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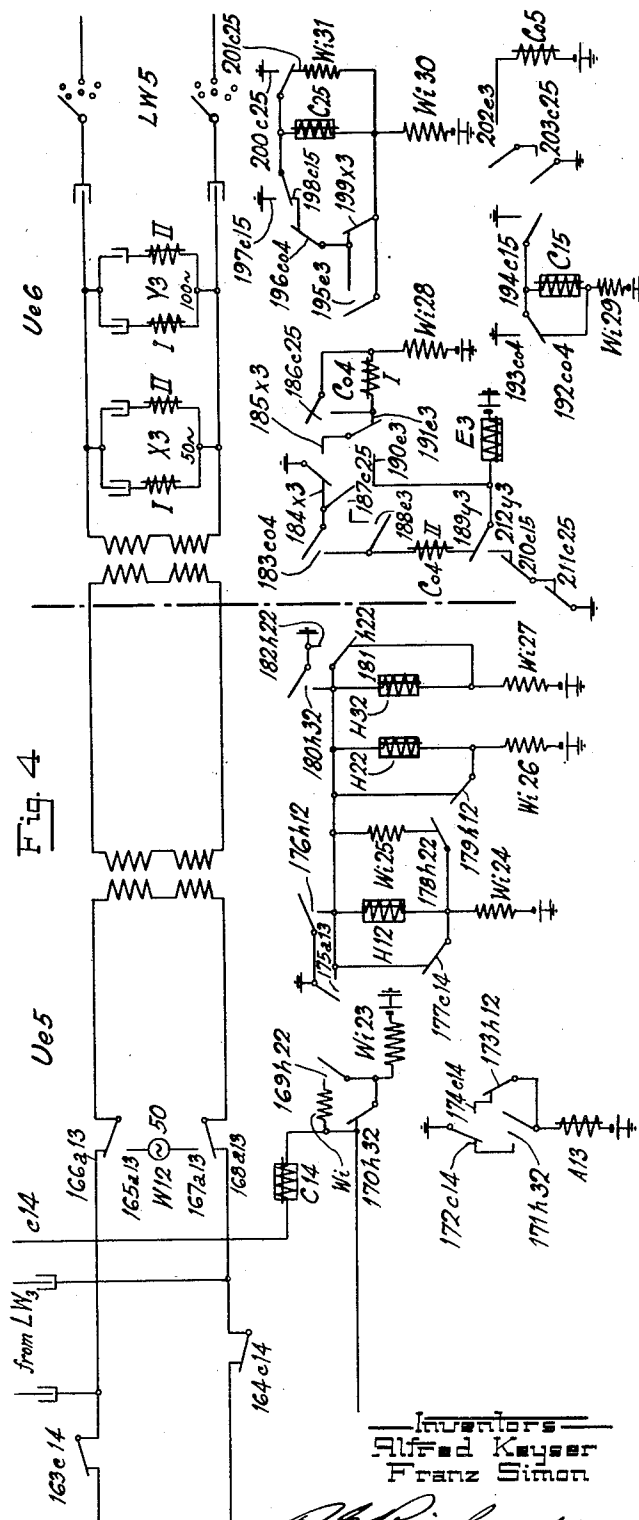
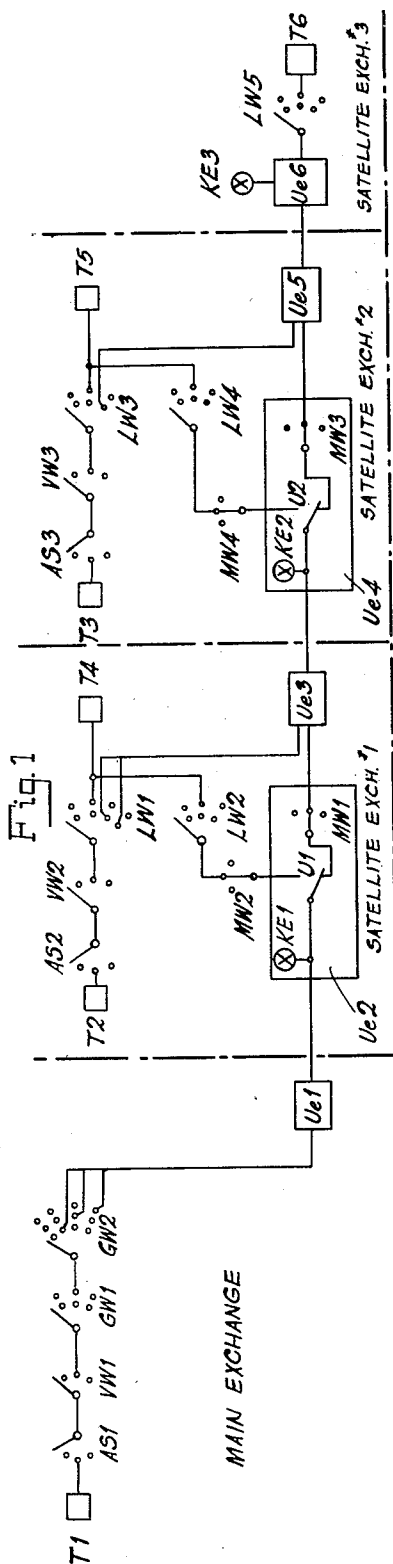
A. KEYSER ET AL

