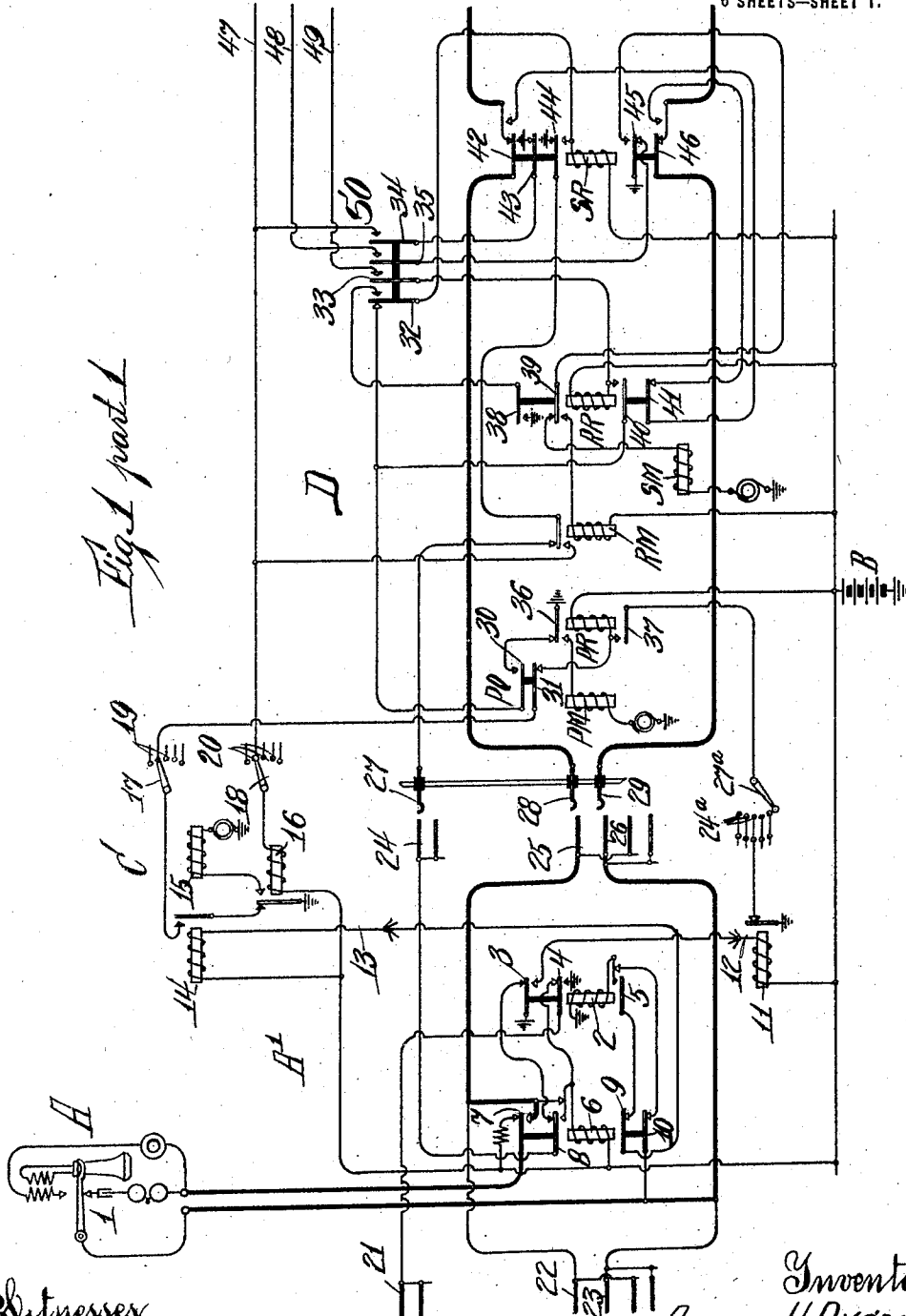


A. H. DYSON.
SELECTIVE TELEPHONE SYSTEM.
APPLICATION FILED NOV. 29, 1907.

1,400,590.

Patented Dec. 20, 1921.

6 SHEETS—SHEET 1.



Witnesses
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J. E. Kellogg

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by Leroy D. Kellogg
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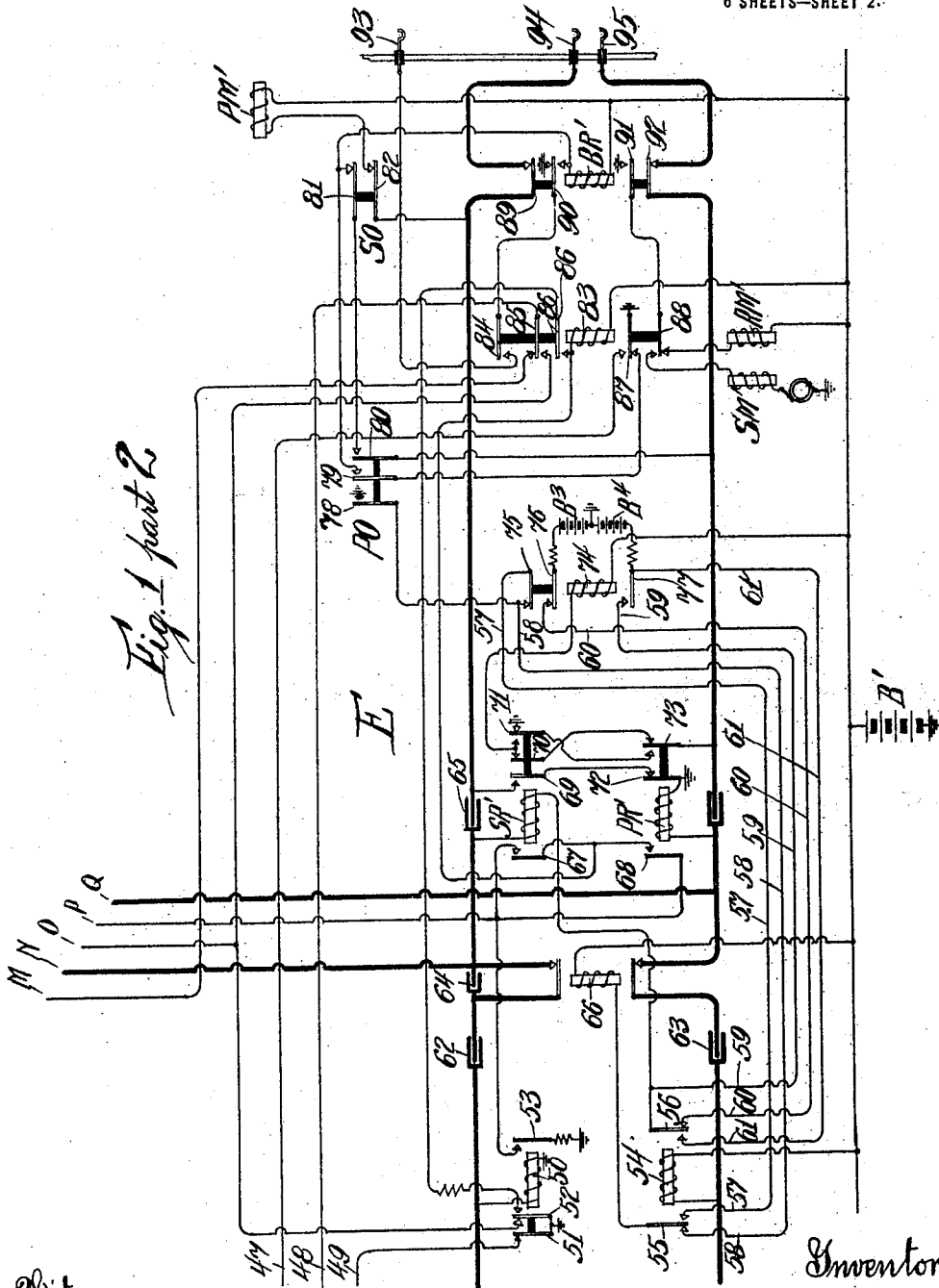


Fig. 1 part 2

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6 SHEETS—SHEET 3.

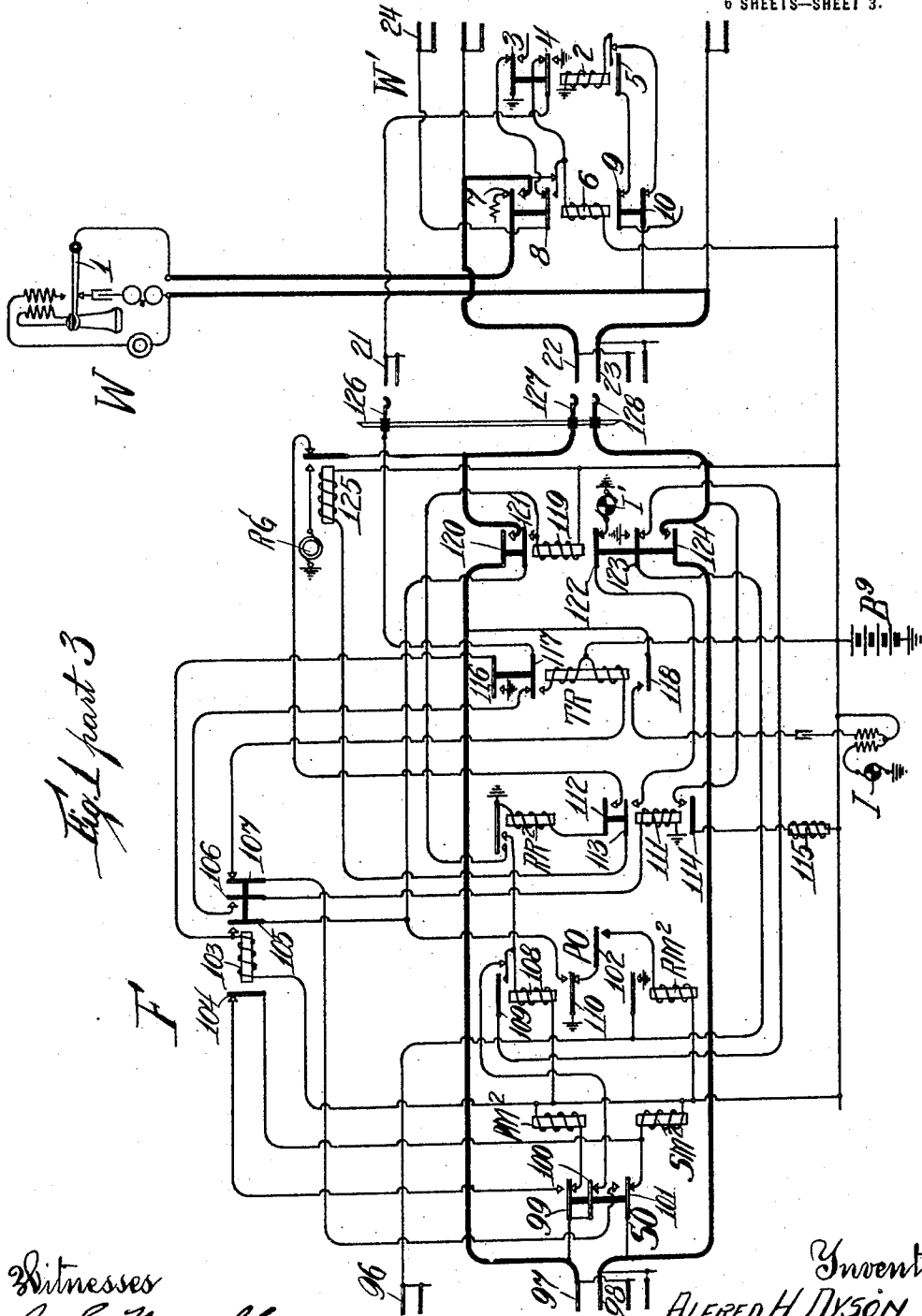


Fig. 1 part 3

Witnesses
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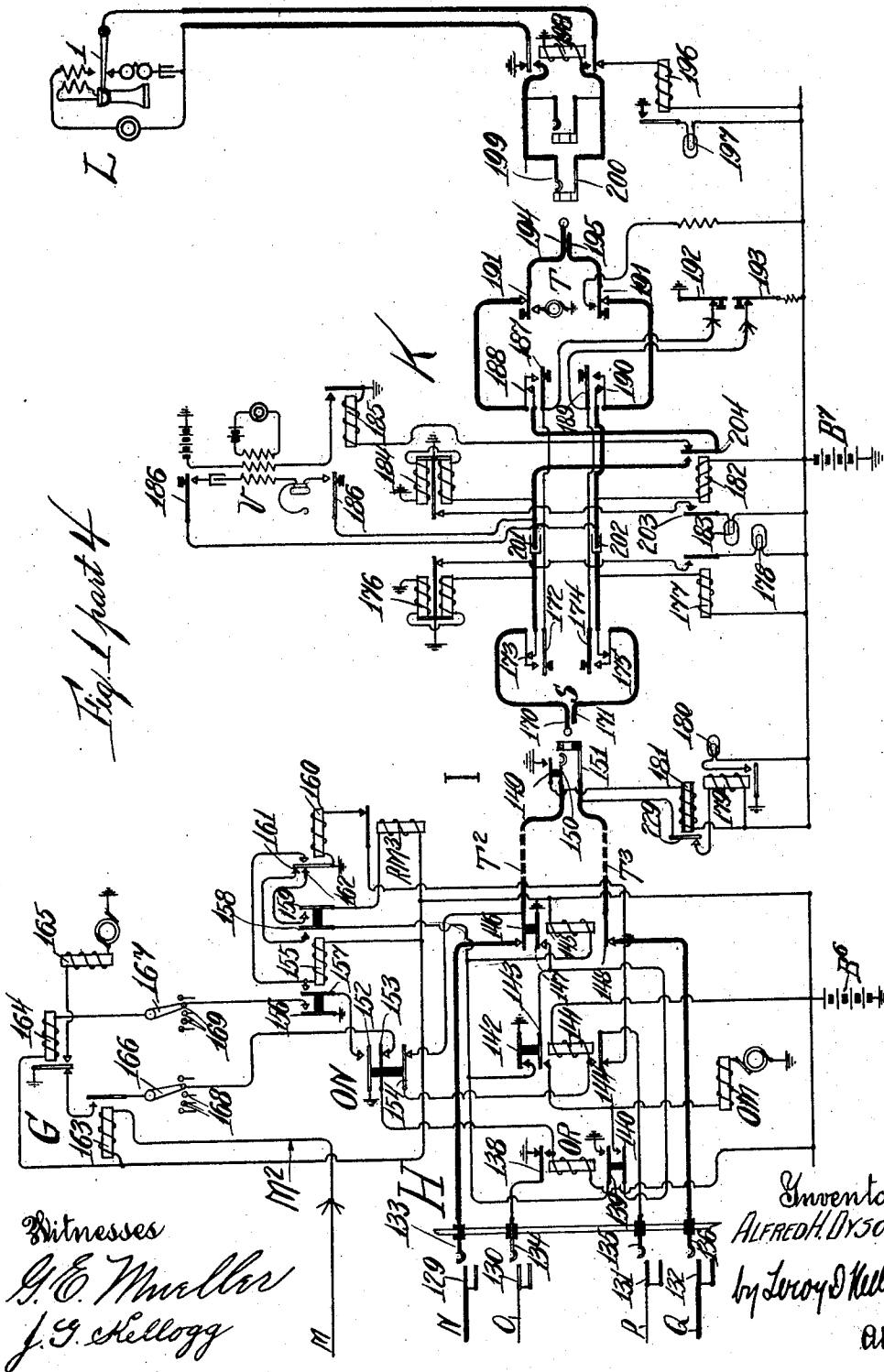
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6 SHEETS—SHEET 4.

