

Dec. 30, 1947.

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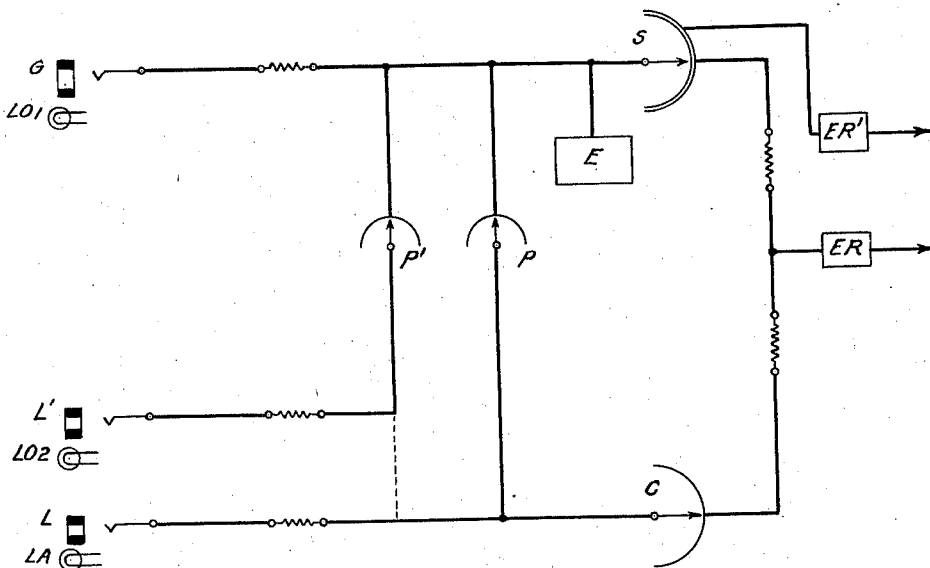
2,433,359

MULTIRURAL SEMI-AUTOMATIC TELEPHONE EXCHANGE SYSTEM

Filed July 23, 1943

5 Sheets-Sheet 1

Fig. 1.



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MULTIRURAL SEMI-AUTOMATIC TELEPHONE EXCHANGE SYSTEM

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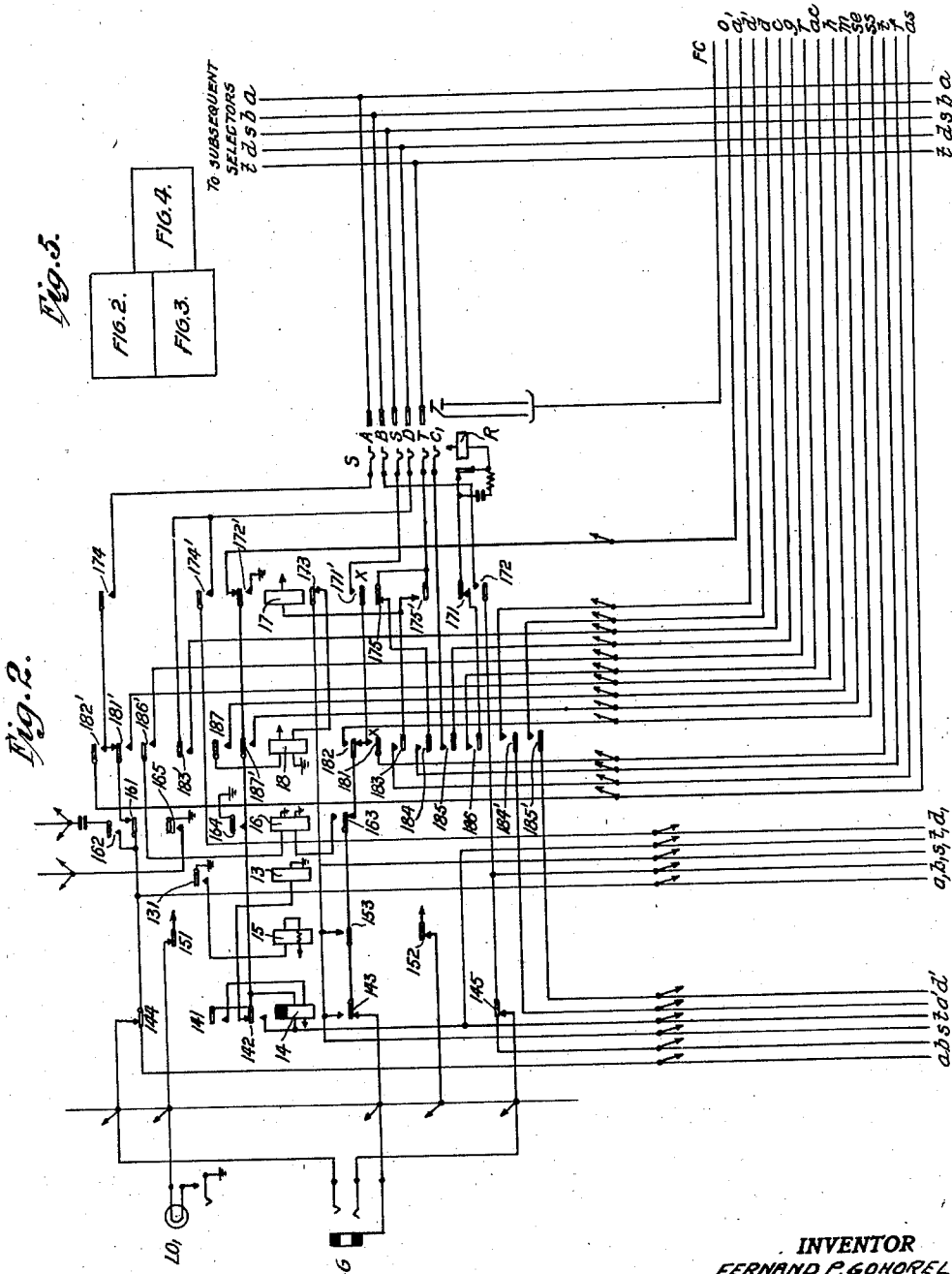


Fig. 3.

Fig. 2.

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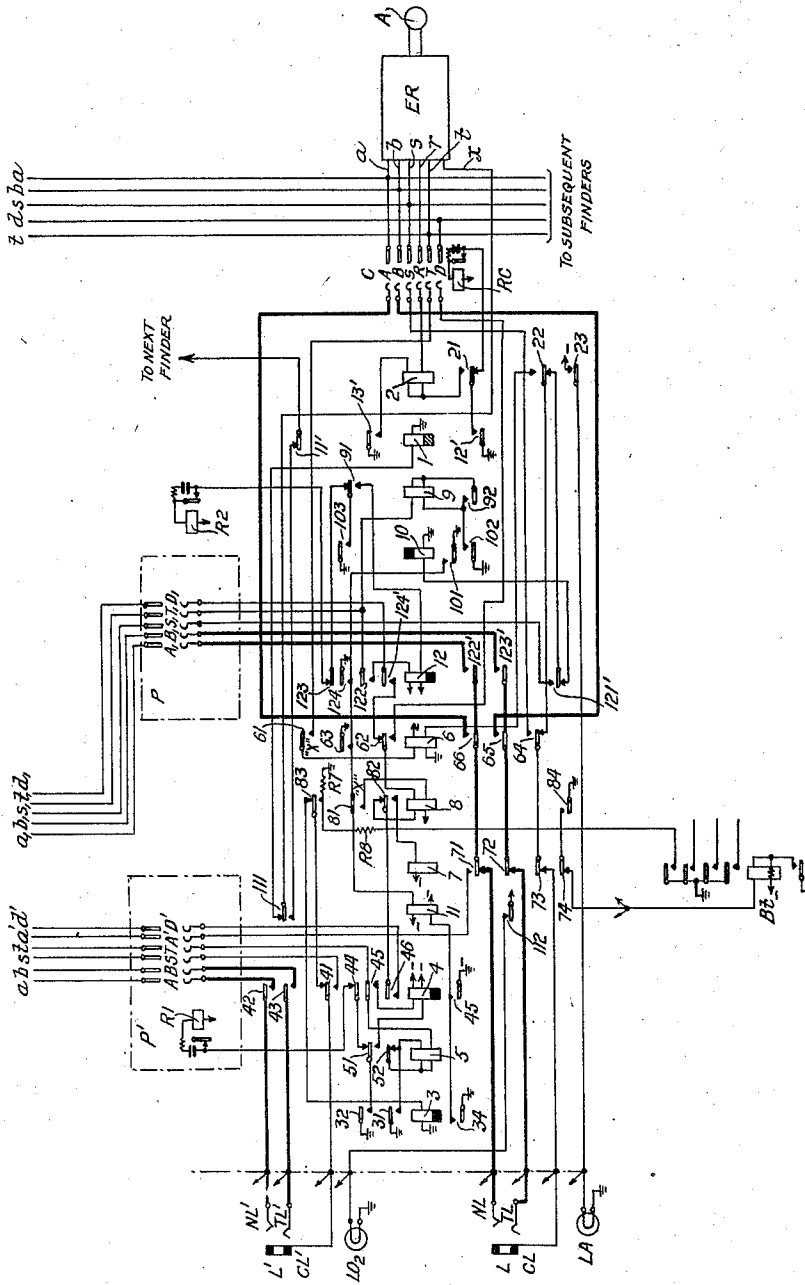
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MULTIRURAL SEMI-AUTOMATIC TELEPHONE EXCHANGE SYSTEM

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Fig. 3.



