

1,146,002.

Patented July 13, 1915.

2 SHEETS—SHEET 1.

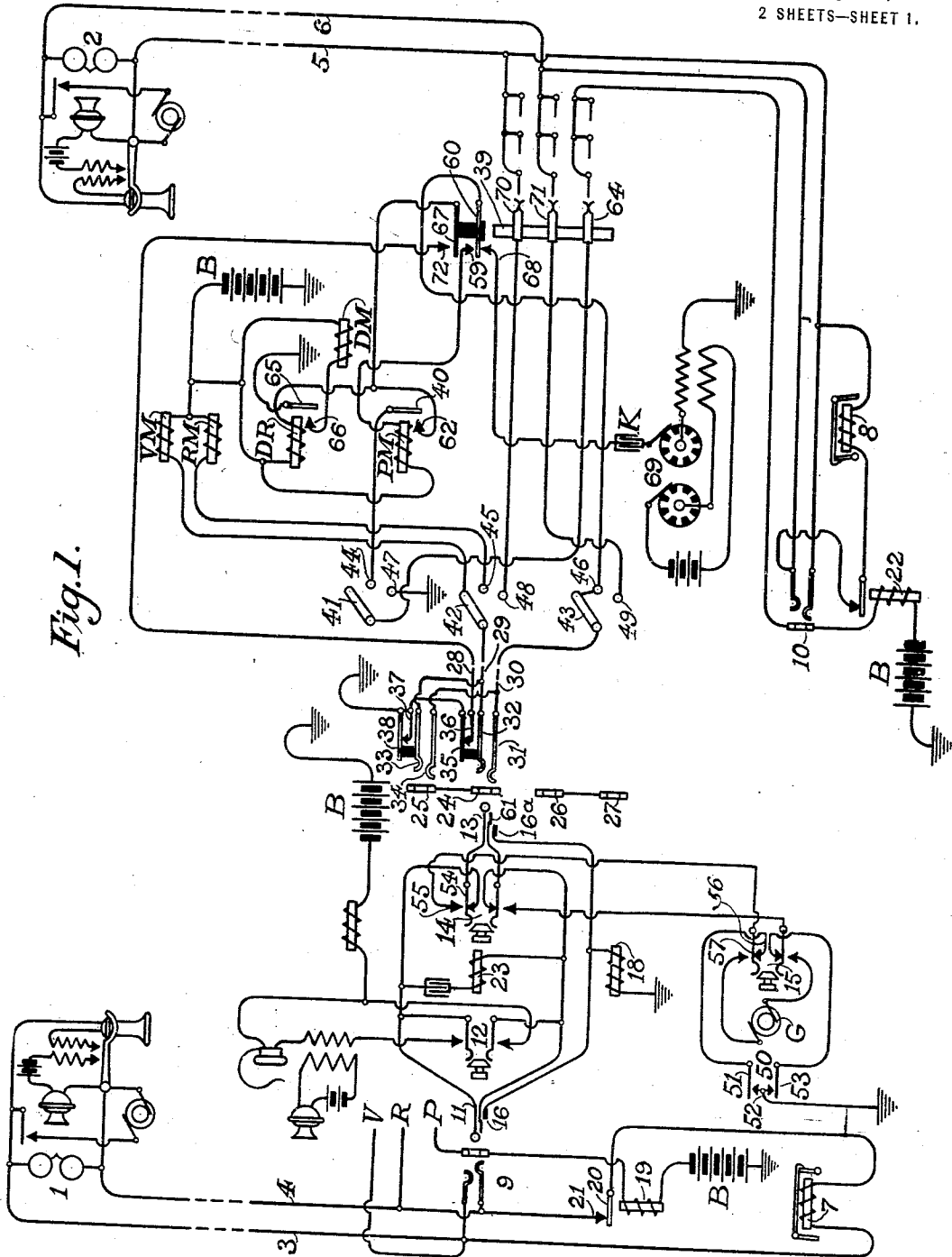


Fig. 1.

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1,146,002.

2 SHEETS—SHEET 2.



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UNITED STATES PATENT OFFICE.

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TELEPHONE SYSTEM.

1,146,002.

Specification of Letters Patent. Patented July 13, 1915.

Application filed November 25, 1904. Serial No. 234,107.

To all whom it may concern:

Be it known that I, EDMUND LAND, a citizen of the Dominion of Canada, and a resident of Grand Rapids, county of Kent, and State of Michigan, have invented a new and useful Improvement in Telephone Systems, of which the following is a specification.

My invention relates to that class of telephone systems in which the call of the subscriber is set before an operator who answers the call by connecting with and speaking over the line, and by then connecting the line with the circuit which is called by the use of cord circuits or similar equipment.

Systems of this kind involving the distinguishing feature of the existence of human operators, are broadly designated "manual systems," and the more prominent type of manual apparatus is that utilizing the multiple switchboard. Broadly speaking, the multiple switchboard enables a satisfactory service to be given, but imposes the burden of investment and maintenance expense for a large number of spring jacks for each line, which expenses increase in more than a direct ratio as the number of lines to be served by an office increases.

When the number of lines centering in an office is fewer than five hundred it is found to be a measure of economy in investment and maintenance to utilize switchboards not having the feature of a multiple of the lines before all of the operators. In such instances, if the switchboard be small enough, one jack per line enables the operator, or either of the two or three operators, to reach directly the jack of the called line. Where the dimensions of the switchboard become such as to place some of the jacks out of the immediate reach of a given operator, relatively inexpensive trunk lines are employed, enabling connections to be trunked to other operators for that portion of the lines lying out of reach of the operator answering the call.

With such a system, involving a small expense in trunk lines to save a large expense in multiple jacks, great economy in apparatus results, but by providing but one spring jack for a line it is necessary that calls trunked to lines out of reach of any assumed answering operator be cared for at their incoming positions by operators whose other duty it is to answer calls from lines in that part of the switchboard. The im-

sition upon an operator of both answering duties and incoming-trunk operator duties reacts upon the service in a number of hurtful ways. The answering of calls is slowed down by the extra service of putting up trunk connections, the taking of orders from subscribers is interfered with by the taking of trunk orders over a call circuit, and frequently in attempting to give an order over a call circuit an operator is delayed in her own work by the fact that the operator who should be receiving the trunk order is for the moment engaged in receiving a call from a subscriber. It is well established by experience that to unite in the same individual the two services known as "A" and "B" functions causes a distinct falling off in the total number of operations which can be performed in a working day. This increases the cost of giving the service.

My invention, by the combination in an office equipment of manual apparatus and automatic line-switching apparatus, enables the operator who answers the call to select trunk lines having such automatic switches associated with them, and through the agency of these devices to connect with the lines of subscribers whose spring jacks, although in the switchboard at which she works, are located in positions beyond her reach.

My invention is illustrated in the accompanying drawings, in which,

Figure 1 gives the circuits, Fig. 2 gives mechanical details of a typical automatic switch, such as would be adapted for use with the circuits of Fig. 1, and Fig. 3 shows the Strowger calling dial connected for use in the operator's circuit, in lieu of the key 50 of Fig. 1.

Referring to Fig. 1, 1 is the station of the calling subscriber, and 2 that of the called subscriber. 3 and 4 are the limbs of the calling line, and 5 and 6 the limbs of the called line. Inasmuch as the particular character of the calling and called subscribers' equipments, both as to the telephones and the switchboard signals, is relatively unimportant in my system, I have shown them to be of the familiar magneto type having an alternating generator at the substation and a drop at the central station. Signals of the common-battery or central-energy type, as well as telephones of that type, can be substituted readily by any

one skilled in the art. For example, such substitution will occur if the line and cord-circuits of Fig. 1 be replaced by "Western Electric" line and cord-circuits of the central energy type, such as illustrated in my prior Patent No. 797,586, granted Aug. 22, 1905.

A switchboard drop for the calling line is designated 7, and for the called line as 8, the spring jack of the calling line as 9, and of the called line as 10.

