Dec. 9, 1941. A. KEYSER ET AL 2,265,235

TELEPHONE SYSTEM

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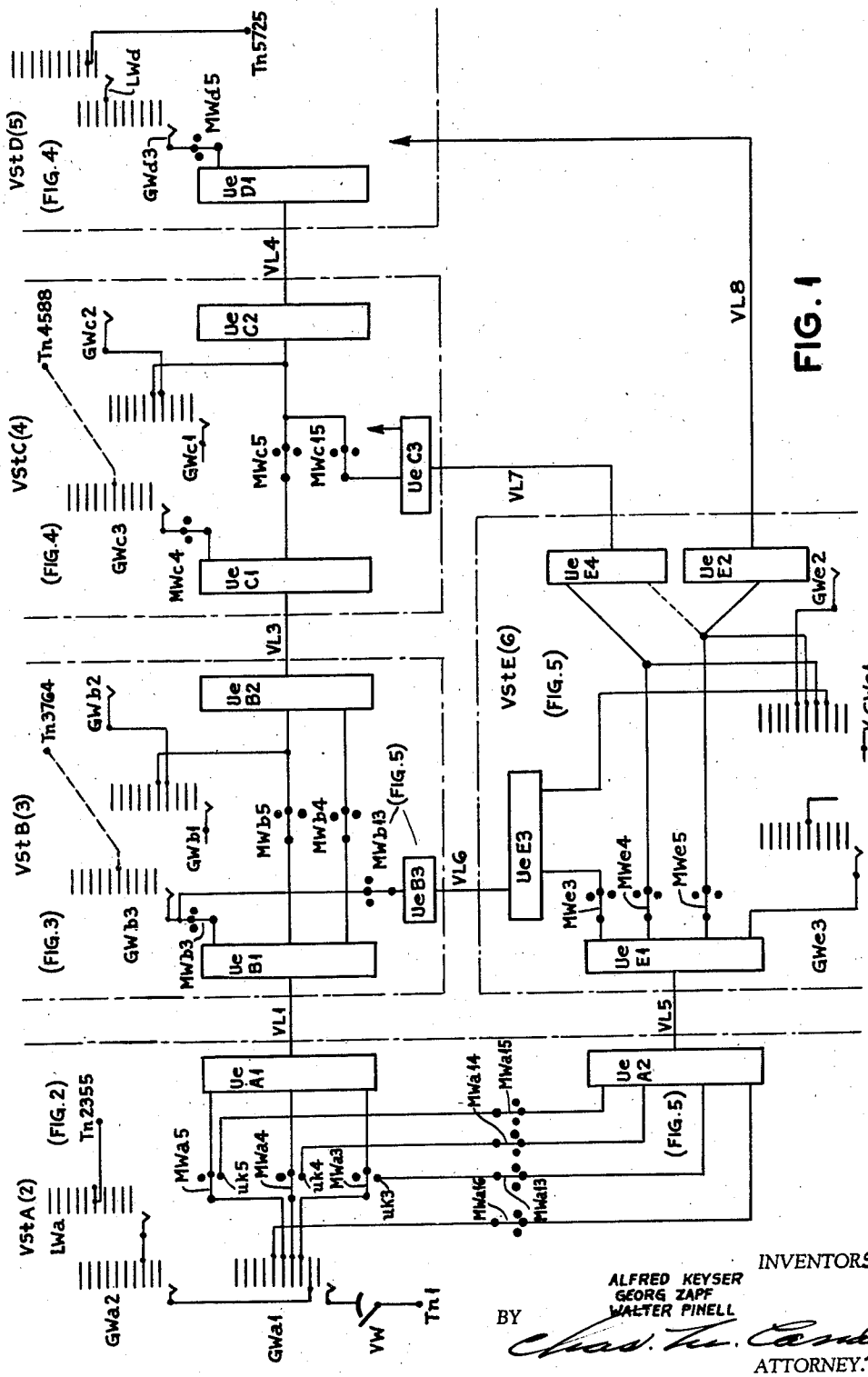


FIG. 1

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TELEPHONE SYSTEM

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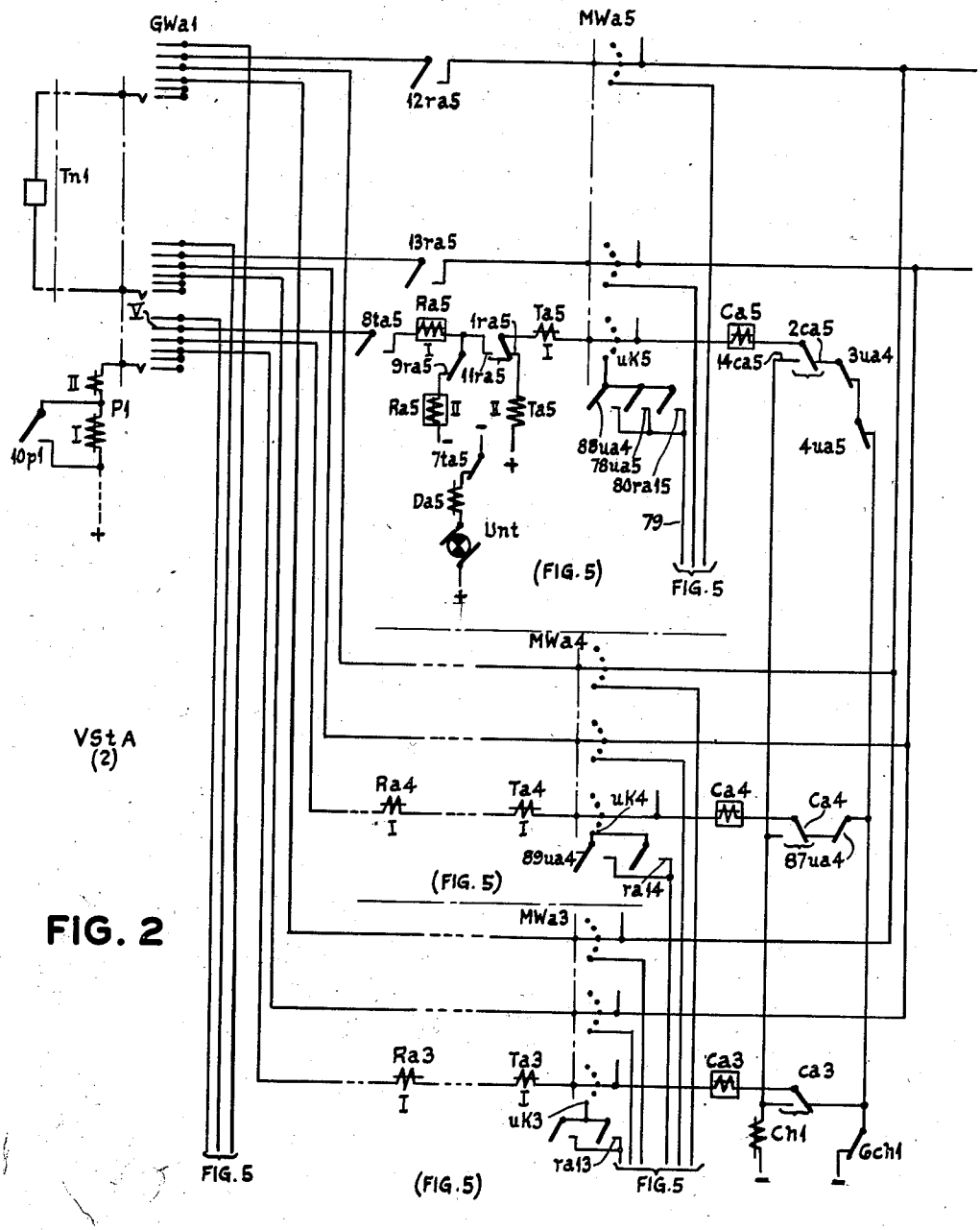


FIG. 2

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TELEPHONE SYSTEM

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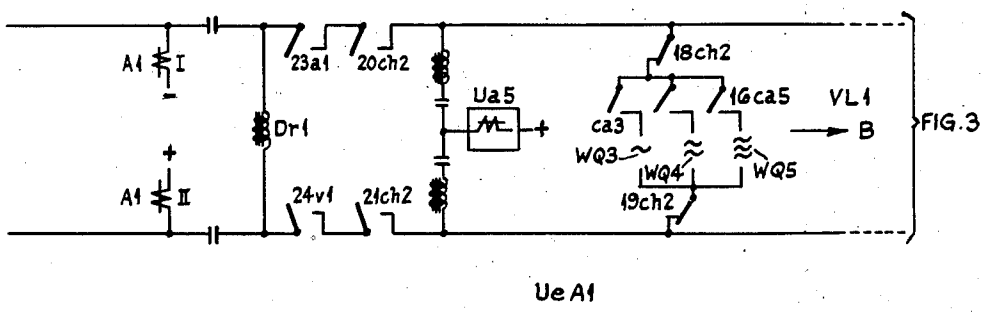
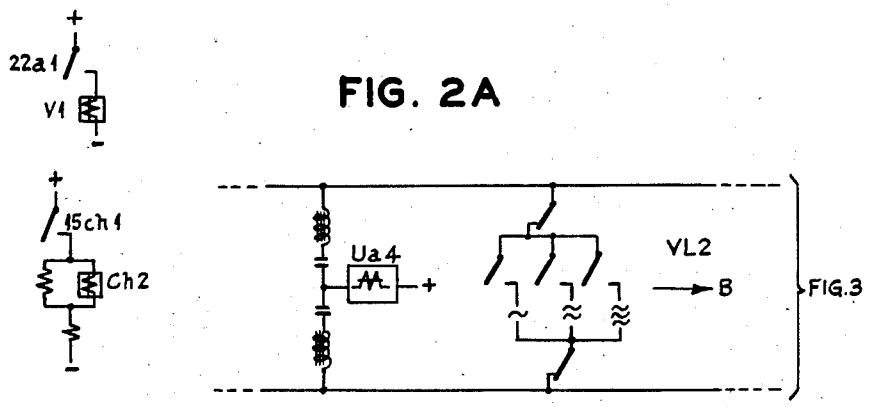


