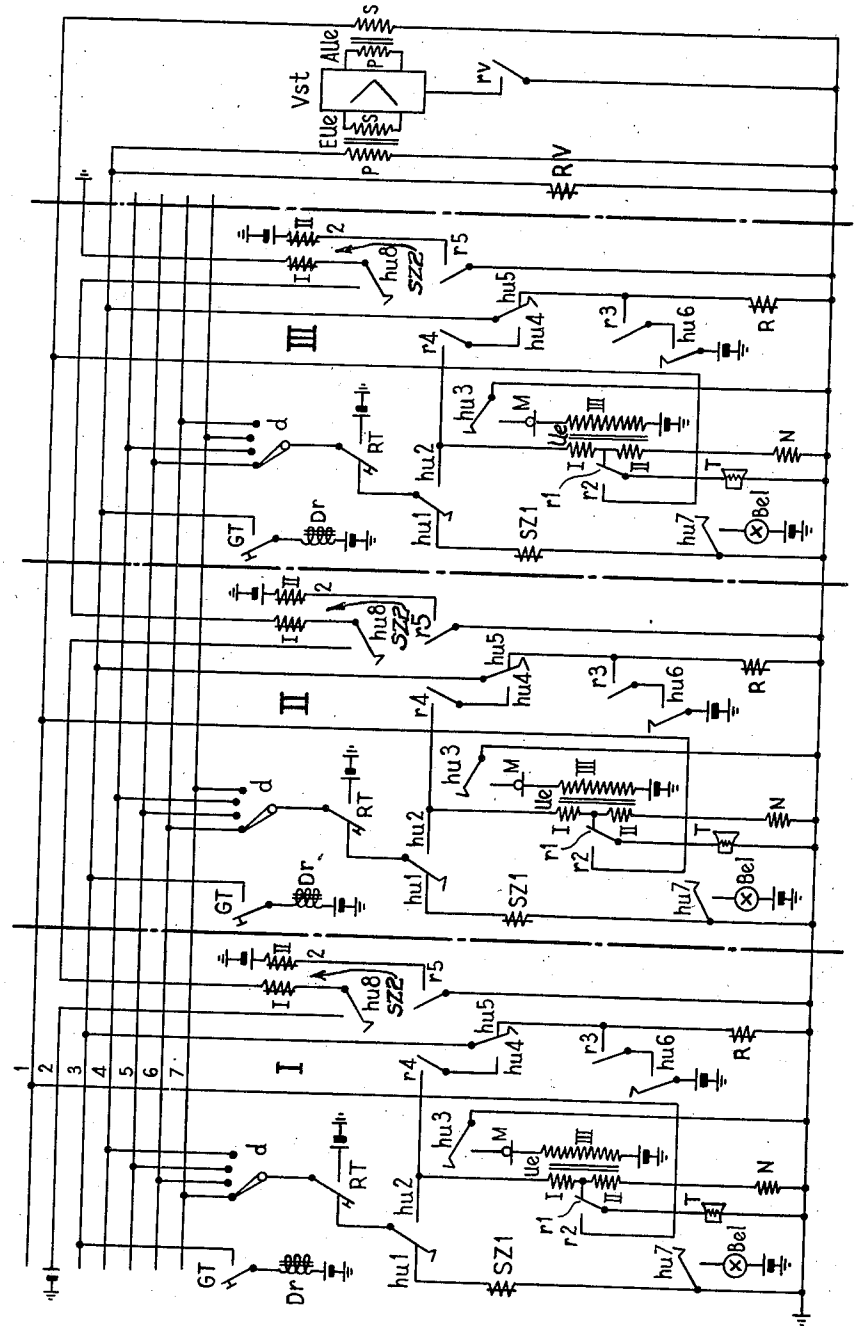
May 14, 1940. K. WOLAK 2,200,814

TELEPHONE SYSTEM

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