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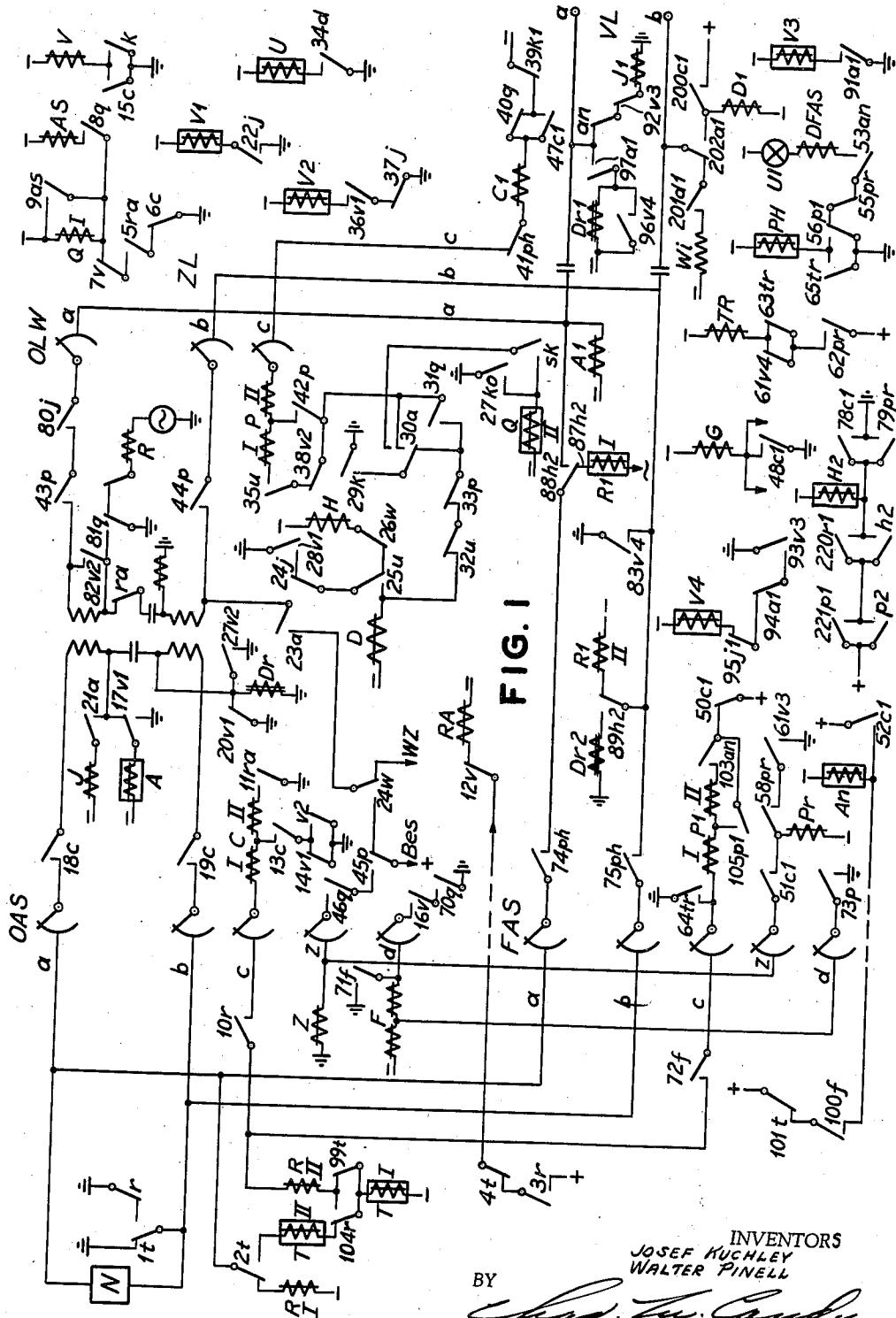
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2,258,854

AUTOMATIC TELEPHONE SYSTEM

Filed Dec. 17, 1938

4. Sheets-Sheet 1



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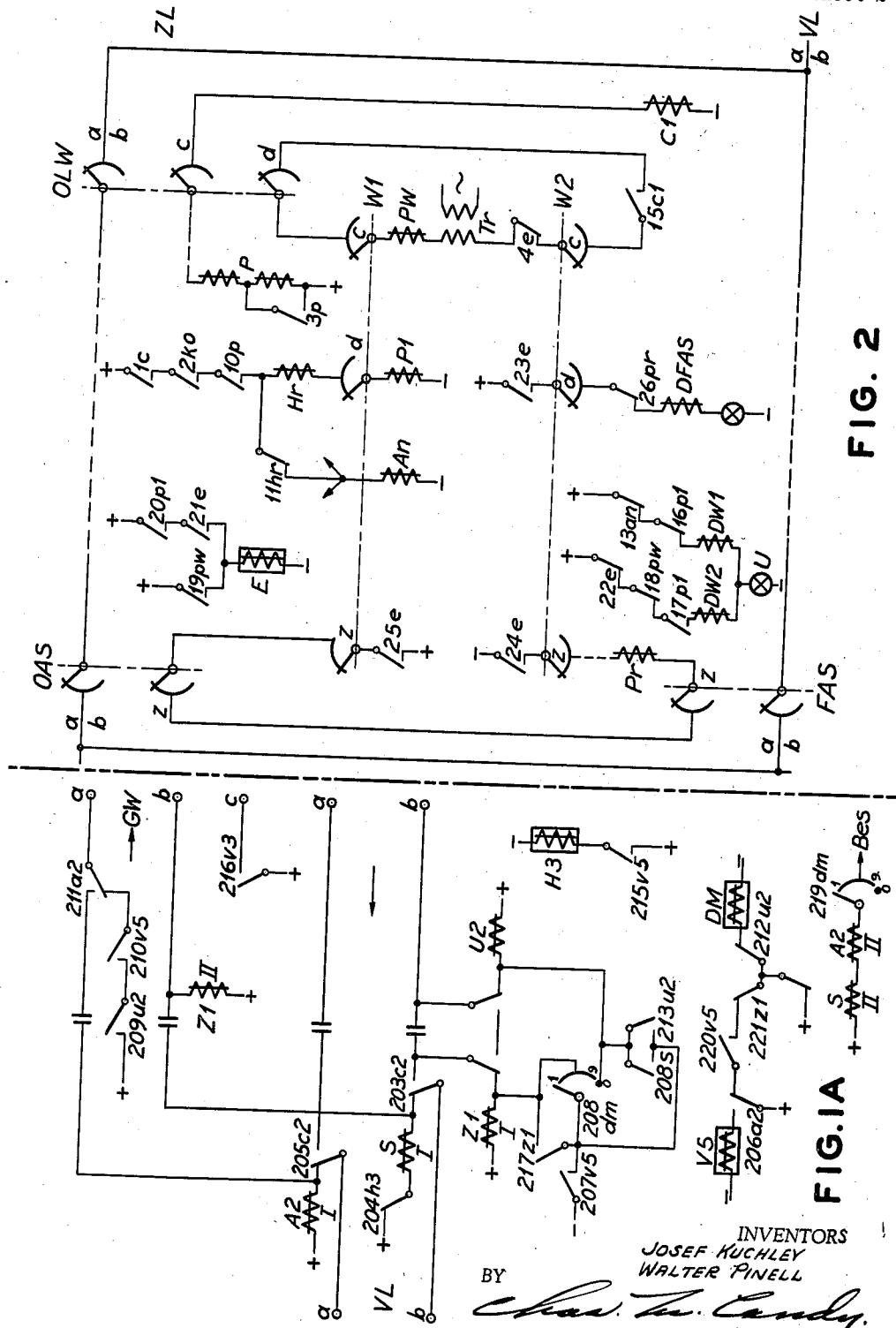


