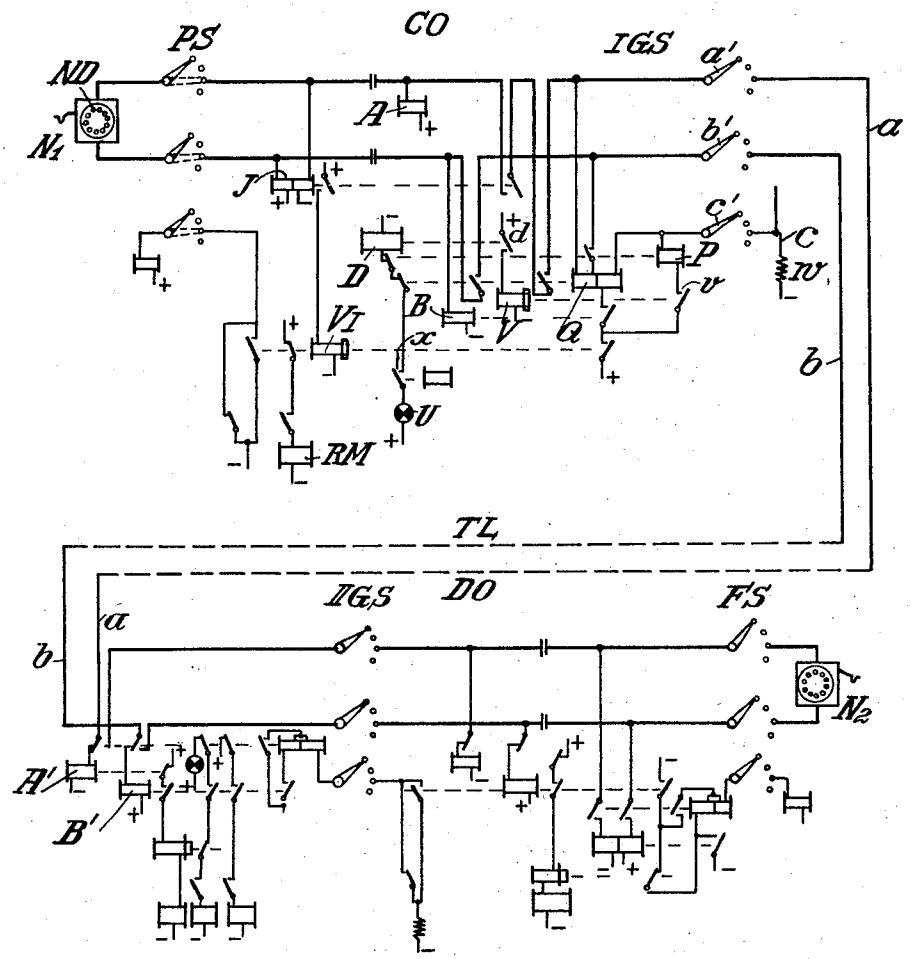
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AUTOMATIC TELEPHONE SYSTEM

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AUTOMATIC TELEPHONE SYSTEM

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This invention relates to automatic telephone systems, and particularly to circuit arrangements in which automatic 3-wire selectors, that is, selectors with two speaking lines and a test line, automatically seek out a disengaged 2-wire trunk line, especially one leading to a distant exchange.

It is well known that the setting of the selector on to a trunk line should not be dependent solely on the same being disengaged, but should at the same time be conditional on the latter being in working order, and also on the switch mechanism at the further or receiving end of the line being ready for use. It should further be conditional on the possibility of blocking or making the trunk line busy at the remote receiving end by a simple switching operation.

In a known arrangement, the setting of a selector in accordance with the above requirement is made conditional on a single testing operation in the selector which is moved for setting on to the trunk line, the testing of the 2-wire trunk line for working condition and freedom, being effected by a relay in bridge connection with the speaking lines of the switched-on selector. This known arrangement has the drawback that the test relay also comes into connection with the speaking lines of engaged trunk lines, a circumstance which may easily lead to disturbances of the conversation proceeding over the trunk line or of signal currents which are being sent through the lines.

According to my invention, this defect is prevented by the arrangement that the switching-on of a testing device in bridge connection with the speaking lines cannot take place unless the trunk line concerned is disengaged, said switching-on being rendered contingent on the result of a preliminary test to ascertain whether the trunk line is disengaged, this preliminary test being performed locally through an auxiliary testing wire allotted to the dispatching end of the trunk line.

The arrangement is naturally of such a character that the test-selector comes to rest only when both tests appear to make switching-on permissible; that is, when the line is both disengaged and in working order; whilst otherwise, the selector can be switched further in the well known manner, in order to seek further for a disengaged and unobstructed trunk line.