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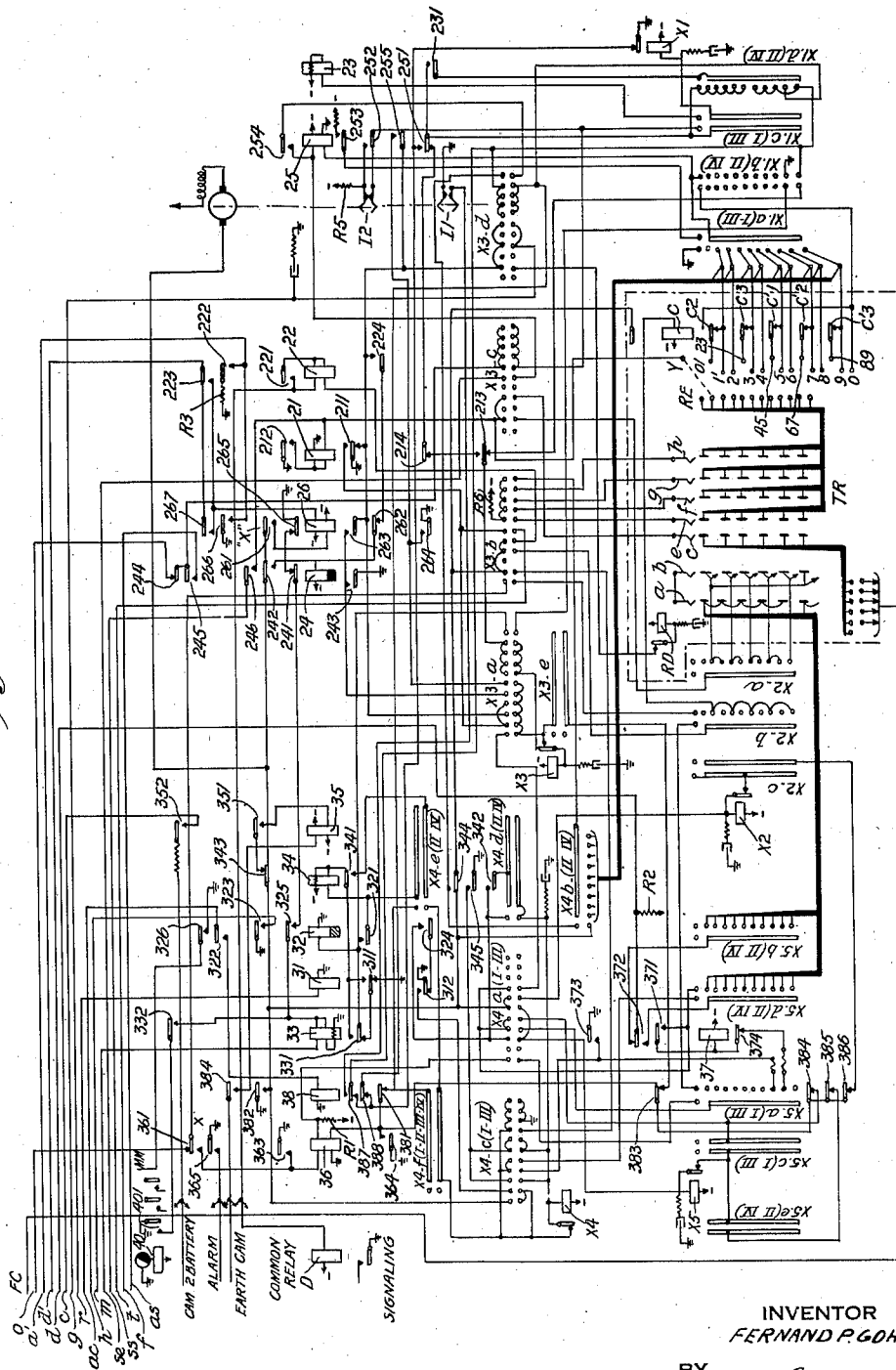
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MULTIRURAL SEMI-AUTOMATIC TELEPHONE EXCHANGE SYSTEM

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5 Sheets-Sheet 4

Fig. A.



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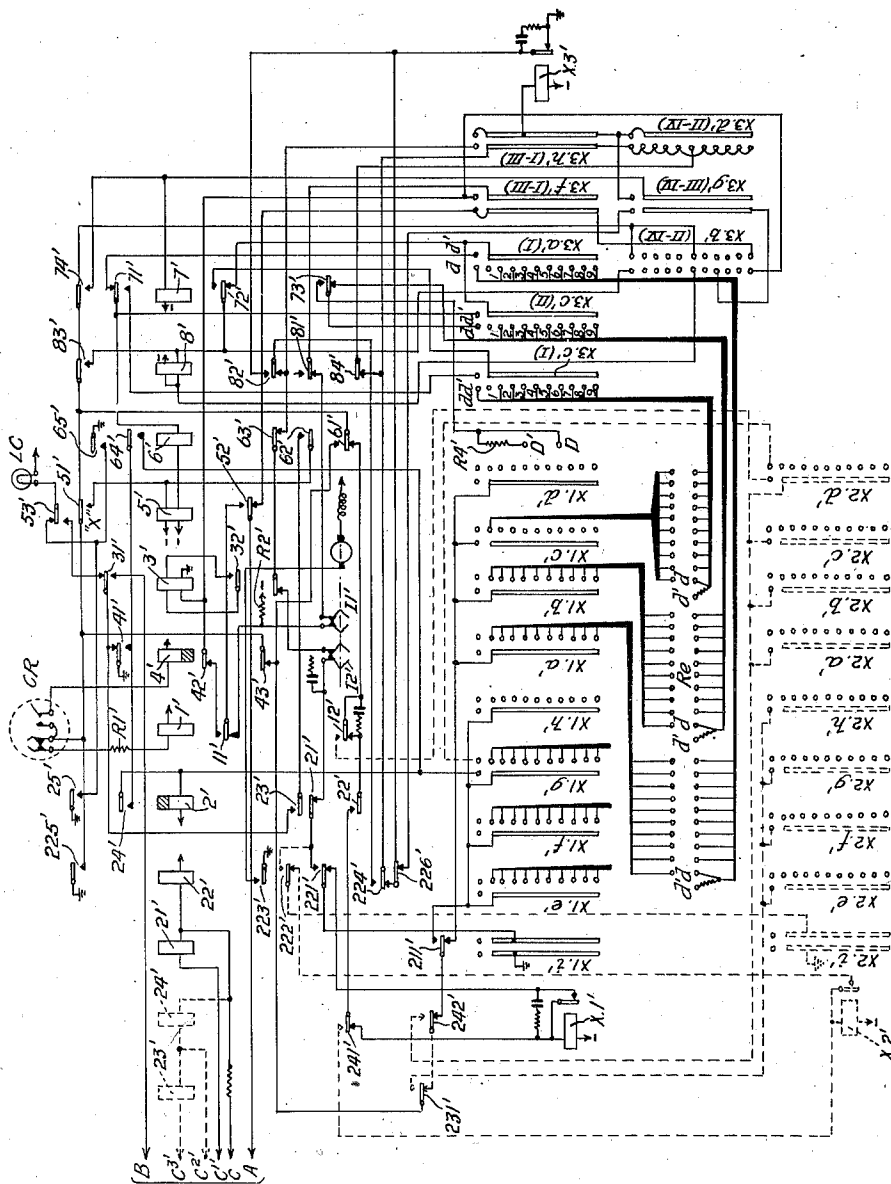
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MULTIRURAL SEMI-AUTOMATIC TELEPHONE EXCHANGE SYSTEM

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Fig. 6.



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MULTIRURAL SEMIAUTOMATIC TELEPHONE EXCHANGE SYSTEM

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11 Claims. (Cl. 179—27)

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The present invention relates to semi-automatic telephone systems and more particularly to systems including rural exchanges in which the establishment of connections is controlled by a distant operator located at a manual central office to which the rural network or district is connected. The various rural networks of a district are connected to the manual central, either directly or indirectly, via one or more rural switches.

In known rural systems, the number of digits of the called subscribers' numbers vary, depending on the position of the switch in the rural group to which the subscriber is connected and on the capacity of the switch. The central operator must know over which circuits the different subscribers may be reached, as well as the numbers that must be added to the subscriber's regular number, which are needed for operating the intermediate switches. All this slows down the operation of a rural district and often necessitates additional operators for handling the traffic of the district.

One object of the present invention is to provide translators for sending the trains of impulses necessary for the intermediate selecting operations to select the rural area of the called subscriber as determined by the first digit or digits of the called number. Thus, the subscribers' lines of a rural district may be uniformly numbered.

In accordance with the invention, the answering jacks of an operator's position connected to the calling lines by means of finders, have access to the rural lines via selectors which are controlled by the translators. These selectors may also be seized over pre-selectors, either from the answering jacks or from inter-rural connection jacks paired with the answering jacks.

According to another feature of this invention, when the operator is connected with a calling subscriber by a finder, she rings the called subscriber over an inter-rural connection jack. If the called subscriber belongs to the same rural area as the calling subscriber, then the selector is not used and the translator impulses are sent over the rural line via a pre-selector connected with the "inter-network" jack and the finder that is already in contact with the said line.

In one embodiment of this invention, the translator registers the digits which cause the sending of the series of impulses controlling the intermediate switches and at least partially the switch to which the called subscriber is connected. The connection may be completed by

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sending one or more trains of impulses that are registered but not translated. Since the number of impulses sent by the translator depends on the position of the subscriber in the district and on the capacity of the switch to which he is connected, arrangements are made that numbers that correspond to certain positions of the translator be absorbed and not sent by the translator.

According to another embodiment of this invention, the operator manually selects the rural area of the called subscriber according to the first digit or digits of the called number. The impulses for effecting the selections in the intermediate centrals are sent by a translator set in accordance with one or more digits of the called number dialed by the operator. The complete or partial control of the switch to which the called subscriber is connected, is effected by the operator when dialing the last digit or digits of the called number.

Various other features will be set forth in the following description and claims.

In the drawings:

Fig. 1 shows a diagram of the connections of the different pieces of equipment in the manual central in the case when the selection of the circuits is effected automatically after dialing of the subscriber's call number by the operator;

Fig. 2 is the connection arrangement of an outgoing selector such as S in Fig. 1, shown schematically;

Fig. 3 is the connection arrangement of incoming equipment such as C in Fig. 1, shown schematically;

Fig. 4 is the connection arrangement of a translator such as E of Fig. 1, shown schematically;

Fig. 5 shows the manner in which the various figures 2 to 4 are to be connected with one another; and

Fig. 6 is the connection diagram of a translator used in the case when the selection of the outgoing circuit is made by the operator according to the indication of the first calling figure or figures of the subscriber.