FIG. 2

FIG. 1A

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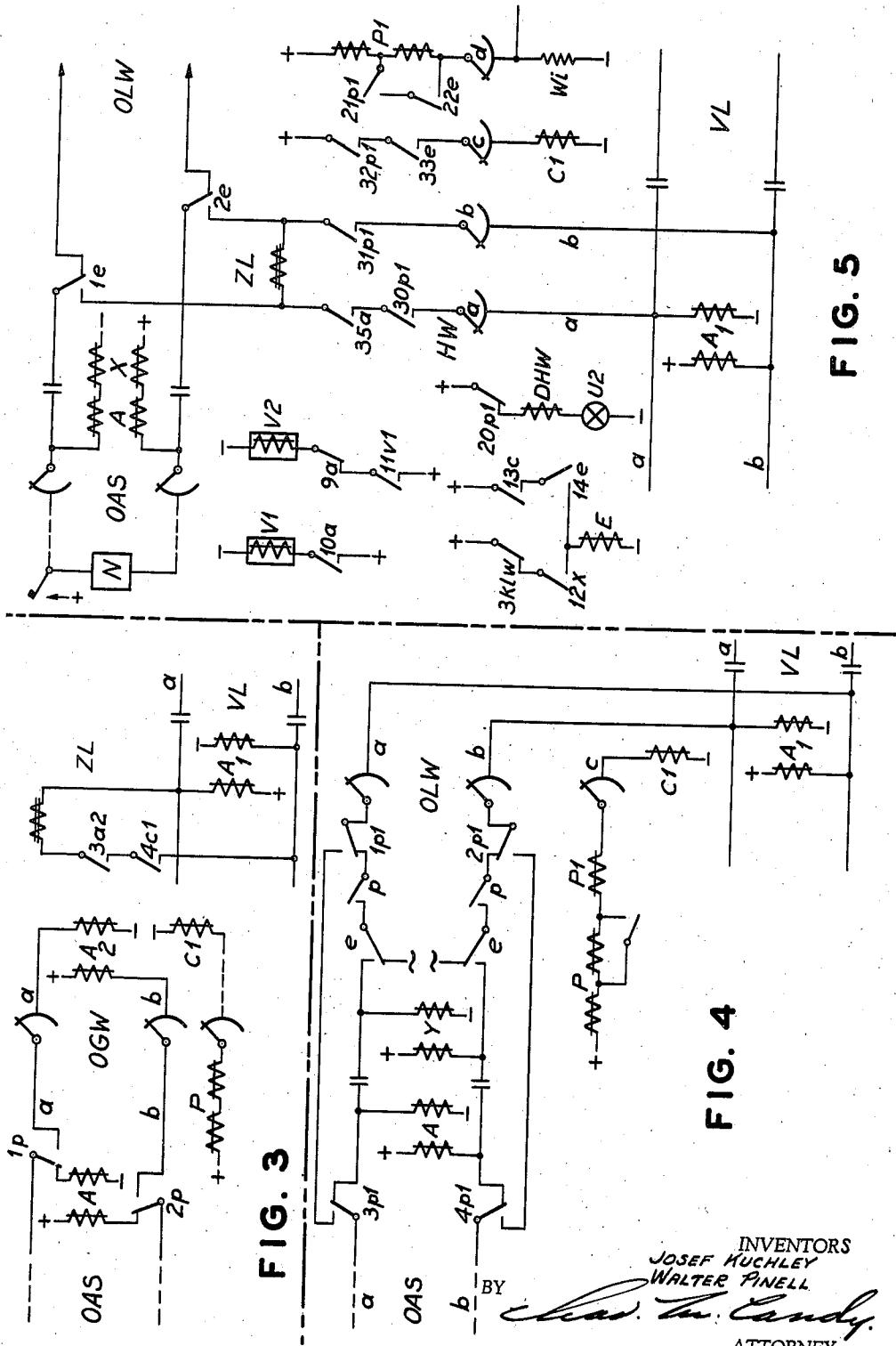
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4 Sheets-Sheet 3



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4 Sheets-Sheet 4

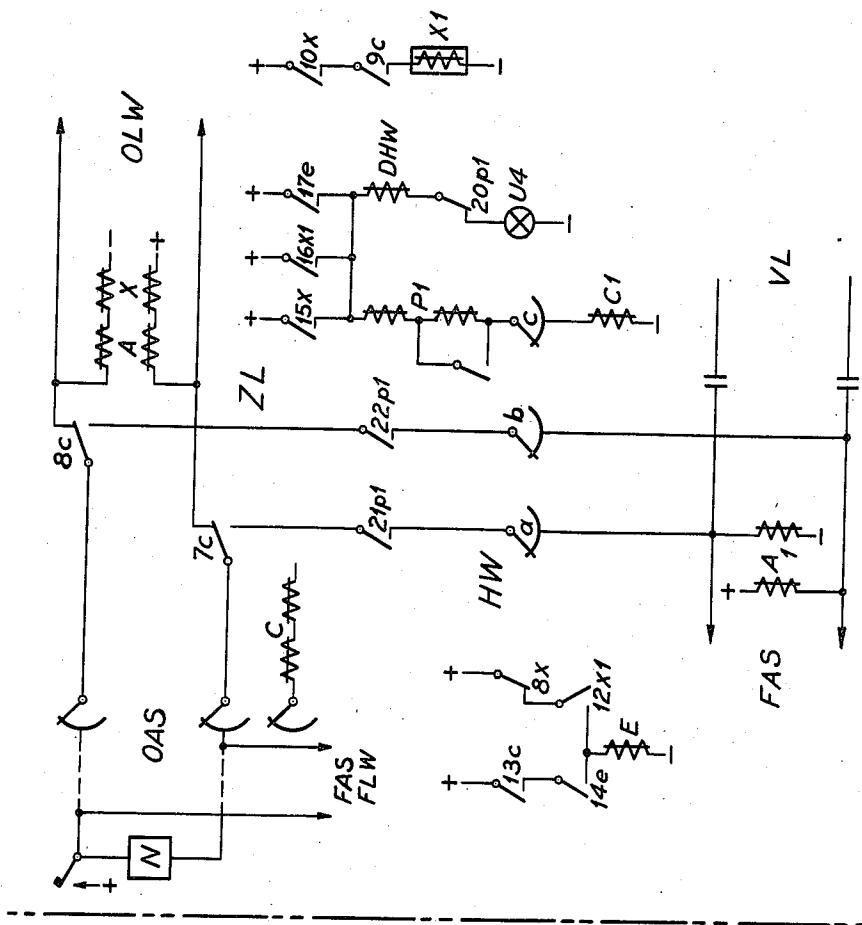


FIG. 7

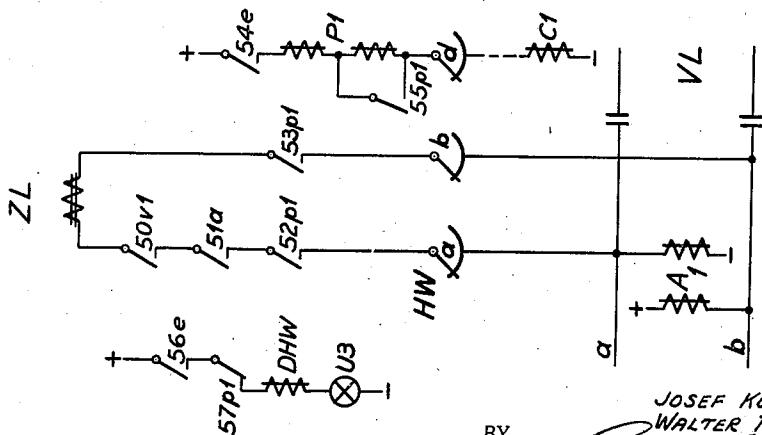


FIG. 6

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2,258,854

AUTOMATIC TELEPHONE SYSTEM

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16 Claims.