1,930,522

MULTIOFFICE AUTOMATIC TELEPHONE SYSTEM

Filed March 19, 1932

3 Sheets-Sheet 1



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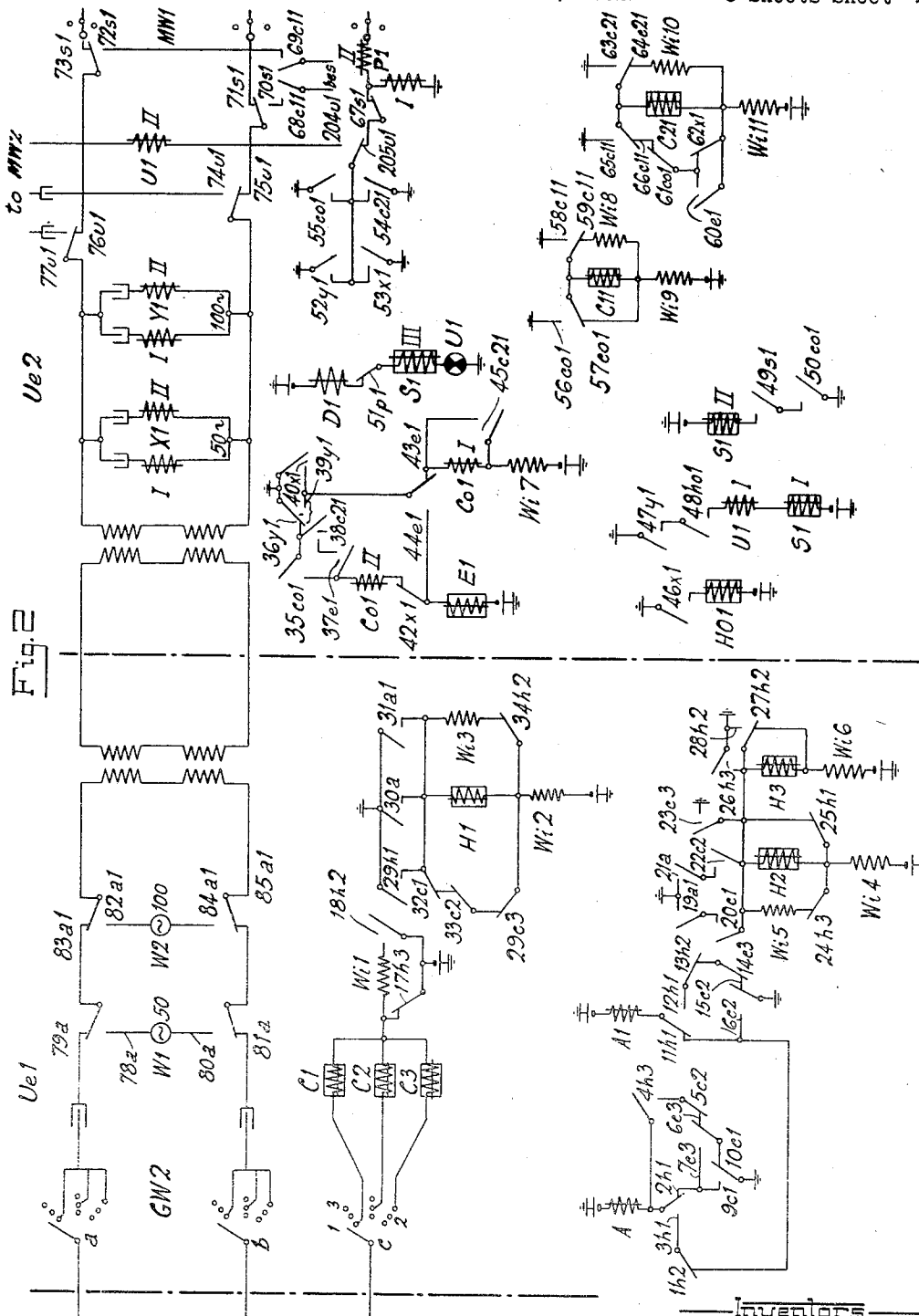
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MULTIOFFICE AUTOMATIC TELEPHONE SYSTEM

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3 Sheets-Sheet 2



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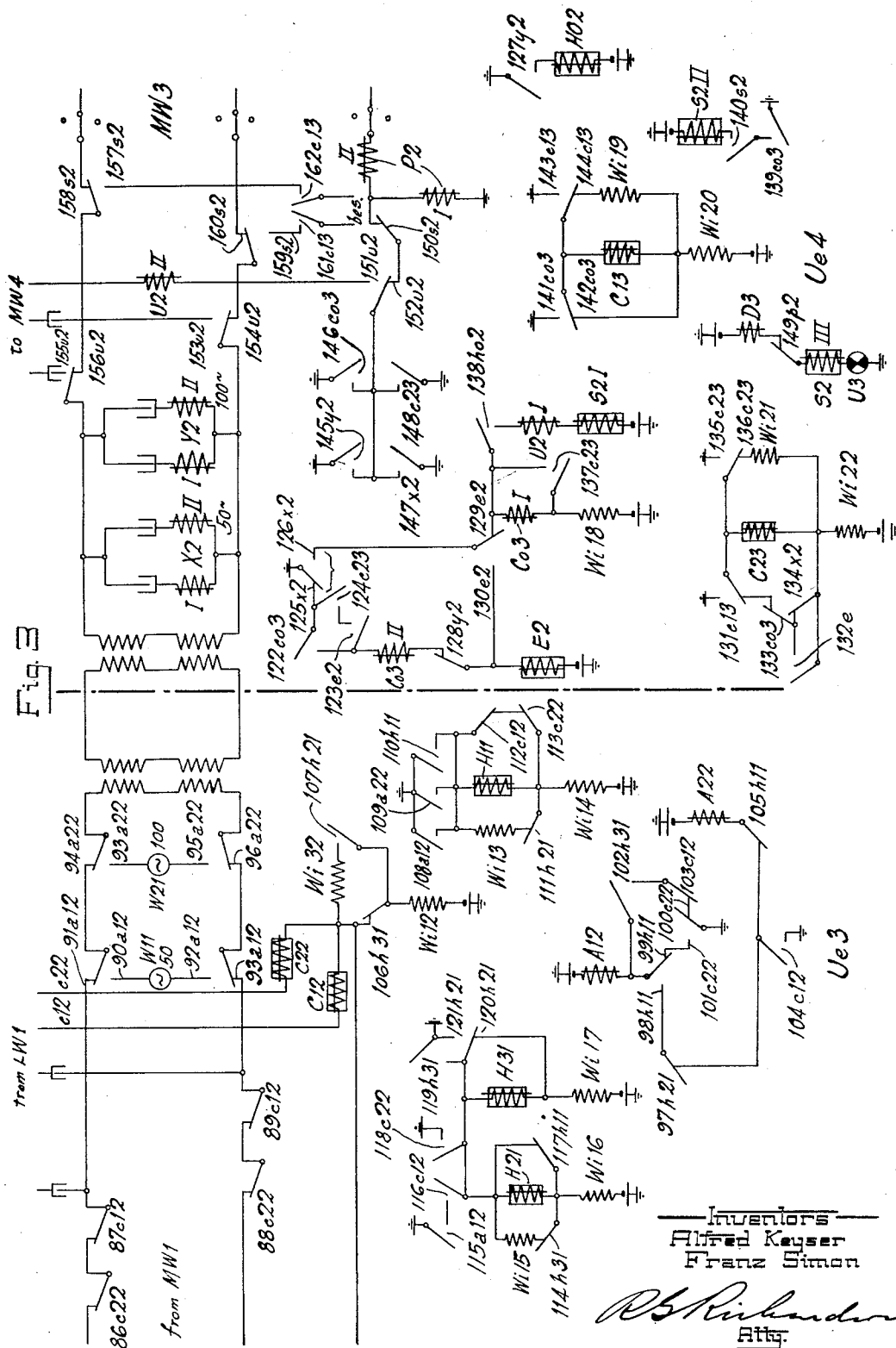
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MULTIOFFICE AUTOMATIC TELEPHONE SYSTEM

