April 1, 1941. B. KUDRNA 2,236,797

TELEPHONE SYSTEM

Filed July 29, 1933 2 Sheets-Sheet 1

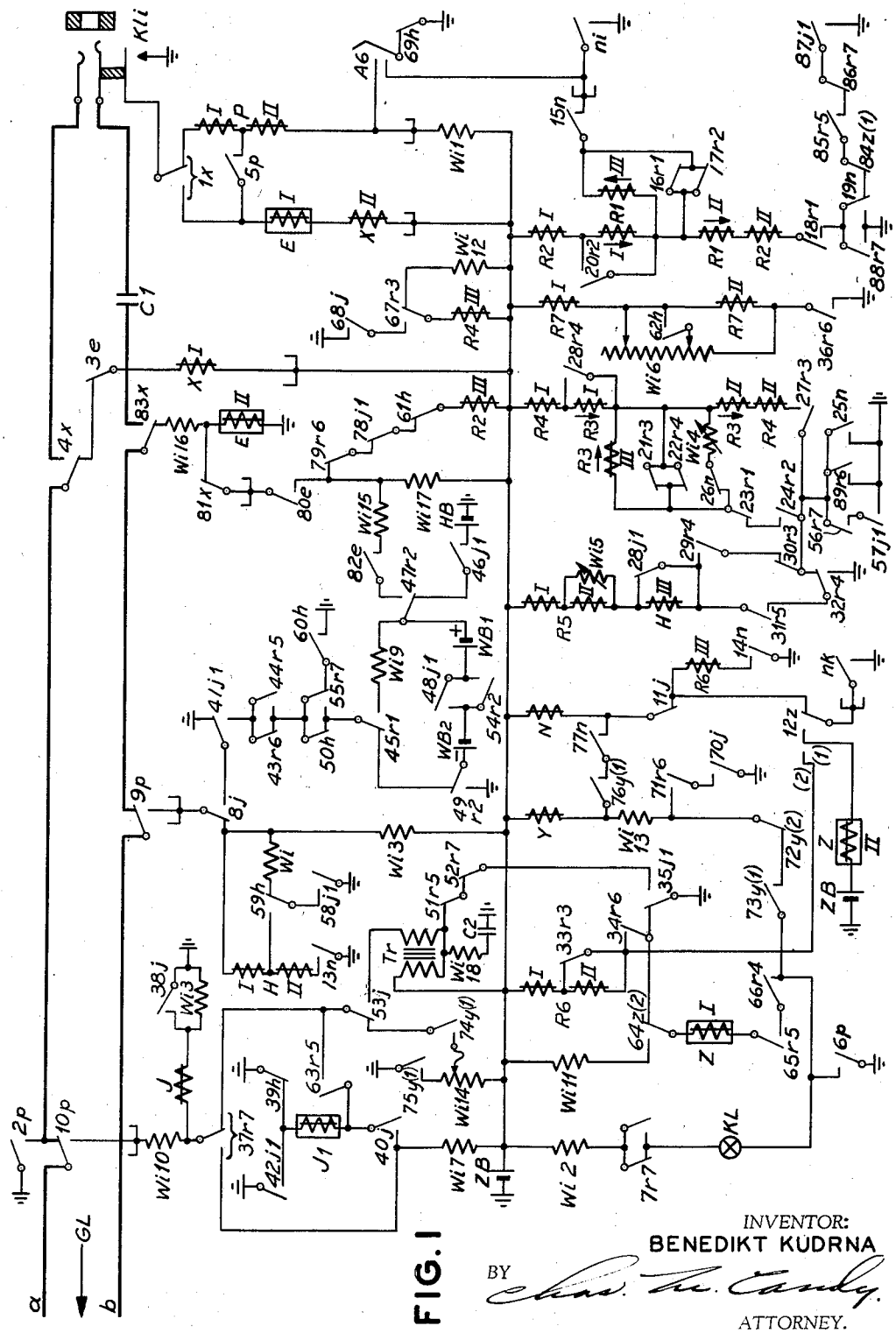


FIG. 1

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TELEPHONE SYSTEM

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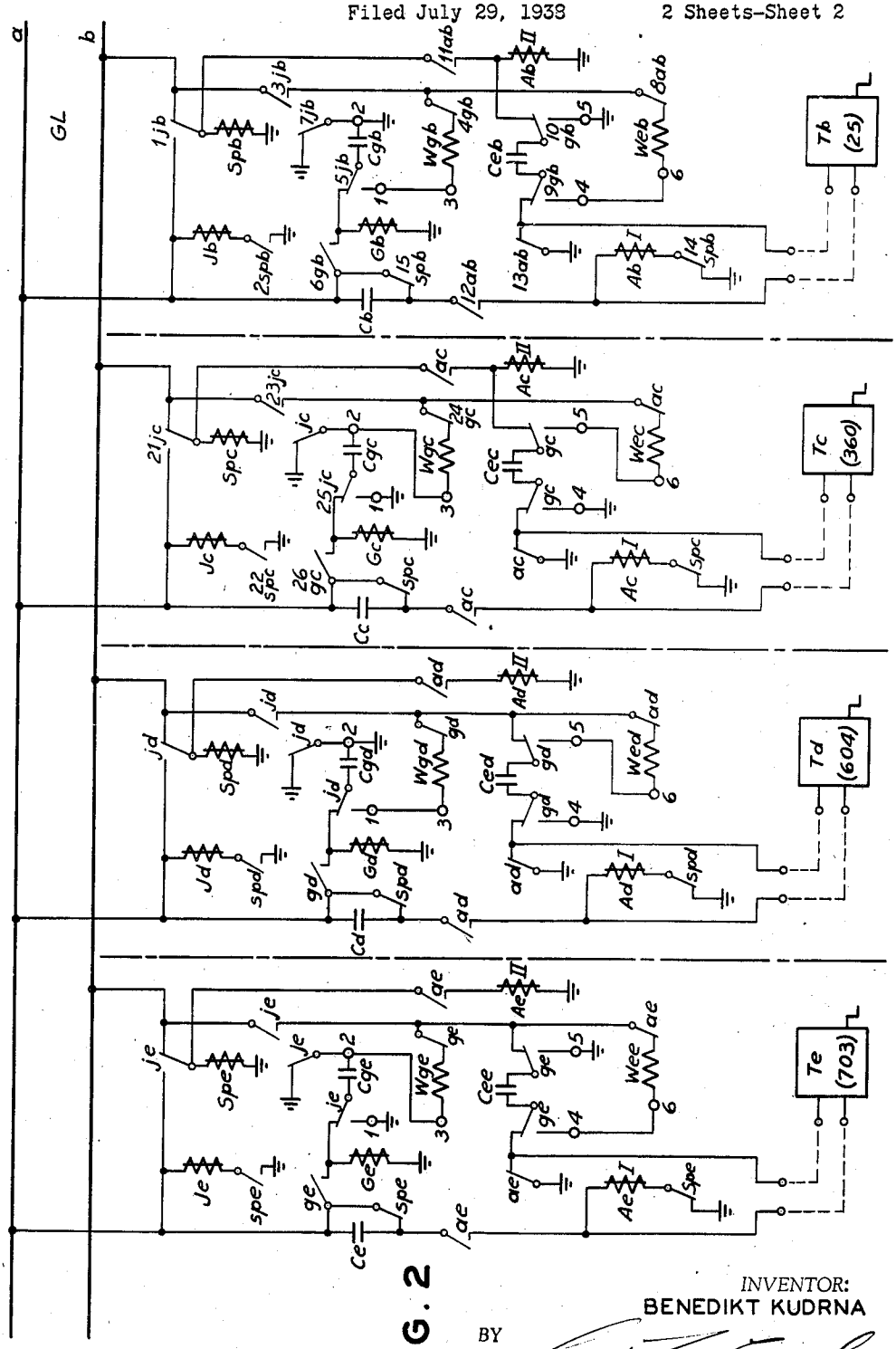


FIG. 2

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UNITED STATES PATENT OFFICE

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TELEPHONE SYSTEM

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Application July 29, 1938, Serial No. 222,047
In Germany August 2, 1937

18 Claims. (Cl. 179—86)

The invention concerns the telephone systems having party lines; more particularly, it relates to sending devices at the exchange which, under the influence of dial impulses, send out station selection impulses of different duration and selecting devices at the individual stations controlled by the impulses.