Upon the giving of a signal for connection by the subscriber at station 1 the indicator 7 will be displayed, the operator will answer by inserting the plug 11 in the spring jack 9; operating the listening key 12, which connects her telephone with the talking conductors of the cord circuit selected, and then the operator will ascertain the number of the desired line. If it lies before her, being for example the jack 10, she will insert the plug 13 in that jack and will operate the ringing key 14, ringing the bell of the called subscriber by connecting the generator G by a simultaneous pressure of the master ringing key 15 with the conductors of the called line. It will be noted that the parts 16 and 16^a of the plugs 11 and 13, respectively, are connected to each other and also to ground through the impedance coil 18. The existence of this ground on the sleeve of the answering plug 11 operated the relay 19 upon the insertion of that plug. This resulted in the breaking of contact between the armature 20 and its back contact 21, cutting off the line signal 7 from the limb 4 of the line. Similarly, the operation of the relay 22 associated with the called line disconnected the signal 8 from that line. Upon the answering of the subscriber at station 2 and the completion of conversation, a disconnect signal given by either subscriber by turning the handle of his generator would operate the disconnect drop 23. In case of signals of the central-energy type, the hanging up of the receivers at the stations would similarly notify the operator of the completion of the conversation, and in either form of disconnect signal she would remove the plugs 11 and 13 from the jacks 9 and 10.

The foregoing is on the assumption of the jacks of the calling and called lines being within reach of the same operator. If the jack of the called line is not within her reach, she will select a properly-marked trunk spring-jack, as 24, inserting the plug 13 in it. As trunks which are connected to such jacks as 24 are required for the greatest economy to be accessible to various operators, so that the former may be kept busy as much of the time as is possible, any such trunk appears in a plurality of switchboard positions and the bushings of all of the jacks belonging to one trunk are connected to each other, but normally to nothing

else. I have indicated this condition by associating jacks 24 and 25 with each other by connecting their test bushings. In case of the substituted common battery line and cord-circuits of my prior patent, these bushings are preferably connected to battery through a suitable resistance. The trunk line appearing in the jacks 24 and 25 is formed of the three conductors 28, 29 and 30. 29 and 30, the true talking limbs of this trunk, are connected to the springs 31 and 32 of the jack 24, and 33 and 34 of the jack 25, these springs in pairs being thus open legs of the talking pair. The conductor 28, however, is carried in series through the respective contact pieces 35 and 36 of the jack 24 to the contact pieces 37 and 38 of the jack 25, the latter of which is grounded. If the series of jacks connected with a given trunk line consisted of more than two, the conductor, similar to 28, would be carried through all of these jacks in series, reaching ground at the proper spring of the last one. During all times when a plug is not in a trunk jack, the conductor, such as 28, will be connected directly to ground. The test bushings 26 and 27 are those of jacks quite similar to 24, and merely illustrate the existence of a plurality of other spring jacks associated with still other trunks.

The trunk leading from the jack 24 is connected in another part of the same office, or, if need be, in a distinct and separate office of the same exchange, with an automatic switch of any standard type involving elements of the general character required by my invention. A particular type suitable for this use is that quite widely in operation and known as the Strowger switch. The construction and operation of a typical switch of this class are well known to those skilled in the telephonic art, and it will be sufficient in designation to say that in such a switch a shaft, as 39, is capable of being lifted in vertical steps by a ratchet 301 connected through armature 306 and pawl 307 with the vertical magnet VM, and, when resting in any lifted level the shaft is further capable of being rotated by a ratchet 302 associated through armature 309 and pawl 310 with the rotary magnet RM, thus passing contact wipers 70, 71, 64, attached to 39, over successive stationary contact pieces or waiting contacts arranged in proper circular arcs.

A further distinguishing feature of such a switch is that a magnet, as DM, is capable through an armature 312 and link 313 engaging pin 305 of withdrawing the combined vertical and rotary pawl 303, pivoted at 304, allowing the shaft 39 to return to its normal position of rest through the action of its springs and gravity.

A further feature found in such switches

is that a magnet, as PM, known as the private magnet, is not only of the character of a relay but has a mechanical connection through its armature 40 and attached link 319, by which, at each release of its armature 40 after an attraction, it has the power to move the mechanically associated levers, 41, 42, 43, as a unit, from their normal to their second, or from their second to their third positions. These levers are shown in their normal positions in the drawings; their second positions would be in contact with their respective points 44, 45, 46, and their third positions would be in contact with their respective points 47, 48, 49. The levers, 41, 42, 43, with their associated contact points, are termed a side-switch or pilot-switch, which term also includes the mechanical mounting of the parts, but usually is not construed to include the private magnet, PM, which controls the side-switch.

A further feature found in switches of this class is the so-called off-normal switch, consisting of a group of electrical contact springs normally tending to assume a predetermined position or relation among themselves, but prevented from assuming that relation by reason of an interference with some part of the main moving portion of the switch, such as the shaft 39. An off-normal switch is shown, consisting of the moving contact-springs 60 and 67, and the fixed contact-springs 59, 68, 72. The relation which would exist among these contact-springs is that 67 would make contact with 72, while 60 would make contact with 59 and would be open or broken from 68, the spring 68 thus standing isolated from the others; however, an interfering or controlling element is shown in the collar 316 upon the shaft 39, which depresses springs 67 and 60 against their spring tendency and causes spring 67 to break contact from spring 72 and also causes spring 60 not only to break contact from spring 59 but to make contact with spring 68. Collar 316 is so located upon shaft 39 that the off-normal switch is held in the position shown when the shaft 39 is in its position of rest, and consequently at the first vertical movement of the shaft 39 the collar 316 is moved away from the off-normal switch, and as the shaft then is out of its normal position of rest, the switch operates under the spring tendency of springs 60 and 67 and assumes that alternative position not shown in the drawings; upon return of the shaft 39 to its normal position, the collar 316 again engages the off-normal switch and restores it, such restoration being made at the conclusion of the travel of the shaft 39 in returning to rest, so that practically the shaft 39 will have returned to normal before the shifting of the off-normal switch to its first or normal position.

A further function of the return to normal of the shaft 39 is shown in Fig. 2 in the engagement of the collar 316 with the projection mechanically associated with the side-switch arms, 41, 42, 43, by which it is seen that those arms, which have been moved to their third positions by the action resultant upon the attraction and release of the armature of the private magnet PM, are returned to their first or normal positions mechanically by the engagement of the collar 316 with a projection associated with the side-switch element of the complete automatic device. It will be noticed that this restoration also is made at the conclusion of the travel of the shaft 39 in returning to rest, so that practically the shaft 39 will have returned to normal before the shifting of the side-switch to its normal or first position.

Upon inserting the plug 13 in the jack 24, as described, the operator will cause a succession of impulses to pass through the trunk wires and the vertical and rotary magnets of the switch, as follows: If 56 is the number of the line which she is calling, she will actuate the key or dial 50 associated with her cord circuit while the key 14 is actuated. In this operation she will cause the spring 51 to make five contacts with the grounded points 52, and this series to be followed by one contact between the spring 53 and 52. Next she will operate the key or dial 50 to cause six contacts between 51 and 52, followed by one contact between 53 and 52.

The results will be that current from the battery B, shown immediately associated with the magnets VM, RM, etc., will cause five impulses to pass through the magnet VM via the lever 42, the conductor 29, the spring 32, the tip of the plug 13, the spring 54 of the key 14, the contact 55 of that key, the contact and spring 56 and 57 of the key 15 to ground at the spring 51. The action will be to lift the shaft 39 in five vertical steps corresponding to Fig. 5 of the number called, stopping the wipers of the shaft opposite horizontal arcs corresponding with contacts of lines bearing numbers having 5 as the tens digit, and also permitting the off-normal switch to assume its alternative position.

