization of said magnet to extend the circuit of said line, and on the next de-energization of said magnet to assume the normal position.

58. In a telephone system, the combination with a telephone line, of switch contacts, a magnet for controlling said contacts, means including suitable circuit connections for energizing and de-energizing said magnet, said magnet serving on one de-energization to close said contacts, on the next de-energization to open the same, on the third de-energization to again close said contacts, and so on substantially as described.

59. In a telephone system, the combination with switch contacts having forward and backward movements, of an electromagnet armature and suitable connections between said armature and said contacts serving on a first retraction of said armature to shift said contacts forward, on a second retraction to move said contacts backward to normal, on a third retraction to again shift said contacts forward, and so on substantially as described.

60. In a telephone system, the combination with an electromagnet, of switch con-

tacts having forward and backward movements, said magnet serving on a first operation to shift said contacts forward from normal, on a next like operation to move said contacts backward to normal, on a third like operation to again shift said contacts forward, and so on substantially as described.

61. In a telephone exchange employing a plurality of kinds of automatic switches, a line switch for each subscriber in the exchange, each line switch having a single series of contact points, a group of larger switches corresponding in number to the contact points on one line switch, each one of the larger switches having a plurality of series of contact points, connections from each one of the larger switches to corresponding contact points on as many line switches as there are contact points in the plurality of contact points on one of the larger switches, and means by which upon a subscriber closing an electrical connection, his line switch will start into an automatic operation capable of making electrical connection in succession to all of the contact points thereon.

62. The combination with the stations of a telephone exchange, said stations divided into groups, and a less number of switches divided into corresponding groups, each switch of any one group being common for the use of any station of the same group but not usable by any of the stations in the other groups, means controlled from any station for automatically selecting an idle one of the switches in the corresponding group, means also controlled from the station for moving the automatically selected switch so as to extend the connections to any of the other groups, and means at the said exchange for supplying said stations with talking current.

63. The combination with a series of groups of telephone stations, of a group of primary switches and a group of secondary switches apportioned to each group of stations, the primary switches being the same in number as the stations and each being of small capacity while the secondary switches are of large capacity and are less in number than the stations, means by which a primary and an automatically selected one of the secondary switches co-operate in extending an electrical connection from a station in one group to a station in some other group, and means at the said exchange for supplying talking current through said switches to said telephone stations.

64. The combination with a series of groups of telephone stations provided with mechanisms and connections for establishing telephonic connections between individual stations of different groups, of two groups of switches apportioned to the exclusive use

of each group of stations, the first of said groups consisting of a series of small switches equal in number to the stations each switch of which is individual for the use of a different station and all of which have connections limited to the switches of the second group, the second of said groups consisting of a series of large switches less in number than the stations each switch of which is common for the use of all stations of the group and all of which second switches have connections extending to the other groups of the exchange, and a battery at the central exchange for supplying talking current through said switches to said telephone stations.

65. The combination with the stations of a telephone exchange, said stations being divided into groups, of two groups of switches apportioned to the exclusive use of the stations of each group, the switches of one of said groups being each individual for the use of a different station, and the switches of the other group being less in number and each being common for the use of all stations of the corresponding group of stations, means by which upon an operation of an individual switch an idle one of the common switches is made temporarily individual for the use of the station associated with the operated individual switch, and a battery at the central exchange from which talking current is supplied through said switches to said stations.

66. In a telephone system, means including connector switches for establishing a talking circuit, means for supplying talking current through the connectors to the subscribers' lines from a centralized source of current-supply, selectors including private wipers, and means for releasing the selectors over circuits which include the private wipers thereof.

67. An electric switch comprising a bank of contacts arranged in the arc of a circle, a spindle, and a plurality of connected wiper arms mounted on said spindle and spaced apart thereon at angular distances representing the same fraction of a circle as the angular length of the arc of contacts, whereby in rotating the spindle, continuous engagement may be maintained between the wiper arms and the bank contacts, only one arm engaging the contacts at the same time however.

68. A telephone system including a pair of connected telephone lines, a pair of selective switches at the exchange through which the talking circuit extends, electromagnetic release means for said switches, respectively, a connection extending between said switches including a wiper contact of one of said switches and separate from the talking circuit connected to said means of both said switches, means controlled over

said talking circuit to simultaneously operate said means to release, and a centralized source of current for supplying said talking circuit with current.

69. In an automatic telephone system, a subscriber's line, a non-numerical selecting switch for said line, a disconnect magnet for said selecting switch, a trunk line to which said selecting switch is adapted to connect said subscriber's line, a selecting switch for said trunk line, a pair of controlling magnets bridged across said trunk line at said latter selecting switch, and a pair of contacts on said controlling magnets actuated when said magnets are simultaneously operated to close a circuit directly through the disconnect magnet of the second named selecting switch and through the disconnect magnet of said first named selecting switch, substantially as described.

70. A telephone system including two telephone lines connected for conversation, a central source of current associated therewith, supplying current for talking purposes, a non-numerical switch and a selector switch associated with said lines at the central exchange, contact pieces included in said switches forming part of the talking circuit, an additional contact piece for each of said switches forming part of a release circuit for its respective switch, and apparatus for returning the switches to their normal position when conversation is finished.

71. In a telephone system, a pair of selecting switches connected by a trunk line, disconnecting devices for each of said selecting switches, a separate conductor extending between said selecting switches for connecting said disconnecting devices, a pair of controlling relays at one of said selecting switches to close an energizing circuit for said disconnecting devices involving said separate conductor, and a centralized source of current supplying talking current over said trunk line.

72. In a telephone system, a pair of automatic switches for extending a line from one point to another, releasing devices in said switches, a release circuit extending between said switches separate from said line, a pair of relays in one of said switches, and a pair of springs controlled jointly by said relays for energizing said release circuit.

73. In a telephone system, a calling line and a called line, a selector switch and a connector switch for extending a talking circuit from the calling line to the called line via a circuit separated into two electrical sections at said connector, a pair of relays bridged across the section nearest the calling subscriber, releasing apparatus for said switches, an energizing circuit for said releasing apparatus, a pair of springs controlled jointly by said relays for energizing said release circuit, and a battery at the cen-

tral exchange supplying talking current to said calling and called lines.