(Cl. 179—18)

In distance communication, in particular telephone systems, it is known that connections in a remote exchange extend over connecting paths for the traffic having junction lines which are connected to the exchange set of the calling subscriber. This arrangement can be uneconomic when the traffic in the remote exchange sets require special auxiliary devices, for example, for the purpose of sending out impulses, supervising, etc., since in such cases all the connecting paths for the internal traffic must be provided with these. With a large concentration of traffic in extraneous exchange sets a large number of connecting paths must be provided especially when the principal traffic peaks or internal and connected traffic coincide.

Connections in remote exchanges can be passed over connecting lines for the internal traffic within the exchange sets of the calling subscriber while the connections themselves extend over special connecting paths. By this arrangement after seizing of the connecting path for internal connections for the calling set the desired remote exchange set is characterized whether by selection of a characterizing digit or by the execution of a particular switching measure (pressing of the key) and thereby connected with a free junction line over the associated selector in the desired direction which is connected with the calling junction line. The connecting path seized by the call is thus freed for internal traffic. This arrangement has the advantage that the connecting path serving for the internal traffic need not be provided with the devices which are necessary solely for the traffic in the extraneous exchange sets. The number is further not increased or only increased to an insignificant amount compared with the number necessary for dealing with internal traffic.

If selectors with multiplied contacts are associated with the junction lines to the exchange sets the connection of the junction lines to the calling junction line requires a certain period of time during which the calling subscriber cannot send out impulses for setting the selector in the remote exchange set. He must await the connection or disappearance of an exchange signal from which he recognizes that impulse receivers are now ready to receive the impulses. This arrangement is specially disadvantageous in the characterizing of the remote exchange set by the selection of a characterizing circuit. Storage devices can now be provided which receive the impulses so that the calling subscriber need not delay sending of dial impulses. Especially with

systems having selectors which are directly set on the calling set it is not desired to provide such auxiliary devices.

The present invention shows a way in which at the same time special instructions for the subscriber (wait until an exchange signal is heard or disappearance) on the initiation of a connection from an extraneous exchange after seizing of a junction line to external connections by a call and further storage or the provision of internal junction lines with devices for fulfilling special requirements for junction traffic (e. g. the signalling devices) are avoided. The invention attains this result in that the outgoing junction lines to the extraneous exchange sets are provided with special access which is obtained over the internal connecting path seized after the characterizing of the remote exchange, and over which dial impulses for setting the selectors in the 10 extraneous exchange can be sent out previous to the connection of a junction line to the calling exchange line resulting when the connection path is switched over.

By means of the arrangement according to the 25 invention the calling subscriber has the possibility of sending out impulses for setting the impulse receiver in the desired exchange directly after characterization of the desired exchange in a particular manner (selection of characterizing digits or pressing of a key). The use of the connecting devices serving for internal traffic continues only until the connection of the junction line to the calling junction line of a special selector serving merely for the junction traffic.

30 A further advantage of the arrangement according to the invention is that large group selectors can be used for traffic with the remote exchange without an especially high operating velocity or specially constructed testing devices or storage devices being necessary, while the subscriber need not delay the sending out of impulses.

40 A special access to the junction line can be obtained over an impulse receiver for internal connections but also over another station of the internal connecting path seized by the call e. g. following a selecting stage.

According to the invention the special access 45 of the junction line can be metallically connected with the speaking conductors of the internal connecting path. It is then possible when the junction line to the remote exchange cannot be made over the connecting selector e. g. as a result of disturbances, to by-pass the speech traffic over

the internal connecting path by the special means of access.

According to another feature of the invention the present switching means are provided which when a desired line becomes disengaged prevent the switching back of the call to an engaged subscriber having call storage facilities, but cause the call to be switched back when the subscriber who has stored the call becomes free. The switching back of the call to the waiting subscriber only results then when the required line and the waiting subscriber who has stored the call are both free.

This has the advantage that the waiting subscriber only has the called line at his disposal when he himself is also free. The subscriber in another conversation is thus not disturbed. The required line can be placed at the disposal of a further subscriber in the interval in which the waiting subscriber is engaged in another conversation.

In arrangements with call storage when a called line is engaged and the storage of the call is maintained through further outgoing and incoming connections the subscriber does not need to undertake the selection of the desired line again after receiving the automatic switching back of the call when the desired line becomes free. He is connected in preparation to the called party by means of the call storing operations of the selector which has operated previously.

In order that the subscriber shall determine whether the selection of the required line shall take place immediately or only after switching back further features are provided according to the invention which are associated with the called line and decide whether the required line is to be reached immediately or after the call has been stored. The selection of the desired line can then take place independently of whether the call is stored or whether the desired line is immediately free. The subscriber also has to perform the necessary switching measures after selecting the desired line again after the switching back of the call. For example, he has to select the characteristic digits of a required line in each case even after call storage before the selection of the digits of the required subscriber is undertaken. If after the switching back of the call no further digit selection takes place the subscriber receives the engaged signal.

In the drawings systems are shown as embodiments in which the selectors serving the traffic to the extraneous exchange are associated with the outgoing junction line. It is understood that the invention can also be used for the purpose of connecting traffic, the junction lines being provided with a special discriminating selector for junction traffic.

Figs. 1 and 1a relate to a circuit for a fully automatic rural exchange with local and main exchanges and characterizing digit selection and call storage.

Fig. 2 shows an arrangement in which in contrast to Fig. 1 on seizing of a free connecting line VL the other connecting lines are not guarded.

Figs. 3 and 4 show further embodiments for impulse receivers serving to send out impulses over internal routes.

In Figs. 5, 6 and 7 various possibilities for sending out impulses to the junction lines having directive selection by the pressing of a key are represented.

Only the details necessary for understanding

the invention are represented and described. Thus in the figures a local group AS, LW and a line VL and a remote group AS only are shown.

Internal routes extend over selectors OAS—OLW and the incoming exchange traffic over FAS and FLW in the usual way. For the purpose of the invention only the outgoing exchange traffic is of interest.