In such systems it is of advantage to connect the selecting devices at the individual stations to the party line only during the actual selection period, in order to avoid false influencing thereof by disturbing impulses extending over the line. In this connection it has been shown that false settings of the selectors occur on many of the branch sets when all of the selectors are not connected to and disconnected from the line in unison. This defect, which is traced more especially to the different times of operation and release of the auxiliary relays bringing about the connection and disconnection of the selector devices, is avoided according to the invention in that the auxiliary relays which connect the selector devices to the branch sets by a selection operation on the common line, are connected under the influence of the selecting set at the beginning of the selection before the connection of the selection current and are disconnected at the end of the selection at the same time as the disconnection of the selection current by means of a counter-current.

By this arrangement the result is obtained that the selection devices are connected to receive selection current with great certainty on all branch sets on the connection of the selection current and at the end of the selection current flow are disconnected immediately. The connecting and disconnecting current controlling the auxiliary relays at the branch sets is controlled by the sending set at the exchange. Switching means are provided for this purpose at the sending set, which automatically come into effect after the characterizing of the duration of the desired selection current and bring about the connection to the party line of a connecting current, controlling the auxiliary relays at the branch sets; switch means are further provided on the sending set, which after characterizing the duration of the desired selection current delay the initiating of the sending out of the selection current in order to make possible a sure connection of the auxiliary relay for connecting the selecting device to the branch set. In this way the delay period before initiating the sending out of selecting impulses is determined by several relays at the sending set also serving for other purposes.

Preferably the same switch means which control the connecting of the selection current in the sending set bring about the sending out of the disconnecting current extending over the auxiliary relays at the branch set in their rest position. This disconnecting current is simply produced with the aid of a transformer whose primary circuit is closed by the relay disconnecting the selection current, whereupon a current is produced in the secondary circuit in the opposite direction to the energizing current of the auxiliary relay at the branch set, which current is connected to the party line.

The system employs condenser resistance arrangements in the branch sets, in which after the sending out of the charging current for the condensers, the condensers of the sets not required are by-passed by transitory earth connection, and a relay in the sending set controlling the completion of the discharge brings about by preference the sending out of the disconnecting current controlling the auxiliary relays at the branch sets.

A wanted subscriber is characterized first by a group selection impulse and then by an individual selection impulse, and the group relays at his set which connect the individual selection devices to the line are influenced by an individual selection in the same way as the auxiliary relays controlling the group selecting device are influenced in the group selection.

The duration and polarity of each selection impulse transmitted over the party line is determined by one or more trains of impulses from a conventional dial. Selection impulses of three different lengths (short, medium, long) are contemplated, and, since these may be of either positive or negative polarity, six different combinations are available for any impulse. By using two impulses to select a station, one for group selection and a second for individual selection, 36 different selecting combinations may be obtained, which will usually be ample for any party line. It is self-evident that this number may be increased by using a fourth selection impulse, still longer than any of the other three.

A difficulty is usually encountered in transmitting selection impulses of long duration under control of a dial, due to the necessity of either limiting the length of any selection impulse to the running down period of the dial or providing large storage devices. This disadvantage has been overcome according to the invention by making long selection impulses depend upon a two-digit combination ("60" or "70", for example) so that the time required for the second

winding up of the dial and for its subsequent running down may be utilized to send the long impulse. The sender is preferably provided with switch means effective after a first operation of the dial to make the duration of the selection impulse thereafter depend upon a time switch alone (for short and medium impulses) or on a further operation of the dial (for long impulses). Means are also provided to prevent the sending out of disconnecting current controlling the auxiliary relays at the branch sets after the first dial operation in the event a long selection impulse is transmitted.

Further details of the invention are illustrated in the following description.

An embodiment of the invention is shown in the attached drawings to which, however, the invention is not limited.

Fig. 1 shows the sending device of an exchange, while in Fig. 2 a party line can be connected to this exchange by four branch sets as represented; the number of branch sets is not, however, limited to four.