FIG. 1




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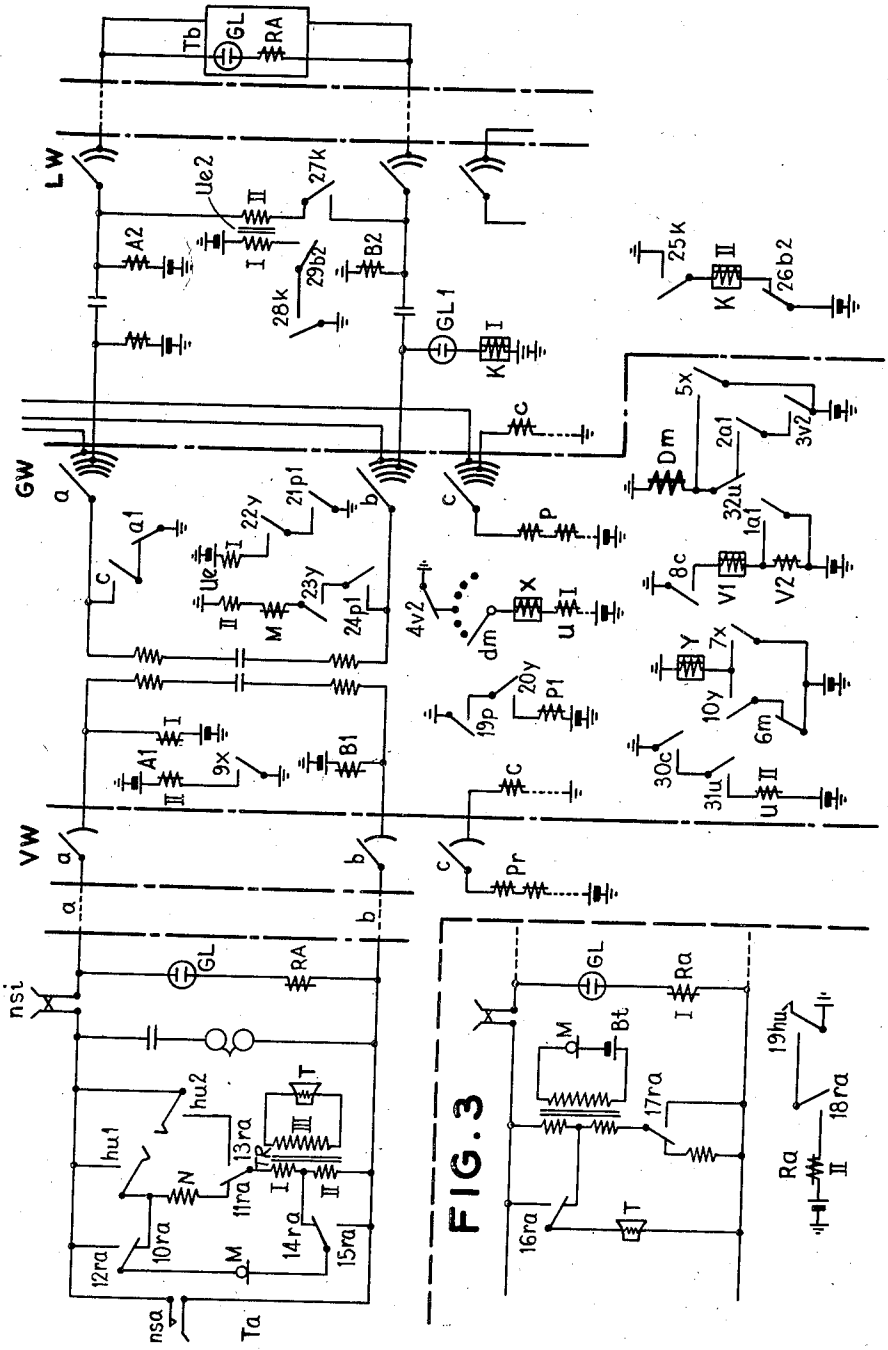