74. In a telephone system, two selecting switches, a trunk line connecting said selecting switches, a battery at the exchange supplying talking current to said trunk line for talking purposes, a pair of controlling relays for one of said selecting switches, disconnecting mechanism for both of said selecting switches, a magnet at each switch for controlling said disconnecting mechanisms, a circuit containing both of said magnets, and a pair of contacts on said controlling relays adapted to control the disconnecting circuit to cause the release of both said selecting switches, substantially as described.

75. In a telephone system, two selecting switches, a metallic circuit trunk line connecting said selecting switches, disconnecting mechanism for one of said switches, a circuit for controlling said disconnecting mechanism, a pair of controlling relays for governing the selecting action of the other of said selecting switches, the coils of said relays being bridged across the metallic circuit of said trunk line, a source of current adapted to supply current through the coils of said controlling relays to the limbs of said trunk line, a third conductor forming a return path for said current, a pair of contacts on said controlling relays included in said disconnecting circuit, means for separately completing the circuit between each limb of said trunk line and said third conductor to cause the separate action of said relays, means for simultaneously completing said connections to cause the simultaneous action of said relays to close said disconnecting circuit, and a centralized source of operating and talking current located at the exchange.

76. In an automatic telephone system, a pair of selecting switches connected by a trunk line, a separate conductor extending between said selecting switches, disconnecting devices for each of said selecting switches adapted to be inclosed in the circuit of said separate conductor, a pair of controlling relays at one of said selecting switches adapted to close the circuit through said separate conductor to energize both of said disconnecting devices, and a centralized source of operating and talking current.

77. In a trunk release system, a pair of automatic selector switches, a wiper for one of said switches, a release circuit extending between said switches including said wiper, a source of current for said release circuit, a release relay coil for one of said switches and a release magnet coil for the other of said switches, both serially included in said release circuit, a release relay for the last named switch, contacts for said relay also in said release circuit for completing the continuity of the same, means for energiz-

ing said last named relay to bring about the release of both said switches, and means for supplying current from said source for talking purposes.

78. In an automatic trunk release system, a pair of switches, a talking circuit and a release circuit independent thereof temporarily extending between said switches, a source of current at the exchange for operating and talking purposes, a wiper of one switch, a release relay coil of one switch, a release magnet coil of the other switch, all serially included in said release circuit, a release relay of the latter switch, and contacts thereof also in said release circuit for controlling the release of both switches.

79. In an automatic trunk release system, a pair of selector switches, a talking circuit extending between said switches, a test contact independent of said talking circuit, a guard circuit including said test contact for guarding the talking circuit against intrusion, a release relay coil of one switch serially included in said guard circuit, a release circuit serially including said guard circuit, a source of current and a release magnet coil of the other of said switches also serially included in said release circuit, means to actuate said release relay and release magnet in series, and means for supplying current to said talking circuit from said source of current.

80. An electric switch comprising a bank of contacts arranged in the arc of a circle, a shaft, a plurality of wiper arms on said shaft and spaced apart thereon at angular distances, representing the same fraction of a circle as the angular length of the arc of contacts, whereby in rotating the shaft continuously engagement may be maintained between the wiper arms and the bank contacts, only one arm effectively engaging the contacts at the same time.

81. An automatic telephone system including subscribers' lines, individual automatic switches at the central exchange, selector switches less in number than the total number of lines, subscriber control means at the substation for causing said individual automatic switches to connect said lines to idle ones of said selector switches, and a central source of current adapted to supply talking current to said subscribers' lines therefrom.

82. An automatic non-restoring trunk-selecting switch comprising an actuating or propelling magnet, a line relay controlling the energizing of said magnet, means including a line circuit conductor for suitably energizing said relay, a local circuit controlled by the relay for energizing the same, and means operated by the said magnet for opening the local circuit to stop the switch on an idle trunk terminal.

83. An automatic non-restoring trunk-

selecting switch comprising a line relay, means including a line circuit conductor for energizing said relay, and means for establishing a guarding potential for any selected trunk terminal by the de-energizing of said relay.

84. An automatic non-restoring trunk-selecting switch comprising a line relay, means including a line circuit conductor for energizing said relay, and means including a local circuit for keeping said relay energized to keep the switch in operation until an idle trunk terminal is found.

85. In a telephone system, a non-numerical non-restoring automatic trunking switch having trunk terminals, line terminals, means including a line relay for bringing the line terminals into engagement with trunk terminals, release trunk terminals corresponding to the trunk terminals, a release magnet, and means for connecting the release magnet with release trunk terminals.

86. In a telephone system comprising a subscriber's line and trunk lines, a subscriber's individual non-restoring trunking switch for finding an idle trunk line when the subscriber calls, and a trunk-release circuit excluded from the path of the voice currents for said individual switch.

87. In a telephone system comprising a subscriber's line and trunk lines, an individual non-numerical non-restoring trunking switch for seizing an idle trunk line when the subscriber calls, and means controlled inductively by the subscriber for releasing said switch.

88. In a telephone system, a plurality of subscribers' lines, means including a non-numerical non-restoring switch and a numerical switch for establishing a connection between a calling and a called subscriber's line, a calling device at the substation for controlling the operation of said numerical switch, and means for controlling the operation of said non-numerical switch from the calling substation prior to the initial operation of said calling device.

89. In a telephone system, a plurality of lines, non-numerical non-restoring switches for said lines, numerical switches common to said lines, relays for said switches one of said relays normally connected with one of said lines, a battery and circuit controllers for controlling current from said battery over said lines, said relay responsive to said battery and to one of said circuit controllers to operate one of said switches to connect one of said lines with one of said numerical switches.

90. In a telephone system, a plurality of lines, non-numerical switches one for each line, numerical switches common to said lines, relays one for each switch and normally connected to the line of its switch, a battery and circuit controllers for con-

trolling current from said battery over said lines, each relay responsive to the circuit controller of the line to operate its switch to connect the line with one of said numerical switches, and means for supplying talking current to said lines from said battery.