The ground contact of the spring 53 of the key or dial 50 causes current from the battery B to pass through the magnet PM, the contact 59, the spring 60, the normal contact of the lever 43, that lever, the spring 31 of the jack 24, the part 61 of the plug 13, thence through an analogous path to that previously traced through the keys 14 and 15 to ground at the key 50 by contact of this spring 53 with 52. This single impulse in closing the armature 40 upon its point 62 produces no result, as the armature 40 is

connected to an open contact 44. At the cessation of the impulse of current through the magnet PM, however, the armature 40 falls away, and by the action of its attached pawl-link 319, moves the levers 41, 42 and 43 to their second positions, as that of 41 upon 44. Upon the receipt of the second series of contacts at the dial, this being six of 51, then one of 53, upon 52, current will flow from the battery B through the magnet RM to the contact point 45 and lever 42, and thence over quite the same path to 51 as originally described, causing the magnet RM to execute six strokes. This will rotate the shaft 39 in six steps, stopping its wipers upon the sixth contacts of the circular arcs engaged by those wipers. The single contact between 53 and 52 will cause the private magnet to be operated quite as it was by the single impulse following the first series of five through the vertical magnet, and the release of that magnet will cause the side switch levers 41, 42 and 43 to execute a second step, placing them upon their last contacts 47, 48 and 49. It is to be noted that if at the moment of actuation of the magnet PM the wipers 64 had in engaging the contacts of the conductor leading to the test bushing of the jack 10 found other than the full potential of the battery B upon that conductor, the disconnect relay DR would have been energized. The circuit of this action may be traced from the battery B through the relay DR, the contact 62, the lever 40, the contact 44, the lever 41 and the wipers 64, to the test bushing of the jack 10. Under a non-busy condition of the jack 10, its test bushing would be at the full battery potential, but at a time of a connection by a plug being in that jack, or by another switch having its wipers upon the test-bushing wire, less than the full battery potential would exist in the one case because of a ground through the impedance coil, as 18, and in the other by the presence of a ground, as that on the contact 47, through a side-switch lever, as 41, in the mentioned other switch.

In such a condition of current through the disconnect relay DR on the wipers engaging a busy line, the armature 65 of that relay would be drawn in contact with its point 66, causing current from the battery B to flow through the disconnect magnet DM to ground. The consequent withdrawal of the pawls controlled by the magnet DM would allow the shaft 39 to return to its normal position through the action of its spring and gravity. The springs 60 and 67 being associated with each other and with the shaft 39 in such a way as to rest in the positions shown in the drawing before any lifting of the shaft 39, but to be forced into contacts described herein by any such lifting, will now be so dropped that the spring 60 will

make contact upon its point 68, although it had made contact with 59 immediately after the first of the described five steps.

By virtue of the entire busy-signal mechanism, designated 69, alternating currents from the induction-coil part of that mechanism will pass through the condenser K, the contact 68, the spring 60, to the normal contact of the lever 43. As all the side-switch levers are restored to their normal positions by the action of the disconnect magnet DM, this busy-signal current will pass to the limb 30 of the trunk line, thence by a path easily traced through the cord circuit, to and over the line of the calling subscriber via the limb 4, through the telephone of the listening subscriber, again to the office over the limb 3, and by the cord circuit and the limb 29 of the trunk to the lever 42 and to ground through the magnet VM, and to battery B. As the operator is also listening with her telephone across the talking conductors of the cord circuit, she will hear the disconnect signal, and, if need be, notify the subscriber of its significance, then withdrawing the plugs 11 and 13 from their respective jacks. If, however, it is assumed that a non-busy condition of the line were found, there will be no actuation of the disconnect relay and disconnect magnet, and the contact of 53 with 52 succeeding the six impulses which selected the called line would have advanced the side-switch levers to their final position, placing the solid ground of the contact 47 upon the wipers 64 through the lever 41, guarding the line by this ground against the stoppage of another switch upon those contacts during the further existence of the connection. Additionally the levers 42 and 43 upon their final contacts will be extended to their respective wipers 70 and 71, thence to the limbs 5 and 6 of the line. The operator may now signal the station 2 quite as has been described with reference to a line selected by her immediately from the jacks within her reach.

In the case of subscriber's line 3-4, the contacts of jacks 9 are extended to connector bank contacts by conductors V, R, P, the same as the contacts of jack 10 are connected to the connector bank contacts shown. By this means, the lines are rendered available for automatic connection whether they be common battery or local battery lines. In case of the substituted common battery line and cord-circuits of my prior patent, the three contacts of the jack of the line would be similarly connected to connector bank contacts, and the battery connections would be reversed in order to bring about proper cooperation with the battery B of Fig. 1.

It has been said that the wipers 64 place a contact upon the wire leading to the test bushing of the jack 10. It will easily be

seen that the relay 22 is actuated in this instance quite as in the instance previously described, wherein the ground of the coil 18 thus caused the signal 8 to be cut off from that line.

During all the progress of the connection, and indeed in any time other than that of the normal position of the shaft 39, the spring 67 will be in contact with the point 72. At the close of the conversation and the withdrawal by the operator of the plug 13 from the jack 24, a ground will be placed upon the conductor 28 in the manner described. Current will then flow from the battery B at the switch through the relay DR and the indicated path. The result of current through the relay DR is always the disconnection of the switch, and this will result quite as was described in the assumption of the engagement of a busy line. As the shaft 39 in returning to a normal position permits 67 to break from 72, the relay DR is then released, as is also the magnet DM, so also is the relay 22, replacing the signal 8 upon the line in readiness to receive a call from the subscriber at station 2.

The element indicated at 50 as a key has been referred to also as a dial: by this latter reference it is intended to indicate that the usual Strowger dial, with its well known operating parts, may be used to replace the key element shown. Such a modification is shown in Fig. 3 of the drawings.

In an office equipped with the apparatus and circuits of my invention, a plurality of equipments such as is shown in connection with the jacks 24—25 would be required, such multiplication of the unit being indicated by the jacks 26—27, which, by their location and connection with each other, indicate another unit such as is shown connected with jacks 24—25, and therefore indicate an indefinite plurality of such equipments, involving also a plurality of automatic trunk switches.

I do not desire to limit myself to the exact means described to attain the results which I have indicated as of advantage, as it is evident that one skilled in the art may substitute other equivalent or analogous means without departing from the spirit of my invention.

That which I claim as my invention and desire to secure by Letters Patent of the United States is,—

1. In a telephone system, a calling telephone line, a called telephone line, a cord-circuit, a plurality of trunk jacks, a trunk connected to said jacks, an automatic switch connected to said trunk line, busy-test and call-signal-removing means adapting said calling telephone line to be connected with by said cord-circuit, busy-test and call-signal-removing means adapting said called telephone line to be connected with by

said automatic switch, means in said cord-circuit, adapting it to connecting said calling line with said trunk-line jacks and with said called line, and means adapting said automatic switch to disconnect said trunk line and said called line upon the disconnection of said cord-circuit from said trunk line, substantially as described.

2. In a telephone system, a spring jack, a trunk line connected thereto, a line-selecting switch, a plurality of lines terminating in said switch, means adapting said switch to interconnect the trunk line and one of said lines, a disconnect magnet adapted to restore said switch to the normal position, a disconnect relay normally in open circuit, a pilot magnet normally in open circuit, means adapting the pilot magnet to be placed in a closed circuit whenever said switch is not in normal position, and means adapting said disconnect relay to be energized only whenever said switch is not in normal position and said trunk jack is not engaged by a plug, substantially as described.

3. In an automatic switch for telephone lines, a disconnect magnet under control of a disconnect relay, a disconnect relay in a circuit normally open, a pilot switch, a pilot relay, a movable contact-bearing shaft, and means adapting said pilot relay to be energized through the agency of said pilot switch on a movement from normal of said shaft, substantially as described.

4. In a telephone system, a plurality of trunk jacks, a trunk line connected thereto, an automatic switch connected to said trunk line, and a disconnect circuit carried serially through contacts in said jacks and contacts in said automatic switch when the latter is in other than a normal condition, substantially as described.

