Aug. 26, 1941. F. BEERMAN ET AL 2,253,998

TELEPHONE SYSTEM

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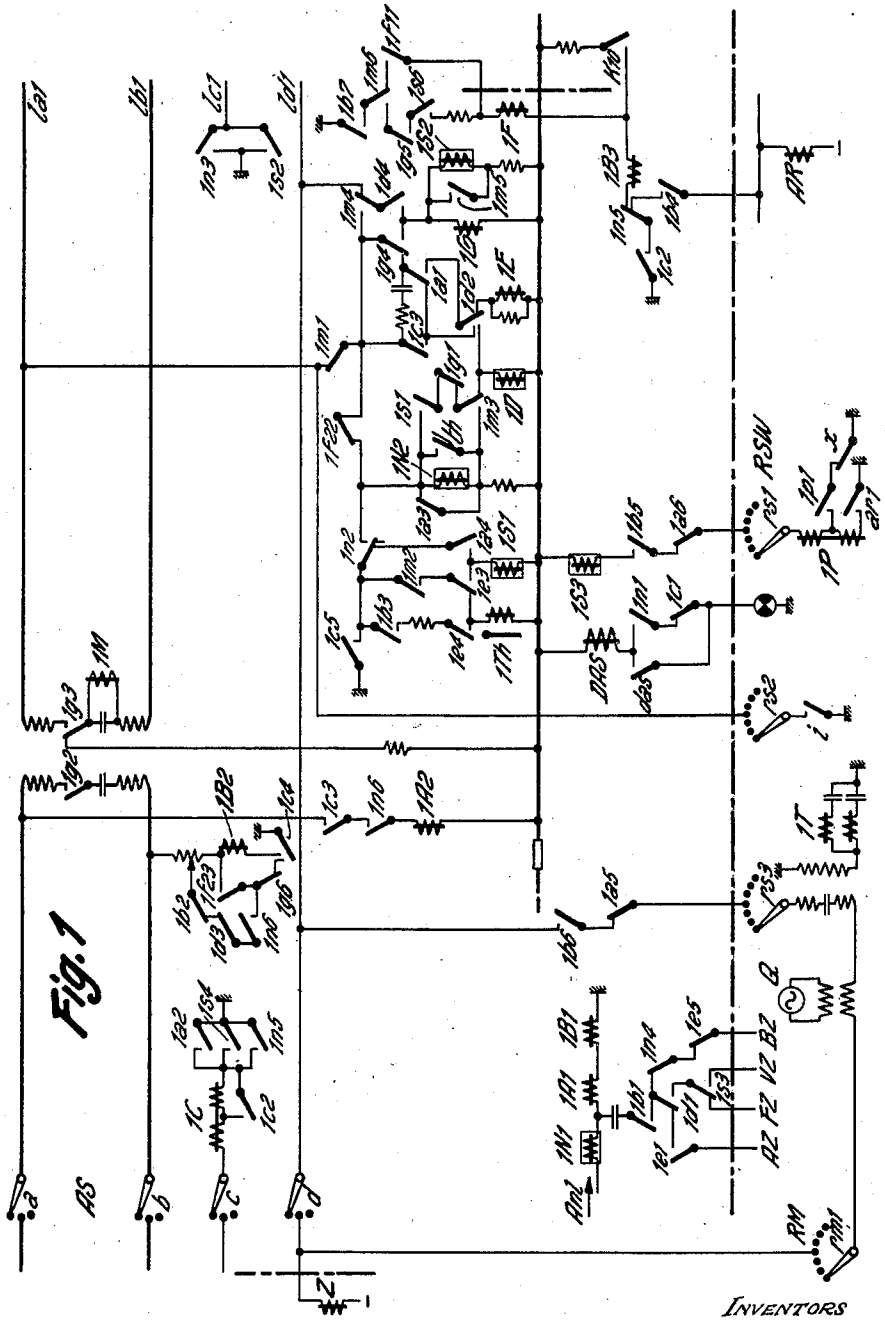


Fig. 1

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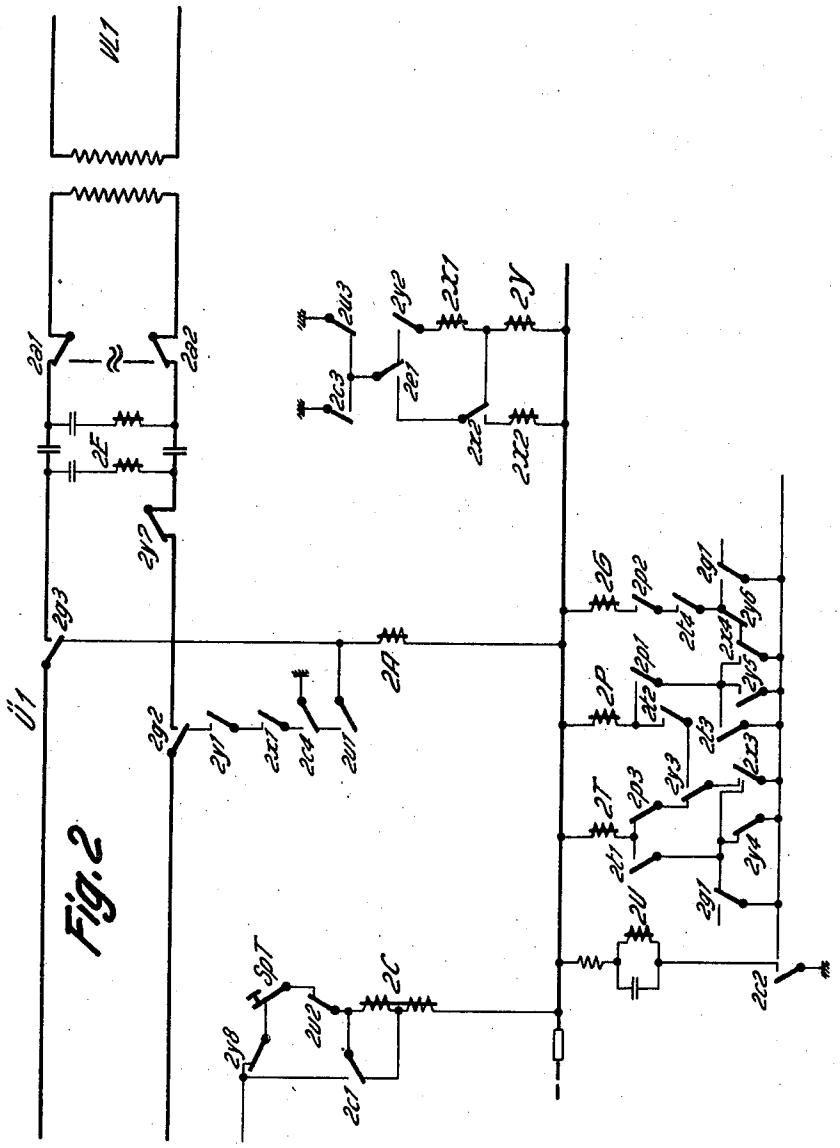


Fig. 2

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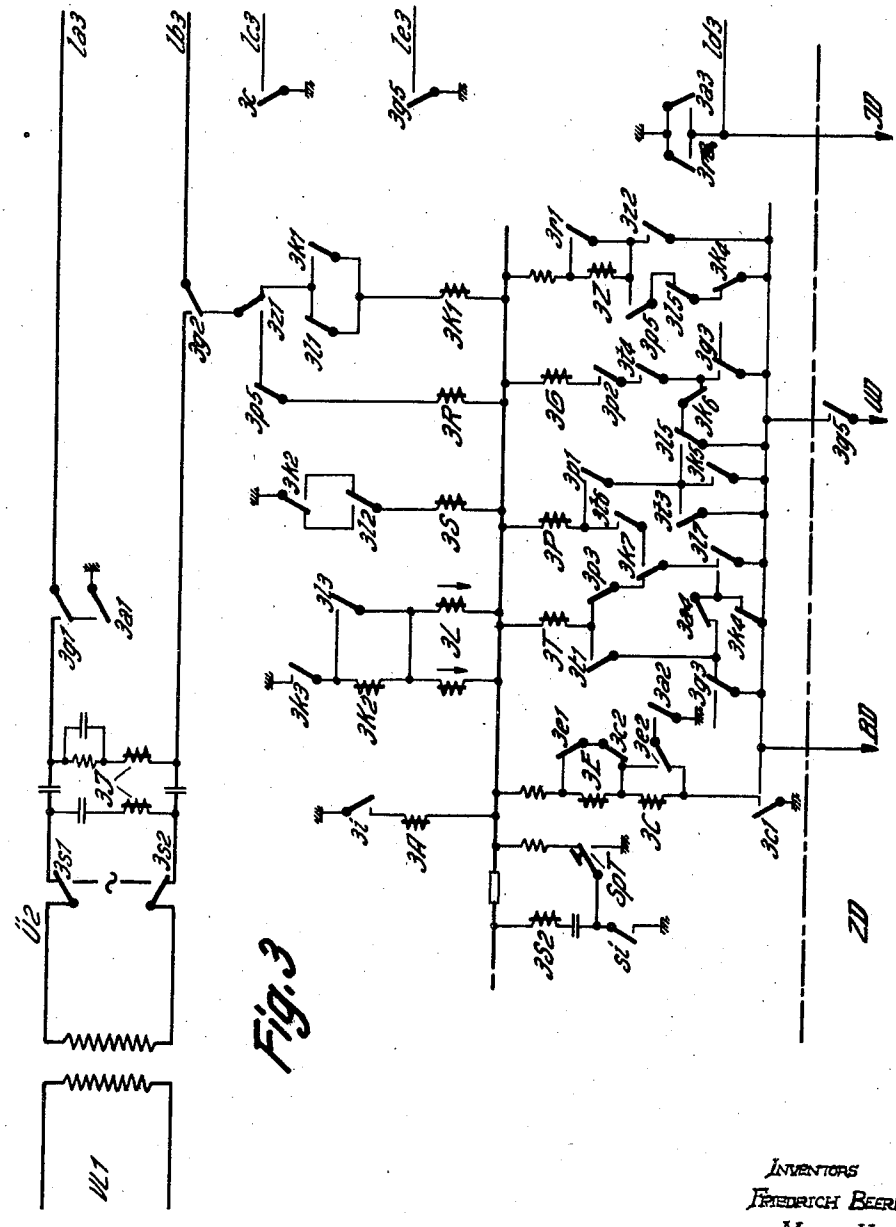


