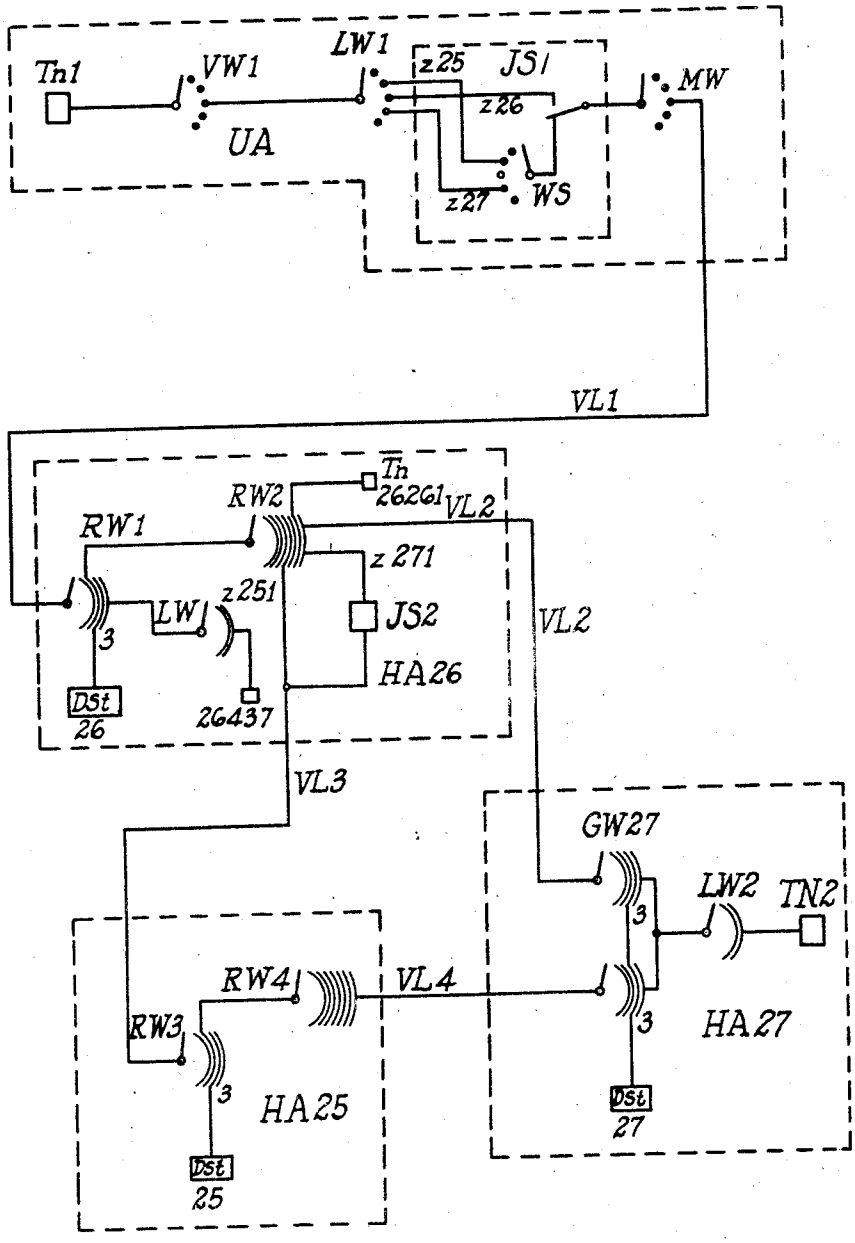
April 1, 1930. W. MÜNCHENHAGEN 1,752,500