Should a subscriber of the party line be called by the exchange the operator in the exchange plugs in the connection to the jack of the desired party line. In this way the jack K*li* is closed and a circuit for the relay P formed: earth, battery ZB, resistance W*i*1, relay P (winding I and II) contact 1*x*, jack contact K*li*, earth. If the sending device common to several party lines is not in use for making another connection the relay P energizes and connects the relay X over its contact 2*p*; earth, battery ZB, relay X, (winding I) contact 3*e*, 4*x*, 2*p*, earth. The relay X operates and holds over contact 1*x* over its winding II; the relay E in series with this winding also operates (winding I). By means of contact 1*x* and 5*p* the high resistance of the winding I of the relay P is short-circuited; the relay P holds over its low resistance winding II. On contact 9*p* negative potential is connected on the *b*-lead and the party line GL: earth, battery ZB, resistance W*i*3, contact 8*j*, 9*p*, *b*-lead of the party line, whereupon the locking relays (S*pb*, S*pc* etc.) on all branches of the party line, Fig. 2, are operated. By means of the contact 10*p* the *a*-lead of the party line is also connected to the sending device. Finally over contact 6*p* and the rest contact 7*r*7, the control lamp KL is connected; earth, battery ZB, resistance W*i*2, contact 7*r*7, control lamp KL, contact 6*p*, earth. When the control lamp lights up the operator in the central exchange recognizes that she can begin to dial.

The characterizing of the line subscriber results by several impulse series of definite impulse number which are converted by the sending device into selecting impulses of definite length and direction. Thus for example:

Selection of the digit 2 indicates a short impulse of negative direction.

Selection of the digit 3 indicates a short impulse of positive direction.

Selection of the digit 4 indicates a medium impulse of negative direction.

Selection of the digit 5 indicates a medium impulse of positive direction.

Selection of the digit 60 indicates a long impulse of negative direction.

Selection of the digit 70 indicates a long impulse of positive direction.

From these call signs a large number of call numbers can be formed; in the embodiment according to Fig. 2 only four subscribers' sets are provided with the following call numbers:

Subscribers T*b* with call number 25=2—5 (short —, medium +)

Subscribers T*c* with call number 360=3—60 (short +, long —)

Subscribers T*d* with call number 604=60—4 (long —, medium —)

Subscribers T*e* with call number 703=70—3 (long +, short +)

The operations in a single selection are now as follows:

By the rotation of the dial the contact *nk* at the exchange is closed, thus the following circuit is made for the relay N: earth, battery ZB, relay N, contact 11*j*, 12*z* (in the rest position) *nk*, earth. The relay N operates and connects relay H over its contact 13*n*, earth, battery ZB, resistance W*i*3, relay H, (winding I and II) contact 13*n*, earth. The relay R6 connected over contact 14*n* (winding III) does not operate since it is short-circuited over *nk* and 12*z*. Over contact 15*n* the impulse input circuit is prepared.

When now the dial runs back *ni* operates impulsively. In this way the relay storage device is set by means of relays R1 to R5. On the first closing of the contact *ni* a circuit is made for the relays R1 and R2: earth, battery ZB, relay R2, (winding I) relay R1 (winding I) contacts 16*r*1 and 17*r*2 in multiple, 15*n*, *ni*, earth. In this circuit as the result of the connection in series of the two relays only relay R1 is operated. Only when at the end of a first impulse contact *ni* is opened again is the relay R2 also energized; earth, battery ZB, relay R2 (winding I), relay R1 (winding I) relay R1 (winding II) relay R2 (winding II) contact 18*r*1, 19*n*, earth. By means of the contact 20*r*2 the winding I of relay R1 is short-circuited, the relay R1 remains energized, however; the contacts 16*r*1 and 17*r*2 are opened. By the second closing of the contact *ni* the relay R1 is disconnected by means of its reverse winding III while the relay R2 holds over its winding I and the contact 20*r*2 short-circuiting the winding I of the relay R1, in spite of the short-circuit of its winding. Contact 18*r*1 is opened so that by the second opening of the contact *ni* the relay R2 also releases. On the third opening of the contact *ni* as on the first opening of this contact the relay R1 operates again while the relay R2 is not energized again. By the third opening, fourth closing and the fourth opening of the contact *ni* the same operations are repeated as on the opening and second opening and second closing etc. i. e., according to impulse series with odd impulses both relays R2 and R1 energize and remain energized over contact 19*n* and 88*r*7, while according to the impulse series with even impulse numbers both relays R1 and R2 are not energized. Thus relay R1 determines the direction of the current sent out over the *b*-lead of the party line in that it connects "+" potential in its rest position. The duration of the selecting current is determined by the number of dialled impulses and the required connecting of the storing relays R1–R5 which takes place as follows: on the second closing of the contact *ni*, since the relay R1 is disconnected by the reverse current and the relay R2 is not yet energized, the relay R3 is connected: earth, battery ZB, relay R4 (winding I) relay R3 (winding I) contacts 21*r*3, 22*r*4, 23*r*1, 24*r*2, 25*n*, earth. The relay R4 in view of series connection with the relay R3 is not operated. The contact 23*r*1 and 24*r*2 now control the relays R3 and R4 in a similar manner as