Devices are also known in which switching means are connected to the speaking lines at the transmitting end of the trunk line and continuously check the freedom from obstruction of the trunk line. In contrast thereto, the device, in my invention, for testing the working condition of the trunk line, and also the testing for free line, is connected with the selector which is to be set, so that no auxiliary contacts and switching devices are needed on the trunk line itself, and the requisite appliances can be used in common for all the trunk lines. In this way, I am able to reduce the cost of installation for the 2-wire trunk lines substantially, so that all the trunk lines need only be of the 2-wire type, whereas, hitherto, the necessity for arranging a large number of relays on the 2-wire trunk lines led to 3-wire trunk lines being preferred for short lines, notwithstanding the higher outlay entailed for wires.

My invention is illustrated in the accompanying drawing, in a purely diagrammatical manner, since the mechanical disposition of the selectors does not present anything specific to the invention, and because the design of these selectors is well known to those skilled in the art. Only such of the paths traversed by the currents are shown which are important for comprehending the invention, whilst those self-evident to the expert, and known switching operations, are not given.

The upper half of the drawing indicates the arrangement of an exchange to which the calling subscriber is connected, and which may be termed the calling exchange, CO. N_1 is the instrument of a calling subscriber connected with the exchange CO.

It is assumed that subscriber N_1 wishes to connect with a subscriber N_2 under another exchange DO (shown in the lower half of the drawing) which is connected with the calling exchange CO by 2-wire trunk lines TL, only one of which is indicated, by broken lines.

It is assumed, in the example, that the connection between the calling subscriber N_1 and the trunk line TL is effected through two selectors, one of them being a well-known preliminary selector PS, and one a so-called first group selector IGS, whilst in the remote exchange, the connection of the line TL with the required subscriber N_2 is effected by setting a so-called second group selector IIGS and a connector or final selector FS. It will be evident to those skilled in the art that the number of selectors depends on the size of the exchanges concerned, and that the number of selectors specified is immaterial to the invention.

With regard to the selectors, it is assumed that the preliminary selectors PS are so arranged, in known manner, that they set to work on the earphone being lifted, and connect the caller's line with a disengaged first group selector. With regard to the group selectors and the connectors, or final selectors, it is assumed, for example, that they are of the known Strowger selector type, and in which the movable connecting contacts or arms are first raised, by lifting-current impulses, to a definite "tens" row of a contact field, after which they are moved over contacts on the selected horizontal contact row by a rotary magnet. In the drawing, the contact field in all cases is merely indicated by a few contacts on a horizontal row. In the case of the so-called group selectors, the rotary movement is effected under the influence of automatic current impulses in the exchange until a disengaged line has been found in the horizontal row concerned.

In the group and final selectors, the raising of the movable contact arms proceeds, in known manner, dependently on current impulses sent out by the calling subscriber. In the case of the final selector, the rotary movement is also controlled by the current impulses from calling subscribers.

The invention relates solely to the operations which take place during and following the automatic setting (rotation) of a group selector.

It is assumed that the calling subscriber N_1 has taken down his earphone, and that the switch arms of his preliminary selector PS have automatically assumed the position indicated by the broken lines, in which position they have connected the subscriber with a disengaged first group selector IGS. After setting the preliminary selector, the line relay J in this group selector responds, by means of the current passing through the closed earphone hook contact of subscriber N_1, and attracts its contacts.

It should be mentioned that, for the sake of clearness, all the contacts allotted to the various relays are not shown, in the drawing, in their true positions in the vicinity of the relays, but, in each case, are marked, together with the corresponding relays, on a thin, broken horizontal line.

The setting of the selectors at the automatic exchanges is effected by subscriber N_1, in known manner, by turning his dial ND, which allows the signal-current impulses to pass to the relay J, which transmits them further by allowing its armature to drop and then attracting it again.

The first series of current impulses which the subscriber N_1 allows to reach the relay J through his dial ND, effects, in known manner the lifting of the movable contact arms a', b', c' of the selector IGS on to a definite row of contacts, to which are attached a plurality of conductors TL leading to the exchange DO. The operations for lifting the arms a', b', c' on to this row of contacts are so well known to those skilled in the art, that any description is superfluous.

At the termination of said lifting movement, a reversing switch contact x is closed (also in well known manner), which through a rotary interrupter U, switches a battery circuit through a rotary magnet D which effects this intermittent rotation of the arms a', b', c' over the selected row of contacts. It should be mentioned that the signs + and − indicate the connection of the corresponding wires to the positive and negative poles of the usual type of exchange battery (not shown).