5. In a telephone system, a trunk line, a trunk-line switch, trunk jacks connected to said trunk line, a cord circuit, a plug connected to said cord circuit, means adapting impulses through said cord circuit to operate said switch, a disconnect circuit normally closed through the jacks of said trunk line and normally open in said switch, means adapting the operation of said switch to close the disconnect circuit therein, means for maintaining said disconnect circuit open in said jacks while closed in said switch, and means adapting said disconnect circuit to be closed in said jacks upon the withdrawal of said plug therefrom, accomplishing the restoring of said switch to normal position, substantially as described.

6. In a telephone system, a telephone line, a switchboard, a line signal therein connected to said telephone line, a plurality of automatic trunk switches, a pair of contact pieces in each of said switches and connected to the limbs of said line, a spring jack connected to said telephone line, means adapting

- another telephone line to be connected with said line at said spring jack or at one of said automatic switches, means adapting the existence of a connection at said spring jack to prevent connection in any one of said switches, and means adapting a connection in one of said switches to prevent a connection with said line at said spring jack or in any other of said switches, substantially as described.
7. In a telephone system, a telephone line, a line signal connected thereto, a spring jack connected to said line, a cord circuit adapted to engage said line in said spring jack, branch terminals from said line accessible in a plurality of automatic trunk switches, means adapting said cord circuit upon connection with said line in said spring jack to disconnect said signal from said line, and means adapting the engagement of said line in one of said automatic trunk switches to disconnect said signal from said line by the same agency, substantially as described.
8. In a telephone system, a telephone spring-jack, a plurality of automatic trunk switches, a telephone line connected to said spring jack and to waiting contacts in said trunk switches, a signal connected to said line, cord circuits adapted to engage said line in said spring jack, trunk circuits adapted to engage said line in said trunk switches, and means adapting an engagement of said line in said spring jacks simultaneously to render said line inaccessible to engagement by trunk lines in said trunk switches and to disconnect said signal from said line, substantially as described.
9. In a telephone system, a telephone line, a spring jack and a signal connected to said line, a plurality of automatic trunk switches, a pair of waiting contacts in each said trunk switch connected in parallel to said line, means adapting a trunk line in one of said trunk switches to engage said telephone line to prevent further engagement of said telephone line in said spring jacks or another of said trunk switches and to disconnect said signal from said line during such engagement, substantially as described.
10. A telephone system comprising telephone lines, operators' positions, means whereby orders may be transmitted to operators at said positions, another telephone line, an impulse controlled automatic switch having access to said latter telephone line, and impulse sending means whereby each of said operators may directly operate said switch to connect to said latter line.
11. A telephone system comprising telephone lines, operators' positions, means whereby orders may be transmitted to operators at said positions, another telephone line, an impulse controlled automatic switch having access to said latter telephone line, and impulse sending means whereby each of said operators may connect said former telephone lines individually to said latter telephone line for conversation through said switch.
12. A telephone system comprising telephone lines, operators' positions, means whereby orders may be transmitted to operators at said positions, other telephone lines, an impulse controlled automatic switch having access to said other telephone lines, and impulse sending means whereby each of said operators may directly operate said switch to connect to desired ones of said other telephone lines.
13. A telephone system comprising telephone lines, operators' positions, means whereby orders may be transmitted to operators at said positions, other telephone lines, an impulse controlled automatic switch having access to said other telephone lines, and impulse sending means whereby each of said operators may connect said former and latter telephone lines for conversation through said switch.
14. A telephone system comprising telephone lines, operators' positions, means whereby orders may be transmitted to operators at said positions, an impulse controlled automatic switch having access to said telephone lines, and impulse sending means whereby each of said operators may directly operate said switch to connect to said lines.
15. A telephone system comprising telephone lines, operators' positions, means whereby orders may be transmitted to operators at said positions, an impulse controlled automatic switch having access to said telephone lines, and impulse sending means whereby each of said operators may connect calling and called ones of said telephone lines for conversation through said switch.
16. In a telephone system, a subscriber's telephone line, a manual terminal for said line, an automatic terminal for said line, manual means for establishing connection to said manual terminal, an impulse controlled automatic switch for establishing connection to said automatic terminal, and operator's impulse sending means for advancing said switch to connect with said automatic terminal or beyond, according to the will of the operator.
17. In a telephone system, a subscriber's telephone line, a manual terminal for said line, an impulse controlled automatic switch having a contact assigned to said line, manual means for establishing connection to said manual terminal, and operator's impulse sending means for advancing said switch to establish connection to said assigned contact, or for advancing it still farther according to the will of the operator.
18. In a telephone system, a subscriber's

telephone line, a jack for said line, an automatic switch passive contact for said line, a plug for insertion into said jack, an automatic switch active contact, impulse controlled means for advancing said active contact into engagement with said passive contact or beyond, and impulse sending means under the control of the operator for causing the operation of said latter means, to advance said active contact into engagement with said passive contact or beyond, according to the will of the operator.

19. A telephone system comprising a telephone line, a manual terminal for said line, an automatic terminal for said line, another telephone line, means for uniting said telephone lines through said manual terminal, means, including impulse controlled automatic switch mechanism, for uniting said telephone lines through said automatic terminal, and impulse sending means under the control of the operator for advancing said mechanism far enough to unite said lines, or farther, according to the will of the operator.

20. A telephone system comprising a telephone line, a manual terminal for said line, an automatic terminal for said line, other telephone lines, means for uniting said telephone line and one of said other telephone lines through said manual terminal, means, including impulse controlled automatic switch mechanism, for uniting said telephone line and one of said other telephone lines through said automatic terminal, and impulse sending means under the control of the operator for advancing said mechanism far enough to unite said lines, or farther, according to the will of the operator.

21. In a telephone system, a telephone line, a manual terminal and an automatic terminal each individual to said line, manual means for establishing connection to said manual terminal, automatic means for establishing connection to said automatic terminal, and operator's means for causing the operation of said automatic means.

22. In a telephone system, a telephone line, a manual terminal individual to said line and an automatic switch having a contact assigned to said line, manual means for establishing connection to said manual terminal, and operator's means for operating said switch to establish connection to said assigned contact.

23. In a telephone system, a telephone line, a jack and an automatic switch passive contact each individual to said line, a plug for insertion into said jack, an automatic switch active contact, means for bringing said active and passive contacts into engagement, and means under the control of the operator for causing the operation of said latter means.

24. A telephone system comprising a telephone line, a signal individual to and normally controlled over said line, automatic means for establishing connection to said line, and means responsive to the operation of said automatic means to destroy said normal control of said signal.

25. A telephone system comprising a telephone line, a signal individual to and normally controlled over said line, automatic means for establishing connection to said line, manual means for establishing connection to said line, and means responsive to the individual operation of said automatic means and said manual means to destroy said normal control of said signal.

26. A telephone system comprising a telephone line, a line electromagnet individual to and normally controlled over said line, automatic means for establishing connection to said line, manual means for establishing connection to said line, and means responsive to the individual operation of said automatic means and said manual means to destroy said normal control of said line electro-magnet.

27. A telephone system comprising a telephone line, automatic means for establishing connection to said line, manual means for establishing connection to said line, an electromagnet for controlling the connections of said telephone line, and means responsive to the individual operation of said automatic means and said manual means to vary the circuit of said electromagnet.

28. A telephone system comprising a telephone line, a manual terminal for said line, an automatic terminal for said line, an electromagnet for controlling the connections of said telephone line, manual means for establishing connection to said manual terminal, automatic means for establishing connection to said automatic terminal, means for completing an energizing circuit for said electromagnet through said manual terminal upon the operation of said manual connecting means, and means for completing an energizing circuit for said electromagnet through said automatic terminal upon the operation of said automatic connecting means.

29. A telephone system comprising a telephone line, a relay for varying the connections of said line, manual and automatic terminals for said line included in circuit with said relay, manual means for engaging said manual terminal to cause the operation of said relay, and automatic means for engaging said automatic terminal to cause the operation of said relay.