91. In a telephone system, a line, a non-numerical switch associated with said line, automatic means comprising a relay normally connected with the line for controlling said switch to connect the line with another line, a circuit controller for said first line for controlling said relay, automatic means for extending connection from said other line, and a battery common to said lines for operating and for talking purposes.

92. In a telephone system, a line, a non-numerical trunk selector associated with said line, automatic means comprising a relay normally connected with the line for controlling said selector to connect the line with another line, a circuit controller for said first line for controlling said relay, automatic means for extending connection from said other line, and a battery common to said lines for operating and for talking purposes.

93. In a telephone system, a line, a non-numerical trunk selector associated with said line, automatic means for controlling said selector to connect the line with an idle trunk, a switch on said trunk, another line, automatic means associated with said other line to connect said other line with said trunk switch when the trunk is idle, and a common battery for operating and for talking purposes.

94. In a telephone system, a subscriber's line, a non-numerical automatic trunk selector switch individual thereto, line wipers for said switch normally disconnected from the line, common means in said switch for both opening the line relay circuit and for connecting both sides of the line and line wipers when the switch makes a call, and a central battery for supplying talking current to said subscriber's line.

95. In an automatic telephone system, a metallic circuit subscriber's line, a metallic circuit trunk line to which said subscriber's line is adapted to be extended, selecting switches including non-numerical switches for said subscriber's line and said trunk line, controlling magnets for each of said selecting switches connected respectively with said subscribers' and trunk lines, means for causing the selecting switch of said line to connect said line with said trunk, and to simultaneously disconnect said controlling magnet from said line, and a centralized source of current for furnishing talking battery thru said switches to said subscriber's line.

96. In a telephone system, means for es-

establishing a talking circuit between a calling and a called subscriber's line including a non-numerical non-restoring switch, said means including a single wound relay for controlling said circuit, and means by which the calling subscriber energizes said relay before the call reaches the called line to maintain the continuity of the circuit during use of the same for talking purposes.

97. In a telephone system, a line, a non-numerical trunking switch individual thereto, trunk lines for talking purposes leading therefrom, said switch having line wipers always in electrical engagement with some one of said trunk lines, which connected trunk line is always the one last employed by said switch for extending a call, normally open connections between said line and line wipers, a relay, means for energizing said relay over the line circuit, and means operated upon the de-energization of said relay to close said normally open connections.

98. In a telephone system, a line, a non-numerical trunking switch, trunk lines for talking purposes leading therefrom, said switch having line wipers always in electrical engagement with some one of said trunk lines, which connected trunk line is always the one last employed by said switch for extending a call, said switch having a step-by-step-actuated shaft that always rotates in the same direction, normally open connections between said line and line wipers, a relay, means for energizing said relay over the line circuit, and means operated upon the de-energization of said relay to close said normally open connections.

99. In a telephone system, a non-numerical trunking switch, trunk lines for talking purposes leading therefrom, said shaft having line wipers always in electrical engagement with some one of said trunk lines, which connected trunk line is always the one last employed by said switch for extending a call, a telephone line to which said switch is individual, and a normally de-energized relay controlling, on de-energization, the connection between the said telephone line and switch.

100. In a telephone system, a line, a non-numerical trunking switch, trunk lines for talking purposes leading therefrom, said switch having line wipers always in electrical engagement with some one of said trunk lines, which connected trunk line is always the one last employed by said switch for extending a call, means for controlling said switch over the two sides of a metallic line circuit in series, normally open connections between said line and line wipers, a relay, means for energizing said relay over the line circuit, and means controlled by said relay to close said normally open connections.

101. In an automatic telephone system, line and trunk circuits, a private conductor for each of said line circuits, and selector means controlled over limbs of one of said lines in series to connect said line with an idle trunk circuit, and to place an abnormal electrical condition on the private conductor of said line to indicate its busy condition, and centralized means for supplying talking current over the two sides of the said line circuit in series.

102. An automatic non-restoring trunk-selecting switch comprising a wiper, a line relay, means including a line circuit conductor for energizing said relay, and a circuit closed by the energizing of said relay and including a winding thereof in series with the said wiper.

103. In a telephone system, the combination of subscribers' telephone lines, a battery common to said lines and normally in bridge of each line, automatic trunk-selecting and connecting apparatus allotted to said telephone lines, trunk-lines leading from said apparatus, subscribers' sub-station switches for closing the line-circuits, said trunk-selecting and connecting apparatus adapted to perform a trunking operation upon the first closure of the line circuit at any calling sub-station, to extend said line circuit beyond said apparatus, automatic switches, means for controlling said automatic switches by electrical impulses transmitted through said trunk selecting and connecting apparatus, and means for supplying talking current from said battery to said lines.

104. In a telephone system, the combination of a subscriber's line, a selectively operated trunking switch therefor, provided with a single-wound operating magnet, a quick acting armature, a slow acting armature, and different circuits controlled or operated by said armatures.

105. In a telephone system, the combination of a subscriber's line, trunk lines, automatic means for distinguishing between busy and idle trunk lines, an operating magnet, a quick acting armature, a slow acting armature, and two energizing circuits for said magnet, one energizing circuit including the subscriber's line, and the other energizing circuit being controlled by both of said armatures.

106. In a telephone system, the combination of a subscriber's line, a non-restoring trunking switch therefor, automatic switching machinery, a circuit for first initiating the operation of said trunking switch, said circuit including both sides of the line in series, and grounded line-circuits extending through said trunking switch and adapted for subsequently controlling the said switching machinery.

107. In a telephone system, the combina-

tion of subscribers' lines, selectively operated non-restoring individual trunking switches for said lines, connectors each adapted to make the final connection directly with the called subscriber's line, energizing circuits for enabling the subscribers to initiate the operation of their individual switches, each of said circuits including the two sides of the line in series, and grounded line-circuits for controlling said connectors, said grounded circuits including the ground between the exchange and the substations of said lines.

