

APPLICATION FILED APR. 15, 1905. RENEWED APR. 17, 1912.

Patented Nov. 26, 1912.

Fig. 1.



Witnesses
D. W. Edelin.
James H. Man

Inventor
Edward E. Clements

E. E. CLEMENT.
TELEPHONE EXCHANGE SYSTEM.

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1,045,515.

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3 SHEETS—SHEET 2.

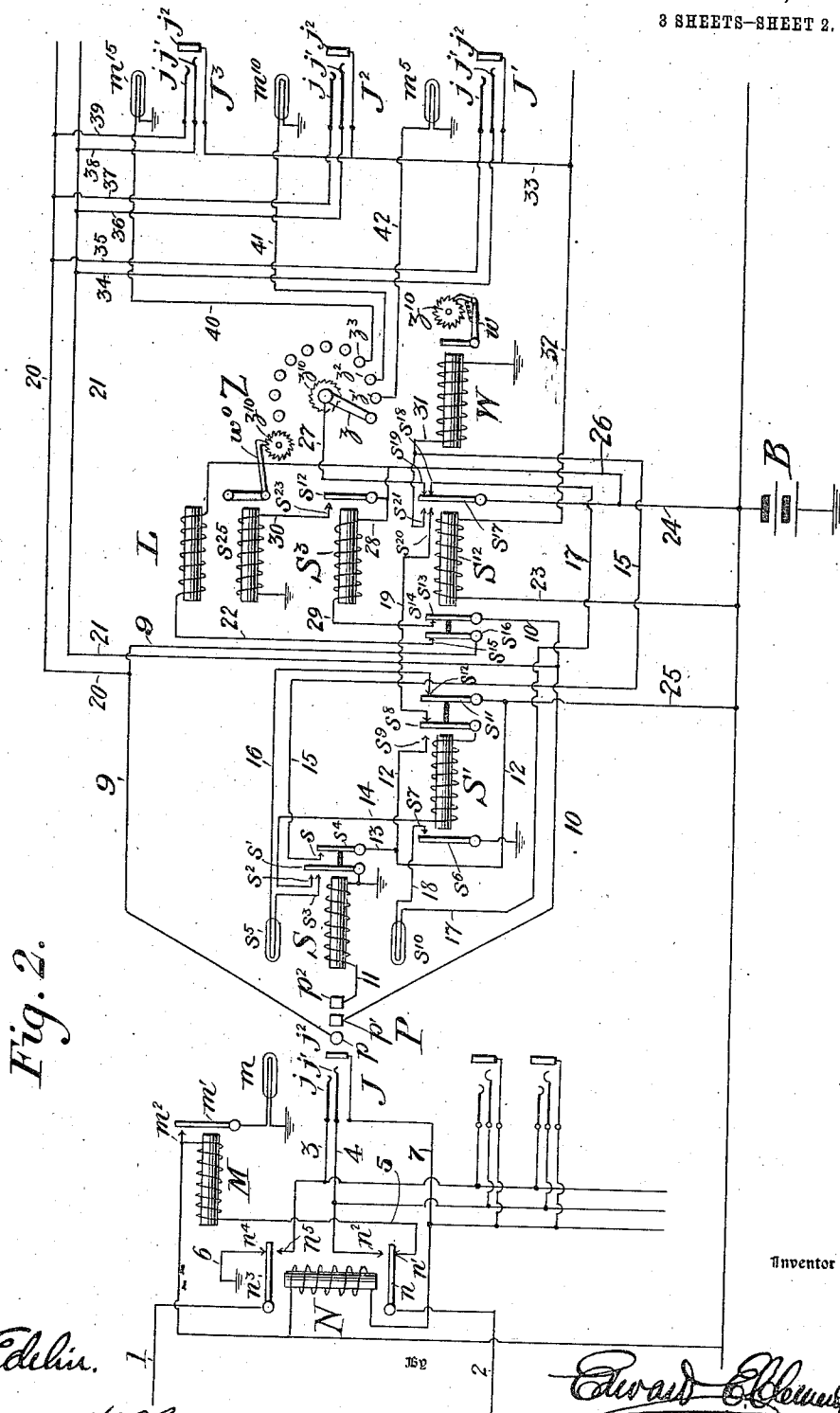


Fig. 2.