30. A telephone system comprising a telephone line, a line electromagnet normally in circuit with said line, a cut-off relay for interrupting said circuit, manual means for

causing the operation of said cut-off relay, and automatic means for causing the operation of said cut-off relay.

31. A telephone system comprising a telephone line, a relay for varying the associated line circuit connections, manual means for causing the operation of said relay, and automatic means for causing the operation of said relay.

32. A telephone system comprising telephone lines, automatic switches having contacts forming terminals of said lines, means for operating said switches in the process of connecting said lines, manual means for uniting said lines for conversation, independently of said switches, and means; when connection is made with a line, to indicate "busy" when another connection with said line is attempted.

33. A telephone system comprising telephone lines, automatic switches having contacts forming terminals of said lines, means for operating said switches in the process of connecting said lines, manual terminals for said lines, manual means for uniting the manual terminals of said lines independently of said switches, and means, when connection is made with a line, to indicate "busy" when another connection with said line is attempted.

34. A telephone system comprising telephone lines, automatic switches having contacts forming terminals of said lines, means for operating said switches in the process of connecting said lines, manual terminals for said lines, manually operated link-circuits for uniting the manual terminals of said lines, whereby said lines are united independently of said switches, and means, when connection is made with a line, to indicate "busy" when another connection with said line is attempted.

35. A telephone system comprising similarly equipped subscribers' telephone lines, means, including automatic switches, for interconnecting said lines for conversation, manual means for interconnecting said lines for conversation independently of said automatic switches, and means, when connection is made with a line, to indicate "busy" when another connection with said line is attempted.

36. A telephone system comprising similarly equipped subscribers' telephone lines, means, including automatic switches, for interconnecting said lines for conversation, manual means under the control of an operator for interconnecting said lines for conversation independently of said automatic switches, means whereby a calling party may signal said operator upon initiating a call, means for signaling said operator at the end of conversation, and means, when connection is made with a line, to indicate

"busy" when another connection with said line is attempted.

37. A telephone system comprising similarly equipped subscribers' lines, automatic switches having contacts forming terminals of said lines, means for operating said switches in the process of connecting said lines, manual means for interconnecting said lines for conversation independently of said automatic switches and means, when connection is made with a line, to indicate "busy" when another connection with said line is attempted.

38. A telephone system comprising similarly equipped subscribers' telephone lines, automatic switches having contacts forming terminals of said lines, means for operating said switches in the process of connecting said lines, manual terminals for said lines, manually operated link-circuits for uniting the manual terminals of said lines, whereby said lines are united for conversation independently of said switches and means, when connection is made with a line, to indicate "busy" when another connection with said line is attempted.

39. A telephone system comprising subscribers' lines having manual substation equipment, means, including automatic switches, for interconnecting said lines for conversation, manual means for interconnecting said lines for conversation independently of said automatic switches and means, when connection is made with a line, to indicate "busy" when another connection with said line is attempted.

40. A telephone system comprising subscribers' lines having manual substation equipment, automatic switches having contacts forming terminals of said lines, means for operating said switches in the process of connecting said lines, manual means for interconnecting said lines for conversation independently of said automatic switches and means, when connection is made with a line, to indicate "busy" when another connection with said line is attempted.

41. A telephone system comprising subscribers' lines having manual substation equipment, automatic switches having contacts forming terminals of said lines, means for operating said switches in the process of connecting said lines, manual terminals for said lines, manually operated link-circuits for uniting the manual terminals of said lines, whereby said lines are united for conversation independently of said switches and means, when connection is made with a line, to indicate "busy" when another connection with said line is attempted.

42. A telephone system comprising telephone lines, automatic switches having passive contacts forming terminals for said lines and cooperating active contacts, means

for actuating said switches in the process of connecting said lines, manual means for uniting said lines for conversation independently of said switches and means, when connection is made with a line, to indicate "busy" when another connection with said line is attempted.

43. A telephone system comprising similarly equipped subscribers' lines, automatic switches having passive contacts forming terminals for said lines and cooperating active contacts, means for cooperating with said switches to interconnect said lines for conversation, manual means for uniting said lines for conversation independently of said switches and means, when connection is made with a line, to indicate "busy" when another connection with said line is attempted.

44. A telephone system comprising subscribers' lines having manual substation equipment, automatic switches having passive contacts forming terminals for said lines and cooperating active contacts, means for cooperating with said switches to interconnect said lines for conversation, manual means for uniting said lines for conversation independently of said switches and means, when connection is made with a line, to indicate "busy" when another connection with said line is attempted.

45. A telephone system comprising telephone lines, manual means for uniting said lines for conversational purposes, automatic switching means arranged to cooperate with said manual means to provide connections between said lines alternative to those provided by said manual means alone and means, when connection is made with a line, to indicate "busy" when another connection with said line is attempted.

46. A telephone system comprising telephone lines having manual connection terminals, manually operated link-circuits for joining said terminals to unite said lines for conversational purposes, automatic switching means whereby said switching means may be joined to said manually operated link-circuits and utilized therewith to unite said telephone lines for conversation by paths other than those provided by said manually operated link-circuits alone and means, when connection is made over one of said paths to a line, to indicate "busy" when another connection with said line is attempted over the other path.

47. A telephone system comprising similarly equipped subscribers' telephone lines, manual means for uniting said lines for conversational purposes, automatic switching means arranged to cooperate with said manual means to provide connections between said lines other than those provided by said manual means alone and means, when connection is made over one of said paths to a

line, to indicate "busy" when another connection with said line is attempted over the other path.

48. A telephone system comprising similarly equipped subscribers' lines having manual connection terminals, manually operated link-circuits for joining said terminals to unite said lines for conversational purposes, automatic switching means whereby said switching means may be joined to said manually operated link-circuits and utilized therewith to unite said telephone lines for conversation by paths other than those provided by said manually operated link-circuits alone and means, when connection is made over one of said paths to a line, to indicate "busy" when another connection with said line is attempted over the other path.

49. A telephone system comprising subscribers' lines having manual substation equipment, manual means for uniting said lines for conversational purposes, automatic switching means arranged to cooperate with said manual means to provide connections between said lines other than those provided by said manual means alone and means, when connection is made over one of said paths to a line, to indicate "busy" when another connection with said line is attempted over the other path.

50. A telephone system comprising subscribers' lines having manual substation equipment, manual connection terminals for said lines, manually operated link-circuits for joining said terminals to unite said lines for conversational purposes, automatic switching means whereby said switching means may be joined to said manually operated link-circuits and utilized therewith to unite said telephone lines for conversation by paths other than those provided by said manually operated link-circuits alone and means, when connection is made over one of said paths to a line, to indicate "busy" when another connection with said line is attempted over the other path.

51. A telephone system comprising subscribers' stations, an impulse controlled automatic switch employed in establishing connection for conversation between said stations, an interconnecting conductor individual to said switch, other conductors connected to said switch, operators' positions, means for transmitting orders to operators at said positions, and impulse sending means whereby said operators may individually operate said switch to establish connections from the said individual conductor to desired ones of said other conductors.

52. A telephone system comprising subscribers' stations, an impulse controlled automatic switch employed in establishing connection between said stations, an interconnecting conductor individual to said switch;

other conductors connected to said switch, operators' positions, means for transmitting orders to operators at said positions, and impulse sending means whereby said operators may individually cause the operation of said switch over circuits including a portion of said individual conductor to establish connections from the said individual conductor to desired ones of said other conductors.

53. In a telephone system, a plurality of operators' positions, trunk connections extending therefrom, an associated conductor, impulse controlled automatic switching means for variously interconnecting said conductor and said operators' positions through said trunk connections, and impulse sending means under the control of each operator for directly operating said switch to cause connection to be established between said conductor and said operator's position.