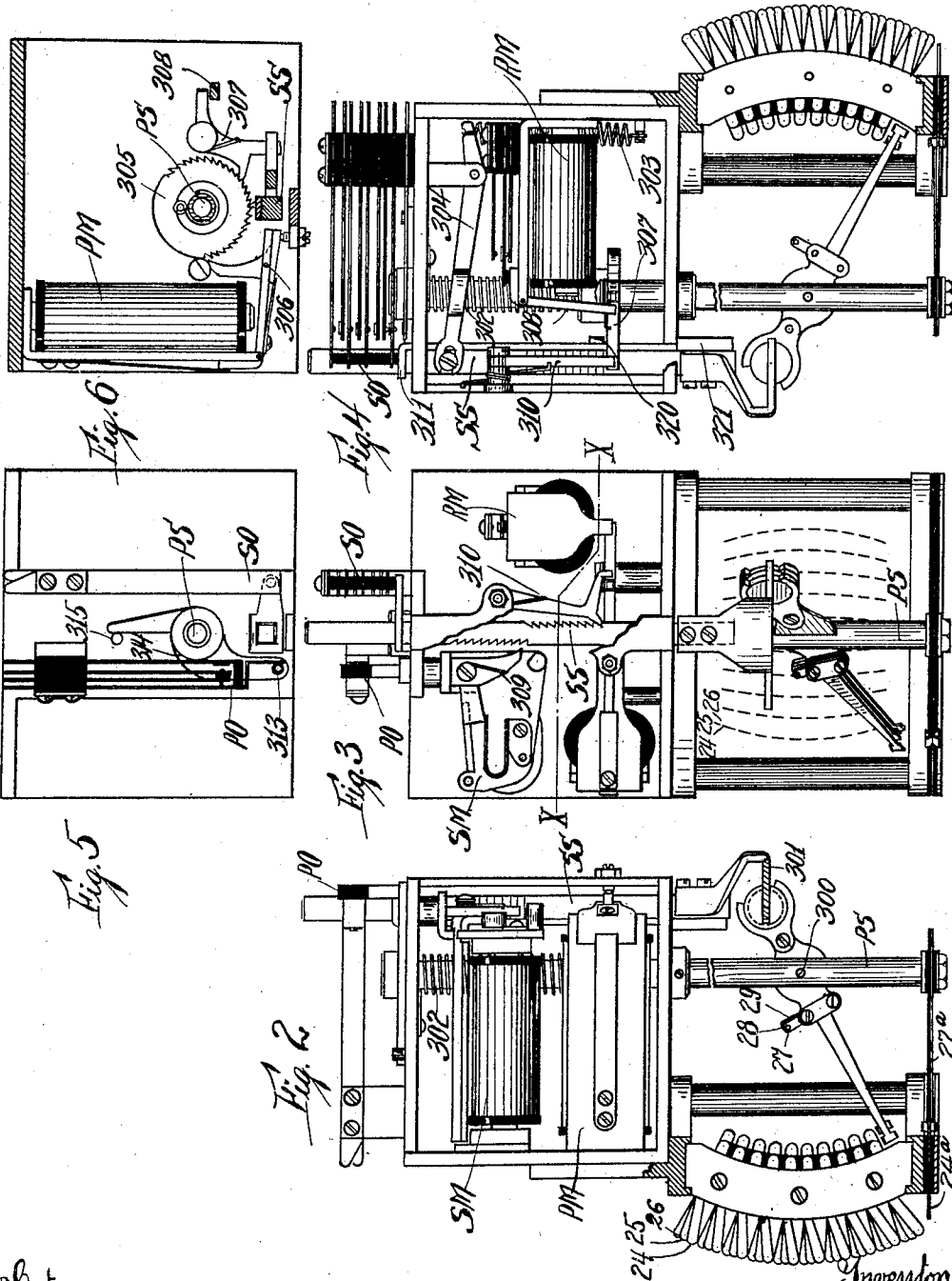


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6 SHEETS—SHEET 5.



Witnesses
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J. G. Kellogg

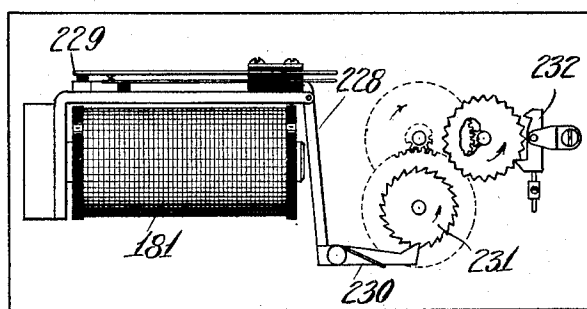
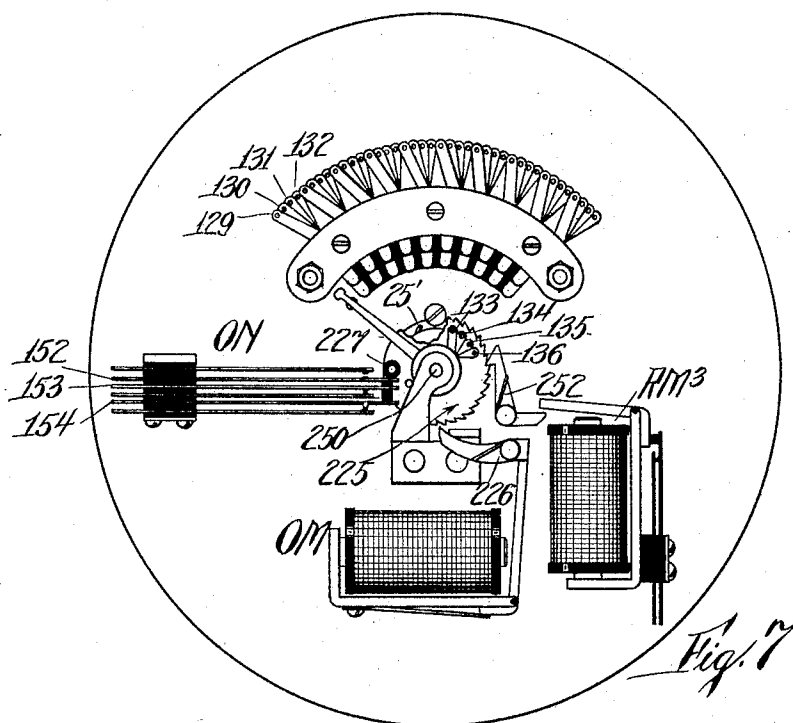
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A. H. DYSON,
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6 SHEETS—SHEET 6.



Witnesses
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UNITED STATES PATENT OFFICE.

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SELECTIVE TELEPHONE SYSTEM.

1,400,590.

Specification of Letters Patent. Patented Dec. 20, 1921.

Application filed November 29, 1907. Serial No. 404,303.

To all whom it may concern:

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

My invention relates to telephone systems in which a portion of the connections made in putting through a call are accomplished by means of automatically operated telephone apparatus, while the remainder of the connections are made with the assistance of operators.

The present invention is well adapted for what may be termed "feeder service," and may be operated in connection with ordinary manual telephone switchboards, although its employment is in no way limited in this respect.

It is generally accepted that, in commercial telephone practice, the supplying of service to subscribers at a point distant from the main exchange, especially where the number of subscribers within reasonable limits of the local point from which service is to be supplied, is relatively small, is a relatively expensive matter. One of the factors entering into this situation is that of the expenses involved in maintaining service at an exchange where but a small number of telephone operators are employed. The factors of supervision, management, etc., in such cases constitute an item of expense producing an expense load, which must be charged upon the cost of the labor of the operators who perform the actual work of connecting subscribers' lines, greatly in excess proportionately to the load which exists where a relatively great number of operators are employed.

The present invention is directed more specifically toward providing a system for outlying exchanges such that connection may be completed by means of mechanism at such outlying exchanges, avoiding however, the use of the usual automatic substation impulse transmitting mechanisms at the telephones whose lines are connected with such outlying exchanges.

Assuming a telephone system including a main switchboard centrally located of the usual manual character, in which the greater part of the lines comprised in the system terminate, in the manner usual in manual

practice, and also including say, two smaller exchanges located at outlying points, the subscribers of each exchange will require connections with subscribers whose lines terminate in their own exchange and also to a considerable extent, connections with subscribers whose lines terminate in each of the other exchanges. A system organized in accordance with the particular embodiment of my invention given in the present application will comprise the following features. Calls between the manual subscribers whose lines terminate in the main exchange will be put up by means of cord-circuit apparatus in the usual manner. A call to be extended from a subscriber of one of the local exchanges to a subscriber of the main exchange will be effected by means of automatic apparatus which will automatically connect the calling line with an operator's position at the main exchange by means of a two-wire trunk of which there will be a plurality provided for connecting the lines of the calling subscribers of such local exchange with the main exchange. When a calling subscriber's line is connected with such trunk, a signal will be displayed and the operator at that position will connect the answering end of a cord with a spring-jack associated with the signal, learn the want of the calling subscriber, and with the calling plug of the cord make the connection to the called-for subscriber's line ringing his bell in the usual manner. Answering and calling supervisory signals are provided operating as usual which will be displayed when the two subscribers replace their receivers. The act of the calling subscriber will also restore the switching mechanism through which connection has been extended to his line at his local exchange to normal, and as soon as the operator withdraws the answering plug, the two-wire trunk referred to will become idle and available for further use.

If a calling subscriber at a local exchange desires a connection with a subscriber whose line terminates in the same exchange, the process of connection is as follows: The removal of the receiver of the calling substation will connect his line by automatic means with a two-wire trunk leading to the main exchange where the operator will answer as before. Learning that the completed connection is to be between two lines at the same local exchange, the operator will actuate a

calling device, associated with her answering cord mechanism, which will transmit directive impulses back over the two-wire trunk circuit to connect the calling line with the wanted called-for line, this being effected by step-by-step switches operating responsive to directive impulses. When her calling device is through operating, the operator will withdraw the answering plug from the jack of the connected trunk which will then be automatically disconnected from operative relation with the calling and called subscribers' switching mechanisms so that the said trunk will be available to other subscribers in the local exchange for making connections.

It is thus seen that, for local connection between subscribers of one outlying exchange, a trunk leading to an operator is held busy for a short period of time only, namely, as long as it takes for the operator to answer the call and transmit the directive impulses required to complete the desired connection, which will ordinarily be a matter of a few seconds only. In fact it may be said that when such a call comes in to the operator, she works back out over the same trunk, hooks the line of the calling subscriber to the line of the called subscriber and then releases the trunk, leaving the two lines hooked together independent of, and without connection to, the main exchange office. When the two subscribers thus connected have finished their conversation, the replacing of their receivers will restore the local exchange apparatus to normal.

If a calling subscriber in the local exchange desires his line to be connected with that of a called-for subscriber in the other local exchange, the removal of the receiver will extend the call over a two-wire trunk to the main exchange, the operator there will answer and, learning that the call is to be extended to a subscriber of the other local exchange, will connect the calling plug of the cord used to a spring-jack forming a terminal of a two-wire trunk leading to the wanted exchange, whereupon automatic mechanism which the operator adjusts by directive impulses transmitted by a calling device associated with the calling end of her cord is operated to complete the connection to the called subscriber's line. In this case also, the replacing of the receiver at the substations of the calling and called subscribers will display the two supervisory signals of the cord at the main exchange employed in the connection, whereon the operator will withdraw the plugs, and the trunks will be then idle.

If a calling subscriber whose line terminates in the main, *i. e.*, manual exchange, wishes to converse with the subscriber of one of the outlying exchanges, the operator, after answering his call in the usual manner by

means of an answering plug, will insert the calling plug into a spring-jack forming a terminal of a two-wire trunk leading to the wanted exchange, and by means of her calling device, will transmit directive impulses to automatic mechanism at the distant exchange, which will have been automatically connected to the trunk she plugged into, to complete the desired connection.

It is thus apparent that my invention realizes a system wherein all connections are put up with the aid of operators who may all be located at one main exchange although the subscribers' lines may be divided among a number of exchanges; further, that for local calls between subscribers at the distant exchanges, the long and relatively expensive trunk lines leading to the main exchange are held busy for a minimum time, while for calls between subscribers of two distant exchanges, the trunk lines are employed to substantially the same extent to which they are employed in ordinary manual telephone practice where a number of exchanges are interconnected.

Referring to the drawings, I show in Figure 1, comprising Parts 1, 2, 3 and 4 circuits of a telephone system containing an embodiment of my invention. Figs. 2, 3 and 4 are respectively left, front and side elevations of a double-motion switch adapted for employment in connection with circuits at D, E, and F in Fig. 1. Fig. 5 shows the off-normal mechanisms of said switch, while Fig. 6 is a sectional view of Fig. 3 on line X X.

Fig. 7 is a front view of mechanism that may be employed for the trunk selector at H.

Fig. 8 shows a mechanism that may be associated with relay 181.

It will be understood that Figs. 2 to 7 are to a certain extent diagrammatic.

Referring first to Fig. 1, Parts 1, 2, and 3 are to be placed adjacent to one another, Part 1 being at the left and Part 3 at the right, while Part 4 is to be placed above Part 2, it being understood that the wires M, N, O, P and Q of Part 4 are extensions of the respective wires M, N, O, P and Q shown in Fig. 1, Part 2. At A and W, I have shown two subscribers' stations comprising a well known type of substation mechanism, hook switch 1 being provided with its contacts to open the normally closed signaling circuit of the substation when the receiver is removed and to operatively connect the substation transmitter in bridge of the line limbs. At A' and W' are shown the line circuits of the substations A and W and as they are alike, a description of A' will suffice for both. Generally speaking, the line of A is provided at A' with the multiplied called terminals 21, 22, 23, which will appear in the banks of a suitable number of connectors, of one of which I illustrate a circuit at F, the arrangements

for selection being similar in a general way to those well known in automatic telephone systems. At A' the line is also provided with multiple calling terminals 24, 25, 26, appearing in the banks of a number of line selectors, one of which I have shown at D, the arrangement being such that when a subscribed as A initiates a call, an idle line selector D will be set into operation by means of master-switch mechanism C, the said line selector D then automatically seeking out and connecting with multiple contacts 24, 25, 26, of the calling line by means of its wipers 27, 28, 29 and 27^a.

Each line selector D has paired with it in permanent electrical association, a first selector E, and each pair of switches DE has a set of wires N, O, P, Q, leading to multiple contacts 129, 130, 131, 132, which contacts are multiplied before a number of trunk switches H, one trunk switch being provided for each of the trunks extending from the local to the main exchange, one of which trunks is indicated by the wires T², T³, in Fig. 1, Part 4. For these trunk switches H a master-switch mechanism G is provided, which serves to control the starting of an idle trunk selector H when the circuit of a switch pair DE is to be extended to the main exchange. To this end, a common wire M² is preferably connected with the mechanism at G which may have a number of branches M, one extending to the mechanism of each switch pair DE.

It will be understood that all the mechanism shown in Fig. 1, Parts 1, 2 and 3 is to be located at one of the local exchanges as is also the mechanisms shown at H and G in Fig. 1, Part 4. The wires T², T³, extend from this local exchange to the main exchange where they terminate in a signaling circuit indicated as a whole at I, which circuit may comprise the spring-jack shown and the relays shown in relation with, and controlling the call signal 180.

An operator's cord-circuit at the manual exchange, indicated as a whole at K, may comprise answering plug S and calling plug T with suitable supervisory, testing and impulse transmitting devices. At L, I show a subscriber's station outfit connected by its line with a well known form of manual line circuit mechanism including the usual multiple spring-jacks together with the usual line and cut-off relays controlling the usual line signal 197.