In the following specification, the relay contacts that are closed when the relay is energized, i. e. in operating position, are indicated with the letter T in front of the number of the spring, and the contacts that are closed when the relay is not energized, i. e. in the resting position, with the letter R in front of the number of the spring. Furthermore, certain rotary switches have been arranged to use 11-direction switches. These switches are provided with a certain num-

ber of wipers which are arranged in such a way as to come into contact with their banks during one or more quarter turns; the quarter turns for which a wiper is in engagement with its bank are indicated by Roman numerals after the reference indication for the wiper.

Referring to Fig. 1, an explanation will first be given of the general mode of operation of one of the devices according to the invention, which makes it possible to give all the subscribers in the rural district call code numbers that comprise the same number of figures, the selection of the circuits that correspond to the subscriber's area as well as the different selections via the switches being effected automatically.

Two groups of lines are used. One of them is multiplied on the calling jacks such as G and the other on the inter-rural paired answering and connection jacks L and L'.

Each of the lines G comprises a multiplied jack in association with the busy lamp LO₁ and connected to a selector S; the rural "mixed" and "special outgoing" circuits such as ER and ER' are multiplied on the banks of the selector. The translators such as E, which serve at the same time as control switches for the selectors, are connected to the said selectors during the time of selection.

Each of the line assemblies L—L' comprises two multiplied paired jacks, one of them being connected to a finder C that has access to the "mixed" rural circuits such as ER and to a pre-selector P which has access to the selectors S, while the other is connected to a preselector P' which has access to the same selectors S. A calling lamp LA is associated with the jack L and a busy lamp LO₂ is associated with the jack L'.

When a rural subscriber makes a call, he turns the magneto of his set or sends any other suitable calling signal, and his call is registered in the rural switch to which he is connected. When the connection circuits with the district central, i. e. the manual exchange, becomes free, the calling line is connected to the said district central via the equipment ER. A free finder such as C hunts for the calling circuit and, when this hunting is finished, the calling lamps such as LA light up in front of the operators. One of them replies by inserting an answering plug of a two-strand cord in the jack L; the calling lamp LA then extinguishes and the busy lamp LO₂ lights up. If the calling subscriber has not hung up after ringing, the supervisory lamp of the cord circuit extinguishes and the operator notes the required communication. If the calling subscriber has hung up, he is rung automatically and the supervisory lamp flashes and then extinguishes when the subscriber replies.

When the plug of the cord circuit is withdrawn from the jack L, the connection is released.

In case the communication is intended for a subscriber who is connected to the manual central and who can be reached directly, the operator proceeds to test the called line and completes the communication in the usual way.

In the case where the communication is intended for a subscriber of the same rural district as the calling subscriber, the operator does not have to bother about knowing whether the called subscriber does or does not belong to the same rural area as the calling subscriber.

The operator inserts the second plug of the two-strand cord into the jack L' and thus, via a pre-selector such as P', seizes a selector such as S

which is associated with a translator or register such as E.

The dial lamp lights up and the operator sets up on her dial the number of the called subscriber. The translator E registers the combination of numbers, translates it and directs the selector S to connect the first circuit of the group of circuits that are in connection with the called rural area.

If the circuit does not belong to the same group as the calling circuit (communication between subscribers of two different rural areas), the selector hunts for a free circuit among the circuits of the called group and the translator sends back the figures necessary for making the selection among the various rural switches that are passed over.

On termination of the selection, the supervisory signals at the operator's position, the ringing of the wanted subscriber and the release upon termination of the call are effected by any suitable one of the well known methods.

If the circuit to which the selector S is directed belongs to the same group as the calling circuit (local or intra-area communication) the translator E sends back the figures required for the selection in the reverse direction to the calling circuit via the preselector P' and the finder C. When the selection is finished, the selector S and the translator E are released, and the communication between the two subscribers is established under the conditions usual for a local call between rural subscribers. When the communication is established, the operator withdraws the plugs of the cord circuit and this effects the release of the finder C and of the circuits not used by the local call. The release upon termination of the call is effected by any well known method.

In case the calling subscriber has hung up after having made his call, the operator calls back the subscriber by inserting the answering plug of a cord circuit in a free jack L and thus connects herself by means of the pre-selector P, which is associated with the jack L, to a free selector S and translator E. She thus puts herself in communication with the calling subscriber who tells her the number of the called subscriber.

The operator then rings the called subscriber by inserting the calling plug of the same cord circuit in the jack L' which is paired with the jack L. She thus connects herself via the pre-selector P' that is associated with the jack L' to another free selector S and register E, and this register may be the same as the one that served for establishing the connection with the calling party. The operator sets up the called subscriber's number and, if the subscriber belongs to a different rural area from that of the calling party, the communication is established via the selectors S, the pre-selectors P and P' and the cord circuit.

If the called subscriber and the calling subscriber are connected to one and the same area, the second selector S directs itself over the same group of lines as the first selector and the register E repeats back the trains of impulses via the pre-selector P', the pre-selector P and the first selector to the circuit by which the calling subscriber has been reached.

Calls proceeding from outside subscribers or from other districts are routed by using a jack G.

The mode of operation of the device will now be explained in detail with reference to Figs. 2, 3 and 4. The equipment of the rural circuit ER has not been shown because the details of its

operation are not necessary for the understanding of the invention.

Call by a rural subscriber.—When a call by a rural subscriber such as A is registered, by known method, on the equipment ER of a rural circuit, a battery is connected to the wire X, and this causes excitation of the relay 1 via R111. At T12' relay 1 completes over R21 the circuit of the electromagnet RC. The call finder C starts out and proceeds to hunt for the calling circuit. When the wipers of the said finder reach the bank contacts of the equipment ER, the following circuit of relay 2 is completed: battery connected to the equipment ER, over the wire r to the receiving end of the call, bank contact and wiper R, the windings, in series, of relay 2, T13' and earth.

Relay 2 comes into the holding position and opens at R21 the circuit of the electromagnet RC. Accordingly the finder C stops at the desired position.

At T23 relay 2 completes the circuit of the calling lamp LA, which lights up. At T21 it completes the circuit of its own low resistance bottom winding and thus denotes the occupation of the circuit.

When the operator inserts the answering plug of a cord circuit into the jack L, a battery is connected to the sleeve of plug CL and completes the following circuit of relay 6: battery on CL, R73, R64, T22, bottom winding of relay 6 and earth. At T65 and T66 the said relay 6 connects the springs NL and TL of the jack L to the conductors a and b of the equipment ER via the wipers A and B of C.

The equipment ER then assumes the ringing position if the calling subscriber has hung up, or it passes to the talking position if he has held the line, and the connection is established with the operator who makes a note of the called subscriber's number and then proceeds to call back the calling subscriber and to ring the called subscriber, as will be explained, further on.

As soon as it is energized, relay 6 has completed at T63 the circuit of the upper winding of relay 11 which pulls up, and at T61 relay 6 completes its holding circuit by its upper winding because of the earth applied to the wire t in the equipment ER, while at T64 it returns the circuit of the sleeve of plug CL over the wire S. Relay 11, which has pulled up, returns at T111 the starting wire to the next finder, and at R111 it opens the circuit of relay 1 which falls back, thus causing the release of relay 2. At T112 relay 11 completes the circuit of the busy lamp LO₂ which lights up.

Establishment of a call between two subscribers of the rural district.—The operator first calls back the calling subscriber. To do this, she inserts the answering plug of a cord circuit into a free jack L. The following circuit of relay 10 is complete: battery applied to the sleeve of the jack L by the plug, R73, R64, R22, R121', winding of 10 and earth.

Relay 10 pulls up and at T101 it completes the circuit of the upper winding of relay 11 which pulls up and causes the lighting up of the busy lamp and the return to the starting wire. At T103 relay 10 completes the circuit of the rotary electromagnet R2 of the pre-selector P via R91 and R123.

The wipers of P advance in free rotation hunting for a free selector which will be assumed to be that of Fig. 2.

As has been shown in Fig. 1, a certain number

of selectors like that of Fig. 2 are associated with a register like that of Fig. 4. When the register is free, relays 13 and 15 in each of the selectors will be in the holding position. The holding circuit of relay 13 is as follows: ground, winding of 13, R142, R172', wire O, R361, bank contacts and wiper b of the switch X3 in the resting position, bank contacts and wiper b of the switch x2 in the resting position, bank contacts and wiper a of switch x5 in the resting position, bank contacts and wiper a of switch x4 in the resting position, resistance R1 and battery. The circuit of relay 15 is completed at T131. At R151 relay 15 opens the circuit of the busy lamp LO₁.

When the wipers of P reach their free selector, the following circuit of relay 9 is completed: ground, T102, windings of relay 9 in series with each other, wiper T1 of P, bank contact of the free selector wire t1, upper winding of relay 14, R172' and battery on the wire O over the previously mentioned circuit.

Relay 9 pulls up and opens at R91 the circuit of the electromagnet R2. The wipers of P stop at the desired position. At T92 relay 9 short-circuits its high resistance bottom windings and at T91 it completes the circuit of the bottom winding of relay 12 which comes into the holding position. At T122' and T123' relay 12 returns the talking conductors to the selector, at R123 it makes a second cut-off in the circuit of the electromagnet R2, at T124 it applies a ground to the holding wire, and at T121' it returns the wire of the sleeve CL of the plug to the wiper S1. The battery CL connected to the wiper completes via R173 the circuit of the bottom winding of relay 18 which pulls up and connects the selector of Fig. 2 to the register of Fig. 4.

Moreover, relay 14 becomes energized over the circuit of the test wire t and it disconnects the selector from the multiplying circuits in the direction of the outgoing jacks such as G. At R142 it opens the circuit of 13 which falls back and causes 15 to drop due to the circuit opening at 131. The circuit of the busy lamp LO₁ is completed at R151.

The battery of the sleeve CL of jack L completes the following circuit of relay 33: battery on CL, R73, R64, R22, T121', wiper S1 of P, wire s1, T143, R163, T182, wire se, both windings of 33 and earth.