54. In a telephone system, a plurality of operators' positions, a trunk multiply connected to terminals at said positions, an impulse controlled automatic switch associated with the distant end of said trunk, a conductor connected to said switch, and impulse sending means under the control of each operator for directly operating said switch to cause said trunk to be connected to said conductor.

55. In a telephone system, a manually operated terminal, an automatic switch connected therewith, an electromagnet employed in the release of said switch, and means for operating said magnet to cause said release by closing a circuit at said manually operated terminal.

56. In a telephone system, a manually operated terminal, an automatic switch connected therewith, an electromagnet employed in the release of said switch, an associated off-normal switch, and a release circuit for said electromagnet including said off-normal switch and normally closed contacts of said manually operated terminal.

57. In a telephone system, a manually operated terminal, an automatic switch connected therewith, a release circuit for said switch normally open at one point, means for opening said circuit at said manually operated terminal and closing it at said normally open point and then closing it at said manually operated terminal, and means for causing the release of said switch upon said last closing.

58. In a telephone system, a manually operated terminal, an automatic switch connected therewith, an electromagnet employed in the release of said switch, a circuit for said electromagnet including normally closed contacts of said manually operated terminal, normally open contacts in said circuit, and manual means for opening said

circuit at said manually operated terminal contacts and closing said normally open contacts and then completing said circuit by closing said manually operated terminal contacts to thereby cause the release of said switch.

59. In a telephone system, a manually operated terminal, an automatic switch having active and passive contacts, conductors extending from said passive contacts and available for other connections than by said switch, means for varying the condition of said conductors thus connected, an electromagnet employed in the release of said switch, means for operating said electromagnet to cause the release of said switch by closing a circuit at said manually operated terminal, and means for operating said electromagnet to cause the release of said switch upon the connection of the active contact of said switch to a passive contact corresponding to a conductor whose condition has been varied.

60. In a telephone system, a manually operated terminal, an automatic switch having active and passive contacts, conductors extending from said passive contacts and available for other connections than by said switch, means for varying the condition of said conductors thus connected, an electromagnet employed in the release of said switch, an associated off-normal switch, a release circuit for said electromagnet including said off-normal switch and contacts of said manually operated terminal, and an alternative release circuit for said electromagnet established upon the connection of the active contact of said switch to a passive contact corresponding to a conductor whose condition has been varied.

61. A telephone system comprising telephone lines, an impulse controlled automatic switch having access to said lines, a trunk extending to said switch, a cord-circuit, manual terminals for connecting said trunk and cord-circuit, impulse mechanism under the control of the operator for causing the operation of said switch to connect to desired lines, and supervisory apparatus associated with said cord-circuit.

62. In a telephone system, an automatic switch, a trunk extending to said switch, multiple cut-off jacks for said trunk, means for establishing connection to said jacks, and a control circuit for said switch including the cut-off contacts of said jacks.

63. In a telephone system, an impulse controlled "connector" switch, a trunk extending to said switch, multiple jacks for said trunk, means for establishing connection to said jacks, and impulse sending means for controlling said connector.

64. In a telephone system, an automatic switch, a trunk extending to said switch, multiple cut-off jacks for said trunk, means

for establishing connection to said jacks, means for determining the idle or busy condition of said trunk, and a control circuit for said switch including the cut-off contacts of said jacks.

65. In a telephone system, an impulse controlled "connector" switch, a trunk extending to said switch, multiple jacks for said trunk, means for establishing connection to said jacks, means for determining the idle or busy condition of said trunk, and impulse sending means for controlling said connector.

66. A telephone system comprising subscribers' telephone lines, means including impulse controlled automatic switches for connecting said lines for conversation, a plurality of operators' positions, and impulse sending means whereby operators at a plurality of said positions may individually control the operation of said switches.

67. A telephone system comprising subscribers' telephone lines, means including an impulse controlled automatic switch whereby said lines may be interconnected for conversation, a plurality of operators' positions, and impulse sending means whereby operators at a plurality of said positions may individually control the operation of said switch.

68. A telephone system comprising a telephone line, an operator's position, means for transmitting an order to an operator at said position, another telephone line, means, including a link-conductor and automatic switching mechanism under the control of said operator, for connecting said lines for conversation, and operator controlled means whereby said parts are restored to normal.

69. A telephone system comprising a telephone line, an operator's position, means for transmitting an order to an operator at said position, other telephone lines, an automatic switch having access to said other telephone lines, a link-conductor, means under the control of said operator to operate said switch to pick out a desired one of said other telephone lines and to utilize said conductor to complete connection therewith from said telephone line, and operator controlled means whereby said parts are restored to normal.

70. In a telephone system, a telephone line, a group of multiple terminals associated with one end of said line, manual means for connecting to certain of said terminals, an impulse controlled automatic switch for connecting to others of said terminals, and operator's impulse sending means for causing the operation of said automatic switch.

71. A telephone system comprising subscribers' telephone lines extending from substations to an exchange, signals for said lines controlled from the substations, oper-

ators' answering means adapted for connection with said lines, other telephone lines, multiple terminals for said other lines, selective switches adapted to be employed for making connection therewith, and operators' switching means to enable the operators to transmit directive currents to said selective switches to cause them to connect said answering means with terminals of particular ones of said other telephone lines whereby connections between subscribers are completed.

72. A telephone system comprising subscribers' telephone lines extending from substations to an exchange, signals for said lines controlled from the substations, operators' answering means adapted for connection with said lines, other telephone lines, multiple terminals for said other lines, selective switches adapted to be employed for making connection therewith, operators' switching means to enable the operators to transmit directive currents to said selective switches to cause them to connect said answering means with terminals of particular ones of said other telephone lines whereby connections between subscribers are completed, and automatic test means for said switches adapted to automatically cause their disconnection from busy lines when brought to engage terminals thereof.

73. A multiple switchboard telephone exchange system including telephone lines, signals for said lines at the exchange, answering terminals for said lines, operators' link-circuits for connecting with said answering terminals, other telephone lines, multiple calling terminals for said lines, selective switches for connecting with said last-mentioned terminals, link-circuits connected with said selective switches, and manually operated terminals for said link-circuits adapted for connection with said operators' link-circuits.

74. A multiple switchboard telephone exchange system including telephone lines, signals for said lines at the exchange, answering terminals for said lines, operators' link-circuits for connecting with said answering terminals, other telephone lines, multiple calling terminals for said lines, selective switches for connecting with said last-mentioned terminals, link-circuits connected with said selective switches, manually operated terminals for said link-circuits adapted for connection with said operators' link-circuits, and means for causing the operation of said selective switches to connect with said other telephone lines.

75. A multiple switchboard telephone exchange system including telephone lines, signals for said lines at the exchange, answering terminals for said lines, operators' link-circuits for connecting with said answering terminals, other telephone lines, multiple