Witnesses

D. W. Edlin.

James H. Man

Inventor

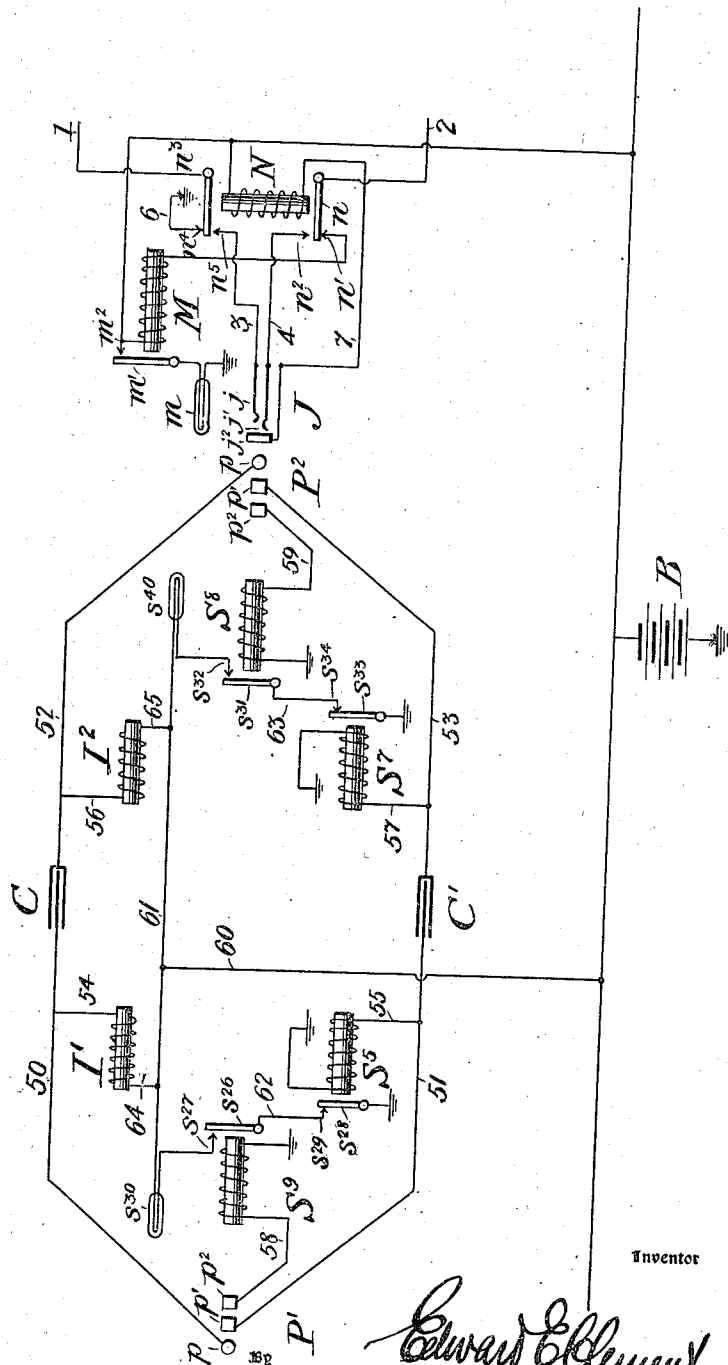
Edward E. Clement

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3 SHEETS—SHEET 3.

Fig. 3.



Witnesses

O. W. Edelin.
 James H. Man

Inventor

Edward E. Clement

UNITED STATES PATENT OFFICE.

