

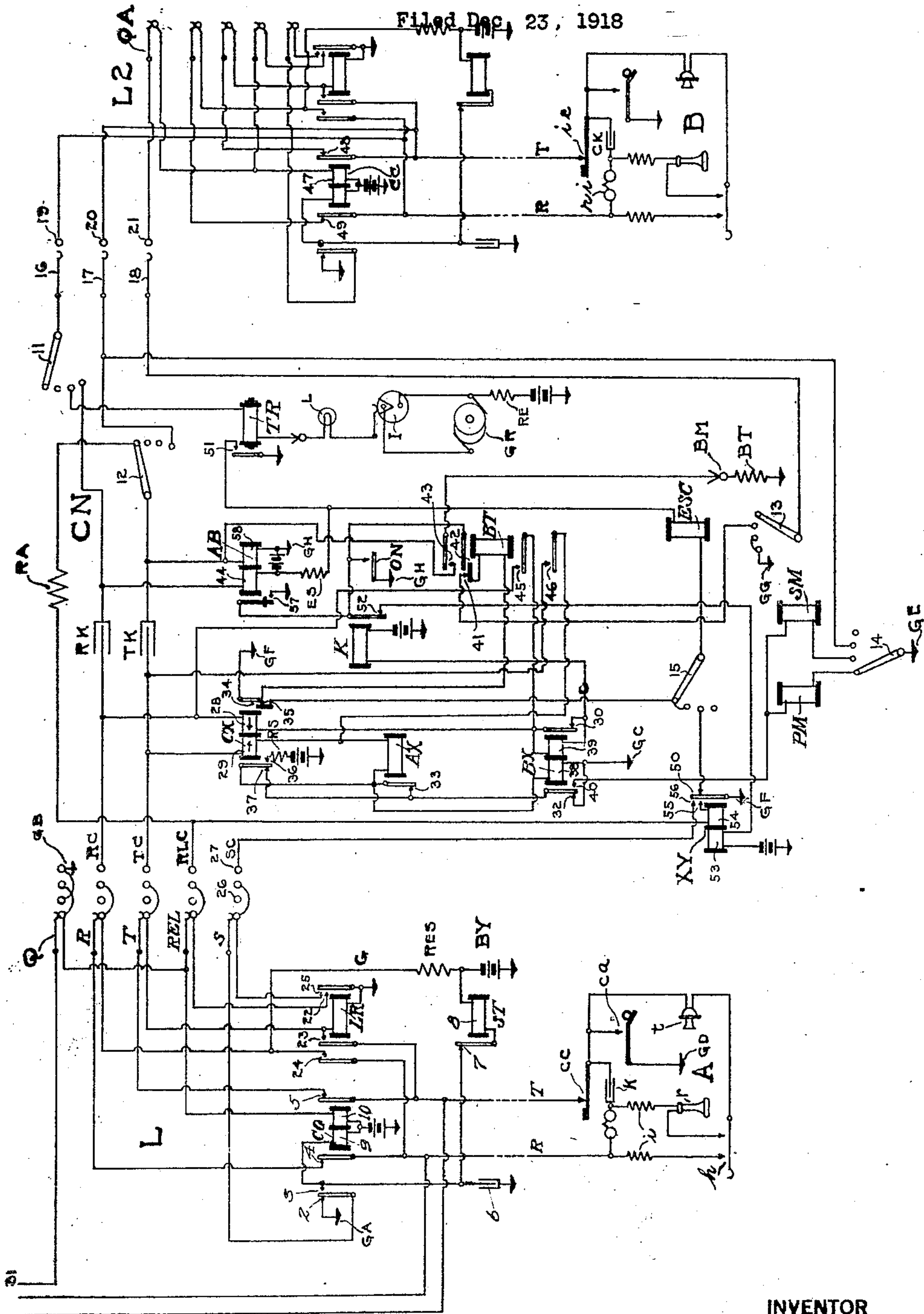
July 7, 1925.

1,545,064

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TELEPHONE SYSTEM

Filed Dec 23, 1918



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Patented July 7, 1925.

1,545,064

UNITED STATES PATENT OFFICE.

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TELEPHONE SYSTEM.

Application filed December 23, 1918. Serial No. 268,116.

To all whom it may concern:

Be it known that I, WINFRED T. POWELL, a citizen of the United States, residing in Rochester, in the county of Monroe and State of New York, have invented certain new and useful Improvements in Telephone Systems, of which the following is a full, clear, concise, and exact description.

This invention relates to telephone exchange systems, and more particularly to systems in which automatic switches are used in establishing connections, either wholly or in part.

In such systems of the art with which I am acquainted, troubles have been encountered due to the necessity for marginal adjustments, particularly where dependence is placed upon the relative speed with which associated relays release their armatures. Also in other systems wherein these troubles are eliminated by the use of a third conductor or ground connection at the substation sending device, the sending device is necessarily complicated in structure, thereby being made expensive to manufacture and to maintain. Also in such systems, there have been other difficulties which by my improved construction are obviated.

A principal object of my invention is to provide means whereby with a very simple form of substation sending device, the central office switching mechanism may be operated under the control of the substation apparatus, including the sending device, to connect the line of the calling subscriber with that of the called subscriber with a minimum of apparatus operating in a most positive way.

It is another object to accomplish this in a system using a third or ground connection at the subscriber's instrument without complicating the construction of the substation apparatus or adding to the structure thereof in any way.

Another object is to provide in such a system an improved individual line switch for each of the subscribers, whereby upon making a call, the line is automatically extended to one of a plurality of selecting switching mechanisms, common to a group of subscribers, which switching mechanism is at the time in an idle or unused condition; and I have furthermore provided means to pre-

vent the extension of the calling line to a busy one of said switching mechanisms, common to the group of subscribers; and I furthermore provide means whereby when such an extension is made, other calling lines may not make connection with the selected switch mechanism.

Another object of my invention is to provide an improved organization of the central office selective switching mechanisms, whereby the same is adapted to be efficiently controlled by my improved substation organization to interconnect a calling line which has been extended to said switching mechanism with a desired called line.

Other objects of my invention are to provide an improved release circuit for the said switching mechanism, by virtue of which the switching mechanism employed and the line switch individual to the calling line may be restored to normal, by the mere opening of the subscriber's line circuit caused by the replacing of the calling subscriber's receiver upon his switchhook, no use being made of the ground connection above referred to, to cause this release, the release being accomplished something after the manner of release used in the so-called "2 wire automatic systems" although in my improved system the release is accomplished without any dependence upon the relative speed of "fast and slow relays."

An improved busy test circuit is also provided as will be seen from the description which follows, in which other objects of my invention will be made apparent.

Referring to the drawing accompanying this specification, at A and B I show two substation instruments connected to telephone lines extending from the substations to an exchange. At the exchange I show line switches, one for each of the said substations L and L² respectively.