FIG. 2A



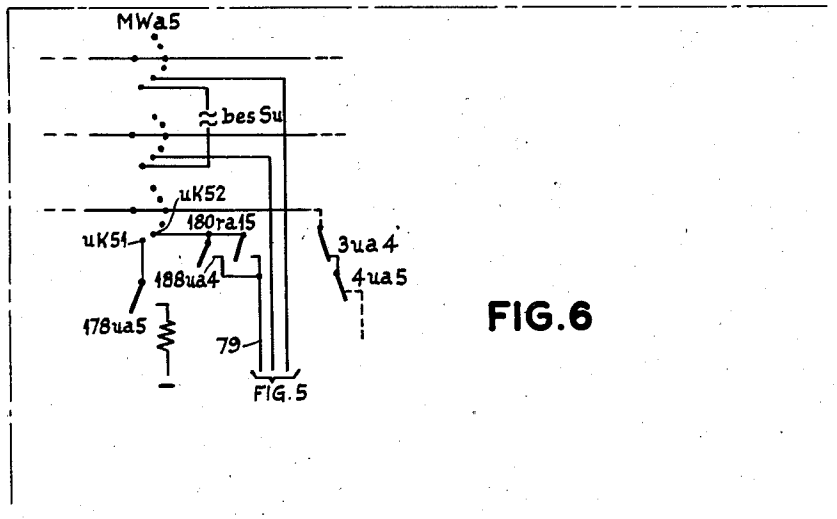


FIG.6

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TELEPHONE SYSTEM

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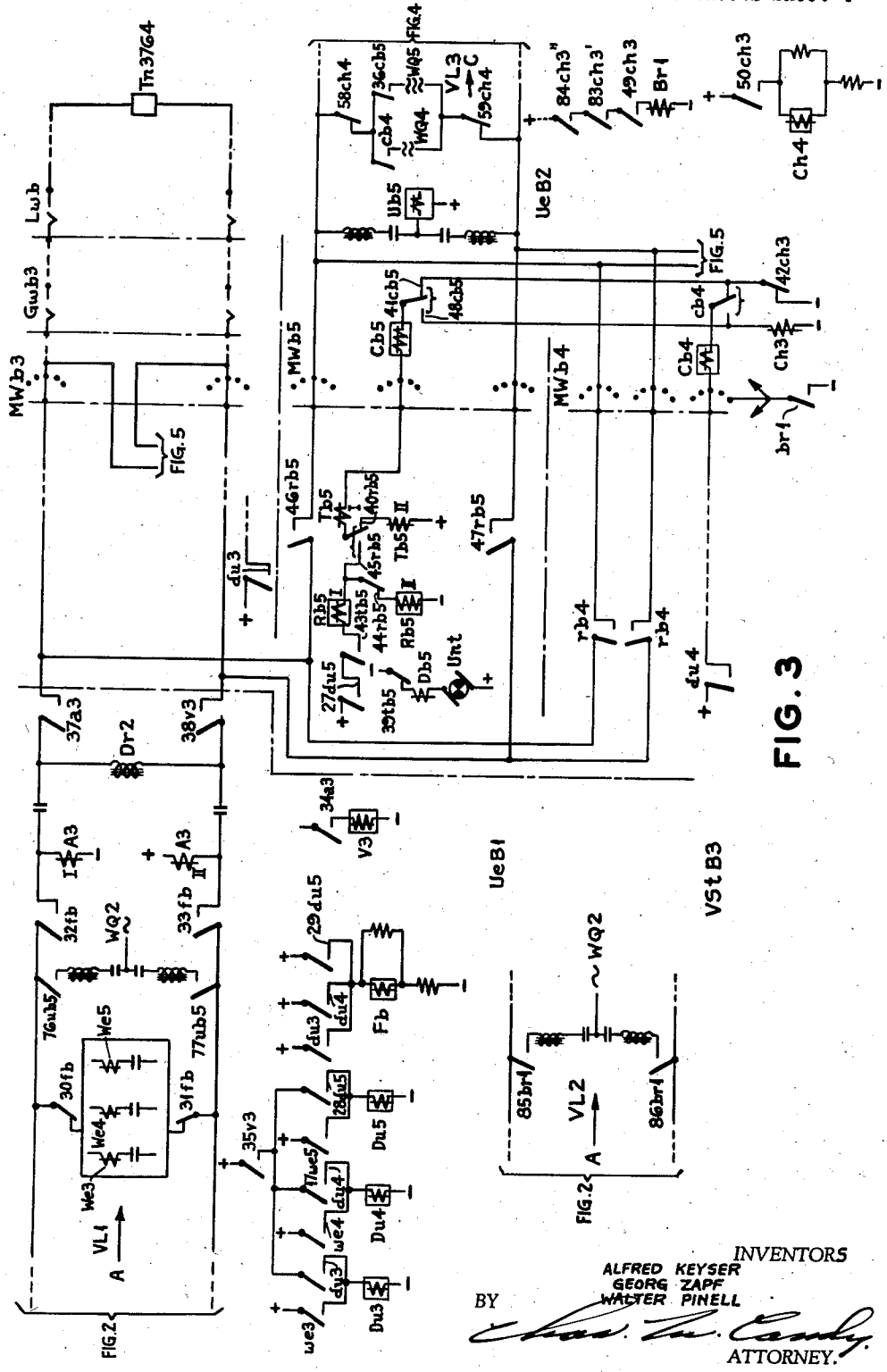


FIG. 3

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TELEPHONE SYSTEM

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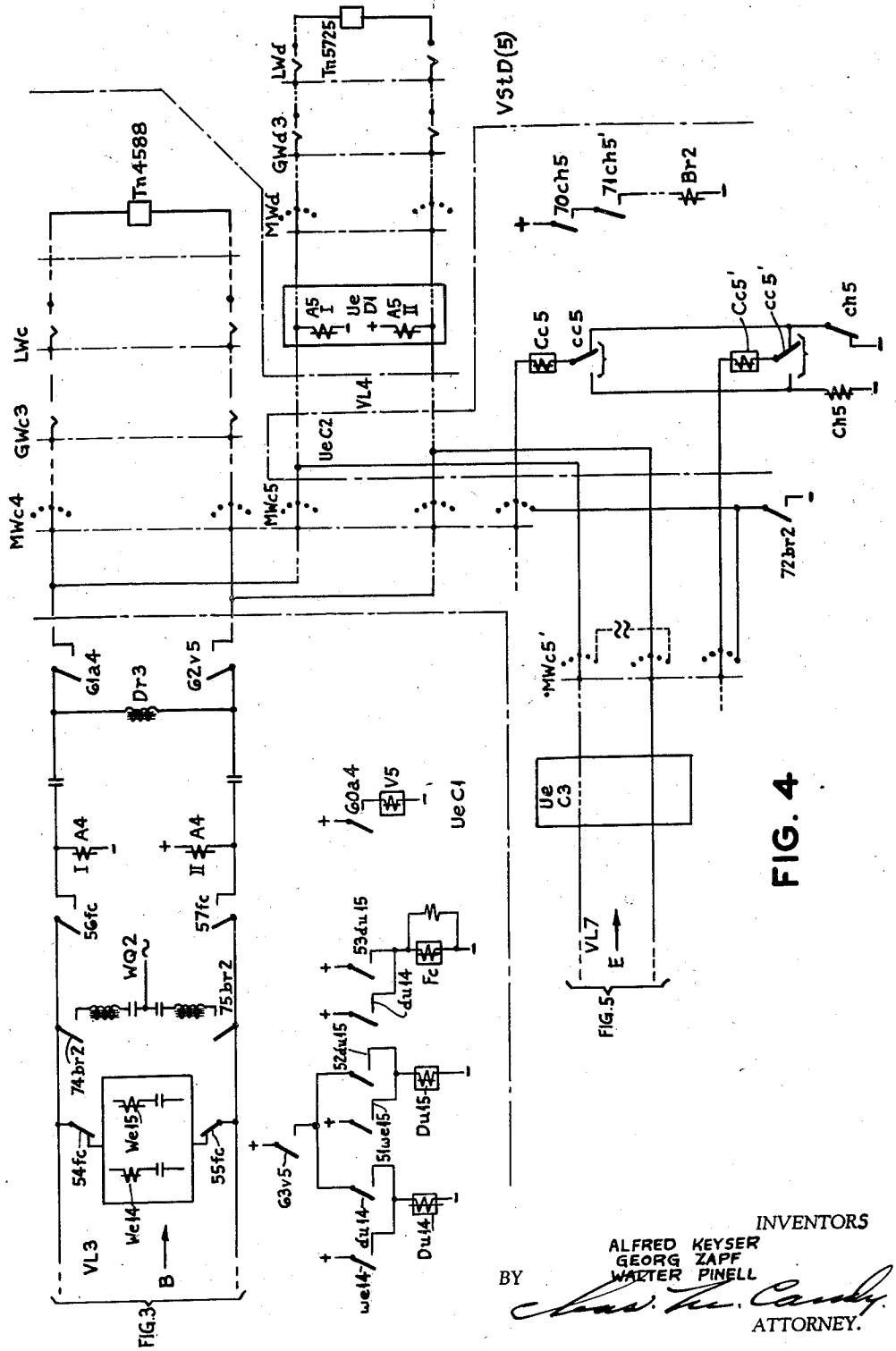