EDWARD E. CLEMENT, OF WASHINGTON, DISTRICT OF COLUMBIA, ASSIGNOR TO THE NORTH ELECTRIC COMPANY, OF CLEVELAND, OHIO, A CORPORATION OF OHIO.

TELEPHONE-EXCHANGE SYSTEM.

1,045,515.

Specification of Letters Patent.

Patented Nov. 26, 1912.

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To all whom it may concern:

Be it known that I, EDWARD E. CLEMENT, a citizen of the United States, residing at Washington, in the District of Columbia, have invented certain new and useful Improvements in Telephone-Exchange Systems, of which the following is a specification, reference being had therein to the accompanying drawing.

My invention relates to telephone exchange systems, and has for its object the provision of means whereby a large number of subscribers may be served and great economies be effected in the central office equipment, and particularly in the number of multiple jacks required. In order to attain my end, I provide a divided multiple switchboard, that is, one in which there are several parts or divisions each appropriated to a particular group of lines as regards their multiple jacks, each line appearing upon one division and no more. All the lines terminate at answering jacks upon an answering switchboard, and from this answering switchboard trunk lines extend to all the multiple divisions, each trunk having a multiple jack for answering purposes at each multiple division, and a signal appropriated to each jack. In each trunk is an automatic selector switch, and all the signals are connected back to said switch which is placed under control of the subscriber in answering his call by connecting the trunk line. At the subscriber's station I provide an impulse transmitter whereby any desired number of impulses may be sent to affect said switch. The subscriber in making his call sets his transmitter to send the number which will signal an operator at the division where the wanted line has its multiple jacks. The trunk operator puts him on a trunk line, whose selector switch responds to his transmitter by signaling the wanted operator, who then connects him with the wanted line as in an ordinary system.

My invention is illustrated in the accompanying drawings, wherein—

Figure 1 shows a subscriber's station with the transmitting device. Fig. 2 is a similar diagram showing the subscriber's line apparatus at the central office and the trunk cord-circuit at the answering position. These trunks are also shown terminating at the different positions in the exchange. Fig. 3 shows the cord-circuit at one of these divisions for completing the call and there is

also shown the subscriber's line-circuit apparatus.

Referring now to Fig. 1, A is the subscriber's station equipped with apparatus 60 usual in common battery systems, consisting of transmitter T, receiver R, hook H, ringer Q, condenser C. In addition to this I have shown the transmitting device for sending in impulses to the central office for picking 65 out the desired division. This apparatus consists of the following: a main shaft d^{10} , on which are mounted the star wheels d^{11} , d^{12} , d^{13} , d^{14} , d^{15} , d^{16} , d^{17} , d^{18} and d^{19} . The teeth of these wheels are engaged respectively by the teeth x , x' , x'' etc., on the push buttons d , d' , d'' , d''' , $d^{(4)}$, $d^{(5)}$, $d^{(6)}$, $d^{(7)}$, $d^{(8)}$ and $d^{(9)}$. These buttons when pulled all the way in meet the various stops x^{10} , x^{11} , x^{12} , x^{13} , x^{14} , x^{15} , x^{16} , x^{17} , x^{18} and x^{19} . These stops are all 75 set at various distances in relation to the push buttons. The first push button d , when pushed in, can only go a certain distance. The second push button d' , when pushed in, can go a little farther, and so on 80 up to the last button, which when depressed travels the greatest distance. These buttons when depressed engage the teeth on the wheels which are fixed rigidly to the shaft d^{10} , causing it to turn. It will be seen that 85 the first push button when depressed causes the shaft to rotate but a short distance, while the last button $d^{(9)}$ causes it to make a complete revolution or a part of a revolution as is necessary. On this same shaft there is 90 mounted a number-wheel d^{21} whose pawl d^{23} engages a ratchet wheel d^{22} . When any button is depressed and the shaft revolves, this number-wheel is not affected, but when the shaft is released by the release magnet, 95 d^{30} , this number wheel then turns with the shaft and the teeth engage the spring d^{26} , which in turn engages the spring d^{27} . A pinion wheel d^{24} is mounted rigidly on the shaft d^{10} and its teeth engage the arm d^{31} , 100 controlled by the release magnet d^{30} . There is also mounted on this shaft a wheel d^{25} , having a groove in which the spring d^{33} normally rests. The first movement of the shaft caused by the depression of any button 105 causes this wheel to turn and the spring d^{33} leaves the groove and rides on the surface of the wheel. This action connects the release magnet d^{30} to No. 1 side of the line by the following path: wire 73, contacts d^{32} 110 and d^{33} to line wire No. 1. At the same time, the subscriber's talking set is opened