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3 Sheets-Sheet 3



UNITED STATES PATENT OFFICE

1,930,522

MULTIOFFICE AUTOMATIC TELEPHONE
SYSTEM

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and in Germany April 23, 1931

9 Claims. (Cl. 179—18)

This invention relates to automatic telephone systems provided with exchanges connected in series by junction lines accessible over free hunting switches.

5 One feature of the invention has for its object to facilitate the setting up of a connecting route in the required traffic direction in a simple and reliable manner. This is achieved by switching means which are caused to operate dependent on a switching operation carried out for determining the particular use to be made of common junction lines and which automatically applies alternating currents of definite frequencies successively to junction lines leading to exchanges and control switching devices arranged in the exchanges for the purpose of forming a connecting route to the required exchange.

10 This arrangement offers special advantages in systems provided with a plurality of exchanges in series due to the fact that a connecting route, extending over a plurality of exchanges may be set up with reliability.

15 Another feature has for its object to set up with great rapidity a connecting route from the calling to the required exchange in such a system independently of the location of the required exchange, this being achieved due to the exchanges being provided with switching devices which preparatorily connect together idle junction lines between the exchanges thus forming a connecting route extending over the series connected exchanges.

20 By this arrangement a connecting route extending over all the series connected exchanges is, therefore, set up already prior to the transmission of impulses characterizing the traffic direction with the result that the required exchange may be immediately reached even if a large number of exchanges are concerned.

25 An embodiment of the invention is shown in Figs. 1-4, Fig. 1 showing diagrammatically the system of interest in this case whereas Figs. 2-4 show the individual circuits of the switch train of this system.

30 As will be seen in Fig. 1, the subscriber T1, associated with a main exchange and shown in this figure, is able to reach subscribers of various satellite exchanges, for example, the subscriber T4 associated with the satellite exchange 1, the subscriber T5 of the satellite exchange 2 and the subscriber T6 associated with the satellite exchange 3.

35 When the subscriber T1 lifts his receiver the call finder AS1 starts hunting for the calling subscriber's line and the preselector VW1 for an

idle first group selector, the subscriber T1 being switched through to an idle group selector, for example, GW1 when the above two switches are brought to rest. Said group selector GW1 now being set to a definite level, in any known manner, by the transmission of number impulses hunts in this level for an idle succeeding second group selector, for example, GW2. The group selector GW2 may also be influenced by impulses sent out by the calling subscriber T1.

40 If the subscriber T1 wishes to set up a connection with the subscriber T4 associated with the satellite exchange 1, an impulse series comprising one impulse only is transmitted which sets the second group selector GW2 to the first level in which it hunts for a free repeater, for example, Ue1.

45 Said repeater Ue1 is connected over a preselecting secondary line switch MW1 to the repeater Ue3, without, however, said repeater Ue3 being guarded by the secondary line switch against seizure by other secondary line switches which, likewise, are capable of seizing this repeater. The repeater Ue3 is also connected over the secondary line switch MW3 in the satellite exchange 2 which, likewise, is preselectively set without furnishing a guard to the repeater Ue6 in the satellite exchange 3 over the repeater Ue5. It will thus be seen that a direct connection exists between the group selector GW2 and the repeater Ue6 in the satellite exchange 3.

50 When the group selector GW2 has reached the repeater Ue1 over its first level in the manner suggested above, a definite signal according to the setting of said group selector is sent out from the repeater Ue1 in the form of a definite frequency. How this signal is produced will be fully explained in a later paragraph. Said signal which denotes the required satellite exchange influences the identifying devices arranged in the various satellite exchanges, thus, in the satellite exchange 1 the identifying device KE1, the identifying device KE2 in the satellite exchange 2 and the identifying device KE3 in the satellite exchange 3. A connection being denoted to the satellite exchange 1 over the first level of the group selector GW2 due to the seizure of the repeater Ue1. The identifying devices KE1 in the repeater Ue2 causes a change over in such a manner that the secondary line switch MW1 associated with the change-over position U1 is disconnected and consequently the secondary line switch MW2 is connected up. It, likewise, has preselected an idle final selector, for example, LW2 without, however, having guarded said final

selector from being seized by other secondary line switches. The guarding of the final selector LW2 is effected as soon as the connection is switched over to it in a manner to be described later. The repeaters Ue3-Ue6 may now be used for the setting up of additional connections.

When the subscriber T1 transmits two additional impulse series, the first one will cause a final selector Lw2 to be raised accordingly, the second one causing it to rotate until the required subscriber T4 is reached. The speaking connection between the subscriber T4 of the satellite exchange 1 then extends from the group selector GW2, over the repeaters Ue1 and Ue2, the secondary line switch MW2 and the final selector LW2.

Should the subscriber T1 wish to set up a connection with the subscriber T5 associated with the satellite exchange 2, instead of sending out one single impulse with the object of setting the group selector GW2 he transmits an impulse series comprising two impulses which cause the group selector GW2 to be raised to the second level. The group selector GW2 in this level hunts for an idle repeater which might be the repeater Ue1 shown in Fig. 1. Since this repeater, however, was seized over the second level of the group selector GW2, an identification signal different from that transmitted in the case of the previous connection will be sent out to said repeater. The identifying devices KE1, KE2 and KE3 are influenced by said signal, but the effect in this case is that a change over will be carried out in the repeater Ue4 of the satellite exchange 2, causing the secondary line switch MW3 to be disconnected and the secondary line switch MW4 to be connected up. This secondary line switch MW4 also has preselected a final selector for example LW4 without, however, guarding this final selector. Only in this moment is the guarding set up at the secondary line switches MW1 and MW4. The final selector LW4 is then set to the required subscriber T5 by the succeeding two impulse series to be sent out by the subscriber T1. The speaking connection between the subscriber T1 and T5 thus extends from the group selector GW2 over the repeater Ue1, the secondary line switch MW1 in repeater Ue2, the repeaters Ue3 and Ue4 as well as over the secondary line switch MW4 and the final selector LW4.