FIG. 2

FIG. 3

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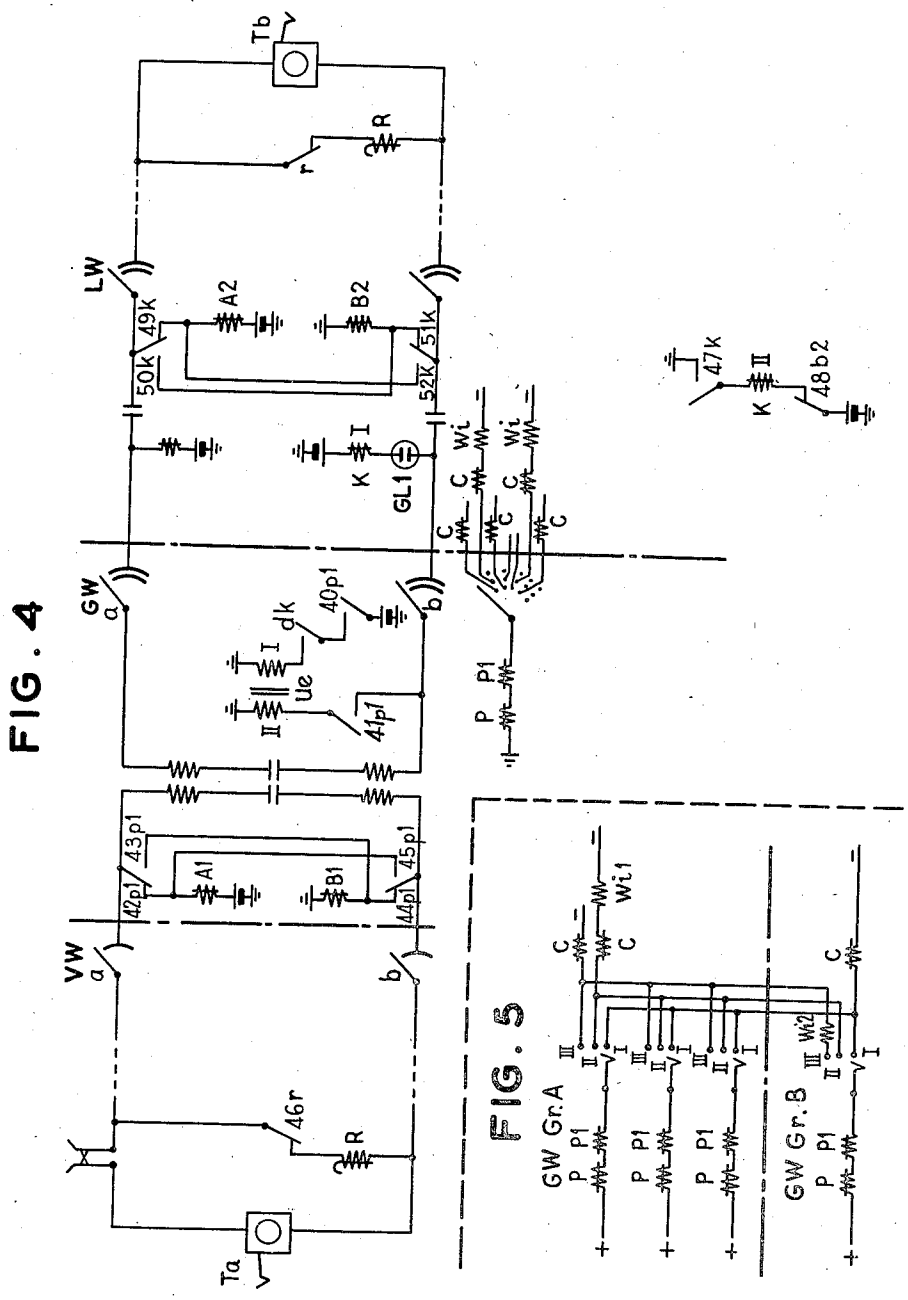



FIG. 4

FIG. 5

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# UNITED STATES PATENT OFFICE

2,200,814

## TELEPHONE SYSTEM

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In Germany August 31, 1936

11 Claims. (Cl. 179—37)

The invention relates to a circuit arrangement for telephone systems having subscribers' stations at which any influencing of the receiver at a particular station by the currents produced in the microphone of the same station is prevented by means of a balancing circuit.

As is known such arrangements have the advantage that the talking party is not disturbed by room noises or by his own speech which can be detected in the receiver. Such circuits, however, involve an undesired damping of the outgoing and incoming speech currents.

Normally the first mentioned advantage is so important that one puts up with the disadvantage of the damping. There are, however, telephone systems in which in particular cases it is not so much the balancing which is important as a transmission of speech which shall be as free as possible from damping, i. e. to give the maximum possible sound intensity. In order to take account of this requirement switching means are associated with the subscriber's station according to the invention which when a particular type of call is established or when a call is established in a particular direction disconnect the balancing circuits at the subscribers' stations which are connected together and connect the receivers and microphones to the subscribers' lines in circuits which are independent of one another.

Fig. 1 shows a line having a plurality of substations embodying the invention.

Fig. 2 shows a switching system in which the balancing circuits at the substations are cut in dependent upon the establishment of calls in a particular direction.