In this description it will be assumed that the substation A is the calling substation, and the substation B is the called substation. Intermediate of the two line switches is shown a connector switch CN which is one of a group of connector switches, common to a large group of telephone lines, and which may be seized by any calling line, such as the line having the substation A, and under the control of the substation apparatus at A to

extend a talking connection to the line of a called subscriber, such as the line having the substation B.

The substation apparatus consists of the usual talking units, such as the transmitter *t*, receiver *r*, induction coil *i* and condenser *k*; and in addition has a sending device consisting, for instance, of the usual impulse contacts *cc* and *ca*. Contacts *cc* when the sending dial is operated, are rapidly operated to open the line circuit a given number of times. In the operation of the dial, the contacts *ca* are arranged to be closed in the preliminary forward motion of the dial, and are adapted to be opened when the dial restores to normal, subsequent to the last interruption of the line circuit by the contacts *cc*.

The mechanical structure of such a dial sender is well-known in the art and, therefore, it is not necessary to illustrate the same in detail here, the contacts only being shown for purposes of description.

Associated with the individual line switch mechanism *L*, are a plurality of active switch wipers *Q*, *R*, *S*, *T* and *REL*, these normally resting upon one of a plurality of sets of passive contacts, which sets of passive contacts known as "home point" contacts are alternately arranged with other sets of passive contacts known as "trunk point" contacts, each set of "trunk point" contacts being connected to a separate trunk connector switching mechanism, such as *CN*; the "home point" contacts being provided for the purpose of establishing a plurality of normal or resting positions for the wipers of the line switch *L* to which they proceed when an established connection is released. Such an arrangement is shown in my prior application, Serial No. 250,617, filed Aug. 19, 1918.

Controlling the movement of these switch wipers is an electromagnetic stepping mechanism *ST*, comprising an electromagnet 8 and normally made contact 7. Each is adapted to be operated from the central source of current supply *BY* to drive the wipers step by step and successively over the alternate trunk and home point contacts when a call is initiated, until a set of trunk point contacts is reached which belong to an idle or unused connector switch mechanism. Control over the stepping mechanism *ST* is exercised by a pair of relays *LR* and *CO*, these relays being under the control of the substation apparatus of the calling subscriber, and under certain conditions of use when the line with which they are associated is a called line, a certain measure of control is exercised by a substation apparatus of another line circuit, which in this case would be a calling line circuit, through the controlled actuation of the mechanism of an

intermediate connector switch mechanism, such as the connector switch mechanism *CN*.

The functions of these two relays *LR* and *CO* is to control in a local circuit the operation of the stepping magnet, to control its circuit and to control the extension of the line conductors of a calling line to a seized connector switch mechanism, such as *CN*, and under other conditions of use when the line is a called line to prevent such extension.

In passing it may be said that I accomplish this without the use of any interlocking or mechanical connection between the two relays, which mechanical connections are a source of trouble due to the difficulty of maintaining proper alignment of the parts, and due to the weight and inertia of the extra parts required in such prior art structures above referred to.

The passive contacts shown in the drawing to the right of the line switch wipers of the line switch *L*, are preferably arranged in vertical sets, there being in this embodiment of my invention twice as many sets of passive contacts as there are trunk connections available to the calling line. In the drawing the switch wipers are resting upon the first set of contacts and the four sets of contacts are illustrated therein. However, in practice the wipers would usually be adapted to engage many more than four sets of passive contacts, twenty or more sets being usually provided, and instead of the contacts in a given row adapted to be engaged by a given line switch wiper being shown in a straight vertical row, they usually are arranged in the arc of a circle which may be, if desired, a complete circumference, or by subdividing the switch wipers each by equivalent means known in the art only an arc of the circumference need be used, in which case the arrangement is such that the conductor leading to a given switch wiper is extended always to one of the said sets of passive contacts. Such a switch structure is shown, for instance, in the British patent to Fairweather, No. 7998 of 1906.

Although my invention is by no means limited to such switch structures, I have chosen to illustrate the same herein in connection with a connector switch mechanism wherein called line terminals are arranged in horizontal rows, one above the other, the switch wipers by means of which connection is extended through the connector switch to a called line being moved upwardly step by step under the control of a first series of circuit interruptions of the calling line circuit, and then subsequently moved in a horizontal direction under the control of a second series of circuit interruptions until the terminals of the called-for line are reached, release of the switch being accom-

plished by the energization of a release magnet provided therefor.

In connection with this switch mechanism, a side switch is provided having a plurality of active switch contacts and four sets of passive contacts adapted to be successively engaged by the active switch contacts, the shifting or "change-over" from one set of passive contacts to the next succeeding set being accomplished following a given series of line circuit interruptions under the control of the calling subscriber's dial, a deenergization of an "escape" magnet so-called, controlling the side switch wipers to escape from a preceding position to the next succeeding position whereby certain controlling circuits of the connector switch are shifted.

This side switch though it may be of various constructions, in this embodiment illustrated and indicated to represent such a switch is spring propelled by a spring individual to the side switch and restored when the main switch is restored against the power of its individual spring, by virtue of the power of a stronger spring, provided for the purpose of restoring the main connector switch mechanism. The escape magnet is shown at ESC and the side switch wipers are shown at 11, 12, 13, 14 and 15, the mechanical structure being well understood, is not specifically illustrated. The connector switch has a movable carriage adapted to be operated in a step by step manner, first in a vertical and then in a horizontal direction, as above mentioned, this carriage carrying three connector switch wipers 16, 17 and 18. To the right of these wipers in the drawing are terminals of one of a large number of lines, these terminals being "called" terminals and are indicated at 19, 20 and 21. Other sets of terminals for other lines would of course be provided in a complete switch structure, only one set being required for the purposes of this description; this set being the set associated with the line switch L^2 which is individual to the called line having a substation B.

Associated with the connector switch mechanism CN are a pair of actuating magnets, the first PM being adapted to lift the switch carriage carrying the switch wipers in a vertical direction when intermittently actuated by impulses of current, and the second SM being adapted to, in like manner, cause the switch wipers to transverse a group of line terminals, successively, until the line terminals, as 19, 20 and 21 of the called line are reached.

Likewise associated with the connector switch mechanism CN are a plurality of controlling relays CX, AX, BX, AB, K, BT, TR and XY. Of these relays, the relays AB, BX and XY have two windings, tandem wound, with respect to each other.

The relay CX has likewise two windings, but these are wound in opposition to each other, so that when both are energized by the simultaneous flow of current through them, their resultant energization equal in strength and opposite in their effect on the relay core, will cause a resultant effect upon the said relay core equal to no energization, but when either one of the windings are energized the armatures of the relay will be attracted. Such a relay is known in the art as a differential relay, and will be so in order called.

The relays CX, AX, K and BX are adapted to be included in circuit with the subscriber's telephone and the central office source of current, the flow of current through their windings is adapted to be directly in circuit with the calling telephone line. Under certain conditions of use and at certain periods of use, however, the relay BX is operated by current through one of its windings, which current flows in a circuit local to the connector switch.