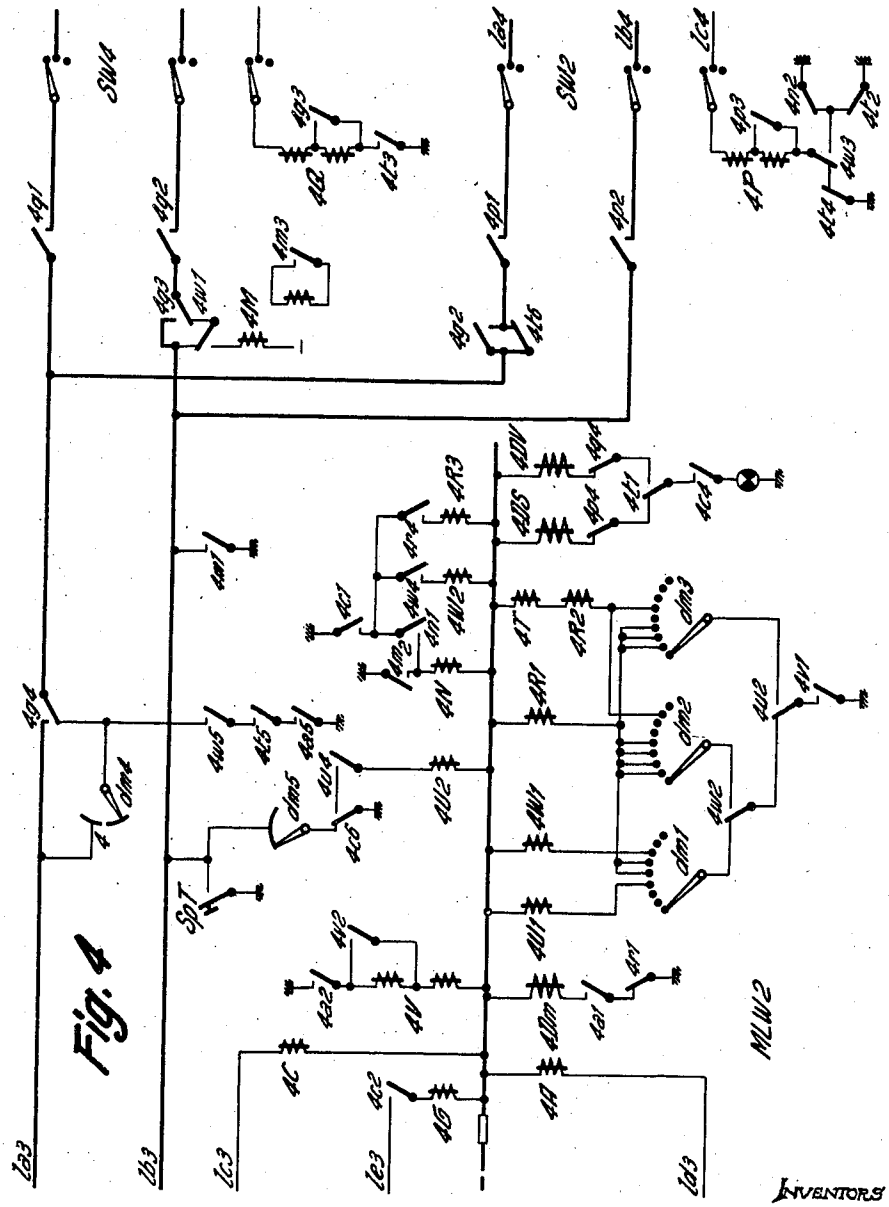
Fig. 3

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TELEPHONE SYSTEM

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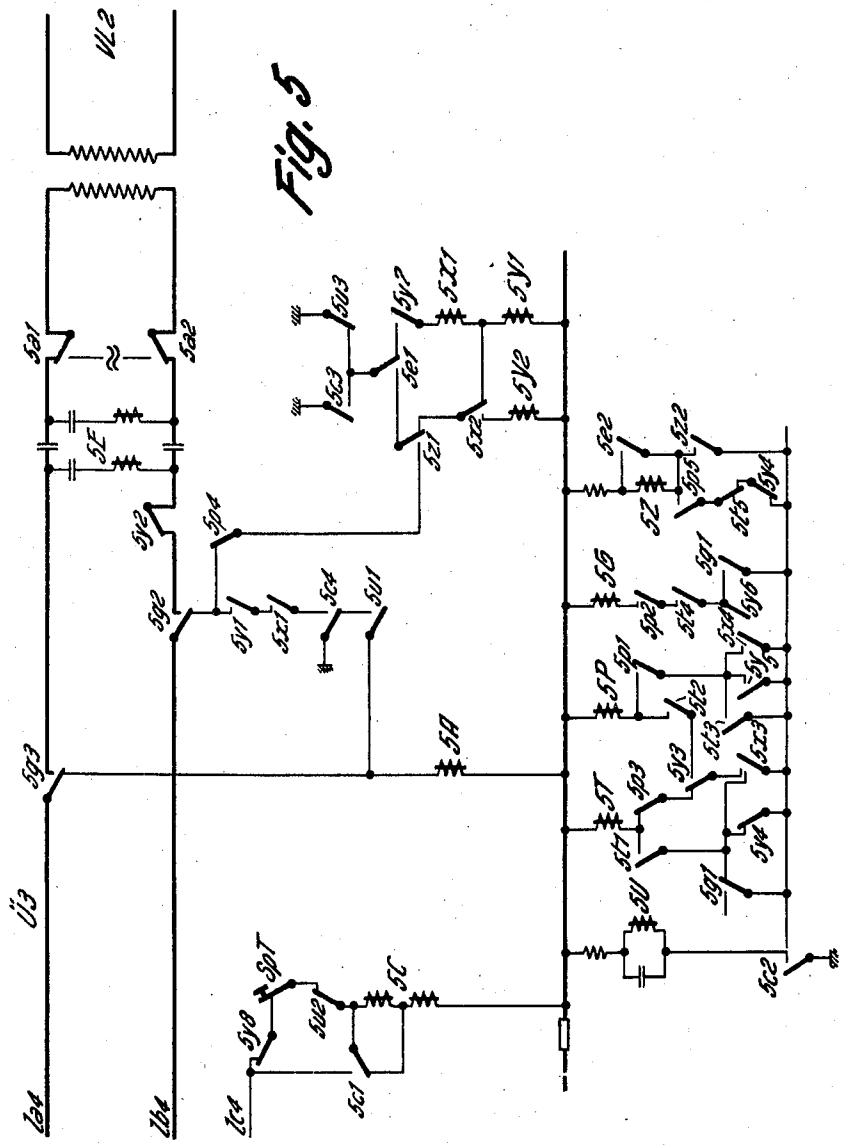

SW4
SW2
4g1
4g2
4g3
4m3
4M
4W1
4D
4L3
4g1
4g2
4g3
4L2
4W3
4L4
4P
4W2
4L1
4C1
4W4
4W5
4R5
4R6
4W6
4C6
4m4
4m5
4m6
4SP
4C2
4A2
4W
4C
4A
4R3
4R5
4W
4L1
4C4
4T
4R2
4R1
4W1
4m3
4m2
4m1
4W2
4W2
4W2
4W2
4C1
4W1
4M2
4N
4W2
4W2
4W2
4W2

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Fig. 5



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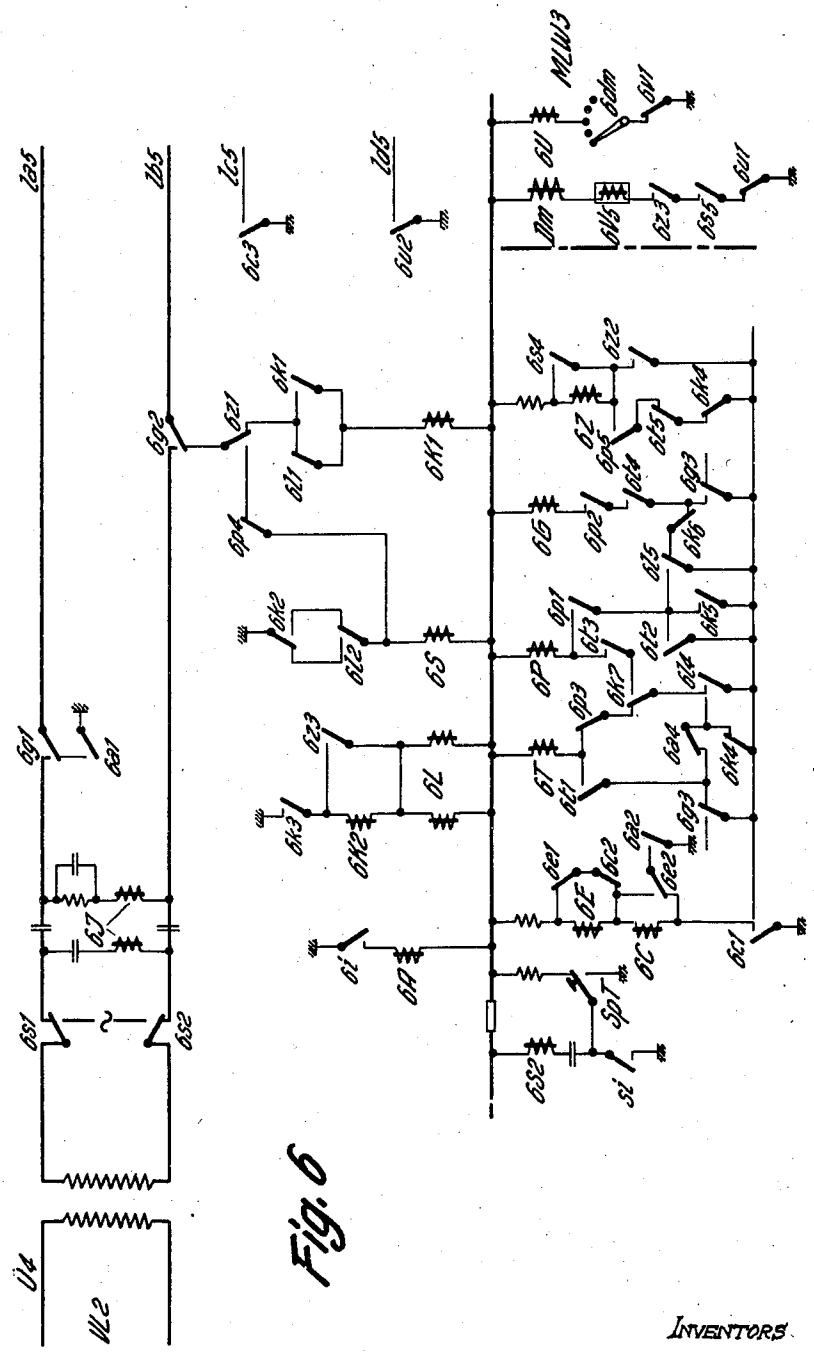