MULTIOFFICE TELEPHONE SYSTEM

Original Filed Aug. 12, 1927 3 Sheets-Sheet 1

Fig. 1



Inventor

Willy Münchenhagen

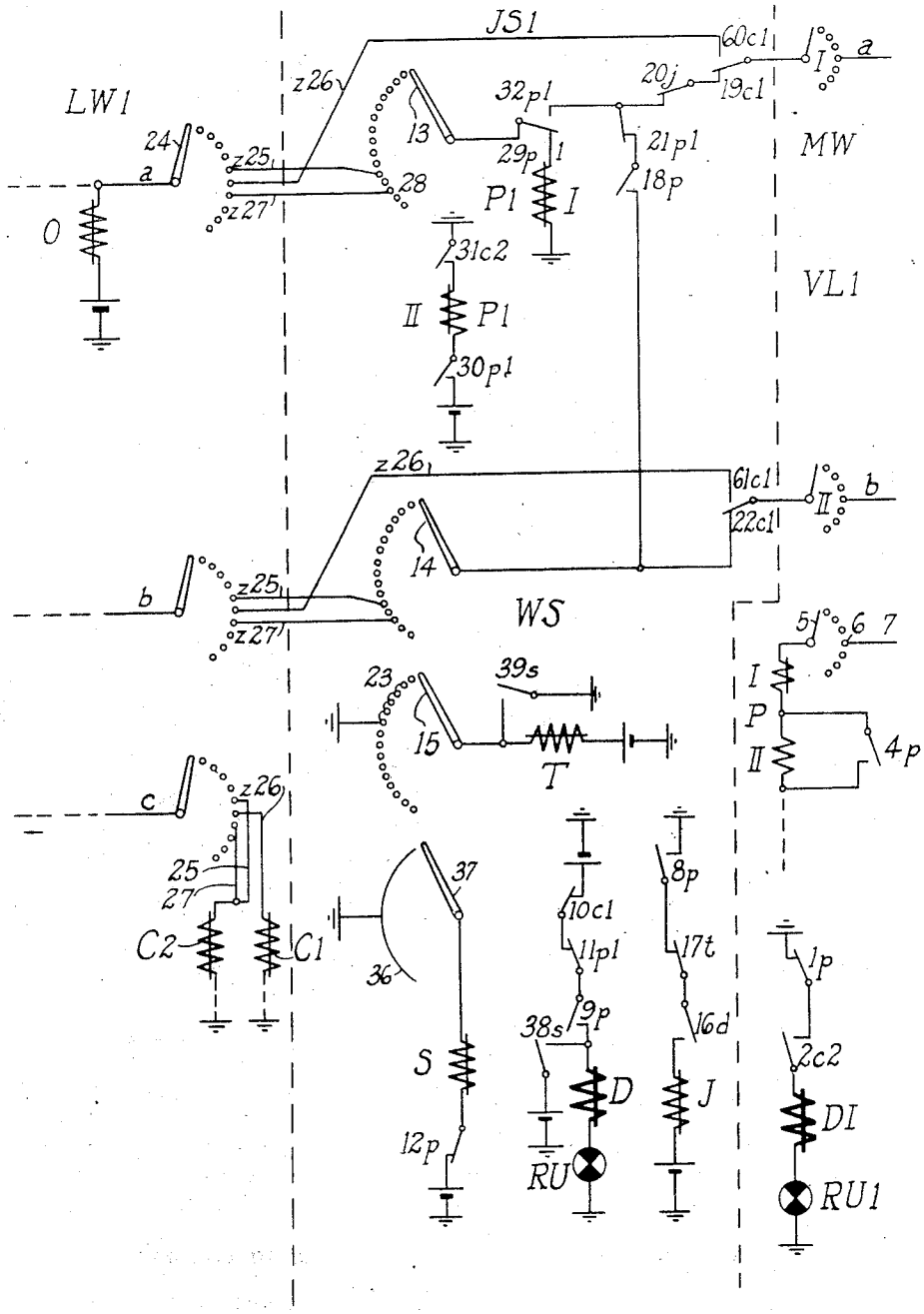
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April 1, 1930. W. MÜNCHENHAGEN 1,752,500

MULTIOFFICE TELEPHONE SYSTEM

Original Filed Aug. 12, 1927 3 Sheets-Sheet 2

Fig. 2



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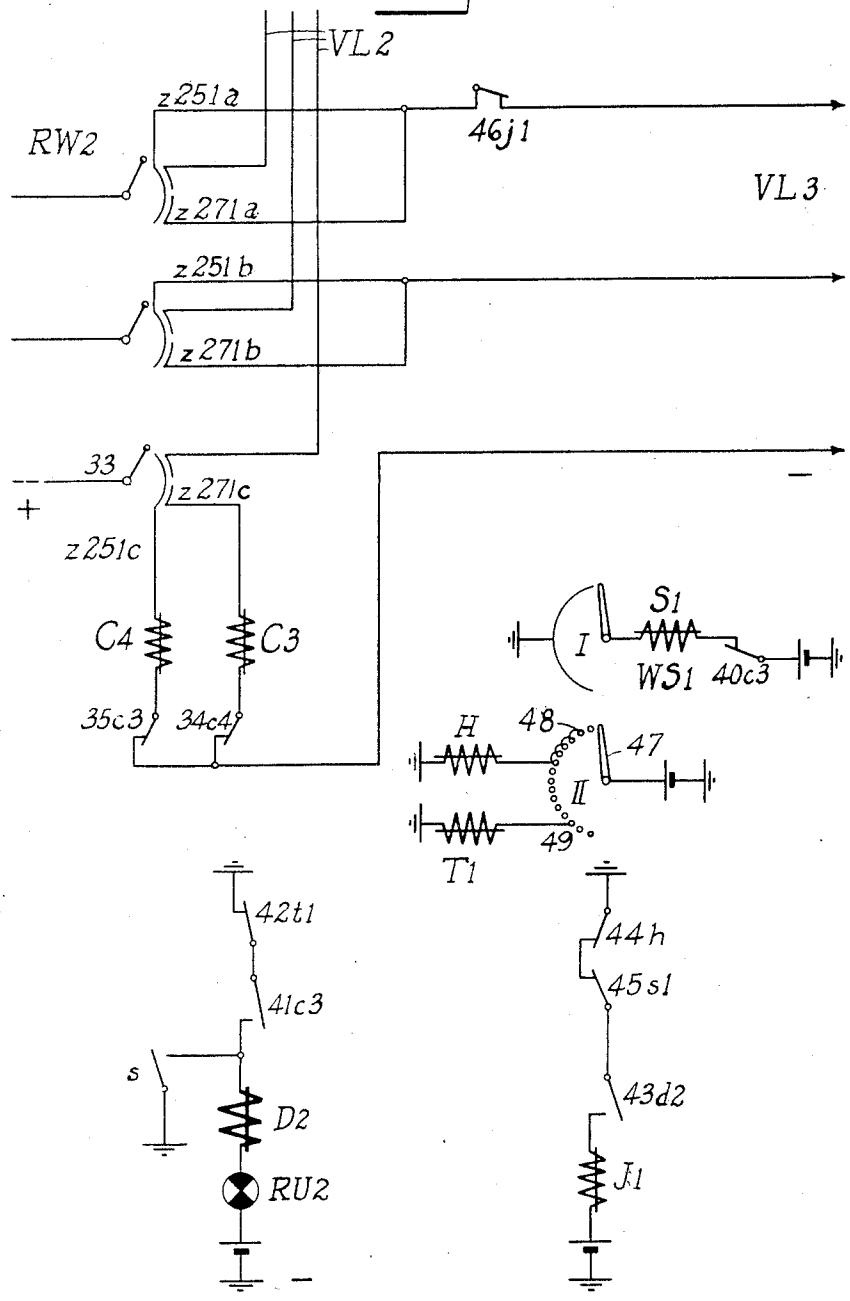
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April 1, 1930. W. MÜNCHENHAGEN 1,752,500