From the preceding it will be understood that a call initiated at substation A causes the line terminals 24, 25, 26, to be selected by a line selector D, and that on such selection a trunk selector H is set in motion to automatically connect its two-wire trunk T², T³, to the switch pair DE of which the line selector D has selected the calling line A and thereon a signal 180 will be displayed

responsive to current over the two-wire trunk, to the operator at the main office, whereon connection will proceed, as before described, according to the exchange for which the called-for subscriber's line terminates.

The trunk selector H is capable of employment in a double capacity. Its circuit mechanism is such that it not only is capable of being set in motion responsive to the initiation of a call at a substation as A at the local exchange, but when idle may be set into motion by the insertion of a plug S or T into the spring-jack of its associated trunk T², T³ at I. When thus set into motion, its selective mechanism operates in a manner quite different from that in which it operates when set in motion responsive to a call originating at the local exchange. Thus when set in motion responsive to the connection of a plug with its spring-jack, the trunk selector H will select only a switch pair DE whose line selector D has not selected a calling line. This is provided because when a trunk selector is set into motion, in the manner just referred to, it means that the called-for subscriber only has his line terminating in the local exchange to which the trunk T², T³ extends, and therefore no calling subscriber in that exchange can have any concern in the connection to be established.

On the other hand, when the trunk selector H is set into travel responsive to the initiation of a call from the local exchange, it is capable of selecting only a switch pair whose line selector has selected a calling line. This employment of an automatic trunk selector H in the double capacity as indicated rendering the single trunk automatically available as an incoming and outgoing trunk, is believed to be novel and will be broadly claimed.

In practising my invention, I preferably employ for the line selectors D, the first selectors E and the connectors F, double-motion switches having their contacts arranged in groups as is usual in automatic telephone practice, while the trunk selectors H may be single-motion switches having only a rotary direction of travel.

That portion of the telephone system shown in Fig. 1, Parts 1, 2 and 3, as far as the processes of selecting the called-for line are concerned, operates substantially as a one thousand line automatic trunking system. That is to say, the subscribers' lines, of which there may be a thousand, will be divided as called lines into ten groups of one hundred lines each and the lines of each such group will have their multiple terminals 21, 22, 23 grouped together at the exchange and appearing in the banks of say ten connectors F, which connectors will be assigned for connections to the particular

line group, there being thus only one hundred connectors. The connectors F will have their multiple contacts 96, 97, 98, multiplied before the wipers 93, 94, 95, of the first selectors E. The contacts 96, 97, 98, of the ten connectors assigned to each hundred called lines will appear at the first selectors grouped together thus forming a group or level of contact sets. On the usual ten per cent. trunking basis there will be required for each one hundred line group as a calling line group, ten line selectors D, the lines as calling lines being preferably divided into groups of one hundred and having multiple called contacts 24, 25, 26, grouped together and multiplied ten times, once to each line selector D serving the calling line group. As there would be ten calling line groups there will be a total of one hundred line selectors and consequently one hundred first selectors E.

It is obvious that the number of trunk lines T^2 , T^3 extending from each local exchange to the main exchange will be determined by the amount of traffic between the main exchange and the respective local exchanges. It may be assumed, taking into consideration that a large proportion of the calls originating in the sub-exchanges will be for local connections that a number of trunks T^2 , T^3 , equal to five per cent. of the number of lines terminating in the local exchanges will be sufficient to handle the business. In such case, assuming that the exchange of A includes one thousand subscribers, fifty trunks would be provided. These fifty trunks may have their switches H arranged in a single group in which case each of the one hundred switch pairs DE would have their terminals 129, 130, 131, 132, appearing at each switch H, so that each switch H would have before its contacts 133, 134, 135, 136, one hundred sets of multiple contacts 129, 130, 131, 132. In such case, the master-switch mechanism G would be capable of starting each of these fifty switches H, and its wipers 166, 167, would have before them fifty contacts 168, 169. Another arrangement would be to divide the fifty switches H into two groups of twenty-five each. In such case, one-half, *i. e.*, fifty of the switch pairs DE would have their contacts 129, 130, 131, 132, multiplied before the wipers of the switches of one group, in which case the said switches H would, of course, become fifty point switches. Under this assumption there would be two master-switch mechanisms G each having twenty-five contacts 168, 169, and the common conductor M^2 would not have one hundred branches, one to each switch pair of the total one hundred as in the previous case, but there would be two such conductors M^2 , one for each of the two master-switch mechanisms G and each would have fifty branches

M, one branch extending to each of the fifty switch pairs DE which its associated switches H had contacts of.

From the above it is apparent that the trunk switches H may be divided into any desired number of groups, the switches of each group having contacts 129, 130, 131, 132, of a portion of the switch pairs DE, there being as many master-switch mechanisms G as there are groups of switches H and groups of switch pairs DE, the system being entirely flexible in this regard.

The arrangement of multiple terminals 24, 25, 26, of the calling subscribers' lines at the banks of the line selectors D is preferably one in which the said contacts are divided into ten groups of ten contact sets each, primary movements of wipers 27, 28, 29, being first effected to select a group, whereafter secondary movements thereof will be produced to select the individual contact set 24, 25, 26, of the calling line out of the selected group. For determining the selection of the group, the lines having their contact sets 24, 25, 26, in a group will be provided with a group contact 24^a normally grounded and with a group relay 11, controlling by its armature, the grounding of the respective group contact. Each group relay 11 has a common conductor 12 extending by branches, one to each line relay 2 of the ten lines of its group.

The master-switch mechanism C which serves to start an idle line selector D is rendered common to the entire group of one hundred lines which its line selectors D serve by having its relay 14 connected to a common conductor 13 which has one hundred branches, one extending to armature switch 9 of each cut-off relay 6 of the one hundred lines.

In describing more specifically the circuit connections shown in Fig. 1, I shall assume first that the subscriber whose substation is shown at A, desires his line to be connected with that of the subscriber whose substation is shown at W, both calling and called substations being thus assumed to be included in the same local exchange, this of course involving the features that the initiated call is manifested over a trunk line T^2 , T^3 , and that the selective impulses, to establish connection with the called line, are transmitted back over the same trunk line.

The subscriber at A removes his receiver whereon hook-lever 1 rises, closing a relatively low resistance circuit through the substation, current then flowing from battery B through normal contact 7, hook lever 1 returning through contact 10, line relay 2 to ground actuating the said relay whose armature 5 attracts and locks the relay through normal contact 9, common conductor 13, master-switch relay 14 to battery, relay 14 being also energized. Armature 4 grounds

private multiple contacts 21 of the calling line at the connectors F rendering said contacts busy. Armature 3 disconnects ground from the private multiple contacts 24 at line selectors D rendering them selectable and said armature, by engaging its alternate contact, energizes the group relay 11 to attract its armature, removing ground from the group contact 24^a, rendering it selectable by group private wiper 27^a. Attracted armature of relay 14 connects ground through contact 17—19 (wipers 17, 18 of master-switch C normally rest engaging contacts 19, 20 of an idle switch pair DE), primary off-normal contact 31 at switch D, primary relay PR to battery B. The said relay now attracts its armature 36, closing circuit from generator through magnet PM, which magnet is now energized by successive impulses, stepping wipers 27^a, 29, 28, 27, in a primary direction, wiper 27^a, engaging the successive contacts 24^a of the different groups, seeking a contact 24^a from which ground has been disconnected by the operation of a group relay 11. Armature 37 of relay PR being attracted on the initial energization thereof, maintains the relay energized over successive locking circuits established by wiper 27^a passing over grounded contacts 24^a (those pertaining to groups among which there are no calling lines), but as soon as wiper 27^a engages the group contact 24^a pertaining to the group among which A is included, the relay PR will be deenergized owing to the absence of ground upon said contact and armatures 36 and 37 will be retracted, primary magnet PM being thereby disconnected whereby the primary steps of the switch cease. It should be noted that the primary off-normal (PO) contacts 30, 31, are shifted with the first step of switch D so that the initial energizing circuit of relay PR extending through contact 17—19 was opened with the first step of the switch. Retracted armature 36 now completes a circuit from ground through shifted contact 30, normal contact 32, secondary relay SR to battery energizing the said secondary relay whose armature 44 connects the relay's winding through normal contact of release magnet RM with the private wiper 27, while armature 45 engages its alternate contact to complete circuit from generator through secondary magnet SM, normal contact 39 to ground, the magnet SM being now energized and deenergized by impulses from generator, stepping wipers 27, 28, 29, step-by-step over the contact sets 24, 25, 26, of the ten lines of the previously selected group until they reach the contact set of the calling line. It will be observed that multiple contacts 24 of non-calling lines will be connected to ground through their normal contacts 3 so that wiper 27 in passing over such contacts will establish suc-

cessive locking circuits for relay SR, through attracted armature 44, holding the relay energized and magnet SM in operative relation with the generator until the wiper 27 engages the contact 24 of the calling line. This contact will be disconnected from ground at armature 3, relay SR will be deenergized and its various armatures retracted. It may be stated that the group wiper 27^a of the line selector D does not partake of the secondary movements of the switch, but remains engaging group contact 24^a opposite whose group of contacts 24, 25, 26, the said wiper 27^a has caused the wipers 27, 28, 29, to be brought. The secondary off-normal (SO) contacts 32, 33, 34, and 35, were shifted to their alternate positions on the first secondary movement of the wipers.

On the deenergization of relay SR, retracted armature 43 closed circuit from ground through shifted contact 34 to contact 20 of the switch pair at master-switch C whereupon relay 16 was energized to remove ground from wiper 17 and to operate connect motor magnet 15 to the generator. The master-switch mechanism C may comprise mechanically the circularly arranged contacts 19, 20, at whose center the wipers 17, 18, may be mounted upon a rotary shaft provided with a ratchet actuated in the usual manner by the motor magnet 15, the movement of the wipers 17, 18, being always in the same direction. Magnet 15 now receives impulses from generator moving the wipers 17, 18, step-by-step over the contacts 19, 20, which operation will of course continue until the wiper 18 engages a contact 20 pertaining to an idle switch pair DE (contacts 20 of idle switch pairs being characterized by the absence of a ground connection), when the relay 16 will be deenergized, magnet 15 operatively disconnected and the mechanisms at C will be ready to start another line selector D on initiation of a call from a line of its group. Before the wipers 17, 18, can select contacts 19, 20, of an idle switch pair, the relay 14 will have been deenergized, as hereafter described.

When relay SR was first energized, the attractions of its armatures 42, 46, which armatures make-before-break both on attractions and retractions, completed a circuit from ground at E through relay 50, alternate contact at 42, contact 41, alternate contact at 46, through relay 54 to battery B' energizing relays 50 and 54, whereby armature 53 placed ground on conductor P and multiple contacts 131 at the trunk selectors H, thus rendering the switch pair DE, which has been made busy, unselectable by wiper 135 of any trunk selector H which may be operating as an outgoing trunk selector with respect to the main

office. When relay SR was deenergized, as described, a circuit was completed from ground through relay 50, normal contact 42, contact 28—25, normal contact at armature 8 of cut-off relay 6 to battery, thus energizing cut-off relay 6, which by armature 8 locked itself over a circuit extending through contact 24—27, to ground at armature 44. Cut-off relay 6 now opens the circuit including relays 2 and 14, deenergizing them, while armature 7 closes a contact in the upper talking conductor of the line circuit of A (talking conductors being indicated throughout by heavy lines) whereby a maintaining circuit for relays 50 and 54 is completed.

Armature 45 at D, when relay SR was deenergized, closed circuit from ground through contact 35, over conductor 48, normal contact 85, wire M, the conductor M² at G, the master-switch relay 133, to battery, B⁶, energizing the said relay 133 whose attracted armature completes circuit from ground through wiper 166 (wipers 166, 167 of master switch G normally engaging contacts 168, 169 of an idle trunk selector H), through the contact 168 of trunk selector H, contact 153 of said trunk selector, operating relay OR, to battery B⁶, whereby relay OR is energized, its armature 139 operating relay 145, whereupon circuit is closed from generator through operating magnet OM of switch H, attracted armatures 140, 147, to ground. As long as relay OR remains energized, relay 145 remains so, and magnet OM will be successively actuated by generator, each actuation effecting a rotary step of wipers 133, 134, 135, 136, a different set of contacts 129, 130, 131, 132 being engaged on each step. Attracted armature 138 of relay OR has connected said relay to the wiper 134, which, as it successively engages multiple contacts 130, establishes successive locking circuit, holding relay OR energized until said wiper 134 finds an ungrounded contact 130. Contacts 130 of any switch pair DE, whose line selector D has not operated to select a calling line, will be grounded either at normal contact 138 of another switch H whose wiper 134 already engages a multiple of 130 or over conductor O and through normal contact 52 of such switch pair. Therefore, the relay OR will continue energized as switch H steps along, keeping circuit closed through magnet OM until wiper 134 engages a multiple contact 130 connected to the conductor O of a switch pair DE whose relay 50 has been energized, as is the case with the pair shown at Fig. 1. When this occurs, no ground being upon the contact 130 engaged by wiper 134, relay OR is deenergized, its armatures fall back, deenergizing relay 145 and preventing further actuation of magnet OM, whereby the wipers

of switch H will remain engaging the multiple contacts of the switch pair whose line selector D has selected the calling line A. Armature 138 in falling back, places ground through wiper 134 upon the multiple contacts 130, so that no other trunk selector H will be able to select the contact 130 pertaining to the switch pair DE.

The armatures of relay 145 having fallen back, a circuit is now completed from battery B⁷ at the main exchange, through signal relay 179, operating it and displaying signal 180, through normal contact of relay 181, over trunk conductor T³, contact 148, contact 136—132, Q, relay PR', to ground, operating said relay, whose armature 68 is attracted, closing circuit from battery B⁷ through relay 83 operating it, contact 68, over P, contacts 131—135, 144, through relay 160, to ground, operating said relay, a branch of this circuit through armature 53 and its connected resistance also existing.

On the initial step of switch H the off-normal contacts ON were shifted to their alternate position, 153 then rendering relay OR independent of the ground on contact 168. Energized relay 160 attracting its armature, now operates relay 155, which, by armature 157, locks to ground, through shifted contact 152 while armature 156 places ground upon the contact 169 of the operated switch H at master-switch G, whereby relay 164 is energized and its armature attracted, to remove ground from the wiper 166 and to connect the rotating magnet 165 operatively in circuit with generator, which magnet will be successively actuated, driving wipers 166, 167 step-by-step as long as relay 164 continues energized over successive locking circuits through wiper 167, and successively engaged contacts 169, the contacts 169 of the busy trunk selectors, H, being grounded at their respective armatures 156.

The operation of relay 83 occurring simultaneously with that of relay 160, by attracted armature 85 removes ground from the conductor M, so that, so far as the switch pair DE controls it, conductor M² is ungrounded and the relay 163 at G will be deenergized, unless there be some other branch M of conductor M² grounded at another switch pair.

The operator at H, observing the display of signal 180, inserts answering plug S within the answering jack associated with said signal, closing contacts 170—150 and 171—151, the insertion of the plug also actuating the spring 149 to close circuit through cutoff relay 181, whose attracted armature deenergizes relay 179, thus putting out lamp 180; but current continues flowing over conductor Q from battery B⁷ without any interruption, circuit now being traced through

supervisory relay 177, normal contact 175, contact 171—151 and out over Q, whereby relay PR' continues operated. Current now flows from ground through the polarized relay 176 (in such direction as to open the contact of said relay), through normal contact 173, contacts 170—150, 146, 133—129, over N, through relay SR' at E, alternate contact 56, through battery B⁴, to ground, whereby relay SR' is energized.