In this rotary movement, the arms a', b', c' hunt for a disengaged trunk line; and it is to the operations now taking place that my invention relates.

At the first current impulse received by the magnet D from the interrupter U, it effects, in addition to rotating the arms a', b', c', the closing of its allotted front contact d, which completes a circuit through a slow-release relay V (of the quick-attraction type), which at once closes its front contact v. The responding of the aforesaid relay J completes, at its left front contact, the circuit for another slow-release relay VI, which is also of the quick-attraction type and retains its armature in the working position all the time the calling subscriber N_1 is connected with the first group selector.

By way of the said contact v of the slow-release relay V, and the right front contact of the relay VI, a relay P for testing whether a line is disengaged, is connected up to the arm c' of the group selector, and this testing relay responds as soon as the arm c' encounters the testing contact of a disengaged trunk line.

Let it be assumed that the first disengaged line on the selected row of contacts is the line marked TL in the drawing. There is then established a circuit for the relay P from the plus pole of the battery, by way of the right front contact of the relay VI, the front contact v of the relay V, the coil

of the relay P, the arm c': and the locally disposed test line c, and also through a resistance w, to the minus pole of the battery. The relay P responds and breaks, at its left back contact, the interrupter circuit through the rotary magnet D. In addition it establishes, at its inner front contact, a bridge connection bewteen the left coil of a two-coil relay Q and the two speaking-wire branches a and b of the trunk line TL.

Two contingencies are now possible, which will be considered below.

1. The trunk line found to be disengaged is not in working order.

If the line TL found to be disengaged is interrupted, for example, unintentionally by reason of damage, or designedly by removing a fuse from one of the two wires a, b, no current can pass through said trunk line, and therefore the switched-on coil of the relay Q remains dead, and therefore the armatures of the relay Q remain in the position of repose.

The switching-off of the rotary magnet D at the outer back contact of the relay P opened the front contact d of the magnet D, and, after a short interval, the slow-release relay V will consequently release its armature and therefore re-open its front contact v again, so that the testing circuit for the test relay P is broken. The relay P therefore releases its armature again, so that the left back contact re-closes in the circuit of the rotary magnet D. The magnet D therefore comes again into action and switches the arms a', b', c' of the group selector IGS on to the next contact, where the described testing operation is repeated. This state of things continues until the group selector has found a disengaged trunk line which is in working order.

2. The trunk line found to be disengaged is in working order.

If the trunk line TL is in working order, directly the inner front contact of the testing relay P is closed, a current flows, from the minus pole of the battery at the distant exchange DO, through the relay A′ on the a-branch, the a-branch of the line, the arm a', the left coil of the relay Q, the front contact of the relay P, the arm b', the branch b of the speaking line, and the coil of the relay B′ in the DO exchange, to the plus pole of the battery. The relay Q responds and, at its right and middle front contacts, switches the two speaking wires of the line, coming from the calling subscriber N_1, on to the two speaking wires a, b of the trunk line TL.

At the same time, the relay Q breaks, at its left back contact, the circuit leading from the interrupter U to the rotary magnet D. When the test relay P, which becomes dead through the fall of the armature of the slow release V (as described above), releases its armature and re-closes its left back contact, the circuit for the rotary magnet D nevertheless cannot be restored, being broken at the back contact of the relay Q.

In switching-through the speaking line by way of the relay Q, current is passed at the same time through the line relays A and B in the group selector IGS, the relay B switching, at its right front contact, the right hand low-ohmic coil of the relay Q on to the test arm c', and thus on to the local test wire c, whereby, on the one hand, is rendered "engaged" so far as other test relays P are concerned, and, on the other hand, the relay Q is kept energized, although, owing to the relay P being dead, its left coil, in bridge connection with the branches of the speaking line, is shut off at the inner front contact of the relay P.

The calling subscriber N_1 is now connected with the group selector IIGS of the distant exchange DO, by way of the trunk line TL, in which exchange, the line relays A′ and B′ were energized in the already described circuit in switching-on. By means of his dial ND and his relay J, and also the a-branch of the speaking line between the relay A in the group selector of his own exchange and the relay A′ in the group selector of the distant exchange, the calling subscriber can now effect repeated interruptions at the right front contact of the relay J, and thus transmit current impulses, by means of the relay A′, to the magnets of the second group selector and other selectors at the exchange DO, so that the selectors IIGS and FS are set on to the connection contact of the required subscriber. The relay arrangements necessary for this purpose are not shown in the drawing, but need no description, the switching operations being immaterial to the invention, and being, moreover, effected in the known manner.