Fig. 6

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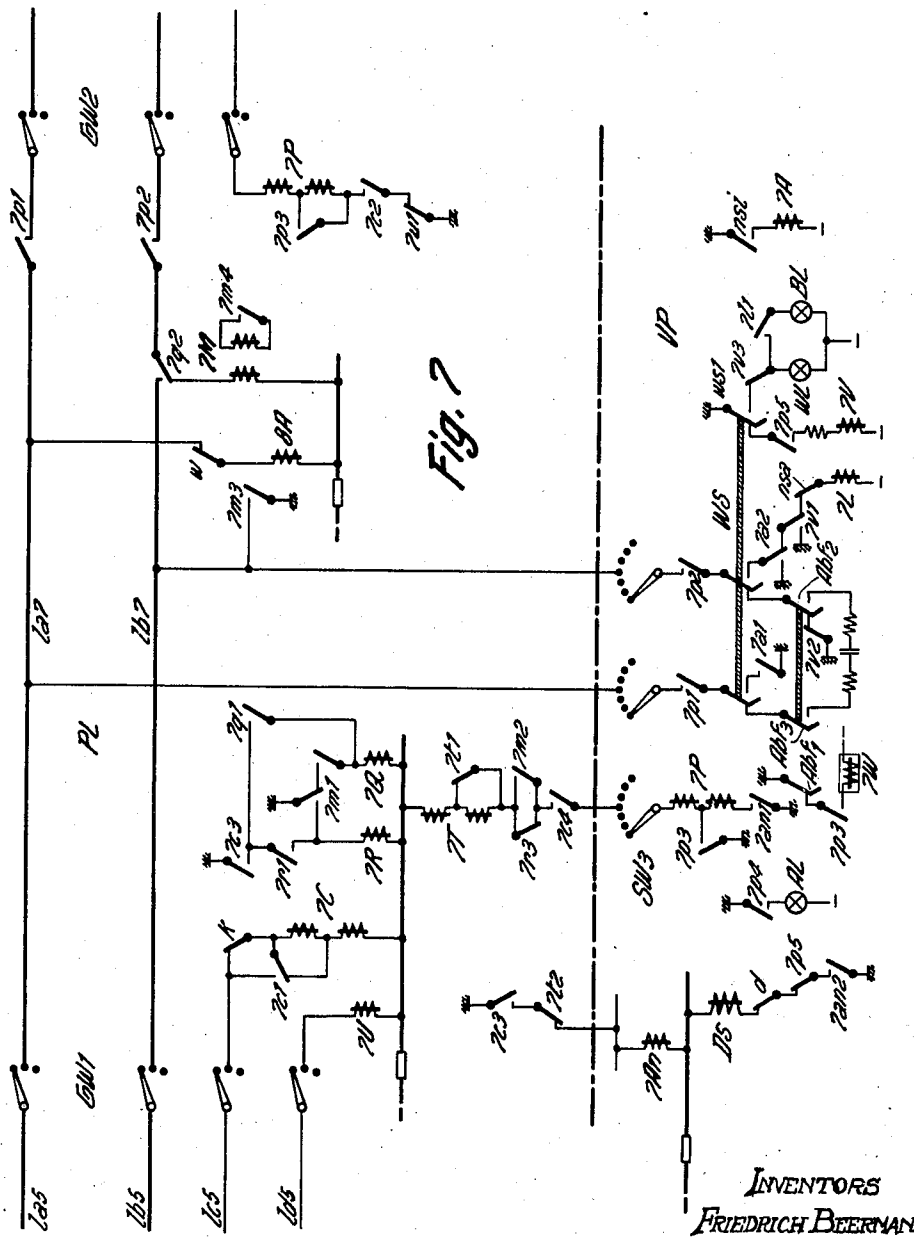


Fig. 7

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TELEPHONE SYSTEM

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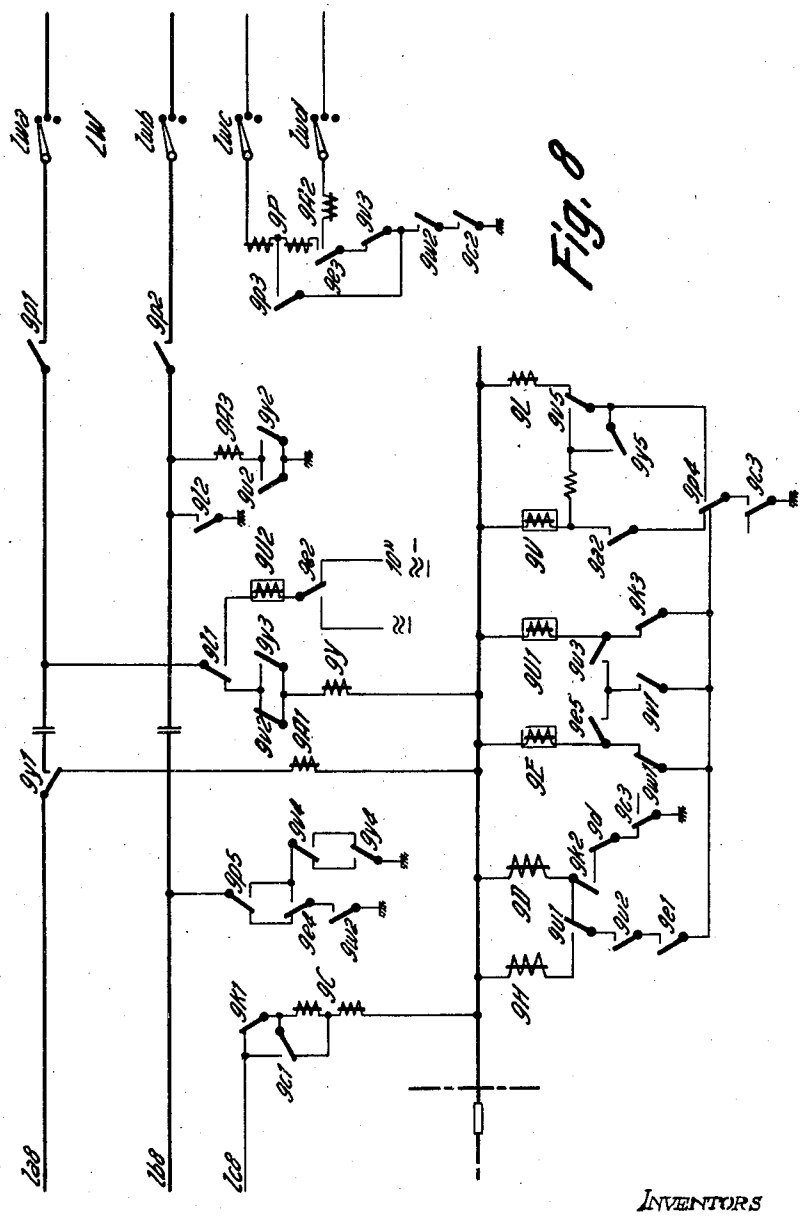


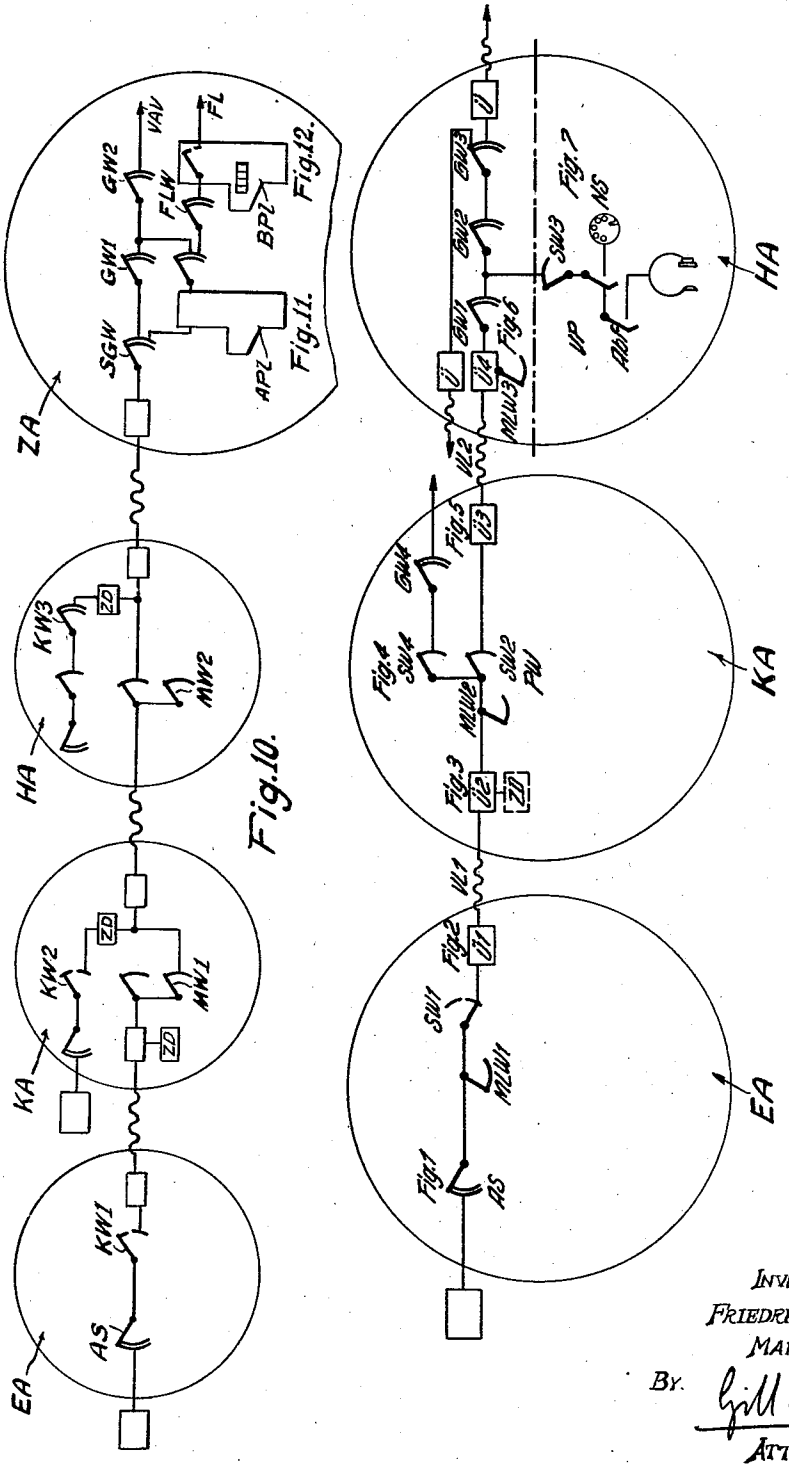
Fig. 8

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Filed April 20, 1939 11 Sheets-Sheet 9