a contact *ni* controlled relay R1 and R2, i. e., on the first opening of the contact 24*r*2 a short circuit of the winding II of the relay R4 already connected over the contact 27*r*3 is removed so that relay R4 also operates and by means of its contact 28*r*4 short circuits the winding of the relay R3. The relay R3 still holds, however, over its winding II. On the second closing of the contact 24*r*2 and after the release of relay R1 (i. e., on the fourth closing of the contact *ni*) the positive winding III of the relay R3 is connected and releases relay R3 while relay R4 holds over its winding I and the contact 21*r*3 short-circuiting its winding III after the release of relay R3. By the second opening of the contact 24*r*2 which follows, relay R4 also releases: on the third closing of the contact 24*r*2 the same sequence of operations of the relays R3 and R4 begins again.

If after the fourth closing of the contact *ni* the relay R3 releases the relay R4 is not yet connected. The circuit is made for relay R5: earth, battery ZB, relay R5 (winding I and II) and parallel resistance Wi5, contact 28*j*1, 29*r*4, 30*r*3, 25*n*, earth. The relay R5 makes a holding circuit for itself over its contact 31*r*5 and over the contact 32*r*4 independently of relay N.

For the storage relays we get then the following table:

Relay R1 is energized by the first holding impulse.
Relays R1, R2 are energized after the first selection impulse.
Relays R2, R3 are energized on the second selection impulse.
Relays R3, R4 are energized after the second selection impulse.
Relays R1, R3, R4 are energized on the third selection impulse.
Relays R1, R4 are energized after the third selection impulse.
Relays R2, R4, R5 are energized on the fourth selection impulse.
Relay R5 is energized after the fourth selection impulse.
Relays R1, R5 are energized on the fifth selection impulse.
Relays R1, R2, R5 are energized after the fifth selection impulse.

And so on to the ten impulses i. e., the chain (R3, R4) is passed over once while the chain (R1, R2) is passed over twice, and the contact *ni* is closed four times. After the fourth selecting impulse the operations repeat with the only difference that relay R5 is already connected and also remains connected. At the end of the selection and the setting back of the dial to its rest position the contact *nk* is opened again. Hence the relay R6 short-circuited hitherto by its winding III comes to operate in the following circuit: earth, battery ZB, relay N, contact 11*j*, relay R6, (winding III) contact 14*n*, earth. Relay R6 holds over its winding I in the following circuit: earth, battery ZB, relay R6 (winding I) contact 33*r*3, 34*r*6, 35*j*1, earth. On the operation of the relay R6 the relay R7 is connected: earth, battery ZB, relay R7 (winding I and II) in parallel over contact 62*h* and resistance Wi6, contact 36*r*6, earth. The relays R6 and R7 maintain over the contacts 89*r*6, etc., 88*r*7 the holding circuit of the energizing storing relays (R1 and R5). The relay R7 further connects negative potential over its contact 37*r*7 and the resistance Wi7 and Wi10 to the *a*-lead of the party line so that on all branches the party line GL, Fig. 2, the auxiliary relays (*Jb*, *Jc*, *Jd*, etc.) connecting the selector devices, and already connected over contacts of the locking relay R (*Spb*, *Spc*, etc.) are energized and also connect the corresponding locking relays to the *a*-lead. At the same time parallel to this auxiliary relay on the branch set over the resistance Wi8 the relay J is connected to the exchange; relay J, which holds over contact 38*j*, sets earth potential over its contact 8*j* and the contact 41*j*1 to the *b*-lead and the party line. It results that at the beginning of the selecting impulse the condensers of the branch set are completely discharged. Only the auxiliary relays bringing about the connection are operated at all branches and the connection of the selecting current is somewhat delayed. In order to produce this delay the holding of the relay N is interrupted by the operation of the relay J by means of the contact 11*j*; the release of the relay N effects the release of the relay H by opening the contact 13*n*. A circuit for the relay J1 switching in the selecting current and preparing its connection is made: earth, battery ZB, resistance Wi7, contact 40*j*, relay J1, contact 39*h*, earth. The relay J1 operates and holds independently of relay H over its contact 42*j*1. By the operation of the contact 41*j*1, earth potential is disconnected from the *b*-lead of the party line, and the connection of the selecting current whose direction and duration is depending on the previous setting of the storing relays R1 to R5 is prepared and undertaken.