For the purpose of setting up a speaking connection between the subscribers T1 and T6 associated with the satellite exchange 3 the group selector GW2 is raised to the third level in consequence of an impulse series comprising three impulses. The group selector may in this level again reach the repeater Ue1 shown in Fig. 1, if it is idle. Due to it being seized over the third level, however, still another identification signal different from those already used has to be sent out. This signal influences the identifying devices KE1, KE2 and KE3 in such a manner that the change-over stations U1 and U2 remain in the position shown, but a final selector LW5 in the satellite exchange 3 will be placed at the disposal of the succeeding impulses. It should be mentioned that only the repeater seized by the secondary line switches MW1 and MW3 is now guarded. When the subscriber now transmits the two last impulse series the final selector LW5 is accordingly set to the required subscriber T6.

The speaking connection then extends from the group selector GW2 over the repeater Ue1, the secondary line switch MW1 in the repeater Ue2,

repeater Ue3, secondary line switch MW3 in the repeater Ue4, repeaters Ue5, Ue6 and final selector LW5.

In addition to the connecting facilities described above, the subscribers associated with the individual satellite exchanges may also be interconnected as well as connected to subscribers associated with other satellite exchanges. Thus, for example, the subscriber T2 is able to reach a final selector LW1 over the call finder AS2 and preselector VW2, in which case said final selector LW1 may be set either to a subscriber of the same satellite exchange T4 or, alternatively, to the repeater Ue3. The repeater Ue3 in the same manner as repeater Ue1 is capable of influencing the identifying devices in the various satellite exchanges by sending out different identification signals in accordance with the access over which it was seized by the final selector LW1. Thus, for example, the change over device U2 in the satellite exchange 2 is actuated in the case of seizure from a particular means of access with the result that the secondary line switch MW3 is disconnected and MW4 connected thus causing, for example, the final selector LW4 in the satellite exchange 2 to be guarded. The subscriber T5 associated with the satellite exchange 2 may then be reached by the appropriate setting of the final selector LW4.

If the final selector LW1, however, is set by another impulse series, sent out by the calling subscriber T2, and consequently reaches the repeater Ue3 over another access, said repeater transmits a different signal which causes no change over in the repeater Ue4, but instead places the final selector LW5 at the disposal of the calling subscriber T2 over the repeaters Ue5 and Ue6, with the result that said final selector LW5 may be set to the subscriber T6 associated with the satellite exchange 3.

In the same manner a subscriber T3 may either reach a subscriber of the same satellite exchange or a subscriber associated with the satellite exchange 3.

In addition, it should be noted that the method of setting the impulse receivers is quite immaterial as regards the feature of this invention. This setting may, for example, be effected by direct current impulses or alternating current selection as assumed for the individual circuits shown. The circuits required for the selection have not been shown and they may take any shape or form of no interest in the present case. The release of the repeaters and switches concerned is also of no interest and consequently will not be described.

Figs. 2-4 are to be joined together for the succeeding specification and in such a manner that the secondary line switch MW1 (Fig. 2) is connected to the repeater Ue3 in Fig. 3 and the secondary line switch MW3 of this figure is connected to the repeater Ue5 in Fig. 4. Accordingly relay P1 associated with the secondary line switch MW1 in Fig. 2, is energized over: earth, windings I and II of relay P1, wiper of the secondary line switch MW1, contact 106h31 (Fig. 3), resistance W12, battery, earth. Relay P2 associated with the secondary line switch MW3 in Fig. 3, is likewise energized over: earth, windings I and II of relay P2, wiper of the secondary line switch MW3, contact 170h32 (Fig. 4), resistance W23, battery, earth.

The energizing circuits for the rotary magnets D1 or D3 of the above mentioned secondary

line switches are therefore cut off at contacts 51p1 (Fig. 2) or 149p2 (Fig. 3).

Assuming, in relation to the description of the individual circuits shown in Figs. 2-4, that a subscriber T1, as indicated in Fig. 1, has reached the group selector GW1 over the call finder AS1 and preselector VW1 and subsequently the group selector GW2 after completed setting on the part of said group selector GW1. If the group selector GW2 is now influenced by alternating current impulses, the various connections, broadly explained above, are set up in the following manner:

- (1) *Setting up a connection between the subscriber T1 associated with the main exchange and the subscriber T4 associated with the satellite exchange 1*

The subscriber T1, for the purpose of setting the group selector GW2, sends out an impulse by means of which, in a manner of no interest in this case, said group selector is set to the first level in which it may reach the repeater Ue1 as indicated in Fig. 2. This repeater is seized due to relay C1 being energized over the c-wiper and the contact bank of the first level by a not shown earth potential in the preceding selecting stage (GW1) in the following circuit: earth, battery, contact 17h3, relay C1, c-wiper of the group selector GW2, to earth potential applied to preceding switch. The closing of contact 9c1 energizes relay A over the following circuit: earth, battery, relay A, contacts 2h1, 9c1, earth. An alternating current impulse of a frequency of 50 cycles derived from an alternating current source of supply W1 is transmitted by the closing of contacts 78a and 80a over the leads shown in Fig. 2 with the object of influencing the identifying devices in the various satellite exchanges. The effect of this alternating current impulse will be described in a later paragraph.

Due to the energization of relay A the relay H1 will be energized, in addition to the transmission of the alternating current impulse, over contact 30a in the following circuit: earth, contact 30a, relay H1, resistance Wi2, battery, earth. This relay is placed in a locking circuit over its contact 29h1. Relay A is disconnected from battery by the opening of contact 2h1 and the alternating current source of supply W1 is consequently disconnected at contacts 78a and 80a. By the closing of contact 12h1 relay A1 will now be energized over: earth, battery, relay A1, contacts 12h1, 13h2, 14c3, 15c2, and earth, with the result that by the closing of contacts 82a1 and 84a1 an alternating current source of supply W2 which sends out an alternating current impulse of a frequency of 100 cycles over the shown junction line will be connected up. The effect which this alternating current impulse has upon the identifying device will also be described later. The energization of relay A1 causes, further, an energization of relay H2 over: earth, contacts 19a1, 20c1, relay H2, resistance Wi4, battery, earth. The closing of contact 28h2 energizes relay H3 over: earth, contact 28h2, relay H3, resistance Wi6, battery, earth. Relay A1 is disconnected from battery by the opening of contact 13h2 and the alternating current source of supply W2 is consequently disconnected by the opening of contacts 82a1 and 84a1. The resistance Wi1 is connected up over contact 18h2 with the result that since, upon the energization of relay H3, the contact 17h3 is opened, the repeater Ue1, reached by the group selector GW2, cannot be seized by

any other group selector. Relays H2 and H3 are maintained energized over contact 26h3.