Certain switch mechanism controlled contacts known as "off-normal" contacts are shown at ON, these contacts being adapted to be operated when the switch mechanism is moved from its normal position. All of the apparatus in the drawing is shown in its normal or un-operated position.

To enable a better understanding of the invention to be secured, a description of the operation of the same will now be had reference being made to the drawing, and under the assumption that the substation calling is the substation A and that the substation called is the substation B, and the first encountered terminals of a connector switch mechanism, common to the telephone lines and which is therefore used to extend the connection between the calling and called lines, is the connector switch mechanism CN.

The subscriber at substation A, upon removing his receiver r , closes an energizing circuit for the line relay LR of the line switch L as follows: ground at G, winding of line relay LR, "home point" contact and wiper T, normally closed contact 5 of the cut off relay CO, line conductor T, impulse springs cc of the substation, transmitter, hook, switch contact h , primary induction coil i , line conductor R, normally closed contact 4 of the cutoff relay CO, wiper and "home point" contact R, resistance coil RES, to the source of current BY.

The line relay LR operates and closes the following circuit: ground G, contact 22 of relay LR, "home point" contact and wiper REL, winding 10 of relay CO to battery. Contact 22 also extends this ground G by way of the Q wiper to the multiple test terminal 31 appearing before all connectors, such as CN, in the group having access to

this line. This causes the calling line switch L to test busy to incoming calls as soon as the line relay operates.

Relay CO operates when the above traced circuit through its winding 10 is closed and opens the normally made contacts 2, 4, 5 and closes the normally open contact 3. Contacts 4 and 5 open the above traced circuit of the line relay LR, but a shunt circuit around these contacts 4 and 5 had previously been closed at contacts 23 and 24 when the relay LR operated. Thus the relay LR will be held up from the closed circuit of the substation A over this substitute path which is independent of the cut off relay CO.

Relay CO also opens contact 2, which does nothing at this time, and closes contact 3, which closes a circuit for the stepping magnet ST as follows: ground G, contact 25 of relay LR, "home point" contact and wiper S, contact 3 of relay CO, contact 7 of stepping magnet ST, winding 8 of magnet ST to battery. The magnet ST energizes, opens its own circuit at contact 7 and then the armature is retracted by spring power in the well-known way. Upon release of the armature of magnet ST, the wipers Q, R, T, REL, S are driven one step, i. e. from the first set of "home point" contacts to the first set of "trunk point" contacts.

Assuming this first trunk to be busy because some other line switch is using it, then there will be a ground on the test terminal 26, which is multiplied before this calling line switch L, and others in the same group. The ground would be placed there from GA, contact 2 of relay CO of the line switch, similar to L, which is holding the trunk busy. Now when the testing line switch wiper S contacts with this grounded terminal 26, ground will flow from the terminal 26, wiper S, contact 3 of relay CO, divide and flow by one path through winding 9 of relay CO, which keeps relay CO energized while the wipers are resting on the busy trunk, so that the connection holding this trunk will not be disturbed. The other path may be traced by way of contact 7 and winding 8 of stepping magnet ST to battery.

This circuit causes the stepping magnet ST to again operate and release, advancing the wipers Q, R, T, REL, S to the next point which is a "home point." Here the first traced circuit from contact 25 of relay LR again causes the switch to step and also keeps the relay CO energized.

Assuming the next trunk to be idle, then there will be no ground on point 27, and relay CO will release, place a busy ground GA, contact 2 and wiper S on the test terminal 27 of this trunk so that other line switches similar to L will not stop here. Contacts 4 and 5 of relay CO also close and

extend the line conductor R by way of wiper R to trunk RC and conductor T by way of wiper T to trunk TC leading to the connector CN.

The line relay LR remains energized after the connector CH has been seized because of the following circuit: ground G, winding of relay LR, contact 23 of relay LR, line conductor T, substation set A, line conductor R, contact 4 of relay CO, wiper R, trunk wire RC, winding 28 of relay CX, contact 30 of relay BX, winding of relay K to battery.

Referring back to the point where ground was placed on the connector terminal 31 to cause the calling line to test busy to incoming calls. This ground was from G, contact 22 of relay LR and "home point" contacts of wipers REL and Q, which ground is disconnected from terminal 31 when the wipers are on trunk point contacts. However, wiper Q, when leaving its "home points" makes contact with terminals which are connected to ground GB at all "trunk points," maintaining the busy potential on terminal 31 constantly during the time that line switch L is in use.

Condenser 6 connected between contact 7 of magnet ST and ground is the usual spark quencher for contact 7.

The circuit has now been traced up to the point where the closed circuit from substation A is extended to trunk wires RC and TC of connector CN. This closed circuit causes relays K and AX to operate and is traced as follows: ground GC, contact 32 of relay BX, contact 33 of AX, winding of AX, winding 29 of relay CX, trunk TC, closed circuit of substation A, trunk RC, winding 28 of relay CX, contact 30 of relay BX, winding of relay K to battery.

CX is a differential relay and will not pull up when an equal amount of current flows through both windings but at this time it will pull up because of the unbalanced circuit caused by relay LR being legged off the TC trunk to ground. This is of no consequence at this time. Contact 34 being closed energizes the escape magnet ESC, but, as is well known, switches of this type keep the side switch wipers mechanically locked in normal position until the switch shafts step away from normal. The other contact 36 of relay CX closes a circuit from ground GC, winding 38 of relay BX, contact 36 of relay CX, resistance coil RS to battery.

This causes relay BX to operate and prepare the circuit to the primary magnet PM, by way of contact 40 but because AX is at this time operated, battery for operating PM is open at contacts 33. In case relay CX pulls up before relay AX, when the connector CN is seized, the magnet PM will not be prematurely operated because BX can-

not operate to close its contact 40 until AX operates and removes a short circuit around BX at contact 33.

The forward movement of the calling device at substation A, for the first digit of the called number, will close contact *ca*, placing a ground on the T line conductor through springs *cc*. This ground is also placed on the R line conductor through the transmitter *t*, hook contact *h* and primary induction coil *i* and is held there as long as the calling device is away from its normal position. The ground on the T line conductor is interrupted by springs *cc* as the calling device returns, the number of interruptions corresponding to the number turned.

As the calling device is pulled forward, relay LR of line switch L releases because it is short circuited by a ground being on both sides, one shown at G and the other coming from GD, contact *ca*, contact *cc*, line T and contact 23. Relay LR can not again energize during this connection because it is open both at contact 23 and at wiper T of the line switch L. Ground GD, contacts *ca* and *cc* of substation A also flows over line conductor T, through line switch cut off relay (CO) springs 5, wiper T, trunk TC, winding 29 of relay CX, winding of AX, contact 36 of relay CX, resistance coil RS to battery. This holds AX as long as contact *cc* at substation remains closed, but as the calling device returns, contact *cc* will be intermittently opened and closed. Each time contact *cc* opens, the circuit to relay AX is broken and it releases.