by the breaking of the contacts d^{34} and d^{35} . A ground is also placed on No. 2 side of the line through the following path: contacts d^{28} and d^{29} , wire 74, contacts d^{35} and d^{36} , wire 70 to line wire No. 2. The main shaft d^{40} is normally in the position as shown in the drawing, but when set by any button it is held in its new position until the release magnet d^{30} is energized and after that is restored again to its normal position by the spring d^{20} .

Referring now to Fig. 2, the line apparatus consists of the following: line relay M, cut-off relay N, answering-jack J and the line signal m . One terminal of the line relay M is connected to battery and the other terminal to the line wire No. 2 by the wire 5, contacts n and n' of the cut-off relay N. No. 1 side of the line is grounded through the contacts n^3 and n^4 of the relay N. The spring j of the jack J is connected to the contact n^5 by the wire 3 and the spring j' , connected to the contact n^2 by the wire 4. One terminal of the cut-off relay N is connected to battery and the other terminal connected to j^2 of the jack J by the wire 7. The trunk circuit consists of the following: trunk plug P, controlling relay S, disconnect signal relay S', cut-off relay S¹², rotary relay S³, rotary magnet S²⁶, retardation coil L, release magnet W and the selecting arm Z. The jacks J', J², J³, etc., and their respective lamps represent various divisions in the exchange. In the transmitting device, Fig. 1, I have shown ten push buttons for picking out any one of ten divisions, while in the drawing, Fig. 2, I have only shown three divisions represented by the jacks J', J² and J³, the other division being omitted for simplicity. The controlling relay S is connected to the third conductor p^2 of the plug P and it controls the circuit of the lamp s^5 through the contacts s' , s^3 , wire 16, contacts s^{12} , and s^{11} of the relay S', wire 25 to battery. The contact s is connected to the release magnet W by the wire 15. The contact s^4 is connected to battery by the wires 13, 12 and 25 and also to the contact s^9 of the relay S' by the wire 12. The tip p of the plug P is multiplied to the springs j of the jacks J', J² and J³. The sleeve p' is connected in multiple to the springs j' of the jacks J', J² and J³ by the wires 10, 21, 34, 36 and 38. One terminal of the relay S' is connected to the contact s^{20} of the relay S¹² by the following path: contact s^8 , wire 19 to contact s^{20} . One terminal of the disconnect lamp s^{10} is connected to the contact s^7 , the other terminal being connected to the contact s^{18} of the relay S¹² by the wire 17. One terminal of the cut-off relay is connected to battery by the wire 23, while the other terminal is connected in multiple to j^2 of the jacks J', J² and J³, by the wires 32 and 33. One terminal of the relay

S³ is connected to battery by the wires 26 and 24, the other being connected to the sleeve p' by the wire 29, contacts s^{14} and s^{13} of the relay S¹² and wire 10. One terminal of the retardation coil L is connected to battery by the wires 26 and 24, the other being connected to the tip p by the wire 22, contacts s^{15} and s^{16} of the relay S¹² and wire 9. One terminal of the magnet s^{25} is connected to ground and the other to the contact s^{23} of the relay S³. One terminal of the release magnet W besides being connected to the contact s of the relay S is also connected to the contact s^{21} of the relay S¹² which places this magnet under joint control of the trunking operator and the connecting operator at one of the divisions. The blade of the switch Z is connected to the contact s^{19} of the relay S¹² and the individual points z' , z^2 and z^3 are connected to the lamps m^5 , m^{10} and m^{15} , respectively, by the wires 42, 41 and 40.

