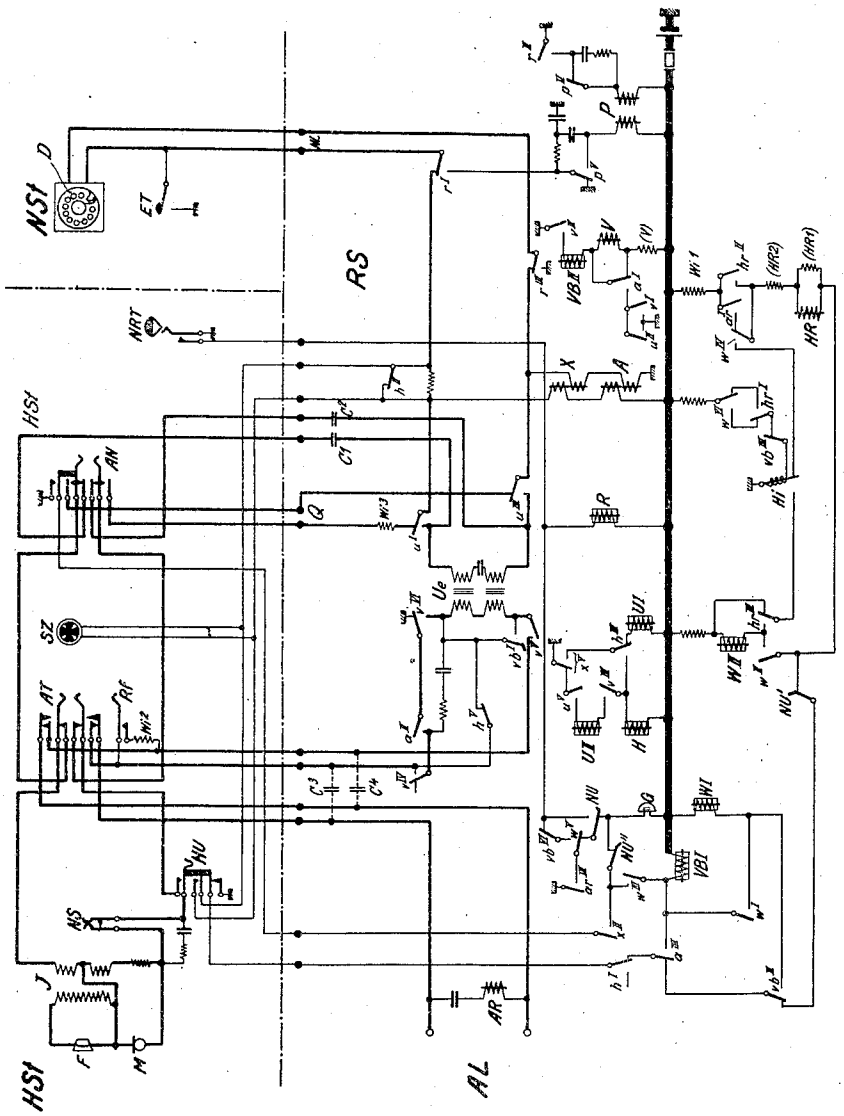
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TELEPHONE SYSTEM

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## TELEPHONE SYSTEM

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The invention relates to telephone arrangements of the type known as private branch exchange systems, and more particularly to arrangements of this kind having one remote extension station and a main station between this and the exchange, and it has for its object to afford the extension station unrestricted automatic traffic with the main station as well as with the exchange. This is attained through switching means which, influenced in a different manner by the extension station and over its two wire line, selectively effect the automatic ringing of the exchange or the transmission of ringing current to the main station.

An incorporation of the invention is described hereafter with reference to the accompanying drawing that diagrammatically shows the circuit arrangement of the main station HS*t* and of the remote extension station NS*t* as well as a relay bank RS comprising a repeating coil U*e*. This bank, for instance can be arranged in a cabinet at the station HS*t*. Station NS*t* has a dial D of any well-known construction.

Relays are denoted by capital letters, their contacts by the respective small letters.