As stated above, relay BX was energized when both CX and AX operated and it, together with CX and K are held energized over the following circuit:—when the calling device is away from normal, ground GD, contact *ca*, transmitter *t*, switchhook contact *h*, induction coil *i*, line conductor R, contact 4 of line switch relay CO, wiper R, trunk wire RC, winding 28 of connector relay CX, winding 39 of relay BX, winding of relay K to battery. When the calling device is normal the holding circuit for these relays BX, CX and K is from ground GC, winding 38 of relay BX, winding of AX, winding 29 of CX, trunk TC, line switch wiper T, contact 5 of relay CO, line conductor T, impulse springs *cc*, transmitter *t*, hookswitch contact *h*, induction coil *i*, line conductor R, contact 4 of relay CO, wiper R, trunk RC, winding 28 of relay CX, winding 39 of relay BX, winding of relay K to battery.

Thus it will be seen that when the calling device is normal, the impedance of the circuit to battery is equal for each side of the line, relay AX and winding 38 of relay BX from the T side and winding 39 of relay BX in series with relay K.

If the first digit of the called number is 2, the impulse springs *cc* at substation A will be momentarily separated twice to thereby cause relay AX to be momentarily deenergized twice. Each time relay AX falls back it closes the following circuit to the primary magnet of the connector: ground GE, side switch wiper 14 and first position thereof primary magnet PM; contact 40 of relay BX, contact 33 of relay AX, contact 36 of relay CX and resistance coil RS to battery. Thus the primary magnet PM receives two impulses and operates to raise the connector switch shaft and wipers 16, 17, 18 two steps to a position opposite the second level or row of bank contacts.

After the impulse springs *cc* at substation A make their last closure, springs *ca* open, this happening just before the calling device reaches normal. Because the ground GD is taken off the line, relay CX gets an equal amount of current through each winding, causing it to release and open the circuit of the escape magnet ESC, which had been previously held energized from ground GF, contact 34 of relay CX, point one and side switch 15, winding of magnet ESC, resistance coil ES to battery. This allows the side switch wipers 11, 12, 13, 14, 15 to move to the second position.

The calling device at substation A may now be operated in accordance with the second digit of the called number, resulting in the energization of relay CX as the calling device is pulled forward, because the ground GD short circuits its winding 29. Relay CX again closes battery through resistance coil RS and contact 36 to contact 33 of relay AX, and, as the calling device again returns, relay AX is momentarily deenergized eight times, if the second digit in the called line is eight. This time however the circuit of PM is open and SM is closed because side switch wiper 14 is in position 2, therefore at each deenergization of relay AX, the secondary magnet SM operates to advance the wipers 16, 17, 18 to the particular contacts in the level previously selected, which correspond to the number of the called line. After the last impulse is delivered, the relay CX again falls down and opens the circuit of the escape magnet ESC at contact 34 of relay CX. If the called line is idle, the escape magnet thereupon deenergizes and allows the side switch wipers 11, 12, 13, 14, 15 to move to the third position. If the called line is busy, the side switch remains in the second position and the calling party is given the busy signal in the following manner: Whenever a line is busy there is a guarding ground on the test terminal appearing before all connectors which can select said line. This ground is placed there if the line is busy because of an originating call, as previously

described, by way of wiper Q. If the line is busy because of a terminating call this ground is placed on the test terminal 21 by some connector similar to CN being in the third or fourth position, said ground coming from GG, side switch wiper 13 and test wiper 18. Consequently, when the test wiper 18 of the connector CN which is testing a busy line, contacts with the terminal 21, a ground is extended from said terminal 21, test wiper 18, side switch 13 and second point thereof, contact 41 of relay BT, winding of relay BT, contact 35 of relay CX (when the dial at substation A stops and relay CX releases), second point and arm of side switch 15, winding of escape magnet ESC, resistance coil ES to battery. The escape magnet ESC remains operated and the relay BT operates over the above traced circuit. Relay BT, upon energizing, closes contact 42 before opening contact 41 which opens the operating circuit above traced and closes a locking circuit to ground at off normal contacts ON thereby holding the side switch arms 11, 12, 13, 14, 15 in second position and holding relay BT energized until the connection is released. The calling party receives the busy tone over the following circuit: common busy wire BM, contact 43 of relay BT, condenser TK, trunk TC, line conductor T, substation A, line conductor R, trunk conductor RC, condenser RK, winding 44 of relay AB, through the battery to ground which is the other side of the busy transformer BT. Relay BT also closes contacts 45 and 46 which places a short circuit around both windings of relay CX so it cannot operate and interrupt the circuit of the escape magnet or cause the switch to step around, if the calling party should again turn the dial without first releasing.

If the called line is idle, the side switch wipers 11, 12, 13, 14, 15 will be advanced to the third position as previously described. Side switch wiper 13 places a guarding ground on the test terminal 21 of the called line, said ground also being used to energize the cut off relay CC of the called line switch L2. This circuit is traced from ground GG, side switch wiper 13, connector wiper 18, terminal 21, "home point" contact and wiper QA of called line switch L2, winding 47 of relay CC to battery. The cut off relay CC operates and disconnects the battery bridge from the called line by means of contacts 48 and 49.

Ringin is now applied to the called line over the following circuit: common generator GR, common interrupter I, common lamp L, winding of relay TR, third position and arm of side switch wiper 11, connector wiper 16, terminal 19, called line conductor R, ringer *re*, condenser *ck* and contact *ic* of the called substation B, line conductor T,

terminal 20, connector wiper 17, third position and arm of side switch 14, ground GE, through the battery and resistance coil RE to the other side of the ringing generator GR.

Connector switch CN with its side switch wipers 11, 12, 13, 14, 15 in the ringing or third position, maintains a circuit for holding the escape magnet ESC energized as follows: ground GF, contact 50 of relay XY (which is the release magnet of the connector switch CN), third position and arm of side switch wiper 15, winding of escape magnet ESC, resistance coil ES to battery. Now when the called party removes the receiver at substation B to answer, a closed circuit is placed across the called line conductors T and R, over which the generator is being applied, as previously described. This closed circuit causes relay TR to operate TR and close its contact 51, said contact placing a short circuit around the escape magnet ESC, causing it to release and allowing the side switch wipers 11, 12, 13, 14, 15 to move to the fourth or talking position. Talking battery is fed to the called substation through the two windings of relay AB, fourth position and arms of side switch wipers 11 and 12, connector switch wipers 16 and 17, by way of the called line conductors T and R. Talking battery is fed to the calling substation A through windings of relays K, BX, CX and AX as previously described. The two lines are linked together for the passage of voice currents by condensers TK and RK.