MULTIOFFICE, TELEPHONE SYSTEM

Original Filed Aug. 12, 1927 3 Sheets-Sheet 3

Fig. 3



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Atty.

Patented Apr. 1, 1930 1,752,500

UNITED STATES PATENT OFFICE

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MULTIOFFICE TELEPHONE SYSTEM

Application filed August 12, 1927, Serial No. 212,433, and in Germany December 2, 1926. Renewed July 3, 1929.

The invention relates to a circuit arrangement for automatic telephone systems comprising several exchanges. With the object of reducing the number of trains of number impulses that have to be transmitted from a calling station when connections are to be set up over several exchanges located in tandem, arrangements are known already whereby direction selectors are automatically positioned in intermediate exchanges after the wanted exchange has been designated, for example by seizing a particular one of several means of access to an undirectional junction line outgoing from the calling exchange. In the known arrangements the direction selectors are also automatically positioned when connections are to be set up to stations connected to the exchanges that contain the direction selectors, and in full automatic systems this arrangement necessitates the provision of special group selecting stages, because the calling station by means of number impulses can selectively position only the switches located beyond the direction selectors in the building up of the connection.

Now the object of the invention is to increase the efficiency of the telephone systems by decreasing the selecting stages, this being effected by only operating certain switching means when the next exchange is designated to be an intermediate exchange (by taking into use a particular one of several differently numbered means of access to a junction line), the said switching means then causes an impulse sender to function for the purpose of automatically positioning the direction selectors. Hence no impulse transmission takes place over the seized junction line for automatically positioning the direction selectors if the next exchange be designated as a terminating exchange.

One method of carrying out the invention is shown in the drawings. These show an arrangement, in which the undirectional junction lines outgoing from a calling exchange are provided with several differently numbered means of access and the wanted exchange is designated by taking into use one means of access. However, the direction of an undirectional junction line and thus the designation of a wanted exchange can be effected in any other manner desired, for example by means of keys at an operator's position in a manual exchange.

Figure 1 shows a telephone area having four exchanges.

In Figure 2 is shown the outgoing end of a normally undirectional junction line outgoing from the calling exchange.

Figure 3 shows diagrammatically the arrangement of the exchange immediately beyond the calling exchange.

In Figure 1 are shown four exchanges HA 25, HA 26, HA 27 and UA of a telephone area. It will be assumed that the exchange UA, which is connected to the exchange HA 26, is a small sub-exchange provided only with preselectors and final selectors. The junction lines VL 1 outgoing from the exchange UA to the exchange HA 26 are accessible over the final selectors LW 1 in the exchange UA and are provided with several differently numbered means of access *z* 25, *z* 26, *z* 27 corresponding to the other three exchanges of the area.

When the subscriber T*n* 1 connected to the exchange U*a* wishes to speak to the subscriber T*n* 2 of the exchange HA 27, the preselector VW 1 in known manner finds an idle final selector LW 1 and the calling subscriber then positions this final selector on the 27th contact by transmitting two trains of impulses comprising 2 and 7 impulses respectively, and thereby he takes into use the access *z* 27 to the junction line VL 1. The taking into use of the access *z* 27 marks the next exchange HA 26 as intermediate exchange and marks the exchange HA 27 as the wanted exchange. Furthermore in the manner hereafter explained, an impulse sending device JS 1 is caused to function, and over the seized junction line VL 1 it transmits impulses for positioning onto a junction line VL 2 going to the exchange HA 27 the direction selectors RW 1 and RW 2, which are located in the next exchange HA 26.

In the example shown the selection of an idle junction line VL 1 is effected by a mixing switch MW. Obviously this mixing switch is not always required, because the non-nu-

mercial selection for connecting up a junction line (if there be several) can be effected by the final selector; for example, if there be three outgoing undirectional junction lines, this could be done by connecting the first junction line with its three means of access to the second, fifth and eighth contacts of a contact group and connecting the second line to the third, sixth and ninth contacts and connecting the third line to the fourth, seventh and tenth contacts. In order to designate a wanted exchange and to designate the direction of an undirectional junction line taken into use, the calling subscriber positions the final selector onto the fifth contact, the final selector then in known manner hunts for an idle one of the junction lines connected up three times like private branch exchange lines.

If the calling exchange UA be provided with group and final selectors, it is likewise not always necessary to provide mixing switches, because the outgoing junction lines can then be reached over several levels of a group selector. For example, if the exchange UA be provided with first and second group selectors, the means of access to the junction lines VL 1 designating the exchanges HA 25, 26 and 27 can be reached over the fifth, sixth and seventh level of the second group selectors.