The arrangement operates as follows:

*Incoming exchange calls*

If a call comes in from the exchange over line AL, call relay AR operates so as to actuate ringer G:

—, G, NU, *w*V, *ar*III, +

Relay HR operates:

ground, HU, *h*I, *a*III, *vb*II, NU', HR/resistance (HR*1*), resistance (HR*2*), *w*IV, *ar*I, W*i1*, —,

and holds over its contact *hr*II.

In order to answer a call, the operator at the main station HS*t* lifts the receiver, so that switch hook HU operates, and presses locking exchange key AT. This establishes a direct connection of the exchange line with the talking device of the main station. The talking device consists of repeating coil J, receiver F, and transmitter M. By removing the receiver the circuit for relay HR is broken at the lowest contact of the switch hook HU.

*Intermediate-call from the main station to the extension station*

If the main station wishes to make an intermediate-call to the extension station, in order to transfer the exchange call to the extension station, for instance, it is necessary to operate key AN at the main station. Key AN locks mechanically and releases exchange key AT. However, intermediate-call spring assembly R*f* remains actuated, so that the exchange line is held over R*f* and W*i2*. The extension station is now called by means of key NRT. Relay R operates and at its contact *r*II it closes the circuit of relay interrupter P, so that alternating current is transmitted to the extension station over contacts *r*III and *r*I as well as over contact *p*V. After lifting the receiver the extension station is fed over supply bridge A, X. This supply bridge serves at the same time the purpose of feeding the main station. Both stations are now connected with each other over the contacts of A*n*, rest contacts *u*I, *u*III and *r*I, *r*III. Since a local call is involved, a damping resistance W*i3* lies in the intermediate-call circuit.

If the main station wishes to end an intermediate-call connection, key AT has to be pressed again, whereby key AN is released. The main station is thus connected again with the exchange. If the hand set has also been replaced at the extension station, the supply bridge will break down.

*Taking over of an exchange call by an extension station*

After the main station has informed the extension station through an intermediate-call that an exchange call is waiting, the latter station can take over the exchange call by operating a grounding key ET. Differential relay X is thereby energized and relay U is caused to operate:

—, UI, *h*III, *x*V, +

Relay V is energized:

—, (V), V, *a*I, *u*II, +

At contacts *u*I and *u*III extension line NL is connected with repeating coil U*e* and the intermediate-call circuit Q, NL of the main station is broken. The secondary winding of the repeating coil has been connected with the exchange line over *v*IV, *a*II, *v*VI and *v*V, consequently the talking connection between the extension station and the exchange has been established. By the pressing of grounding key ET on the part of the extension station, ringer G is caused to operate:

—, G, NU', *x*II, AN, +

so that the main station will receive an audible signal of the taking over of the call. If the

grounding key is released at the extension station, relay X returns to its rest position, so that ringer G will stop ringing. Furthermore, relay H operates:

—, H, *v*III, UII, *u*V, *x*V, +

The short circuit of visible signal SZ is removed at contact *h*II, so that, after replacing the hand set, that is to say after opening the center contacts of HU, it becomes evident at the main station that the exchange line has been seized by the extension station. On replacing the receiver, exchange key AT is automatically released.

*Call back from the extension station to the main station*

If key ET is operated at the extension station, relay X will operate as has already been described. Holding winding II of U is open-circuited at *x*V in order to cause U to release. At *u*I and *u*III the extension station is switched off from the repeating coil Ue and thereby from the exchange line and is switched over to the call back line Q of the main station. Relay H remains energized over *x*V until, after the release of the grounding key, relay X releases. After the release of relay H, the exchange line is held over *h*V and *v*V; also winding VBI of relay VB is energized over *a*III, *h*I, HU and ground.

In order to call the main station, the extension station will turn its dial from any digit onward. Relay A will release in the rhythm of the dial. After the first release of relay A, winding I of relay W is energized over *vb*II. Every time that relay A is now caused to operate, ringer G will ring over *a*III, *w*III and NU'' and thereby the main station is called in the rhythm of the dial interruptions. The receiver is removed at the main station and exchange key AN is operated, so that the talking device of the main station is connected with the extension station.

When the intermediate call is ended, key ET has to be operated once more, so that relays X and U will operate. After releasing the key and after the release of X, H is also energized again. The extension station is thus as before again connected with the exchange. The talking device at the main station has to be restored.