FIG. 4

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TELEPHONE SYSTEM

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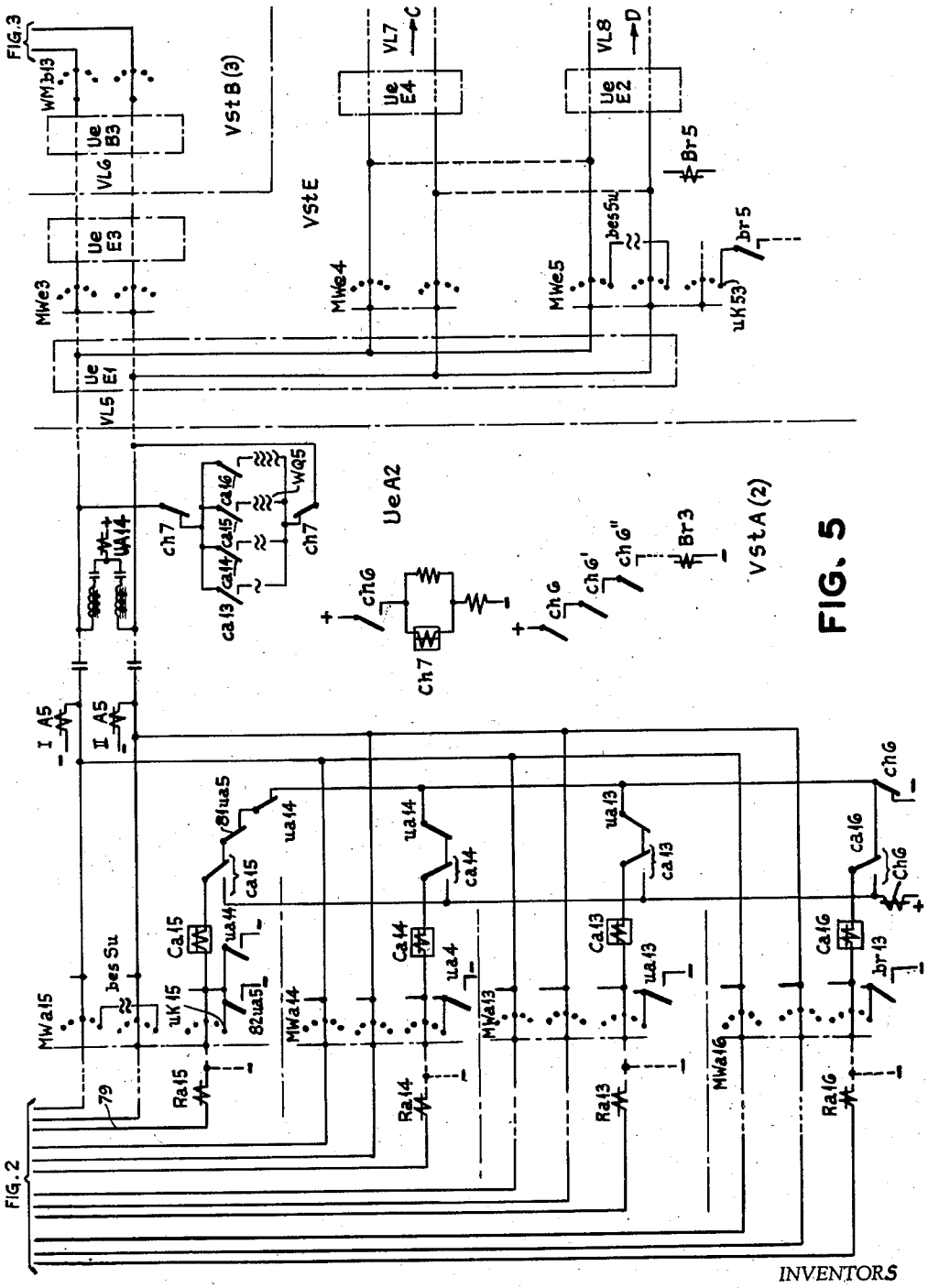


FIG. 5

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TELEPHONE SYSTEM

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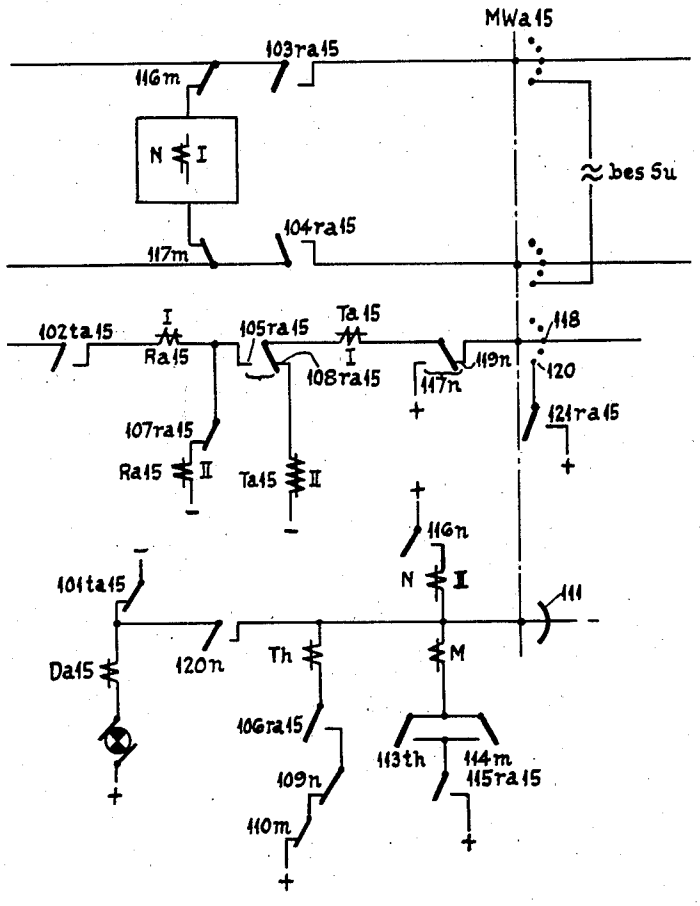


FIG. 7

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TELEPHONE SYSTEM

Filed May 2, 1938 8 Sheets-Sheet 8

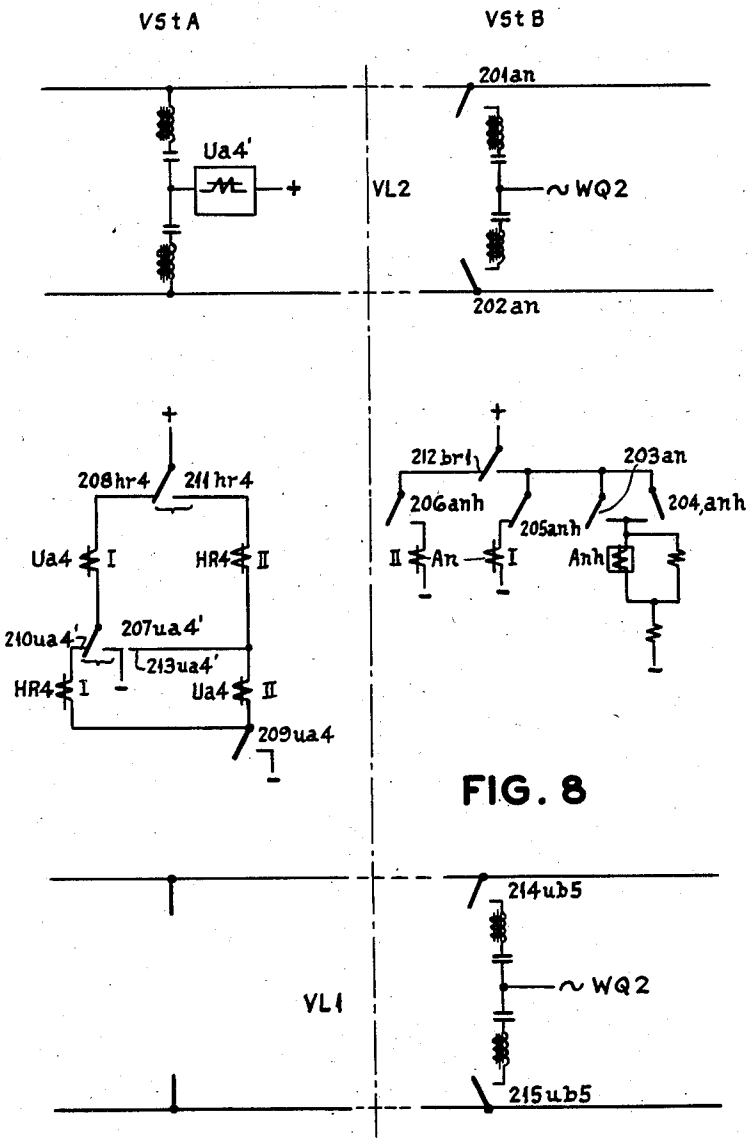


FIG. 8

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Patented Dec. 9, 1941 2,265,235

UNITED STATES PATENT OFFICE

2,265,235

TELEPHONE SYSTEM

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Application May 2, 1938, Serial No. 205,480
In Germany May 5, 1937

22 Claims. (Cl. 179—18)

The present invention relates to telephone systems having a plurality of exchanges adapted for automatic operation and in particular to such telephone systems in which outgoing connecting paths leading in various main traffic directions over intermediate exchanges are at the calling subscriber's disposal for setting up calls to the wanted exchange.

In order to be able to utilize all the connecting paths over which a wanted exchange can be reached, it is known for a hunting switch automatically to search for a free connecting line in another main traffic direction in the event of the preferred connecting line outgoing in a particular main traffic direction being engaged, the wanted call being also able to be established over the free connecting line.

Moreover, it has also been proposed that when establishing a call over one or more intermediate exchanges a connecting path established from one to another intermediate exchange should be released if all the outgoing connecting lines in the desired direction which can be reached over this intermediate exchange are engaged. The connection is then established automatically over another exchange.

The present invention now enables all the outgoing connecting paths in various main traffic directions which come into question for setting up a call to be utilized in that in the exchange (the starting exchange) from which the connecting paths outgoing in various traffic directions are reached, switching means are provided which extend a call which can be set up over intermediate exchanges lying in different main traffic directions over a path extending through a certain intermediate exchange in the event of the outgoing connecting lines which can be reached over another of these intermediate exchanges being inaccessible without a connection being established to this latter intermediate exchange.