The means of access *z* 25 and *z* 27, which designate the exchange HA 26 as an intermediate exchange, are not directly connected to the junction line, but are connected to a call seeker WS. When one of the means of access *z* 25 or *z* 27 is taken into use, the call seeker WS hunts for the one taken into use and during its positioning movement it generates the impulses required for positioning the direction selectors RW 1 and RW 2; the manner of generating these impulses will be described in full later on.

After the direction selectors RW 1 and RW 2 have been positioned in the main exchange HA 26 by the impulse sender JS 1 in the exchange UA and a free junction line VL 2 has been taken into use, the calling party T*n* 1 transmits impulses for positioning the switches GW 27 and LW 2 in the exchange HA 27. A connection has thus been set up between the subscribers T*n* 1 and T*n* 2 extending over the following connecting devices and lines: calling subscriber T*n*1, preselector VW 1, final selector LW 1, means of access *z* 27, call seeker WS, mixing switch MW, junction line VL 1, direction selectors RW 1, RW 2 in the exchange HA 26, junction line VL 2, group selector GW 27 and final selector LW 2 in the exchange HA 27, subscriber T*n* 2.

It may now happen that the junction lines VL 2 going from the exchange HA 26 to the exchange HA 27 are unavailable for the traffic, for example owing to being busy or out of order. In that case the direction selector RW 2 automatically hunts for a junction line going to the exchange HA 25 in order to deviate the connection, as the exchange HA 27 can also be reached over HA 25. The manner of doing this is known per se and will be described hereafter. The junction lines VL 3 between the exchanges HA 26 and HA 25 have two differently numbered means of access; of these the access *z* 251 is connected to the fifth level of the direction selector RW 2, while the access *z* 271 is connected to the seventh level of the direction selector RW 2. The last mentioned access *z* 271 again contains an impulse sender JS 2, which causes the direction selectors RW 3 and RW 4 in the exchange HA 25 to be automatically positioned onto a group of junction lines VL 4 going to the exchange HA 27. After a junction line VL 4 has been taken into use, the calling station in known manner positions the switches in the exchange HA 27 onto the wanted line.

If the subscriber T*n* 1 wishes to set up a connection to a subscriber connected to the exchange HA 26, he positions the final selector LW 1 in the exchange UA onto the contact 26, thereby taking into use the means of access *z* 26, which in any desired manner is directly connected to the junction line VL 1 and circumvents the call seeker WS with the impulse sending device JS 1, or if mixing switches be provided the access *z* 26 is directly connected to the wipers of the mixing switch MW. Thus the direction selectors RW 1 and RW 2 in the exchange HA 26 reached over the junction line VL 1 are not automatically positioned, and after the junction line VL 1 has been taken into use, the subscriber transmits impulses to selectively position the direction selectors RW 1 and RW 2. It will be assumed that subscribers' lines are also connected to the direction selector RW 2. In that case the direction selector RW 2 also acts as a final selector and is provided with the devices required for that purpose. Now in order to call for example the subscriber T*n* 26261 in the exchange HA 26, the subscriber T*n* 1 positions the direction selector RW 1 onto the second level and the direction selector RW 2 onto the first contact of the sixth level. The operator's position DS*t* 26 in the exchange HA 26 is accessible over the direction selector RW 1. If the subscriber T*n* 1 wishes to set up a connection to this position, he must first take into use the junction line VL 1 over the means of access *z* 26 and the direction selector RW 1 and need then only position the latter onto a certain level, for example the third level.

The switching operations performed in setting up the different connections will now be described in detail with reference to the Figures 2 and 3. It will first be assumed that the subscriber T*n* 1 wishes to set up a connec-

tion to the subscriber Tn 2 connected to the exchange HA 27. The Figure 2 only shows the wipers and one relay of the final selector LW in the exchange UA. The subscriber positions this switch onto the seventh contact of the second level, to which the means of access z 27 connected that designates the traffic direction, that is to say the exchange HA 27.

After the final selector has been positioned, the relay C 2 is energized over the wiper c. In the present example it is assumed there are mixing switches, hence the relay C 2 first closes the circuit of the driving magnet D 1 of the mixing switch MW: earth, battery, contacts 1 p, 2 c 2, driving magnet D 1, interrupter RU 1, earth. The mixing switch MW having found an idle outgoing junction line VL 1 to the exchange HA 26, the test relay P is energized in known manner over its windings II and I, the test wiper 5, the test contact 6 and over the lead 7; it marks the selected junction line engaged by short circuiting the high resistance winding II at contact 4 p and opens the circuit of the driving magnet D 1 of the mixing switch at contact 1 p. Furthermore the contacts 8 p and 9 p bring the impulse sending device JS 1 into action. The relay S is disconnected by the opening of the contact 12 p. Contact 18 p places a bridge across the wipers I and II of the mixing switch and thus across the a and b leads of the outgoing junction line VL 1. Hence in the exchange HA 26 at the other end of the junction line VL 1 a bridging relay (not shown) is operated and it prepares the direction selector RW 1 to receive impulses.

The means of access z 25, z 27 are connected to the contacts of a call seeker WS and are reached over the final selector LW 1; they indicate that the next exchange HA 26 is an intermediate exchange. This call seeker WS also serves to generate the impulses required for automatically positioning the direction selectors.