In Fig. 1 initiating of an outgoing exchange connection to another exchange takes place as follows:

When the subscriber N lifts up his receiver the subscriber's relay R operates over contact 1t, subscriber's loop, contact 2t, winding I of relay R, battery. By means of a contact 3r the seizing circuit for the selector OAS is closed over contact 4t. The relay RA operates over contact 12v and by means of its contact 5ra completes a circuit for relay Q, winding I, over contacts 6c and 7v. Over contact 8q the rotary magnet AS is connected. The selector OAS rotates its wiper in alternate play between the relay Q and contact 9as until the relay C tests on the subscriber's connection characterized by means of the contact 10r over the c-wiper of the selector OAS over the following path: earth, contact 11ra, windings I and II of relay C, c-wiper of selector OAS, contact 10r, winding II of relay R, operated contact 104r winding I of relay T, battery. Relay C operates and stops the selector at contact 6c and switches through the talking conductors over contact 18c and 19c. Over contacts 18c and 14v1 relay C holds, short-circuits its winding II and guards the finder switch against further seizure. Over the contact 15c the relay V operates, and over contact 16v the d-conductor of selector OAS prepares a circuit for the relay F associated with the subscriber. Contact 7v causes the relay Q to restore again.

Over contact 17v1 in its normal position, upper winding of the repeater, a-conductor, operated contact 18c, a-wiper of the selector OAS, subscriber's set, b-conductor, b-wiper of the selector OAS, operated contact 19c, lower winding of the repeater, contact 20v1, and earth, the relay A operates. Contact 21a operates the relay J and contact 22j the relay V1. Relay V1 holds during the sending out of impulses. Relay A holds over operated contact 17v1, relay J holds over earth on the choke coil Dr after the operation of contact 20v1. Over contact 23a and off-normal contact 24w of the selector OLW the subscriber receives the exchange signal or dial tone WZ.

It will be assumed that the subscriber who wishes to make a local or remote call, will select the digit 0 for this purpose. By the interruption of the loop the relay J restores. Over contacts 37j and 36v1 relay V2 operates and during the impulse transmission this relay holds and short-circuits the choke Dr by means of its contact 27v2. Over the operated contact 28v1, contact 24j in its normal position, contact 25u and off-normal contact 26w of OLW, the vertical magnet H of the selector OLW operates. The wipers of the selector OLW are now raised by a number of steps corresponding to the number of interruptions in the loop.

After the switch has been stepped up, i. e., in the case assumed, after it has reached the setting 70 corresponding to the characterizing digit 0, the rotary off-normal contact 27ko of the selector OLW is operated and causes relay Q to energize over its winding II. Over earth, contact 78q, 16v, d-wiper of the selector OAS, the relay F associated with the subscriber N is operated and holds

Over contact **11f** independently of whether the subscriber N has hung up or not.

Relay F characterized over its contact **12f** the subscriber N, who has selected the characterizing digit, on the c-conductor of the selector FAS. Thus independently of whether an exchange line is free or not the subscriber's call is stored. The subscriber can make internal connections with incoming as well as outgoing lines without the relay F affecting the storage releasing.

Over the operated off-normal contact **29k** of the selector OLW, the operated contacts **30a**, **31q**, the unoperated contacts **33p** and **32u**, the rotary magnet D of the selector OLW is operated. The rotary off-normal contact **34d** of the selector OLW energizes the relay U and the relay U interrupts the circuit for the rotary magnet D at contact **32u**. This alternate control causes the rotary magnet D to rotate the wipers of selector OLW over the bank contacts to hunt for a free junction line. Relay P test over the c-wiper of the selector OLW, contacts **35u**, **38v2**, **39a** and **29k** to the battery potential on the c-conductor.

Junction line free

It will first be assumed that a connecting line, for example selector FAS, is free and the contact **40g** is in the normal position. The relay G, which is common to all selectors FAS, operates when one selector FAS is seized and guards all the remaining junction lines by operating all the contacts corresponding to **40g** until selector FAS has been set on the subscriber's junction line.

In this way cross connections to a subscriber's junction line by the simultaneous testing of several selectors FAS is avoided.

The relay P of the selector OLW operates over: battery, off-normal contact **39k1** of FLW, contact **40g**, winding of relay C1, contact **41ph** and c-conductor. By means of contact **42p** the winding I of relay P is short-circuited and the line on which the selector OLW is tested is guarded. Over contact **33p** the magnet D is disconnected and the selector OLW is stopped. Over contacts **43p** and **44p** the talking conductors of the selector OLW are switched through. Over contacts **45p** and **46q** earth is connected to the z-wiper of the selector OAS over the conductor Bes and thus the subscriber N is characterized by a multiple connection z to the selector FAS.

By means of the short-circuiting of winding I of relay P the relay C1 associated with the connecting line VL operates and holds independently of contact **40g** over its contact **47c1**. Contact **48c1** energizes the relay G which opens contact **40g**. Over contact **50c1** earth is disconnected from the c-conductor of the selector FAS so that the relay P1 can no longer test. At contact **51c1** the test circuit of relay Pr is prepared. Over contact **52c1** the starting relay An of the selector FAS operates and over contacts **53an**, **55pr** and **56p1** the rotary magnet DFAS operates and rotates the selector FAS under control of the interrupter U1.

When the z-wiper of the selector FAS reaches earth connected over the line Bes, contacts **45p** and **46q** and the z-conductor of the selector OAS, relay Pr operates and disconnects the rotary magnet DFAS at contact **55pr**.

Further selection

After the selection of the characterizing digit the subscriber can immediately begin to dial the next impulse series. He need not delay the im-

pulse sending until a connection to the junction line VL is completed over the selector FAS.

If the connecting line VL is free, selector OLW has direct access to the impulse relay A1, associated with VL, which is operated over the a-conductor, OLW, contact **80j**, **43p** and **81q**. Contact **91a1** brings up the relay V3 which holds during the impulse series. Contact **92v3** cuts off the relay J1 serving for incoming traffic from the a-conductor of VL. Contact **97a1** connects battery to the a-conductor of the exchange line over the coil Dr1.

On the operating of the dial the relay J of the local connection is restored as well as in the characterizing digit selection and at its contact **80j** disconnects earth from the a-lead over contacts **81q**, **82v2**, **43p**. In this way the relay A1 in the a-conductor of the junction line VL is restored and at contact **97a1** removes battery from the a-lead in synchronism with the impulses. On the release of the relay A1 relay V4 operates over contacts **93v3**, **94a1** and **95j1** and holds during the impulse series and the coil Dr1 is short-circuited by its contact **96v4**.

In order to ensure that the impulses are not mutilated the arrangement is such that the switching through of the selector FAS associated with the connecting line VL is only possible at the end of an impulse train.

For this purpose it is arranged that in dependence on the relay V4 which is operated by an impulse train, an additional relay Tr is influenced which controls the switching through relay PH.

In Fig. 1 the circuit of the relay Tr is interrupted by means of contact **61v4**. At the end of the impulse train the contact **61v4** is restored to normal. Meanwhile the relay Pr of the selector FAS has tested on the subscriber's junction line, as described previously, and the relay Tr operates over contacts **61v4** and **62pr** and holds over its own contact **63tr**. Contact **64tr** connects earth to the c-wiper of the selector FAS, so that the switching through relay C of the selector OAS is short circuited and the internal connecting path is released. By means of contact **65tr** the switching through relay PH is energized and effects the switching through of the talking conductors of the selector FAS by means of its contacts **74ph** and **75ph**.

Over contact **73ph** earth is connected to the d-wiper of the selector FAS and is connected to the d-wiper of the line leading to the selector OAS. The relay F which maintains the storage of the impulses is thus short circuited and restores. The impulses are no longer stored. Over contact **41ph** and c-conductor to the selector OLW is interrupted. Relay C1 associated with the connecting line is restored.