Relay 33 comes into the holding position and completes the following circuit of relay 32: ground, winding of 32, T331, non-inductive upper winding of 34 and battery. Relay 32 pulls up and via T325 it short-circuits the high resistance bottom winding of relay 33 via R241 and R265, and this results in bringing the supervisory relay into the holding position and accordingly causing the lighting up of the supervisory lamp of the cord circuit.

The operator is thus notified that she can proceed to dial the subscriber's code digits and she depresses her dial key. One result of this manipulation is the connecting of the impulse circuit of the operator's dial to the plug conductor that is connected to the spring and the following circuit of relay 31: battery, on spring NL, R71, T122', wiper A1 of P, wire a1, R61, T181', wire ae, winding of relay 31, and ground. Relay 31 comes into the holding position and at T311 it closes a new circuit for the relay 32; ground, winding of 32, R331, T311, non-indicating upper winding of 34 and battery. By its various contacts, relay 32 prepares the register's operating circuit, and at T323 it places an earth

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on the wire *m* in order to hold the pre-selector in engagement.

Manipulation of the dial key has furthermore had the effect of short-circuiting in the cord circuit the battery that had been applied on the plug's sleeve CL and this causes the release of relay 33 of the register.

At T322 relay 32 (Fig. 4) completes the circuit of relay 38 over the wire *h* and T187 to the upper winding of relay 18. Relay 38 pulls up and completes the circuit of the electromagnet of switch X4: ground, T382, wiper C of X4 at the resting position, contact and electromagnet X4, battery.

The switch X4 passes to the first working position. As soon as the wiper *a* has left its resting position, the circuit of the above mentioned test wire O is opened. All the relays 13 and 15 of the selectors associated with the register fall back and at R151 the circuit of the busy lamps such as LO₁ is completed:

Since relay 31 is energized, the circuit of X4 is completed by: ground, T312, wiper C at the first working position, contact and electromagnet X4 and battery. The wipers of X4 pass to the second working position.

The operator will now proceed to dial the code digits of the called subscriber. It will be assumed, for example, that all the subscribers of the rural district have a four figure call number. The operator proceeds to dial the first figure. The manipulation of the calling dial causes cut-offs on the battery connected to the spring NL of L.

Relay 31 of the register will then follow the impulses emitted by the operator's dial. Upon each dropping of relay 31, the following circuit is completed: ground, R312, T324, wiper *a* of X4 at the second working position, electromagnet X5 and battery. The wipers of the switch X5 will then advance by as many steps as there are impulses receiving on relay 31.

At the first dropping of relay 31, the following circuit of relay 34 is completed: battery, series windings of 34, T321, R331, R341 and ground. This relay 31 pulls up and holds up during the receiving of a train of impulses owing to the fact that it is retarded by the short-circuiting of its bottom winding over a circuit including: right hand terminal of the winding, T311, R331, T321 and left hand outlet of the winding.

When relay 34 has pulled up, it completes the circuit of the electromagnet X4 via T345 across the wiper *c*. This electromagnet attracts its armature. Upon termination of the receipt of the train of impulses, relay 34 falls back and opens at T345 the circuit of the electromagnet which releases its armature. The wipers of X4 pass to the third working position. It has been assumed, for example, that the capacity of the rural district is limited to 2,000 subscriber lines.

The first of the figures received on the register will determine on which of the wipers *b* or *d* of the switch X5 the second figure will be registered, i. e. will effect the selection of the thousand digit in which the called subscriber's line is. For example, according to the connections shown in the drawings for the bank contacts associated with the wiper *a*, if the first figure is 8, the following circuit of X4 is completed when the wipers of the switch pass to the third working position after relay 34 falls back: ground, T382, wiper *a* of X4 at the third working position, bank contacts and wiper *a* of X5 at the eighth working position, wiper *c* of X4 at the third working position, contact and electromagnet X4 and battery.

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The electromagnet X4 makes the wipers pass to the fourth working position.

If the first figure received had been 9, the ground of the wiper *a* of X5 would have completed the circuit of relay 37 which would have pulled up. At T371 relay 37 closes its holding contact on the ground of T382, at T372 it puts into service the wiper *d* of X5, and at T373 it closes the circuit of the electromagnet X4 which makes its wipers pass to the fourth working position.

When the wipers of X4 reach the fourth working position, the following circuit is completed: ground, T382, wiper *a* of X4, bank segments and wiper C of X5, contact and electromagnet X5 and battery. The wipers of X5 advance in free rotation and pass into the resting position that corresponds to the second quarter turn.

Wipers *e*, *d*, *b* are engaged and wipers *a* and *c* are disengaged. The following circuit of the electromagnet X4 is completed: ground, T382, wiper *d* of X5 at the resting position, wiper *c* of X4 at the fourth working position, contact and electromagnet X4 and battery.

The electromagnet X4 makes its wipers pass to the fifth working position.

The second train of impulses will be received on the electromagnet X5 via: ground, R312, T324, wiper *a* of X4 at the fifth position, electromagnet X5 and battery.

The wipers *b*, *d* and *e* of X5 will advance on their bank contact by a number of steps equal to the figure received.

Upon termination of the receipt of the second train of impulses, the electromagnet X4 which had attracted its armature when relay 34 pulled up, releases it when T345 is opened and the wipers of the switch X pass to the sixth working position.

The third train of impulses is then received on the electromagnet X2 which advances its wipers by a number of steps corresponding to the number of impulses received.

When relay 34 falls back, the electromagnet X4 advances its wipers to the seventh working position. The following circuit of the electromagnet X3 is then completed: ground, T382, wiper *a* of X4 at the seventh position, wiper *a* of X3 at the resting position, contact and electromagnet X3 and battery.

The electromagnet X3 moves its wipers to the first working position. The following circuit of the electromagnet X4 is completed: ground, T382, wiper *b* of X3 at the first working position, wiper C of X4 at the seventh working position, contact and electromagnet of X4 and battery. The electromagnet X4 moves its wipers to the eighth position and then advances via the ground placed on the bank contacts to the resting position that corresponds to the second quarter turn.

Wipers *a* and *c* are disengaged, and the other wipers are engaged.

The fourth figure is then received on the switch X4 over: ground, R312, T324, wiper *d* and bank contact for the first figure, T342, wiper *d* and bank contacts for the next figures. The switch X4 will advance its wipers during the 2d quarter turn by a number of steps equal to the number of impulses received.

An explanation will now be given of how the translator TR is controlled and how the impulses are repeated back by the register. When the wipers of switch X3 are at the first working position, the following circuit of the electromagnet RD of the translator TR is completed: ground, R211, wiper *d* of X3 at the first working position, contact and electromagnet RD and battery.

It will be noted that at the banks of contacts of the switch of translator TR it has been assumed that each bank contacts of the wipers *b* and *d* of X4 has been multiplied on five bank contacts. For the total of ten bank contacts of the wipers *b* and *d* of X5 there will accordingly be one hundred contacts on the switch of the translator. Only some of these contacts are shown in the drawings. Moreover, for each position of the translator's switch, the marking wipers (*e*, *f*, *g* and *h*) have access, by means of the distribution frame Re and the relay set C, to twenty marking positions on the switch X, and this gives for the total 100 contacts of the said translator switch the marking positions for the 2,000 or less subscribers for whom it is assumed to be arranged.

The switch wipers advance, since the circuit of the electromagnet RD is closed, as mentioned.

When the wipers *a*, *b* of RD reach the contact carrying members that correspond to the combination of the first three digits registered, the following circuit of relay 21 is completed: ground, series windings of relay 21, wiper *a* of X2 at the position to which it has been brought by the third train of impulses, bank contact associated with the wiper *b* of RD, wiper *a* and, for example, bank contact of the wiper *b* of X5 to which the said wiper has been brought by the second train of impulses, wiper *b*, R372, resistance R2 and battery.

Relay 21 pulls up and opens at R211 the circuit of the electromagnet RD. The wipers of the translator stop at the desired position, and this position depends on the first three impulses receiving on the register.

At T211 relay 21 forms the circuit of the electromagnet X3 over the wiper *a* at the first working position. This electromagnet advances the switch wipers to the second working position. At the latter position, the circuit of relay 21 is opened at the wiper C; the said relay falls back and completes the circuit of the electromagnet X3 over the wiper *a* at the second working position. The wipers of X3 pass to the third working position.

The starting circuit of the selector of Fig. 2 is completed over: ground, R211 (Fig. 4), wiper *d* at the third working position, wire *r*, T186, R171, contact and electromagnet R and battery.

The electromagnet R will advance the wipers of the selector S in free rotation in order to proceed with the control of the selector to the group of lines of the rural area that corresponds to the figure marked by the translator. When the wipers of S reach a free line of the called direction, the following circuit of relay 21 is completed: ground, series windings of 21, wiper C of X3 at the third working position, wiper C of RD and bank contact on which the said wiper stopped, control wire FC, wiper C₁ of selector S, T183, wire C, resistance R2 and battery. Relay 21 pulls up and opens at R211 the circuit of the electromagnet R of S. The wipers of the said selector stop at the free line associated with a rural equipment such as ER.

In the example shown in the drawings, if the third digit registered is an even number 0, 2, 4, 6, or 8, the following circuit of relay C of the translator is completed: battery, winding of relay C, wiper *b* of X2 at an even number position, wiper *b* of X3 at the third working position, T382 and ground. Relay C pulls up.

When relay 21 has pulled up, it has completed at T211 the circuit of the electromagnet X3 which advances its wipers to the fourth working position or position of discrimination.

The following circuit of relay 22 is completed:

battery, common relay D, series windings of relay 22, wiper *b* of X3 at the 4th working position, T382 and ground. If there is no other register in a position of discrimination (position 4 of a switch X3), relay 22 becomes energized and short-circuits its high resistance upper winding in order to make impossible the energization of relay 22 of another register coming into the position of discrimination. At T224 it completes the circuit of relay 24: battery, winding of 24, R262, T224, R211 and ground; at T223 it connects the wire *d* to the upper winding of relay 25 and connects a ground in series with the resistance R3 on the wire *d'*. In the case under consideration, the circuits of wires *d* and *d'* do not enter into action.