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TELEPHONE SYSTEM

Filed April 20, 1939 11 Sheets-Sheet 10

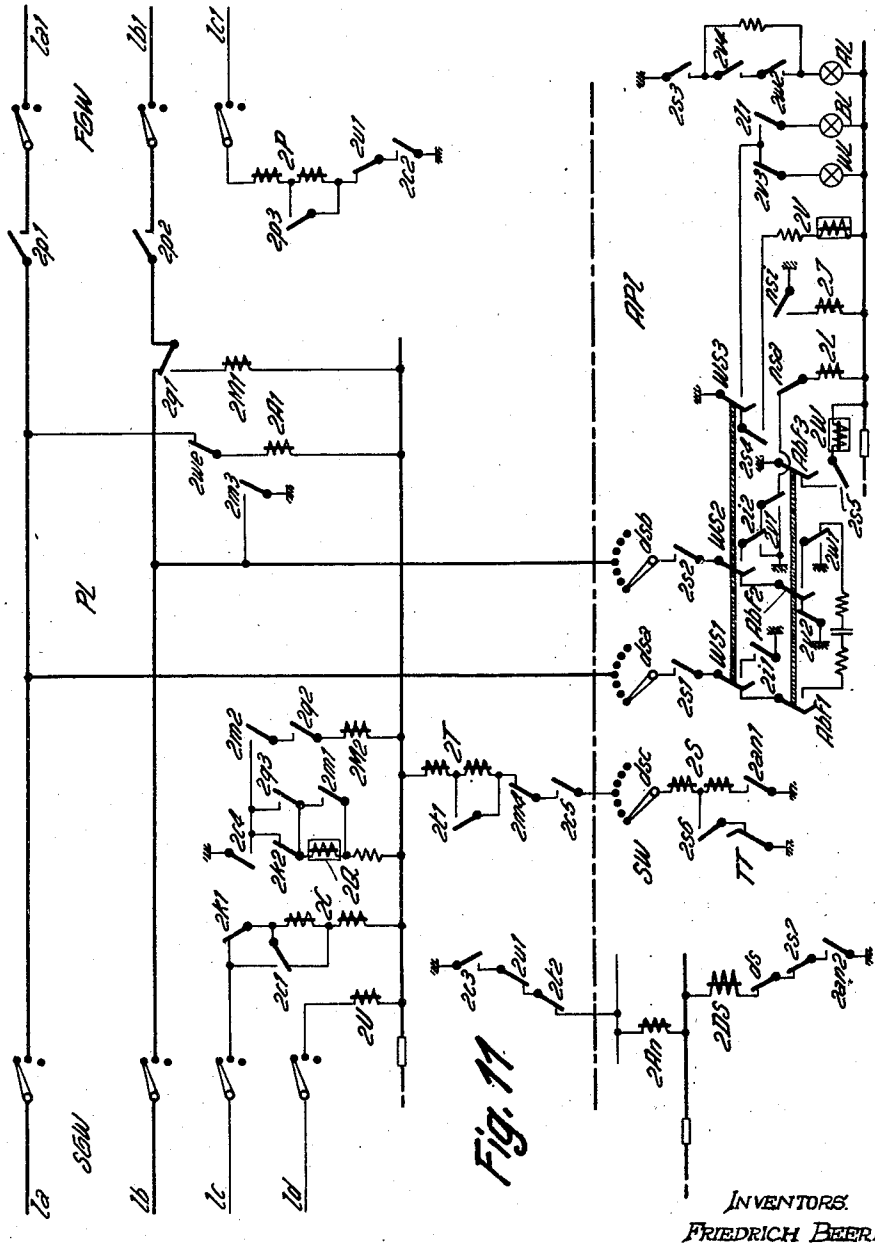


Fig. 11.

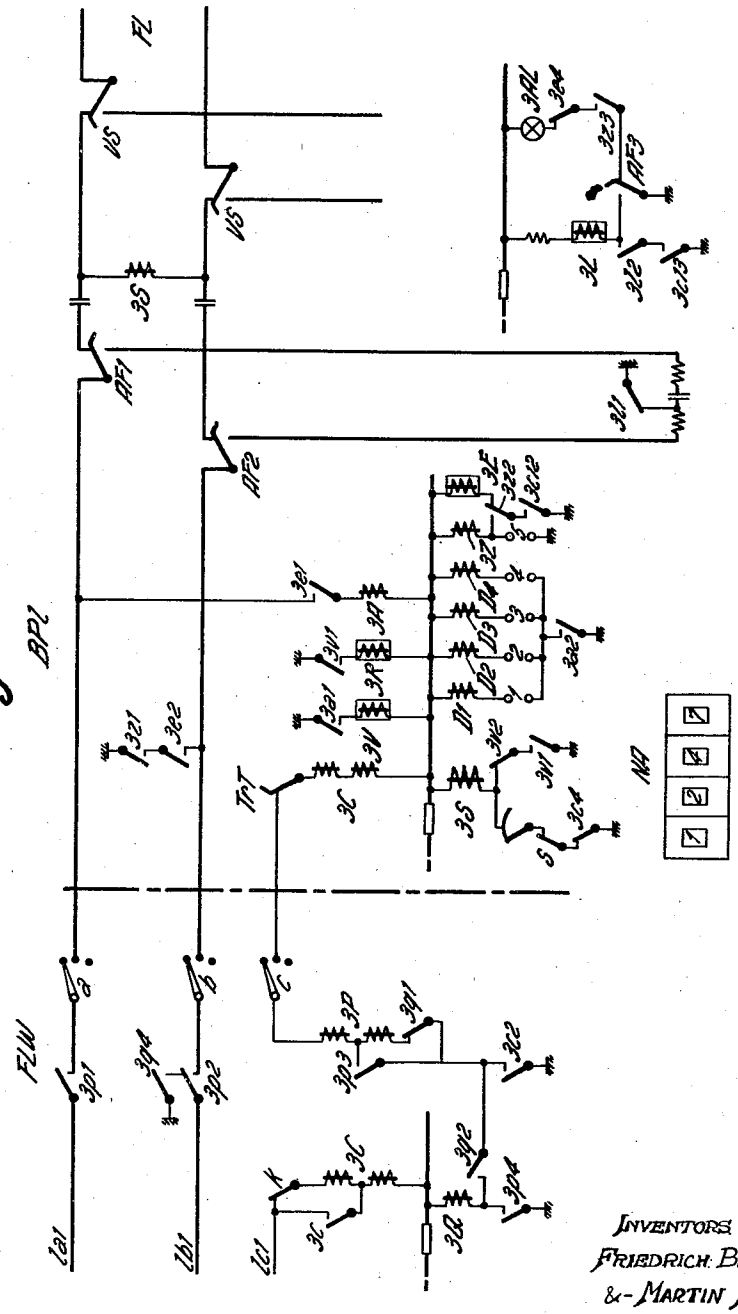
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TELEPHONE SYSTEM

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Fig. 12



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Patented Aug. 26, 1941 2,253,998

UNITED STATES PATENT OFFICE

2,253,998

TELEPHONE SYSTEM

Friedrich Beermann, Munich, and Martin Hebel, Oberbayern, Germany

Application April 20, 1939, Serial No. 268,930
In Germany April 23, 1938

20 Claims. (Cl. 179—7.1)

This invention relates to automatic telephone systems.

In such systems connections are generally made directly by the calling subscriber who causes impulses to be transmitted by actuation of his dial. The exchanges are generally provided with devices which automatically select the shortest route for any given connection. Also, the exchanges generally have devices for recording the essential particulars of all calls from which the charges to be made can be evaluated or with devices which evaluate the charges directly. The above-mentioned devices are actuated by impulses which are sent out when the calling subscriber dials and which are used to build up the wanted connection.

Where the system comprises a large number of exchanges, it is desirable that a calling subscriber should be able to make his call through an operator if he should so desire. In such cases, he can connect himself to the operator by dialling a particular digit or series of digits such as 00. As the impulses used in making the connection to the wanted subscriber are sent out not by the calling subscriber but by the operator, they cannot be used for actuating the devices mentioned above, for selecting the shortest route, evaluating the charge and so on if, as is usual, these devices are situated between the operator and the calling subscriber. The operator therefore has to do what is necessary herself.

The invention is concerned with the problem of reducing the amount of work to be done by the operator in these circumstances.

The systems with which the invention is concerned comprise a number of exchanges which are arranged so as to enable a subscriber to make a connection fully automatically or semi-automatically through an operator. When a connection is made through the operator, impulses sent out by the latter to extend the connection towards the wanted subscriber are also transmitted backwardly over the connection already made between the calling subscriber and the operator and, while being so transmitted, cause apparatus to be actuated as it would have been actuated by the impulses transmitted forwardly had the connection been fully automatically made by the subscriber himself without the help of the operator.

This considerably simplifies the operator's work and therefore, allows her to deal with a greater number of calls in a given time.

The invention can be applied to systems in which a connection is made with the help of more than one operator, for example where an operator who has received the calling subscriber's instructions passes these on to an operator at a more distant exchange who then dials the wanted number. In that case, the impulses which are sent out by the first operator in order to extend the connection to the second operator are also transmitted backwardly towards the calling subscriber. These can be used to identify the exchange at which the second operator is situated. The first operator can then transmit to the second operator impulses which are also transmitted backwardly towards the calling subscriber so that the various particulars of the connection recorded some at the second operator's exchange and some between the first operator's exchange and the calling subscriber can be co-related. This considerably simplifies the charging of long distance calls.

An example of the construction and operation of a system in accordance with the invention will now be described with reference to the accompanying drawings in which—

Figure 1 shows the essential circuits of a finder in a terminal exchange in a system illustrated diagrammatically in Figure 9.

Figure 2 shows the essential circuits of a repeater in a terminal exchange at the outgoing end of a line.

Figure 3 shows the essential circuits of a repeater in a subsidiary group exchange at the incoming end of the line.

Figure 4 shows the essential circuits of the selectors in the subsidiary group exchange.

Figure 5 shows the essential circuits of the repeater in the subsidiary group exchange at the outgoing end of a line.

Figure 6 shows the essential circuits of a repeater of a main group exchange at the incoming end of a line.

Figure 7 shows the essential circuits of an operator's position at the main group exchange and

Figure 8 shows the essential circuits of a final selector.

Figure 10 illustrates diagrammatically how the system illustrated in Figure 9 can be adapted to make it suitable for long distance calls.

Figure 11 shows the essential circuits of an operator's position in a central exchange of the system illustrated in Figure 10, and

Figure 12 shows the essential circuits of a long distance operator's position at the central exchange.

The system illustrated in Figure 9 comprises a main group exchange HA, to which are connect-

ed a number of subsidiary group exchanges such as that shown at KA. Each subsidiary group exchange has connected to it a number of terminal exchanges such as that shown at EA. When a subscriber of the terminal exchange EA removes his receiver he is automatically connected by a finder AS to an impulse responding switch MLW1. If the subscriber wishes to make a connection outside his own exchange he has to dial 0. The 10 impulses thus sent out act on the switch MLW1 which on receipt of the fifth impulse causes a hunting switch SW1 to seize a free line VL1. The 7th, 8th, 9th and 10th impulses are then transmitted over a wiper of the switch MLW1 to the repeater Ü1 and thence to the line VL1. These impulses are received in the subsidiary group exchange KA by the repeater Ü2 and are transmitted to an impulse responding switch MLW2, which, on receipt of the first impulse (the 7th of the train) causes a hunting switch SW2 to seize a free line VL2. The fourth impulse (the 10th of the train) is transmitted over a wiper of the switch MLW2 to the repeater Ü3 and thence to the line VL2. The repeater Ü4 in the main group exchange HA is thus seized.

The calling subscriber then dials the number of the wanted exchange. Further impulse trains are thus transmitted over the lines VL1 and VL2. Of these trains, the first acts on the switches MLW1 and 2 and sets the group selector GW1 in the exchange HA; the second and subsequent trains set other group selectors (not shown).

If the subscriber has dialled the number of the exchange KA through which runs the connection which has been made to the main group exchange HA, the switch MLW2 seizes a hunting switch SW4 which seizes a free group selector GW4 in the exchange KA. The line VL2 and the connecting apparatus at the exchange HA are then released.

The repeater Ü2 at the exchange KA has associated with it a device ZD for recording details of the calls from which the charge to be made can be evaluated. All impulses sent out by the calling subscriber act on this device ZD.

The main exchange HA includes an operator's position VP. If the subscriber wishes to make a connection through the operator he first dials 0 as explained above and then dials 0 again. The group selector GW1 is thus set on a line PL (Figure 7) leading to the operator's position VP and to which a second group selector GW2 is connected. The operator is then connected to the calling line by a switch SW3 and can take the calling subscriber's instructions.

The impulses sent out by the operator are transmitted over a wire of the speech line to the group selector GW2 which extends the connection to a group selector GW3 in the desired direction. The impulses are transmitted backwards at the same time over another wire of the speech as far as the finder AS in the calling subscriber's exchange EA. These impulses act on a switch MLW3 in the repeater Ü4, on the switch MLW2 in the subsidiary group exchange KA and on the recorder ZD. If the connection is to be extended backwards from the exchange HA, the impulses sent out when the operator dials the number of the wanted exchange cause the switch MLW3 to disconnect the group selectors GW2 and GW3. Also, the switch MLW2 causes the hunting switch SW4 to seize a free group selector GW4. The further impulses sent out by the operator are received by this group selector GW4 which makes the connection to the wanted subscriber by means of further selectors which are not illustrated. The impulses which are transmitted backwards to the finder AS are used to actuate the apparatus serving for the evaluation of the charge and also the switches which serve to ensure that the connection is made over the shortest route.