The starting exchange need, of course, not necessarily be the calling subscriber's own exchange but may be an intermediate exchange lying in the connecting path of the connection which has been established.

The connections are established in the shortest time by using the arrangement according to the invention because the partial establishment of the connection to an intermediate exchange and the release of the latter when the further connecting lines extended from this exchange are blocked and the fresh establishment of a connection in another direction is prevented. Moreover impulse repeaters, registers and the like which enable the connection to be set up over another exchange after the release of the partially established connection are not required.

For characterizing the inaccessibility of the outgoing connecting lines from an intermediate exchange in a particular direction a "blocked" signal is transmitted from the intermediate exchange back to the starting exchange.

According to the invention the connections are set up over secondary switches which calling stations when initiating calls connect to the connecting lines of these main traffic directions over which free outgoing lines from the intermediate exchanges are reached.

Under the influence of switching means controlled by the "blocked" signal the secondary switches can only seize outgoing free connecting lines in a particular direction when a call is initiated.

By using secondary switches which are preset the connecting path which can be used for a connection to be established can always be prepared.

When a connecting path is taken into use the connection at the intermediate exchanges is automatically switched through to the wanted terminal exchange. This is preferably achieved by using a plurality of approaches to the outgoing connecting lines which are given different digit combinations in that when seizing one of these approaches a signal peculiar to the wanted exchange is transmitted to the next exchange.

In the drawings some embodiments of the invention are represented to which however the invention is not limited.

All details which are not absolutely necessary for the understanding of the invention have been omitted. In the embodiments one-way connecting lines can also be used.

Fig. 1 shows diagrammatically and without circuit details a telephone system having five exchanges VStA, VStB, VStC, VStD and VStE.

Figs. 2 and 2A show the devices in the exchange VStA for outgoing traffic to the exchange VStB.

Fig. 3 shows the devices in the exchange VStB for incoming traffic from the exchange VStA and outgoing traffic to the exchange VStC.

Fig. 4 shows the devices in the exchanges VStC and VStD.

Fig. 5 shows the devices in the exchange VStA for traffic to the exchange VStE and the devices in the latter exchange.

Figs. 6 and 7 show the circuits of the secondary switches, and

Fig. 8 an arrangement in which a temporary "blocked" signal is transmitted to the starting exchange.

I. Basic Establishment of the Connection as per Fig. 1

Each exchange of the system has a definite characterizing number which has to be dialled by the calling subscriber independent of the exchange in the system to which the wanted subscriber belongs. The characterizing numbers for the exchanges VS*t*A, VS*t*B, VS*t*C, VS*t*D and VS*t*E are the digits 2, 3, 4, 5 and 6 respectively.

From the exchange VS*t*A to which it will be assumed the calling subscriber T*n*I is connected, the exchanges VS*t*C and VS*t*D can only be reached over the intermediate exchange VS*t*B or the intermediate exchange VS*t*E. The connecting path over the intermediate exchange VS*t*B is preferably to be used. Only if this connecting path is inaccessible calls to the exchanges VS*t*C and VS*t*D are set up over the connecting path via exchange VS*t*E.

The call from subscriber T*n*I to the subscriber 2355 connected to his own exchange VS*t*A is set up over the group selector GW*a*I (second level) group selector GW*a*2 (third level) and the final selector LW*a* (fifth level and fifth contact).

For establishing a connection to the subscriber 3764 who is connected to the exchange VS*t*B, the group selector GW*a*I is raised to the level 3 corresponding to the characterizing digit 3 for the exchange VS*t*B and searches in this level for the approach to a free connecting line VLI associated with the exchange VS*t*B. Other approaches to the connecting lines VLI which are also used for calls to the exchanges VS*t*E and VS*t*D may be reached over the levels 4 and 5 of the group selector GW*a*I corresponding to the digits 4 and 5 of these exchanges. In each approach there is disposed a secondary switch which is preferably pre-set.

After the group selector GW*a*I has been set, switching means become operative in the repeater U*e*AI of the connecting line VLI and transmit a signal over the connecting line VLI which connects up the branch of the connecting line VLI which passes over the secondary switch MW*b*3 in the repeater U*e*BI in the exchange VS*t*B. The secondary switch MW*b*3 is also preset. The subscriber T*n*3764 is reached by the corresponding setting of the group selector GW*b*3 and a final selector which is not shown.

A call to subscriber 5725 who is connected to the exchange VS*t*D is established. The group selector GW*a*I is set on the fifth level and seized the approach to the connecting line VLI in which is connected the secondary switch MW*a*5. In the repeater U*e*AI a signal peculiar to the exchange VS*t*D is applied to the connecting line VLI. In repeater U*e*BI the approach to the connecting line VL3 containing the secondary switch MW*b*5 is coupled with the connecting line VLI. Switching means in the repeater U*e*B2 transmit the signal characterizing the exchange VS*t*D over the outgoing connecting line VL3, this causing the connecting line VL3 to be connected via the secondary switch MW*c*5, to the connecting line VL4, in repeater U*e*CI. A calling impulse is now transmitted from the repeater U*e*C2 to the wanted exchange VS*t*D and this in the repeater U*e*DI of the exchange VS*t*D causes the connecting line VL4 to be switched through to the secondary switch MW*d*5 and thus to the group selector GW*d*3. The connection to the subscriber 5725 is completed by setting the group selector GW*d*3 on the seventh level and the final selector on the fifth contact of the second level.

Calls proceeding from the exchange VS*t*A to the exchange VS*t*E pass over the secondary switch MW*a*I6, the repeater U*e*A and the connecting line VL5 after the group selector GW*a*I has been set on the sixth level. The repeater U*e*A2 transmits the signal peculiar to the exchange VS*t*E over the connecting line VL5 and this causes the connecting line VL5 to be coupled with the group selector GW*e*3 in the incoming repeater U*e*EI. Through the transmission of the further numerical impulse trains in accordance with the wanted subscriber's number, the connection is completed.

The progress of calls when there are no lines accessible between the two exchanges will now be considered.

All the connecting lines VLI between the exchanges VS*t*A and VS*t*B are blocked.

When the characterizing signal for this condition becomes effective the secondary switches MW*a*3, MW*a*4 and MW*a*5 are set on an overflow contact *ük*3, *ük*4, and *ük*5 respectively. To each overflow contact is connected an approach to connecting line VL5 leading to the exchange VS*t*E. In each of these approaches there is disposed a pre-set secondary switch for example in the approach reached over the overflow contacts *ük*3 of the secondary switch MW*k*3 and which characterizes the exchange VS*t*B, the secondary switch MW*a*I3; in the approach over the overflow contact *ük*4 of the secondary switch MW*a*4 which characterizes the exchange VS*t*C, the secondary switch MW*a*I4, and in the approach reached over the overflow contact *ük*5 and which is associated with the exchange VS*t*D, the secondary switch MW*a*I5.

If with the connecting paths in this condition a call is initiated to the subscriber 3714 of the exchange VS*t*B the calling subscriber is connected to the connecting line VL5 over the secondary switches MW*a*3, MW*a*I3 and the repeater U*e*A2 after the group selector GW*a*I has been set. Through the transmission of the exchange characterising digit of the exchange VS*t*B from the repeater U*e*A2 to the repeater U*e*EI, the secondary switch MW*e*3 in the latter is connected up. In the repeater U*e*E3 a signal is applied to the connecting line VL6 leading to the exchange VS*t*B which causes the switching through on to the secondary switch MW*b*I3 which stands on the line to a free group selector GW*b*3.

If when setting up a call to the subscriber T*n*5725 of the exchange VS*t*D all the connecting lines VS*t*A and VS*t*B are engaged, the calling subscriber T*n*I is connected to the connecting line VL4 over the secondary switches MW*a*5 and MW*a*I5 and the repeater U*e*A2 after the group selector GW*a*I has been set on the fifth level. The signal characteristic of the exchange VS*t*D is connected to the connecting line VL5 in the repeater U*e*A2. This causes switching through to the repeater U*e*E2 in the repeater U*e*EI over the approach to the secondary switch MW*e*5 associated with the exchange VS*t*D.

It will be assumed that connecting lines VL8 run directly from the exchange VS*t*E to the exchange VS*t*D. In the repeater U*e*E2 a call

initiating impulse is applied to the seized connecting line VL8 and causes the switching through on to a free group selector GW*d*3 in the exchange VS*t*D.

If no connecting lines VL8 are provided between the exchanges VS*t*E and VS*t*D the repeater U*e*E2 is dispensed with. Calls to the exchange VS*t*S from the exchange VS*t*E are set up over the intermediate exchange VS*t*C. The secondary switch MW*e*5 is then disposed in an approach (shown dotted) characterizing the exchange VS*t*D, to the repeater U*e*E4 and thus to the connecting line VL7.

In the repeater U*e*E4 when this is seized over the secondary switch MW*e*5 the signal characteristic of the exchange VS*t*D is applied to the connecting line VL7 whereby switching means in the repeater U*e*C3 causes the line to be switched through to the secondary switch MW*c*15 and thus to the repeater U*e*C2. From the latter a call initiating impulse is transmitted to the exchange VS*t*D over the connecting line VL4.

If connecting lines VL8 are provided calls proceeding to the exchange VS*t*D can be extended over the connecting path over the connecting lines VL7 and thus via the exchange VS*t*C in the event of the lines VL8 being inaccessible. This can be brought about by the secondary switch MW*e*5 on being set on an overflow contact seizing an approach to a connecting line VL7 in which is disposed a pre-set secondary switch in the same way as in the case of the outlets from the overflow contacts of the secondary switches MW*a*3, MW*a*4 and MW*a*5 in the exchange VS*t*A.

In the event of the connecting lines VL7 being busy, connections to the exchanges VS*t*D and VS*t*C can be extended over the lines VL6 and the exchange VS*t*B. In this case the secondary switches MW*e*5 and MW*e*4 would be set on approaches characterizing the exchanges VS*t*D and VS*t*C to the connecting lines VL6, which approaches are connected to overflow contacts.