*Exchange calls from the extension station*

After lifting the hand set at the extension station, grounding key ET has to be operated. Relays X and U in the relay bank are thereby actuated. Relay V also pulls up. After releasing the key, relay X is caused to release and H pulls up. As soon as the exchange signal sounds, the transmission of impulses can be started. Contact *a*II transmits the dial impulses, which are received by relay A. During the first release of relay A, the short circuit for winding II of relay VB is interrupted by contact *a*I, so that this relay remains switched over during the entire series of impulses and that it short-circuits those windings of repeating coil Ue at *vb*I, which are shown on the left, in order to assure a faultless transmission of impulses to the exchange. After each series of impulses, relay VB is again caused to release at *a*I through a short circuit.

If the hand set is restored at the extension station, A is deenergized and the exchange loop is opened at *a*II. *a*I causes V to release through a short circuit and *v*II causes relay VB to be deenergized. Contact *v*III switches off relays U and H, so that the exchange line is released.

*Calling of the main station by the extension station*

After lifting the hand set at the extension station, relay A pulls up. Over its winding I relay VB is energized over ground, HU, *h*I, *a*III. The dial D is now turned from any desired digit onward, so that winding I of relay W is energized over *a*III and *vb*II. Now ringer G of the main station is operated over

ground, HU, *h*I, *a*III, *w*III, NU''

in the rhythm of the dial impulses. If the main station does not answer, it is called again by repeated dialing. Relay W returns to its rest position after each series of impulses and it switches off the ringer at *w*III. By lifting the receiver and pressing key AN, the main station is connected with the extension station. Both instruments are supplied over the windings of relays A and X.

*Night traffic*

During the night, night switch NU, NU', NU'' of the main station is switched over. When an exchange call comes in, relay R is energized over

ground, *ar*III, *w*V, NU

This relay connects pole changer P at *r*II, so that the extension station is called indirectly. After lifting the hand set at the extension station, key ET must be temporarily operated, whereby relays X, U, V and H are caused to operate in the described manner. After releasing the key, the extension station is in connection with the exchange subscriber.

*Automatic transfer of the exchange call*

If it has been forgotten to switch the night switch NU, NU', NU'', then with the incoming of an exchange call relay HR is energized:

ground, HU, *h*I, *a*III, *vb*II, NU', HR/(HR*l*), resistance (HR2), *w*IV, *ar*I, W*i*l, —.

Relay HR holds over *hr*II. Hot wire relay H*i* is connected at *hr*I. Since the main station does not answer, the hot wire relay will throw over its contact after 15 to 20 seconds and over *hr*III it causes relay W to pull up over its second winding. W holds over

*w*II, NU', *vb*II, *a*III, *h*I, HU, ground

In the next ringing current period relay R is energized over

ground, *ar*III, *w*V, *vb*VI,

and the extension station is called, as already described, by means of pole changer P. If the extension station does now answer, relay A will operate, relays W and HR being thereby thrown off through *a*III. If key ET is now operated, then the extension station is in connection with the exchange subscriber.

*The extension station does not answer*

Also, if the extension station does not answer, hot wire relay H*i* will return to its state of rest after some time, because the circuit for its heat winding was interrupted at contact *w*VI. Relay HR is thereby after a delay caused to release due to contact *w*IV, and consequently relay H*i* is heated anew over *w*VI and *hr*I because relay VB did not switch over. Relay H*i* switches its contact again after a while and it now causes relay W to release through a short circuit over *hr*III.

The heating circuit is thereby broken and in addition the call circuit is again switched at contact *w*V to ringer G over NU.

*Listening in*

Over condensers C1, C2 the main station is in a position to listen in on exchange calls of the extension station, and over condensers C3, C4 the extension station may be enabled to listen in on calls of the main station, in case this is desired.

What is claimed is:

1. In a telephone system, an exchange, a main telephone station, a line connecting said main station and said exchange, a subordinate station, a two-wire line connecting said subordinate station and said main station, switching means associated with the main station adapted for causing the actuation of a call signal at either the exchange or the main station, a first means at said extension station for applying a ground to said line while leaving said line otherwise intact to actuate a call device only at said exchange, and separate means at said extension station for causing a periodically interrupted current to flow serially through both wires of said line to actuate a call device only at said main station.