The alternating current impulses of different frequencies sent out successively from the alternating current sources of supply W1 and W2 influence relays X1, Y1 in the repeater Ue2: X2, Y2 in the repeater Ue4 and X3, Y3 in the repeater Ue6, which are tuned to the corresponding frequencies. Relay X1 is tuned to the frequency of 50 cycles and is associated with the repeater Ue2 and is influenced by the alternating current source of supply W1.

Relay Co1 is energized by the closing of contact 40x1 in the following circuit: earth, contacts 40c1, 43e1, winding I of relay Co1, resistance Wi7, battery, earth. Relay Ho1 is energized over contact 46x1. By the closing of contact 55co1, the guarding of the line reached by the secondary line switch is maintained by the closing of contact 53x1. The secondary line switch MW1 seized the repeater Ue3 in its normal position. It thus caused relay P1 to be energized over: earth, windings I and II of relay P1, secondary line switch MW1, repeater Ue3, contact 106h31, resistance Wi12, battery, earth. The repeater Ue3 is guarded by the short circuit of winding I of relay P1 as indicated above. Relay X1 releases when the alternating current source of supply W1 is disconnected, whereupon an alternating current impulse of a frequency of 100 cycles influences relay Y1, tuned to this frequency, by the connecting up of the alternating current source of supply W2. Relay Co1 is now re-energized over contact 39y1. The closing of contact 47y1 causes relays U1 and S1 to be energized (relay Ho1 is still maintained energized after the de-energization of relay X1 due to the fact that it is constructed as a slow acting relay) over: earth, contacts 47y1, 48ho1, windings I of relays U1 and S1, battery, earth. The opening of contact 67s1 removes the guarding of the repeater Ue3 seized by the secondary line switch MW1. A change over in the repeater Ue2 to the secondary line switch MW2 is effected by the closing of contacts 77u1, 74u1 and 204u1 associated with relay U1. Relay U1 is maintained energized with its winding II over: earth, contacts 55co1, 204u1, winding II of relay U1 and battery in the not shown secondary line switch MW2.

As will be seen from Fig. 1, the subscriber T1 thus, in a manner of no interest in the present case, may reach, for example, the final selector LW2 in the satellite exchange 1 over the secondary line switch MW2. He can now cause this final selector LW2 to hunt for the required subscriber T4 by issuing an additional series of impulses.

Upon the de-energization of relay Y1 when the alternating current source of supply W2 is disconnected, relay Co1 remains energized over its winding II simultaneously energizing relay E1 over: earth, contacts 36y1, 35co1, winding II of relay Co1, contact 42x1, relay E1, battery, earth. Relay C11 which is maintained energized over contact 58c11 is energized over contact 56co1. Relay C21 is energized by the closing of contact 65c11 in the following circuit: earth, contact 65c11, relay c21, resistance Wi11, battery, earth. Relay C21 remains energized over contact 63c21.

The action the alternating current impulses has on relays X2 and Y2 in the repeater Ue4 (Fig. 3), said impulses being sent out by the repeater Ue1 as described above, is as follows: Relay X2 in the repeater Ue4 is energized by the alter-

minating current impulse of a frequency of 50 cycles transmitted over the leads of the junction line. Consequently, relay Co3 will be energized over contact 126x2. This circuit extends as follows: earth, contacts 126x2, 129e2, winding I of relay Co3, resistance Wi18, battery, earth. Relay Co3 is energized in this circuit. An earth potential is applied at contact 147x2 so as to guard the repeater Ue5 reached over the secondary line switch MW3, said repeater Ue5 being seized by the secondary line switch only.

When relay X2 is disconnected from battery at the end of the alternating current impulse of a frequency of 50 cycles, relay Co3 is de-energized by the opening of contact 126x2. If additional alternating current impulses of 100 cycles are transmitted from the repeater Ue1, relay Y2 which is tuned to a frequency of 100 cycles is energized and causes an energization of relay Ho2 over contact 127y2. Since a change over in the repeater Ue2 (Fig. 2) to the secondary line switch MW2 is effected at the contacts of relay U1 in the manner described above no further switching operations occur in the repeater Ue4. Relay Ho2 is, therefore, disconnected from battery and the guarding of the repeater Ue5 is removed.

The alternating current impulses have the following influence on the relays associated with the repeater Ue6 (Fig. 4).

Relay X3 is energized by the alternating current impulse of a frequency of 50 cycles and causes an energization of relay Co4 by the closing of contact 285x3 in the following circuit: earth, contacts 185x3, 191e3, winding I of relay Co4, resistance Wi28, battery, earth.

Relay X3 releases at the end of said alternating current impulse and consequently causes the release of relay Co4.

The alternating current impulse of a frequency of 100 cycles then causes relay Y3 to be energized. Since the change over in the repeater takes place now, no further switching operations can occur in the repeater Ue6.

2. Setting up a connection between the subscriber T1 associated with the main exchange and the subscriber T5 associated with the satellite exchange 2