108. In a telephone system, calling telephone lines and called telephone lines divided into groups, automatic step-by-step switching means controlled by the calling subscriber for extending connection to a called line, a circuit including both sides of the calling line for initiating the operation of said automatic switching means, to select a group of the exchange, suitable circuits extending over the calling line for controlling the operations by which the automatic switching means completes the connection to the called line, and a central battery supplying current over said circuit for talking purposes.

109. In a telephone trunking system, the combination of subscribers' telephone lines, a battery common to said lines and normally in bridge of each line, automatic trunk selecting and connecting apparatus allotted to said telephone lines, trunk lines leading from said apparatus, means having vertical motion, under substation control, to select groups or divisions of the exchange, and rotary motion to connect with a line in the selected group, for extending connection from the selected trunk line in the direction of the called subscriber, subscribers' substation apparatus for closing the line circuits, said apparatus adapted to be started in its selecting motion by the initial closure of the line circuit at any calling substation, and means for supplying talking current from said battery to said lines.

110. In a telephone trunking system, the combination of subscribers' telephone lines, trunk lines, automatic trunk-selecting and connecting apparatus for connecting a calling subscriber's line with an idle trunk line, actuated by the initial closure of the line to select a trunk, means having vertical motion, under substation control, to select groups or divisions of the exchange, and rotary motion to connect with a line in the selected group, for extending connection from the selected trunk line in the direction of the called subscriber, and a battery normally in bridge of each line for supplying operating and talking current thereto.

111. In a telephone trunking system, the combination of subscribers' telephone lines,

a common battery or centralized source of electric current supply, automatic trunk-selecting and connecting machinery provided with means for normally maintaining said battery in bridge of each telephone line, subscribers' switches for closing the lines at the substations thereof to enable a calling subscriber to initiate the operation of said machinery, trunk lines leading from said machinery, means including connectors for establishing connection between any selected trunk line and the line of the calling subscriber, each connector having vertical motion to select groups or divisions of the exchange and rotary motion to connect with a line in the selected group for extending connection from the selected trunk line in the direction of the called subscriber, and provided also with suitable coils or windings for temporarily maintaining said battery in bridge across any talking circuit, temporarily established between calling and called subscribers' lines, to supply talking current to the substations thereof.

112. In a telephone trunking system, the combination of a subscriber's line, a non-restoring trunking switch therefor, automatic switching machinery having vertical motion under substation control, to select groups or divisions of the exchange, and rotary motion to connect with a line in the selected group, for extending connection from the trunk seized by the switch in the direction of the called subscriber, a circuit for initiating the operation of said trunking switch, said circuit including both sides of the line in series, and grounded line circuits for subsequently controlling the said switching machinery.

113. In a telephone trunking system, the combination of a calling subscriber's line, a called subscriber's line, automatic means for trunking the calling line into connection with the called line, including a non-numerical, non-restoring switch and means having vertical motion under substation control, to select groups or divisions of the exchange, and rotary motion to connect with a line in the selected group, for extending connection from the trunk seized by the switch in the direction of the called subscriber, a circuit including both sides of the calling line for initiating the operation of said automatic means, a suitable circuit extending over the calling line for initiating the release of the said automatic means, and a calling mechanism for causing the vertical and rotary motion, said mechanism requiring a separate actuation thereof for each digit of the called number, operative to transmit impulses by each operation.

114. In automatic switching apparatus, non-numerical non-restoring selector switches containing multiple test terminals, means for maintaining test potential on ter-

minals that are busy, and a test relay for each switch adapted upon initial energization to connect itself to the test wiper of the switch through a circuit controlled by itself exclusively.

115. A telephone system including subscribers' lines, automatic individual switches for said lines, numerical switches less in number than the number of automatic switches, subscriber controlled means located at the substation for performing a switching operation to cause the automatic switch of the line to connect said line into circuit with an idle one of said selector switches, and a central source of current for supplying talking current to said lines.

116. In a telephone exchange system, the combination with a plurality of lines, a non-restoring automatic switch for interconnecting the same, a motor for driving said switch, and a relay adapted to be energized upon the initiation of a call to start said motor in motion, and means for maintaining said motor active while a call is in progress.

117. A telephone system including a pair of subscribers' lines, a non-numerical switch and a numerical switch for connecting said lines in conversational circuit, contact pieces included in said switches forming part of the talking circuit, a central battery for supplying talking current to said talking circuit, an additional contact piece for each of said switches forming a part of a trunk release circuit, and apparatus for releasing said switches when conversation has finished.

118. A non-numerical trunk-selecting switch mechanism comprising a pair of line wipers, a release mechanism, a release magnet for operating said release mechanism and controlling the connection to said wipers, trunk terminals to be seized by said wipers, and a source of electrical current and connections therefrom for operating purposes.

119. A telephone system comprising a subscriber's individual trunk-selecting switch, and a plurality of trunk lines with some one of which said individual switch is always in connection whether busy or idle.

120. A telephone system comprising a trunk-selecting switch, and a plurality of trunk lines with some one of which said switch is always in connection whether busy or idle, said switch having voice current conductors.

121. A telephone system comprising a subscriber's individual trunk-selecting switch, a plurality of trunk lines with some one of which said individual switch is always in connection whether busy or idle, and switching mechanism having a group and trunk-selecting motion for each trunk line.

122. A telephone system comprising a trunk selecting switch, a plurality of trunk lines with some one of which said switch is

always in connection whether busy or idle, said switch having voice current conductors, and a switching mechanism having a group and trunk-selecting motion for each trunk line.

123. In a telephone system a non-numerical trunking switch, trunk lines for talking purposes leading therefrom, said switch having line wipers always in electrical engagement with some one of said trunk lines which connected trunk line is always the one last employed by said switch for extending a call, a telephone line to which said switch is individual, and a relay controlling the connection between said telephone line and said switch.

124. A telephone system including a subscriber's line, a non-numerical switch and a numerical switch for extending the connection therefrom, a central battery for supplying talking current through said switches to said line, contact pieces in said switches included in said talking circuit, and separate contact pieces for said switches for use in restoring said switches to normal.