Relay 24 becomes energized and pulls up and at T246 it completes the following circuit of relay 21: ground, windings of relay 21, T246, wire *t*, T184, R175, wiper T of S, wire *t* and battery connected to the wire *t* in the rural equipment ER. The relay 21 pulls up.

At T243 relay 24 completes via the wiper *a* of X3 at the fourth working position the circuits of the electromagnet X3 which becomes energized and advances its wipers to the fifth working position.

At this position the circuit of relay 17 of the selector is completed: ground, T211, wiper *b* of X3 at the fifth position, wire *f*, T183, winding of relay 17 and battery.

At R175 relay 17 opens the circuit of relay 21 which falls back. The following circuit of relay 25 of the register is completed: battery, upper winding of 25, wiper C of X3 at the fifth working position, wire *ss*, T181, T171', wiper *s* of selector S, wire *s* and ground applied on the wire *s* in the rural equipment ER.

When relay 21 has fallen back, the advance circuit of switch X3 is completed: ground, R211, T255, wiper *a* at the fifth working position, electromagnet X3 and battery. The wipers of X3 pass into the sixth working position. For this position the battery connected over the wiper C is suppressed on the wire *ss* and consequently on the wire *s* that terminates at the rural equipment, and this results in passing the equipment into dialing position.

The battery over relay 23 is shunted by the wiper *b* of X1, which is in resting position, with the battery over the springs of impulses I₂ and resistance R5. When the ground in the rural equipment ER is applied to the wire *a* to indicate that the equipment is ready to receive the dialing impulses, the ground is received over T174 and T182' on the wire *as*, and over T245 the wiper C of X3 at the sixth position energizes the relay 23 when the cam I₂ opens its contact.

The wiper *b* of X3 at the sixth position connects a battery to the wiper *a* of TR over the resistance R6.

The four wipers *e*, *f*, *g* and *h* control the sending of the trains of impulses. In the example shown in the drawings it can be seen that the first three digits of the registered number can effect the control of the selector connected to the register, and also the sending of four trains of impulses, i. e. five selections in all. In case one or more trains of impulses are not to be sent, the bank contacts that correspond to the wipers *e*, *f*, *g*, *h* are connected at Re to the terminal Y and this causes the advance of the corresponding positions by the electromagnet X3.

When relay 23 becomes energized upon the opening of the impulse springs I₂, it closes the cir-

circuit of the electromagnet **X1** over the impulse cam **I1** via: battery, winding of **X1**, **T231**, **R251**, **R214**, **T387**, impulse contacts **I1** and ground (it will be noted that the impulse springs **I1** are closed when the impulse springs **I2** are open).

The wipers of **X1** pass into the first position, and the circuit of relay **23** shunted on the impulse springs **I2** is suppressed and battery impulses are sent over the circuit via: battery, resistance **R5** impulse springs **I2**, wiper **c** of **X3**, **T245**, wire **as**, **T182**, **T174**, wiper **A** of **S**, wire **a** and impulse relay of the equipment **ER**.

The switch **X1** advances under the action of the impulses emitted by the impulse springs **I1** over the circuit: ground, springs **I1**, **T387**, **R214**, **R251**, wiper **c** of **X1**, electromagnet **X1** and battery.

When the wipers of **X1** have advanced by the number of steps that correspond to the number of impulses to be sent, which is determined by the connection made on the distribution frame **Re** of **TR**, the following circuit of relay **25** is completed: ground, bottom winding of **25**, wiper **a** of **X1**, bank contact to which there is connected in **Re** the wire that belongs to the contact of the wiper **e** on which the wiper has stopped, distribution frame **Re**, bank contact and wiper **e** of **RD**, wiper **b** of **X3** at the sixth working position, resistance **R6** and battery.

Relay **25** pulls up and at **T252** it short-circuits the impulse springs **I2** and this stops the sending of the impulses over the line equipment. At **T253** it closes its holding circuit over the resistance **R4**, and at **T251** it completes the automatic rotation circuit of **X1**: battery, electromagnet **X1**, wiper **c** of **X1**, wiper **d** of **X1**, **T251**, interruptor spring of **X1** and ground. The switch **X1** thus advances in free rotation as far as its sixteenth position. In order to retard its return to the resting position, the advance to the last positions is controlled by the cam **I1** over the circuit: battery, electromagnet **X1**, bank and wiper **d** of **X1**, **T387**, impulse springs **I1** and ground; and for the last bank contact but one over; bank and wiper **d** of **X3**, **T387**, impulse springs **I1**, and ground.

When the switch **X1** has returned to its resting position, the wiper **s** short-circuits the relay **25** which falls back, and relay **23** is again connected to the wire **as** over the wiper **c** of **X1** at its resting position.

During the passage of the wiper **b** of **X1** a ground impulse is sent to the electromagnet **X3** over the circuit: ground, spring contacts **I1**, **T387**, wiper **b** of **X1** at the last position, **R213**, wiper **a** of **X3** at the sixth position, electromagnet **X3** and battery. The wipers of **X3** pass to the seventh working position for which the battery over the resistance **R6** is applied to the wiper **f** of the translator **TR**.

The above indicated procedure is repeated for each train of impulses whose sending is caused by the ground applied to the wire **as** from the rural equipment **ER**, the ground effecting the energization of relay **23**, as has been explained. The stoppage of the sending of the impulses is effected, as shown for the first digit, when the wiper **a** of **X1** reaches the bank contact to which is connected the wipers **f**, **g**, or **h** of **TR** that controls the emitted impulse.

As has been shown, some of the registered digits may not be repeated back by the translator. In this case, the bank contacts of the wipers **e**, **f**, **g**, **h** that correspond to the said figures are connected to the terminal **Y** of **Re** and, when the wipers of **X3** reach the corresponding position, the

circuit of relay **21** is completed over the wiper **b** of **X3**, the resistance **R6** and the battery. Relay **21** pulls up and opens at **R214** the advance circuit of switch **X1**, and at **T213** it springs **I1**, **T367**, **T213**, wiper **a** of **X3**, electromagnet **X3** and battery. The electromagnet **X3** advances its wipers to the next position.

If, for example, it is assumed that each position of the translator corresponds to a group of 20 subscribers, i. e. two of 10: 00 to 19, 20 to 39, etc., the wire controlling the sending of the tens impulses should be connectable to two different contacts in the bank of sender **X1**. Thus for the tens beginning with 0 and 1, this wire is connected to the second contact of the wiper **a** of **X1** for the tens beginning with 1, and to the tenth contact for the tens beginning with 0, and to the contacts 3 and 4, etc., for the tens beginning with 2 and 3, etc. This switching to one contact or the other is effected by the relay **C** of **TR**, the operation of which has been explained for the fourth working position of the switch **X3**.

When all the trains of impulses that have been determined by the position of the translator **TR** have been sent, the switch **X3** will have brought its wipers to the tenth working position. The sending of the impulses of the units whose number is determined by the received digit that has been registered on the switch **X4** will now take place. The battery over the resistance **R5**, the wiper **b** of **X3** and the wiper **b** of **X4**, is connected to the control wire that corresponds to the registered number, the control wire being connected to the contact that corresponds to the bank of wiper **a** of the switch **X1**. The sending of the impulses accordingly takes place in the already described manner.

When the wipers of the switch **X1** reach the last contact but one of the bank, after the sending of the unit digit, they stop, since the advance circuit is open on the wiper **d** of the switch **X3**. Relay **32** is short-circuited by the circuit: ground, wiper **b** of **X1** at the ninth working position, wiper **a** of **X3** at the tenth working position, left hand terminal of the winding of relay **32**. The relay falls back and opens at **T322** the circuit of the relays **38** of the register and **18** of the selector, which fall back.

The circuit of relay **36** is completed: ground, bottom winding of **36**, **R381**, segments and wiper **f** of **X4**, contact and electromagnet **X4** and battery. Relay **36** pulls up and at **T364** it completes the return to rest circuits of the switches **X4**, **X5**, **X2** and **X3**.

The circuit of **X4** is: ground, **T364**, **R381**, segments and wiper **f**, contact and electromagnet **X4** and battery. This circuit is opened when the switch **X4** has returned to its resting position.

Circuit of **X5**: battery, electromagnet **X5**, segments and wipers **C** or **e** according to the position of the switch, **R384**, **T364**, and ground.

Circuit of **X2**: battery, electromagnet **X2**, segments and wiper **C**, **R386**, **T364** and ground.

Circuit of **X3**: battery, electromagnet **X3**, wiper **e**, **R383**, **T364** and ground.

When these various switches have returned to the resting position, the following short-circuiting circuit of relay **36** is completed: ground, **T363**, **T361**, wiper **b** of **X3** at its resting position, wiper **b** of **X2** at its resting position, wiper **a** of **X5** at its resting position, wiper **a** of **X4** at its resting position, right hand outlet of the upper winding of relay **36**. Relay **36** falls back and closes at **V361** the engagement circuit of the register.

Upon the falling back of relay **38**, the switch

X1 will have cleared the ninth working position via the circuit: ground, contact of the electromagnet X1, R388, wiper *b* at the ninth position, electromagnet X1 and battery. The tenth position is cleared by the circuit: ground, contact of X1, R367, wiper *b* at the tenth position, electromagnet X and battery. The switch X1 returns to the resting position. When relay 18 has fallen back, since its circuit is open at R323 of the register, it will have cut off the connections with the register and will have completed at R131' the connection of the rural area to the cord circuit. The operator can then ring the called subscriber and enter into conversation in the usual manner.

It will be noted that, after the dialing of the subscriber has been completed and the operator lifts her dial key, the ground that had been applied to the third wire of the cord circuit, i. e. to the sleeve CL of the jack L, is suppressed and the battery is applied again to the sleeve and this again causes relay 33 of the register to come into holding position on the above-mentioned circuit. The supervisory lamp of the cord circuit will flash as a result of the ground applied at T401 by the impulsing relay 40 on relay 33 for short-circuiting its high resistance bottom winding. This flicker will continue during the entire time of sending of the impulses and will end when the register is again released.