The release of the connection will now be described. As long as the receiver *r* at substation A is off the hook, current will flow through relay K as follows: ground GC, winding 38 of relay BX, winding of relay AX, winding 29 of relay CX (or contact 46 of relay BT if releasing from a busy connection), trunk TC, through the line switch L and substation apparatus A, trunk RC, winding 28 of relay CX (or contact 45 of relay BT if releasing from a busy connection), winding 39 of relay BX, winding of relay K to battery. Also during the time that this circuit is open at contact *cc* of substation A, relay K will get an energizing circuit as follows: ground GD at substation A, contact *ca*, transmitter *t*, hook switch contact *h*, induction coil *i*, line R, through line switch L, trunk RC, winding 28 of relay CX (or contact 45 of relay BT if connector CN is on a busy connection), winding 39 of relay BX, winding of relay K to battery. With relay K energized the circuit to the release magnet XY is open and when the receiver of substation A is placed on the hook, the circuit of relay K is opened, allowing it to fall down and close its contact 52.

This causes the connector release magnet

XY to operate over the following circuit: ground GH, off normal contact ON, contact 52 of relay K, winding 53 of release magnet XY to battery. In addition to causing the release of connector CN in the well known manner, release magnet XY closes its contacts 55 and 56. Contact 55 extends the ground GF through winding 54 of magnet XY, connector trunk RLC, line switch wiper REL, winding 10 of relay CO, to battery. This operates relay CO and locks the release magnet XY in its operated position by way of low winding 54, until the line switch L is stepped away from this trunk to its next "home point" contact. Relay CO, of the line switch L, when operated, closes the following circuit to cause the said line switch to step away from this trunk: ground GF, contact 56 of connector release magnet XY, connector trunk CS, line switch wiper S, contact 3 of line switch cut off relay CO, contact 7 and winding 8 of stepping magnet ST to battery. This ground GF, being held on trunk wire SC until both the connector CN and the line switch L release, also serves to cause this trunk to test busy to other line switches during the time taken to release both the connector and line switch. When the line switch L steps away from the trunk, winding 54 of release magnet XY is opened and when the connector switch shaft reaches normal and opens contact ON, winding 53 of release magnet XY is opened. The connector CN is now ready to be again seized and used for establishing another connection. Line switch L is also resting at a "home point" contact ready to be again used by substation A in selecting another idle connector.

It will be noted that relay AB is provided with a make contact 57 which is closed by a slow operating armature when said relay is energized. This contact and resistance coil RA are for the following purpose: If a calling party removes his receiver, causes his line switch L to select a connector CN and then hangs up without turning the dial, there would be no operation of the connector release magnet XY to cause the release of the line switch L. By using contact 57 of relay AB this difficulty is overcome by causing connector switch CN to go through the release operation under the above mentioned condition and it is accomplished in this way: When the line switch L seizes connector CN, the following circuit is closed to operate relay AB: ground GH, winding 58 of relay AB, side switch wiper 12 and first position thereof, resistance coil RA, connector trunk RLC, line switch wiper REL, winding 10 of relay CO to battery. Relay AB is made slow to operate so that relay K will get up over the line circuit first. Therefore when relay AB operates,

its contact 57 does nothing at this time. If the dial is turned, side switch wiper 12 will leave its first position and open this circuit of relay AB. If the dial is not turned and the calling party hangs up the receiver, relay K will fall down and close the following circuit: ground through contact 57 of relay AB, contact 52 of relay K, winding 53 of release magnet XY to battery. This causes a release operation of both the connector CN and the line switch L as described above. When the line switch steps away from this trunk the circuit of relay AB is opened at line switch wiper RLC and said relay falls down, leaving the connector CN in its normal condition.

What I claim is:

1. In a telephone system, the combination with a plurality of telephone lines, substations for each of the said lines, a pair of individual line conductors for each of the said lines arranged to be serially included in a conversational circuit leading to the said substations, sending mechanism at each substation comprising a pair of contact sets, a central office switch adapted to be controlled by a calling telephone line sending mechanism, means to operate the said switch in a primary direction in one plane, means to operate the said switch in a secondary movable direction in a second plane, a third conductor common to all of the telephone lines of a group, a circuit conductor normally broken by one of the said pairs of contacts for each substation sending mechanism leading from the said third conductor through normally closed contacts of the other contact set of the said substation sending mechanism to a line conductor of the associated telephone line, a substation switchhook having normally open contacts in the circuit of the other line conductor, relay mechanism under the joint control of the said sets of contacts to control the motion of the said switch, means to operate the said switch under the control of the said relay mechanism by intermittently opening the second set of contacts a definite number of times to move it in a primary direction, means to maintain the first set of contacts closed during the said interruptions by the second set of contacts, and means responsive to a subsequent opening of the first set of contacts to alter the control exercised by the said relay mechanism over the said switching mechanism, whereby a subsequent set of interruptions by the second set of contacts will operate the said switch in a secondary direction.

2. In a telephone system, the combination with a plurality of telephone lines, a pair of line conductors for each of the said lines, station apparatus for each of the said lines at which the said line conductors terminate, a line switch individual to each of the said

lines, a common group of switching mechanisms for the said lines, means to operate the line switch of a calling line to cause it to make connection with an unused or idle switching mechanism of the common group, a line relay for the said line switch to initiate its operation, a source of current and circuit conductors to cause the operation of the said line relay when the station apparatus of a calling line makes connection to the said line, a circuit for the said switch operating means including an active contact of the said line switch and passive contacts adapted to be traversed thereby, contacts of the said line relay controlling the initiation of the said switch operating means, means to continue the operation of the said switch including passive contacts, one for each busy switching mechanism, and means responsive to the electrical condition of a traversed passive contact of an idle switching mechanism to disable the said switch operating means, a station sender for controlling the selected idle switching mechanism, and contacts for the said station sender arranged for progressive and retrograde movements operative when the said sender is operated, to restore the said line relay.

3. In a telephone system, the combination with a telephone line, a line switch individual to the said line, a plurality of switching mechanisms, means under the control of the said substation apparatus to cause the said line switch to make connection with one of the said switching mechanisms, a release circuit for the said line switch extending through contacts of the said line switch and controlling contacts in the selected switching mechanism, a release magnet for the said switching mechanism controlling the said controlling contacts, a pair of relays for the said switching mechanism, means to cause one of the said relays to operate when the switching mechanism is selected, means to operate the other relay over a circuit including the said substation apparatus through contacts of the said line switch, retarding means for the armature of the first named relay, and a circuit for the said release magnet including normally open contacts of the first named relay and normally closed contacts of the second relay, said circuit including a source of current.