125. In a telephone system, the combination of subscribers' telephone lines, a common battery or centralized source of electric current supply, automatic trunk selecting and connecting machinery provided with means for normally maintaining said battery in bridge of each telephone line, subscribers' switches for closing the lines at the substations thereof to enable a calling subscriber to initiate the operation of said machinery, trunk lines leading from said machinery, and means including automatic progressively movable connectors for establishing connection between any selected trunk line and the line of the called subscriber, each connector provided with suitable coils or windings for temporarily maintaining said battery in bridge across any talking circuit, temporarily established between calling and called subscribers' lines, to supply talking current to both the said subscribers' substations.

126. In a telephone system, the combination of subscribers' telephone lines, trunk selecting and connecting mechanism therefor, trunk lines leading from said mechanism, automatic switching machinery, energizing circuits for enabling any calling subscriber to initiate the operation of said trunk selecting and connecting mechanism, said circuits each including the two sides of the calling subscriber's line in series, grounded circuits for subsequently controlling said switching machinery, said grounded circuits including the ground between the exchange and the substations of said lines, and a central battery for supplying talking current to said subscriber's line.

127. In a telephone system, a calling subscriber's line, a called subscriber's line, step-

by-step automatic means for trunking the calling line into connection with the called line, a circuit including both sides of the calling line for initiating the operation of said trunking means, suitable circuits extending over the calling line for controlling the operations by which said automatic means completes the connection to the called line, and a central battery for supplying said lines with talking current.

128. A telephone system including a subscriber's line, a non-numerical non-restoring switch and a numerical switch for extending connection therefrom, and trunk release circuits for one of said switches.

129. In a telephone trunking system, the combination of subscribers' telephone lines, subscribers' selectively operated individual trunking switches actuated by the initial closure of the line to select a trunk, trunk lines leading from the said individual switches, means having vertical motion, under substation control, to select groups or divisions of the exchange, and rotary motion to connect with a line in the selected group, for extending connection from the selected trunk line in the direction of the called subscriber, a common battery normally in bridge of each telephone line through the medium of said individual switches, and means for supplying talking current from said battery to said line.

130. In a telephone trunking system, the combination of subscribers' telephone lines, a common battery, individual switches for normally maintaining said battery in bridge of each line, and connectors having vertical motion to select groups or divisions of the exchange and rotary motion to connect with a line in the selected group for extending connection from the selected trunk line in the direction of the called subscriber, provided also with means for temporarily maintaining the battery in connection with calling and called subscribers' lines to supply talking current to the substation.

131. In a telephone trunking system, the combination of a subscriber's telephone line, a non-restoring selectively operated trunking switch for said line, trunk lines leading from said switch, said switch having an initial energizing circuit including both sides of the telephone line in series, means having vertical motion under substation control, to select groups or divisions of the exchange, and rotary motion to connect with a line in the selected group, for extending connection from the selected trunk line in the direction of the called subscriber, and a calling mechanism for causing the vertical and rotary motion, said mechanism requiring a separate actuation thereof for each digit of the called number, operative to transmit impulses by each operation.

132. In a telephone trunking system, the

combination of a subscriber's line normally open at the substation thereof, a subscriber's non-restoring selectively operated individual trunking switch actuated by the initial closure of the line to select a trunk, means for closing the line at the substation to initiate the operation of said switch, and means having vertical motion, under substation control, to select groups or divisions of the exchange, and rotary motion to connect with a line in the selected group, for extending connection from the trunk seized by the switch in the direction of the called subscriber.

133. In a telephone trunking system, the combination of subscribers' telephone lines, non-restoring trunk selecting and connecting mechanism therefor, trunk lines leading from said mechanism, automatic switching machinery having vertical motion to select groups or divisions of the exchange and rotary motion to connect with a line in the selected group for extending connection from the selected trunk line in the direction of the called subscriber, energizing circuits for enabling any calling subscriber to initiate the operation of said trunk selecting and connecting mechanism, said circuits each including the two sides of the calling subscriber's line in series, and grounded circuits for subsequently controlling said switching machinery, said grounded circuits including the ground between the exchange and the substations of said lines.

134. In a telephone trunking system, the combination of a calling subscriber's line, a called subscriber's line, automatic means for trunking the calling line into connection with the called line, including means having vertical motion under substation control, to select groups or divisions of the exchange, and rotary motion to connect with a line in the selected group, for extending connection from the trunk seized by the switch in the direction of the called subscriber, a circuit including both sides of the calling line for initiating the operation of said trunking means, suitable circuits extending over the calling line for controlling the operations by which said automatic means completes the connection to the called line, a central battery for supplying said calling line with talking current, and a calling mechanism for causing the vertical and rotary motion, said mechanism requiring a separate actuation thereof for each digit of the called number, operative to transmit impulses by each operation.

135. A telephone system including a subscriber's line, a non-restoring switch and a restoring switch for extending the connection therefrom, a central source of current for supplying said line with talking current, and trunk release circuits for said switches.

136. In a telephone system, the combination of subscribers' telephone lines, trunk lines, automatic trunk selecting and connecting apparatus for connecting a calling subscriber's line with an idle trunk line, a battery normally in bridge of each line, means in said apparatus for disconnecting both poles of the battery from the subscribers' lines, and means for supplying current from said battery to said lines for talking purposes.

137. In a telephone system, the combination of subscribers' telephone lines, a common battery, individual non-numerical switches for normally maintaining said battery in bridge of each line, and connectors provided with means for temporarily maintaining the battery in connection with calling and called subscribers' lines to supply talking current to the substations.

138. In a telephone system, a subscribers' rotatable calling device, adapted to be given a separate actuation for each digit of the called number, operative to transmit impulses at each operation, a metallic line circuit, automatic switching apparatus for extending connection in the direction of the called subscriber, including means responsive to said rotatable calling device, and including also an automatic switch controllable by the called subscriber over the metallic line circuit, and a central battery for supplying talking current to said called subscriber.