The circuits are the same whether the operation is semi-automatic working, i. e. the calls are made through an operator, or fully automatic. The construction and operation of a system in accordance with the invention will now be described in detail. If the operation is fully automatic, the calling subscriber sends out all impulse trains for effecting the connection and after the last impulse train has been sent out from the final selector, a backward signal is sent which indicates whether the wanted subscriber is free or engaged and causes an appropriate signal to be sent to the calling subscriber from the finder in his exchange. When the wanted subscriber removes his receiver, a second backward signal is sent out by the final selector by means of which the speech circuits are closed in the repeaters. Also, the device which records particulars of the call is acted upon for the duration of the connection. When the wanted subscriber replaces his receiver, a third backward signal is sent from the final selector. This signal opens the speech circuits. A transmitting device in the finder transmits impulses corresponding to the number of the calling subscriber to the recorder and the connection is then released.

If the operation is semi-automatic, the calling subscriber first connects himself to a free operator's position whereupon a backward signal is transmitted to him. A second backward signal is transmitted to the calling subscriber when the operator removes his receiver. This signal closes the speech circuits in the repeaters. Before the operator dials the wanted number, she causes a third backward signal to be transmitted. This signal is different from that which, in fully automatic operation, indicates that the called subscriber has replaced his receiver. It only causes the speech circuit to be opened and prepares the connection between the operator and the calling subscriber for the transmission over it of the impulses now to be dialed. When the connection to the wanted subscriber is finally made, the three backward signals are repeated in succession by the final selector. The signal which indicates replacement of the called subscriber's receiver, as in the case of fully automatic operation, causes the number of the calling subscriber to be determined and the connection to be released.

It is not necessary that the number of the calling subscriber should be determined at the end of the conversation. It can be determined at any stage, for example, after transmission of the backward signal indicating that the called subscriber is free.

For the evaluation of the charge to be made, a device can be used which records all essential particulars of the connection, or else a time-zone metering device can be used which transmits a number of impulses to the calling subscriber's meter in accordance with the number of the wanted exchange and the duration of the conversation. In the latter case, it is not necessary to ascertain the number of the calling subscriber.

Where the operation is fully automatic, the procedure is as follows:

When a subscriber of the terminal exchange EA removes his receiver, the relays 1N1, 1A1, and

1B1 of a free finder AS (Figure 1) are energised over a wire A*n1*. This (in known manner) causes the wipers of the finder to be set on the calling subscriber's line so that the relay 1C responds and its contacts 1*c*3 and 1*c*4 connect the windings 1A2 and 1B2 to the speech line. The relay 1E is energised over the contacts 1*c*5, 1*n*2 and 1*a*1. The contacts 1*b*1 and 1*e*1 connect the source of alternating current AZ which transmits dialling tone to the calling subscriber. A circuit is closed through the line *lc*1 by means of the contact 1*n*3 so that the impulse responding switch MLW1 (Figure 9) which is not illustrated in detail is seized.

If the subscriber wishes to make a connection to a subscriber of another exchange, he first dials 0. This causes the relay 1A to be intermittently de-energised. The contact 1*a*1 transmits the current impulses to the line *la*1. At the first impulse, the relay 1B drops and the contact 1*b*2 short circuits the winding 1B2 so that the relay 1B cannot respond. The contact 1*b*1 disconnects the A. C. source AZ.

The impulses of the first train actuate the switch MLW1 (Figure 9). On receipt of the 5th impulse, this switch causes a free hunting switch SW1 to seize a free repeater Ü1 (Figures 2 and 9). In the repeater Ü1, the relay 2C is energised in known manner. On receipt of the 7th impulse, the switch MLW1 closes an impulse transmitting circuit through the repeater Ü1. The 7th and subsequent impulses are received by the relay 2A in the repeater Ü1. At each energisation of this relay, the contacts 2*a*1 2*a*2 send an A. C. impulse through the connecting line VL1.

In the repeater Ü2 (Figure 3), the A. C. impulses are received by a relay 3I which energises the relay 3A. The contact 3*a*1 transmits the impulses through the line *la*3. The first impulse energises the relays 3C and 3E which remain energised for the duration of the connection. The contact 3*c*1 closes a circuit through the line BD leading to a device ZD which records the essential particulars of the connection. The contact 3*a*3 transmits the impulses simultaneously to the line JD and thus to the recording device ZD.

The impulses are also transmitted over the line *ld*3 to the relay 4A of the switch MLW2 (Figure 4). The relay 4C is energised in a circuit running through the line *lc*3. The contact 4*c*4 closes a circuit for the driving magnet 4DS for the hunting switch SW2 which seizes the repeater Ü3 of a free line VL2. The relays 4P (Figure 4) and 5C (Figure 5) are then energised over the line *lc*4. The relay 4P connects the speech line. The last four impulses of the first train which act on the relay 4A cause the wipers *dm* of the switch MLW2 to be stepped through four steps. At the fourth step, the wiper *dm*4 connects the line *la*3 to the line *la*4. The 4th impulse thus influences the relay 5A of the repeater Ü3 (Figure 5) which sends out an A. C. impulse to the line VL2. In the repeater Ü4 (Figure 6), this impulse is received by the relays 6J, 6A. The relays 6C and 6E are energised and remain energised throughout the duration of the connection. The contact 6*c*3 closes a circuit through the line *lc*5 through which the group selector GW1 which is not shown in detail is seized.

The subsequent impulse trains sent out by the calling subscriber cause the group selectors in the main group exchange HA and, if required, those in the subsidiary group exchange KA to be set. The last two impulse trains act on a final selector LW (Figure 8) in the wanted subscriber's exchange which is seized by the previous group selector through the line *lc*8 so that the relay 9C is energised. The wipers of the final selector are set on the contacts of the wanted subscriber in known manner by a rotary and an axial movement. The contacts 9*k* are thrown during the axial movement and the contacts 9*w* during the rotary movement.

When the last train has been received, a slow-to-release relay 9V which was energised by the impulses, drops, so that its contact 9*v*1 unlocks the slow-to-release relay 9E which has so far been energised. A circuit for the testing relay 9P is closed for the duration of the delay in release of the relay 9E. If the wanted subscriber is free, the relay 9P can respond; if he is engaged, the relay 9P remains de-energised. If the subscriber has a number of lines, the final selector can be automatically stepped until a free line is found. For this purpose, the relay 9A is energised in a circuit running through the wiper *lwd*, the stepping being effected by interaction of the relays 9A and 9V.

If, the wanted subscriber being engaged, the relay 9P does not respond, a backward signalling circuit is closed by the contacts 9*w*2, 9*e*4, 9*p*5 through the line *lb*8 when the relay 9E drops. It will be assumed that the line *lb*8 is directly connected to the line *lb*5 (Figure 6) through one or more group selectors. The relay 6K is energised in the backward signalling circuit and its contact 6*k*3 energises a slow-acting relay 6L. The relay 6S is energised for the duration of the delay in response of the relay 6L and sends out a short A. C. impulse through the line VL2. In the repeater Ü3 (Figure 5), this impulse is received by the relay 5E which, by means of its contact 5*e*1, first energises the relay 5Y and then the relay 5X. The contacts 5*c*4, 5*x*1, 5*y*1 and 5*g*2 then close a backward signalling circuit through the line *lb*4 which is connected to the line *lb*3. In the repeater Ü2 (Figure 3), the relay 3K responds and by acting on the relays 3L and 3S causes an A. C. impulse to be sent over the line VL1. In the repeater Ü1 (Figure 2), the relay 2E responds and energises the relays 2Y and 2X. The contacts 2*x*1, 2*y*1 close a backward signalling circuit through the lower speech wire which is connected to the line *lb*1 (Figure 1). In the finder AS, the relay 1M is energised and energises the relay 1S. The contacts 1*s*1 and 1*m*3 short circuit the winding 2 of the relay 1N. The connection is released when the relay 1N drops. The A. C. source BZ is connected by the contacts 1*n*4 and 1*e*5 and transmits a "busy" signal to the calling subscriber.

If a group selector cannot find a free line, an appropriate backward signal is sent out which causes the connection to be released and the "busy" signal to be emitted.

If, the wanted subscriber being free, the relay 9P (Figure 8) can respond, the contact 9*p*5 is thrown but the relay 9E has not yet dropped. The backward signalling circuit through the line *lb*8 is thus closed only for the duration of the delay in release of the relay 9E. On response of the relay 6K (Figure 6) which is connected to the line *lb*8 by the line *lb*5, an A. C. impulse is sent through the line VL2 by the relay 6S as in the case of the "busy" signal. When the back-

ward signalling circuit is opened again, the relay 6K drops. For the duration of the delay in release of the relay 6L, the relay 6S is again energised and sends a second A. C. impulse to the line VL2. Also, the relay 6T is energised and is locked. If the repeater Ü3 (Figure 5), the relays 5Y and 5X are again energised by the first A. C. impulse of the "idle" backward signal. The second impulse of this signal de-energises first the relay 5Y and then the relay 5X. The backward signalling circuit through the line *lb*4 is thus closed only for the duration of time which elapses between the receipt of the two impulses. When the relay 5Y drops, the relay 5T is energised and locked. In the repeaters Ü2 (Figure 3) and Ü1 (Figure 2), the same operations are effected as in the repeaters Ü4 and Ü3. Also, the relays 3T and 2T are energised and a backward signalling circuit through the line *lb*1 is momentarily closed.

In the finder AS (Figure 1), the relay 1M momentarily responds and the relay 1S energises. When the relay 1M drops, the relay 1D is energised by the contacts 1*s*1 and 1*m*3, is locked by its contact 1*d*2 and opens the circuit for the relay 1E. The contact 1*d*3 removes the short circuit from the winding 2 of the relay 1B so that the latter responds again. For the duration of the relay in release of the relay 1S, the A. C. source VZ is connected up by the contacts 1*d*1 and 1*s*3 and sends a short "idle" signal to the calling subscriber. The A. C. source FZ is then connected up by the contacts 1*s*3 and sends an intermittent "idle" signal to the calling subscriber.

In the final selector (Figure 8), the relay 9L has in the meantime been energised and connects a source of ringing current to the wanted subscriber's line. When the wanted subscriber removes his receiver, the relay 9U is energised and opens the circuit for the relay 9L and energises the relay 9Y. The calling subscriber's feed circuit includes the relay 9Y and the winding 3 of the relay 9A. The contact 9*y*5 closes a circuit for the relay 9V which includes a resistance R which causes the response of the relay 9V to be delayed. For the duration of the delay in response of the relay 9V, the backward signalling circuit is closed through the line *lb*8 by the contacts 9*y*4 and 9*v*4. An A. C. impulse is sent to the line VL2 by the relays 6K, 6L and 6S (Figure 6) at the beginning and at the end of this backward signal which indicates that the subscriber has removed his receiver.