If in the outgoing connecting paths from the exchange VS*t*A which are to be used in preference for calls to the exchange VS*t*C and VS*t*D over the intermediate exchange VS*t*B there are free connecting lines VL1 available between the exchanges VS*t*A and VS*t*B but all the lines VL3 outgoing from the exchange VS*t*B or the lines VL4 leading from the exchange VS*t*C to VS*t*D are inaccessible, connections to the exchanges VS*t*C and VS*t*D are immediately extended over a connecting path leading in another main traffic direction over which the desired exchanges VS*t*C and VS*t*D also can be reached without a connection being established to the exchange VS*t*B. In the present case the connecting path in question will be that over the exchange VS*t*E.

All the connecting lines VL3 connecting the exchanges VS*t*B and VS*t*C are inaccessible.

Over the connecting line VL1 or a signalling lead common to all the connecting lines VL1 a "blocked" signal is transmitted from the exchange VS*t*B to the exchange VS*t*A. The result of this is that switching means are influenced in the repeater U*e*A1 and cause the secondary switches WM*a*4 and WM*a*5 to be set on overflow contacts *ük*4 and *ük*5. Secondary switch MW*a*3 is not influenced since the connecting lines VL1 are still accessible for calls to the exchange VS*t*B so that a diversion of this traffic over the exchange VS*t*E is not necessary. The establishment of calls to the exchanges VS*t*C and VS*t*D takes place in the same way as when the connecting lines VL1 were busy.

If when the connecting lines VL1—VL3 are free all the connecting lines VL4 between exchanges VS*t*C and VS*t*D are inaccessible a "blocked" signal is transmitted from the exchange VS*t*C to the exchange VS*t*B and from this exchange to the exchange VS*t*A. A special relay arranged in this exchange causes only the secondary switch MW*a*5 to be set on the overflow contact *ük*5 and thus on the approach to the connecting lines VL5 to the exchange VS*t*E. The secondary switches MW*a*4 and MW*a*3 are not influenced by this "blocked" signal.

Calling subscribers of the exchange VS*t*A can establish calls to the exchange VS*t*D by way of auxiliary connecting path over the exchange VS*t*E in the manner described above.

In a similar way to the subscribers of the exchange VS*t*A the subscribers of the other exchanges of the system can use outgoing connecting paths in other main traffic directions by using the devices shown in the exchange VS*t*A in the event of the connecting lines in a particular direction being inaccessible irrespective of whether these are the lines proceeding from the subscriber's own exchange or from an intermediate exchange over which the call is to be established.

It was assumed that for all calls to the exchanges VS*t*C and VS*t*D the connecting path over the intermediate exchange VS*t*B was preferably to be used. The system can also be arranged so that calls to the exchange VS*t*C preferably pass over the intermediate exchange VS*t*B while for calls to the exchange VS*t*D the connecting path passing over the intermediate exchange VS*t*E is preferably to be used. In this case calls to the exchange VStC could be extended over the auxiliary path over the exchange VS*t*E and calls to the exchange VS*t*D over the auxiliary path over the exchange VS*t*B.

In a similar manner to that in which calls to subscribers of the exchanges reached over the connecting line VLI can be extended over the exchange VS*t*E if all these lines are busy, so in the event of all the lines VL5 being busy calls to the exchange VS*t*E can be set up over the exchange VS*t*B. In this case the secondary switch MW*a*16 would be set on an overflow contact on the reception of the "blocked" signal to which contact is connected an approach to connecting lines VL1 characteristic of the exchange VS*t*E.

II. Connections Between the Subscriber Tn1 (VS*t*A) and TN5725 (VS*t*D) Over the Exchange VS*t*B (Figs. 2 and 4)

The secondary switch MW*a*5 in the approach to the connecting lines VL1 characterizing the exchange VS*t*D is pre-set. Relay T*a*5 energizes over: positive, winding II of relay T*a*5, contact 1*ar*5, winding I of relay T*a*5, wiper and contact of the secondary switch MW*a*5, relay C*a*5, contacts 2*ca*5, 3*ua*4, 4*ua*5, 6*ch*1 and negative. In this circuit on account of the high resistance of winding I of relay T*a*5, relay T*a*5 does not energize. Over contact 7*ta*5 the circuit of magnet DA5 of switch MA5 is broken and at contact 8*ta*5 the seizing circuit over the switch MW*a*5 and thus that for the connecting line VL1 is prepared. When the test wiper of the group selector GW*a*1 which is set on the fifth level by the first digit dialled by the subscriber, finds the secondary switch MW*a*5 when seeking for a free connecting line VL1, the testing circuit is com-

pleted over: positive, windings I and II of relay P1, wiper and contact in the group selector GWa1, contact 8ta5, winding I of relay Ra5, contact 9ra5, winding II of relay Ra5 and negative. Both relays P1 and Ra5 energize. The relay P1 brings the group selector to rest in the known way, switches the speaking leads through and at contact 10p1 short-circuits the high resistance winding I. Relay Ra5 closes its contact 11ra5 and then opens contact 1ra5. It switches the speaking leads through at contacts 12ra5 and 13ra5 and by opening contact 9ra5 disconnects winding II. In the circuit over positive contact 10p1, winding II of relay P1, wiper and contact of the group selector GWa1, contact 8ta5, winding I of relay Ra5, contact 11ra5, winding I of relay T5, wiper and contact of the secondary switch MWa5, relay Ca5, contacts 2Ca5, 3ua4, 4ua5 and 6ch1 set up on the closing of contact 11ra5, relay Ca5 energizes. It locks up at contact 14ca5 in a circuit passing over relay Ch1 and opens contact 2ca5. Relay Ch1 disconnects the free potential (negative), at contacts 6ch1 whereby the testing relays Ta5 of all free secondary switches standing on the contact line VL1, i. e., for example the test relays Ta4 and Ta3 of the secondary switches MWa4 and MWa3 are deenergized. These secondary switches are pre-set on other free connecting lines VL1.

The repeater UeA1 of the connecting line VL1 has three approaches corresponding to the three exchanges VStB, VStC and VStD which can be reached over the connecting line VL1 and to which different numbers are allotted as has appeared already from the description of Fig. 1. When one of these approaches is seized the connection is automatically switched through at the incoming end of the connecting line, in that direction which is characterized by the approach seized. For promoting this switching through alternating current of a particular frequency is temporarily connected in the repeater UeA1 to the connecting line VL1. The connection takes place on the energizing of the seizing relay Ca associated with the approach seized. This characterizing current is disconnected by a relay Ch2 which is slow-to-operate and which is connected up at contact 15ch1 by relay Ch1.

Since in the present case the approach characterizing the exchange VStD was seized over the secondary switch MWa5, the relay Ca5 by closing contact 16ca5 has connected the alternating current source WQ in bridge across the leads of the connecting line VL1. Only relay We5 of the junction controlling device is energized in the repeater UeB1 in the exchange VStB, Fig. 3, by alternating current flowing over the connecting line VK1 and this switches on the "switch-through" relay Du5 at contact 17we5. The relays We3 and We4 do not energize in response to the alternating current WQ5 characterizing the exchange VStD.

Before proceeding with the description of the further switching operations in the exchange VStB the switching operations in the exchange VStA consequent on the connection of the alternating current source WQ5 will be explained:

On the energizing of relay Ch2 connected by the seizing auxiliary relay Ch1 at contact 15ch1, the source WQ5 of alternating current is disconnected from the connecting line VL1 by the opening of contacts 18ch2 and 19ch2. The speaking leads are switched through at contacts 20ch2 and 21ch2.

After the speaking leads have been switched through in the group selector GWa1 and the secondary switch MWa5 the bridge relay A1 energizes in the known way over a bridge across the speaking leads established at the impulse repeater in the group selector GWa1. It closes its contact 22a1 and thereby energizes the slow release relay V1. At contacts 23a1 and 24v1 the speaking leads of the connecting line VL1 are finally switched through.

In the exchange VStB the "switchthrough" relay Du5 connects the approach characterizing the exchange VStD to the connecting line VL3 in which the secondary switch MWb5 is disposed by closing contact 27du5. At contact 28du5 it prepares a locking circuit at contact 29du5 switches on the slow-to-energize relay Fb which on energizing disconnects the junction controlling device comprising relays We3, We4 and We5 by opening contacts 30fb and 31fb, and switches the speaking leads through at contacts 32fb and 33fb. In the direct current circuit set up over the choke coil Dr1 (Fig. 2) the bridge relay A3 (Fig. 3) energizes and switches on the slow-release relay V3 which at contact 35v3 completes the locking circuit for relay Du5 prepared at contact 28du5. The speaking leads are switched through at contacts 37a3 and 38a3.

The secondary switches (MWb5 and MWb4) in the exchange VStB are pre-set as those in the exchange VStA. Thus the secondary switch MWb5 for example is standing on the free connecting line VL3 shown in the drawing. Relay Tb5 which holds the circuit of the rotary magnet Db5 open at contact 39tb5 is energized over: positive, winding II of relay Tb5, contact 40rb5, winding I of relay Tb5, wiper and contact of the switch MWb5, relay Cb5, contacts 41cb5 and 42ch3 and negative. In this circuit relay Cb5 does not energize on account of the high resistance of winding II of relay Tb5. The seizing circuit of the secondary switch MWb5 is prepared at contact 43tb5 and is completed on the closing of contact 27du5; positive, contacts 27du5, 43tb5, winding I of relay Rv5, contacts 44rb5, winding II of relay Rb5 and negative. Relay Rb5 closes its contact 45rb5 and thereupon opens its contact 40rb5 and also contact 44rb5. The speaking leads in the secondary winding switches MWb5 are switched through contacts 46rb5 and 47rb5.