Recapitulating, the line at A has now been selected by the switch D of switch pair DE, said switch pair has been connected by the operation of a trunk selector H with the main office, the operator has made connection with the trunk line of the operated switch H, at which private contacts 130, 131 have been duly grounded, whereby the switch pair DE in connection with the line of A is protected from seizure by any other switch H, whether operating in its incoming trunk or its outgoing trunk capacity. Also the primary relay PR' and the secondary relay SR', by whose deenergizations the primary and secondary switch impulses are to be transmitted to the directive operated first selector and connector to be used in completing the connection with a called line, have been duly energized preparatory to their directive control by the operator at K.

The operator at K now actuates levers 186, connecting her talking set in operative relation with calling line A, the connection from plug S being traced over the heavily marked conductors, and learns the number of the called-for subscriber, which, for purpose of description, may be assumed to be Local 333, the word "Local" indicating that the called line has its terminals in the same exchange as that wherein the line of the calling subscriber A terminates. Having ascertained the number, the operator at K actuates levers 172, 174, thereby operatively connecting the impulse springs 192, 193 with conductors N and Q through the contacts of plug S. By the "make-before-break" arrangement of levers 172, 174, no deenergizations of relays PR' and SR' are produced by the connecting of the said impulse springs.

Although I have illustrated and shall describe the said impulse springs as a pair of ordinary keys, it will be understood that in practice the operator will be provided with an automatic dial or other impulse-controlling device not requiring the amount of care and attention that the operation of the keys 192, 193 would involve. It will also be understood that the impulse mechanism is common to the operator's position having branches extending to the levers 172, 174 and 187, 189 of each operator's circuit at the position.

The operator now opens contact at 193 three times, thus producing three deener-

gizations of primary relay PR', whose armatures are retracted three times, the opening of contact 68, however, producing no effect upon relay 83 since said relay, by armature 86, has locked itself to ground at alternate contact 52. Each retraction of armature 72 transmits a current impulse from ground therethrough, through attracted armature 69, secondary off-normal contact 82, primary magnet PM', to battery B', whereby said magnet is actuated three times and advances the wipers 93, 94, 95 in a primary direction, to bring them adjacent to a group of ten multiple contact sets 96, 97, 98, forming terminals of connectors F assigned for connections to the third hundreds group of lines of the local exchange. After having opened contact 193 three times as described, the operator will open contact 192 once, whereby a single deenergization of secondary relay SR' will be effected, and an impulse of current transmitted from ground through normal contact 71, alternate contact 73, the shifted contact 80 (the primary off-normal contacts 78, 79, 80 having all been shifted with the first step of the first selector), through secondary off-normal contact 81, busy relay BR', to battery, said relay BR', by its armature 91, connecting the secondary magnet SM' operatively with generator, whereby said magnet will be successively actuated, moving wipers 93, 94, 95, over the multiple contacts 96, 97, 98, of the selected group in search of a set pertaining to an idle connector F. By armature 90, relay BR' now has its winding connected through attracted armature 84 with the private wiper 93, which, by engaging successive contacts 96 (contacts 96 of busy connectors being grounded) will establish successive locking circuits for relay BR' until an ungrounded, *i. e.*, idle, contact 96 is reached, when relay BR' will be deenergized and its armature 91 will fall back, preventing further actuation of magnet SM', whereby wipers 93, 94, 95, will rest engaging the contacts 96, 97, 98, of the idle connector, assumed to be that shown at F in Fig. 1, Part 3. The secondary off-normal SO contacts 81, 82 were shifted on the first secondary step of the first selector.

To transmit the tens digit of the called number, the operator opens contact 193 three times, deenergizing relay PR' three times, the resulting three current impulses being transmitted now through contact 89, contact 94—97, normal contact 99; magnet PM², to battery B², actuating said magnet three times, which moves wipers 126, 127, 128 to a position adjacent to a group of ten contact sets 21, 22, 23, forming terminals of subscribers' lines numbered 331 to 339, inclusive, followed by the terminals of line 330, zero being represented by ten impulses, in automatic telephone systems. The first impulse of current through contact 94—97 as de-

scribed, has passed in part through normal contact 100, relay 108, to battery, operating said relay 108, which locked itself by armature 109, through normal contact 123, contact 96—93, attracted armature 84 and through armature 90, to ground, whereby the shifting of primary off-normal contact 102 on the first step of connector F did not operate release magnet RM², since armature 110 was then attracted.

The operator now opens contact 192 once, deenergizing relay SR', armature 71 falling back to transmit an impulse, through alternate contact 73, contacts 92, 95—98, 101, and through magnet SM², to battery, energizing said magnet, which effects a step of wipers 126, 127, 128 toward the previously selected group of contacts, not moving them sufficiently to engage the first contact set of the group, the position of the connector wipers after being brought to a selected group being a space of two steps distant from the first contact set. This first secondary step of connector F shifts the secondary off-normal contacts 99 to engage its alternate contact, 100 to disengage its contact, and 101 to disengage its normal contact, but not sufficiently to engage its alternate contact, the latter being effected only on the second secondary step of connector F.

The operator at K now opens contact 193 three times, deenergizing relay PR' three times, three impulses being transmitted as before through contact 94—97, the impulses now passing through alternate contact 99, contact 104, secondary magnet SM², to battery B⁹, actuating said magnet three times, whereby wipers 126, 127, 128 are advanced three secondary steps to engage, on the third step, contacts 21, 22, 23, terminals of the called line, Local 333, assumed to be that indicated at W. The operator now opens contact 193 once, deenergizing relay SR', a current impulse being transmitted as before, through contact 95—98, the current then passing through alternate contact 101, normal contact 107, through lower winding of test relay TR, to battery B⁹, the said test relay TR then attracting its armatures to test the called-for line, its operation being such that, if the line tested be idle, its armatures will fall back, which will result in connecting the ringing generator shown at RG to the called line, whereas if the called line be busy, the relay TR will hold its armatures attracted to give the busy signal from interruptor I to the calling subscriber.

Before proceeding to a description of the testing, it may be observed that as soon as the operator has momentarily opened the contact 193 as last described, her work has ended and she will at once withdraw the plug S from the spring jack associated with signal 180, whereby the trunk selector H will be instantly restored to normal as fol-

lows: On the removal of plug S, ground, of course, is removed from contact 150 and, consequently, from conductor N. Battery is removed from contact 151 and from conductor Q for a short space of time, because relay 181 is slow to allow the retraction of its armature, which may be effected by providing a copper shell about its core. Relays SR' and PR' will, therefore, now be simultaneously deenergized for the first time since relay PR' was first energized and conductor P will, since that time, now be first disconnected from the battery B', its previous connections therewith having been either through armature 67 or 68 and the winding of relay 83. Relay 83 remains operated because of its locking armature 86, but relay 160 at G is deenergized, release magnet RM³ being thereby operated by current through contact 162, contact 159, to battery, which magnet withdraws the retaining pawl from the ratchet with which wipers 133, 134, 135, 136, are mechanically connected and the restoring spring of switch H turns the switch wipers back to normal, the talking wipers 133, 136, during restoration being on open circuit at contacts 146, 148, relay 145 being energized by current through contact 161—158, said relay 145, to battery. As soon as switch H reaches normal, the off-normal ON contacts 152, 153, 154, are shifted to the position shown, whereby relay 155 is unlocked, its retracted armature deenergizing magnet RM³ and relay 145, and taking the ground off contact 169 at master-switch G, whereby the switch H and the trunk circuit T² T³ become idle and are available for further use for incoming or outgoing calls. The multiple contacts 130, 131, of the switch pair DE still remain busy, *i. e.*, grounded, 130, by connection through O, armature 85 and over conductor 48 to switch D, while 131, of course, continues grounded at armature 53 over P.

Returning now to switch F, test relay TR had just received an energizing impulse through its lower winding. If the called-for line W is idle, as will now be assumed, its contact 21 will be connected only to the active side of battery B⁹, and since the test relay TR has its winding connected with the active side of said battery, on the cessation of the impulse transmitted by relay SR', the relay TR will be deenergized and its armatures retracted. Before this occurs, armature 116 will have closed circuit through relay 103, said relay, by armature 105, locking itself to ground at armature 110. Armatures 104 and 107 now disconnect respectively magnet SM² and the lower winding of relay TR from contacts 97, 98, while armature 106 completes a circuit effective, on the retraction of armature 117 of relay TR, to energize the relay 111 and cut-off relay 6 of the line at W, by current from ground,

through relay 111, closed contact 106, normal contact 117, contacts 126—21, 4, relay 6, to battery. Armature 8 of relay 6 is attracted, connecting the ground through relay 111 upon the multiple private calling contacts 24 of the line circuit of W at the line selectors, armature 7 closing a contact in the talking circuit of the line of W, while armature 10 opens the circuit of line relay 2 so that it cannot be operated. At relay 111 armature 113 now completes a circuit extending from ground through interrupter I', contact 122, contact 113, relay 125, to battery B⁹, the said relay 125 now being energized and deenergized through the operation of interrupter I', alternately connecting and disconnecting ringing generator RG to and from the called subscriber's line, current from said generator flowing, when armature of relay 125 is attracted, through contact 127—22, alternate contact 7, condenser and bell at substation W, returning through contact 23—128, and through the now attracted armature 114 of relay 111, to ground through battery B⁹. The bell at the called substation W is thus rung, and when the called subscriber answers, a circuit will be completed from ground through release relay RR², attracted armature 112, back contact at relay 125, as soon as said relay is deenergized, contact 127—22, through the substation at W and the now raised hook lever 1, returning through contact 23—128, attracted armature 114, to battery B⁹. Relay RR² is now energized and its armature attracted to close circuit through relay 119, energizing the said relay, whose armatures 120—124 close contacts in the talking circuit. Armature 121, locks said relay 119 to ground at armature 110, while armature 122 disconnects interrupter I', so that relay 125 continues inert. Armature 123 places an additional busy ground upon the private contact 96. It will be noted that the attraction of armature 123 opened the original locking circuit of relay 108, but before this occurred, relay RR² completed an alternate circuit for said relay which thus remains energized, so that magnet RM² cannot operate.

Current also finds its way from ground through relay RR² over the line W as described, and through contact 124, as soon as relay 119 is energized, current flowing thence through contact 98—95, contact 92, normal contacts 73—70 and relay 74, to battery B'. Relay 74 is energized, and by its armature 75 opens the circuit, which had been closed with the first step of the first selector, extending from ground through primary off-normal (PO) contact 78, normal contact 75, alternate contact 55, relay 66, to battery, the relay 66 having been held energized, and the lower talking conductor open at its armature, to the end that the directive impulses trans-

mitted over conductor Q may not effect disturbances in the telephone receiver at substation A which the subscriber will have at his ear. Thus when the called subscriber answers, the resulting operation of relay 74 by the attraction of armature 75 deenergizes relay 66, so that its armatures are retracted and the complete talking circuit is closed from substation A to substation W, as indicated by the heavily marked conductors, condensers being interposed in the talking conductors as shown at E. The transmitter at substation A is energized by current from battery B' through the impedance of relay 54, returning through the impedance of relay 50, to ground, while the transmitter at substation W is energized by current from relay RR² flowing through the substation, returning to battery, through inductive resistance 115 and through relay 74 at E.

The two subscribers A and W are now in conversation over switchboard connections entirely local to their own exchange, the apparatus at the main office being entirely disconnected from the circuit now existing and having no longer any function whatever to perform in connection therewith. When the subscribers A and W have finished their conversation, they replace their receivers. When W does so, the connector F is restored to normal, while when A does so, the line selector D and the first selector and other mechanism at E are restored to normal, at which time the busy grounds will be removed from conductors OP and also from contact 20 at the master-switch C.

When subscriber W replaces his receiver, relay RR² energized by current through hook lever 1, becomes deenergized, and its retracted armature causes relay 108 to be deenergized whose retracted armature 110, closes circuit from ground, primary off-normal (PO) contact 102, release magnet RM², to battery B⁹. Release magnet RM² being thereby energized, withdraws the retaining pawls from the primary and secondary shafts of connector F and the connector wipers and primary and secondary off-normal contacts are automatically brought back to their normal positions. Magnet RM² remains energized, until connector F finally reaches normal opening contact 102, whereby the armature of said release magnet RM² continues attracted holding a busy ground on private contacts 96 until the connector is restored and finally becomes idle and so available for further use. When relay 108 was deenergized, it opened the locking circuits of relays 103 and 119, so that the contacts at 120 and 124 were opened and wipers 127, 128 were on open circuit, while the connector was restoring. As soon as contact 106 was opened, cut-off relay 6 of the line at W was deenergized and its line circuit restored to its normal idle condition.

When the subscriber A replaces his receiver, the act deenergizes relays 50 and 54 and their armatures are retracted, the retraction of armature 52 opening the locking circuit of relay 83, whose armatures fall back, armature 87, closing circuit from ground, through its normal contact, the shifted contact 79 and busy relay BR', to battery, operating the said busy relay, which attracts its armatures, whereof 91 closes the circuit of release magnet RM', the circuit extending through normal contact 88. Upon the operation of magnet RM', retaining pawls are withdrawn from the primary and secondary ratchets of the first selector and the switch restores to normal, at which time the primary and secondary off-normal switches will also be shifted back to their original condition.

The retracted armature 51 closes circuit from ground over conductor 49, shifted contact 33, release relay RR at switch D, to battery, which relay, by armature 38, energizes secondary relay SR, and, by armature 40, locks itself to ground through primary off-normal contact 30 and contact 36. Circuit is now closed from ground through alternate contact 45 at relay SR, alternate contact 39, release magnet RM, to battery B, resulting in the energization of relay RM, restoring the first selector D to normal when the primary and secondary off-normal switch springs will be shifted to their normal positions.

It will be seen that when relay SR was energized, thus removing the ground previously existing through contacts 43 and 34 upon contact 20 at the master-switch C, a substitute ground will be immediately placed thereon, extending from said contact 20 through the attracted armature of magnet RM, alternate contact 44, alternate contact 33, attracted armature 38 and its grounded contact. With the shifting to normal of the switch springs SO, (occurring when wipers of switch D are restored as to their secondary movements) ground will still be maintained on said contact 20 through normal contact 32, contacts 30, 36, until switch D finally reaches normal, when the opening of contact 30 will remove ground from said contact 20 and also open the locking circuit of release relay RR which will be deenergized together with release magnet RM and secondary relay SR.

It will be observed that as soon as the release operations controlled from substation A are initiated, ground is placed on conductor O, at armature 52 so that the switch pair DE continues unselectable by any trunk selector H operating under control of its wiper 134.

It will now be assumed that when the test relay TR of the connector F was operated by the impulse transmitted by secondary

relay SR', the called line W was busy. In such case its multiple contacts 21 would be grounded, in case the line W was busy, because some other connector had connected therewith, by a connection extending through normal contact 117 of said other connector, its attracted armature 106, to ground through its relay 111; or in case the line W was busy as a calling line, its multiple contacts 21 would be connected to ground either at attracted armature 4 of its line relay 2, or over a connection extending through normal contact 4, alternate contact 8, and through one of the multiple contacts 24 at the line selectors, to ground at normal contact 44 of some line selector D that had selected the line (see Fig. 1, Part 1). In either case, as soon as test relay TR was energized by the impulse before referred to, current would find its way from battery B^o through the upper winding of said relay TR, alternate contact 117, wiper 126, to ground through the engaged multiple contact 21, thus locking the relay TR, which, by armature 118, would hold connected the busy back machine I with the calling substation over a circuit extending through said closed contact 118, to the left over the upper talking conductor, through the condensers at E, over the calling line and through the substation, producing the customary busy tone in the receiver, returning over the lower talking conductor and through relay 54, to battery B', the calling subscriber being thus advised that the called line was busy. Relay 103 would be energized and locked by the operation of relay TR as before described, but relay 111 would not be energized because of the continued attraction of armature 117. The calling subscriber replaces his receiver and the line selector D and the first selector E are restored to normal in the manner before described. The restoration of the connector F is also effected by the calling subscriber, under these circumstances, since upon the deenergization of relay 83, the circuit of wiper 93 will be opened, whereby the locking circuit of relay 108 is opened and the relay deenergized to close circuit by its armature 110, through release magnet RM², whereby the conductor F is restored to normal as before described. It is thus seen that until the called-for subscriber has answered the call to effect the energization of relay 119, the connector F is capable of being released by the calling subscriber.