Referring now to Fig. 3, I have shown the connecting operator's cord-circuit at one of the divisions and also the central office end of the subscriber's line. The latter being identical with that shown in Fig. 2, will not be described. The cord-circuit consists of the answering-plug P', calling-plug P², supervisory relays S⁵ and S⁷, retardation coils I', I², the controlling relays S⁹ and S⁸, supervisory lamps s^{30} and s^{40} . The tip p of the plug P' is connected to the tip p of the plug P² by the strand 50, condenser C and strand 52, and the sleeve p' of the plug P' is connected to the sleeve p' of the plug P² by the strand 51, condenser C' and strand 53. One terminal of the retardation coil I' is connected to the strand 50 by the wire 54, the other terminal being connected to battery by the wires 64, 61 and 60. One terminal of the relay S⁵ is connected to the strand 51 by the wire 55, the other terminal being grounded. One terminal of the retardation coil I² is connected to the strand 52 by the wire 56, the other being connected to battery by the wires 65, 61 and 60. One terminal of the relay S⁷ is connected to the strand 53 by the wire 57, the other being grounded. The relay S⁹ is connected to the third conductor p^2 of the plug P' by the wire 58, the other terminal being grounded. One terminal of the relay S⁸ is connected to the strand p^2 of the plug P² by the wire 59, the other being grounded.

The operation of my system is as follows: The subscriber desiring to be connected to a party on a certain division in the exchange depresses his button corresponding to that division. Supposing the party he desires to be connected with is located on the third division of the board. In this case he depresses the third button d^1 . This button when depressed engages the wheel d^{12} , causing the shaft to revolve until the button d^2