139. In a telephone system, a metallic line circuit, apparatus controllable by the calling subscriber for extending connection in the direction of the called subscriber, including means having straight motion to select groups or divisions of the exchange and rotary motion to connect with a line in the selected group or division, a ratchet mechanism for producing each motion and including also a non-numerical automatic trunking switch controllable by the calling subscriber over the metallic line circuit, and a central battery for supplying talking current to said calling subscriber.

140. In a telephone system, a metallic line circuit, means common to the different subscribers for extending connection in the direction of the called subscriber, having straight motion under substation control, to select groups or divisions of the exchange, and rotary motion to connect with a line in the selected group or division, subscribers' individual trunking switches for extending trunking connection to said means having the straight and rotary motion, each individual trunking switch being controllable over the metallic line circuit, a calling mechanism for causing the straight and rotary motion, said mechanism requiring a separate actuation thereof for each digit of the called number, operative to transmit im-

pulses by each operation, and a central battery for supplying the calling and called lines with talking current.

141. A non-restoring-wiper line switch for telephone systems comprising only contacts and co-operating wipers, motor mechanism for operating said wipers, simple relays each having individually controlled contacts, and circuit connections controlled by the contacts of said relays for operating said motor mechanism and wipers and restoring said switch.

142. A telephone system comprising a calling telephone line, a line switch therefor having contacts and co-operating wipers, a line relay, motor mechanism controlled thereby for operating said wipers to select a set of contacts, and simple relays each having individually controlled contacts and circuit connections only, for rendering said switch available for another selecting operation without moving said wipers.

143. A telephone exchange system comprising a telephone line and associated automatic line switch for service in extending the circuit of said line, said switch including only passive and active contacts, a magnet and connected mechanism for operating said active contacts, simple relays each having individually controlled contacts and suitable electrical connections controllable over the connected line for operating said switch to select a set of contacts and thereafter rendering said switch available for another selecting operation without moving the active contacts.

144. A non-numerical non-restoring-wiper line switch for telephone systems comprising bank contacts and co-operating wipers, electromagnetically controlled motor mechanism for operating said wipers, simple relays provided with only individually controlled contacts, circuit connections controlled by said relays for operating said motor mechanism and wipers to select a set of said bank contacts, and means for restoring said switch without altering its antecedent progressive position.

145. A telephone system including a calling telephone line, a line switch individual thereto provided with bank contacts and co-operating wipers, motor mechanism for operating said wipers, simple electromagnets provided with only individually controlled contacts, circuit connections controlled by said electromagnets for operating said motor mechanism and wipers to select a set of said bank contacts, and means for restoring said switch without altering its selective position.

146. A non-numerical non-restoring-wiper line switch comprising bank terminals and co-operating wipers, relays, contacts for said relays, said contacts being individually

controlled by their respective relays, motor mechanism for operating said wipers, and circuit connections controlled by the contacts of said relays for operating said motor mechanism and wipers to select a set of said bank terminals and restoring said switch.

147. A telephone system including a calling telephone line, a non-numerical line switch individual thereto provided with contact wipers, electromagnets, spring contacts individually controlled by said electromagnets, motor mechanism for operating said wipers, circuit connections controlled by the contacts of said electromagnets for operating said motor mechanism and wipers, and means for restoring said switch without altering its selective position.

148. An automatic telephone system including a first selector having vertical and rotary movements and provided between the substation and the first selectors with a non-restoring trunk selector for automatically connecting a substation with an idle first selector, and means for operating said first selectors vertically and rotatively in accordance with the first digit of the called number.

149. An automatic telephone system including first selectors and provided between the substations and the first selectors with non-restoring trunk selectors adapted upon a subscriber's taking down the receiver, to automatically pass by busy trunks and stop on the first idle trunk leading to the first selectors.

150. An automatic telephone system including first selectors and provided between the substations and the first selectors with trunk selectors adapted upon a subscriber's taking down the receiver to automatically pass by all busy trunks leading to the first selectors and automatically select a trunk which is idle, means for operating said first selectors vertically and rotatively in accordance with the first digit of the called number, a central battery for supplying talking current to said lines through said switches, and trunk release circuits for said switches independent of said talking circuits.

151. In a telephone system, first selectors, means for operating a selector vertically in accordance with the first digit of the called number, each selector adapted to rotate to automatically extend connection in the direction of the called subscriber, connectors adapted to be selected by said selectors, means for selecting idle first selectors, and means for supplying talking current through the connectors to calling and called subscribers.

152. In a common battery system, two or more vertical and rotary motion first selectors common to two or more subscribers' lines, means for establishing a talking circuit

between said lines comprising said first selectors, central office means for supplying said talking circuit with talking current, a progressively movable switch individual to a subscriber's line for automatically selecting an idle first selector, bridges in said selectors across the talking conductors for normally shunting the talking conductors, and means for cutting off or opening said bridges to prevent shunting of the common battery and voice currents.

153. A common battery telephone exchange system provided with vertical and rotary motion switches less in number than the common battery substations between which they are adapted to give service, means for operating said switches from one of the substations in accordance with the first digit of the called number, a switch individual to a calling line for automatically selecting idle switches, and central office means for supplying said common battery substation with talking current.

154. In a telephone system, first selectors, an automatic switch individual to a calling line for selecting idle ones of said first selectors, means for operating from one of the substations one of said first selectors vertically in accordance with the first digit of the called number, each selector adapted to rotate to extend connection in the direction of the called subscriber, and common battery means for supplying talking current.

155. In a common battery telephone system including non-numerical progressively movable switches, vertical and rotary motion first selectors arranged on a percentage basis, bridges in said selectors across the conductors of the talking circuit, said selectors provided with means for cutting off or opening up the bridges thereof during talking, and means for supplying talking current to the subscribers' lines from the central exchange.

156. A common battery telephone exchange system provided with vertical and rotary motion first selectors less in number than the common battery substations between which they are adapted to give automatic trunking service, non-numerical progressively movable switches for connecting said common battery substations with said first selectors, a central battery for supplying talking current to said common battery substations, and trunk release circuits for said switches.

157. A telephone system including a subscriber's telephone line, a first selector switch, a non-numerical switch for connecting said line and said first selector switch, a central source of current for supplying said line with talking current, and a trunk release circuit for said non-numerical switch separate from the circuit including the talking current.