In the circuit over the low resistance windings I of relays Rb5 and Tb5 established at contact 45rb5, relay Cb5 energizes, locks up in a circuit passing over relay Ch3, at contact 45cb5 and thereupon opens contact 41cb5. Relay cH3 at contact 42ch3 breaks the testing circuits of all the other secondary switches standing on the seized connecting line VL3. These search for another free connecting line. Contact 49ch3 is closed for a purpose to be explained later. At contact 50ch3 relay Ch4 which is slow to operate is connected up.

Since the approach to the connecting line VL3 characterizing the exchange VStD was seized the alternating current WQ5 characterizing the exchange VStD is connected up through the energizing of relay Cb5 at contact 36cb5. This alternating current influences the junction controlling device bridge across the connecting line VL3 in the exchange VStC (Fig. 4). Only the relay We15 energizes and this switches on the "switch-through" relay Du15, at contact 51ew15 and this in turn prepares a locking circuit for itself at contact 52du15, switches on the slow-to-operate relay Fc at contact 53du15 and closes the seizing circuit (not shown) for the secondary

switch MWc5. When the relay Fc pulls up its armature the junction controlling device with the relays We15 and We14 is disconnected at contacts 54fc and 55fc, and at contacts 56fc and 57fc the speaking leads are switched through.

In the exchange VStB, Fig. 3, the source WQ5 of alternating current which was connected at contact 36cb5 is disconnected by the slow-to-operate relay Ch4, which was operated on the operation of relay Ch3, by the opening of contacts 58ch4 and 59ch4.

After the speaking leads have been switched through in the repeater UeC1 at contacts 56fc and 57fc the bridge relay A4 is energized in the circuit passing over the choke-coil Dr2 in the repeater UeD1. It switches on the slow release relay V5 at contact 60a4 and at contact 61a4 switches through the upper speaking lead. The lower speaking lead is switched through at contact 62v5.

Since the exchange VStD is the last in the source the preparatory transmission of a special exchange signal as occurs in the preceding exchanges through the temporary connection of the alternating current source WQ5 is not necessary but may be used if calls are to be characterized in the same way at the terminal exchange as in the case of the intermediate exchanges.

In the present case it is arranged that a call initiating impulse is given to the exchange VStD by the establishment of a direct current bridge across the speaking leads of the connecting line VL4. This D. C. bridge contains the choke-coil Dr3 over which the bridge relay A5 in the repeater UeD1 is energized after the connecting line VL3 has been switched through at contacts 61a4 and 62v5 in the repeater UeC1. The relay A5 initiates the switching operations necessary for the further establishment of the call.

When the calling subscriber Tn1 transmits numerical impulses for setting the switches in the exchange VStD the impulses are extended by relay A1 (Fig. 2) by means of contact 23a1 to relay A3 (Fig. 3) and from this by means of contact 37a3 to relay A4 (Fig. 4) and from this by means of contacts 61a4 to relay A5. Relay A5 controls the circuit serving to set the group selector GWd3 and the final selector LWd.

In the arrangement shown the release of the connection and the restoration of the connecting lines used is dependent upon the calling subscriber Tn1. When this subscriber hangs up his receiver the circuit over relays P1, Ra5, Ta5, Ca5 and Ch1 is broken by the release relay (not shown) in the group selector GWa1. Relay Ra5 breaks the speaking leads. Relays A1, A3, A4 and A5 release in succession and this results in the release of all the connecting devices in the exchange.

III. Establishment of Calls Proceeding From the Exchange VStA When Connecting Lines Extending From An Intermediate Exchange Are Inaccessible

1. All connecting lines VL4 between the exchanges VStC and VStD blocked

If all the connecting lines VL4 are blocked all the relays Ch5 (Fig. 4) are energized. The busy relay Br2 is operated over the serially arranged contacts 70ch5, 71ch5', etc., and applies negative potential to the overflow contacts of the secondary switches MWc5 and MWc5' over contacts 72br2. All the free secondary switches in the approaches to the connecting lines VL4 set themselves on these overflow contacts.

Furthermore relay Br2 closes contacts 74br2 and 75br2 and thereby connects the source WQ2 of alternating current to the leads of the connecting line VL3, for transmitting the blocking signal. This connection occurs both in the case of free and also in the case of engaged connecting lines.

In the previous exchange VStB in the connecting path the relay Ub5 connected in a bridge between the connecting line VL3 and earth is energized by the alternating current WQ2 transmitted over the leads of the connecting line VL3 in parallel. Relay Ub5 by closing contacts 76ub5 and 77ub5 connects a source WQ2 of alternating current to the connecting line VL1.

In the exchange VStA relay Ua5 energizes in response to this alternating current and opens its contact 4ua5 in the approaches to all the connecting lines VL1 which are characteristic of the exchange VStD. The result of this is that the circuits which are maintained by free secondary switches in the approaches to connecting lines VL1 which are used on calls to the exchange VStD are broken. Thus the circuit over relay Ta5 of the secondary switch MWa5 is broken. It releases and completes the circuit for the rotary magnet Da5 at contacts 7ta5. The secondary switch MWa5 operates until its test wiper reaches the overflow contact ük5 to which negative potential is connected by contact 78ua5. Relay Ta5 then energizes over: positive, winding II of relay Ta5, contact 1ra5, winding I of relay Ta5, overflow contact ük5, contacts 78ua5, lead 79, relay Ra15 and negative.

Relay Ta5 energizes. The secondary switch is brought to rest through the opening of contact 7ta5. At contact 8ta5 the seizure is prepared by a group selector CWa1.

In the secondary switch MWa15 whose circuit corresponds to that of the secondary switch MWa5, relay Ra15 does not yet energize because the resistance of winding II of relay Ta5 is too great.

The secondary switch MWa15 on which the secondary switch MWa5 is now set lies in that approach to the connecting line VL5 which is to be used for calls to the exchange VStD.

If with the connecting path in this condition the subscriber Tn1 wishes to set up such a call relay Ra5 is energized after the setting of the group selector GWa5. It switches the speaking leads through at contacts 12ra5 and 13ra5 and also the blocking lead at contact 11ra5. In the secondary switch MWa15 relay Ra15 energizes in the blocking circuit. It switches through both the speaking leads and the blocking lead (contacts not shown) and closes contact 80ra15 which lies in parallel with contact 78ua5 (Fig. 2). The result of the closing of this contact is that when a connecting line VL4 in the connecting path which is preferably to be used becomes free, and relay Ua5 releases, the connection established over the secondary switches MWua5 and MWua15 in the course of being established is not influenced.

In the repeater Uea2 relay Ca16 energizes in the blocking circuit. Through the cooperation of relay Ca15, Ch6, Ch7, the alternating current WQ5 characterizing the exchange VStD is temporarily transmitted. In the repeater UeE1 at the incoming end of the connecting line VL5, a junction line is energized and couples the incoming connecting line VL5 via the secondary switch

MWe5 with the connecting line VL8 leading to the exchange D. These operations correspond to those described for the establishment of the call over the intermediate exchange VStB so that a detailed description is not necessary at this point.

After the calling subscriber is connected to the exchange VStD the call is completed by the setting of the switches within this exchange.

If no direct connecting lines VL8 are provided between the exchanges VStE and VStD the secondary switches MWe5 are disposed in the exchange VStE (as indicated in dotted lines) in approaches to the connecting lines VL7 which lead to exchanges VStC. Any routing of calls to the exchange VStD over the exchange VStE then serves no purpose. If, however, in setting up the system connecting lines VL8 are provided the routing of calls to the exchange VStD over the exchange VStE can be provided for from the start so that no considerable alteration to the system will later be necessary.

In this case when relay Ua5 becomes operative which relay characterizes the inaccessibility of the connecting lines VL4, the secondary switch MWa5 is set on overflow contact. A connecting line VL5 is not seized however since relay Ua5 also causes the secondary switch MWa15 to be set in the overflow position *ük*15 by the opening of contact 81*ua*5 and the closing of contact 82*ua*5. In the overflow position *ük*15 the busy signal is connected to the speaking leads and this the subscriber hears if he attempts to set up a call to the exchange VStD. If later connecting lines VL8 are provided the ability to establish calls from the exchange VStD to exchange VStE is provided by simply shunting the contact 81*ua*5 and disconnecting negative potential from contact 82*ua*5.

If no contact lines VL8 are provided between the exchanges VStD and VStE and it is not proposed to provide any later, it is, of course, necessary for the secondary switch MWa5 to be set on an approach to a connecting line VL5 when the connecting lines VL4 become blocked and relay Ua5 energizes. As may be seen from Fig. 6 relay Ua5 in this case characterizes the special overflow contact *ük*51 as free by closing contact 178*ua*5, the secondary switch becomes set on this overflow contact because the relay Ua5 breaks its testing contact at contact 4*ua*5 as already described.

If a call to the exchange VStD is initiated while the secondary switch MWa5 is standing on the overflow contact *ük*51, the calling subscriber immediately hears the busy signal after the connecting has been switched through at the group selector GWa1 and at the secondary switch MWa5 since the busy signal is applied to the speaking leads in this overflow position.

2. *All connecting lines VL3 between exchanges VStB and VStC blocked*

If all the connecting lines VL3 between exchanges VStB and VStC are blocked the characterizing signal for the inaccessibility of the outgoing connecting lines VL3 from the exchange VStC is transmitted over one of the connecting lines between the exchanges VStA and VStB for example the connecting line VL2.

Since in this case the relays Ch3 in all the connecting lines are energized the busy relay Br1 is energized over the serially arranged contacts 49*ch*3, 83*ch*3' and 84*ch*3'' and connects the source WQ2 of alternating current to the two leads of the connecting line VL2 in parallel over its contact 85*br*1 and 86*br*1. In the exchange VStA relay UA4 energizes and opens the contacts in the approaches characterizing the exchange VStC and also in those approaches over which calls are established to the exchange VStD. This last is necessary because when all the connecting lines VL3 are blocked no connection to the exchange VStD can be established over the preferred connecting path. Thus contact 3*ua*4 in the approach over the secondary switch MWa5 and 87*ua*4 in the approach over the secondary switch MWa4 are open. The contacts 88*ua*4 and 89*ua*4 are closed and thus "free" potential is applied to the overflow contacts *ük*5 and *ük*4 of the secondary switches MWa5 and MWa4. The secondary switches MWa5 and MWa4 step to the overflow position in which the approaches to connecting lines VL5 leading to the exchange VStE are connected.