It will also be seen that if the calling subscriber were to replace his receiver while the operator was transmitting the impulses to make the connection with the called line, the automatic switching mechanisms will be restored to normal in due course. The line selector D will be restored as before described as soon as the subscriber replaces

his receiver. The first selector E will, however, not be restored to normal until the operator has completed sending the directive impulses and has removed the plug S from the spring jack of the trunk. This will be apparent from consideration of the fact that the relay 83 of the first selector will, until the withdrawal of the plug as described, and the consequent simultaneous deenergization of relays PR' and SR', be continued energized over a circuit extending through one of the attracted armatures 67 or 68 and over conductor P, through contact 131—135, and relay 160, to ground. As soon, however, as a plug is withdrawn, the resulting restoration before described of switch H opens this circuit of relay 83 and the relay is deenergized, whereupon the release of the first selector and of connector H proceeds as before described.

If the calling subscriber A desires his line to be connected with that of a subscriber such as L, whose line terminates in the manual main office, the removal of the receiver at substation A effects operations as before described, whereby the line at A is extended to the manual position K and the call manifested upon the signal 180. The operator answering, inserts the answering plug S, putting out signal 180 and establishing conditions before described, whereby the sleeve supervisory relay 177 is energized by current over conductor Q and through relay PR', to ground, relay SR' being also energized by current through supervisory relay 176 at K, the current through said relay 176 flowing in such a direction as to tilt the armature of the said relay upward so as to disengage its contact. The relay 66 during the process of this connection, is not employed, remaining inert, because the first selector of the switch pair DE is not used and therefore remains at normal, contact 78 remaining open.

The operator learning the number of the called subscriber, inserts a calling plug T within a multiple spring-jack of the called line, assumed to be that shown at L, whereupon current will flow from battery B through the sleeve supervisory relay 182, contacts 190, 191, 195—200, cut-off relay 198, to ground, operating said cut-off relay to attract its armatures and relay 182 to close the circuit of calling supervisory signal 183 which is now displayed by current to ground through the armature of relay 184. The operator will, of course, insert the plug T only after having tested the called-for line in the usual manner, the well-known arrangement including the high wound test relay 185 being provided for this purpose. The operator now actuates levers 191 of her ringing key, to ring the bell of the called subscriber. When levers 191 are released, and the called subscriber answers the call,

current will flow from ground through relay 184, through alternate contact 204, contacts 188, 191, 194—199, attracted upper armature of relay 198, through transmitter and hook lever 1 at the substation, returning through attracted lower armature of relay 198, contacts 200—195, 191, 190, relay 182, to battery. This current flow is in a direction to tilt the armature of polarized relay 184 upward, so that the calling supervisory signal 183 is unlighted during conversation. It will be understood that the talking circuit extends from substation A over conductors N and Q, trunk wires T² T³ and the strands of operator's circuit K, to substation L. Under these circumstances, the first selector, which is paired with the line selector D, is, of course, not available for use, although its mechanism takes no active part in the connection established.

When the subscribers finish their conversation, they replace their receivers, the act at substation L opening circuit through relay 184 which is deenergized and by the falling back of its armature, lights the calling supervisory lamp 183.

When the calling subscriber A replaces his receiver, the line selector D is automatically restored in the manner before described. The trunk selector H is, however, not restored to normal, since the relays SR' and PR' continue energized, and, hence, the relay 83 associated with the first selector. The replacing of the receiver at substation A deenergizes the relay 54, of course, which relay, by its now retracted armature 56, is effective to reverse the direction of the current flow through the polarized relay 176 of the operator's circuit K. It will be remembered that the initial current through said relay 176 was from the negative or active side of battery B⁴ and alternate contact 56, relay SR' and over wire N. By the falling back of armature 56, negative battery at B⁴ is disconnected from wire N and positive battery at B³ substituted therefor, whereby the relay 176 will be energized by current in such a direction as to tend to throw its armature downward, which armature engaging its contact, will close the circuit of the answering supervisory signal 178. The operator observing the two signals 178 and 183 displayed, will withdraw plugs S and T, the withdrawal of T restoring the line circuit of L and the calling end of the cord-circuit to normal, while the withdrawal of S simultaneously deenergizes the relays SR' and PR', whereby the trunk selector H is restored to normal as before described. It will be seen that since the relay 83 is only deenergized when the operator withdraws the plug S, its armature 87 continues to hold ground upon wire 47 connected to the contact 20 of the switch pair DE used in the connection at the master-

switch C, so that although the line selector D was disconnected from the calling line before the operator withdrew the plug S, yet switch pair DE continued busy at its master-switch contact 20. Although the reversing of current, before described as occurring when subscriber A replaces his receiver, over the circuit including the relays SR' and 176, may cause the relay SR' to retract its armatures, no effect upon the mechanism of the first selector will be produced by the retraction of armature 71, since the circuit of armature 73 through which the circuit would be closed from contact 71, is open at primary off-normal contact 80, which is in its normal condition.

It will now be assumed that L is the calling subscriber and that W in the local exchange is the called-for subscriber. The removal of the receiver at substation L will operate line relay 196 to display line lamp 197 in the well-known manner, whereupon the operator inserting answering plug S to engage tip and sleeve contacts 199, 200 of the answering jack of line L, will operate the sleeve supervisory relay 177 in series with cut-off relay 198, deenergizing the line relay and putting out the lamp by the operation of relay 198, although supervisory signal 178 will not be displayed because relay 176 will open its contact when operated by current over the calling line L. The operator having learned that the calling subscriber wishes to converse with a subscriber in a local exchange, will insert the calling plug T within a jack of one of her trunk lines T² T³ leading to a selector H in the exchange wanted, having first thrown the levers 187, 189 to connect the impulse springs 192, 193 with the tip and sleeve contacts of the plug T respectively, and waits a moment before actuating the impulse springs 193, 192 in order to give the switch H time to select the idle switch pair DE at the local exchange. Cut-off relay 181 is of course operated when the plug is inserted.

Upon the insertion of plug T, current flows from ground through spring 192, contact 187, 188, contact 194—150, through normal contact 154, relay 141, to battery, operating the said relay, which, by armature 142, energizes relay 145 to place wipers 133—136 on open circuit. Circuit is also closed from generator through operating magnet OM, attracted armatures 143—147, to ground, whereby magnet OM is successively actuated to move the wipers 133, 134, 135, 136 in search of multiple contacts forming terminals of an idle switch pair DE. This selection is effected by control of relay 141 exercised over it by the private wiper 135 engaging successive contacts 131 connected to wires P extending to the different switch pairs, the contacts 131 of a busy switch pair being grounded at armature 53 of a pair whose line selector D

has been operated from a calling substation, or the contacts 131 of a busy switch pair will be grounded through a relay 160 if some other trunk selector H has selected and is resting with its wipers engaging the contacts of the switch pair, circuit in such latter case being traced through normal contact 144 and wiper 135 engaging a multiple contact 131. Relay 141 will, therefore, remain operated over successive locking circuits established by wiper 135 in its search for an idle contact 131, the said locking circuits extending to ground through busy contacts 131. As soon, however, as an idle contact 131 is reached, the said contact will be ungrounded, because conductor P will be on open circuit at armatures 53, 67 and 68 of the idle switch pair. The armatures of relay 141 will then fall back, deenergizing relay 145, and opening the circuit of operating magnet OM.

It will be understood, of course, that this automatic selection of an idle switch pair DE by the trunk selector H is completed in a very short space of time, it having been found feasible to operate rotary step-by-step switches at a rate of eighty steps per second. With the first step of switch H, the off-normal (ON) contacts 152, 153, 154 were shifted, 153 so that relay OR was disconnected from contact 168, master-switch mechanism G being then unable to affect the mechanism of switch H if its relay 163 should be operated.

The multiple private contacts 130 of the selected switch pair DE, which is assumed to be that shown in Fig. 1, has a busy ground placed upon it by wiper 134, through normal contact 138, so that no other switch H operating under the influence of relay OR can select the now busy switch pair DE. Also the private contact 131 is rendered busy by ground placed upon it through relay 160 and normal contact 144.

As soon as relay 145 is deenergized as described, current flows from battery B' through spring 193, contact 190—189 contact 195—151, 136—132, over wire Q, through relay PR, to ground, operating the relay PR'. The operation of relay PR' energizes relay 83 by current through attracted armature 68 over wire P, contact 131, 135, and through relay 160, to ground, whereby relay 160 was also energized to operate and lock relay 155. Relay 155 now renders the contact 169 of the operated switch H at the master switch busy, so that if the wipers 166, 167 are engaging the contacts 168, 169, they will be moved off from them, or if they subsequently engage them, they will pass by them.

The operation of relay 83 by armature 87 will place ground on wire 47 and upon the contact 20 of the selected switch pair DE at master-switch C, so that if the wipers 17, 18 of said master-switch were engaging

the contacts 19, 20 of the selected switch pair, they would be moved off from them, the contact 20 remaining unselectable until the relay 83 was again deenergized. Thus it will be impossible for the master-switch mechanism C, when its relay 14 is energized by any calling line, to start the line selector D, since whenever wiper 17 will engage the contact 19 of switch D, the armature of relay 16 will be attracted.

Under the present circumstances, namely, those of a call being extended from a calling manual line to a called local exchange line, the line selector D of the switch pair DE to be used in the connection is not employed at all, as a calling subscriber's line at the local connection can have nothing to do with the connection being put through.

Assuming that the number of the called subscriber was Local 333, as before, the operator actuates lever 193 to produce three set of deenergizations of relay PR', each set consisting of three deenergizations and being followed by a single deenergization of relay SR' produced by the opening of contact 192. The various deenergizations of relays PR' and SR' operate in the same manner as before described to adjust the first selector at E and the connector F to establish connection with the called-for subscriber's line, assumed to be line W. The called-for line is tested in precisely the same manner as before described, and if found idle, the bell of the called subscriber is caused to be rung.

When the operator at K finished transmitting the impulses, she immediately released levers 187 and 189 of her calling device key, whereby, by the "make-before-break" arrangement of springs 188 and 190, a maintaining circuit for relay PR' including relay 182 was established and also a maintaining circuit for relay SR', which may be traced from ground through the tip supervisory relay 184, attracted armature 204, normal contact 188, contact 194—150, contact 133—129, over N, through relay SR', normal contact 56, to positive battery at B³, the flow of this current being in such a direction that the relay 184 tends to tilt its armature downward, the calling supervisory signal 183 therefore being energized. When the called subscriber answers the call, circuit changes as previously described are effected, resulting in the connecting of ground through relay RR² at switch F over the line of subscriber W, through contact 23—128, attracted armature 124, contact 98—95, through attracted armature 73 and 71 (which remain attracted because the plug T is left within the jack) and through relay 74, to battery B'. Relay 74 is, therefore operated, and by attracting its armature 76, disconnects positive battery from wire N, and, by armature 77, connects negative battery thereto over wire 59 and re-

lay SR'. The direction of the flow of current through relay 184 is thereby reversed on the response of the called subscriber and the said relay tilts its armature upward, to open circuit through signal 183 which is no longer lighted, the operator thus knowing that the called local subscriber has answered the call.

Battery being supplied to the called subscriber W for talking purposes as before, and also to the calling subscriber L, conversation can take place over a talking circuit extending from substation L, through the answering jack of said line and the connected answering plug S, thence through calling plug T and the jack contacts of trunk wires T² T³ and over wires N and Q to the talking conductors of the first selector and through the connector and the called line, to substation W. When the subscribers finish their conversation, they replace their receivers. The act at substation L opened the circuit of relay 176 and its armature is retracted to light the answering supervisory signal 178. When the subscriber W replaces his receiver, the connector F is restored as before described, and the circuit of relay 74 is opened and its armatures fall back, whereby the direction of current through calling supervisory relay 184 is reversed and the said relay tends to tilt its armature downward, said armature then closing circuit through calling supervisory signal 183. The two signals being now displayed, the operator withdraws plugs S and T, the withdrawal of S restoring the line circuit at L and the answering end of the cord-circuit to normal; the withdrawal of plug T causes ground to be disconnected from tip contact 150 of the trunk spring-jack and battery from sleeve contact 151 thereof, relay 181 releasing slowly as before specified. Thus relays PR' and SR' are simultaneously deenergized, whereby the circuit through relay 83 at E, including serially the relay 160 at H, is opened and the two relays deenergized, the deenergization of 160 restoring trunk selector H to normal as before described. Relay 83 being deenergized, armature 87 falls back, closing the circuit of busy relay BR' as before described, whereupon release magnet RM² is operated and the first selector at E is placed at normal, when all apparatus will be at normal.

Had the line W been busy, test relay TR would have been locked and the busy signal extended from the interrupter I over the upper talking conductor to the left, through condenser 65, over wire N, over the upper talking conductor in Fig. 1 (Part 4) and through substation L, returning to ground through cut-off relay 198, advising the calling subscriber that the called line was busy. L would, therefore, replace his receiver and the two supervisory signals 178, 183, would

then be displayed. The operator would withdraw the plugs, and upon the withdrawal of plug T from the spring-jack of trunk line T² T³, the first selector would be released, the deenergization of relay 83 opening the locking circuit of relay 108, said relay being then deenergized to energize relay RM² and restore connector F.

If a calling subscriber, such as A, desires to be connected with a called-for subscriber, such as W, whose line will now be assumed to terminate in the other of the two local exchanges from that in which the line of A terminates, the processes of connection will be as follows: The subscriber A removes his receiver and his line is connected to an operator's position at the main exchange precisely as before described, and the operator learning that the called subscriber is in the other local exchange, will insert the calling plug T of the cord-circuit with which she answered, into a spring-jack connected with a trunk T² T³ leading to the distant exchange, and the connections from this point on will proceed just as in the case in which the calling subscriber L was connected with called subscriber W. In such case, of course, the talking circuit finally completed will extend from substation A in the first exchange through the talking conductors of the line selector D of a switch pair (whose first selector will have no concern in the conversation), over the wires N and Q of such switch pair, and wires T² T³ whose switch H selects, over the cord-circuit at the manual exchange, out over another trunk T² T³ and wires NQ of a switch pair at the other local exchange, through the first selector connected to said wires and through a selected connector thereat, and over called subscriber's line, to the substation. The supervision of the cord-circuit as respects the calling line, is controlled in the same manner as that described where the calling line A was connected to the called line L, while the supervision at the cord-circuit as to the called-for subscriber, is controlled in the same manner as that described when the calling subscriber L has his line connected with that of subscriber W. The release of the mechanism employed at the distant offices is effected on the withdrawal of plugs S and T in the same manner as described in those cases, respectively.

It will be observed that while a switch H is operating under control of the private wiper 134, *i. e.*, when started by the master-switch mechanism G, there is no busy potential upon the sleeve contacts 151 and it is barely conceivable that between the time the switch starts and the lamp signal 180 is displayed, the operator might plug into the jack of the trunk, whose switch H was operating, with a calling plug. In such case, a misconnection would, of course, result and

the subscribers would replace their receivers and the operator withdraw the plugs, thus restoring all apparatus to normal.

In view of the rapidity of operation of the trunk selectors H, I have not deemed it advisable to unnecessarily complicate the trunk circuit by making special provision against the above-mentioned contingency, as it would in practice rarely, if ever occur, although it is, of course, within the scope of the invention that such means should be provided.