4. In a telephone system, the combination with a telephone line, a line switch individual to the said line, a plurality of switching mechanisms, means under the control of the said substation apparatus to cause the said line switch to make connection with one of the said switching mechanisms, a release circuit for the said line switch extending through contacts of the said line switch and controlling contacts in the selected switching mechanism, a release

magnet for the said switching mechanism controlling the said controlling contacts, a pair of relays for the said switching mechanism, means to cause one of the said relays to operate when the switching mechanism is selected, means to operate the other relay over a circuit including the said substation apparatus through contacts of the said line switch, retarding means for the armature of the first named relay, a second telephone line, operating means for the said switching means to cause a telephonic connection to be extended from the first telephone line to the second telephone line, circuit conductors and switch contacts to include the said first-named relay in circuit with the said second telephone line, windings for the said first relay, and a source of current serially connected with the said windings in serial circuit with the substation instrument of the second telephone line and in bridge with the said telephonic connection circuit conductors to feed transmitter battery to the substation of the second telephone line.

5. In a telephone system, the combination with a telephone line, substation apparatus for the said line, a line switch individual to the said line, a plurality of switching mechanisms, means under the control of the said substation apparatus to cause the operation of the said line switch whereby the said line switch makes connection with an idle one of the said switching mechanisms, a release circuit for the said line switch extending through a movable contact thereof and a stationary contact thereof, which stationary contact is associated with the selected switching mechanism, a circuit conductor leading through the said stationary contact through a winding, and a normally open contact of a release relay for the said switching mechanism, a second winding for the said relay and a circuit therefor including a source of current and serially connected normally closed contacts of a first relay and normally open contacts of a second relay, means to cause the said second relay to operate responsive to the selection of the switching mechanism, and means to cause the first relay to be operated responsive to the presence of the subscriber's substation apparatus on the said line.

6. In a telephone system, the combination with a telephone line, substation apparatus for the said line, a line switch individual to the said line, a plurality of switching mechanisms, means under the control of the said substation apparatus to cause the operation of the said line switch whereby the said line switch makes connection with an idle one of the said switching mechanisms, a release circuit for the said line switch extending through a movable contact thereof and a stationary contact thereof, which station-

ary contact is associated with the selected switching mechanism, a circuit conductor leading through the said stationary contact through a winding, a normally open contact of a release relay for the said switching mechanism, a second winding for the said relay and a circuit therefor including a source of current and serially connected normally closed contacts of the first relay and normally open contacts of a second relay, means to cause the said second relay to operate responsive to the selection of the switching mechanism, means to cause the first relay to be operated responsive to the presence of the subscriber's substation apparatus on the said line, and retarding means for the normally open contacts of the second relay to prevent a too rapid closure thereof.

7. In a telephone system, the combination with a telephone line, substation apparatus for the said line, a line switch individual to the said line, a plurality of switching mechanisms, means under the control of the said substation apparatus to cause the operation of the said line switch, whereby the said line switch makes connection with an idle one of the said switching mechanism, a release circuit for the said line switch extending through a movable contact thereof and a stationary contact thereof, which stationary contact is associated with the selected switching mechanism, a circuit conductor leading through the said stationary contact to a winding, and a normally open contact of a release relay for the said switching mechanism, a second winding for the said relay and a circuit therefor including a source of current and serially connected normally closed contacts of the first relay and normally open contacts of a second relay, means to cause the said second relay to operate responsive to the selection of the switching mechanism, means to cause the first relay to be operated responsive to the presence of the subscriber's substation apparatus on the said line, and retarding means for the normally open contacts of the second relay to prevent a too rapid closure thereof.

8. In a telephone system, the combination with a plurality of telephone lines, line switches for the said lines, a group of switching mechanisms adapted each for the use of a calling one of the said lines, switch actuating means for each of the said line switches under the control of a calling substation of the associated line, circuit connections for each of the said switching mechanisms to cause continuance of the operation of an operating line switch when the said switching mechanism is busy, and to cause a discontinuance of the said operation when the said switching mechanism is idle, a pair of relays for each line switch

controlling its switch actuation means, means to actuate both of the said relays when a call is initiated by a calling substation of the line, means to retire one of the said relays when an idle switching mechanism is selected by the said line switch, and means to retire the second of the said relays by a subsequent operation of switching contacts associated with a calling substation prior to the termination of a call.

9. In a telephone system, the combination with a plurality of telephone lines, line switches for the said lines, a group of switching mechanisms adapted each for the use of a calling one of the said lines and releasing means for the same, switch actuating means for each of the said line switches under the control of a calling substation of the associated line, circuit connections for each of the said switching mechanisms to cause continuance of the operation of an operating line switch when the said switching mechanism is busy, and to cause a discontinuance of the said operation when the said switching mechanism is idle, a pair of relays for each line switch controlling its switch actuating means, means to actuate both of the said relays when a call is initiated by a calling substation line, means to retire one of the said relays when an idle switching mechanism is selected by the said line switch, and means to retire the second of the said relays by a subsequent operation of switching contacts associated with a calling substation prior to the release of said idle switching mechanism, said first relay interposing normally closed contacts in the circuit of the line conductors leading from the line substation apparatus to the line switch movable contacts.

10. In a telephone system, the combination with a plurality of telephone lines, line switches for the said lines, a group of switching mechanisms adapted each for the use of a calling one of the said lines, switch actuating means for each of the said line switches under the control of a calling substation of the associated line, circuit connections for each of the said switching mechanisms to cause continuance of the operation of an operating line switch when the said switching mechanism is busy, and to cause a discontinuance of the said operation when the said switching mechanism is idle, a pair of relays for each line switch controlling its switch actuating means, means to actuate both of the said relays when a call is initiated by a calling substation line, means to retire one of the said relays when an idle switching mechanism is selected by the said line switch, and means to retire the second of the said relays by a subsequent operation of switching contacts associated with a calling substation, said first relay interposing normally closed con-

tacts in the circuit of the line conductors leading from the line substation apparatus to the line switch movable contacts, said second relay having normally open contacts interposed between the passive contacts of the said line switch and the substation apparatus of the line.

11. In a telephone system, the combination with a plurality of telephone lines, line switches for the said lines, a group of switching mechanisms adapted each for the use of a calling one of the said lines, switch actuating means for each of the said line switches under the control of a calling substation of the associated line, circuit connections for each of the said switching mechanisms to cause continuance of the operation of an operating line switch when the said switching mechanism is busy, and to cause a discontinuance of the said operation when the said switching mechanism is idle, a pair of relays for each line switch controlling its switch actuating means, means to actuate both of the said relays when a call is initiated by a calling substation line, means to retire one of the said relays when an idle switching mechanism is selected by the said line switch, and means to retire the second of the said relays by a subsequent operation of switching contacts associated with a calling substation, said first relay interposing normally closed contacts in the circuit of the line conductors leading from the line substation apparatus to the line switch movable contacts, the said second relay having normally open contacts interposed between the line conductors of the line and passive contacts of a set upon which the line switch wipers normally rest.