- calling terminals for said other lines, selective switches for connecting with said last-mentioned terminals, link-circuits connected with said selective switches, manually operated terminals for said link-circuits adapted for connection with said operators' link-circuits, means for causing the operation of said selective switches to connect with said other telephone lines, apparatus for changing the electrical character of said multiple terminals to render them busy when said switches are connected with said other lines, and test means for said selective switches whereby they automatically disengage said multiple terminals when busy.
76. A telephone exchange system including telephone lines having answering terminals at the exchange, signals at the exchange adapted to be controlled by currents over said lines, operators' connective means adapted to be connected with said answering terminals, multiple terminals of said lines at the exchange, selective switches adapted for operation to complete connections from said answering terminals to said multiple terminals, and operators' switching means for controlling the operation of said switches to select terminals of particular lines.
77. A telephone exchange system including telephone lines having answering terminals at the exchange, signals at the exchange adapted to be controlled by currents over said lines, operators' connective means adapted to be connected with said answering terminals, multiple terminals of said lines at the exchange, selective switches adapted for operation to complete connections from said answering terminals to said multiple terminals, operators' switching means for controlling the operation of said switches to select terminals of particular lines, means for changing the electrical character of its terminals to render them busy when connection is made with a line, and automatic test means for said switches sensitive to the electrical character of said terminals to render connections ineffective when said terminals are busy.
78. A telephone exchange system including telephone lines having answering terminals at the exchange, signals at the exchange adapted to be controlled by currents over said lines, operators' connective means adapted to be connected with said answering terminals, multiple terminals of said lines at the exchange, selective switches adapted for operation to complete connections from said answering terminals to said multiple terminals, operators' switching means for controlling the operation of said switches to select terminals of particular lines, and means for releasing said selective switches when disconnection is required.
79. A telephone exchange system comprising subscribers' lines having answering terminals at the exchange, signals for said lines at the exchange adapted to be operated from the substations, operators' link-circuits provided with manually manipulated terminals for connecting with said answering terminals, multiple line terminals of said lines for completing connections to said lines when called, selective switches for connecting with said multiple terminals, operators' means for connecting said switches with said link-circuits, and apparatus controlled by the operators for causing said selective switches to connect said link-circuits with multiple terminals of desired lines.
80. A telephone exchange system comprising subscribers' lines having answering terminals at the exchange, signals for said lines at the exchange adapted to be operated from the substations, operators' link-circuits provided with manually manipulated terminals for connecting with said answering terminals, multiple line terminals of said lines for completing connections to said lines when called, selective switches for connecting with said multiple terminals, operators' means for connecting said switches with said link-circuits, apparatus controlled by the operators for causing said selective switches to connect said link-circuits with multiple terminals of desired lines, automatic test means for said switches whereby connections made with busy called lines are ineffective, and apparatus controlled by the operators for releasing said switches.
81. A telephone exchange system comprising subscribers' lines having answering terminals at the exchange, signals for said lines and manually manipulated operators' connective means for connecting with said answering terminals when said signals are displayed, multiple terminals of said lines for use in completing connections to said lines when called, and selective switches for connecting with said multiple terminals and apparatus controlled by the operators for causing said selective switches to connect said manually manipulated means with multiple terminals of desired called lines.
82. A telephone exchange system comprising subscribers' lines having answering terminals at the exchange, signals for said lines and manually manipulated operators' connective means for connecting with said answering terminals when said signals are displayed, multiple terminals of said lines for use in completing connections to said lines when called, selective switches adapted to extend connections from said manually manipulated means to said multiple terminals, and apparatus controlled by the operators for determining the selection of said terminals by said switches.
83. A telephone exchange system comprising subscribers' lines having answering

terminals at the exchange, signals for said lines and manually manipulated operators' connective means for connecting with said answering terminals when said signals are displayed, multiple terminals of said lines for use in completing connections to said lines when called, selective switches adapted to extend connections from said manually manipulated means to said multiple terminals, apparatus controlled by the operators for determining the selection of said terminals by said switches, automatically controlled test means for said switches whereby connections made with busy called lines are ineffective and release magnets controlled by the operators for disconnecting said switches.

84. A multiple switchboard telephone exchange system including telephone lines, signals for said lines at the exchange, answering spring jacks for said lines, operators' cord-circuits provided with plugs for connecting with said spring jacks, multiple calling terminals of said lines divided into groups, a plurality of connector switches adapted to make connections with the lines of each of said groups, means controlled by the operators for completing connections from said cord-circuits to said connector switches, and calling devices controlled by the operators for transmitting directive switching currents to said switches to cause them to select particular called lines of their groups.

85. A multiple switchboard telephone exchange system including telephone lines, signals for said lines at the exchange, answering spring jacks for said lines, operators' cord-circuits provided with plugs for connecting with said spring jacks, multiple calling terminals of said lines divided into groups, a plurality of connector switches adapted to make connections with the lines of each of said groups, means controlled by the operators for completing connections from said cord-circuits to said connector switches, calling devices controlled by the operators for transmitting directive switching currents to said switches to cause them to select particular called lines of their groups, means for changing the electrical character of its terminals to render them busy when connection is made with a line, and test means for said switches whereby a connection made with a busy line is ineffective.

86. A multiple switchboard telephone exchange system including telephone lines, signals for said lines at the exchange, answering spring jacks for said lines, operators' cord-circuits provided with plugs for connecting with said spring jacks, multiple calling terminals of said lines divided into groups, a plurality of connector switches adapted to make connections with the lines

of each of said groups, calling devices controlled by the operators for transmitting directive switching currents to said switches to cause them to select particular called lines of their groups, and manually manipulated operators' switches for connecting said cord-circuits with said switches.

87. A multiple switchboard telephone exchange system including telephone lines, signals for said lines at the exchange, answering spring jacks for said lines, operators' cord-circuits provided with plugs for connecting with said spring jacks, multiple calling terminals of said lines divided into groups, a plurality of connector switches adapted to make connections with the lines of each of said groups, manually manipulated operators' switches for connecting said cord-circuits with said switches, calling devices controlled by the operators for transmitting directive switching currents to said switches to cause them to select particular called lines of their groups, means for changing the electrical character of its terminals to render them busy when connection is made with a line, and test means for said switches whereby a connection made with a busy line is ineffective.

88. A multiple switchboard telephone exchange system including subscribers' lines, signals for said lines adapted for operation from the substations, answering spring jacks for said lines, multiple calling terminals of said lines divided into groups, a plurality of connector switches adapted to make connection with the lines of each of said groups, link-circuits extending to said switches for controlling their operation, spring jack terminals of said circuits, operators' cord-circuits having answering plugs for connecting with said answering spring jacks and calling plugs for connecting with said spring jack terminals, and calling devices controlled by the operators for transmitting directive switching currents to said switches to cause them to select particular lines of their groups.

89. A multiple switchboard telephone exchange system including subscribers' lines, signals for said lines adapted for operation from the substations, answering spring jacks for said lines, multiple calling terminals of said lines divided into groups, a plurality of connector switches adapted to make connection with the lines of each of said groups, link-circuits extending to said switches for controlling their operation, spring jack terminals of said circuits, operators' cord-circuits having answering plugs for connecting with said answering spring jacks and calling plugs for connecting with said spring jack terminals, calling devices controlled by the operators for transmitting directive switching currents to said switches to cause them to select particular

lines of their groups, and automatic test means for said connector switches to cause them to avoid busy lines.

90. A multiple switchboard telephone exchange system including subscribers' lines, signals for said lines adapted for operation from the substations, answering spring jacks for said lines, multiple calling terminals of said lines divided into groups, a plurality of connector switches adapted to make connection with the lines of each of said groups, link-circuits extending to said switches, multiple spring jack terminals of said circuits, means enabling the operators to determine the idle or busy condition of said spring jack terminals, operators' cord-circuits having answering plugs for connecting with said answering spring jacks and calling plugs for connecting with said spring jack terminals, and calling devices controlled by the operators for transmitting directive switching currents to said switches to cause them to select particular lines of their groups.

91. A multiple switchboard telephone exchange system including subscribers' lines, signals for said lines adapted for operation from the substations, answering spring jacks for said lines, multiple calling terminals of said lines divided into groups, a plurality of connector switches adapted to make connection with the lines of each of said groups, link-circuits extending to said switches for controlling their operation, multiple spring jack terminals of said circuits, means enabling the operators to determine the idle or busy condition of said spring jack terminals, operators' cord-circuits having answering plugs for connecting with said answering spring jacks and calling plugs for connecting with said spring jack terminals, calling devices controlled by the operators for transmitting directive switching currents to said switches to cause them to select particular lines of their groups, and automatic test means for said connector switches to cause them to avoid busy lines.

92. A multiple switchboard telephone exchange system including telephone lines, signals for said lines at the exchange, answering spring jacks for said lines, operators' cord-circuits provided with plugs for connecting with said spring jacks, other telephone lines, multiple terminals of said other lines divided into groups, a plurality of connector switches adapted to make connections with the lines of each of said groups, means controlled by the operators for completing connections from said cord-circuits to said connector switches, and calling devices controlled by the operators for transmitting directive switching currents to said switches to cause them to select particular lines of their groups.