In order to set up the connection the subscriber T1 sends out an impulse series comprising two impulses with the object of setting the group selector GW2. These impulses cause the group selector GW2 to be raised to the second level. In this level the group selector GW2 may find the repeater Ue1 to be idle with the result that relay C2 in the repeater Ue1 is energized over the c-wiper of the group selector GW2. This circuit extends as follows: earth, battery, contact 17h3, relay C2, c-wiper of the group selector GW2, and earth potential in the not shown preceding group selector. Relay A1 will now be energized by the closing of contact 16c2 in the following circuit: earth, battery, relay A1, contacts 11h1, 16c2, earth. The closing of contacts 82a1 and 84a1 connects up the alternating current source of supply W2, thus sending out an alternating current impulse of a frequency of 100 cycles to influence the identifying devices in the various satellite exchanges. Relay H1 is energized by contact 31a1 over: earth, contact 31a1, relay H1, resistance Wi2, battery, earth, and is maintained energized over its contact 29h1. The opening of contact 11h1 disconnects relay A1 from battery and consequently also disconnects the al-

ternating current source of supply W2. This results in an energization of relay A as follows: earth, battery, relay A, contacts 3h1, 1h2, 16c2, earth. The closing of contacts 78a and 80a connects up the alternating current source of supply W1 to the leads of the junction line, whereupon an alternating current impulse of a frequency of 50 cycles will be sent out. When relay A is energized, relay H2 also is caused to be energized over: earth, contacts 21a, 22c2, relay H2, resistance Wi4, battery, earth. The opening of contact 1h2 disconnects relay A from battery and consequently also disconnects the alternating current source of supply W1. Relay H3 is energized by the closing of contact 28h2 over: earth, contact 28h2, relay H3, resistance Wi6, battery, earth. Relays H2 and H3 are maintained energized over contact 26h3. The resistance Wi1 is connected up by the contact 18h2 with the result that, since the contact 17h3 is opened due to the energization of relay H3, the repeater Ue1 cannot be seized by any other group selectors.

The alternating current impulses transmitted from the repeater in the order 100 cycles—50 cycles cause the following switching operations to be performed in the satellite exchanges: relay Y1 tuned to a frequency of 100 cycles is first influenced in the repeater Ue2 with the result that relay Co1 is energized over contact 39y1 in the following circuit: earth, contacts 39y1, 43e1, winding I of relay Co1, resistance Wi7, battery, earth. When relay Y1 releases at the end of the alternating current impulse, relay Co1 will be de-energized but is re-energized upon the energization of relay X1 over contact 40x1 due to the alternating current impulse of a frequency of 50 cycles. Relay X1 releases at the end of this alternating current impulse whereupon relay Co1 is maintained energized over its winding II and at the same time causes relay E1 to be energized over: earth, contacts 36y1, 35c1, winding II of relay Co1, contact 42x1, relay E1, battery, earth. After the repeater Ue3, reached by the secondary line switch MW1 due to an earth potential being applied at contact 53y1, has been guarded in the manner described above, said guarding will be maintained at contact 55c1.

The connection now remains switched through over the secondary line switch MW1 to the repeater Ue3 (Fig. 3). Relay C11 is energized by the closing of contact 56c1 and is maintained energized over contact 58c11. Relay C21 is energized over contact 65c11 (locking circuit extending over contact 63c21). No further switching operations will take place in the repeater Ue2.

The following switching operations will be initiated in the repeater Ue4, however, by the transmission of the alternating current impulse:

The relay Y2 which is tuned to a frequency of 100 cycles is first energized. Thereupon the relay Ho2 is energized over contact 127y2. Relay Y2 releases at the end of the alternating current impulse. Relay X2 is now energized by the alternating current impulse of a frequency of 50 cycles and in turn causes an energization of relay Co3 over: earth, contacts 126x2, 129e2, winding I of relay Co3, resistance Wi18, battery, earth. The guarding of the repeater Ue5, already caused by contacts 147x2 and 145y2 is maintained over the secondary line switch MW3 by the closing of contact 146c3. Further, the relays U2 and S2 are energized over: earth, contacts 126x2 129e2, 138h2, windings I of relays U2 and S2, battery,

earth. When relay X2 releases at the end of the alternating current impulse of a frequency of 50 cycles, relay Co3 is maintained energized over its winding II and at the same time causes the energization of relay E2 over: earth, contacts 125x2, 122co3, winding II of relay Co3, contact 128y2, relay E2, battery, earth. The guarding of the repeater Ue5 (Fig. 4) is again removed at contact 150s2 by the above mentioned energization of relay S2, whereas the secondary line switch MW4 will be connected up at contacts 155u2, 153u2, and 151u2 of relay U2 in place of the secondary line switch MW3. Relay U2 then remains energized with its winding II over: earth, contacts 146co3, 151u2, winding II of relay U2, to battery in the not shown secondary line switch MW4. The closing of contact 141co3 energizes relay C13 and causes it to be maintained energized over contact 143c13. By closing contact 131c13 it causes relay C23 to be energized which in turn is maintained energized over contact 135c23.

The secondary line switch MW4 is preparatorily set to a final selector LW4 in the manner indicated in Fig. 1. When the calling subscriber T1 sets this final selector to the required subscriber T5, the speaking connection is completed.

The transmission of alternating current impulses produces the following switching operations in the repeater Ue6:

The energization of relay Y3 causes an energization on the part of relay E3 (alternating current impulses of a frequency of 100 cycles) over: earth, contacts 211c25, 210c15, 212y3, relay E3, battery, earth.

When, at the end of this impulse series, relay Y3 releases, the relay E3, being constructed as a slow acting relay, is still operated, and is maintained energized over contact 185x3 of relay X3 which is energized on receipt of the succeeding alternating current impulse of a frequency of 50 cycles.

When relay X3 releases at the end of this impulse, relay E3 also is de-energized after a short period with the consequence that the repeater Ue6 will be restored to normal.

3. Setting up a connection between the subscriber T1 associated with the main exchange and the subscriber T6 associated with the satellite exchange 3

The group selector GW2 with the object of setting up this connection is set to the third level by the calling subscriber T1 so that, on the assumption that the first idle repeater encountered is the repeater Ue1, shown in Fig. 2, relay C3 will be energized over the c-wiper over: earth, battery, contact 17h3, relay C3, c-wiper of the group selector Gw2, earth applied to the preceding group selector. The closing of contact 7c3 energizes relay A over: earth, battery, relay A, contacts 2h1, 7c3, 10c1, earth. An alternating current impulse of a frequency of 50 cycles from the alternating current source of supply W1 is transmitted upon the closing of contacts 78a and 80a to the identifying devices of the various satellite exchanges. Relay H1 is energized over contact 30a causing relay A to be de-energized on the opening of contact 2h1, thus, at the same time disconnecting the alternating current source of supply W1. The opening of contact 25h1 removes the short circuit for relay H2 with the result that this relay is energized. An energization of relay H3 is then caused over contact 28h2. Relays H2 and H3 are placed in a locking circuit over contact 26h3. An alter-

nating current impulse of a frequency of 50 cycles is consequently sent out from the repeater Ue1. This impulse influences only relay X1 in the repeater Ue2 with the result that relay Co1 is energized in the following circuit due to the closing of contact 40x1: earth, contacts 40c1, 43e1, winding I of relay Co1, resistance W17, battery, earth. Relay Ho1 will be energized when contact 46x1 is closed. Relay Co1 is maintained energized with its winding II upon the de-energization of relay X1 and at the same time causes relay E1 to be energized over: earth, contacts 36y1, 35co1, winding II of relay Co1, contact 42x1, relay E1, battery, earth. The repeater Ue3, reached by the secondary line switch MW1, is guarded in the manner already described in several instances. After relay Co1 has been energized, relay C11 is also caused to be energized over contact 50co1. Relay C11 causes an energization of relay C21 by closing contact 65c11.