In order to set up a connection to a junction line VL 2 outgoing from the exchange HA 26 and going to the exchange HA 27, in the present example two trains of impulses are required containing two and seven impulses each. Obviously the number of such trains of impulses will depend on the arrangement of the network in each particular case. The method of generating the trains of impulses for automatically positioning the direction selectors will now be described.

On energizing the test relay P of the mixing switch MW, the contact 8 p prepares the circuit of the impulse repeating relay J, and the contact 9 p closes the circuit of the driving magnet D of the call seeker WS: earth, battery, contacts 10 c 1, 11 p 1, 9 p, rotary magnet D, interrupter RU, earth. The first time the rotary magnet D is operated, the wipers 13, 14 and 15 of the call seeker are moved on one step, furthermore at contact 16 d is connected up the impulse repeating relay J as follows: earth, contacts 8 p, 17 t, 16 d, relay J, battery, earth. The relay J at contact 20 j opens the bridge over the contact 18 p between the leads a and b of the junction line VL 1 and thereby causes the momentary de-energization of the bridging relay (not shown) at the direction selector RW 1 in the exchange HA 26, so that the direction selector is moved on one step. When the interrupter RU opens the circuit of the magnet D. the latter falls back and opens the circuit of the relay J, which closes its contact 20 j and so establishes the bridge across the leads a and b of the junction line VL 1 again. The next impulse from the interrupter RU again operates the magnet D, which moves on the wipers 13—15 of the call seeker WS one step and energizes the relay J, which sends another impulse of current over the junction line VL 1. After the impulses have been transmitted for positioning the direction selector RW 1 onto the main traffic direction, that is to say onto a contact group, in which is reached the direction selector RW 2 that is connected to the junction lines VL 2 (see Fig. 1), auxiliary switching means belonging to the call seeker WS come into action and for a certain length of time prevent the transmission of further impulses. In the present case the main traffic direction is reached over the second level of the direction selector RW 1, hence the wiper 15 reaches the first earthed contact 23 at the end of the second step. Thereby the relay T is energized, it opens the contact 17 t in the circuit of the impulse repeating relay J and so prevents the latter being affected by the further energization of the rotary magnet D.

Owing to no further impulses being transmitted for the present, a switching over takes place at the direction selector RW 1 in known manner, thereby the magnet for the group positioning is disconnected and the magnet for the individual line selection is connected up in its place.

The number of contacts 23 at the call seeker WS and therefore the pause between the trains of impulses to be transmitted is such that an idle direction selector RW 2 can be selected in a reliable manner by the direction selector RW 1 and the direction selector RW 2 can be made ready to receive a train of number impulses before the wiper 15 leaves the last earthed contact 23. This having been done, the relay T falls back and prepares the circuit of the relay J, which is now energized the next time the rotary magnet D is operated and it transmits another impulse over the junction line VL 1. In this manner the direction selector RW 2 has been positioned onto the seventh level in order to reach a junction line VL 2, the means of access z 27 is connected to a contact of the call seeker, which

is located seven contacts beyond the last of the earthed contacts 23.

When the wipers 13—15 reach the means of access *z* 27 taken into use by the final selector LW, the following circuit is established for the test relay P 1: earth, battery, relay O at the final selector LW, wiper 24, contact and means of access *z* 27, contact 28 at the call seeker WS, wiper 13, contact 29 *p* 1, winding I of test relay P 1, earth. The test relay P 1 arrests the call seeker WS by opening the contact 11 *p* 1 and locks itself in a circuit prepared at the contact 31 *c* 2 and extending over the contact 30 *p* 1 and the winding II of P 1. The relay P 1 also opens its contacts 21 *p* 1 and 29 *p* 1 and closes its contact 32 *p* 1. Thereby it has disconnected itself from the wiper 13 and has opened the bridge across the leads *a* and *b* of the junction line VL 1 and furthermore it has switched through the upper speaking lead.

The energizing of the relay O in the above described circuit effects circuit changes at the final selector, which cause the realy O to be disconnected from the upper speaking lead.

The subscriber T*n* 1 now receives feeding current from the test relay at the group selector GW 27 in the exchange HA 27. By operating his number dial, he positions the switches located in the exchange HA 27 onto the wanted subscriber's line.

At the end of the call the positioned switches are released when the subscribers hang up their receivers. In the present example it has been assumed that the feeding bridge for the calling station is in the called exchange HA 27, hence the release is affected by interrupting the current flowing over the lead 7 of the junction line VL 1. The relay P therefore falls back and in any desired manner, which is of no particular interest here, causes an interruption of the circuit over the relay C 2 and the testing devices of the final selector, thereby the switch in the preselecting stage is also brought into the normal position. However, on falling back, the relay P also closes the contact 12 *p* and so establishes the circuit of the relay S: earth, contact segment 36, wiper 37, relay S, contact 12 *p*, battery, earth. The relay S at its contact 38 *s* closes the circuit of the driving magnet D and at contact 39 *s* it connects up the relay T. The call seeker is moved into its normal position, but the relay J cannot transmit impulses over the junction line VL 1, because the contact 17 *t* was opened when the relay T was energized. The wiper 37 leaves the contact segment 36 when the call seeker reaches its normal position. The relay S falls back and opens the circuit of the rotary magnet D.