12. In a telephone system, the combination with a plurality of telephone lines, line switches for the said lines, a group of switching mechanisms adapted each for the use of a calling one of the said lines, switch actuating means for each of the said line switches under the control of a calling substation of the associated line, circuit connections for each of the said switching mechanisms to cause continuance of the operation of an operating line switch when the said switching mechanism is busy, and to cause a discontinuance of the said operation when the said switching mechanism is idle, a pair of relays for each line switch controlling its switch actuating means, means to actuate both of the said relays when a call is initiated by a calling substation line, means to retire one of the said relays when an idle switching mechanism is selected by the said line switch, and means to retire the second of the said relays by a subsequent operation of switching contacts associated with a calling substation, said first relay interposing normally closed contacts in the circuit of the line conductors

leading from the line substation apparatus to the line switch movable contacts, the said second relay having normally open contacts interposed between the line conductors of the line and passive contacts of a set upon which the line switch wipers normally rest, the said first-named relay having two windings, one to initially operate it, and the other to continue its operation until contacts of an idle switch mechanism are encountered.

13. In a telephone system, the combination with a calling telephone line, means to extend the circuit of the said calling line and a connector switch, directly operating means, a test relay for the said connector switch, a test wiper therefor, controlling contacts at the substation of the said calling telephone line to directly control the movement of the said wiper to cause it to make contact with a passive contact of the said connector leading to apparatus of a called telephone line, a pair of relays for the said connector, each of which has a winding in circuit with the calling substation, one of the said relays having a single winding and the other relay having two differential windings, means to continuously operate the said differentially wound relay during the operation of the controlling contacts of the calling substation, means to operate the other relay in unison with the operation of the said controlling contacts, said directly operating means being under the joint control of the two relays, and means to include the said test relay and a source of current in circuit with the said test wiper upon the retiring of the said differential relay at the end of a series of operations of the said substation contacts.

14. In a telephone system, the combination with a calling telephone line, means to extend the circuit of the said calling telephone line and a connector switch, directly operating means, a test relay for the said connector switch, a test wiper therefor, controlling contacts at the substation of the said calling telephone line to directly control the movement of the said wiper to cause it to make contact with a passive contact of the said connector leading to apparatus of a called telephone line, a pair of relays for the said connector, each of which has a winding in circuit with the calling substation, one of the said relays having a single winding and the other relay having two differential windings, means to continuously operate the said differentially wound relay during the operation of the controlling contacts of the calling substations, means to operate the other relay in unison with the operation of the said controlling contacts, said directly operating means being under the joint control of the two relays, means to include the said test relay and a source of current in circuit with the said test

wiper upon the retiring of the said differential relay at the end of a series of operations of the said substation contacts, and a locking circuit to maintain the said test relay energized after an initial energization by the closure of the said first-named circuit.

15. In a telephone system, the combination with a calling telephone line, means to extend the circuit of the said calling line and a connector switch, directly operating means, a test relay for the said connector switch, a test wiper therefor, controlling contacts at the substation of the said calling telephone line to directly control the movement of the said wiper to cause it to make contact with a passive contact of the said connector leading to apparatus of a called telephone line, a pair of relays for the said connector, each of which has a winding in circuit with the calling substation, one of the said relays having a single winding and the other relay having two differential windings, means to continuously operate the said differentially wound relay during the operation of the controlling contacts of the calling substation, means to operate the other relay in unison with the operation of the said controlling contacts, said directly operating means being under the joint control of the two relays, means to include the said test relay and a source of current in circuit with the said test wiper upon the retiring of the said differential relay at the end of a series of operations of the said substation contacts, and a locking circuit for the said test relay exclusive of the said circuit including the first test wiper.

16. In a telephone system, the combination with a calling telephone line, means to extend the circuit of the said calling line and a connector switch, directly operating means, a test relay for the said connector switch, a test wiper therefor, controlling contacts at the substation of the said calling telephone line to directly control the movement of the said wiper to cause it to make contact with a passive contact of the said connector leading to apparatus of a called telephone line, a pair of relays for the said connector, each of which has a winding in circuit with the calling substation, one of the said relays having a single winding and the other relay having two differential windings, means to continuously operate the said differentially wound relay during the operation of the controlling contacts of the calling substation, means to operate the other relay in unison with the operation of the said controlling contacts, said directly operating means being under the joint control of the two relays, means to include the said test relay and a source of current in circuit with the said test wiper

upon the retiring of the said differential relay at the end of a series of operations of the said substation contacts, and a locking circuit including off-normal contacts of the said connector switch.

17. In a telephone system, the combination with a calling telephone line, means to extend the circuit of the said calling line and a connector switch, directly operating means, a test relay for the said connector switch, a test wiper therefor, controlling contacts at the substation of the said calling telephone line to directly control the movement of the said wiper to cause it to make contact with a passive contact of the said connector leading to apparatus of a called telephone line, a pair of relays for the said connector, each of which has a winding in circuit with the calling substation, one of the said relays having a single winding and the other relay having two differential windings, means to continuously operate the said differentially wound relay during the operation of the controlling contacts of the calling substation, means to operate the other relay in unison with the operation of the said controlling contacts, said directly operating means being under the joint control of the two relays, means to include the said test relay and a source of current in circuit with the said test wiper upon the retiring of the said differential relay at the end of a series of operations of the said substation contacts, a locking circuit including off-normal contacts of the said connector switch, a side switch adapted to be advanced from one side switch position to a further side switch position upon successive de-energizations of the said differential relay, and means under the control of the said busy test relay when energized to prevent further operation of the said side switch.

18. In a telephone system, the combination with a calling telephone line, means to extend the circuit of the said calling line and a connector switch, directly operating means, a test relay for the said connector switch, a test wiper therefor, controlling contacts at the substation of the said calling telephone line to directly control the movement of the said wiper to cause it to make contact with a passive contact of the said connector leading to apparatus of a called telephone line, a pair of relays for the said connector, each of which has a winding in circuit with the calling substation, one of the said relays having a single winding and the other relay having two differential windings, means to continuously operate the said differentially wound relay during the operation of the controlling contacts of the calling substation, means to operate the other relay in unison with the

operation of the said controlling contacts, said directly operating means being under the joint control of the two relays, means to include the said test relay and a source of current in circuit with the said test relay upon the retiring of the said differential relay at the end of a series of operations of the said substation contacts, a locking circuit including off-normal contacts of the said connector switch, a side switch adapted to be advanced from one side switch position to a further side switch position upon successive de-energizations of the said differential relay, and means under the control of the said busy test relay when energized to prevent further operation of the said side switch, said last-named means including disabling means for the said differential relay.

19. In a telephone system, the combination with a calling substation, a telephone line leading therefrom to a main station, a connector switch at the main station associated with the said calling line, sending mechanism at the said substation adapted to send successive series of current impulses to the connector switch mechanism under the manual control of an operator, a pair of relays at the main station for the said connector switch in circuit with the said substation sending mechanism, one of the said relays being a differential relay, controlling contacts for the said sending mechanism and circuit connections to cause the said differential relay to be continuously operated during the sending of a series of impulses by the said sending mechanism, circuit connections to cause the other relay to be responsive to each impulse of every series of impulses, a called substation telephone line, switch actuating mechanism operated under the control of the said pair of relays to cause the said connector switch to make connection with the desired line, and "change-over" switching mechanism adapted to alter the control of the said sending mechanism over the said switch actuating mechanism after each operation of the said differential relay.