Relay X2 in the repeater Ue4 (Fig. 3) is influenced by the alternating current impulse of a frequency of 50 cycles and causes relay Co3 to be energized over its contact 126x2 in the following circuit: earth, contacts 126x2, 129e2, winding of relay Co3, resistance W18, battery earth. Relay Co3, upon de-energization of relay X2, is maintained energized with its winding II, at the same time causing an energization of relay E2 over: earth, contacts 125x2, 122co3, winding II of relay Co3, contact 128y2, relay E2, battery, earth. No further switching operations occur in the repeater Ue4 in addition to the guarding of the repeater Ue5 described in several instances after energization of relay C13 over contact 141co3 and the subsequent energization of relay C23 over contact 131c13.

The alternating current impulse causes the following operations in the repeater Ue6 (Fig. 4). Relay X3 is actuated and closes its contact 185x3 which in turn causes an energization of relay Co4 over: earth, contacts 185x3, 191e3, winding I of relay Co4, resistance W128, battery, earth. Relay Co4 is maintained energized over its winding II after relay X3 has released but at the same time causes relay E3 to be energized over: earth, contacts 184x3, 183co4, winding II of relay Co4, contact 189y3, relay E3, battery, earth. Relay C15 is energized over contact 193co4, causing relay C25 to be energized over contact 197c15 and subsequently relay Co5 to be influenced over contacts 203c25 and 202c3. The final selector LW5 in the satellite exchange 3 is seized and guarded by relay Co5 in a manner of no interest in the present case. The calling subscriber T1 may now set the final selector to the required subscriber by transmitting additional impulses.

In the manner shown in Fig. 1, the various subscribers associated with the satellite exchanges are in a position to set up connections either to subscribers associated with the same satellite exchange or to subscribers associated with other satellite exchanges.

4. Setting up a connection between the subscriber T2 associated with the satellite exchange 1 and the subscriber T5 associated with the satellite exchange 2

As will be seen from Fig. 1, the subscriber T2 is able to reach a final selector LW1 over the call finder AS2 and preselector VW2. By sending out two impulse series the subscriber T2 may set the final selector LW1 to a definite contact of a level in a manner of no interest in this case and thus

- size, for example, the repeater Ue3, shown in Fig. 3, over the test lead C12. Relay C12 is energized over this lead by an earth potential applied in any suitable manner to the final selector LW1 (earth applied to the final selector LW1, lead c12, relay C12, contact 106h31, resistance Wi12, battery, earth). The closing of contact 104c12 energizes relay A22 over: earth, battery, relay A22, contacts 105h11, 104c12, earth. The alternating current source of supply W21 is connected to the leads of the shown junction line over the contacts 93a22 and 95a22 and transmits an alternating current impulse of a frequency of 100 cycles. Relay H11 is energized by the closing of contact 109a22 in the following circuit: earth, contact 109a22, relay H11, resistance Wi14, battery, earth. Relay H11 is thus energized in this circuit and by the opening of contact 105h11 causes relay A22 to be de-energized. By the closing of contact 98h11, relay A12 will be energized over: earth, battery, relay A12, contacts 98h11, 97h21, 104c12, earth. The alternating current source of supply W11 is connected to the leads of the junction line over contacts 90a12 and 92a12 with the object of transmitting cycles. The removal of the short-circuit at contact 117h11 causes relay H21 to be energized over: earth, contacts 115a12, 116c12, relay H21, resistance Wi16, battery, earth. The closing of contact 121h21 energizes relay H31 over: earth, contact 121h21, relay H31, resistance Wi17, battery, earth. The opening of contact 97h21 de-energizes relay A12 and consequently disconnects the alternating current source of supply W11. A resistance Wi32 is connected up in the circuit by the opening of contact 106h31 and the closing of contact 107h21 and this prevents the repeater Ue3 from being seized by another side. Relays H21 and H31 are maintained energized over contact 119h31.
- The alternating current impulses transmitted from the alternating current sources of supply W21 and W11 influence the individual repeaters in the manner described under heading 2. The only difference in operation is that the reached final selector may be set by the subscriber T2.
5. *Setting up a connection between a subscriber T2 associated with the satellite exchange 1 and the subscriber T6 associated with the satellite exchange 3*
- When the subscriber T2 wishes to set up a speaking connection with subscriber T6, the final selector LW1 after the setting of the call finder AS2 and preselector VW2 (Fig. 1), is set in such a manner that it reaches the repeater Ue3, shown in Fig. 3, over the test lead c22. The following circuit is then completed: earth applied to the final selector LW1, lead c22, relay C22, contact 106h31, resistance Wi12, battery, earth. Relay C22 is energized in this circuit and by the closing of its contact 101c22 causes relay A12 to be energized over: earth, battery, relay A12, contacts 99h11, 101c22, earth. The alternating current source of supply W11 is connected to the lead of the junction line over contacts 90a12 for the purpose of sending out an alternating current impulse of a frequency of 50 cycles. Due to the closing of contact 108a12, relay H11 will be energized over: earth, contact 108a12, relay H11, resistance Wi14, battery, earth. The energizing circuit for relay A12 is cut off at contact 99h11 thus causing the alternating current source of supply W11 to be disconnected. After removing the short circuit at contact 117h11, relay H21 is energized over contact 118c22 in the following circuit: earth, contact 118c22, relay H21, resistance Wi16, battery, earth. The closing of contact 121h21 energizes relay H31 over: earth, contact 121h21, relay H31, resistance Wi17, battery, earth. Relays H21 and H31 are maintained energized over contact 119h31. No further alternating current impulses are now transmitted from the repeater Ue3. The switching operations already described under heading 3 are initiated in the other repeaters due to this individual alternating current and upon the completion of said switching operations the final selector LW5 may be set by the calling subscriber T2 to the required subscriber T6.
6. *Setting up a connection between the subscriber T3 associated with the satellite exchange 2 and the subscriber T6 associated with the satellite exchange 3*
- As will be seen from Fig. 1 the subscriber T3, after setting the call finder AS3 and the preselector VW3 reaches a final selector LW3 which said subscriber may set by transmission of number impulses to a contact over which the repeater Ue5 is reachable. This repeater Ue5 is therefore seized over the test lead c14 in the manner shown in Fig. 4, and thus influences relay C14 in a manner of no interest in the present case. The closing of contact 174c14 energizes relay A13 over: earth, contacts 174c14, 173h12, relay H13, battery, earth. An alternating current source of supply W12 is connected up to the leads of the junction line over contacts 165a13 and 167a13 for the purpose of transmitting an impulse of a frequency of 50 cycles. Upon the energization of relay A13, relay H12 will also be energized over: earth, contact 175a13, relay H12, resistance Wi24, battery, earth. The opening of contact 173h12 disconnects relay A13 and, at the same time, the alternating current source of supply W12 from battery, at contacts 165a13 and 167a13. Relay H22 is energized over contact 176h12 upon the opening of contact 179h12 (earth, contact 176h12, relay H22, resistance Wi26, battery, earth), and, by the closing of contact 182h22, energizes relay H32. Relays H22 and H32 are maintained energized over contact 108h32.
- Relay X3 in the repeater Ue6 is influenced by the alternating current impulse of a frequency of 50 cycles and, in the manner described under heading 3, seizes the final selector LW5 whereupon this can be set to the required subscriber.
- What is claimed is:
1. A telephone system comprising a main exchange and a plurality of sub-exchanges, a trunk line connecting said main exchange and said sub-exchanges in series, a repeater in said main exchange arranged to send out coded alternating current impulses over said trunk line, identifying devices in said sub-exchanges for receiving said alternating current impulses, said identifying devices comprising means for selectively connecting the sub-exchanges to said trunk line, and means in each of said sub-exchanges for extending said trunk line to a called party.
 2. In a telephone system a main exchange and a sub-exchange, a trunk line connecting said main exchange and said sub-exchange, a repeater in said main exchange arranged to send out coded alternating current impulses over said trunk line, an identifying device in said sub-exchange for receiving said alternating current impulses, said identifying device comprising means for connecting said sub-exchange to said