meets the stop x^{12} . The wheel d^{25} has now revolved a sufficient distance to cause the spring d^{33} to leave the groove and ride on the surface of the wheel making and breaking the following connections: The release magnet d^{30} is connected to No. 1 side of the line through the contacts d^{32} and d^{33} and ground is placed on No. 2 side of the line through the contacts d^{28} and d^{29} of the release magnet d^{30} , wire 74, contacts d^{35} and d^{36} , wire 70 to No. 2 side of the line. The shaft d^{40} is held in the position caused by the depression of the button d^2 by the arm d^{31} of the release magnet d^{30} . The shaft in revolving does not affect the number-wheel d^{21} , as the ratchet d^{23} gives freely on the pinion wheel d^{22} when the wheels are set. When the button was first depressed the contacts d^{33} and d^{34} were broken, disconnecting the subscriber's talking set. It will be noticed that the release magnet d^{30} is connected from No. 1 side of the line to ground at the subscriber's instrument, and that No. 1 side of the line is also grounded at the central office through the contacts n^3 and n^4 of the cut-off relay N, Fig. 2; this magnet therefore remains deenergized. As before stated, a ground is placed on No. 2 side of the line which closes the circuit of the line-relay M at the central office. This relay attracting its armature closes the circuit of the line lamp m causing it to glow. The trunking operator perceiving this signal inserts the trunk plug P into the jack J which places the windings of the relays S and N in series from ground to battery, energizing them and causing their armatures to be attracted. The relay N attracting its armatures disconnects the line-relay M which in turn extinguishes the line lamp m and connects No. 1 and No. 2 side of the line to the springs j and j' , respectively, of the jack J. The relay S attracting its armatures closes the circuit of the lamp s^5 , causing it to glow, at the same time it closes the contacts s^1 and s^2 partly completing the circuit of the relay S'. The contacts s and s^4 are also closed, which completes the circuit of the release magnet W, energizing it, causing its arm w to engage the shaft wheel of the switch Z. When the operator first answered the call by placing the plug into the jack, battery was sent out over No. 1 side of the line through the release magnet d^{30} at the subscriber's station by the following path: battery, wires 24, 26, retardation coil L, wire 22, contacts s^{15} and s^{16} of the relay S¹², wire 9, tip p , spring j , wire 3, contacts n^3 and n^5 , line-wire 1; and in Fig. 1, contacts d^{32} and d^{33} , wire 73, release magnet d^{30} to ground. The release magnet now becoming energized, attracts its armatures, breaks the contacts d^{28} and d^{29} , disconnecting ground from No. 2 side of the line. It also lifts the arm d^{31} , releasing the shaft d^{40} . This shaft now under the influence of the spring d^{20} starts back to its normal position and in revolving carries the number-wheel d^{21} with it, whose teeth then engage the spring d^{26} causing it to make and break contact with the spring d^{27} according to the number of the teeth engaging it. When the button d^2 was depressed it revolved the shaft against the tension of the spring d^{26} sufficiently to cause the shaft in running back to make the number-wheel d^{21} move the space of three teeth. The making and breaking of the contacts d^{26} and d^{27} affects the relay S³ in Fig. 2. This relay being actuated a number of times corresponding to the making and breaking of contacts d^{26} and d^{27} causes it to attract its armature, closing the contacts s^{12} and s^{23} , closing the circuit of the magnet s^{25} . This magnet being energized, and then deenergized according to the number or division of the board wanted, moves its armature back and forth, actuating the pawl w^0 which engages the wheel z^{10} and thereby operates the switch Z, causing the arm z to rotate and make connection with the individual contacts. In this case as No. 3 division is wanted the arm z comes to rest on the contact z^3 , causing the signal lamp m^{15} to glow. The circuit of this signal is completed by the following path: battery, wire 24, contacts s^{17} , s^{19} of the relay S¹², wire 27, z , z^3 , wire 40, signal m^{15} to ground. The operator at the connecting position, Fig. 3, receiving the signal inserts the answering-plug P' into the jack J³ of her division, which places the relay S⁰, Fig. 3, in series with the relay S¹², Fig. 2, by the following path: ground, S⁰, wire 58, p^2 , j^2 , wires 33 and 32, S¹² to battery. Both of these relays now become energized and attract their armatures. The relay S¹², attracting its armatures, breaks the contacts s^{13} and s^{14} , disconnecting the relay S⁰ from the sleeve p' of the plug P. It also breaks the contacts s^{15} and s^{16} , disconnecting the retardation coil L from the tip p of the plug P. The contacts s^{19} , s^{18} and s^{17} are broken, disconnecting the switch Z and extinguishing the signal lamp m^{15} , and also opening the wire 17 leading to the lamp s^{10} . At this time the circuit of the relay S' is completed through the closing of the contacts s^{17} and s^{20} , and becoming energized attracts its armatures and locks itself through the contacts s^8 and s^9 . It also opens the contacts s^{11} and s^{12} , extinguishing the lamp s^5 , and notifying the trunking operator that the operator at one of the divisions has answered the call. The contacts s^6 and s^7 are also closed, forming part of the circuit of the lamp s^{10} . After the shaft in the subscriber's transmitting device has returned to its normal position under the influence of the spring d^{20} , the contacts d^{23} and d^{34} are closed, and connect the subscriber's talking set across the line.