20. In a telephone system, the combination with a calling substation, a telephone line leading therefrom to a main station, a connector switch at the main station associated with the said calling line, sending mechanism at the said substation adapted to send successive series of current impulses to the connector switch mechanism under the manual control of an operator, a pair of relays at the main station for the said connector switch in circuit with the said substation sending mechanism, one of the said relays being a differential relay, controlling contacts for the said sending mechanism and circuit connections to cause the

said differential relay to be continuously operated during the sending of a series of impulses by the said sending mechanism, circuit connections to cause the other relay to be responsive to each impulse of every series of impulses, a called substation telephone line, switch actuating mechanism operated under the control of the said pair of relays to cause the said connector switch to make connection with the desired line, "change-over" switching mechanism adapted to alter the control of the said sending mechanism over the said switch actuating mechanism after each operation of the said differential relay, a test wiper for the said connector switch adapted to make contact with a test contact of the called telephone line, a test relay in circuit with the said test wiper and adapted to be responsive to a busy condition of the tested called line, and means responsive to a deenergization of the said differential relay and a given stage of operation of the said "change-over" switching mechanism to close the circuit of the said busy relay whereby the said busy relay is operated.

21. In a telephone system, the combination with a calling substation, a telephone line leading therefrom to a main station, a connector switch at the main station associated with the said calling line, sending mechanism at the said substation adapted to send successive series of current impulses to the connector switch mechanism under the manual control of an operator, a pair of relays at the main station for the said connector switch in circuit with the said substation sending mechanism, one of the said relays being a differential relay, controlling contacts for the said sending mechanism and circuit connections to cause the said differential relay to be continuously operated during the sending of a series of impulses by the said sending mechanism, circuit connections to cause the other relay to be responsive to each impulse of every series of impulses, a called substation telephone line, switch actuating mechanism operated under the control of the said pair of relays to cause the said connector switch to make connection with the desired line, "change-over" switching mechanism adapted to alter the control of the said sending mechanism over the said switch actuating mechanism after each operation of the said differential relay, a test wiper for the said connector switch adapted to make contact with a test contact of the called telephone line, a test relay in circuit with the said test wiper and adapted to be responsive to a busy condition of the tested called line, means responsive to a de-energization of the said differential relay and a given stage of operation of the said "change-over" switching mechanism

to close the circuit of the said busy relay whereby the said busy relay is operated and switch contacts under the control of the said busy relay to maintain it operated.

22. In a telephone system, the combination with a calling substation, a telephone line leading therefrom to a main station, a connector switch at the main station associated with the said calling line, sending mechanism at the said substation adapted to send successive series of current impulses to the connector switch mechanism under the manual control of an operator, a pair of relays at the main station for the said connector switch in circuit with the said substation sending mechanism, one of the said relays being a differential relay, controlling contacts for the said sending mechanism and circuit connections to cause the said differential relay to be continuously operated during the sending of a series of impulses by the said sending mechanism, circuit connections to cause the other relay to be responsive to each impulse of every series of impulses, a called substation telephone line, switch actuating mechanism operated under the control of the said pair of relays to cause the said connector switch to make connection with the desired line, "change-over" switching mechanism adapted to alter the control of the said sending mechanism over the said switch actuating mechanism after each operation of the said differential relay, a test wiper for the said connector switch adapted to make contact with a test contact of the called telephone line, a test relay in circuit with the said test wiper and adapted to be responsive to a busy condition of the tested called line, means responsive to a de-energization of the said differential relay and a given stage of operation of the said "change-over" switching mechanism to close the circuit of the said busy relay whereby the said busy relay is operated, switch contacts under the control of the said busy relay to maintain it operated, additional switch contacts under the control of the said busy relay for preventing a further operation of the said "change-over" switching mechanism.

23. In a telephone system, the combination with a calling substation, a telephone line leading therefrom to a main station, a connector switch at the main station associated with the said calling line, a sending mechanism at the said substation adapted to send successive series of current impulses to the connector switch mechanism under the manual control of an operator, a pair of relays at the main station for the said connector switch in circuit with the said substation sending mechanism, one of the said relays being a differential relay, controlling contacts for the said sending mechanism and circuit connections to cause the said dif-

ferential relay to be continuously operated during the sending of a series of impulses by the said sending mechanism, circuit connections to cause the other relay to be responsive to each impulse of every series of impulses, a called substation telephone line, switch actuating mechanism operated under the control of the said pair of relays to cause the said connector switch to make connection with the desired line, "change-over" switching mechanism adapted to alter the control of the said sending mechanism under the said switch-actuation mechanism after each operation of the said differential relay, a test wiper for the said connector switch adapted to make contact with a test contact of the called telephone line, a test relay in circuit with the said test wiper and adapted to be responsive to a busy condition of the tested called line, means responsive to a de-energization of the said differential relay and a given stage of operation of the said "change-over" switching mechanism to close the circuit of the said busy relay whereby the said busy relay is operated, switch contacts under the control of the said busy relay to maintain it operated, additional switch contacts under the control of the said relay for preventing a further operation of the said "change-over" switching mechanism, and means responsive to the operation of the said busy relay to project a busy tone back over the line of a calling subscriber.

24. In a telephone system, the combination with a calling substation, a telephone line leading therefrom to a main station, a connector switch at the main station associated with the said calling line, a sending mechanism at the said substation adapted to send successive series of current impulses to the connector switch mechanism under the manual control of an operator, a pair of relays at the main station for the said connector switch in circuit with the said substation sending mechanism, one of the said relays being a differential relay, controlling contacts for the said sending mechanism and circuit connections to cause the said differential relay to be continuously operated during the sending of a series of impulses by the said sending mechanism, circuit connections to cause the other relay to be responsive to each impulse of every series of impulses, a called substation telephone line, switch actuating mechanism operated under the control of the said pair of relays to cause the said connector switch to make connection with the desired line, "change-over" switching mechanism adapted to alter the control of the said sending mechanism under the said switch actuating mechanism after each operation of the said differential relay, a test wiper for the said connector switch adapted to make contact with a test contact of the called telephone line, a test

relay in circuit with the said test wiper and adapted to be responsive to a busy condition of the tested called line, means responsive to a de-energization of the said
5 differential relay and a given stage of operation of the said "change-over" switching mechanism to close the circuit of the said busy relay whereby the said busy relay is
10 operated, switch contacts under the control of the said busy relay to maintain it oper-

ated, additional switch contacts under the control of the said busy relay for preventing a further operation of the said "change-over" switching mechanism, and disabling means for the said switch actuating means
15 under the control of the said busy relay.

In testimony whereof, I hereunto subscribe my name this 20th day of Dec., A. D. 1918.

WINFRED T. POWELL.