trunk line, and means in said sub-exchange for extending said trunk line to a called party.

3. In a telephone system a main exchange and a sub-exchange, a trunk line connecting said main exchange and said sub-exchange, automatic switching means in said main exchange, a repeater in said main exchange, means for selecting said repeater, said repeater comprising means for sending out coded alternating current impulses, a second repeater in said sub-exchange comprising means for receiving said alternating current impulses, a switching device in said second repeater comprising means for connecting said sub-exchange to said trunk line, automatic switches in said sub-exchange, and means for controlling said automatic switches to extend said trunk line to a called party.

4. In a telephone system, a main exchange and a sub-exchange, a trunk line connecting said main exchange and said sub-exchange, automatic switching means in said main exchange, a repeater in said main exchange, means for selecting said repeater by said automatic switches, said repeater comprising means for sending coded alternating impulses over said trunk line, a second repeater in said sub-exchange, an identifying device and a switching device included in said second repeater, said identifying device including means for receiving said impulses, said switching device comprising means for connecting said sub-exchange to said trunk line, automatic switches in said sub-exchange, and means for controlling said automatic switches to extend said trunk line to a called party.

5. In a telephone system a main exchange, a first sub-exchange and a second sub-exchange, a trunk line connecting said main exchange and said sub-exchanges in series, a repeater in said main exchange, a second repeater in said first sub-exchange, a third repeater in said second sub-exchange, said first repeater comprising means for sending coded alternating current impulses corresponding to the code for said second sub-exchange over said trunk line, means controlled by said third repeater for connecting said second sub-exchange to said trunk line, and means in said sub-exchange for extending said trunk line to a called party.

6. In a telephone system, a main exchange, a first sub-exchange and a second sub-exchange, a trunk line connecting said main exchange and said sub-exchanges in series, said trunk line comprising a section extending from said main exchange to said first sub-exchange and a second section extending from said first sub-exchange to said second sub-exchange, automatic switching means in said main exchange, a repeater in said main exchange, means for operating said automatic switches to select said repeater, a second repeater in said first sub-exchange, an identifying device and a switching device in said second repeater, a rotary line switch in said second repeater comprising means

for preparatorily connecting said sections, a third repeater in said second sub-exchange, a second identifying device and a second switching device in said third repeater, said first repeater comprising means for sending coded alternating current impulses corresponding to the code for said second sub-exchange over said trunk line, said second identifying device comprising means for receiving said impulses, said second switching device containing means for connecting said second sub-exchange to said trunk line, automatic switches in said second sub-exchange, and means for controlling said automatic switches to extend said trunk line to a called party.

7. In a telephone system, a first sub-exchange and a second sub-exchange, a trunk line connecting said sub-exchanges, a repeater in said first sub-exchange, automatic switching means in said first sub-exchange, means for operating said automatic switches to select said repeater, a second repeater in said second sub-exchange, an identifying device and a switching device in said second repeater, said first repeater comprising means for sending coded alternating current impulses corresponding to the code for said second sub-exchange, said identifying device containing means for responding to said impulses, said switching device comprising means for connecting said second sub-exchange to said trunk line, automatic switches in said second sub-exchange, and means for controlling said automatic switches to extend said trunk line to a called party.

8. In a telephone system, a main exchange and a sub-exchange, a trunk line connecting said main exchange and said sub-exchange, a repeater in said main exchange arranged to send out coded alternating current impulses over said trunk line, an identifying device in said sub-exchange for receiving said alternating current impulses and connecting said sub-exchange to said trunk line, means in said identifying device for guarding said trunk line, and means in said sub-exchange for extending said trunk line to a called party.

9. In a telephone system comprising a main exchange and a plurality of sub-exchanges, a trunk line connecting said main exchange and said sub-exchanges in series, a repeater in said main exchange, a plurality of switching means in said repeater arranged to effect the transmission of coded alternating current impulses of different frequencies respectively, means for causing said switching means to function in a sequence dependent upon the route over which the repeater is taken into use, identifying devices in said sub-exchanges for receiving said alternating current impulses, means in said identifying devices for selectively connecting the sub-exchanges to said trunk line, and means in each of said sub-exchanges for extending said trunk line to a called party.

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