Referring again to Fig. 3, the operator

upon inserting the answering plug P' asks for the number in the usual manner and places the calling plug P² into the jack of the line desired. This insertion places the relay S⁸ and the relay N in series energizing them. The relay N in attracting its armatures disconnects the line relay M and connects the line wires 1 and 2 to the springs j and j' of the jack J. The relay S⁸ in attracting its armature closes the circuit of the lamp s⁴⁰, which glows and continues to glow until the called subscriber answers. When the called subscriber answers he closes the circuit of the relay S⁷, which attracting its armature opens the contacts s³³ and s³⁴, extinguishing the lamp s⁴⁰, notifying the operator that the call is answered. At the end of the conversation the relay S⁷ is deenergized, causing the lamp s⁴⁰ to glow the second time, notifying the operator that the called subscriber has hung up his telephone, and the calling subscriber in hanging up his telephone deenergizes the relay S⁵, causing the lamp s³⁰ to glow. The operator now knows conversation is finished. Upon withdrawing the calling plug P² the relays S⁸ and N are deenergized and the line relay M is again placed across the line terminals ready for another call. The relay S³ becoming deenergized, extinguishes the lamp s⁴⁰. Upon withdrawing the answering plug P', the relay S⁹ becomes deenergized, extinguishing the lamp s³⁰, and the relay S¹² becomes deenergized and its armatures fall back. The relay S³ is again connected to the sleeve p' of the plug P and the retardation coil L is connected to tip p of the plug P. The contacts s¹⁷ and s¹⁸, now being closed, the circuit of the lamp s¹⁰ is completed, notifying the operator that the connecting operator has taken down the connection and that the call is finished. She at once withdraws the plug P from the calling subscriber's line and deenergizes the relays S and N. The relay N becoming deenergized the relay M is again connected to the line. The relay S becoming deenergized opens the contacts s' and s², deenergizing the relay S', which opens the contacts s⁶ and s⁷, extinguishing the lamp s¹⁰. The contacts s and s⁴ of the relay S are also broken, which opens the circuit of the release magnet W whose arm w now leaves the toothed wheel z¹⁰ and releases the switch Z, allowing it to return to its normal or starting position. It will be noticed that the operator who first answers the call is provided with two supervisory lamps which give her complete supervision over the connection. By means of the lamp s⁸ she can tell when the operator at one of the divisions has answered the call, and by means of the lamp s¹⁰ she can tell when the conversation is completed. Both operators have control of the release magnet W which will not become deenergized to

release the switch Z until both operators have withdrawn their plugs. This provides for any contingency, such as one operator taking down the connection by mistake, the magnet in this case being held energized by the other operator.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:

1. In a telephone exchange system, subscribers' lines terminating at a central office on single answering terminals and multiple connecting terminals, the latter being distributed among different divisions of the exchange, and no one line having terminals in all the divisions thereof; operators' trunk circuits adapted to be connected to the answering terminal in response to a call, a driven switch in each trunk circuit, a plurality of branch circuits leading from each driven switch to answering terminals in the different divisions of the exchange, a signaling means associated with each branch, means at the subscriber's station for first indicating a call and thereafter for controlling said driven switch to set the signal at any desired division, and answering and connecting means adapted to cooperate with the trunk answering terminals in each division substantially as described.

2. In a telephone exchange system, a switchboard having a plurality of divisions and subscribers' lines with multiple jacks in the several divisions, each line appearing upon the several sections of one division only, an answering jack and signal for each line, a trunk line or lines extending from each answering position in parallel to answering jacks upon the several multiple divisions, a signal associated with each of the trunk answering jacks, all the signals of the same trunk being connected to a selective device at the answering position; and means at the subscriber's station to operate said selective device when connection is made with his line, so as to call directly the operator having control of that answering jack of his trunk, which lies upon the division where the line wanted has its multiple jacks, substantially as described.

3. In a telephone exchange system, a subscriber's station connected by a line to an answering jack and signal device at a central office switchboard, a main switchboard carrying multiple terminals of subscribers' lines and divided into several parts, each appropriated to a particular group of lines appearing there and nowhere else, a trunk circuit with terminal plug extending from an answering position to multiple answering jacks at all of the multiple divisions, a signal for each trunk answering jack, connections from said signals to terminals of a selective switch, a viper terminal for each switch cooperating with said signal ter-

minals, and an impulse transmitter at the subscriber's station for actuating said switch as predetermined by the subscriber to select and actuate the signal of the trunk connected with his line, which appears upon the same multiple division as the line of the wanted subscriber, substantially as described.