It will now be assumed that the lines VL 2 accessible over the direction selectors RW 2 be engaged, so that it is necessary to divert the call over the exchange HA 25. Also it will be assumed that there are five junction lines outgoing to the exchange HA 27. These five junction lines VL 2 can be reached over the first contacts of the seventh level of the direction selector RW 2. To the other contacts in this level of the direction selector RW 2 are connected the means of access *z* 271 to the junction lines VL 3, while the means of access *z* 251 to the same junction lines can be reached over the fifth level of the same direction selectors RW 2.

When the direction selector RW 2 takes into use an idle means of access, for example the shown means of access *z* 271 *a*, *z* 271 *b*, *z* 271 *c* to a junction line VL 3, then the relay C 3 is operated over the test wiper 33;—pole of the battery, wiper 33, means of access *z* 271 *c*, relay C 3, contact 34 *c* 4,—pole of the battery, earth. The relay C 3 opens the contact 35 *c* 3 and so marks the means of access *z* 251 *c* to the seized junction line VL 3 engaged. The opening of the contact 40 *c* 3 disconnects the relay S 1, while at contact 41 *c* 3 is closed the circuit of the driving magnet D 2: earth, contact 42 *t* 1, contact 41 *c* 3, rotary magnet D 2, interrupter RU 2, battery, earth. The impulse sender WS 1 takes one step, and at the same time the impulse repeating relay J 1 is connected up at the contact 43 *d* 2: earth, contacts 44 *h*, 45 *s* 1, 43 *d* 2, relay J 1, battery, earth. The relay J 1 opens the contact 46 *j* 1 located in the upper speaking lead and so interrupts the feeding circuit for the calling station, which was closed after switching through to the direction selector RW 3 in the exchange HA 25. This interruption causes the bridging relay (not shown) in the direction selector RW 3 to fall back and repeat one impulse to the driving magnet. Simultaneously with the moving on of the impulse sender WS 1, impulses are transmitted until the wiper 47 reaches the first of the earthed contacts 48, whereupon the relay H is operated and by opening the contact 44 *h* it prevents the further transmission of impulses. The relay H falls back when the wiper 47 leaves the last earthed contact 48 after it has taken several steps, the number of such steps being so chosen that sufficient time elapses between two trains of impulses for the direction selector RW 4 to be found in the exchange HA 25 and to be made ready to receive a train of current impulses. The relay H closes the contact 44 *h*, and during the further moving on of the impulse sender WS 1 the relay J 1 repeats impulses over the junction line VL 3 to the exchange HA 25. At the impulse sender WS 1 the relay T 1 is connected up after 7 switching steps have been taken after the last earthed contact 48 was left and when the contact 49 is reached. Relay T 1 arrests the impulse sender. The subscriber now completes the connection by

positioning the switches in the exchange HA 27.

It will now be assumed that the subscriber Tn 1 in the exchange UA wishes to set up a connection with a subscriber of the exchange HA 26. The final selector LW 1 in the exchange UA is positioned on the means of access z 26. While being positioned on this means of access, the relay C 1 is operated and by closing the contacts 60 c 1 and 61 c 1 it connects the means of access z 26 directly to the junction line VL 1 or, as in the present example it is assumed that there are mixing switches, to the wipers of the mixing switch MW. Consequently the means of access z 26 is not connected to the call seeker WS; it is brought into connection with the outgoing junction line while the entire impulse sending device is circumvented. The relay C 1 also opens the contact 10 c 1.

As the impulse sending device is not operated, the direction selectors located in the exchange HA 26 are not automatically positioned, but they are selectively positioned (by the subscriber transmitting number impulses) onto the contact group that happens to be wanted, and when the direction selector RW 2 operates also as a final selector, as in the present example, it is positioned onto the individual line contact.

What is claimed is:

1. In a telephone system, a first exchange, a second exchange, an impulse sender in said first exchange, automatic switches in said second exchange, a trunk line connecting said exchanges, means in said first exchange for seizing said trunk line over any one of a plurality of paths, and switching means in said first exchange automatically operated only in case the path over which said trunk line is seized designates said second exchange as an intermediate exchange for automatically operating said impulse sender to automatically position said switches in said second exchange.

2. In a telephone system, an exchange, a trunk line extending to said exchange and terminating in a first automatic switch, a second automatic switch accessible to said first switch, said second switch having access to subscriber's lines terminating in said exchange and having access to other trunk lines, a third automatic switch having a plurality of means of access to said first trunk line, subscriber controlled means for directively controlling said switches to extend a connection to a subscriber's line in said exchange, automatic means for automatically controlling said first and second switches to select an idle one of said other trunk lines, and means dependent upon the means of access over which said third switch seizes said first trunk line for determining whether said subscriber controlled means or said automatic means operate said first and second switches to extend a connection.

3. In a telephone system, a first exchange, a second exchange, a trunk line connecting said exchanges, automatic switches in said second exchange, means in said first exchange responsive to a call for seizing said trunk line over one means of access provided the called line terminates in said second exchange, means controlled by the calling subscriber for directively operating said switches in the second exchange to complete the desired connection, a third exchange, said first means responsive to a call for seizing said trunk line over another means of access providing the called line terminates in said third exchange, a trunk line connecting the second and third exchanges, an impulse sender in said first exchange, and switching means in said first exchange operated responsive to said last seizure for automatically operating said impulse sender to automatically position said switches to select said last mentioned trunk line.