Relay H2 which operated over contact **78c1** holds over contact **79pr**. Contact **88h2** closes the a-conductor of the selector FAS and over contact **89h2** and choke Dr2 connects earth to the b-conductor of the junction line VL. The relay Pr holds over the contacts **58pr** and **61v3** which is operated during the impulse transmission.

After the closing of the final connecting path from the connecting VL over the selector FAS to the subscriber's connection and release of the local apparatus OAS-OLW, the dial impulses are transmitted as loop impulses over earth, choke Dr2, contacts **89h2**, **83v4**, **75ph**, b-wiper of FAS, b-conductor, subscriber's station N, a-conductor, a-wiper of FAS, contact **74ph**, **88h2**, re-

lay A1. The delay in the operation of the switching through relay PH of selector FAS and the release period of the switch through relay C of selector OAS is so arranged in view of the short-circuiting, that no impulse gets lost. In order to avoid controlling the impulse relay A1 simultaneously at VL over the internal as well as over the final connecting path, both periods are made substantially the same.

No junction line free

If no junction line to the extraneous exchange is free a subscriber receives the engaged signal over contacts 45p, 24w, 23a. He can hang up and hold an internal conversation during the waiting period. His call remains stored over the relay F during the local conversation of the subscriber. Junction lines which became free are at the disposal of other subscribers.

If several subscribers' calls are stored but are not engaged in local conversations and therefore are ready to seize the connection, the subscriber whose associated selector first reaches the junction line VL seizes the connection to the remote exchange.

It will be assumed that the subscriber N with a stored call is the first who is ready to seize the line.

Revertive calling

When on the release of a junction line VL, the subscriber N is free and has hung up, the selector FAS associated with the free connecting line over contacts 100f and 101t starts up in that the relay An operates.

The selector FAS of the junction line VL therefore comes under the control of two call receiving devices in the first place under the control of the seizing relay C1 which is reached only over the internal connecting path with special access to VL, and in the other case under the influence of relay F storing the call when all connecting lines VL are engaged.

Over contacts 53an, 55pr and 55pl the rotary magnet DFAS operates and rotates the selector FAS with the aid of the interrupter U1 until the test relay P1 tests over contacts 50c1 and 103an, c-wiper of the selector FAS, contact 72f, winding II of relay R, contact 99t, winding I of relay T. The contact 50c1 is in its normal position when the corresponding junction line is free.

By testing on the call of the subscriber N stored over the contact 72f relay P1 operates and again stops the selector FAS over contact 56pl and short circuits its second winding by means of contact 105pl.

Over the operated contact 56pl the relay PH operates and switches through the talking conductors of the selector FAS over the contacts 74ph and 75ph. Over the contacts 87h2 and 89h2 and the windings I and II of relay R the subscriber N receives calling current over the talking conductors. The call from the exchange is conveniently differentiated from an internal call by the length of the ringing signal.

The subscriber N after receiving the call lifts up his receiver and immediately receives the exchange signal from selector FAS.

The subscriber can, after lifting up his receiver, send out the number of the desired subscriber corresponding to the characterizing digits of the resulting impulse train. Then in known manner the selector in the main exchange is set corresponding to the impulse train and the connection to the desired subscriber is set up.

The arrangement can, however, also be conveniently such that the subscriber after the switching back of the call has to select the complete number of the called party again, i. e., he must carry out the digit selection again. He need then, not differentiate between the selection without call storage and the selection after call storage. If the subscriber in the last arrangement described forgets to dial the characterizing digit again, he receives the engaged signal.

Further selection according to this arrangement will be described in detail with reference to Figs. 1 and 1a.

The arrangement is such that switch means having access to the junction line differentiate between the various arrangements for reaching the main exchange from the junction line, as to whether the connection extends over internal connecting devices and the special access means (when a connecting line is free), or (after the junction lines have all been engaged) directly over selectors serving only the connecting traffic to the remote exchange.

In the selection over the internal connecting path to the other exchanges the dial impulses are transmitted freely by means of the switch means affecting the differentiation, while by the selection directly over the selector of the junction line the impulses are freely transmitted only on the selection of the characterizing digit.

The testing occurring on the selection of the characterizing digit is performed by a discriminator which by means of the switch means carrying out the differentiation on the selection is brought directly under the control of the dial impulses over selectors of the junction lines. On selection of the characterizing digit switch means are controlled by means of the discriminator which makes it possible to send on the impulses to the main exchange. On the selection of digits which do not correspond to the characterizing digit the impulse transmission to the main exchange is prevented, however, and the calling subscriber receives the engaged signal.

It will be assumed that the number of the desired subscriber at the main exchange is O 365. The calling subscriber in the sub-exchange then must always select this subscriber's number whether the connecting line of the remote exchange is free or is first engaged.

Connecting line free

If the connecting line is free on the setting up of the connection to the main exchange over the internal connecting path the calling subscriber receives the exchange signal after the digit selection, as described, over the internal connecting path. On the selection of the following characterizing digit 3 then, as already described, the relay A1 of the access means to the junction line is controlled in synchronism with the impulses and the impulses are transmitted over contact 97a1. Over contacts 96v4, 97a1 and 205c2 relay A2, (Fig. 1a) is controlled in synchronism with the impulses. One the energization of the relay A2 the relay V5 operates over contact 206a2 and holds during an impulse train.

On the seizing of the junction line to the remote exchange over the special access means relay C1 was energized and operated the relay D1 over contact 200c1. Over resistance Wi, the operated contact 201d1, and contact 202a1 which is set back to its normal position by each impulse, battery is connected to the b-conductor of the connecting line to the main exchange

Whereby over contacts 203c2 and 204h3 which are in their normal positions, relay S is operated. Over contacts 207v5 and 208s the relay U2 is operated. Over contacts 209u2 and 210v5 the impulse transmission to the group selector GW in the main exchange is made possible. By the control of contact 211a2 positive potential is connected to the a-conductor to the main exchange and the group selector, which is not shown, is stepped up to the third bank after the digit has been selected. Over contact 212u2 the rotary magnet DM of the discriminator is disconnected and the setting of the discriminator is prevented. Relay U2 holds over its own contact 213u3 and contact 207v5. The discriminator DM is therefore not operated in this case.

Junction lines all engaged at first.

Revertive calling

If all junction lines are engaged the calling subscriber receives the engaged signal from the local connecting path after selecting the characterizing digit 0. He hangs up. His trunk call is stored. The subscriber is free for local traffic. If in the meanwhile a junction line to another exchange becomes free and in addition the calling subscriber is free, as described, the revertive call is made automatically over the selector FAS of the junction line whereby the calling subscriber is switched through to the main exchange. The subscriber lifts up his receiver and receives the revertive call signals. The relay R1 of the junction line VL operates and connects the relay H2 (Fig. 1) with contacts 220r1 and 221p1. By the operation of the contacts 88h2 and 89h2 the relay R1 is disconnected from the conductors a, b of the junction line VL.

The subscriber must now select the number of the subscriber 0.365 again. After the transmission of impulses the relay A1 of the junction line VL which is operated by the operation of the contacts 88h2 and 89h2 restores in synchronism with the impulses. Relay V3 holds in the manner described over contact 91a1 and the relay V4 over contacts 93v3, 94a1 and 95j1. The impulses are transmitted in the manner already described over the contact 91a1 to the relay A2 (Fig. 1A). On the release of the relay A2 the relay V5 operates over contact 206a2 in the manner already described and holds during an impulse series. Relay U2 does not operate. The rotary magnet DM of the discriminator is therefore controlled in synchronism with the impulses over contacts 206a2, 220v5, 221z1 and 212u2 i. e. on the selection of the digit 0 it is brought into the position O.