4. In a telephone exchange system, a subscriber's station and a central station, an impulse transmitter at the former, and a terminal jack and signal for the line at the latter, means whereby the subscriber may set a number and at the same time display his line signal, an answering operator's cord circuit cooperating with the jack, a switchboard containing multiple jacks of all subscribers' lines but divided into several parts each appropriated to and containing the multiple jacks of a certain group of subscribers only, a trunk line extending from the answering operator's cord circuit to all of the said multiple board divisions and connected in each to an answering jack, a source of current supply connected to the operator's cord and supplying current there-through to the subscriber's line for signaling and talking purposes, a step-by-step selector switch, a controlling magnet and a release magnet therefor, and controlling relays, together with supervisory and clearing out signals associated with the cord, a signal associated with each trunk jack in the multiple divisions, connections from the several signals to the cord selector switch, and operator's cord circuits with battery supply and supervisory signals, at the several multiple positions, the whole so arranged and operating that a subscriber calling is first connected to a trunk line, then by the operation of his transmitter calls the operator at that division where the line wanted has its jacks, and is there answered and connected as in an ordinary direct system, substantially as described.

5. In a telephone system, a subscriber's station and line and a central source of current supply grounded on one side and normally connected across the line in one direction, a selective transmitter at the substation, and a magnet controlling the same, means actuated in setting the signal to connect the controlling magnet between the dead or grounded side of line and the ground, whereby the magnet will not be energized, together with means actuated in making connection with the line at the central office to reverse the battery to line, substantially as described.

6. In a telephone exchange system, a switchboard having a plurality of divisions and subscribers' lines with multiple jacks in

the several divisions, an answering jack and signal for each line, a trunk line provided with a plug at one end and terminating at the other end in a series of answering jacks multiplied in the different divisions, operators' cord circuits at the different divisions, a selective device, and means at the subscriber's station to operate said selective device when connection is made with his line to indicate connection of the trunk with a cord circuit at a desired division.

7. In a telephone exchange system, subscribers' lines, answering terminals for said lines, a trunk circuit provided with a connecting plug at one end and terminating at the other end in a series of answering jacks multiplied in different divisions, a trunk signal and operator's cord circuits at each division, a selective device in the trunk circuit adapted to be operated from the calling subscriber's station to actuate a desired signal, and means controlled jointly by the trunk operator and the answering operator for restoring the selective device to its normal condition.

8. In a telephone exchange system, subscribers' lines, answering terminals for said lines at the exchange, a trunk circuit provided with a connecting plug at one end and terminating at the other end in a series of answering jacks multiplied in different divisions, a trunk signal and operators' cord circuits at each division, a selective switch in the trunk circuit, a selective impulse transmitter at the calling subscriber's station adapted to operate a desired signal to indicate connection of the trunk with a desired cord circuit, and means controlled jointly by the trunk operator and the answering operator for restoring said switch to its normal position.

9. In a telephone exchange system, subscribers' lines, answering terminals for said lines at the exchange, associated line signals therefor, a trunk circuit provided with a connecting plug at one end and terminating at the other end in a series of answering jacks multiplied in different divisions, a signal associated with each of said trunk answering jacks, operators' cord circuits at each division, a selective switch in each trunk circuit, a selective impulse transmitter at the calling subscriber's station adapted to operate said switch to actuate any desired signal of the trunk connected with his line, and means to restore said selective switch.

In testimony whereof I affix my signature in presence of two witnesses.

EDWARD E. CLEMENT.

Witnesses:

H. M. STERLING,

JAMES H. MARR.