Fig. 3 shows the circuit of a local battery subscriber's station.

Fig. 4 is a further modification in skeleton form showing the switches for extending a connection between two substations.

Fig. 5 shows the modified arrangement in which two groups of group selectors are shown.

The attached figures show embodiments of the invention. Only those details are shown which are necessary to enable the invention to be understood.

Fig. 1 shows an arrangement in which the balancing circuit is switched over at the subscribers' stations in dependence upon the particular type of call, for example a conference call. In Fig. 1 a line circuit is represented having subscribers I, II and III. All the subscribers' stations are constructed in identical manner. All the circuit details are shown at subscribers' stations I and II. The references are the same at all the stations. Individual calls can be set up between two subscribers and also conference calls in which any particular subscriber can connect the other subscribers together in a conference call. When a conference call is set up an amplifier *Vst* common to all the stations is connected up.

The establishment of an individual call will first be described. If subscriber I for example desires a connection to subscriber II he sets his selecting device, of which the wiper *d* is shown, on the contact associated with the desired subscriber II. When this has taken place he depresses the calling key RT and thereby closes the circuit for an indicating signal at the called subscriber's station: earth, battery, calling key RT (thrown to the right) wiper *d*, lead 6, wiper *d* at station II, calling key RT in the rest position, switchhook contact *hu1*, indicating signal SZ1 and earth.

At the called subscriber's station II an indicator is operated and the subscriber takes up his receiver and thereby closes the contacts *hu2*, *hu3*, *hu4*, *hu6*, *hu7* and *hu8* operated by the switchhook. At the same time contact *hu1* is opened. By contact *hu7* a "seized" lamp Be1 is switched on at the called subscriber's station. By contact *hu2* the speech transformer *Ue* is connected to lead 6. At contacts *hu3* the microphone feeding circuit is completed over: earth, contact *hu3*, microphone M, winding III of the speech transformer Ue battery and earth. The operation of the other contacts of the switchhook is of no significance for this call.

At the calling station I the subscriber also takes up his receiver after restoring the calling key RT to the left-hand position and thereby similarly closes the contacts *hu2*, *hu3*, *hu4*, *hu6* and *hu7*. Here also at contact *hu2* the transformer Ue2 is connected over the calling key RT in the rest position and wiper *d* to lead 6. The "seized" lamp Be1 is switched on at the calling station by contact *hu7*, furthermore, the microphone feeding circuit is completed by contact *hu3*. The operation of the other contacts of the switchhook is without significance. Conversation can now take place. The speech currents at both stations pass over the speech transformer *Ue*. The circuit of the transformer is arranged in the known manner so that the microphone M which is fed from a local source, is coupled inductively over a winding III to the windings I and II of the transformer which are connected to the lead 6. Winding II is in series with a balancing coil N. The telephone T is connected

between the two windings I and II of the transformer. The transformer is accordingly in the known form of a bridge circuit in a diagonal of which the telephone T is disposed. It serves the purpose of keeping the microphone currents from the talking party's receiver.

The connection is released on the replacement of the receiver at the two subscribers' stations and restoration of the line switch to normal at the calling station.

If a subscriber, for example, subscriber I, wishes to establish a conference call in which all the subscribers connected to the system are to be connected together, he depresses the key GT. In consequence the relay R is energized at each station in the followng circuit: earth, battery, choke-coil Dr, key GT, lead 3, the branch lead to the R relays at each subscriber's station, contact *hu*5 of the switchhook, the windings of the relays R and earth. Relay R energizes at each station. Contact *r*1 is opened and contacts *r*2 to *r*5 are closed. Contact *r*5 operates a visual signal SZ2 at each subscriber's station. Through the opening of contact *r*1 the telephone T is disconnected from the windings of the transformer at each station and thereby disconnects the telephone T from the bridge circuit. By means of contact *r*2 the telephone T at all the subscribers' stations is connected directly to the common line 1. The incoming speech currents since they are no longer damped can pass in amplified form through the receiver.

When after the visual signal has been operated the receivers are taken up the microphones M which are inductively coupled to windings I and II of the transmitter are connected to the common lead 3 over contacts *r*4 and *hu*4. The microphone currents also pass to the line in amplified form since the bridge circuit involving a diminution of current is removed.