In the position O the relay U2 operates over contact 207v5 and wiper 208dm of the discriminator. Over contact 212u2 the rotary magnet DM of the discriminator is disconnected. Over contact 215v5 the relay H3 operates and connects earth on the c-conductor of the group selector GW in the main exchange, by means of its contact 216h3. Contact 209u2 which previously prevented transmission of impulses to the group selector GW is closed. Over contacts 209u2, 210v5 and 211a2 impulses following on the digit characterization are transmitted to the group selector GW in the main exchange. The group selector GW is stepped on to the third contact bank as previously corresponding to the selection of the digit 3.

If the subscriber instead of selecting the complete subscriber's number 0 365 only selects the

digits 365 after receiving the reverted call he receives the engaged signal. The transmission of impulses to the main exchange is prevented.

In order to obtain this result the relay U2 effecting the impulse transmission is not operated if the discriminator is not set in its position O.

On the selection of the digit 3, after receiving the revertive call, the rotary magnet DM of the discriminator as described, is controlled over contacts 206a2, 220v5, 221z1 and 212u2 and brings the wiper 208dm into position 3 corresponding to the digit 3. In the positions 1-9 lower down than the position O of the wiper 208dm the relay Z1 operates over contact 207v5 and wiper 208dm and locks up over contact 217z1. Contact 221z1 interrupts the circuit for the rotary magnet DM. The relay U2 cannot operate as in the digit selection. The impulse transmission to the group selector GW is prevented by means of the contact 209u2 in its normal position. The calling subscriber receives the engaged signal over windings II of the relays S and A2 and wiper 219dm.

In this way the calling subscriber is compelled to select the complete number of the desired subscriber.

In the embodiment shown in Fig. 1 on the seizing of a junction line (VL) over a final selector OLW of the internal connecting path by means of the operating relay C1 the blocking relay G common to all junction lines, is energized, and as described, by opening the contact corresponding to the contact 40g in the access means to the other junction line VL prevents a further junction line from being seized until the selector FAS of the seized junction line has reached the line of the calling subscriber N.

The arrangement can also be such, however, (Fig. 2) that after the seizing of an internal junction line over connecting paths of the internal traffic, the seizing of another free junction line is not prevented but so long as the free junction lines can still be reached, all the free junction lines can be seized over connecting paths for internal traffic, but the connecting devices can never hunt for different connecting lines at the same time as the calling line.

For this purpose the arrangement according to Fig. 1 is provided with an auxiliary connecting path. Two auxiliary selectors are provided of which one sets itself on that local connecting path over which a connecting line has been seized and a second auxiliary selector sets itself on the seized junction line. The setting of these two auxiliary selectors can be made dependent in known manner on the closing of an individual testing circuit which is only completed when over connecting devices of the connecting path for internal traffic, taken into use over the two auxiliary selectors and the seized junction line, a circuit containing a particular current source is completed. Furthermore, a test circuit for the selector of the seized junction line is extended over the auxiliary connecting path and over internal connecting devices taken into use, and test potential is connected to the test wiper of the selector of the junction line as well as to the internal connecting path used by means of the auxiliary selector. It is convenient to set the rotary magnets of these two auxiliary selectors over a further wiper.

In Fig. 2 it is shown diagrammatically how the testing can be performed with the aid of two auxiliary selectors W1 and W2 without all of the junction lines being blocked when a junction line

is seized over the internal connecting path and several junction lines are free.

When the selector OLW tests on a free junction line VL relay P associated with the selector OLW operates and, over the contact 1c operated by the seizing of a selector OAS, contact 2ko of the selector OLW operated when the selector steps up to the tenth contact bank, contacts 10p and 11hr the relay An operates and over contacts 13an, 16p1 operates the rotary magnet DW1 of the auxiliary selector W1 over an interrupter U. Contact 3p short circuits a winding of the relay P and brings the relay Cl of the special access means ZL to the junction line VL. When the auxiliary selector W1 tests on positive potential over the contacts 1c, 2ko, 10p, and winding of the relay Hr, relay P1 of the auxiliary selector operates and over contact 16p1 disconnects the rotary magnet DW1. The auxiliary selector W1 is stopped.

Over contacts 17p1, 22e, 18pw the auxiliary selector W2 is rotated over its rotary magnets DW2 and the interrupter U until in the circuit: c-wiper of the auxiliary selector W1, d-wiper of the selector OLW, contact 15c1, c-wiper of the auxiliary selector W2, contact 4e and alternating current repeater Tr, the relay PW is operated. Over contact 18pw the rotary magnet DW2 is disconnected and the auxiliary selector W2 is stopped on the position characterized by means of contact 15c1. Over contact 19pw the relay E operates and holds over contacts 20p1 and 21e. Contact 4e interrupts the alternating current test circuit and contact 22e, the circuit for the rotary magnet DW2. Contact 23e connects the rotary magnet DFAS of the selector FAS to the junction line VL over the d-wiper of the auxiliary selector W2 and contact 23e. Over contacts 24e and 25e test potentials are connected to the wipers z of the auxiliary selector W, W2. FAS operates until the following test circuit is completed for the relay Pr: negative, contact 24e, z-wiper of the auxiliary selector W2, relay Pr, z-wiper of the selector FAS, z-wiper of the selector OAS, z-wiper of the auxiliary selector W1, contact 25e, positive. Over contact 26pr the magnet DFAS is disconnected. The connection between the junction line VL and the subscriber's line is set up.

The impulse transmission over the internal connecting devices and the special access means ZL (Fig. 1) extending to a junction line VL can also be arranged according to Figs. 3 and 4.

Fig. 3 relates to the impulse transmission of an internal group selector and a bridge relay as an impulse repeater in the special access means to the junction line VL. In this case after the testing operation, e. g. of the group selector OGW the contacts 1p and 2p are operated, the bridge relay A disconnected, and over contact 4c1 the impulses are transmitted to the relay A1 of the junction line by means of the relay A2 and contact 3a2.

In Fig. 4 is represented the disconnection of the bridge relay A on the seizing of the junction line over a line selector OLW and metallic switching through over special access means to the junction line. When the relay P tests over the c-wiper of the selector OLW on to the relay Cl of the junction line VL which in contrast to the relay of the subscriber's line, is of a low resistance, the relay P1 operates and disconnects the bridge relay A by means of its contacts 1p1, 2p1, 3p1 and 4p1 and switches through the talking conductors a, b.

The loop interruptions on the dial impulse transmissions can be transmitted in Figs. 3 and 4 directly to the relay A1 of the junction line VL after the switching through. This case is shown in Fig. 4.

The loop interruptions can, however, be transmitted to a bridge relay A2 of the special access means of the selector OLW and OGW as shown in Fig. 3. Contact 3a2 closes the circuit for the relay A1 of the junction line prepared by means of the contact 4c1. In the second case no metallic switching through of the internal connecting path to the free junction line takes place. No talking can occur over the outgoing line.

In Figs. 1-4 it is assumed that connecting devices in particular dial impulse receivers of the internal connecting path hunt freely for access to a free junction line. A free junction line can, however, be hunted for over a special auxiliary selector in particular when junction lines in another exchange cannot be set up over internal dial impulse receivers with free hunting. The selector OLW is then set on a particular contact by means of a characterizing digit. The auxiliary selector with free hunting which is arranged further on is either started by the characterizing digit selection or it is preset.