When the relays 6K and 6L are energised, a circuit is closed for the relay 6P which is then locked. When the relays 6K and 6L drop, the relay 6G is energised and its contacts 6*g*1 and 6*g*2 close the talking circuit. In the repeater Ü3 (Figure 5), the relays 5Y and 5K are energised on receipt of the first A. C. impulse of the backward signal indicating that the called subscriber has removed his receiver, and close a backward signalling circuit through the line *lb*4 and energise the relay 5P. On receipt of the second impulse, the relays 5Y and 5X drop and close a circuit for the relay 5G so that the contacts 5*g*2 and 5*g*3 close the talking circuit and open the backward signalling circuit. The same operations take place in the repeaters Ü2 (Figure 3) and Ü1 (Figure 2), the relays 3P, 3G and 2P, 2G being energised.

In the repeater Ü2 (Figure 3), a circuit UD for a device for recording particulars of the connection is prepared by the contact 3*g*4 which is periodically closed by a contact *u* and causes the duration of conversation to be recorded. The relay 4G in the switch MLW2 (Figure 4) which closes the talking circuit is energised by the contact 3*g*5. In the finder AS (Figure 1), the relay 1M is momentarily energised by the backward signal denoting the removal of the called subscriber's receiver. The contact 1*m*3 opens the circuit for the relay 1D which drops after a delay. For the duration of this delay, the relay 1G is energised by the contacts 1*m*4, 1*d*4 and is locked by the contact 1*g*4. The contacts 1*g*2 and 1*g*3 close the talking circuit. When the calling subscriber makes a fully automatic connection to an exchange other than his own, the impulse which is sent out when the called subscriber removes his receiver is of such a length that the relay 1D drops before the relay 1M. In the case of local calls, i. e. to a subscriber belonging to the calling subscriber's own exchange, the corresponding impulse sent through the line *lb*1 is so short that the relay 1M drops before the relay 1D.

In the case of a local call, when the relay 1M has dropped, a circuit for the line *ld* to which the calling subscriber's meter Z is connected is made by the contacts 1*g*4, 1*d*4 and 1*m*4. The meter is thus moved forward by one step. The case of calls made outside the calling subscriber's exchange, the meter is not actuated, the charges being evaluated from recorded particulars of the call. When, at the end of the conversation, the called subscriber replaces his receiver, the relays 9Y and 9A (Figure 8) drop and the contacts 9*y*1 and 9*v*1 close a backward signalling circuit through the lines *la*8 and *lb*8. In the repeater Ü4 (Figure 6), the winding of the relay 6I which is connected to the lines *la*5, *lb*5 is energised and its contact 6*i* switches in the relay 6A. The contact 6*a*4 unlocks the relay 6T, the contact 6*t*4 of which unlocks the relay 6G. The contacts 6*g*1 and 6*g*2 open the talking circuit. The relay 6K is thus again connected to the backward signalling line *lb*5. It responds and the relay 6S sends an A. C. impulse to the line VL2 which energises the relays 5Y and 5X in the repeater Ü3 (Figure 5). The contact 5*y*4 unlocks the relay 5T, the contact 5*t*4 of which unlocks the relay 5G. The contacts 5*g*2 and 5*g*3 close a backward signalling circuit through the lines *la*4 and *lb*4. In the repeaters Ü2 (Figure 3) and Ü1 (Figure 2), the same operations are repeated, the relays 3G and 2G being deenergised. The circuit UD of the recording device is opened. In the finder AS (Figure 1), the relay 1M is constantly energised over the lines *la*1, *lb*1. The contact 1*m*2 closes a circuit for the thermo-relay 1T*h* which, after a time, closes its contact *th* and short circuits the winding 2 of the relay 1N. The A. C. source BZ is thus switched in and transmits a "busy" signal to the calling subscriber. The contact 1*n*6 opens the calling subscriber's feed circuit.

When, in order to make a connection to another exchange, the calling subscriber dials 0, the switch MLW1 (Figure 9) closes the contact *k*10 (Figure 1). When the relay 1N drops, the winding 3 of the relay 1B is energised. A circuit for the driving relay AR of a hunting switch RSW is closed by the contacts 1*c*2, 1*n*5 and 1*b*4 so that the wipers *rs*1—*rs*3 are stepped in the usual manner until the relay 1P responds. The winding 3 of the relay 1S of the finder AS which, owing to its delayed release, has not yet dropped, is energised in the testing circuit of the relay 1P.

The relay 1P starts up another hunting switch RM, the contacts of which are connected to the line *ld*1. The wiper *rm*1 is thus stepped forward until it reaches the line *ld* when a circuit supplied from the A. C. source Q is made through the wiper *rs*3. The alternating current energises a relay 1T which stops the hunting switch RM and brings a current impulse transmitter (not illustrated) into action for the emission of impulses in accordance with the setting of the wiper *rm*1. These impulses are transmitted by the contact *i* through the wiper *rs*2 to the line *la*1. They are characteristic of the number of the calling subscriber. At the end of the impulse transmission, a contact *x* is opened and de-energises the relays 1S and 1P. The contact *1s*2 then opens the circuit through the line *lc*1 and thus brings about the release of the connection. The impulse trains which are sent out by the contact *i* are transmitted by the repeater Ü1 to the line VL1. The relays 3J and 3A in the repeater Ü2 (Figure 3) transmit the impulses to the circuit JD of the recorder which then prints the calling subscriber's number. The connecting devices which lie beyond the repeater Ü2 in which the recorder is situated can, if desired, be released before the recorder is actuated.

In the case of a fully automatic connection, impulse trains are also transmitted to the relay 4A of the switch MLQ2 (Figure 4), the contact *4a*1 of which controls the driving magnet 4D*m* for this switch. If the subscriber dials the number of the exchange KA (Figure 9) in which the switch MLW2 is arranged, the relays 4U, 4T and 4R are energised in succession through the wipers *dm*1 and *dm*3. The contact *4t*4 opens the testing circuit of the hunting switch SW2 and the contact *4t*1 starts the driving magnet 4DV of the hunting switch SW4 which seizes a free group selector GW4 in the exchange KA, whereupon the relay 4Q is energised. The line VL2 leading to the main exchange HA is released and the connection is finally made through the connecting apparatus of the group exchange by the shortest path to the wanted subscriber's exchange.

In the case of a semi-automatic connection which is made by an operator, the following switching operations are effected. When the calling subscriber removes his receiver and dials 0, he is connected, as in the case of a fully automatic connection, to the repeater Ü4 (Figure 6) of the main exchange HA over the lines VL1 and VL2. In order to call the operator, the subscriber has to dial 0 again. The impulses thus emitted are transmitted over the lines VL1 and VL2 and cause the group selector GW1 (Figure 7) to be set on to its tenth contact row out of which it selects a free line PL so that the relay 7C is energised. The ten impulses also act upon the relay 4A of the switch MLW2 (Figure 4) in the exchange KA, the wiper of which is stepped on to a contact connected to the relay 4W. The relay 4W is energised and locked.

When the relay 7C (Figure 7) in the main exchange HA is energised, a circuit is closed for a relay 7A*n* which causes the hunting switch SW3 of a free operator's position to be set on to the line PL which was seized by the group selector GW1. The relays 7P and 7T are energised and respond. The contact *7p*4 switches in a signal lamp AL and the contacts *7p*1 and *7p*2 connect the operator's speech line to the line PL. The contact *7p*5 closes the circuit of the relay 7V which responds after a delay. A backward signalling circuit is then closed through the lines *lb*7, *lb*5 by the contacts *7v*2 and *7p*2.

The signal which is transmitted is exactly the same as the "idle" signal sent back in the case of a fully automatic connection when the final selector has been set. In the repeaters, the relays 6T, 5T, 3T and 2T are energised; in the finder AS (Figure 1), the relay 1D is energised and switches in the "idle" signal.

As soon as the operator actuates the key A*bf* (Figure 7) a relay 7W (Figure 7) is de-energised by the contact A*bf*1 and, after a delay, releases. The contacts *7w* and A*bf*2 close a backward signalling circuit through the lines *lb*7, *lb*5 for the duration of the delay in release of the relay 7W. A second backward signal is thus transmitted in the same way as the backward signal is given by the final selector in a completely automatic connection when the called subscriber takes up his receiver. In the repeaters, the relays 6P, 6G, 5P, 5G, 3P, 3G, 2P and 2G are energised. In the finder AS (Figure 1), the relay 1G is energised. The speech circuits are thus closed in the finder and in all the repeaters. The operator can now take the calling subscriber's instructions.

To make the wanted connection, the operator opens the key A*bf* and actuates the selecting key WS (Figure 7). The contact WS1 opens the circuit through the relay 7V which drops after a delay of about 300 milliseconds, for which period a backward signalling circuit is closed through the lines *lb*7, *lb*5, *la*5, *la*7 by the contact *7v*1. This backward signal corresponds to the signal given by the final selector in a completely automatic connection when the called subscriber puts back his receiver. During the transmission of this signal, the following operations take place in the repeaters.

In the repeater Ü4 (Figure 6), the relays 6J and 6A are energised and the relays 6T and 6G drop. The relay 6G opens the talking circuit and connects the relay 6K to the backward signalling line *lb*5 so that this relay responds for the duration of the backward signal. The relays 6L, 6S send an A. C. impulse over the line VL2. When, on interruption of the backward signalling circuit at the operator's position, the relay 6K drops, the relay 6Z is energised by the contacts *6k*4, *6p*5 and is locked. The relays 6L, 6S then send a second backward signalling impulse over the line VL2.

In the repeater Ü3 (Figure 5), on receipt of the first backward signalling impulse, the relays 5Y and 5X are energised and open the circuits of the relays 5T and 5G. The backward signal is transmitted over the lines *la*4 and *lb*4. When, on receipt of the second backward signalling current impulse, the relay 5Y drops, the relay 5Z is energised by the contact *5y*4, *5p*5 and closes a locking circuit. The same switching operations take place in the repeaters Ü2 and Ü1 (Figure 3) as in the repeaters Ü4 and Ü3. In the finder AS, on receipt of the backward signal, the relay 1M is energised and closes a circuit for the two-step relay 1F which makes its first step and closes its contact *1f*11. When, at the end of the 300 millisecond backward signal, the relay 1M drops, the relay 1F makes its second step and the contact *1f*22 unlocks the relays 1G and 1S so that the talking circuit is opened. The contact *1f*23 again circuits the winding 2 of the relay 1B which drops and opens the circuit of the relay 1F. The finder is now in the condition in which it is before a subscriber starts to dial. In the repeaters Ü1 to

Ü4, the counting relays T, P, G are de-energised but the relays 3Z, 5Z and 6Z in the repeaters Ü2 to Ü4 are energised.

When the operator dials, the relay 7A is energised by the impulse contact *nsi*. The contact *7a1* sends impulses to the line *la7* and thus to the relay 8A of the group selector GW2 which is therefore set. At the same time, the contact *7a2* sends impulses over the lines *lb7*, *lb5*. In the repeater U4, owing to the energisation of the relay 5Z, the relay 6S is connected to the backward signalling line *lb5* and transmits A. C. impulses through the line VL2. In the repeater U4 (Figure 6), there is an impulse responding switch MLW3, the driving magnet 6D*m* of which is actuated by the impulses sent out by the operator through the contact *6s5* and steps the wiper *6dM*.