2. A telephone system according to claim 1, further comprising means for establishing an intermediate-call connection between the extension station and the main station during the existence of a connection between the exchange and the extension station, said means being under the control of the said switching means.

3. A telephone system according to claim 1, wherein the means for discriminatively influencing said switching means comprises a device for grounding the two-wire line and a device for interrupting this line periodically, which comprises at the main station means, controlled by this grounding device, for initiating a call-back connection and means governed by said line-interrupting device for transmitting ringing current to the main station.

4. A telephone system comprising an exchange, a main station, an exchange line connecting said exchange and said main station, a main station telephone associated with said main station, an extension station, a two-wire line connecting said extension station and said main station, an extension telephone associated with said extension station, switching means at said main station alternatively operable to establish a connection between said extension telephone and said exchange line or to initiate a call from said extension telephone to said main station telephone, selectively operable means associated with the extension station for selectively controlling said switching means over said two-wire line, and means for maintaining in nonoperative condition an exchange connection established between said exchange and said extension telephone and for initiating a call between said extension telephone and said main telephone responsive to actuation of said selectively operable means while so maintaining said exchange connection.

5. A telephone system comprising an exchange, a main station, an exchange line connecting said exchange and said main station, a main station telephone associated with said main station, an extension station, a two-wire line connecting said extension station and said main station, an extension telephone associated with said extension station, switching means at said main station operable to answer a call from said exchange, means to establish a connection between said main station telephone and said extension telephone while maintaining said exchange line in answered condition, and selective switching means at said main station for establishing a connection between said extension station and said answered exchange line while maintaining said exchange line answered responsive to a signal received from said extension station.

6. A telephone system comprising an exchange, a main station, an exchange line connecting said exchange and said main station, a main station telephone associated with said main station, an extension station, a two-wire line connecting said extension station and said main station, an extension telephone associated with said extension station, switching means at said main station operable to answer a call from said exchange means to establish a connection between said main station telephone and said extension telephone while maintaining said exchange line in answered condition, selective switching means at said main station for establishing a connection between said extension station and said answered exchange line while maintaining said exchange line answered responsive to a signal received from said extension station, and means for giving an indication at said main telephone in response to the reception of said signal from said extension station.

7. A telephone system according to claim 1, comprising a supply circuit for the extension station, and a visual signal at the main station included in this circuit in order to indicate to the main station that the exchange line is busy.

8. In a telephone system according to claim 1, an arrangement for establishing a call back connection from the main station to the extension station, and an arrangement for establishing a call back connection from the extension station to the exchange, the call back line of the latter arrangement being a by-path by which the call back line of the former arrangement is passed around.

9. A telephone system according to claim 1, which further comprises a switch at said main station which is adapted upon actuation to lead incoming exchange calls directly to the extension station.

10. In a telephone system according to claim 1, a switch associated with the main station and adapted upon actuation to lead incoming exchange calls directly to the extension station, an interrupter, means for starting this in response to an incoming exchange call, and means for transmitting ringing current from this interrupter to the extension station.

11. In a telephone system according to claim 1, a switch associated with the main station and adapted upon actuation to lead incoming exchange calls directly to the extension station, an interrupter, means for starting this responsive to incoming exchange call means for transmitting ringing current from this interrupter to the extension station, means enabling the main station to originate a call back connection, and provisions for transmitting ringing current from said interrupter to this call back connectiton.

12. In a telephone system according to claim 1, a switch associated with the main station and adapted to lead incoming exchange calls directly to the extension station, an interrupter, means for starting this by an incoming exchange call, a timing switch, means for energizing said timing

switch in response to an incoming exchange call, said energizing means being adapted to be cut out by the said switch, and means, governed by said timing switch, for transmitting ringing current from said interrupter to the extension station.

13. In a telephone system according to claim 1, a switch associated with the main station and adapted to lead incoming exchange calls directly to the extension station, an interrupter, means for starting said interrupter by an incoming exchange call, a timing switch, means for energizing said timing switch in response to an incoming exchange call, said energizing means being adapted to be cut out by said first named switch, means governed by said timing switch, for transmitting ringing current from said interrupter to the extension station, and means, controlled by this timing switch, for terminating the ringing of the extension station.

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