In Figs. 5, 6, 7 circuit arrangements are shown in which the connections to another exchange are set up over points which have access to internal connecting devices in particular to dial impulse receivers and to a special access means to a junction line in another exchange. Over the points, impulses can be transmitted to another exchange until a connection is set up between the seized connecting line extending to the other exchange and the subscriber's line. The switching operation results conveniently by the pressing of the key at the subscriber's station. In order to hunt for a free junction line an auxiliary selector HW is used which either operates by means of pre-setting (see Fig. 5) so that when a junction line is free indirect impulses can be transmitted to the junction line connected to the other exchange, or the auxiliary selector is only started up after the operation of the points (see Figs. 6-7). The arrangement according to the preceding figures can be such that over the points a metallic connection to the special access means in the junction line is set up (Figs. 5 and 7). The arrangement, however, can be such that over the internal connecting path only dial impulses for setting dial impulse repeaters can be transmitted to the other exchange without a talking connection being set up (see Fig. 6).

In Fig. 5 after the selector OAS has been stepped up and has tested on the subscriber's line in known manner the relay C is energized (not shown). By the pressing of the key at the subscriber's station for setting up a connection to another exchange the relay X is energized, and by means of its contact 12x energizes the relay E over the rotary off-normal contact 3klw of the selector OLW. The point contacts 1e and 2e are operated. Relay E holds over contacts 14e and 13c independently of the pressing of the key. A further contact, not shown, of the relay E interrupts the setting circuit of the selector OLW so that this can no longer be influenced by the impulses which follow.

The auxiliary selector HW is provided with a pre-setting arrangement and when a junction line is free it sets itself on this free junction line. The auxiliary selector HW is rotated until the operation of its test relay P1 over contact 20p1,

rotary magnet DHW and interrupter U2, when the test relay P1 operates by testing on a resistance Wi associated with a free junction line VL. It is arranged that one winding of the test relay is only short circuited when the access means ZL to the junction line VL is seized by the operation of the relay E. By the operation of the relay E the second winding of the relay P1 is short circuited over contacts 21p1 and 22e. This has the consequence that the other auxiliary selectors whose test relays are also operated over their d-wipers and the resistance Wi and are stopped on the same contact, again restore since by the short-circuiting of one winding of the relay P1 over contacts 21p1 and 22e they are disconnected. The remaining auxiliary selectors are, therefore, connected again to the interrupter and stepped on to the next free junction line. After the operation of the relay P1 the magnet DHW of the auxiliary selector is disconnected over contact 20p1. The contacts 30p1 and 31p1 switch through the talking conductors a and b. Over contacts 32p1, 33e, wiper c of the auxiliary selector HW, relay C1 of the junction line operates.

If the auxiliary selector is not pre-set on a free junction line, it is started in dependence on the operation of the points which in the present case is done by relay E. Fig. 6 represents this arrangement. When this is used the rotary magnet DHW of the auxiliary selector is energized over the interrupter U3 until the relay P1 tests on a free junction line (relay C) over contact 54e and d-wiper of the auxiliary selector HW. The contact 57p1 disconnects the rotary magnet DHW. Contacts 55p1 short-circuits a winding of the relay P1. The contacts 52p1 and 53p1 switch through the conductors a and b of the auxiliary selector HW.

The impulse transmission to the relay A1 of the junction line VL takes place in Fig. 5 over contact 35a of the relay A of the internal connecting path. During the impulse transmission the relay V1 holds and the relay V2 operates over contacts 11v1 and 9a. Relay V2 holds during an impulse train.

In Fig. 6 the impulses are transmitted over contact 51a after the contact 50v1 has been closed. Relay A1 of the junction line is restored in synchronism with the loop interruption and as in Fig. 1 transmits the impulses over the junction line.

The initiating of a connection from the seized junction line to the subscriber's line by by-passing the local connecting path (OAS) can take place in Figs. 5 and 7 directly after the direction selector e. g. by means of the relay E, or by seizing of the junction line (VL, relay C1) as shown in Fig. 1. After the by-passing of the local connecting path the impulse transmission as in Fig. 1 follows directly over the selector FAS.

In Fig. 7 a further embodiment is shown for by-passing by means of points and selection of a free junction over an auxiliary selector. The impulses are here transmitted to the relay A1 of the junction line VL directly without using internal impulse repeaters. After the pressing of the key and operation of the relay X the relay X1 is operated over contacts 10x and 9c. On release of the key, i. e. the release of relay X, the switching relay E is operated over contacts 8x and 12x1 and holds over contact 13c and 14e. Over contacts 15x and 20p1 the rotary magnet DHW is energized over the interrupter U4. The operating circuit is maintained after the release 75

of relay X over contact 16x1 and after the disconnection of the relay X1 over contact 17e. When the auxiliary selector HW tests on relay C1 associated with a free junction line VL relay P1 operates, and disconnects the rotary magnet DHW at contact 20p1 and stops the auxiliary selector HW. Over contacts 21p1 and 22p1 the talking conductors of the auxiliary selector HW are switched through. Contacts 7e and 8e control the access means to the junction line VL.

The loop interruptions caused by the dialling of the subscriber N directly control the relay A1 associated with the junction line.

What is claimed is:

1. In a telephone or like system, a first exchange having one or more trunk lines outgoing to a second exchange, a calling subscriber's line in the first exchange, means local to said first exchange controlled over said calling line at times to extend a connection from said calling line to the line of another subscriber in the same exchange and at other times to extend a temporary connection from said calling line to one of said trunk lines, a calling device at the calling station operated by the subscriber thereat at said other times to control switching apparatus at the second exchange over said temporary connection and said trunk line, and means for releasing said temporary connection before completion of the controlling of said switching apparatus at the second exchange and, at substantially the same time, substituting another connection for said temporary connection, said calling device thereafter controlling the switching apparatus at said second exchange over said other connection and said trunk line.

2. In a telephone system, a first exchange having a trunk line extending to a second exchange, subscribers' lines terminating at the first exchange, switching apparatus at the first exchange having access to said trunk line and to said subscribers' lines, means for seizing said switching apparatus over a calling one of said subscribers' lines and at times controlling same to seize said trunk line, means in said switching apparatus responsive to impulses received over the calling line for controlling the transmission of corresponding impulses over the trunk line to operate switches in said second exchange, other switching apparatus in the first exchange terminating said trunk line and operated to connect with the calling line responsive to said seizure of the trunk line, means for releasing said first switching apparatus when said other switching apparatus has connected with the calling line, said impulse responsive means in said first switching apparatus being disabled upon said release thereof, and means in said other switching apparatus thereafter responsive to impulses received over the calling line for controlling the transmission of corresponding impulses over the trunk line to continue the operation of the switches in said second exchange.

3. In a telephone system, a local exchange having trunk lines outgoing to a distant exchange, subscribers' lines terminating at the local exchange, a local switch train for completing connections between said subscribers' lines, means for at times controlling said switch train over a calling one of said subscribers' lines to extend a temporary connection from said calling line to a trunk line, means for subsequently completing another connection between said calling line and the trunk line and for thereupon releasing said temporary connection, means controlled over said

temporary connection from the calling station before said release thereof for transmitting impulses over said trunk line, said last means being controlled over said other connection from the calling line after the release of said temporary connection.