In the repeater Ü3, the impulses are received by the relay 5E and are transmitted by the contacts *5e1* and *5z1* over the lines *lb4*, *lb3*. In the repeater Ü2 (Figure 3) the relay 3R is connected to the line *lb3* by the contact *3z1* and its contact *3r2* transmits the impulses over the line *ld3* to the relay 4A of the switch MLW2. The magnet 4D*m* steps the wipers *dm1*—*dm4* in accordance with the impulses sent out by the operator. As the relay 4W is energised, the wiper *dm2* is effective. If the operator dials the number of the exchange KA through which the calling subscriber is connected to the operator's position, the wiper of the switch MLW3 (Figure 6) comes on to a contact to which is connected the relay 6U while the wiper *dm2* of the switch MLW2 (Figure 4) comes on to a contact to which are connected the relays 4T and 4R. On energisation of the relay 6U, the driving magnet 6D*m* is disconnected by the contact *6u1* so that further impulses from the operator are unable to influence the switch. The contact *6u2* closes a circuit through the line *ld5* so that the relay 7U (Figure 7) is energised. The contact *7u1* opens the testing circuit for the group selector GW2 so that the connection made through this group selector is released. In the switch MLW2 (Figure 4), on energisation of the relay 4T, a circuit is closed for the driving magnet 4DV of the hunting switch SW4 which seizes a free group selector GW4 (Figure 9) of the exchange KA. The relay 4Q (Figure 4) then responds. The testing circuit of the hunting switch SW2 remains closed at first through the contacts *4w3*, *4n2*. The contact *4r1* prevents the switch MLW2 being further influenced by impulses from the operator which are transmitted by the contacts *4a5*, *4t5*, *4w5*, *4q1*, to the not illustrated group selector in the exchange KA. A connection is thus made by the shortest route through the group selector of the exchange KA. All impulses which are used by the operator for making the connection are also transmitted by the contact *3r1* (Figure 3) to the circuit JD of the recorder ZD which records the dialled number.

If a final selector, such as the selector LW illustrated in Figure 8, has been set by the impulses sent out by the operator on to the wanted subscriber's contact, a backward signal is given as in a fully automatically made connection. If the subscriber is engaged, the backward signalling circuit through the line *lb8* is held permanently closed in the final selector; if he is disengaged, the backward signalling circuit is only momentarily closed.

If the connection made by the operator runs through the group selector GW2 (Figure 7), the relay 7M is energised in the backward signalling circuit. The contact *7m3* transmits the backward signal to the line *lb7*, *lb5* and thence, in the manner already described, to the finder AS (Figure 1) which, in the event of the wanted subscriber being engaged, causes the release of the connection. As long as the operator has not restored the key WS to its normal position, a circuit for the relay 7L is closed by the contact *7m3* so that the contact *7l1* switches in a lamp BL.

If the relay 7M is only momentarily energised by the "idle" backward signal, a circuit is closed for the relay 7Q when the relay 7M drops. The relay 7Q is then locked and its contact *7q2* closes the talking circuit and disconnects the relay 7M.

In the repeater (Figure 6), on receipt of the first backward signal after the connection has been made, the relay 6S is energised. The contact *6s4* short circuits the relay 6Z so that the latter drops. The relay 6K is then again connected to the backward signalling line *lb5*. The further backward signals are transmitted in the manner already described. In the repeaters Ü3 (Figure 5) and Ü2 (Figure 3), the relays 5Z and 3Z are also short circuited. The transmission of the signals indicating removal and replacement of the called subscriber's receiver are thus effected in the same manner as in the case of fully automatic connections.

If the impulses sent out by the operator cause the connection to the wanted subscriber to be made through the hunting switch SW4 and the group selectors of the exchange KA, the backward signals given by the final selector are received by the relay 4M which transmits them to the line *lb3* by means of the contact *4m1*. On receipt of the first backward signal after the final selector has been set which indicates whether the wanted subscriber is free or engaged, the relay 4N is energised by the contact *4m2* and is locked. The contact *4n2* opens the testing circuit for the relay 4P so that the relay 5C in the repeater Ü3 drops and opens the circuit of the slow-to-release relay 5U. The relay 5A is energised for the duration of the delay in dropping of the relay 5U and sends a long A. C. impulse to the line VL2. In the repeater Ü4 (Figure 6), the relay 6C is thus short circuited and the circuit of the relay 6E is then opened. The contact *6c3* opens the seizing circuit of the group selector GW1 so that the latter is released. The line VL2 between the exchange KA and the exchange HA is thus released.

In the case of a connection made directly over the selectors of the exchange KA, the "idle" signal and the signals denoting the removal and the replacement of the called subscriber's receiver are transmitted to the finder AS in the same manner as in the case of fully automatic connections. The speech circuit is closed in all repeaters and in the finder by the signal denoting the removal of the receiver. The signal denoting the replacement of the receiver brings into action the device which determines the calling subscriber's number and transfers it to the recorder ZD.

The operator does not need to supervise the connection she has made. All she has to do is to take instructions from the calling subscriber and to send out the selecting impulses for making the wanted connection. When she has done this, she is again free to make a new connection. For evaluating charges the same apparatus (a slip printing device or a time-zone metering de-

vice) is used as in the case of connections which are made fully automatically.

Instead of the final selector shown in Figure 8, selectors which allow the operator to connect herself to a busy subscriber's line and to sever the existing connection can be used. Such selectors are known in themselves.

In the system illustrated in Figures 10–12, a subscriber belonging to a terminal exchange EA or to a subsidiary group exchange KA to a main group exchange HA can by dialing 0 be connected in known manner to the selector SGW of the central exchange ZA from which radiate lines leading to other main group exchanges HA. The second digit dialled by the subscriber causes the group selector SWG to be set at a group selector GW1 which through a further group selector GW2 may seize a line VAV leading to the wanted main group exchange to be seized in a circuit made through the group selectors SWG, GW1 and GW2. The subscriber can then himself establish the connection to the wanted subscriber. Between the calling subscriber and the central exchange ZA, there is a recording device ZD which is here assumed to be a printing device which under the influence of the impulses sent out by the calling subscriber records the wanted subscriber's number, his exchange, the duration of the call and the calling subscriber's number.

If the second digit dialled by the calling subscriber is 0, the selector SGW at the central exchange ZA is set on to a line which leads to the operator's position AP*l*. The relay 2C (Figure 11) is energized over the line *lc* and closes circuits for the relays 2Q and 2A*n*. The contact 2*an*2 closes a circuit for the driving magnet 2DS of a hunting switch SW which connects the connecting devices of the operator's position AP*l* to the line PL which is seized by the group selector SGW. When the wipers of the hunting switch SW reach this line, the relays 2T and 2S are energised through the wiper *dsc*. The contacts 2*s*1 and 2*s*2 connect the operator's speech wires; the contact 2*s*3 switches in a signal lamp AL; the contact 2*s*4 closes a circuit for a slow-to-respond relay 2V and the contact 2*s*5 a circuit for a slow-to-respond relay 2W. For the duration of the delay in response of the relay 2V, a backward signalling circuit is closed through the line *lb* by the contacts 2*v*2 and 2*s*2. The impulse thus sent causes an "idle" signal to be transmitted over the calling subscriber's feed circuit.

When the operator actuates the key A*bf*, the circuit of the relay 2W is opened by the contact A*bf*3. The relay 2W drops after a delay for the duration of which a circuit is closed through the line *lb* by the contacts 2*w*1 and A*bf*2. The relatively long impulse thus sent back causes the "idle" signal to be switched off in the calling subscriber's feed circuit and speech lines to be connected up. It also causes the speech circuits to be closed in the repeaters through which the connection has been made.

The operator at the position AP*l* can now speak to the calling subscriber and take his instructions. To connect the subscriber to another subscriber of the same network, the operator actuates the dial WS. The contact WS3 then opens the circuit through the relay 2V. This relay drops after a delay during the duration of which a circuit is again closed through the line *lb* by the contacts 2*v*1 and WS2. The impulse thus sent back causes the speech circuits to be opened in the repeaters and in the calling subscriber's feed circuit. The operator now actuates her dial, the contact *ns*1 of which energises the relay 2J. The contact 2*i*1 sends impulses to the line *la* which act on the relay 2A of the group selector FGW. The contact 2*i*2 sends impulses to the line *lb* which are transmitted to the slip printing device ZD (Figure 10) which is connected to the circuit made between the calling subscriber and the operator's position. By dialling one of the numerals 1 to 9 the group selector FGW is set and a connection is made to one of the group selectors GW2 of the exchange ZA (Figure 10) through which a line to the wanted exchange is then selected.

When the connection to the wanted subscriber has been completed, the final selector momentarily closes a backward signalling circuit through one speech wire in which the relay 2M (Figure 11) is energised. The contact 2*m*1 then short circuits the relay 2Q while the contact 2*m*2 locks the relay 2M which is unlocked again when the relay 2Q drops.

In the meantime, the contact 2*m*3 closes a backward signalling circuit through the line *lb* which causes an "idle" signal to be transmitted over the calling subscriber's feed circuit. The contact 2*m*4 opens the circuit of the relay 2S and thus disconnects the operator's position AP*l*. When the called subscriber replies, a further backward signal impulse is sent by the final selector through the speech wire which, owing to the dropping of the relay 2Q (Figure 11), is now connected by the contact 2*q*1 to the line *lb*. This impulse closes the speech circuits in the repeaters and in the calling subscriber's feed circuit. The beginning of the conversation is at the same time recorded on the slip printing mechanism ZD (Figure 10). When the called subscriber replaces his receiver, a backward signalling circuit through the line *lb* is permanently closed by the final selector which opens the speech circuits in the repeaters. Furthermore, an auxiliary device is caused to send out impulses corresponding to the called subscriber's number to the slip printing device ZD which records that number. The connection is then released in known manner.

If the calling subscriber wishes to be connected to a subscriber who can only be reached through a long distance operator at the position PB*l* (Figure 10), the operator at the position AP*l* after actuating the selecting key WS dials 0 and thus sets the group selector FGW on to a line which leads to a free selector FLW. The ten impulses thus sent out are transmitted in the manner described above over the line *lb* to the connection made between the calling subscriber and the operator's position AP*l* and act upon the slip printing device ZD. The operator AP*l* by dialling one or two more digits makes a connection through the selector FLW (Figure 12) to a long-distance operator's position BP*l* from which run trunk lines FL. The impulses are also transmitted over the line *lb* to the slip printing device ZD.

When the selector FLW is set, the relays 3B and 3C are energised. The contact 3*c*12 closes a circuit through a relay 3E so that the contact 3*e*1 connects the relay 3A to the line *la*1. At the long-distance position BP*l* there is a number indicating device NA which is actuated by the driving magnets D1—D4. The circuits of these driving magnets are successively closed by a control switch the driving magnet 3S of which is momentarily energised after each impulse train.

When the operator at AP*l* sends further im-

pulse trains which characterise the wanted connection, for example, the wanted subscriber's exchange, the relays 3V and 3R are energised during each train which is transmitted over the lines *la, la1* to the relay 3A. When the control switch is in its position *1*, the contact *3a2* transmits the impulses to the driving magnet D*1*. At the end of the train, the relays 3V and 3R, after a delay release one after the other. The contacts *3r1*, *3v2*, temporarily close a circuit through the control switch magnet 3S so that the latter is stepped into its position 2. The impulse trains are thus transmitted to the driving magnets D*1*—D4 of the indicating device NA. They are also transmitted from AP*l* in the manner described to the line *lb* and act upon the slip printing device ZD.