The operator will now proceed to call the wanted subscriber. For this purpose she inserts the second plug of the cord circuit that was used for calling back the calling subscriber in the jack L' associated with the jack L used for the recall. A battery is connected to the sleeve CL' of the plug L' and it completes over R41 and R83 this circuit of relay 3 which pulls up.

The starting circuit of the preselector P' is completed via earth, T32, R51, R44, contact and electromagnet R1 of P'.

The wipers of P' advance, hunting for a free selector, which will be a selector identical to that of Fig. 2. In the hereunder given description the explanations will be given as if referring to the diagram of Fig. 2, although in reality this particular selector is in engagement with the rural circuit of the calling subscriber as already explained.

When the wipers of P' reach the free selector, the circuit of relay 5 is completed thus: ground, T31, series windings of relay 5, wiper T of P', bank contact and wire *t* of the free selector, upper winding of relay 14, R172' and battery on the wire O via the register that is associated with the selector as mentioned in the preceding case. Relay 5 pulls up and completes at T51 the circuit of the bottom winding of relay 4, which becomes energized.

The operator then receives the same supervisory signals and proceeds to perform the same operations as mentioned in the preceding case for the call back to the calling subscriber. If the called subscriber belongs to a different rural area from that of the calling subscriber, the procedure for routing the call is the same as in the preceding case. After disconnection of the register, the subscribers are put in communication over: rural equipment ER of the called subscriber's circuit, a selector like the one of Fig. 2, a preselector P, the jack L, the cord circuit, the jack L', a preselector P', a second selector like the one of Fig. 1, and an equipment ER of the called subscriber's rural circuit.

The supervisory signals are given in the supervisory lamps of the cord circuit according to one of the methods adopted for rural networks.

Upon termination of the conversation, the operator withdraws the plugs of the cord circuit, the battery is suppressed on the wires *s* and the selectors are released.

If the called subscriber belongs to the same rural area as the calling subscriber, the following circuit of relay 26 is completed when the register passes into position 4 (discrimination): ground, resistance R3, T222, wire *d'*, T195', wire *d'*, wiper D' of the preselector P', T46, R82, upper winding of relay 8, R62, T124', wiper D1 of the preselector P, wire *d1* and, in the selector in engagement with the calling subscriber, T174', wiper D, wire *d* multiplied on the selector banks, wiper D of the selector used for calling the wanted subscriber, T183', common wire *d*, T223, upper winding of relay 26 and battery.

Relay 8 does not become energized owing to the value of the resistance R3.

At T261 relay 26 completes its holding circuit on its bottom winding over the ground of T382, and at T266 it short-circuits the resistance R3 of the wire *d'*, at R262 it opens the energization circuit of relay 24 before the relay becomes energized; at T263 it completes the circuit of the electromagnet X3 over the wiper *a* at the fourth working position and the ground of R211. The switch X3 passes to the third working position for which the circuit of the electromagnet is again completed across the wiper *a* and the ground of T264. The switch X3 passes to the sixth working position.

When the resistance R3 is short-circuited, the intensity of current becomes sufficient to cause energization of relay 8 (Fig. 3) over the circuit that has been mentioned. At T81 it completes its holding circuit over the ground of T124 (relay 12 has pulled up as mentioned when discussing the call of the wanted subscriber). At T82 relay 8 completes the circuit of relay 7 over the ground of wire *d'*.

Relay 7 pulls up and at R73 it cuts off the battery of CL on the wire *s'* in the direction of the equipment ER of the circuit on which the call back of the calling subscriber has been made, and this results in the passing of the equipment to the dialing position; at T71 it connects the dialing wire A', which comes from the register across the preselector P' and a selector, to the dialing wire that is connected to the equipment ER via the preselector P and the selector which effects the calling of the wanted subscriber.

When the circuit can receive impulses, the ground applied to the wire *a* in the equipment ER causes energization of relay 23 over the circuit: ground across the dialing relay of ER, wire *a*, wiper A of the selector used for the call back of the calling party, T, 174, R181', R161, wire *a1*, wiper A1 of the preselector P, T122', T71, wiper A' of the preselector P', T122', T71, wiper A' of the preselector P', wire *a'*, selector used for calling the wanted subscriber, T184', common wire *a'*, R24 (Fig. 4), wiper *c* of X3 at the positions 6 to 10 and, on the one hand, wiper *c* of X1 at the resting position of relay 23 and, on the other hand, impulse springs *l2*, resistance R5 and battery.

The sending of the impulses is then effected in the way mentioned in the preceding case.

When the register has returned to the resting position after the impulses have been sent, the selector used for calling the wanted subscriber asso-

ciated with the selector is released as mentioned in the preceding case. This selector had been controlled to the called direction, but the connection had not been made; this connection had been made impossible owing to the energization of relay 26 of the register which had prevented the excitation of relays 24 of the register and 17 of the selector.

Upon the release of the selector, the ground on the wires *d* and *t'* of the preselector P is suppressed and this causes the falling back of the relays 4 and 7 (Fig. 3).

The conductors of the plug used for the call back of the calling party are again connected to the equipment ER of the rural circuit across the preselector P and the selector that is associated with it.

The equipment passes into the calling and conversation positions in the normal manner, and with the usual supervision for establishing communication between two subscribers of one same area.

When relay 4 falls back (Fig. 3), a supervisory circuit (rapid flicker) is established by the supervisory lamp of the plug used for calling the wanted subscriber. This supervisory circuit warns the operator that this plug is to be withdrawn: supervisory circuit, wire CL' of plug L', R41, T33, relatively high resistance R1, and ground, on the one hand, and low value resistance R8 and ground on the contact of the beater relay S1, on the other hand.

Whenever the operator completes the connection between two subscribers of the rural district without calling back the calling subscribers, she remains in contact with the calling subscriber via the finder C (Fig. 3) across which the calling circuit has been seized. In order to ring the called subscriber she inserts in the jack L', which is paired with the jack L that is used for answering the calling subscriber, the second plug of the two-strand cord used for the said reply.

The mode of operation is the same as in the preceding case, but, in the equipment of Fig. 3, relay 12 has not become energized while relay 6 has become energized and maintained pulled up as in the case of the reply to a call from a rural subscriber. The circuit of relay 26 of the register used for calling the wanted subscriber is then completed in the following way: ground, resistance R3 (Fig. 4), T222, wire *d'*, T186', wire *d'*, wiper D' of the preselector P', T46, R32, upper winding of relay 8, T62, wiper D of C, wire *d* multiplied on the banks of the selectors, wiper D of the selector used for calling the wanted subscriber, T103', common wire *d*, T223, upper winding of relay 26 and battery.

It is only in this case that the equipment at the input end shown in Fig. 3 remains in engagement until the operator has withdrawn the plugs of the cord circuit used for establishing the local connection.

When the operator establishes communication between a subscriber outside of the rural district and a subscriber within the district, she can use the jack G (Fig. 2) of a free outgoing selector. The general mode of operation is the same as that described in the case of the call back of the calling subscriber, except that the equipment of Fig. 3 does not come into play and relay 14 (Fig. 2) remains in the resting position, since the connection of the conductors of the two-strand cord with the circuit is effected by R144, R143 and R145.

It will be noted that after a register has been

seized; if for any reason (slowness of the operator in setting up the number, congestion of the rural circuits, etc.) the succession of operations does not take place normally, the already established connections are released after a certain time (varying from 20 to 40 seconds) and the operator receives the busy signal. For this purpose, the cam 1 effects the energization of relay 35 on its upper winding. If relay 34 has fallen back, relay 35 completes its holding circuit at T351 on the ground of T382. When the cam 2 closes its contact, the circuit of relay 16 of the selector is completed by T352, wire *g*, T166', upper winding of 16.

At T161 and T163 it closes its holding circuit across the cord circuit, either on the wire *a* or on the wire *s*; at T162 it connects the busy signal which is sent to the operator, and at R163 it effects the release of the register.

In the device shown in Figs. 1 to 4, that has just been described, it has been seen that the choice of the circuit as well as the different selections, were effected automatically by the translator.

The operator does not have to worry about the rural area to which the called subscriber belongs; it is sufficient for her to use a free jack and to dial the code digits of the subscriber for the connection to be set up.

Referring to Fig. 6, an explanation will now be given of a device that permits simplification of the preceding equipment and that can be used in small district centrals. This device which is associated with each operating position makes it possible to give the subscribers of one district call numbers comprising the same number of figures. The choice of the circuit is made by the operator while making the call with the actual number of the called subscriber. For example, in the case of a four figure dialing, the choice corresponding to the first digit is made by the operator by plugging into a certain jack, and the device only registers and translates the hundreds digit. In case the rural subscriber is connected to a rural exchange that only requires a single digit, the tens digit is absorbed in the device and only the units digit is sent to the rural switchboard.

In the illustration of Fig. 3 it has been assumed, for example, that this translator could serve a network comprising 4,000 numbers, i. e. 40 exchanges or hundreds, each of the switches X1' and X2' having a capacity of 20 exchanges or hundreds.

The hundreds digit may be translated by 0, 1, 2 or 3 selections (connections of the banks X1a', X1b', X1e' to the banks X3a' (I), X3c' (III), and X3e' (I) of the sender switch X3'). The connections at the terminals *d* and *d'* determine whether the two last figures (tens digit and units digit) or if only the last figure (units digit) will be sent direct over the rural circuit.

When the operator has inserted the plug of a cord circuit in the corresponding jack of the called subscriber's area and she has received the dialing signal from the rural equipment, she depresses the dial key and relay 22' (or relay 22' and one of the relays 21', 23' or 24') becomes energized by the ground applied on the wire C (or C1', C2' or C3').

The wire C is multiplied on all the dial keys of circuits that serve, for example, the calling numbers of the first thousand, C1' on those of the second thousand, C2' on those of the third thousand and C3' on those of the fourth thousand.