93. A multiple switchboard telephone exchange system including telephone lines, sig-

nals for said lines at the exchange, answering spring jacks for said lines, operators' cord-circuits provided with plugs for connecting with said spring jacks, other telephone lines, multiple terminals of said other lines divided into groups, a plurality of connector switches adapted to make connections with the lines of each of said groups, means controlled by the operators for completing connections from said cord-circuits to said connector switches, calling devices controlled by the operators for transmitting directive switching currents to said switches to cause them to select particular lines of their groups, means for changing the electrical character of its terminals to render them busy when connection is made with a line, and test means for said switches whereby a connection made with a busy line is ineffective.

94. A multiple switchboard telephone exchange system including telephone lines, signals for said lines at the exchange, answering spring jacks for said lines, operators' cord-circuits provided with plugs for connecting with said spring jacks, other telephone lines, multiple terminals of said other lines divided into groups, a plurality of connector switches adapted to make connections with the lines of each of said groups, manually manipulated operators' switches for connecting said cord-circuits with said connector switches, and calling devices controlled by the operators for transmitting directive switching currents to said switches to cause them to select particular lines of their groups.

95. A telephone exchange system including telephone lines having answering terminals at the exchange, signals at the exchange adapted to be controlled by currents over said lines, operators' connective means adapted to be connected with said answering terminals, other telephone lines, multiple terminals of said other lines, selective switches adapted for operation to complete connections from said answering terminals to said multiple terminals, and operators' switching means for controlling the operation of said switches to select terminals of particular lines.

96. A telephone exchange system including telephone lines having answering terminals at the exchange, signals at the exchange adapted to be controlled by currents over said lines, operators' connective means adapted to be connected with said answering terminals, other telephone lines, multiple terminals of said other lines, selective switches adapted for operation to complete connections from said answering terminals to said multiple terminals, operators' switching means for controlling the operation of said switches to select terminals for particular lines, means for changing the electrical char-

acter of its terminals to render them busy when connection is made with a line, and automatic test means for said switches sensitive to the electrical character of said terminals to render connections ineffective when said terminals are busy.

over said line, other telephone lines, impulse controlled electromagnetic switching apparatus, and impulse transmitting means under the control of the operator to actuate said apparatus to complete a connection from said telephone line to a desired one of said other telephone lines.

97. A telephone system including a calling line, an operator's link-circuit connected therewith, other telephone lines, multiple terminals for said other lines, selective switches adapted to be employed for making connection therewith, and operators' switching means to enable the operators to transmit directive currents to said selective switches to cause them to connect said answering means with terminals of particular ones of said other telephone lines whereby connections between subscribers are completed.

102. In a telephone system, a plurality of trunk jacks having separable contacts, a trunk line connected thereto, an automatic switch connected to said trunk line, and a disconnect circuit carried serially through the separable contacts in said jacks and contacts in said automatic switch when the latter is in other than a normal condition, substantially as described.

98. A telephone system including a calling line, an operator's link-circuit connected therewith, other telephone lines, multiple terminals for said other lines, selective switches adapted to be employed for making connection therewith, operators' switching means to enable the operators to transmit directive currents to said selective switches to cause them to connect said answering means with terminals of particular ones of said other telephone lines whereby connections between subscribers are completed, and automatic test means for said switches adapted to automatically cause their disconnection from busy lines when brought to engage terminals thereof.

103. In a telephone system, a plurality of jacks, a line connected thereto, an automatic switch connected to said line, a disconnect circuit carried serially through contacts in said jacks and contacts in said automatic switch when the latter is in other than a normal condition, a plug for insertion into said jacks, and means for varying said disconnect circuit upon the withdrawal of said plug to restore said switch to normal.

104. In a telephone system, a plurality of jacks, a line connected thereto, a spring-returned automatic switch connected to said line, and a disconnect circuit carried serially through contacts in said jacks and contacts in said automatic switch when the latter is in other than a normal condition.

105. In a telephone system, a telephone line, a manual terminal for said line, an automatic terminal for said line, means for establishing alternative conversational circuits over said line either through said manual terminal or said automatic terminal, and operator's means for controlling the establishment of the connection through said automatic terminal.

106. In a telephone system, a telephone line, a manual terminal for said line, an automatic terminal for said line, manual means for connecting to said manual terminal to establish connection to said line, automatic means for connecting to said automatic terminal to establish an alternative connection to said line, and operator's means for causing the operation of said automatic means.

107. In a telephone system, a telephone line, a manual terminal for said line, an automatic switch having a contact assigned to said line, manual means for connecting to said manual terminal to establish connection to said line, and operator's means for operating said switch to connect to said assigned contact to establish an alternative connection to said line.

108. In a telephone system, a telephone line, alternative connection terminals for said line including a jack and an automatic switch contact, a plug for insertion into said

100. A telephone exchange system including subscribers' lines, answering terminals and signals for said lines at the exchange, calling terminals for said lines, operators' connecting means comprising manually movable terminals for connecting with said answering terminals, impulse controlled electromagnetically movable terminals for connecting with said calling terminals, and impulse transmitting means under the control of the operator for causing the operation of said electromagnetically movable terminals.

101. A telephone system including a telephone line, an operator's position, a signal at said position, means responsive to currents over said line to display said signal, means to enable the operator to converse

jack, an automatic switch active contact; means for bringing said active and passive contacts into engagement, and means under the control of the operator for causing the operation of said latter means.

109. A telephone system comprising a telephone line, alternative connection terminals for said line including a manual terminal and an automatic terminal, another telephone line, means for uniting said telephone lines through said manual terminal, means including automatic mechanism for uniting said telephone lines alternatively through said automatic terminal, and means under the control of the operator for causing the operation of said latter means.

110. A telephone system comprising a telephone line, alternative connection terminals for said line including a manual terminal and an automatic terminal, other telephone lines, means for uniting said telephone line and one of said other telephone lines through said manual terminal, means including automatic mechanism for uniting said telephone line and one of said other telephone lines alternatively through said automatic terminal, and means under the control of the operator for causing the operation of said latter means.

111. In a telephone system, a manually operated terminal, an automatic spring-restored switch connected therewith, an electromagnet employed in the release of said switch, an associated off-normal switch, and a release circuit for said electromagnet including said off-normal switch and contacts of said manually operated terminal.

112. In a telephone system, an automatic switch adapted to be controlled by directive current impulses; a trunk extending to said switch, multiple jacks for said trunk, means for establishing connection to said jacks, and an operator's impulse sending device for sending directive current impulses over such connection to operate said switch.

113. In a telephone system, an automatic switch adapted to be controlled by directive

current impulses, a trunk extending to said switch, multiple jacks for said trunk, means for establishing connection to said jacks, an operator's impulse sending device for sending directive current impulses over such connection to operate said switch, and means for determining the idle or busy condition of said trunk.

114. A telephone system comprising subscribers' telephone lines, means including automatic switches responsive to directive current impulses for connecting said lines for conversation, a plurality of operators' positions, and means including a current impulse sending device whereby operators at a plurality of said positions may individually control the operation of said switches.

115. A telephone system comprising subscribers' telephone lines, means including an automatic switch responsive to directive current impulses whereby said lines may be interconnected for conversation, a plurality of operators' positions, and means including a current impulse sending device whereby operators at a plurality of said positions may individually control the operation of said switch.

116. A telephone system comprising telephone lines terminating in spring jacks before an operator's position, cord circuits at said position for interconnecting said lines, other operators' positions, other telephone lines terminating thereat, operators' means for answering calls, other lines terminating at said other positions, and automatic switching means controlled by the operator from said other positions for connecting said answering means with lines terminating at said first position.

Signed by me at Grand Rapids, county of Kent, and State of Michigan, in the presence of two witnesses.

EDMUND LAND.

Witnesses:

LOTTIE M. NELSON,
FRED M. RAYMOND.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."