When the control switch reaches its position 5, a relay 3Z (Figure 12) is energised so that the contact *3z2* opens the circuit of the relay 3E. A backward signalling circuit is closed through the line *lb1* for the duration of the delay in release of the relay 3E by the contacts *3z1* and *3e2*, so that the relay 2M of the selector FGW drops.

The relay 2Q is thus de-energised in the manner already described and a backward signalling circuit is temporarily closed through the line *lb*. When the relay 3E has dropped, the contact *3z3* (Figure 12) switches in the lamp 3AL. When the operator at BP*l* actuates the switch AF, a slow-to-respond relay 3L is energised by the contact AF3. A backward signalling circuit is closed through the line *lb1* for the duration of the delay in response of the relay 3L by the contacts *3l1* and AF2. When the relay 2Q (Figure 11) drops, the line *lb1* is connected to the line *lb*. This backward signalling circuit causes the speech circuits to be closed in the repeaters. The operator at BP*l* can now speak to the calling subscriber and obtain the wanted subscriber's number. The operator can then connect herself in known manner to the long distance line FL by actuation of the switch VS and call the operator at the other end of this line in order to make the desired connection. When the connection to the wanted subscriber has been made, the operator at BP*l* connects the calling subscriber to the long distance line FL and notes the beginning of the conversation on a call slip. The operator also enters on this call slip the number which was set on the indicating device NA.

At the end of the connection, the operator at BP*l* actuates the key T*r*T. The relay 3P in the selector FLW drops and the contacts *3q4* and *3p2* close a backward signalling circuit through the line *lb1* which is connected to the line *lb* (Figure 11). The permanent backward signal causes the speech circuits to be opened in the repeaters. Furthermore, in the calling subscriber's exchange the auxiliary device is started which sends out impulses to the slip printing device ZD in accordance with the number of the calling subscriber.

The impulse trains by means of which the operator at AP*l* makes the connection to BP*l* are transmitted to the slip printing device ZD, the calling subscriber and the operator's position AP*l*. The two digit or three-digit number thus recorded can be used to indicate that the connection runs to a certain district, region or country. As the operator at BP*l* makes an appropriate note upon the call slip, and the time of the connection is recorded both in the slip printing device ZD and also by the operator at BP*l*, it is possible subsequently to identify the two call slips.

This identification is facilitated by the supplementary distinguishing marks recorded or shown on the slip printing device and to the number indicating device NA.

The operator at AP*l* can sometimes connect herself directly to BP*l* by inserting a plug into an appropriate socket. In this case, only the number indicating device NA need be provided. This is set by one or more supplementary impulse trains which are transmitted at the same time to the slip printing device ZD. The numbers appearing on the device NA may give information regarding the wanted connection, for example the number of the wanted exchange. They may, however, be used merely for the serial numbering of the various connections and thus for the identification of the call slip written by the operator at the long-distance position BP*l* with the information recorded by the slip printing device ZD. In any case, the operator at BP*l* can immediately make the wanted long-distance connection without it being necessary for a separate connection to be made to the calling subscriber, because the number of the calling subscriber is clearly recorded by the device ZD.

We claim:

1. A selector operated telephone system comprising a plurality of exchanges including a central exchange, a calling subscriber, a called subscriber, a connecting path between said calling subscriber and said central exchange, means for transmitting dialling impulses sent by said calling subscriber over said connecting path, discriminating means associated with said connecting path and controlled by said dialling impulses, an operator at said central exchange, means controlled by said operator for transmitting dialling impulses to the selectors of said central exchange, and means for transmitting said last-mentioned dialling impulses over said connecting path to said discriminating means.

2. A selector operated telephone system comprising a plurality of exchanges including a central exchange, a calling subscriber connected to a calling exchange, a called subscriber connected to a called exchange, a connecting path between said calling exchange and said central exchange, means for transmitting dialling impulses sent by said calling subscriber over said connecting path, discriminating switches associated with said connecting path and controlled by said dialling impulses of said calling subscriber, a selector in said central exchange connected to said connecting path, an operator in said central exchange adapted to be called by the setting of said selector on to a predetermined level, group selectors in said central exchange adapted to be seized by said selector on its being set on to another level, means controlled by said operator for transmitting dialling impulses to said group selectors of said central exchange, means for transmitting said dialling impulses of said operator over said connecting path backwardly to said discriminating switches, a discriminating switch in said central exchange controlled by said backward dialling impulses of said operator, and means controlled by said discriminating switch for releasing said selectors of said central exchange set by said operator.

3. A selector operated telephone system comprising a plurality of exchanges including a calling subscriber connected to a calling exchange, a central exchange and an intermediate exchange

situated between said calling exchange and said central exchange, a connecting path between said calling exchange and said central exchange, a called subscriber connected to said intermediate exchange, a discriminating switch in said intermediate exchange for preparing selectors of said exchange, means for transmitting dialling impulses sent by said calling subscriber over said connecting path, means controlled by said dialling impulses for setting said discriminating switch of said intermediate exchange, an operator associated with said central exchange, group selectors associated with said central exchange, dialling impulse emitting means controlled by said operator, means controlled by said dialling impulses of said operator for setting said group selectors and means for transmitting said dialling impulses of said operator over said connecting path to said discriminating switch of said intermediate exchange.

4. In an automatic telephone system in which a subscriber can make a call at will either directly or through an exchange operator, the provision of means whereby impulses sent out by the operator to extend the connection towards the wanted exchange are also transmitted backwardly over the connection already made between the calling subscriber and the operator.

5. An automatic telephone system comprising a plurality of exchanges including a calling subscriber's exchange and an attended exchange through which all calls from said subscriber's exchange to another exchange are made, and means at said attended exchange under the control of the operator of said exchange for the transmission of current impulses forwardly towards the called subscriber's exchange and simultaneously backwardly towards the calling subscriber's exchange.

6. An automatic telephone system as claimed in claim 5 comprising between said calling subscriber's exchange and said attended exchange means for recording data for use in evaluating the charge to be made for a call, said means being acted upon by said backwardly transmitted impulses.

7. An automatic telephone system as claimed in claim 5 comprising between said calling subscriber's exchange and said attended exchange means for routing a connection, said means being acted upon by said backwardly transmitted impulses.

8. An automatic telephone system comprising a plurality of automatic exchanges including a calling subscriber's exchange, a called subscriber's exchange, an exchange provided with an operator's position and an exchange between said first and third mentioned exchanges, means under the control of a subscriber of said first mentioned exchange for connecting said exchange through said fourth mentioned exchange to said third mentioned exchange and for calling the operator over the connection thus made, impulse transmission means under the control of said operator for connecting said third to said second mentioned exchange through said fourth mentioned exchange, said last mentioned means being effective also to transmit impulses at the same time over the connection made between said first and said third mentioned exchange and means actuated by said impulses for breaking the connection between said third and fourth mentioned exchanges.

9. An automatic telephone system comprising a calling subscriber's exchange, an attended exchange, a called subscriber's exchange, an exchange intermediate said calling and attended exchanges and said attended and called exchanges, means under the control of a subscriber of said calling exchange for making a connection from said calling to said attended exchange through said attended exchange and for calling the operator at said attended exchange over said connection, means under the control of said operator for extending said connection to said called exchange through said intermediate exchange, said last-mentioned means being effective to transmit impulses simultaneously forwardly over the extended connection and backwardly over the connection made from said calling exchange, a final selector at said called exchange adapted to be actuated by said impulses, means controlled by said final selector for sending back a signal indicating that said selector has found a free outlet and means at said intermediate exchange adapted, on receipt of said signal, to release the connection between said intermediate and attended exchanges.

10. An automatic telephone system as claimed in claim 5 comprising means at the wanted exchange for sending back signals indicating that a wanted line is idle and that the wanted subscriber has removed his receiver, and means at the attended exchange for sending back similar signals indicating that the operator is free and that she has removed her receiver.

11. An automatic telephone system as claimed in claim 5 comprising means at the wanted exchange for sending back signals indicating that a wanted line is idle and that the wanted subscriber has removed his receiver, means at the attended exchange for sending back similar signals indicating that the operator is free and that she has removed her receiver, and means actuated by said last mentioned signal for closing a talking circuit between the calling subscriber and the operator.

12. An automatic telephone system as claimed in claim 5 comprising means at the wanted exchange for sending back signals indicating that a wanted line is idle and that the wanted subscriber has removed his receiver, means at the attended exchange for sending back similar signals indicating that the operator is free and that she has removed her receiver, means actuated by said last mentioned signal for closing a talking circuit between the calling subscriber and the operator and means under the control of the operator for opening the talking circuit without breaking the connection between the attended and calling exchanges.

13. An automatic telephone system comprising a calling subscriber's exchange, an attended exchange, a called subscriber's exchange, means under the control of a subscriber of said calling exchange for transmitting impulses, means controlled by said impulse-transmitting means for making a connection to said attended exchange and for calling the operator at said attended exchange over said connection, at least one repeater through which said connection is made, means for sending to said calling subscriber signals indicating that the operator is free and that the operator has removed her receiver, impulse transmitting means under the control of said operator for extending said connection towards said called exchange and means under the control of the operator for influencing said repeaters whereby to cause impulses emitted by said transmitting

means to be transmitted backwards over said connection between said attended and said calling exchanges.

14. An automatic telephone system as claimed in claim 13, comprising a device for recording data to be used in evaluating the charge to be made to the calling subscriber, said device being acted upon by said backwardly transmitted impulses.

15. An automatic telephone system as claimed in claim 13, comprising a final selector at said called subscriber's exchange adapted to act upon said impulses used for extending the connection, means for sending out a backward signal indicating that said selector has found a free outlet and a device for recording data to be used in evaluating the charge to be made to the calling subscriber for the connection, said device being acted upon by said backwardly transmitted impulses for the recording of an indication of the called subscriber's number and by said backward signal for the recording of an indication of the calling subscriber's number.

16. An automatic telephone system as claimed in claim 5 comprising means situated between the calling and attended exchanges which are influenced when a connection is made between said exchanges to enable the operator to extend the connection over different routes to the called exchange.

17. An automatic telephone system comprising a calling subscriber's exchange, a first attended exchange, a second attended exchange, means under the control of a subscriber of said calling subscriber's exchange for transmitting impulses, means controlled by said impulse-transmitting means for making a connection to said first attended exchange and for calling the operator at said attended exchange over said connection, means under the control of said operator for extending said connection to said second attended exchange and for calling the operator at said second attended exchange over the extended connection, means under the control of the operator at said first attended exchange for transmitting impulses simultaneously forwardly over said extended connection and backwardly over the connection between said calling subscriber's exchange and said first attended exchange and a device in said connection between said calling subscriber's exchange and said first attended exchange for recording data to be used in evaluating the charge to be made to the calling subscriber for the connection, said device being actuated by said backwardly transmitted impulses.

18. An automatic telephone system as claimed in claim 17 comprising also a device in the extended connection for recording data to be used in evaluating the charge to be made for the connection, said device being acted upon by said forwardly transmitted impulses.

19. An automatic telephone system as claimed in claim 17, in which said device is adapted under the influence of said impulses to record the number of the wanted subscriber.

20. An automatic telephone system as claimed in claim 17, in which said device is adapted under the influence of said impulses to record a serial number for identification of the call.

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