When the connection has been made, the subscriber N_1 can speak with the called subscriber N_2. On subscriber N_1 hanging up his ear-phone at the close of the conversation, the circuit of the line relay J is thereby broken for some time. Consequently, the relay VI, which is unaffected by short interruptions of the circuit during the emission of impulses, will also release its armature and break, at the right front contact, the circuit for the right holding coil of the relay Q. At the same time, by closing its left inner back contact, it completes the circuit for a releasing magnet RM, which returns the group selector IGS into the position of repose. At the same time, the preliminary selector PS is also put out of action (on occasion), for example by opening the left outer front contact of the relay VI. The selectors at the second exchange are also put out of action in a similar manner, this being also effected by the called subscriber hanging up his earphone. These disconnecting operations do not form part of my inven-

tion, being, moreover, known and needing no description.

I claim:—

1. In an automatic telephone system comprising a plurality of telephone exchanges; two-wire trunk lines between said exchanges; automatic selectors in said exchanges adapted automatically to select a disengaged trunk line, each of said selectors embodying three brushes and a three-wire multiple field; means in these selectors for testing over a wire of the multiple field arranged locally in the exchange of the said selector whether the selected line is disengaged; and means brought into action by said testing means to determine whether the said trunk line is in working order.

2. In automatic telephone systems comprising a plurality of telephone exchanges, two-wire trunk lines between said exchanges, automatic selectors, in the exchanges, adapted automatically to select a disengaged trunk line, a testing arm on the working selector, a test relay attached thereto, testing contacts brushed by the testing arm, testing lines proceeding from the said testing contacts and disposed solely in the exchange of the testing selector, a second test relay in the selector, and means for switching this test relay on to the speaking-line branches of the selector and trunk line in consequence of the response of the first test relay.

3. In automatic telephone systems comprising a plurality of telephone exchanges, two-wire trunk lines between said exchanges, automatic selectors, in the exchanges, adapted automatically to select a disengaged trunk line, a testing arm on the working selector, a test relay attached thereto, testing contacts brushed by the testing arm, test lines proceeding from said testing contacts and disposed solely in the exchange of the testing selector, a second test relay in the selector, means for switching this test relay on to the speaking-line branches of the selector and trunk line as the result of the response of the first test relay, and means on said second test relay for switching the calling subscriber through to the speaking-line branches of said trunk line.

4. In automatic telephone systems comprising a plurality of telephone exchanges, two-wire trunk lines between said exchanges, automatic selectors in the exchanges, adapted automatically to select a disengaged trunk line, a testing arm on the working selector, a test relay attached thereto, testing contacts brushed by the testing arm, test lines proceeding from said testing contacts and disposed solely in the exchange of the working selector, a second test relay in the selector, means for switching this test relay on to the speaking-line branches of the selector and trunk line as the result of the response of the first test relay, means on the second test relay for switching the calling subscriber through to the speaking-line branches of said trunk line, a line relay brought into operation on the switching through to the speaking line, and a holding circuit for said second test relay, said circuit being completed on the responding of said line relay.

5. In automatic telephone systems comprising a plurality of telephone exchanges, two-wire trunk lines between said exchanges, automatic selectors in said exchanges, an operating magnet in the selector, adapted to move the movable contacts of the selector automatically for hunting for a disengaged trunk line, a front contact on said magnet, a circuit established through said front contact and containing a slow-release relay, a testing arm on the selector, a test relay connected with said testing arm, a contact disposed in the circuit of the test relay and being closed when said slow-release relay responds, and a locally disposed test line proceeding from the contacts brushed by the testing arm.

6. In automatic telephone systems comprising a plurality of telephone exchanges, two-wire trunk lines between said exchanges, automatic selectors in said exchanges, an operating magnet in the selector adapted to move the movable contacts of the selector automatically for hunting for a disengaged trunk line, a front contact on said magnet, a circuit established through said contact and containing a slow-release relay, a testing arm on the selector, a test relay connected with said testing arm, a contact disposed in the circuit of the test relay and being closed when said slow-release relay responds, a locally disposed testing circuit proceeding from the contacts brushed by the testing arm, a second test relay in the selector, means for switching this test relay on to the speaking-line branches of the selector and trunk line as the result of the responding of the first test relay, means on said second test relay for switching the calling subscriber through to the speaking-line branches of said trunk line, a line relay which comes into operation on switching through to the speaking line, a holding circuit passing through said testing arm and the local testing line for the second test relay, an interruption contact in the energizing circuit of said operating magnet, which contact is opened when the said first test relay comes into action, and a second interruption contact, in said circuit, which is opened when the said second test relay comes into action.

In testimony whereof I affix my signature.

FRIEDRICH MERK.