The energization of relay Ua4 is not influenced on the secondary switch MWa3 because calls to subscribers of the exchange VStB can still be set up.

If during the time in which the secondary switch MWa5 is in the overflow position on account of the connecting lines VL3 being busy the calling subscriber Tn1 wishes to establish a call to the exchange VStD, he connects again to a free connecting line VL5 over the secondary switches MWa5 and MWa15, after dialling the characterizing digit 5. In the repeater UeA2 the source WQ5 of alternating current is temporarily connected up and influences the junction controlling device (not shown) in the repeater UeE1. According as to whether connecting lines VL8 are available or not the connection is either extended directly from the exchange AStE to AStD or via the intermediate exchange VStC.

If there are no connecting lines VL8 provided the secondary switch MWa5 possesses two overflow positions *ük*51 and *ük*52 as shown in Fig. 6. As explained in the previous section the secondary switch is set in the overflow position *ük*51 if calls to the exchange VStD cannot be established on account of all the lines VL4 being blocked. Over the overflow position *ük*52 calls to the exchange VStD are extended over the exchanges VStE and VStC when the lines VL3 are busy. When relay Ua4 energizes the secondary switch MWa5 is brought to the overflow position *ük*52 by the opening of contact 3*ua*4 and the closing of contact 188*ua*4. To this overflow position an approach to the connecting line VL5 over the secondary switch MWa15 (Fig. 5) is connected. The establishment of a call to the exchange VStD then takes place in the manner described.

3. *Inaccessibility of the connecting lines extending from an intermediate exchange in the auxiliary connecting path*

If when the connecting lines extending from an intermediate exchange in the preferred connecting path are engaged the secondary switches in the starting exchanges corresponding to this traffic direction are brought into the overflow position and thus are set on an outgoing connecting path in another direction, it may happen that the outgoing connecting lines from the intermediate exchanges of this auxiliary connecting path are also inaccessible.

If it is assumed that on account of the connecting lines VL3 being busy the secondary switch MWa4 and MWa5 are set on connecting lines VL5 to the exchange VStE, all the connecting

lines VL7 and VL8 which lead from the exchange VStE to the exchanges VStC and VStD may be busy. In this case the blockage of these connecting lines can be indicated in the exchange VStA in the same way as the blockage of the connecting lines VL3 and VL4 in the preferred connecting path. The secondary switches MWa14 and MWa15 are then set in the overflow positions and the busy signal is transmitted to the calling subscriber.

Alternatively when the secondary switches are set on an auxiliary connecting path, one may refrain from immediately controlling the secondary switches in the event of outgoing connecting lines from an intermediate exchange in this connecting path being blocked, in the event of a further auxiliary path no longer being available. Assume that the secondary switch MWa5 stands on the approach to the connecting line VL5 on account of the connecting line VL4 being blocked. All the connecting lines VL8 are blocked. A call to the exchange VStD is initiated and the calling subscriber is switched through to the secondary switch MWe5 in the approach to the connecting line VL8 over GWa1, MWa5, MWa15, UeA2, V15 and UeE1. Since all the lines VL8 are blocked, relay Br5 is energized and has closed the secondary switch MWe5 to be set in the overflow position *ük*53. In the overflow position *ük*53 the busy signal is connected to the speaking leads. The secondary switch MWa15 in the exchange VStA can then be influenced by this busy signal so that it passes into an overflow position and releases the connecting path over the exchange UStE. Since the unnecessary seizure of the connecting path over VL5 to the exchange VStE only occupies a fraction of a second, this can be tolerated particularly seeing that the secondary switch MWa15 only has to pass into the overflow position when it has been seized and not also when it is not seized when all the connecting lines VL8 are blocked.

A circuit whereby the secondary switch MWa15 is able to be brought into the overflow position under the influence of the busy signal which is connected up in the overflow position of the switch MWe5 is shown in Fig. 7.

The secondary switch is set in preparation on an approach to a free connecting line. Relay Ta15 is thus energized and has opened contact 101*ta*15, and closed contact 102*ta*15. When the group selector GWa1 is set on the secondary switch MWa5 which occupies the overflow position *ük*5, relay Ra15 is energized by current over its two windings I and II. It closes contacts 103*ra*15, 104*ra*15, 105*ra*15, 115*ra*15 and 106*ra*15 and opens contacts 107*ra*15 and 108*ra*15. The speaking leads are switched through as is also the seizing lead.

A device which can be influenced by a busy signal is bridged across the speaking leads in the secondary switch. This device includes a relay N which is energized when the busy signal is applied at a succeeding point in the connecting path. It is disconnected if a busy signal is not applied within a definite period after the secondary switch has been seized. For this purpose a slow-to-operate relay is provided. This may be a thermo-relay T*h* which is connected up over contact 106*ra*15 and the contact segment 111 when the secondary switch MWa15 is seized. If the busy signal is not applied within the heating period of the thermo-relay, relay T*h* energizes and switches on relay M at contact 113*th* which locks up over contact 114*m* and contact 115*ra*15. At contact 116*m* and 117*m* the device influenced by the busy signal and disposed between the speaking leads is disconnected. Relay M remains energized throughout the duration of the call.

If before relay T*h* becomes operative busy signal is applied at a subsequent point in the connecting path, relay N energizes. It locks up over its winding II at contact 116*n* and applies positive potential directly to winding I of relay Ta15 at contact 117*n*. It thus maintains the circuit over this relay independent of the potential applied over wiper 118. The thermo-relay T*h* is switched off at contact 109*n*. Contact 119*n* is opened. At contact 120*n* the rotary magnet Da15 is connected to the wiper standing on the contact segment 111. Secondary switch is switched forward until its wipers reach an overflow position in which the lower wiper has left the contact segment 111. The secondary switch is brought to rest. Relay N releases since current no longer flows over its winding II. Relay Ta15 and the relays in series with it are maintained energized over contact 119*n*, wiper 118, overflow contact 120 and contact 121*ra*15; the busy signal is connected to the speaking leads in the overflow position. This the calling subscriber hears. After the receiver has been replaced, relays P1, Ra1, Ta5, Ra15 and Ta15 release. The secondary switches are set afresh on a free outgoing line.

The devices which become operative when the busy signal is applied and which include the winding I of relay N can also be arranged in the connecting line seized by the secondary switch. Relay N would then energize a controlling relay in the secondary switch on energizing and the secondary switch would be started up and be brought to rest in the overflow position.

4. Transmission of the "blocked" signal from the intermediate exchange to the starting exchange

As previously described a characteristic signal for the blockage of a group of connecting lines is transmitted over one of the connecting lines during the time that the blocking is effective. The system can be so arranged that when all outgoing connecting lines are blocked and one subsequently becomes free, temporary potential is connected to the connecting line over which the signalling is to take place.

Such an arrangement is shown in Fig. 8. The devices of the exchange VStA and VStB are only shown in so far as they are necessary. The relay Ua4 which controls the secondary switches MWa4 and MWa5 when the connecting lines VL3 are inaccessible is not connected to the connecting line VL2 but in a local circuit. The repeating relay Ua4' is consequently connected to the connecting lines.

When relay Br1 which is operated in the exchange VStB when all the connecting lines VL3 are blocked pulls up its armature it switches on the relay A*n* (winding I) over contact 200*br*1. At contacts 201*an* and 202*an* the source WQ2 of alternating current is connected in parallel to the two leads of the connecting line VL2. For disconnecting the source WQ2 of alternating current the slow-to-energize and slow-to-release relay A*nh* is connected up at contact 203*an*, and locks up in a circuit over contact 204*anh*, and contact 205*anh* breaks the circuit over winding I of relay A*n* and at contact 206*anh* prepares for the energization of winding II of relay A*n*. When

the circuit over winding I of relay An is broken the relay releases and by opening contacts 201an and 202an disconnects the source WQ2 of alternating current from the connecting line VL2.

For indicating the blocked condition of the outgoing connecting lines VL3 the source of alternating current is only applied temporarily to the connecting line VL2. The current flowing over this line operates the relay Ua4' which is connected in a bridge between the speaking leads and earth in the exchange VStA and by closing its contact 207ua4' switches on winding I of relay Ua4: positive, contact 208hr4, relay Ua4, (winding I) contact 207ua4' and negative. Relay Ua4 energizes and controls the secondary switch in the manner described. At contact 209ua4 it prepares a circuit which will be explained later.

When relay Ua4' releases after the disconnection of the alternating current in the exchange VStB the following circuit is established: positive, contact 208hr4, winding I of relay Ua4, contact 210ua4', winding I of relay Hr4, contact 209ha4 and negative. Relay Ua4 remains energized and relay Hr energizes. The latter closes at contact 211hr4 and then opens its contact 208hr4. The following locking circuit is now set up: positive, contact 211hr4, winding II of relays Hr4 and Ua4, contact 209ua4 and negative.

When the connecting lines VL3 become free relay Br in the exchange VStB releases, contact 201br1 is open and contact 212br1 is closed, winding II of relay An is switched on over positive contacts 212br1 and 206ang, winding I of relay An and negative. By closing contacts 201an and 202an relay An connects the source WQ2 of alternating current in parallel to the speaking leads of the connecting lines VL3 for transmitting a signal characterizing the free condition of the connecting lines VL3.

When contact 209br1 opens, the locking circuit for relay Anh is broken. Relay Anh makes a delayed release and among others opens its contact 206anh. Relay An is thus disconnected and releases. By opening contacts 201an and 202an it disconnects the source WQ of alternating current from the connecting line VL2.