The diagrammatically illustrated switch of Figs. 2 to 6 is more specifically the line selector D.

As indicated in Figs. 2 and 3, in which latter figure each line contact set 24, 25, 26 is indicated by a single short line, the line contacts are arranged in ten vertical rows, each row being a group, the said contact sets projecting as from the inner surface of a section of a sphere. The group contacts 24^a are located immediately below their respective groups.

The wipers 27, 28, 29, and group wiper 27^a are connected with the rotary primary shaft PS, wiper 27^a being rigidly connected, while wipers 27, 28, 29 are pivotally connected at 300.

Primary movements of the wipers are effected by rotating shaft PS step-by-step from left to right, a ratchet 305, Fig. 6, being fastened to said shaft and adapted to be driven by armature actuated pawl 306 of magnet PM, the retaining pawl 307 being provided to prevent return movement under the influence of spring 302 against whose tension shaft PS is rotated. Each actuation of pawl 306 steps ratchet 305 and shaft PS to move wipers 27, 28, 29, opposite the next contact group, wiper 27^a being correspondingly moved to engage the next group contact 24^a.

Secondary movements of wipers 27, 28, 29, (wiper 27^a then remaining motionless) are effected, after the primary adjustment is completed, by secondary magnet SM whose armature actuated pawl 309 engages the teeth of its associated ratchet cut in shaft SS. Said shaft has fastened to it a broad piece 301 which engages an anti-friction bearing in the rearwardly extending support of wipers 27, 28, 29, said piece being broad so that however the wipers may be primarily adjusted, the bearing will still engage said piece 301.

Successive actuations of magnet SM, by pawl 309, step shaft SS downward, retaining pawl 310 holding the shaft against back movement under the influence of spring 303, whose tension is exerted against the downward movement of SS being linked thereto by the pivoted lever 304 loosely engaging a screw on shaft SS. Each downward step of shaft SS by piece 301 steps the contact

ends of wipers 27, 28, 29, a step upward to engage a next set of contacts 24, 25, 26.

To release the switch, release magnet RM is energized. Its attracted armature 303 turns retaining pawl 307 about its pivot to disengage ratchet 305, which pawl being in interlocking relation with retaining pawl 310 withdraws the latter to disengage the retaining ratchet by shaft SS.

The secondary shaft SS is now restored by spring 303, the wipers 27, 28, 29, being brought down to free the contact bank.

To prevent tension of spring 302 from being effective while shaft SS is restoring, detent 320 is provided upon piece 311, which piece, when shaft SS is at normal, is pressed upward by piece 321. The first downward step of shaft SS permits piece 311 to fall down when detent 320 will engage any adjacent tooth of ratchet 305 to hold the ratchet and shaft PS, in adjusted position until the shaft SS reaches normal, when piece 321 lifts piece 311, bringing detent 320 to normal when spring 302 is free to restore the primary shaft and wipers.

It is obvious that movement of piece 311 on the first step of shaft SS permits the secondary off-normal SO, springs to shift by their tension to their alternate positions, while the restoration of shaft SS, restoring piece 311, also restores the secondary off-normal springs.

Piece 314 fastened to primary shaft PS, Fig. 5, has a stud 313 normally engaging the controlling spring of the primary off-normal, PO, contacts. With the first step of shaft PS, stud 313 frees said spring and the off-normal contacts shift under their tension. On restoration of shaft PS, stud 313 engages the controlling spring shifting the contacts back to normal.

For first selector E and connector F, the mechanical arrangement of Figs. 2 to 6 may be employed, the arrangements of primary and secondary off-normal contacts indicated in Fig. 1 being of course provided.

The group wiper 27^a and contacts 24^a are, of course, unnecessary for these employments.

As before indicated, for the connector F, two secondary steps of the wipers are required to bring the wipers to engage the first contact set of a selected group.

Referring now to Fig. 7, this mechanism may be employed for trunk selector H. This switch may comprise the rotary shaft 250 supporting wipers 133, 134, 135, 136 and ratchet 225, the latter adapted to be engaged by pawl 226 of magnet OM, whereby successive actuations of said magnet step the wipers to engage successive contact sets 129, 130, 131, 132, of which ten sets only are shown, although it will be understood that fifty, one hundred or even more sets may be

provided, suitable teeth of ratchet 225 being provided.

Shaft 250 is rotated against the tension of spring 251. To restore the switch, magnet RM³ is energized whose armature withdraws retaining pawl 252 when spring 251 turns shaft, ratchet and wipers back to normal.

The off-normal, ON, contacts 152, 153, 154, are released, so that they may shift on the first movement of the switch, and restored when the switch is restored in an obvious manner by stud 227 fastened to ratchet 225.

In Fig. 8, I show an alternate means for rendering relay 181 at I in Fig. 1, Part 4, slow to close its contact 229 when its circuit is opened. The armature 228 is provided with a pawl 230 adapted to engage an adjacent tooth of ratchet 231 when relay 181 is energized. When deenergization occurs, the retraction of armature 228 and the closing of contact 229 will occur slowly since pawl 230 will have to actuate the gear train connected with ratchet 231 and controlled by the escapement 232.

It will be understood that I have employed the customary battery symbol wherever convenient for the purposes of the drawing, and that the various symbols B, B', B², B³ and B⁴ of Fig. 1 (all belonging to a local exchange) are preferably a single source. B⁴ of opposed polarity is a separate source of battery. B⁷ at the distant exchange is also a separate source. Similarly a common source of alternating current may be employed for the various symbols associated with the mechanism of the local exchange.

Obviously, many changes may be made from the structures herein shown without departing from the substance of the invention, and I desire not to be limited in these respects as for instance, to the manually operated connectors S and T at the main exchange, but what I claim is:

1. A semi-automatic telephone system including telephone lines, a main exchange in which a portion of said lines terminate, a branch exchange in which a portion of said lines terminate, trunk lines interconnecting said exchanges, means for automatically connecting a calling line of said branch exchange over an idle one of said trunks with said main exchange, impulse controlling mechanism at said main exchange for transmitting directive currents back over said same trunk to link the calling line to the called line, and means operated alternatively to said mechanism to manually link the connected trunk to the called line.

2. A semi-automatic telephone system including telephone lines, a main exchange in which a portion of said lines terminate, a branch exchange in which a portion of said lines terminate, trunk lines interconnecting

said exchanges, means for automatically connecting a calling line of said branch exchange over an idle one of said trunks with said main exchange, impulse controlling mechanism at said main exchange for transmitting directive currents back over said same trunk to link the calling line to the called line, means for thereon freeing the trunk while leaving the connection of subscribers continuing, and means used alternatively to said impulse controlling mechanism and said trunk freeing mechanism to manually link the connected trunk to the called line.

3. A semi-automatic telephone system including telephone lines, a main exchange in which a portion of said lines terminate, a branch exchange in which a portion of said lines terminate, trunk lines interconnecting said exchanges, means for automatically connecting a calling line of said branch exchange over an idle one of said trunks with said main exchange, impulse controlling mechanism at said main exchange for transmitting directive currents back over said same trunk to link the calling line to the called line, switches at the substations of lines so connected for rendering them idle when disconnection is desired, and manual means for linking the connected trunk to the called line instead of sending impulses back over and subsequently freeing the trunk.

4. A semi-automatic telephone system including telephone lines, a main exchange in which a portion of said lines terminate, a branch exchange in which a portion of said lines terminate, trunk lines interconnecting said exchanges, means for automatically connecting a calling line of said branch exchange over an idle one of said trunks with said main exchange, impulse controlling mechanism at said main exchange for transmitting directive currents back over said same trunk to link the calling line to the called line, means for thereon freeing the trunk while leaving the connection of subscribers continuing, switches at the substations of lines so connected for rendering them idle when disconnection is desired, and manual means for linking the connected trunk to the called line instead of sending impulses back over and subsequently freeing the trunk.

5. A semi-automatic telephone system comprising telephone lines, a main exchange and a local exchange, terminals of said lines divided between said exchanges, trunk lines connecting said exchanges, permanently mated switch pairs at said local exchange for use in interconnecting lines of said exchange, each pair including an automatically operable line selector and a directly operable selector, means responsive to initiation of a call serving to set in travel the automatic selector of an idle pair to connect

with the calling line, trunk selectors associated with said trunk lines, means including a master switch for automatically setting in travel an idle trunk selector to connect a switch pair, in connection with a calling line, with an idle trunk line, and an operator's signal adapted to be displayed thereon.

6. A semi-automatic telephone system comprising telephone lines, a main exchange and a local exchange, terminals of said lines divided between said exchanges, trunk lines connecting said exchanges, permanently mated switch pairs at said local exchange for use in interconnecting lines of said exchange, each pair including an automatically operable line selector and a directly operable selector, means responsive to initiation of a call serving to set in travel the automatic selector of an idle pair to connect with the calling line, trunk selectors associated with said trunk lines, means including a master switch for automatically setting in travel an idle trunk selector to connect a switch pair, in connection with a calling line, with an idle trunk line, and operator's means for controlling the directly operable selector of said switch pair by currents over said same trunk line in completing connection from the calling line to a called line in the same exchange.

7. A semi-automatic telephone system comprising telephone lines, a main exchange and a local exchange, terminals of said lines divided between said exchanges, trunk lines connecting said exchanges, permanently mated switch pairs at said local exchange for use in interconnecting lines of said exchange, each pair including an automatically operable line selector and a directly operable selector, means responsive to initiation of a call serving to set in travel the automatic selector of an idle pair to connect with the calling line, trunk selectors associated with said trunk lines, means including a master switch for automatically setting in travel an idle trunk selector to connect a switch pair, in connection with a calling line, with an idle trunk line, an operator's signal adapted to be displayed thereon, and operator's means for controlling the directly operable selector of said switch pair by currents over said same trunk line in completing connection from the calling line to a called line in the same exchange.

8. A semi-automatic telephone system comprising telephone lines, a main exchange and a local exchange, terminals of said lines divided between said exchanges, trunk lines connecting said exchanges, permanently mated switch pairs at said local exchange for use in interconnecting lines of said exchange, each pair including an automatically operable line selector and a directly

operable selector, means responsive to initiation of a call serving to set in travel the automatic selector of an idle pair to connect with the calling line, trunk selectors associated with said trunk lines, means including a master switch for automatically setting in travel an idle trunk selector to connect a switch pair, in connection with a calling line, with an idle trunk line, operator's means for controlling the directly operable selector of said switch pair by currents over said same trunk line in completing connection from the calling line to a called line in the same exchange, and means controlled by the operator for thereon rendering said trunk line idle while maintaining said telephone lines in conversational relation.

9. A semi-automatic telephone system comprising telephone lines, a main exchange and a local exchange, terminals of said lines divided between said exchanges, trunk lines connecting said exchanges, permanently mated switch pairs at said local exchange for use in interconnecting lines of said exchange, each pair including an automatically operable line selector and a directly operable selector, means responsive to initiation of a call serving to set in travel the automatic selector of an idle pair to connect with the calling line, trunk selectors associated with said trunk lines, means including a master switch for automatically setting in travel an idle trunk selector to connect a switch pair, in connection with a calling line, with an idle trunk line, an operator's signal adapted to be displayed thereon, operator's means for controlling the directly operable selector of said switch pair by currents over said same trunk line in completing connection from the calling line to a called line in the same exchange, and substation switching mechanism for controlling the restoration to normal of said switch pair.

10. A semi-automatic telephone system comprising telephone lines, a main exchange and a local exchange, terminals of said lines divided between said exchanges, trunk lines connecting said exchanges, permanently mated switch pairs at said local exchange for use in interconnecting lines of said exchange, each pair including an automatically operable line selector and a directly operable selector, means responsive to initiation of a call serving to set in travel the automatic selector of an idle pair to connect with the calling line, trunk selectors associated with said trunk lines, means including a master switch for automatically setting in travel an idle trunk selector to connect a switch pair, in connection with a calling line, with an idle trunk line, an operator's signal adapted to be displayed thereon, operator's means for controlling the directly operable selector of said

switch pair by currents over said same trunk line in completing connection from the calling line to a called line in the same exchange, and mechanism for disconnecting said trunk line from said switch pair as soon as said connection of telephone lines is completed, while continuing connection of said lines.

11. A semi-automatic telephone system comprising telephone lines, a main exchange and a local exchange, terminals of said lines divided between said exchanges, trunk lines connecting said exchanges, permanently mated switch pairs at said local exchange for use in interconnecting lines of said exchange, each pair including an automatically operable line selector and a directly operable selector, means responsive to initiation of a call serving to set in travel the automatic selector of an idle pair to connect with the calling line, trunk selectors associated with said trunk lines, means including a master switch for automatically setting in travel an idle trunk selector to connect a switch pair, in connection with a calling line, with an idle trunk line, an operator's signal adapted to be displayed thereon, operator's means for controlling the directly operable selector of said switch pair by currents over said same trunk line in completing connection from the calling line to a called line in the same exchange, mechanism for disconnecting said trunk line from said switch pair as soon as said connection of telephone lines is completed, and substation switching mechanism for controlling the restoration to normal of said switch pair.

12. A telephone system including telephone lines, two telephone exchanges, terminals of part of said lines at each exchange, two-way trunk lines interconnecting said exchanges, means for automatically extending a call initiated at either exchange to the other exchange over an idle trunk, and mechanism controlled by an operator at one exchange for working back over the same trunk to complete the connection from terminals of the calling line to terminals of the called line at the other exchange.

13. A telephone system including telephone lines, two telephone exchanges, terminals of part of said lines at each exchange, two-way trunk lines interconnecting said exchanges, means for automatically extending a call initiated at either exchange to the other exchange over an idle trunk, and mechanism controlled by an operator at one exchange for working back over the same trunk to complete the connection from terminals of the calling line to terminals of the called line at the other exchange with means for freeing the trunk.

14. A telephone system including a call-

ing subscriber's line, terminals therefor at an exchange, a central office link-circuit, adapted to be automatically connected with said line on initiation of a call, an operator's position, a trunk line leading thereto, a signal for said trunk line, an electrically controlled selective switch at the exchange, means for initiating travel thereof to connect said link-circuit and trunk line in response to the operation of said selective switch, a called subscriber's line, terminals therefor at the exchange, operator's means for transmitting directive currents over said trunk line to establish a connection from the terminals of the calling line to terminals of the called line, with operator's means for freeing said trunk line at any time after its selection.

15. A telephone system including a calling subscriber's line, terminals therefor at an exchange, a central office link-circuit, an automatic switch at the exchange operable responsive to initiation of a call over said line to connect said link-circuit and line, an operator's position, a signal thereat, a trunk line leading thereto, automatic switching means for interconnecting said link-circuit and trunk line whereby said signal is displayed to indicate the call, a called subscriber's line, terminals therefor at the exchange, directly operable selective switches associated with said link-circuit, operator's means for electrically controlling adjustment of said selective switches to complete a connection from terminals of the calling line to terminals of the called line, a circuit by which said control is exercised including said trunk line and said link-circuit, and operator's means for disconnecting said trunk line from said link-circuit when said telephone lines have been connected and at any time after the interconnection of said link circuit and trunk line.

16. A telephone system including a calling subscriber's line, terminals therefor at an exchange, a central office link-circuit, adapted to be automatically connected with said line on initiation of a call, an operator's position, a trunk line leading thereto, an electrically controlled selective switch at the exchange, means including a master switch for initiating travel thereof to connect said link circuit and trunk line in response to the operation of said selective switch, a called subscriber's line, terminals therefor at the exchange, operator's means for transmitting directive currents over said trunk line to establish a connection from the terminals of the calling line to terminals of the called line, with means for thereon freeing said trunk line.