At T225' relay 22' completes the circuit of re-

lay 1': ground, T225', closed contact of the dial CR, resistance R1', winding of 1' and battery. When relay 1' has pulled up, the circuit of relay 2' is completed: ground, T225', R61', T12' wiper *d* of the switch X2' at the resting position, wiper *g* of X1' at the resting position, winding of relay 2' and battery.

The circuit of the dial lamp LC is completed over: ground, T25', R53', lamp LC and battery.

When the dial lamp has lighted up, the operator sets up the hundreds digit on the dial CR. This dialing will control the switch X1', or X2' depending on whether the number is comprised in the 3d or 4th thousand in the example shown in the drawing.

Assuming that the subscriber's number is comprised in the third thousand, the circuit of the electromagnet X1', will be completed over: ground, T225', R62, R12' (at each falling back of relay 1' whose circuit is open on the impulse springs of the dial CR), T22', R241', electromagnet X1', and battery.

As soon as the dial CR leaves its resting position, the circuit of relay 4' is completed: ground, T225', right hand contact of Cr which is closed during the entire time of dialing, relay 4' and battery. At T41', relay 4' completes over T24' the holding circuit of relay 2' whose holding up circuit is opened as soon as the wiper *g* of X1' leaves its position of rest.

Upon termination of the series of impulses, relay 4' falls back, since its circuit is opened on the right hand contact of the dial, and at T41' it opens the circuit of relay 2' which falls back. Ground is applied to the wipers *a*, *b*, *c*, and *d* of X1' by the circuit: ground, T225', R43', R231, R242', R211' and wipers.

The circuit of the electromagnet X3' is completed by: ground, wiper *i* of X1' out of its resting position, T221', R21, impulse springs 12', R33', R63', wiper *h* of X3' at its resting position, electromagnet X3' and battery.

Upon each cut-off of the impulse springs 12', the electromagnet X3' advances its wipers by one step. After the first step, the circuit of the electromagnet X3' closes over: ground, wiper *i* of X' out of its resting position, T221', R21', impulse springs 12', R33', R63', R82', T224', wiper *b* of X3'.

The bank contacts of the wipers *a*, *b*, and *c* of V1' are connected to the bank contacts of the wipers *e*, *c* and *a*' of X3' by means of the distribution frame Re in such a way as to translate the registered figure by 0, 1, 2 or 3 selections.

Let us assume, for example, that the receiver figure is to be translated by three selections, the first of which consists of a train of two impulses, the second by a train of seven impulses and the third by a train of ten impulses.

In this case the bank contact on which the wiper *a* of X1' has stopped will be connected to the third contact of the bank of the wiper *a* of X3', the bank contact on which the wiper *b* of X1' has stopped will be connected to the bank of the wiper *c* of X3', and the bank contact on which the wiper *c* of X1' has stopped will not be connected (sending of 10 impulses).

As has been shown, the electromagnet X3' advances its wipers under the action of the cut-offs of the impulse springs 12'.

After the first step of the switch X3', the impulse springs 1'2' are connected to the wire A which is joined to the impulse circuit of the rural equipment over: battery, resistance R2', impulse

springs 1'1', R81' banks and wiper *f* of X3', R52' and wire A.

It can be seen that for each step after the first one by which the switch X3' advances, an impulse is sent over the wire A, i. e. to the impulse circuit of the rural equipment.

In the example under consideration, when the wiper *a* of X3' reaches the third bank contact, i. e. the second working contact, the following circuit of relay 8' is completed: ground on the wiper *a* of X1' over the above-mentioned circuit, connection at the distribution frame Re, third contact and wiper *a* of X3', R12', series windings of relay 8 and battery. At R81' the impulse circuit is opened and the sending of impulses terminates. At T83' relay 8' closes its holding circuit on the ground of T223', and at T82' it completes the automatic rotation circuit of the electromagnet X3': ground, contact of the electromagnet X3', T82', T224', wiper *b* of X3' for the first and third quarter turns and wiper *d* for the second and fourth quarter turns, electromagnet X3' and battery.

The electromagnet X3' advances its wipers as far as the sixth position of the second quarter turn in which its circuit is open. At this position relay 8' is short-circuited by the circuit: ground, T225', wiper *b* of X3' at the sixth position and left hand outlet of the windings of relay 8'. The circuit of the electromagnet X3' is then completed over: ground, wiper *i* of X1', T221', R21', impulse springs 1'2', R33', R63', R82', T224', wiper *d* of X3', electromagnet X3' and battery, and for the sixth position: R84', wiper *d* of X3', electromagnet X3' and battery. The wipers of X3' then advance step by step under the control of the impulse springs 1'2'. The object of this arrangement is to retard the return of the switch X3' to its resting position so as to leave sufficient time for the falling back of the slow relay that is associated with the impulse relay on which the train of impulses that have just been sent are received before the said switch passes to its last bank contact.

When the wiper *b* of X3' passes to the last contact of its bank, it completes the circuit of relay 3' on the battery connected to the wire A over the rural equipment: ground, bottom winding of relay 3', wiper *b* of X3' at the last working position, R52' and wire A. Relay 3' remains pulled up as long as the selectors in the rural exchange are not in a position to receive the next train of impulses.

At R33' relay 3' makes a cut-off in the advance circuit of the switch X3'.

As soon as the rural exchange is in a position to receive the next train of impulses, the battery on the wire A is removed, according to one of the known methods, and relay 3 falls back.

The above-mentioned circuit of the electromagnet X3' is again completed and the train of impulses that corresponds to the next figure are sent over the rural circuit in the same way as has been shown for the preceding figure.

The wiper C of X3' is then engaged with its bank (3d quarter turn). When it reaches its eighth bank contact after seven impulses have been sent across the wiper *f* of X3', the circuit of relay 8 is again completed. The said relay becomes energized over the circuit: battery, series windings of 8', R12', wiper *e* on the seventh working position, wire 1' at the distribution frame Re connected to the wire on which the wiper *b* of X1' has stopped, wiper *b*, R211', R242', R31', R43', T225' and ground.

Relay 8' stops the sending of impulses and advances the switch X3' as described for the sending of the preceding digit.

The wipers of X3' that are now in engagement with their bank contacts are those of the fourth quarter turns.

When the wiper *b* of X3' passes to the 8th position of its bank, relay 7' becomes energized over the circuit: ground, T225', bank contact and wiper *b* of X3', banks and wiper *g*, relay 7' and battery.

The relay 7' pulls up and at T74' it closes its holding circuit on the ground of T225', at T72' it connects the circuit of relay 8' to the bank of the wiper *e* of X3', and at T71' it prepares the circuit of relays 5' and 6'.

The other successive operations are carried out as indicated above, particularly the pulling up of relay 3'.

When relay 3' falls back, the electromagnet X3' starts again and the third train of impulses is sent over the rural circuit. Since there is no connection in the illustrated example between the bank contacts of the wiper *c* of X1' and *e* of X3', relay 3' only becomes energized when the wiper *b* of X3' is on the first contact of its bank, i. e. after the sending of 10 impulses, as the impulse circuit is opened when the wiper of X13' has left its bank.

The electromagnet X3' advances its wipers to the resting position of the third quarter turn. Relay 3' is connected in and the following circuit of relays 3' and 6' is completed over the resting position of the wiper C of X3: ground, T225', R43', R231', R242', R211', wiper *d* of X1 and bank contact connected either to terminal D or D', T73', wiper C of X3' in the resting position, relay 6', bottom winding of relay 3' and battery. At R63' the advance circuit of the electromagnet X3' is opened.

If the next digit, the tens digit, e. g., is not to be sent, the bank contact of wiper *d* is connected to the terminal D', and the resistance R4', which is then inserted in the just mentioned circuit of relays 5' and 6', prevents energization of relay 5'.

If the tens digit is to be sent, the bank contact of wiper *d* is connected to the terminal D and relays 5' and 6' become energized in series.

If the tens digit is to be absorbed when relay 6' becomes energized, while relay 5' remains at rest, the circuit of the lamp of dial LC is completed over: ground, T65' and R53'. The lamp lights up and the operator responds by setting up the tens digit on her dial. Relay 4' becomes energized as soon as the dial CR leaves its resting position and closes the circuit of relay 2' over: ground, T41', T64', relay 2' and battery. When the dial effects the cut-offs on the dialing springs, relay 1' beats, but its contact T11' is open at T52' and that of its contact T12' at R61'.

Upon termination of the train of impulses, relay 4' falls back when the dial CR has returned to its resting position and before the energization of relay 2' which is slow in falling back, and the circuit of relay 5' is completed over: ground, R41', T23, T62', upper winding of relay 5' and battery.

Relay 5' pulls up; at T51' it completes its holding circuit over the ground of T225'; at T52' it connects the bottom winding of relay 3' to wire A across T11'; and at T53' it prepares the circuit of the lamp of the dial LC. When the rural central is ready to receive the last digit, the units digit, relay 3' falls back and the circuit of the

lamp LC is completed over: ground, R41', R31' and T53'.

The operator sets up on the dial CR the units digit and everything takes place in the way described, for the tens digit, except that the impulses transmitted at R11' via relay 1' are sent over the wire A of the circuit across T52'.

The testing of the called subscriber's line is done in any convenient well-known manner and, when the operator lifts the dial key, the translator becomes released, since the circuit of relay 22' is open.

At T225' relay 22' opens the holding circuit of relays 5', 6' and 7' and closes the releasing circuit of the rotary switches—circuit X1': ground, wiper *i* out of its resting position, R221', spring and electromagnet X1', battery.

Circuit of X3': ground, interrupter spring of X3' and on the one hand, R226', wiper *g* of X3' at the resting position, electromagnet X3', battery and, on the other hand, R224', wiper *d* on the second and fourth quarter turns or wiper *h* on the first and third quarter turns, electromagnet X3' and battery.

When the wipers of the switches reach their resting position, the releasing circuits are opened and the switches stop.