In the exchange VStA relay Ua4' energizes in response to the alternating current flowing over the connecting line VL2 on account of the release of relay Br1. Contacts 207ua4' and 213ua4' are closed. Winding II of relay Ua4 is consequently short-circuited at contact 213ua4'. Relay Ua4 cannot remain energized over its windings I because contact 208hr4 is open. Relay Ua4 thus releases and thereby causes the secondary switches such as MWa5 and MWa4 to be set again on approaches to connecting lines in the connecting path which is preferably to be used.

When relay Ua4' releases on account of the disconnection of the alternating current from the connecting line VL2 in the exchange VStB, contacts 207ua4' and 213ua4' are opened. Contact 210ua4' is closed. Since relay Ua4 has already released and accordingly contact 209ua4 is open, current no longer flows over one of the windings of relay Hr4. This therefore releases and opens contact 211hr4 and closes its contact 208hr4.

The devices for receiving temporary signals indicate the blockage of all the connecting lines VL3 reached over the intermediate exchange VStB or the relays of one or more of them is now once more in the rest condition.

When the signal characterizing the blockage of all the connecting lines VL4 from the exchange VStC which is disposed beyond the intermediate exchange VStB is to be transmitted to the exchange VStB, this signal can be extended to the exchange VStA in that the relay Ub5 (not shown) which is disposed in the exchange VStB and is energized temporarily like relay Ua4' in the exchange VStA connects the source WQ2 of alternating current to the connecting line VL1 provided for transmitting this signal at contacts ub5 and 215ub5 and thereby controls the receiving devices in the connecting line VL1 in the exchange VStA in the same manner as already described. These receiving devices are then controlled in the same way when outgoing connecting lines VL4 from the exchange VStC become free.

Instead of only transmitting one blocked signal over a connecting line all signals can be transmitted over a single connecting line, for example in that alternating currents of different frequency are connected permanently (Figs. 2, 3, etc.) or temporarily (Fig. 8) to this line.

Instead of transmitting the signal for the inaccessibility of outgoing connecting lines from an intermediate exchange, over connecting lines carrying the speech currents, the signal can alternatively be transmitted over a separate signalling line common to all the connecting lines. A separate signalling line may be provided for each signal or alternatively a single signalling line can be provided for all signals in that the currents used are of different types such as direct current and alternating current or alternating currents of differing frequencies.

What is claimed is:

1. In a telephone system, a pair of exchanges interconnected by trunk lines, means in one of said exchanges operated responsive to all of said trunk lines becoming busy, a distant exchange, and means in said distant exchange operated responsive to the operation of said last means.

2. In a telephone system, a pair of exchanges interconnected by trunk lines, a third exchange, means associated with said trunk lines and effective to transmit a signal to the third exchange responsive to all of said trunk lines becoming busy.

3. In a telephone system, a pair of exchanges interconnected by a group of trunk lines, a third exchange, means associated with said group of trunk lines and effective to signal transitorily to said third exchange responsive to an all-trunks-busy condition thereof, means in the third exchange operated by said transitory signalling and maintained operated after the cessation thereof, said first means thereafter effective responsive to the cessation of said all-trunks-busy condition to signal transitorily to said third exchange to restore said last means.

4. In a telephone system wherein calls from a first exchange to a second exchange are extended through an intermediate exchange over trunk lines, means for making any of said trunk lines busy, means effective if all of the trunk lines between the intermediate exchange and the second exchange are busy to transmit an all-trunks-busy signal to the first exchange over a trunk line extending from the first exchange to the intermediate exchange, said last means transmitting said signal over said last trunk line regardless of whether said last trunk line is busy or idle.

5. In a telephone system wherein connections from a local exchange to a distant exchange are extended over a predetermined route including one or more tandem exchanges, means in the local exchange individual to each group of interex-

change trunks along said route, said means operated responsive to all trunks in the corresponding group becoming busy.

6. In a telephone system, an exchange, a group of trunks over which calls incoming to said exchange are received, a plurality of groups of trunks over which calls outgoing from said exchange may be extended, means individual to each group of said plurality of groups of trunks, said means operated responsive to an all-trunks-busy condition of the corresponding group and effective to revert a signal from said exchange over a trunk of said first group.

7. In a telephone system, a plurality of serially related exchanges, means for extending a call from the first exchange of the series to any other desired exchange of the series through those exchanges of said series which intervene between said first and said desired exchange, means associated with the trunk lines joining each pair of adjacent exchanges in said series and operated when none of the trunk lines between that pair of exchanges is available, and means controlled by said last means to indicate at all times in said first exchange whether or not a trunk line between each pair of exchanges in said series is available.

8. In a telephone system, a plurality of serially related exchanges, means for extending calls over idle trunk lines from the first exchange of said series to any other desired exchange of the series through those exchanges of the series which intervene between said first and said desired exchange, and means for preventing the partial extension of those calls which cannot be completed to the desired exchange because of the unavailability of idle trunk lines beyond some one of said intervening exchanges through which the call would pass.

9. In a telephone system wherein calls from subscribers in an originating exchange to subscribers in a terminating exchange are extended through an intermediate exchange over trunk lines, means effective if none of the trunk lines between the intermediate exchange and the terminating exchange are available to prevent a trunk line from the originating exchange to the intermediate evchange from being seized for a call from said originating exchange to said terminating exchange.

10. In a telephone system wherein calls from subscribers in an originating exchange to subscribers in a terminating exchange are extended through a plurality of intervening exchanges in series over trunk lines, means effective if none of the trunk lines extending from the last intervening exchange of said series to the terminating exchange are available to prevent a trunk line from the originating exchange to the first intervening exchange of said series from being seized for a call from said originating exchange to said terminating exchange.

11. In a telephone system wherein connections from a first exchange to a second exchange may be extended over a predetermined route which includes one or more tandem exchanges, means effective when all of the trunks outgoing over said predetermined route from one of the tandem exchanges are busy to prevent any trunk incoming over said route to that tandem exchange from being seized for the extension of a connection to said second exchange.

12. In a telephone system wherein connections from a first exchange to a second exchange may be extended over a predetermined route which includes a plurality of serially related intervening exchanges, means effective when all of the trunks outgoing over said predetermined route from any one of the intervening exchanges are busy to prevent any trunk incoming from said first exchange to the first intervening exchange of said series from being seized for the extension of a connection to said second exchange.

13. In a telephone system, a plurality of serially related exchanges, means for extending a call from the first exchange of the series to any other desired exchange of the series through those exchanges of said series which intervene between said first and said desired exchange, means associated with the trunk lines joining each pair of adjacent exchanges in said series and operated when none of the trunk lines between that pair of exchanges is available, and means controlled by said last means for preventing the partial extension of those calls from said first exchange which cannot be completed to the desired exchange because of the unavailability of trunks beyond some one of said intervening exchanges through which said call would pass.

14. A telephone system as claimed in claim 13, having an exchange not in said series over which calls may be extended to said desired exchange, wherein said last means routes calls to the desired exchange over said last exchange when some portion of the route through said series of exchanges is unavailable.

15. In a telephone system wherein connections from a first exchange to a second exchange may be extended over a preferred route or an alternative route, a tandem exchange included in said preferred route, and change-over means in the first exchange operated to render the alternative route effective responsive to all trunks outgoing from the tandem exchange in said preferred route becoming busy.

16. In a telephone system wherein calls from subscribers in an originating exchange to subscribers in a terminating exchange may be extended over a preferred route or an alternative route, said preferred route including one or more tandem exchanges, means effective if said calls cannot be completed over the preferred route due to the unavailability of trunks outgoing in the preferred route from one of said tandem exchanges to direct said calls over the alternative route without first attempting to extend same over said preferred route.

17. In a telephone system, two exchanges, means for extending connections from the first to the second of said exchanges over either of two groups of trunks outgoing from said first exchange, one or more tandem exchanges through which must be completed those connections extended from said first exchange over the first of said groups of outgoing trunks, and routing means in the first exchange operated responsive to all of the trunks outgoing from any of said tandem exchanges toward the second exchange becoming busy, said routing means effective to direct the extension of connections from the first to the second exchange over the second of said groups of trunks outgoing from the first exchange.

18. In a telephone system, a trunk for extending calls in any of a plurality of traffic directions, a plurality of approaches having access to said trunk, each approach corresponding to one of said traffic directions, and means responsive to a traffic direction becoming impassable to calls for

blocking only that approach to said trunk which corresponds to that direction.

19. In a telephone system, a switching center, a plurality of groups of trunks over which calls outgoing from said switching center may be extended, a group of trunks over which calls incoming to said center are received, a plurality of approaches having access in common to the trunks of said last group, each of said approaches corresponding to one of said groups of trunks, and means responsive to an all-trunks-busy condition of any of said groups for blocking the approach corresponding to that group.

20. In a telephone system, a plurality of serially related exchanges, means for extending a call from the first exchange of the series to any other desired exchange of the series through those exchanges of said series which intervene between said first and said desired exchange, a plurality of approaches, in said first exchange, to the trunk lines between said first exchange and the second exchange of said series, each approach corresponding to one of the exchanges of said series to which calls from the first exchange may be extended, and means responsive to any exchange of said series becoming inaccessible due to all of the trunks extending thereto from the next preceding exchange of said series becoming busy for blocking, in said first exchange, both the approach corresponding to said inaccessible exchange and the approaches corresponding to all exchanges of the series to which calls must be extended via the inaccessible exchange, the approaches corresponding to exchanges between said first exchange and said inaccessible exchange remaining unblocked to permit the extension of calls thereto.

21. In a telephone system, a pair of exchanges interconnected by trunk lines, means associated with said trunk lines and operated responsive to all of said trunk lines becoming busy, a third exchange, and means controlled by said last means to indicate at all times in said third exchange whether or not all of said trunk lines are busy.

22. In a telephone system, two exchanges interconnected by trunk lines, a third exchange, a device in the third exchange, and means associated with said trunk lines effective to operate said device in one way whenever all of said trunk lines are busy and to operate said device in a different way whenever at least one of said trunk lines is not busy.

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