17. A telephone system including a calling subscriber's line, terminals therefor at an exchange, a central office link-circuit, adapted to be automatically connected with said

line on initiation of a call, an operator's position, a trunk line leading thereto, an electrically controlled selective switch at the exchange, means including a master switch for initiating travel thereof to connect said link-circuit and trunk line in response to the operation of said selective switch, a called subscriber's line, terminals therefor at the exchange, directly operable selective switches associated with said link-circuit, operator's means for electrically controlling adjustment of said selective switches to complete a connection from terminals of the calling line to terminals of the called line, a circuit by which said control is exercised including said trunk line and said link-circuit, and means for disconnecting said trunk line from said link-circuit when said telephone lines have been connected.

18. A telephone system including a main exchange and a sub-exchange, telephone lines terminating in said exchanges, trunk lines connecting said exchanges adapted to link together a calling telephone line terminating in the main exchange and a called telephone line terminating in the sub-exchange, means for using said trunk line as an impulse transmitting medium to cause automatic connection of two lines terminating in said sub-exchange, with means for freeing said trunk line for further use when employed as said medium as soon as connection is established.

19. A telephone system including telephone lines, a plurality of permanently mated switch pairs at the exchange, each pair including a line selector provided with active contacts to select the calling line, the other switch of each pair being a first selector, connectors for connecting directly with called lines, link-circuits operatively associating said connectors with switch pairs, multiple terminals for said switch pairs, including talking terminals permanently connected to talking conductors of said switch pairs, trunk lines leading to an operator's position, trunk selectors therefor having contact wipers to select said multiple terminals, means responsive to initiation of a call at a station of said line serving to control operation of a line selector and a trunk selector to extend the call to and manifest it at said operator's position, and operator's means for transmitting directive currents over a trunk line in connection with a switch pair to electrically adjust a first selector and a connector to effect a connection from the calling line to the called line.

20. A telephone system including telephone lines, a plurality of permanently mated switch pairs at the exchange, each pair including a line selector provided with active contacts to select the calling line, the other switch of each pair being a first selector, connectors for connecting directly

with called lines, link-circuits operatively associating said connectors with switch pairs, multiple terminals for said switch pairs, including talking terminals permanently connected to talking conductors of said switch pairs, trunk lines leading to an operator's position, trunk selectors therefor having contact wipers to select said multiple terminals, means responsive to initiation of a call at a station of said line serving to control operation of a line selector and a trunk selector to extend the call to and manifest it at said operator's position, operator's means for transmitting directive currents over a trunk line in connection with a switch pair to electrically adjust a first selector and a connector to effect a connection from the calling line to the called line, and means for freeing said trunk line while leaving the completed connection existing.

21. A telephone system including telephone lines, a plurality of permanently mated switch pairs at the exchange, each pair including a line selector provided with active contacts to select the calling line, the other switch of each pair being a first selector, connectors for connecting directly with called lines, link-circuits operatively associating said connectors with switch pairs, multiple terminals for said switch pairs, including talking terminals permanently connected to talking conductors of said switch pairs, trunk lines leading to an operator's position, trunk selectors therefor having contact wipers to select said multiple terminals, means responsive to initiation of a call at a station of said line serving to control operation of a line selector and a trunk selector to extend the call to and manifest it at said operator's position, operator's means for transmitting directive currents over a trunk line in connection with a switch pair to electrically adjust a first selector and a connector to effect a connection from the calling line to the called line, and release mechanism associated with said trunk selector operable to free said trunk line from terminals of a switch pair while leaving said pair in adjusted position.

22. In a telephone system, the combination with a trunk line, of a trunk selector, multiple terminals selectable thereby, link-circuits connected with said multiple terminals, and having connection devices at their distant ends, means for effecting travel of said trunk selector under one condition of use to select multiple terminals of a link-circuit whose devices are idle, and means for effecting travel of said trunk selector under another condition of use to select terminals of a link-circuit whose devices are in use.

23. In a telephone system, the combination with a trunk line, of a trunk selector, a pair of private wipers for said selector, a link-circuit and a pair of private contacts there-

for, one for each of said wipers, apparatus rendering one of said contacts normally unselectable by its wiper, the other contact being normally selectable by the other wiper, and means for changing the conditions of said contacts to render the one selectable and the other unselectable.

24. In a telephone system, the combination with a trunk line, of a trunk selector, a pair of private wipers for said selector, a link-circuit and a pair of private contacts therefor, one for each of said wipers, apparatus rendering one of said contacts normally unselectable by its wiper, the other contact being normally selectable by the other wiper, means for changing the conditions of said contacts to render the one selectable and the other unselectable, and mechanism for thereon initiating travel of said selector under control of the wiper of said first contact to select said link-circuit.

25. In a telephone system, the combination with a trunk line, of a trunk selector, a pair of private wipers for said selector, a link-circuit and a pair of private contacts therefor, one for each of said wipers, apparatus rendering one of said contacts normally unselectable by its wiper, the other contact being normally selectable by the other wiper, means for changing the conditions of said contacts to render the one selectable and the other unselectable, mechanism for thereon initiating travel of said selector under control of the wiper of said first contact to select said link-circuit, means for restoring said selector to normal, and apparatus for initiating travel of said selector from normal under control of the wiper of said other contact to select said link-circuit when its contacts are in their normal condition.

26. A telephone system including telephone lines, automatic selectors and connectors at outlying points for interconnecting said lines, a central station having operators' impulse means for adjusting said selectors and connectors to complete desired connections, and means initially controlled under one operating condition at said outlying points and under another operating condition at said central station to bring said selectors and connectors into operative relation with said central office.

27. A telephone system including telephone lines, automatic selecting mechanisms at outlying points for interconnecting said lines, a central station having operators' positions, means responsive to initiation of a call for operating one of said mechanisms to connect with the calling line, means for thereon displaying a signal at an operator's position, operators' plug and jack connecting apparatus and transmitting devices for transmitting directive impulses to another of said mechanisms in connecting the calling line with a called line, and means operating

in one class of service to connect said jack to the calling line and operating in another class of service upon insertion of the plug into the jack to connect said jack to idle
5 automatic selecting mechanisms.

28. A telephone system including telephone lines, automatic selecting mechanisms at outlying points for interconnecting said lines, a central station having operators' positions, means responsive to initiation of a call for operating one of said mechanisms to connect with the calling line, means for thereon displaying a signal at an operator's position, operators' apparatus for transmitting directive impulses to another of said mechanisms in connecting the calling line with a called line, a switch for disconnecting said apparatus from said last-mentioned mechanism after its operation, and means
20 whereby said switch may be advanced under the subsequent control of the operator to extend a circuit from her apparatus to idle ones of said mechanisms.

29. A telephone system including telephone lines, automatic selecting mechanism for interconnecting said lines, link circuits associated with said mechanisms, means automatically controlled by a calling subscriber for causing certain of said mechanisms to connect the calling line with a link-circuit, operator's plug and jack connecting means and transmitting devices to direct current impulses to certain of said mechanisms to connect to a called line, an operator's signal, and means controlled at one time by certain of said mechanisms to display said signal and at another time by said plug and jack to bring certain of said mechanisms into operative connection with said
40 impulse devices.

30. In a telephone exchange system, a number of subscribers' lines, a number of trunks less than the number of lines, each trunk terminating at one end in a primary selector switch, and at the other end in a first selector switch, an operator's circuit and apparatus including a telephone set and a sending device, and an automatic switch associated with the operator's circuit and containing terminals of a number of said trunks, the automatic terminals being permanently connected to talking trunk conductors and all of the switches specified being normally in a zero or inoperative position, and adapted to be started up to test and connect with bank terminals in their numerical order, substantially as described.

31. In a telephone exchange system, a number of subscribers' lines, a number of trunks less than the number of lines, each trunk terminating at one end in a primary selector switch, and at the other end in a first selector switch, an operator's circuit and apparatus including a telephone set and a
65 sending device, and an automatic switch as-

sociated with the operator's circuit and containing terminals of a number of said trunks, the talking terminals being permanently connected to talking conductors of said trunks, together with release or restoring means for all of said switches, substantially as described.

32. In a telephone exchange system, a number of subscribers' lines, a number of trunks less than the number of lines, each trunk terminating at one end in a primary selector switch, and at the other end in a first selector switch, an operator's circuit and apparatus including a telephone set and a sending device, and an automatic switch associated with the operator's circuit and containing terminals of a number of said trunks, together with driving means for the primary selector switches controlled by the calling subscribers, and driving means for the operators' switches controlled by the primary selector trunks in one class of service and by the operator in another class of service, substantially as described.

33. In a telephone exchange system, a number of subscribers' lines, a number of trunks less than the number of lines, each trunk terminating at one end in a primary selector switch, and at the other end in a first selector switch, an operator's circuit and apparatus including a telephone set and a sending device, and an automatic switch associated with the operator's circuit and containing terminals of a number of said trunks, together with driving means and release or restoring means for the primary selector switches controlled by the calling subscribers, and driving means for the operators' switches controlled in the use of the primary selector trunks in one class of service and by the operator in another class of service, substantially as described.

34. In a telephone exchange system, a number of subscribers' lines, a number of trunks less than the number of lines, each trunk terminating at one end in a primary selector switch, and at the other end in a first selector switch, an operator's circuit and apparatus including a telephone set and a sending device, and an automatic switch associated with the operator's circuit and containing terminals of a number of said trunks, together with driving means and release or restoring means for said primary selector switches controlled by the calling subscribers, driving means for the operators' or secondary switches controlled in the use of the primary selector trunk in one class of service and by the operator in another class of service, and release or restoring means for the operators' or secondary switches controlled by the operator, substantially as described.

35. In a telephone exchange system, a number of subscribers' lines, a number of trunks less than the number of lines, each

trunk terminating at one end in a primary selector switch, and at the other end in a first selector switch, an operator's circuit and apparatus including a telephone set and a sending device, and an automatic switch associated with the operator's circuit and containing terminals of a number of said trunks, together with driving means and release or restoring means for the primary selector switches controlled by the calling subscribers, driving means for the operators' switches controlled in the use of the trunks in one class of service and by the operator in another class of service, release or restoring means for the operators' switches controlled by the operator, and driving means for the forward or calling selector switches controlled by the operator, substantially as described.

36. In a telephone exchange system, a number of subscribers' lines, a number of trunks less than the number of lines, each trunk terminating at one end in a primary selector switch, and at the other end in a first selector switch, an operator's circuit and apparatus including a telephone set and a sending device, and an automatic switch associated with the operator's circuit and containing terminals of a number of said trunks, together with driving means and release or restoring means for the primary selector switches controlled by the calling subscribers, driving means for the operators' switches controlled in the use of the trunks in one class of service and by the operator in another class of service, release or restoring means for the operators' switches controlled by the operator, driving means for the forward or calling selector switches controlled by the operator, and release or restoring means for the said calling selector switches controlled over the lines connected, substantially as described.

37. In a telephone exchange system, the combination with a plurality of exchanges, of a plurality of subscribers' lines connected with each of said exchanges, each of said exchanges comprising automatic switches for effecting connections between subscribers' lines, talking trunks extending between said exchanges, and operators' equipments comprising means for controlling said automatic switches over said talking conductors and cord circuits for linking said talking conductors into a talking circuit between calling and called subscribers' lines.

38. In a telephone exchange system, the combination with an exchange, of a plurality of subscribers' lines connected thereto, said exchange comprising a plurality of talking trunks, means for connecting a calling subscriber with an idle one of said talking trunks, selector switches associated with said trunks, operators' equipments comprising

means for controlling said selector switches and located at an office separated from said exchange, other talking trunks extending from said office to said exchange, other subscribers' lines terminating in said office, and operators' cord circuits for completing conversational circuits between subscribers' lines terminating in said exchange and office over said other trunks.

39. In a telephone exchange system, the combination with an exchange, of a plurality of subscribers' lines connected thereto, said exchange comprising talking trunks for connecting subscribers' lines and automatic switches, operators' equipments comprising means for controlling said automatic switches and located at an office separate from said exchange, trunks extending from said office to said exchange, means located at said exchange for automatically selecting an idle operator's equipment, other subscribers' lines connected to said office, and operators' means for extending a calling subscriber's line to a called subscriber's line connected to said office, as alternative to controlling said automatic switches by the selected operator's equipment.

40. In a telephone exchange system, the combination with an exchange, of a plurality of subscribers' lines connected thereto, said exchange comprising talking trunks for connecting subscribers' lines and automatic switches, operators' equipments comprising means for controlling said automatic switches and located at an office separate from said exchange, trunks extending from said office to said exchange, means located at said exchange for automatically selecting an idle operator's equipment, said trunks extending from said office to said exchange being less in number than said talking trunks, other subscribers' lines connected to said office, and operators' means for extending a calling subscriber's line to a called subscriber's line connected to said office, as alternative to controlling said automatic switches by the selected operator's equipment.

41. In a telephone exchange system, the combination with a plurality of exchanges, of a plurality of subscribers' lines, connected to each of said exchanges, each of said exchanges comprising a plurality of talking trunks, means for connecting a calling subscriber with an idle talking trunk and selector switches, operators' equipments comprising means for controlling said selector switches and located at an office separate from said exchanges, operators' trunks extending from said office to each of said exchanges, means located at each of said exchanges for selecting an idle operator's trunk, other subscribers' lines connected to said office, and operators' means for extending a calling subscriber's line to a called sub-

scriber's line connected to said office, as alternative to controlling said selector switches over a selected idle operator's trunk.

42. In a telephone exchange system, the combination with a plurality of exchanges, of a plurality of subscribers' lines connected to each of said exchanges, each of said exchanges comprising a plurality of talking trunks, means for connecting a calling subscriber with an idle talking trunk and selector switches, operators' equipments comprising means for controlling said selector switches and located at an office separate from said exchanges, operators' trunks extending from said office to each of said exchanges, means located at each of said exchanges for selecting an idle operator's trunk, the number of said operators' trunks extending to an exchange being less than the number of talking trunks at that exchange, other subscribers' lines connected to said office, and operators' means for extending a calling subscriber's line to a called subscriber's line connected to said office, as alternative to controlling said selector switches over a selected idle operator's trunk.

43. In a telephone exchange system, the combination with a plurality of exchanges, of a plurality of subscribers' lines connected with each of said exchanges, automatic selector and connector switches and talking trunks at each of said exchanges, talking trunks extending between said exchanges, a plurality of operators' equipments, each comprising means for operating said selector and connector switches and located at an office removed from said exchanges, trunks extending from said office to each of said exchanges, means at each of said exchanges for selecting an idle trunk extending to said office, other subscribers' lines connected to said office, and operators' means for extending a calling subscriber's line to a called subscriber's line connected to said office, as alternative to controlling said selector and connector switches over a selected idle trunk.

44. A telephone exchange system comprising a plurality of subscribers' lines, automatic switches and associated trunks operative to establish conversational circuits between calling and called ones of said lines, a control trunk, an operator's equipment comprising means for controlling certain of said switches over said control trunk in establishing each such conversational circuit, and release means for certain of said switches under operator control while said switches are being controlled over said control trunk and subsequently under subscriber control.

45. A telephone exchange system comprising a plurality of subscribers' lines, automatic switches and associated trunks for interconnecting said lines, means for restoring said switches and trunks to normal, an op-

erator's equipment comprising means for controlling certain of said switches, a control trunk extending from said equipment to said certain switches, and means for freeing said operator's trunk and equipment for further use before operating said restoring means, part of said restoring means being under operator control while said switches are being controlled over the control trunk and under subscriber control at other times.