It will be noted that the banks of the wipers *a*, *b*, *c* of X1' are respectively connected to the bank contact of the resting position of the wipers *a*, *c* (across R73') and *e* of the switch X3 via the wire *d* (distribution frame Re) if the train of impulses that corresponds to this position is not to be sent. This connection causes energization of relays 5' and 6' in the way already described for the circuit of the wiper *d* of X1', and the trains of impulses that correspond to the last two digits are sent by the dial over the rural circuit.

If the connection is made by the contact *d*, the resistance that is inserted in the circuit prevents the energization of relay 5' and the tens digit is absorbed in the already described manner.

It is of course understood that the above embodiments have only been given as examples without limitation of the invention thereby, and that it is possible, without departing from the scope of the invention, to provide any arrangement of switches or relays that makes it possible to obtain the desired translations, to replace the rotary switches by relays or vice versa, and to provide other modifications that may be necessary for integrating the devices in any rural system.

I claim:

1. In a telephone exchange system, a plurality of rural exchanges and a main exchange, subscribers' lines terminating at said rural exchanges, said lines being designated by numbers having the same number of digits, automatic selector switches at said rural and main exchanges over which calling and called subscribers' lines may be inter-connected, an operator's position at the main exchange, a calling device and a register operable in accordance with all the digits of the called numbers for controlling the establishment of connections between two subscribers' lines over a certain number of selector switches and between two other lines over a different number of selector switches.

2. In a telephone exchange system, a plurality of rural exchanges, subscribers' lines terminating at said exchanges, said lines being designated by numbers having the same number of digits, automatic switches at said exchanges for inter-con-

necting said subscribers' lines, a main exchange, an operator's position at the main exchange, line finders for connecting said position to calling lines at the rural exchanges, a calling device and a translator for controlling the switches at rural exchanges over a switch at the main exchange, and means for operating said translator to control the switches at the rural exchanges over a line finder.

3. The system according to claim 2 and pre-selectors for connecting selectors at the main exchange with the operator's position.

4. In a telephone exchange system, a plurality of rural exchanges, subscribers' lines terminating at said exchanges, a main exchange, selector switches at said exchanges for inter-connecting calling and called lines, an operator's position at the main exchange, a calling device at the operator's position, a translator at the main exchange controlled by the calling device, non-numerical switches at the main exchange for connecting a rural exchange with the operator's position, means operable when the called subscriber belongs to the same rural exchange as the calling subscriber for operating said translator to send impulses to a selector at the called rural exchange over a selector at the main exchange, and means operable when the called subscriber belongs to a different rural exchange from the calling subscriber for sending impulses to the called rural exchange via a non-numerical switch.

5. In a telephone exchange system, a plurality of groups of rural exchanges, subscribers' lines terminating at said exchanges, a main exchange, selector switches at said exchanges for inter-connecting calling and called lines, an operator's position at the main exchange, a calling device at the operator's position, a translator at the main exchange controlled by the calling device, a pre-selector and a line finder at the main exchange for connecting a rural exchange with the operator's position, means operable when the called subscriber belongs to the same rural group as the calling subscriber for operating said translator to send impulses to the rural exchange via a selector at the main exchange, and means operable when the called subscriber belongs to a different rural group from the calling subscriber for sending impulses to the called rural exchange via a pre-selector and a line finder.

6. In a telephone exchange system, a plurality of groups of rural exchanges, subscribers' lines terminating at said exchanges, a main exchange, selector switches at said exchanges for inter-connecting calling and called lines, an operator's position at the main exchange, a calling device at the operator's position, a translator at the main exchange controlled by the calling device, a pre-selector and a line finder at the main exchange for connecting a rural exchange with the operator's position, means operable when the called subscriber belongs to the same rural group as the calling subscriber for operating said translator to operate a selector at the main exchange to select the called rural group and then to send impulses via the operated selector to operate selectors for connecting with the called subscriber, and means operable when the called subscriber belongs to a different rural group from the calling subscriber for operating said translator to operate a selector at the main exchange to select the called rural group and then to send impulses to the called rural exchange via a pre-selector and a line finder.

7. In a telephone system, a plurality of groups of rural exchanges, lines terminating at said exchanges, selectors at said exchanges for inter-connecting calling and called lines, a main exchange, an operator's position at the main exchange, a translator, a calling device at the operator's position for operating the translator in accordance with the first digit of the called number to select the group to which the called rural subscriber belongs, and means for operating the translator for sending impulses to control selectors at the called rural exchange.

8. In a telephone exchange system, a plurality of rural exchanges, subscribers' lines terminating thereat, selector switches at said exchanges for inter-connecting calling and called lines, a main exchange, an operator's position thereat, a translator at the main exchange, a selector switch at the main exchange, a calling device at the operator's position for operating said translator in accordance with the digits of the called number, means controlled by the translator for operating the selector switch at the main exchange and the selector switches at the called rural exchange, and means in said translator for absorbing certain digits of the called number.

9. In a telephone exchange system, a plurality of rural exchanges, a central exchange comprising an operator's position, the numerical designations of all the lines terminating at the rural exchanges being composed of the same number of digits, trunk lines between said exchanges, automatic switches at said rural exchanges for establishing connections with subscribers' lines, numerical and non-numerical switches at the main exchange, connections from each numerical switch to the operator's position and to the non-numerical switches in multiple, connections from the position to the non-numerical switches, a translator arranged to be connected with the numerical switches, a first and a second rural circuit link, multiple connections from the first circuit link to the numerical and the first non-numerical switch and multiple connections from the second link to the numerical switches, means responsive to the initiation of a call by a rural subscriber for operating the first non-numerical switch to extend the calling line over the first rural circuit link and the first non-numerical switch to the operator's position, means controlled by the operator for establishing a connection with a called rural subscriber over a numerical switch, and over a non-numerical and numerical switch in series, the last-mentioned means including a calling device operable in accordance with the numerical designations of the called rural line, means in the translator for registering the digits sent out by the calling device, means controlled by the translator for operating said numerical switch to select a rural circuit link depending on the location of the called subscriber and for controlling the operation of the switches at the called rural exchange to select the called subscriber, means controlled by the translator when the called subscriber is located within the same exchange or group of exchanges as the calling subscriber for sending impulses over the operated non-numerical switches and the first rural circuit link for operating the switches at the called rural exchange to connect with the called subscriber, and means operative upon the establishment of the connection between the calling and called rural subscribers for releasing the translator and all the switches at the main exchange.

10. In a telephone exchange system, a plurality

of groups of rural exchanges, a central exchange comprising an operator's position, other exchanges, subscribers' lines terminating at said exchanges, the numerical designations of all the lines terminating at the rural exchanges being composed of the same number of digits, trunk lines between said exchanges, automatic switches at said rural exchanges for establishing connections with subscribers' lines, selector, finder and pre-selector switches at the main exchange, said position having first means over which connections from said other exchanges to the rural exchanges can be established, second means over which connections between rural subscribers can be established, connections from each selector to a first means calling jack and to the pre-selectors, connections from each second means to a pre-selector, connections from certain second means to a finder, a translator arranged to be connected with the selectors, a first and a second rural circuit link, connections from the first circuit link to the finders and the selectors, connections from the second link to the selectors, means responsive to the initiation of a call by a rural subscriber for operating said finder switch to extend the calling line over the first rural circuit link and a finder to the operator's position over the second means, means controlled by the operator for establishing a connection with a called rural subscriber over a first means and the associated selector, and over a second means, the associated pre-selector, and a selector, the last-mentioned means including a calling device operable in accordance with the numerical designations of the called rural line, means in the translator for registering the digits sent out by the calling device, means controlled by the translator for operating said selector to select a rural circuit link depending on the location of the called subscriber and for controlling the operation of the switches at the called rural exchange to select the called subscriber, means controlled by the translator when the called subscriber is located within the same exchange or group of exchanges as the calling subscriber for sending impulses over the operated pre-selector, the operator's position, the finder and the first rural circuit link for operating the switches at the called rural exchange to connect with the called subscriber, and means operative upon the establishment of the connection between the calling and called rural subscribers for releasing the translator and all the switches at the main exchange.

11. In a telephone exchange system, a plurality of groups of rural exchanges, a central exchange comprising an operator's position, other exchanges, subscribers' lines terminating at said exchanges, the numerical designations of all the lines terminating at the rural exchanges being composed of the same number of digits, trunk lines between said exchanges, automatic switches at said rural exchanges for establishing connections with subscribers' lines, selector, finder and pre-selector switches at the main exchange, each having a terminal bank and wipers cooperating therewith, said position having calling jacks over

which connections from said other exchanges to the rural exchanges can be established, and inter-rural paired answering and connecting jacks over which connections with rural subscribers can be established, connections from the wipers of each selector to a calling jack and to the terminal banks of the pre-selectors in multiple, connections from each connecting jack to the wipers of a pre-selector, multiple connections from each answering jack to the wipers of a pre-selector and a finder, a translator arranged to be connected with the wipers of the selectors, a first and a second rural circuit link, multiple connections from the first circuit link to the terminal banks of the finder and the selectors and multiple connections from the second link to the selectors, means responsive to the initiation of a call by a rural subscriber for operating said finder switch to extend the calling line over the first rural circuit link and a finder to the associated answering jack, means controlled by the operator for establishing a connection with a called rural subscriber over a calling jack and the associated selector, and over an answering or a connecting jack, the associated pre-selector, and a selector, the last-mentioned means including a calling device operable in accordance with the numerical designations of the called rural line, means in the translator for registering the digits sent out by the calling device, means controlled by the translator for operating said selector to select a rural circuit link depending on the location of the called subscriber and for controlling the operation of the switches at the called rural exchange to select the called subscriber, means controlled by the translator when the called subscriber is located within the same exchange or group of exchanges as the calling subscriber for sending impulses over the operated pre-selector, the associated jack, the finder and the first rural circuit link for operating the switches at the called rural exchange to connect with the called subscriber, means operative upon the establishment of the connection between the calling and called rural subscribers for releasing the translator and all the switches at the main exchange, means controlled by the operator for ringing a subscriber over a circuit including a connecting jack and the associated pre-selector and selector, and means controlled by the operator for ringing a rural subscriber over a connection including an answering jack and the associated pre-selector and selector.

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