Through the opening of contact *hu*5 the relays R1 of the stations are disconnected from the common lead 3. The relays lock up, however, over: earth, winding of relay R, contact *r*3, switchhook contact *hu*6, battery and earth. When all the subscribers have taken up their receivers the following circuit is closed over the opposing winding I of all the visual signal relays SZ2 at the stations: earth, battery, lead 2, switchhook contact *hu*8 at station I, winding I of the visual signal SZ2 at station I, switchhook contact *hu*8 and winding I of the visual signals SZ2 at stations II and III and earth. The visual signals at the stations are restored through the operation of the counter-winding. This serves to indicate to the calling station that all the stations which have been called for the conference, have replied.

To lead 3 there is also connected a relay RV in addition to the relays R at the individual stations and this is associated with the amplifier V*st* which is common to all the subscribers' stations. Through the closing of the conference call key GT at the calling station I this relay also is energized over: earth, battery, choke-coil Dr, key GT, lead 3, winding of relay RV and earth. Relay RV closes its contacts *rv* and thereby completes the striking circuit (indicated diagrammatically) for the amplifier V*st*. The amplifier is thus ready for operation.

Since the lead 3 to which all the microphone circuits of the individual stations are connected passes over the primary winding P of the input transformer EU*e*, and lead 1 to which the telephones of all the subscribers' stations are connected passes over the secondary winding S of the output transformer Au*e* of the amplifier V*st* all the microphones and telephones are coupled together over the amplifier. The subscribers can converse together over the amplifier V*st*.

The conference call is released in that the conference call switch GT is restored in the calling station I whereby relay RV releases and disconnects the amplifier. Through the receivers being replaced at the stations the locking circuits for the relays R are opened and the telephones T are again connected to the junction between windings I and II of the transformers. Through the opening of the switchhook contact *hu*3 the microphone feeding circuits at all the stations are broken. The remaining contacts of the switchhook re-establish the normal condition to enable the establishment of individual calls.

Fig. 2 shows an arrangement in which the balancing circuits at the subscribers' stations which are connected together are switched over in dependence upon the establishment of calls in a particular direction.

It will be assumed that subscriber T*a* wishes to set up a connection in a direction in which the balancing circuit is to be switched over. He takes up his receiver, thereby closing the switchhook contacts *hu*1 and *hu*2. A line relay in the preselector VW associated with the calling subscriber's line is thereby energized over the completed loop in the known way. The preselector is set in operation and searches for a free line leading to a first group selector GW. The circuits have no bearing on the invention and are, therefore, not shown. When the preselector VW has found a free line the relays A1 and B1 energize in the group selector GW over the subscriber's loop. Relay V1 is energized over: earth, contact 8*c*, winding of relay V1, contact *1a*1, battery and earth. The testing relay P*r* of the preselector and the seizing relay C of the first group selector are energized over the testing lead of the preselector VW. Subscriber T*a* now transmits impulses for setting the group selector GW by means of his dial switch. Four levels of the group selector are indicated in the drawing. Over level 3 pass calls in which switching over is to take place at the subscriber's stations while over level 4, for example, connections are set up in other directions in which no switching over of the subscribers' circuits takes place. The characterizing number for the traffic directions in which the balancing circuits have to be switched over at the subscribers' stations is thus the digit 3. The subscriber first transmits an impulse train of three impulses which are transmitted over the receiving relay A1 to the group selector vertical magnet in the known way. The group selector is set on the third level. At the end of the vertical motion it searches freely for a line leading to a further group selector or as indicated in the figure directly to a final selector LW.

A discriminating device in the form of a rotary switch is associated with the group selector GW, the rotary magnet D*m* and the wiper *dm* being shown. When the group selector is set by the first impulse train the discriminator is also set on the contact 3, this taking place in the following way:

When relay A1 falls back for the first time relay V2 energizes. Relay V2 is short-circuited impulsively during the impulsing at contact *1a*1 and holds up on account of its slow-to-release feature. When relay A1 energizes again for the first time the following circuit is completed for the rotary magnet D*m* of the discriminator:

earth, the winding of the rotary magnet Dm, contacts 2a1, 3v2 and 32u, battery and earth. The rotary magnet of the discriminator is advanced in this way to contact 3. At the end of the impulse train relay V2 is again short-circuited by contact 1a1 so that it releases and now closes the following circuit for relay X: earth, contact 4v2, wiper dm of the discriminator in position 3, winding of the slow relay X, winding I of relay U, battery and earth. Relay U locks up over: earth, contacts 30c, 31u, winding II of relay U, battery and earth. Through the opening of contact 32u the original energizing circuit of the rotary magnet Dm is broken. Relay X at contact 7x closes the circuit for the slow relay Y. At contact 9x relay X closes a circuit for winding II of relay A1. An impulse is thus induced for winding I of relay A1 and passes to earth over lead a of the calling subscriber's line, wiper a of the preselector VW, the glow lamp GL, relay Ra, lead b of the subscriber's line, wiper b of the preselector VW, and the winding of relay B1. Relay Ra at station Ta has energized by this impulse. At the end of this impulse the armature of relay Ra is held in the operated position mechanically in dependence upon the switchhook or switchhook pin in any known way. The locking of the relay is only released again when the receiver is replaced. Relay Ra opens its contacts 10ra, 11ra and 14ra and closes its contacts 12ra, 13ra and 15ra. Through the opening of contacts 10ra and 14ra the microphone M at the subscriber's station which is disposed in parallel with winding I and the balancing element N is disconnected from the speech transformer Tr and is connected directly across the speaking leads at contact 12ra and 15ra. The receiver T at station Ta which is inductively coupled to windings I and II of the speech transformer over winding III of the transformer is connected across the speaking leads over contact 13ra and the switchhook contact hu2 the balancing element N being disconnected at the same time. Thus the shunt constituted by winding I of the transformer and the balancing element N is disconnected as regards the outgoing currents from the microphone M. The incoming speech currents are also less damped in their passage to the telephone T on account of the disconnection of the balancing element N.

The embodiment represents a system having central battery feeding. The switching operations can, of course, also be applied in local battery systems. Fig. 3 represents the circuit for a local battery subscriber's station. Winding I of relay Ra is energized by the induced impulse and by closing contacts 16ra and 17ra connects the telephone and microphone directly across the speaking leads. At the end of the induced impulse relay Ra holds up over a second winding in the following circuit: earth, switchhook contact 19hu, contact 18ra, winding II of relay Ra, battery and earth.

In the group selector GW (Fig. 2) relay X completes a circuit for the rotary magnet Dm over contact 5x. The discriminator takes a further step and is thereupon advanced to normal over an interrupter which is not shown. Relay X thereupon releases, relay Y holds up after the release of relay X in the following circuit: earth, winding of slow relay Y, contacts 10y and 6m, battery and earth.

After the reception of the first impulse train the group selector GW searches freely for a free line. When such a line has been found the testing relay P energizes over wiper c of the group selector in the known way. Relay P brings the group selector to rest and guards the called line against further seizure. In the final selector LW the seizing relay C is energized in the normal way. After the energizing of relay P in the first group selector the following circuit is set up for relay P1: earth, contacts 19p and 20y, winding of relay P1, battery and earth. Relay P1 energizes and closes the following circuit for winding I of the transformer Ue: earth, contacts 21p1 and 22y, winding I of the transformer Ue, battery and earth. On account of the closing of this circuit an impulse is induced in winding II of the transformer Ue which energizes relay K in the final selector LW over lead b: earth, winding II of the transformer Ue, winding of relay M, contacts 23y and 24p1, wiper b of the group selector GW, glow lamp Gl1, winding I of slow relay K, battery and earth. In this circuit relays M and K energize. Relay M in the group selector GW opens its contact 6m and thereby breaks the locking circuit for relay Y. Relay Y releases and thus opens the circuit for winding I and II of the transformer Ue. This terminates the induced impulse. Relay Y in addition breaks the circuit for relay P1 at contact 20y.

Relay K is energized by the induced impulse in the final selector LW as already mentioned. Relay K holds up after the termination of the induced impulse in the following circuit: earth, contact 25k, winding II of relay K, contact 26b2, battery and earth. In addition relay K connects winding II of a transformer Ue2 across the speaking leads by closing its contact 27k. Furthermore, relay K by closing its contact 28k prepares a circuit for winding I of the transformer Ue2.