4. In a telephone system, a first exchange, a second exchange, an impulse sender in said first exchange, automatic switches in said second exchange, a trunk line connecting said exchanges, means for seizing said trunk line over either one of two paths, one of said paths designating said second exchange as a terminating exchange and the other path designating said second exchange as an intermediate exchange, a finder switch in said first exchange associated with said other path, and means only responsive to the seizure of said other path for operating said finder and said impulse sender to automatically position said switches in said second exchange.

5. In a telephone system, a first exchange, a second exchange, an impulse sender in said first exchange, automatic switches in said second exchange, a trunk line connecting said exchanges, means for seizing said trunk line over either one of two paths, one of said paths designating said second exchange as a terminating exchange and the other path designating said second exchange as an intermediate exchange, a finder switch in said first exchange associated with said other path, means only responsive to the seizure of said other path for operating said finder to find said path, and means controlled by the operation of said finder for operating said impulse sender to send a predetermined number of impulses to operate said automatic switches.

6. In a telephone system, a first exchange, a second exchange, an impulse sender in said first exchange, automatic switches in said second exchange, a trunk line connecting said exchanges, means for seizing said trunk line over either one of two paths, one of said paths designating said second exchange as

a terminating exchange and the other path designating said second exchange as an intermediate exchange, means responsive to the seizure of said other path for operating said impulse sender to automatically send a predetermined number of impulses to operate said automatic switches, means responsive to the seizure of said first path for disconnecting said impulse sender, and subscriber controlled means for subsequently directively operating said automatic switches.

7. In a telephone system, a first exchange, a second exchange, an impulse sender in said first exchange, automatic switches in said second exchange, a trunk line connecting said exchanges, means for seizing said trunk line over either one of two paths, one of said paths designating said second exchange as a terminating exchange and the other path designating said second exchange as an intermediate exchange, a finder switch in said first exchange associated with said other path, means only responsive to the seizure of said other path for operating said finder to find said path, means controlled by the operation of said finder for operating said impulse sender to send a predetermined number of impulses to operate said automatic switches, and means responsive to the seizure of said first path for directly connecting said first path with said trunk line and for circumventing said finder switch.

8. In a telephone system, a first exchange, a second exchange, an impulse sender in said first exchange, automatic switches in said second exchange, a trunk line connecting said exchanges, means for seizing said trunk line over either one of two paths, one of said paths designating said second exchange as a terminating exchange and the other path designating said second exchange as an intermediate exchange, a finder switch in said first exchange associated with said other path, means only responsive to the seizure of said other path for operating said finder to find said path, means controlled by the operation of said finder for operating said impulse sender to send a predetermined number of impulses to operate said automatic switches, the number of impulses sent by said impulse sender to the first of said automatic switches being determined by a switching device associated with said finder, and the number of impulses sent by said sender to the second of said switches being determined by the path over which said trunk line is seized.

9. In a telephone exchange system, a first, a second, a third, and a fourth exchange, a first group of trunks connecting the second and third exchanges, a second group of trunks connecting said second and fourth exchanges, a third group of trunks connecting said fourth and third exchanges, automatic switches in said exchanges, means responsive to a call from said first exchange to a called subscriber's line terminating in the third exchange for automatically operating the automatic switches in the second exchange to seize an idle trunk in said first group of trunks and in case all the trunks in said first group are unavailable for seizing an idle trunk in the second group of trunks, and an impulse sender in the second exchange taken into use only when an idle trunk in the said second trunk group is taken into use instead of a trunk in said first group for transmitting a plurality of series of impulses over the seized trunk in the said second group to automatically operate the switches in the fourth exchange to seize an idle trunk of said third trunk group extending to the third exchange.

10. In a telephone system, a first exchange, a second exchange, a trunk line connecting said exchanges, means in the first exchange for seizing said trunk line over any one of a plurality of paths, an impulse sender in the first exchange, and means responsive only in case a particular one of said paths is taken into use for seizing and automatically operating said impulse sender to transmit a plurality of series of impulses over said trunk line, each of said series comprising more than one impulse.

11. In a telephone system, a first exchange, a second exchange, a third exchange, a first trunk line connecting the first and second exchanges and a second trunk line connecting the second and third exchanges, means in said first exchange for seizing said first trunk line, automatic switches in the second exchange, means controlled by the calling subscriber for directly operating said switches to complete a desired connection to a called subscriber's line terminating in the second exchange, an impulse sender in the first exchange, means only responsive to a call in said first exchange for a subscriber's line terminating in the third exchange for seizing said sender and for causing said sender to operate said switches to seize said trunk line, and automatic switches in the third exchange directly controlled by the calling subscriber in the first exchange for completing the connection to the called line in the third exchange.

12. In a telephone system, a first exchange, a tandem exchange, a third exchange, automatic switches in the tandem exchange directly controlled by a calling subscriber in the first exchange in case such subscriber is calling a subscriber's line terminating in the tandem exchange, an impulse sender in the first exchange, and means for operating said sender in case the calling subscriber is calling a subscriber's line terminating in the third exchange to control said switches to extend the connection to the third exchange.