158. A telephone system including a subscriber's telephone line, numerical automatic trunking means, a non-numerical switch for connecting said line to said numerical trunking connection, central office means for supplying said line with talking current, contacts for said non-numerical switch included in the circuit of the path of the talking current, and a trunk release circuit for said non-numerical switch.

159. An automatic common battery telephone system comprising subscribers' lines connected through the medium of a non-numerical switch and a plurality of automatic step-by-step switching machines whereof one is provided with a "release relay", and another with a "release magnet", and a "release circuit" for said switches including said relay and magnet, together with connections whereby talking current is furnished through one of said machines to the talking circuit established between subscribers.

160. An automatic common battery telephone system comprising telephones and automatic switches, a centralized source of talking and switching current, means for supplying talking current from said source to said telephones, a trunk release circuit, and a guarding potential circuit including a portion of said release circuit.

161. An automatic common battery telephone system comprising a trunk selecting switch mechanism, trunk lines leading therefrom, said mechanism provided with three wipers or movable switch contacts, a centralized source of talking and switching current, means for supplying current from said centralized source to subscribers' lines for talking purposes, connections for talking through two of said wipers or movable switch contacts, a release circuit including the third wiper or movable switch contact, and a guarding potential circuit including a part of said release circuit.

162. In a telephone system, means having one motion to select groups and another motion to find the called line in any selected group, devices including non-numerical and numerical switches for automatically trunking to said means, apparatus controlled at the said means for supplying current for talking purposes, a busy test circuit for said devices, and a trunk release circuit in part coincident with a portion of the busy test circuit.

163. In a telephone system, a connector having one motion to select groups and another motion to find the called line in any selected group, means including non-numerical and numerical automatic trunk selectors for extending connection to said connector, means controlled at the connector for supplying current for talking purposes, busy test circuits for said selectors, and

trunk release circuits controlled at the connector and in part coincident with a portion of said busy test circuits.

164. In a telephone system, means including non-numerical and numerical switches for automatically trunking between calling and called subscribers, a busy test circuit for said numerical switch, a trunk release circuit for said numerical switch including a portion of the busy test circuit, a central source of current included in both of said circuits, and a talking circuit receiving current from said source for talking purposes.

165. In a telephone exchange system provided with selector switches of various classes at the exchange, including connector switches adapted to co-operate with calling devices at the substations in establishing desired connections, the combination with a subscriber's line, of a first selector switch adapted to be operated under substation control, second selector switches, multiple terminals of said second selector switches and wipers included in said first selector switch adapted to engage said terminals, a part of said wipers being for conversational use, a test wiper enabling said first selector to select and isolate an idle second selector, means for causing a flow of current over said wiper when disconnection is desired, release mechanism at the exchange operated responsive to said flow, and a common battery for supplying talking current to said substations.

166. A telephone system including a pair of connected subscribers' lines, a plurality of selective switches including a non-numerical switch at the exchange connecting said lines, talking contacts included in said switch through which the conversational circuit extends, contacts included in some of said switches not forming part of the conversational circuit with means controlled by said contacts for preventing intrusion upon the connection, a relay at the exchange controllable responsive to circuit changes produced at the calling substation, means controlled by said relay for altering the connections of said last-mentioned contacts to release the switches, and a common battery for supply talking current to said subscribers' lines.

167. A telephone system including a pair of connected telephone lines, a plurality of selective switches at the exchange including non-numerical switches through which the conversational circuit extends, a multiple private or test contact for one of said switches for preventing intrusion upon the conversational circuit, means for altering the electrical condition of said contact to restore to normal one of said switches, and a common battery for supplying talking current to said connected telephone lines.

168. A telephone system including tele-

phone lines, interconnecting link circuits, a plurality of interconnecting automatic switch mechanisms for uniting calling and called lines by link circuits into a talking circuit, testing contacts associated with certain of said switch mechanisms for use in determining the link circuits to be included in said talking circuit, means for releasing one of said switch mechanisms, a circuit including a testing contact, means operated by said releasing means over said circuit to release another of said switch mechanisms, and a common battery for supplying talking current to said telephone lines.

169. In an automatic telephone system, a subscriber's line, a selecting switch for said line at a central office, said switch having a wiper shaft with a third wiper thereon, a trunk line to which said subscriber's line is extended by the movement of the selecting switch of said subscriber's line, a selecting switch for said trunk line, a pair of controlling magnets for each of said selecting switches adapted to control the selecting movements of said switches, the magnets at the selecting switch of said subscriber's line being in an open bridge across said subscriber's line during a connection between said line and said trunk, said magnets in the selecting switch of said trunk being connected in a closed bridge across said trunk during a connection with said line, means associated with the selecting switch of said line, including a release circuit through the said third wiper, and controlled by the bridged magnets of the selecting switch of said trunk to cause the selecting switch of said line to assume its normal position, disconnecting said line from said trunk, a busy test circuit including the same wiper, and a common battery for supplying talking current to said subscriber's line, substantially as described.

170. A telephone system including telephone lines, interconnecting link circuits, a plurality of selective switch mechanisms for uniting a calling and a called line by link circuits into a talking circuit, a testing contact associated with one of said mechanisms for selecting a link circuit to be included in said talking circuit, a circuit for releasing one of said switch mechanisms including said testing contact, means for controlling said circuit, and a common battery for supplying talking current to said telephone lines.

171. In a telephone system, a connector, a subscriber's non-numerical individual trunking switch, means for connecting the said individual switch with the said connector, a central source of current for supplying a subscriber's line with talking current, release means for said individual switch under the control of said connector, means for prevent-

ing a release of the said individual switch if the called subscriber's line is busy, automatic means for releasing the connector without releasing the individual switch if the called subscriber's line is busy, and means for supplying talking current through said connector to said called subscriber's line if the calling subscriber is idle.

172. In a telephone system, an automatic connector, a subscriber's non-numerical individual trunking switch, means for connecting the individual switch with the connector, release means for said individual switch under the control of the connector, means for preventing the individual switch from releasing when the connector attempts to seize a busy subscriber's line, and means for supplying talking current from said connection to an idle called line.