The final selector LW is now set by the subscriber Ta by two further impulse trains. If the called subscriber indicated by Tb is free he is called in the known way. He takes up his receiver and thereby completes over his own loop a circuit for the feeding bridge relays A2 and B2 in the final selector. After relay B2 has energized the following circuit is set up for winding I of the transformer Ue2: earth, contacts 28k and 29b2, winding I of the transformer Ue2, battery and earth. An impulse is thereby induced in winding II of the transformer Ue2 and by way of glow lamp Gl and relay Ra disposed in series therewith effects the switching over of the balancing circuit provided for normal calls at the subscriber's station Tb in the same way as in the case of the calling subscriber's station. The circuits completely correspond to those of the calling station Ta and will not therefore be described separately. After the energizing of relay B2 in the final selector LW the locking circuit for winding II of relay K is broken by the opening of contact 26b2 relay K releases and thereby on the one hand disconnects winding II of the transformer Ue from across the speaking leads and on the other hand breaks the normal circuit through the winding I of the repeater Ue2.

The connection is released in the known way through the replacement of the receiver at the calling subscriber's station. The replacement of the receiver at station Ta releases the mechanical locking of relay Ra. Relay Ra releases and reestablishes the original balancing circuit between the microphone, receiver and transformer. On account of the interruption of the subscriber's loop relays A1 and B1 in the group selector GW release. These bring about the release of the preselector VW and the release of the group selector

and after the called subscriber has replaced his receiver the release of the final selector LW. The circuits for this operation do not concern the invention and accordingly are not shown.

In Fig. 2 the criterion for the switching over of the receiver and microphone circuits comprises an induced impulse transmitted from the first group selector to the calling and to the called subscriber. Naturally other arrangements for transmitting this criterion are possible.

Fig. 4 shows a further embodiment. All unimportant details are omitted from the figure. In the group selector GW in place of a discriminator a relay P*l* is provided in the testing circuit of the group selector in addition to the testing relay P and this promotes the transmission of the switching criterion to the subscriber's station. This relay P*l* can only energize in the testing circuit when the group selector GW is set on a particular level. This level may for example be the level *l*. To the contacts of this level are connected the seizing relays C of the final selectors as is shown in the figure. To the contacts of the other levels, for example level 2, the seizing relays C are likewise connected but with a resistance W*i* in series which prevents the additional relays P*l* from energizing. If after being seized by the calling subscriber T*a*, the group selector GW is set on level *l* relay P*l* energizes. Moreover, when the switch is set on level *l* a so-called "level contact" *dk* is closed by the switch. After the group selector has found a free line the additional relay P*l* energizes in the testing circuit in addition to the testing relay P and the seizing relay C. Relay P*l* opens its contacts 42*pl* and 44*pl* and closes its contacts 43*pl* and 45*pl*. The direction of the current to the subscriber's line is thereby reversed. The polarized relay R which is disposed across the speaking lines at the subscriber's station energizes in response to this reversal of current. Relay R disconnects itself from the subscriber's line at its contact 46*r* but is held operated until the end of the call, for example, by a mechanical device in dependence upon the switchhook.

In the group selector GW relay P*l* closes the following circuit for winding I of the transformer U*e*: earth, winding I of transformer U*e*, "level contact" *dk*, contact 40*pl*, battery and earth. An impulse is thereby induced in winding II of the transformer U*e* which since contact 41*pl* opens after contact 40*pl* is transmitted over the glow lamp G*ll* to winding I of relay K of the final selector LW: earth, winding II of the transformer U*e*, contact 41*pl*, wiper *b* of the first group selector, glow lamp GL*l*, winding I of relay K, battery and earth. After the termination of the impulse relay K holds up over earth, contact 47*k*, winding II of relay K, contact 48*b*2, battery and earth. Relay K opens its contacts 49*k* and 51*k* and closes its contacts 50*k* and 52*k*. After the final selector has been set on the called subscriber's line the subscriber is rung again. When he takes up his receiver the feeding bridge relays A2 and B2 in the final selector are energized over the completed subscriber's loop. After relay B2 has energized the circuit for winding II of relay K is broken by the opening of contact 48*b*2 and relay K releases and accordingly opens its contacts 50*k* and 52*k* and closes its contacts 49*k* and 51*k*. Current is thus reversed back to the called subscriber's line. The polarized relay R at station T*b* which corresponds completely to the polarized relay R at the station T*a* energizes in response to this reversal of current and in the same way as at station T*a* effects the switching over of the microphone and receiver circuits.

Calls are also set up from different groups of subscribers disposed in different exchanges. Since the various groups of subscribers are connected in a common multiple over the group selectors subscribers which do not require any switching over at their stations can also bring about such switching by dialling the corresponding characterizing number. In order to avoid this the arrangement according to Fig. 5 can be provided.