13. In a telephone system, a first exchange, a tandem exchange, a third exchange, automatic switches in said exchanges, the automatic switches in the first and tandem ex-

changes being directly controlled by a calling subscriber in the first exchange in case a subscriber's line terminating in the tandem exchange is called, the automatic switches in the first and third exchanges being directly controlled by the calling subscriber in case a subscriber's line terminating in the third exchange is called, and an impulse sender in the first exchange for automatically operating the switches in the tandem exchange to complete the connection between the automatic switches in the first and third exchanges when the called line is in the third exchange.

14. In a telephone system, a first exchange, a tandem exchange, a third exchange, automatic switches in said exchanges, a calling device at the station on a calling subscriber's line in the first exchange for directively operating the switches in the first and tandem exchanges to complete a connection to a called subscriber's line terminating in the tandem exchange, and for directively operating the switches in the first and third exchanges in case a subscriber's line terminating in the third exchange is called, and an impulse sender in the first exchange for automatically operating the automatic switches in the tandem exchange when a subscriber's line in the third exchange is called.

15. In a telephone system, three automatic exchanges, means for setting up a connection by operating switches in all three exchanges, a subscriber's calling device for controlling the switches in the first and third exchanges, and an impulse sender in the first exchange for controlling the switches in the second exchange.

16. In a telephone system, a train of directive switches for connecting a calling and a called line, means whereby the calling subscriber directly controls the first and last switches in said train, and an automatic impulse sender for controlling an intermediate switch in said train.

17. In a telephone system, three serially related exchanges, automatic switching apparatus in the second exchange operable under direct control of a calling subscriber on calls from the first exchange to the second exchange, and a sender at the first exchange for automatically operating said switching apparatus on calls from the first exchange to the third exchange.

18. In a telephone system, three serially related exchanges, automatic switching apparatus in the first and third exchanges operable only under the direct control of a calling subscriber, automatic switching apparatus in the second exchange operable under the direct control of a calling subscriber on calls from the first to the second exchange, and a sender at the first exchange for automatically operating said switching apparatus at the second exchange on calls from the first exchange to the third exchange.

19. In a telephone system, a trunk, two sets of terminals associated with said trunk, a switching device, means for extending a connection to either of said terminal sets via said device, a finder switch associated with said trunk, means responsive to the extension of a connection to one of said terminal sets for operating said finder to further extend the connection to said trunk, and means responsive to the extension of a connection to the other of said terminal sets for further extending the connection to said trunk independent of said finder.

20. In a telephone system, a trunk having two normally disconnected branches, means for seizing either branch via a directively operable switching device, means responsive to the seizure of one of said branches for directly connecting said one branch and said trunk, a finder switch, and means responsive to the seizure of the other of said branches for connecting said other branch and said trunk through said finder switch.

21. In a telephone system, a trunk having two normally disconnected branches, means responsive to the seizure of one of said branches for directly connecting said one branch and said trunk, a finder switch, means responsive to the seizure of the other of said branches for connecting said other branch and said trunk through said finder switch, and a device for automatically transmitting impulses over said trunk controlled by said finder switch.

22. In a telephone system, a trunk, a finder switch terminating said trunk, lines accessible to said switch, means responsive to a call on one of said lines for operating said switch to hunt for and connect the trunk with the said line, and a device for automatically transmitting impulses over said trunk during the hunting operation of said switch.

23. In a telephone system, four exchanges, a trunk route connecting the first and second exchanges via the third exchange, an alternate trunk route connecting the first and second exchanges via the third and fourth exchanges, and means in the third exchange for rendering said alternate trunk route effective.

24. In a telephone system, four exchanges, trunk lines connecting said exchanges, means normally effective for automatically extending a connection from the first exchange to the second exchange via the third exchange in tandem, and means for automatically extending a connection from the first exchange to the second exchange via the third and fourth exchanges in tandem whenever all trunks between the third exchange and the second exchange are busy.

25. In a telephone system, four exchanges, trunk lines connecting said exchanges, means including a trunk line for extending a call from the first exchange to the second exchange, means including another trunk line

for automatically extending the call from the second exchange directly to the third exchange, and means including other trunk lines used alternatively with last said means for automatically extending the call from the second exchange to the third exchange via a fourth exchange when all trunk lines between the third and second exchanges are busy.

26. In a telephone system, a first and a second exchange, a first and a second tandem exchange, two routes by which calls may be extended from the first to the second exchange, one of said routes including said first tandem exchange, the other of said routes including both of said tandem exchanges, and automatic means in the first tandem exchange for determining the route to be used for a call.

27. In a telephone system, a first and a second exchange, a first and a second tandem exchange, a normally effective trunk route including said first tandem exchange for extending calls from said first to said second exchange, and means in said first tandem exchange for including said second tandem exchange in the trunk route under certain abnormal conditions.

28. In a telephone system, a first and a second exchange, two routes by which connections may be extended from the first exchange to the second exchange, one route being by way of a third exchange, and the other route being by way of said third exchange and a fourth exchange, and means in the third exchange for determining the particular route to be used.

29. In a telephone system, a first and a second exchange, two routes each including the same tandem exchange by which connections may be extended from the first exchange to the second exchange, one route being by way of a direct trunk between the tandem exchange and the second exchange, the other route being by way of a second tandem exchange, means normally effective for causing such connections to be extended over the first of said routes, and means effective in case no direct trunk between the tandem exchange and the second exchange is available for automatically causing such connections to be extended over the other of said routes.

In witness whereof, I hereunto subscribe my name this 15th day of July, A. D. 1927.

WILLY MÜNCHENHAGEN.