173. In a telephone exchange system, the combination of trunk lines, a non-numerical switch, means for operating said switch to select idle trunk lines, means for releasing said switch from the trunk lines, and for causing said switch to occupy the trunk line after releasing therefrom.

174. In a telephone exchange system, the combination of trunk lines, means for selecting idle trunk lines, means for releasing from the trunk lines, means for occupying the trunk line after releasing therefrom, means including common battery connector switches for extending connection from said trunk lines to the called subscriber's line, and means for supplying talking current through the said connector switches to the substations of calling and called subscribers.

175. In a telephone exchange system, the combination of a plurality of trunks, automatic means by which a subscriber after using a trunk may temporarily occupy the same after disconnecting therefrom, automatic means whereby another subscriber may call and seize the idle trunk, thus temporarily occupied by the first subscriber, means including common battery connector switches for extending connection from said trunk lines to the called subscriber's line, and means for supplying talking current through the said connector switches to the substations of calling and called subscribers.

176. In a telephone exchange system, the combination of a plurality of trunks or common talking connections, a plurality of telephone lines, said trunks being less in number than the telephone lines, means including switches for connecting the telephone lines with idle trunks, means by which the disconnection of a calling telephone line from a seized trunk temporarily retains the switch in its selected position relative to said trunk, means including common battery connector switches for extending connection from said trunk lines to the called subscriber's line, and means for supplying talking current

through the said connector switches to the substations of calling and called subscribers.

177. In a telephone exchange system, the combination of a plurality of trunk lines, a plurality of telephone lines, automatic means for closing connection between a calling telephone line and an idle trunk line, means for disconnecting the calling telephone line from the seized trunk line, means for retaining the disconnected telephone line and its automatic means in selective relation to the trunk line with which it was connected, means by which another telephone line may connect with the said occupied idle trunk line, means including common battery connector switches for extending connection from said trunk lines to the called subscriber's line, and means for supplying talking current through the said connector switches to the substations of calling and called subscribers.

178. In a telephone exchange system, the combination of a plurality of trunk lines, means by which a calling subscriber connects with an idle trunk line, means by which a calling subscriber in releasing continues to occupy the disconnected trunk line, means including common battery connector switches for extending connection from said trunk lines to the called subscriber's line, and means for supplying talking current through the said connector switches to the substations of calling and called subscribers.

179. In a telephone exchange system, a subscriber's line, trunk lines, electrically controlled means for selecting an idle trunk line for said line, electrically controlled means for releasing from the selected trunk line and for remaining in connection with the trunk line assigned notwithstanding the release therefrom, whereby the subscriber may release, call again and get a trunk.

180. In a telephone exchange system, the combination of a plurality of trunks, automatic means by which a subscriber after using a trunk may temporarily occupy the same after disconnecting therefrom, automatic means whereby another subscriber may call and seize the idle trunk thus temporarily occupied by the first subscriber, and means for supplying the subscriber's line with talking current from the central exchange.

181. In a telephone system, the combination of means operative under substation control to supply current for talking purposes from the exchange or central station to the telephones of the substations thereof, a switching device consisting of a bank of contacts, said contacts arranged in sets, a shaft adapted to rotate always in the same direction, wipers mounted upon said shaft and adapted to engage said contacts, each of said wipers being provided with a plurality of arms, so that when one arm is leav-

ing the bank of contacts at one end another arm is engaging the bank contact at the opposite end thereof.

182. In a telephone system, the combination of means operative under substation control to supply current for talking purposes from the exchange or central station to the telephones of the substations thereof, a bank of contacts, said contacts arranged in sets, a shaft adapted always to rotate in the same direction, a wiper mounted on said shaft and adapted to engage said contacts, a ratchet wheel on said shaft, a pawl for actuating said ratchet wheel, an electromagnet for operating the pawl and a spring for returning the same, a circuit-breaking device connected in series with said magnet and operated thereby, and trunk-connecting switches connected with sets of said contacts.

183. In a telephone system, the combination of means operative only after the called line is found for supplying talking current from the exchange or central station to the subscribers' telephones at the substations thereof, a switching device consisting of a bank of contacts, said contacts arranged in sets, a shaft adapted to rotate always in the same direction, wipers mounted upon said shaft and adapted to engage said contacts, each of said wipers being provided with a number of arms so arranged that when one arm is leaving the bank of contacts another arm of the same wiper is engaging a contact of the bank of contacts, and trunk connecting switches connected with sets of said contacts.

184. A telephone system including a subscriber's line, a non-numerical automatic switch and a numerical automatic switch for extending connection from said line, a battery and means for supplying talking current to said line from said battery through said switches.

185. A telephone system including a subscriber's line, an automatic switch provided with contact makers adapted to always rotate in the same direction for extending a connection from said line, and a central office battery for supplying talking current to said line through said switch.

186. A telephone system including a subscriber's telephone line, a plurality of trunk line circuits having different busy and idle conditions and provided with line terminals, a selector switch adapted to connect said subscriber's line to one of said trunk lines, means for actuating said switch to move from a position of rest successively over the trunk line terminals, means governed by the condition of any trunk line for automatically stopping the movement of said selector switch when an idle trunk line is reached, said means including a self locking controlling relay having its locking circuit com-

pleted through the trunk line test terminals and depending upon the condition thereof, and a battery at the central exchange for supplying talking current to the said subscriber's line.

187. A telephone system including a subscriber's line circuit, a plurality of trunk lines having different busy and idle conditions, an individual selector's switch adapted to connect said lines to said subscriber's line, means for actuating said selector switch to move from a position of rest successively over the trunk line terminals, a testing relay governed by the condition of any line

for acting to stop the movement of said selector switch when an idle line is reached, said relay after initial energization locking itself through line test terminals, and a central source of current supplying talking battery through said switch to said subscriber's line.

In witness whereof, I hereunto subscribe my name this 9th day of March, A. D., 1905.

ALFRED H. DYSON.

Witnesses:

L. D. KELLOGG,
G. E. MUELLER.