4. In a telephone system, a local exchange having trunk lines outgoing to a distant exchange, subscribers' lines terminating at the local exchange, a local switch train for completing connections between said subscribers' lines, means for at times controlling said switch train over a calling one of said subscribers' lines to extend a temporary connection from said calling line to a trunk line, said means including a calling device at the calling station thereafter operated by the subscriber thereat to transmit impulses over said temporary connection and said trunk line to set switches at the distant exchange, and means for releasing said temporary connection before completion of the setting of said switches at the distant exchange and, at substantially the same time, substituting another connection for said temporary connection, the impulses from said calling device thereafter being transmitted over said other connection and the trunk line to the distant exchange.

5. In a telephone system, a local exchange having trunk lines outgoing to a distant exchange, subscribers' lines terminating at the local exchange, a local switch train for completing connections between said subscribers' lines, means for at times controlling said switch train over a calling one of said subscribers' lines to seize one of said trunk lines, a finder switch in said local exchange terminating said trunk line and operated to connect with the calling line responsive to said seizure of the trunk line, means for releasing said local switch train when said finder has connected with the calling line, means responsive to impulses transmitted over said calling line and said local switch train before said release thereof for transmitting corresponding impulses over the trunk line to control the setting of switching apparatus in the distant exchange, said last means being responsive to impulses transmitted over said calling line and said finder switch after said release of said switch train for transmitting corresponding impulses over the trunk line to continue controlling the setting of the switching apparatus in the distant exchange.

6. In a telephone system, a local exchange having trunk lines outgoing to a distant exchange, subscribers' lines terminating at the local exchange, a local switch train for completing connections between said subscribers' lines, said train including a numerical switch, means controlled by the initiation of a call from one of said subscribers' lines for extending a connection from the calling line to said numerical switch, a calling device at the calling station operated at times after a connection has been extended to said numerical switch to control said switch to extend a connection to a wanted subscriber's line in the local exchange, other means at the calling station operated at other times after a connection has been extended to said numerical switch to seize one of said trunk lines without operating said switch, switching apparatus in the local exchange terminating said one trunk line and operated to connect with the calling line responsive to said seizure of the trunk line, means for releasing the connection from said calling line to said numerical switch when said switching apparatus has

connected with the calling line, and means controlled by the calling device at the calling station both before said switching apparatus has connected with the calling line and after said connection from the calling line to said numerical switch has been released to control the setting of switching apparatus in the distant exchange.

7. In a telephone system, a local exchange having trunk lines outgoing to a distant exchange, a calling subscriber's line terminating at the local exchange, means at times controlled over said calling line to extend a local connection therefrom to another subscriber's line in the same exchange, a key at the calling station operated at other times to control said last means to extend a temporary connection to a trunk line, a calling device at the calling station thereafter operated by the subscriber thereat to transmit impulses over said temporary connection and said trunk line to set switches at the distant exchange, and means for releasing said temporary connection before completion of the setting of said switches at the distant exchange and, at substantially the same time, substituting another connection for said temporary connection, the impulses from said calling device thereafter being transmitted over said other connection and the trunk line to the distant exchange.

8. In a telephone system, a local exchange having trunk lines outgoing to a distant exchange, subscribers' lines terminating at the local exchange, a plurality of link circuits for completing local calls between said subscribers' lines, means for controlling one of said link circuits over a calling one of said subscribers' lines to seize one of said trunk lines, means for controlling another of said link circuits over another calling one of said subscribers' lines to seize another of said trunk lines at substantially the same time, switching apparatus in the local exchange controlled by the seizure of said one trunk line to extend a connection therefrom to said one calling line, other switching apparatus in the local exchange controlled by the seizure of said other trunk line to extend a connection therefrom to said other calling line, and means for preventing said first switching apparatus from extending the connection from said one trunk line to said other calling line and preventing said other switching apparatus from extending the connection from said other trunk line to said one calling line.

9. In a telephone system, a first exchange having a trunk line to a second exchange, means for engaging said trunk line for an inter-exchange call, a plurality of calling lines in the first exchange, means controlled over each calling line to designate a call to the second exchange, means for storing said calls, means controlled at times over one of said calling lines while its call is in storage for extending a local call to the line of another subscriber in said first exchange, a finder switch in said first exchange terminating said trunk line and operated responsive to said trunk line becoming available for another inter-exchange call to search for and seize one of said calling lines, and means for preventing said finder switch from seizing said one calling line while same is engaged in said local call.

10. A telephone system as claimed in claim 9, wherein said last means comprises means individual to said one calling line and operated while same is engaged in said local call to characterize said one line in the bank of said finder switch.

11. In a telephone system, a first exchange having trunk lines outgoing to a second exchange,

a calling line in the first exchange, means in said first exchange operated over the calling line to designate a call to the second exchange, means for thereupon storing said call if no trunk line to the second exchange is available, means at times controlled over said calling line while said call is in storage for completing one or more local calls to the lines of other subscribers in said first exchange, and means effective responsive to a trunk line becoming available while said call is in storage for connecting that trunk line to said calling line only if said calling line is not engaged in a local call.

12. In a telephone system as claimed in claim 11, means responsive to the designation of a call to the second exchange for seizing a trunk line outgoing thereto substantially at once if one of said trunk lines is available, and discriminating means operated differently in dependence upon whether a trunk line is seized for the call at once or after becoming available while said call is in storage.

13. In a telephone system, a first exchange having trunk lines outgoing to a second exchange, a calling line in the first exchange, means in said first exchange operated over the calling line to designate a call to the second exchange, means for thereupon storing said call if no trunk line to the second exchange is available, means thereafter responsive to a trunk line becoming available for seizing the calling line and signalling the subscriber thereover, means at times controlled over said calling line while said call is in storage for extending one or more local calls to the lines of other subscribers in the first exchange, and means for disabling said third means at said times.

14. In a telephone system, a first exchange having trunk lines outgoing to a second exchange, a calling line in the first exchange, means in said first exchange operated over the calling line to designate a call to the second exchange, means controlled by said designation for seizing a trunk line to said second exchange substantially at once if one is available, means for storing the call if no trunk line to the second

5 exchange is available, means effective responsive to a trunk line subsequently becoming available while said call is in storage for connecting that trunk line to the calling line, a calling device at the calling station operated to control the transmission of impulses over the trunk line to set switching equipment in the second exchange, and means in said second exchange for at times absorbing certain of said impulses depending upon whether the trunk line was seized substantially at once or after becoming available while said call was in storage.

15. In a telephone system, a first exchange having trunk lines outgoing to a second exchange, a calling line in the first exchange, means in said first exchange operated over the calling line to designate a call to the second exchange, means controlled by said designation for seizing a trunk line to said second exchange substantially at once if one is available, means for storing the call if no trunk line to the second exchange is available, means effective responsive to a trunk line substantially becoming available while said call is in storage for connecting that trunk line to the calling line, a calling device at the calling station operated to control the transmission of trains of impulses over the trunk line to operate switching apparatus in the second exchange, and means in said second exchange effective at times in dependence upon whether the trunk line was seized substantially at once or after becoming available while said call was in storage for preventing the operation of the switching apparatus in the second exchange if a predetermined one of the trains of impulses received over said trunk line does not contain a predetermined number of impulses.

16. In a telephone system according to claim 15, means for absorbing said predetermined one train of impulses at times depending upon whether the trunk line was seized substantially at once or after becoming available while said call was in storage.

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