46. A telephone exchange system comprising a plurality of subscribers' lines, automatic switches and associated trunks for interconnecting said lines, means for restoring said switches and trunks to normal, an operator's equipment comprising means for directly controlling the operation of certain of the said switches used in putting through each connection, a control trunk extending from said equipment to said certain switches, means for freeing said operator's trunk and equipment for further use as soon as the operator in each instance has completed said directive control, and release means for certain of said switches under operator control while said switches are being controlled over said control trunk and subsequently under subscriber control.

47. A telephone exchange system comprising a plurality of subscribers' lines, automatic switches and associated trunks for interconnecting said lines, means for restoring said switches and trunks to normal, an operator's equipment comprising means for directly controlling the operation of certain of said switches used in putting through each connection, a control trunk extending from said equipment to said certain switches, and means for freeing said operator's trunk for further use in each instance after the operator has completed said directive control and before operating said restoring means, part of said restoring means being under operator control while said switches are being controlled over the control trunk and under subscriber control at other times.

48. A telephone exchange system comprising subscriber's lines, a group of two-way talking trunks, automatic switching mechanism including terminals multiply connected to said trunks, said mechanism being operative to automatically select idle trunks, means for extending the circuits of selected trunks to unite subscribers' lines into conversational circuits, and means whereby an operator may control the operation of said switching mechanism over said trunks.

49. A telephone exchange system comprising subscribers' lines, a group of two-way talking trunks, automatic switching mechanism including terminals multiply connected to said trunks, said mechanism being operative to automatically select idle trunks, means for extending the circuits of selected

trunks to unite subscribers' lines into conversational circuits, means under operator and subscriber control for restoring said switching mechanism to normal, and means whereby an operator may control the advance of said switching mechanism over said trunks.

50. A telephone exchange system comprising subscribers' lines, talking trunks, automatic switches for uniting said lines and talking trunks into conversational circuits, means for restoring said switches and trunks to normal, means whereby an operator may directively control the operation of certain of said switches over said control trunk, means for freeing said control trunk for further use after the exercise of said directive control and before the operation of said restoring means, and means whereby the operator may unite a calling line into conversational circuit with a called line over said control trunk.

51. A telephone exchange system comprising subscribers' lines, talking trunks, automatic switches for uniting said lines and talking trunks into conversational circuits, a control trunk, means whereby calling subscribers may communicate their orders to an operator some over said control trunk and some independently of said trunk, and means whereby an operator may directively control the operation of certain of said switches over said control trunk.

52. A telephone exchange system comprising subscribers' lines, talking trunks, automatic switches for uniting said lines and talking trunks into conversational circuits, a control trunk, means whereby calling subscribers may communicate their orders to an operator some over said control trunk and some independently of said trunk, means whereby an operator may directively control the operation of certain of said switches over said control trunk, and means operative under certain conditions of service for freeing said control trunk for further use as soon as said directive control has been exercised.

53. A telephone exchange system comprising subscribers' lines, talking trunks, automatic switches for uniting said lines and talking trunks into conversational circuits, means for restoring said switches and trunks to normal, a control trunk, means whereby calling subscribers may communicate their orders to an operator some over said control trunk and some independently of said trunk, means whereby an operator may directively control the operation of certain of said switches over said control trunk, and means operative under certain conditions of service for freeing said trunk for further use prior to the operation of said restoring means.

54. A telephone exchange system comprising

subscribers' lines, talking trunks, automatic switches for uniting said lines and talking trunks into conversational circuits, means for restoring said switches and trunks to normal, a control trunk, means whereby calling subscribers may communicate their orders to an operator some over said control trunk and some independently of said trunk, means whereby an operator may directively control the operation of certain of said switches over said control trunk, and means operative under certain conditions of service for freeing said control trunk for further use after the exercise of said directive control and before the operation of said restoring means.

55. A telephone exchange system comprising subscribers' lines, automatic switches and trunks for extending the circuits of said lines, an operator's impulse sending device for controlling certain of said switches in extending such circuits, and means independently of said sending device for automatically establishing connection between said sending device and any idle one of certain of said trunks.

56. A telephone exchange system comprising subscribers' lines, automatic switches and trunks for extending the circuits of said lines, an operator's impulse sending device for controlling certain of said switches in extending such circuits, operator-controlled means for restoring certain of said switches and trunks to normal, and means independently of said sending device for automatically establishing connection between said sending device and any idle one of certain of said trunks.

57. A telephone exchange system comprising subscribers' lines, automatic switches and trunks for extending the circuits of said lines, an operator's impulse sending device for controlling certain of said switches in extending such circuits, means for restoring said switches and trunks to normal, and means independently of said sending device for automatically establishing connection between said sending device and any idle one of certain of said trunks.

58. A telephone system comprising telephone lines terminating in a plurality of exchanges, a switchboard having operators' positions, automatic means at said plurality of exchanges for extending calling lines to said switchboard and displaying signals thereat, operators' means for extending said calling line circuits through said switchboard to called lines, other means for displaying calling line signals at said switchboard, operators' impulse controlling means at said switchboard, selective switches operable responsive to said latter means in completing connections through said switchboard from calling lines to called lines.

59. A telephone system comprising tele-

phone lines extending to a plurality of exchanges, an operator's exchange, trunk lines adapted for use in interconnecting lines of said first-mentioned exchanges, automatic switches at said first-mentioned exchanges including multiply connected bank contacts, wipers and test means, means for varying the electrical condition of said multiply connected bank contacts to determine the bank contacts to be selected upon test, and means including two-way trunks, under the control of the operator at said operator's exchange for automatically linking together trunk lines through certain of said automatic switches to interconnect any line of any exchange with any line of any other exchange.

60. A telephone system comprising telephone lines extending to an operator's exchange, telephone lines extending to an auxiliary exchange, two-way trunks extending between said exchanges, means controlled by an operator over said two-way trunks to automatically extend the circuits of calling lines of said auxiliary exchange toward called lines of the same exchange, means for freeing a two-way trunk so used as soon as the connection controlled over said trunk has been established, and other operator-controlled means for connecting calling and called lines of the different exchanges through two-way trunks in either direction.

61. A telephone system including telephone lines, an operator's position, two-way trunk lines, automatic mechanism for connecting a calling line over an idle trunk line with, and signaling, said operator's position, operator's means for working back over said trunk and selectively extending the circuit of said calling line toward a wanted line, means for freeing said trunk for further use as soon as such selective extension has been accomplished, and means whereby the operator may subsequently work back over the same trunk to selectively extend a circuit toward another wanted line.

62. A telephone system including telephone lines, two-way trunk lines, an operator's position, automatic mechanism for connecting a calling line over an idle trunk line with, and signaling, said operator's position, operator's means for working back over said trunk line and selectively extending the circuit of the calling line toward a wanted line, and means whereby the same trunk line will be freed and may be worked over in the same direction to extend another circuit toward another wanted line while said first connection remains established.

63. A telephone system including telephone lines, an operator's position, two-way trunk lines, automatic mechanism for connecting a line over an idle trunk line with, and signaling, said operator's position, operator's means for working back over said

trunk line and selectively connecting said line with another wanted line, and means for freeing said trunk line for further use when the connection is established, said automatic mechanism being operable in response to a call from the operator to connect an idle trunk through to a wanted line.

64. In a telephone exchange system, a plurality of subscribers' lines, a number of trunks less in number than the number of lines, an operator's circuit including a telephone set and an impulse sending device, means for automatically connecting a calling line with any one of said trunks, thereby rendering the said trunk busy, means for automatically connecting the operator's sending device with said busy trunk under one operating condition and with an idle trunk under another operating condition, and means for automatically connecting the connected trunk with a wanted line.

65. In a telephone exchange system, a number of subscribers' lines, a number of trunks less than the number of lines for interconnecting said lines, an operator's impulse sending device associated with said trunks and means associated with said sending device for automatically connecting with any busy trunk under one operating condition and with an idle trunk under another operating condition, together with restoring means for said connecting means.

66. In a telephone exchange system, a number of subscribers' lines, a number of trunks less than the number of lines for interconnecting said lines, an operator's impulse sending device associated with said trunks, means associated with said operator's sending device and becoming active when a trunk is connected to a calling line for automatically connecting the operator's sending device with said connected trunk and becoming active when first appropriated by an operator for automatically connecting the operator's sending device with an idle trunk, and means for restoring said connecting means.

67. In a telephone exchange system, subscribers' lines, a number of trunks less than the number of lines, an operator's impulse sending device, means for automatically connecting a calling line with a trunk, means thereupon becoming active for automatically connecting the operator's sending device with the busy trunk and becoming active under other conditions of service for automatically connecting the operator's sending device with an idle trunk, and automatic switches for completing the connection to a wanted subscriber, said switches being controlled by impulses from the operator's sending device, together with restoring means for the connecting means.

68. In a telephone exchange system, subscribers' lines, trunk circuits for intercon-

necting said lines less in number than the number of lines, an operator's impulse sending device associated with said trunks, an automatic switch associated with said operator's sending device for connecting said sending device with any of said trunks, said connections being with busy trunks under one control and with idle trunks under another control, automatic means for completing a talking connection, and means operative under that condition wherein connection was made with a busy trunk and as soon as said talking connection has been completed to restore said automatic switch for rendering it available for effecting the connection of the operator's sending device with another trunk of the group.

69. A telephone system including selective switches, telephone lines adapted to be interconnected for conversations by said switches, operators' impulse transmitters for adjusting said switches, trunk lines extending from points adjacent to said switches to said transmitters, automatic trunk selectors intermediate of said switches and trunk lines for interchangeably connecting said trunk lines and switches, and a master switch for said trunk selectors under a control exercised by said switches.

70. A telephone system including selective switches, telephone lines adapted to be interconnected for conversations by said switches, operators' impulse transmitters for adjusting said switches, trunk lines extending from points adjacent to said switches to said transmitters, automatic trunk selectors intermediate of said switches and trunk lines for interchangeably connecting said trunk lines and switches, a master switch for said trunk selectors under a control exercised by said switches, and means automatically controlled at said transmitters for disconnecting said trunk lines and switches.

71. A telephone system including a plurality of telephone lines, selective switches capable of uniting said line into a plurality of conversational circuits, operators' impulse transmitters less in number than said switches for directly adjusting the same, trunk lines extending to points adjacent to all said switches, automatic means for interconnecting switches and trunk lines, circuit connections controlled at said switches for operating said means under one condition of service, and controlled at said transmitters for operating said means under another condition of service.

72. A telephone system including a plurality of selective switches, operators' impulse transmitters less in number than said switches for directly adjusting the same, trunk lines extending to points adjacent to all said switches, automatic means for interconnecting switches and trunk lines, circuit connections controlled at said switches

for operating said means under one condition of service, and controlled at said transmitters for operating said means under another condition of service, and apparatus controlled at said transmitters for restoring said means.

73. A telephone system including a plurality of selective switches, operators' impulse transmitters less in number than said switches for directly adjusting the same, trunk lines extending to points adjacent to all said switches, automatic means for interconnecting switches and trunk lines, circuit connections controlled at said switches for operating said means, under one condition of service, and controlled at said transmitters for operating said means under another condition of service, apparatus controlled at said transmitters for restoring said means, and signals one for each trunk line for display responsive to connection of a switch with the corresponding trunk line.

74. A telephone system including telephone lines, directly operable selective switches including first selectors for connecting said lines in pairs for conversation, operators' impulse transmitters for adjusting said switches, trunk lines extending to points adjacent to said selectors, a signal for each said trunk line, and automatic means intermediate of said trunk lines and selectors for interchangeably connecting the same in response to a control exercised at said switches in one class of connections and at said transmitters in another class of connections.

75. A telephone system including telephone lines, directly operable selective switches including first selectors for connecting said lines in pairs for conversation, operators' impulse transmitters for adjusting said switches, trunk lines extending to points adjacent to said selectors, a signal for each said trunk line, automatic means intermediate of said trunk lines and selectors for interchangeably connecting the same in response to a control exercised at said switches in one class of connections and at said transmitters in another class of connections, and selective apparatus for connecting said selectors with calling lines, the connection of a selector with a calling line being effective to actuate said automatic means in one class of connections.

76. A telephone system including telephone lines, directly operable selective switches including first selectors for connecting said lines in pairs for conversation, operators' impulse transmitters for adjusting said switches, trunk lines extending to points adjacent to said selectors, a signal for each said trunk line, automatic means intermediate of said trunk lines and selectors for interchangeably connecting the same in response to a control exercised at

said switches in one class of connections and at said transmitters in another class of connections, selective apparatus for connecting said selectors with calling lines, the connection of a selector with a calling line being effective to actuate said automatic means in one class of connections, and circuit changers at said transmitters effective, when impulses to complete said last-mentioned class of connections are transmitted, to automatically disconnect selectors connected with them, whereby said transmitters become available for other use.

77. A telephone system including telephone lines, automatic switches and connections for extending the circuits of said lines, operator's equipment, selectors for variously connecting said equipment into circuit with said automatic switches, a master switch responsive to conditions in said switches to start an idle selector, and connections under operator control for starting said selector independently of said master switch.

78. In a telephone system, a two-way connecting trunk, selectors for varying the connections of said trunk, a master switch responsive to a control exercised at one point to start an idle selector, and means responsive to a control exercised from another point to operate a selector independently of said master switch.

79. In a telephone system, a two-way connecting trunk, selectors and a master switch associated with said trunk, means for operating an idle selector through said master switch for connections through said trunk in one direction and independently of said master switch for connections through said trunk in the opposite direction.

80. In a telephone system, a trunk having a manual terminal, an automatic switch associated with said trunk, an operator's cord circuit having a plug for use with said jack, sleeve and tip supervisory relays connected with said plug contacts, a starting circuit for said switch extending through plug and jack tip contacts and said tip relay, a master switch, and a second starting circuit for said automatic switch extending through contacts of said master switch.

81. In a telephone system, a trunk having a manual jack, an automatic switch associated with said trunk, an operator's cord circuit having a plug for use with said jack, sleeve and tip supervisory relays connected with said plug contacts, a starting circuit for said switch extending through plug and jack tip contacts and said tip relay, a master switch, a second starting circuit for said automatic switch extending through contacts of said master switch, and a release circuit

for said automatic switch controlled by plug and jack contacts.

82. A telephone system including telephone lines, a trunk line for use in interconnecting telephone lines, selective switching mechanism at both ends of said trunk line for determining the connections thereof, means for controlling said mechanism to render said trunk available for a connection originating at either end thereof, and means for utilizing certain of said selective switch mechanisms in establishing connections originating at either end of said trunk.

83. A telephone system including telephone lines, a trunk line for use in interconnecting telephone lines, selective switching mechanism at both ends of said trunk line for determining the connections thereof, circuit connections altered on initial placing in use of said trunk line by a connection originating at either end to render said trunk unavailable for originating use at the other end, and means for utilizing certain of said selective switch mechanisms in establishing connections originating at either end of said trunk.

84. A telephone system including telephone lines, a trunk line for use in interconnecting telephone lines, selective switching mechanism at both ends of said trunk line for determining the connections thereof, means for controlling said mechanism to render said trunk available for a connection originating at either end thereof, and circuit connections altered on initial placing in use of said trunk line by a connection originating at either end to render said trunk unavailable for originating use at the other end.

85. A telephone system including a trunk line, selective switching mechanism at both ends thereof, means for using said trunk line for calls originating at both ends, the mechanism at each end including connections for guarding said trunk line against originating employment at the other end when said line is initially placed in use.

86. A telephone system including telephone lines, a trunk line for interconnecting different lines, selective switching mechanism at both ends of said trunk line whereby it may be selectively connected with a calling line at either end, and a call signal operated responsive to calls originating at one end of said trunk line only.

In witness whereof I hereunto subscribe my name this 26th day of November, 1907.

ALFRED H. DYSON.

Witnesses:

G. E. MUELLER,

THOMAS H. FERGUSON.