In Fig. 5 two groups of group selectors are shown to which corresponding groups of subscribers have access. Only the testing wipers of the group selectors, indicated by the reference *c*, are shown. The contacts I, II and III indicate the various levels of the group selector over which different directions are reached. The criterion for the switching over of the subscriber's station circuits is indicated in the same way as in Fig. 4 by an additional relay P*l* in the testing circuit of the group selector. As is also shown in Fig. 4 the operation of this additional relay P*l* is dependent upon the resistance in the seizing circuits which are reached over the various levels in the group selectors.

In the case of a call from the selector group A in the level I which corresponds to a particular direction, relay P*l* of the seized group selector of group A is energized together with the testing relay since the only other resistance in the seizing circuit is relay C, and thus brings about the switching over of the subscriber's station circuit. Switching over of the subscriber's station circuits also takes place in the case of a call from the selector group B in the direction I as is shown in the figure.

In the case of a call from the selector group A in the level II corresponding to another direction, relay P*l* does not energize on account of the additional resistance W*il* in series with the seizing relay C so that no switching over takes place at the corresponding subscriber's station. The same is true in the case of a call from the selector group B in the direction II.

In the case of a call from the selector group A in the level III corresponding to a third traffic direction, relay P*l* again effects a switching over of the station circuits on account of the seizing relay C being disposed without other resistance in the seizing circuit, but in the case of a call from the selector group B in the direction III no switching over of the station circuits takes place since an additional resistance W*i*2 is inserted between the bank contact of the level III of the seized selector and the multiple.

Finally it may be mentioned that the invention may be applied not only in the case of conference calls, constituting a special type of call, but also for example in the case of distant calls. The switching over of the station circuits can thus be effected in dependence upon the "long distance criterion" which is transmitted on long distance calls or alternatively by the trunk group selector disposed in the connecting path initiating the criterion for the switching over of the station circuits when seized independently of a particular characterizing digit.

What is claimed is:

1. In an anti-side tone substation circuit having means for preventing the receiver from being influenced by the currents from the microphone thereat, the provision of electro-responsive switching means at the station automatically

operable only in certain calls from said substation for rendering said side tone preventing means ineffective.

2. In a telephone system, a substation, means for extending different connections therefrom, said substation normally connected for side tone prevention, and electro-responsive means in the substation automatically operated only when certain connections are extended therefrom for changing the connections at the substation to remove the side tone preventing connections.

3. In a telephone system, a substation normally connected to prevent side tone in the receiver, means for extending connections therefrom and for establishing conference calls therefrom and a relay in the substation automatically operated to change the substation from anti-side tone to side tone whenever conference calls are made therefrom.

4. In a telephone system, a pair of substations each normally connected to prevent side tone in the receivers by currents generated by the associated transmitter, and means in each substation automatically operated when a connection is extended from one to the other for changing the connections in the associated substation so they are not connected to prevent side tone.

5. In a telephone system, a substation, the transmitter and receiver of said substation normally connected to prevent side tone in the receiver caused by currents generated in the transmitter, automatic switches for extending connections therefrom, and means in the substation, controlled from the automatic switches, for changing the connections in the substation so as to permit side tone.

6. In a telephone system, a substation, a relay in the substation for changing the connections thereof, means for extending a talking circuit therefrom, and means for transmitting an induced impulse over said talking circuit to operate said relay.

7. In a telephone system, a substation, a relay at the substation for changing the connections of the transmitter and receiver in said substation, means for extending a connection to said substation, and means for transmitting an induced impulse to said substation over said connection to operate said relay.

8. A telephone system as claimed in claim 7 in which said relay is connected to said substation through a glow lamp.

9. A telephone system as claimed in claim 6 in which said relay is held operated after the termination of said induced impulse.

10. In a telephone system, a substation, a relay at the substation for changing the connections of the transmitter and receiver to said substation, means for extending connections from the substation, means for operating said relay only when certain connections are extended, the operation or non-operation of the relay dependent on the traffic direction in which the connection is extended.

11. In a telephone system, substations, a relay in each substation for changing the connections of the transmitter and receiver therein, means for extending connections to and from said substations and means for operating the relay at a substation, where either the line is calling or is called, said relays being operated in each instance by a reversal of the direction of current flow therein.

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