Finally over contact 10*j* the relay Y is connected for its first step: earth, battery ZB, relay Y, resistance Wi13, contact 71*r*6, 10*j*, earth. The relay Y holds on its first step over the contact 72*y* (2) 73*y* (1) and 6*p*; over its contact 74*y* (1) it maintains the connection of negative potential to the *a*-lead of the party line, also, when the relays R7 and J have restored, so that during this time the connecting relays (*Jb*, *Jc*, etc.) and locking relays (*Spb*, *Spc*, etc.) to all branch sets of the group relays (*Gb*, *Gc*, etc.) and individual relays (*Ab*, *Ac*, etc.) at the selected sets remain energized: earth, battery ZB, resistance Wi14, contact 74*y*, (1) 53*j* (in rest position) 37*r*7 (in rest position) resistance Wi10, contact 10*p*, *a*-lead of the party line. The relay Y remains energized in its first position.

The operations will now be considered which come into play by the selection of various characterizing digits.

If the sending out of a short selection impulse is concerned, by the selection of the digits "2" or "3" the storing relays are so influenced that relay R5 is not yet operated. When now in this case the relay J1 operates at the end of the numerical selection over contact 41*j*1, no connection of selection current is yet made since the contact 43*r*6 as well as the contact 45*r*1 is open. Furthermore the relay R6 disconnected by the opening of the contact 35*j*1 must first release. Only then is the contact 43*r*6 closed and the selection battery WB thus connected to the *b*-lead of the party line. The direction of the selection current sent out is determined by the energized condition of the relay R1 which over its contact 45*r*1 connects positive or negative potential. Thus for example by the selection of the digit "2" i. e., when the relays R1 and R2 have released (moreover the relays R3 and R4 are energized, but not R5) negative potential is connected and current flows over earth, auxiliary battery HB, contacts 46*j*1, 47*r*2, selection battery WB1, contact 48*j*1, selection battery WB2, contacts 49*r*2, 45*r*1 (in rest position)

50*h* and 55*r*7, 43*r*6, 41*j*1, 8*j*, 9*p*, to *b*-lead of the party line. Two selection batteries WB1 and WB2 of, for example, 36 volts are provided and connected together only for the purpose of sending out selection impulses and are charged in a manner not described in detail from the central battery ZB of, for example, 60 volts. The auxiliary battery HB is connected by negative impulse with attention to the high resistance of earth on the branch sets. By means of the release of the relay R6 the circuit of the relay R7 is also interrupted; the relay R7 releases, however, only after delay in view of the resistance Wi6 situated in parallel to its winding II which for the purpose of accurate setting of the release time is made alterable. After the delayed release of the relay R7 the circuit of the relay J is also interrupted so that this travels back to its rest position and by shifting its contact 8*j* interrupts the selection current from the selection battery. The selection time for the short-selection impulse (e. g. 25 milliseconds) is therefore determined by the period between the release of the relay R6 and the release of the relay J.

In order to obtain a definite release of the auxiliary relays (*Jb*, *Jc*, etc.) at the moment of disconnection of the selection current and thus to begin the discharge of the condensers on all branch sets at the same time, after the release of the relay R7 in the exchange the current in opposite direction to the holding current of the relays J, *Jb*, *Jc*, etc., is sent out over the *a*-lead of the party line; the production of this current results over: earth, battery ZB, transformer Tr, contacts 51*r*5, 52*r*7, 35*j*1, and earth, whereby the induction impulse excited in the secondary winding passes in a completely determinate direction over earth, contact 35*j*1, 52*r*7, 51*r*5, transformer Tr, contact 53*j*, 37*r*7, resistance Wi10, contact 10*p*, and then over the *a*-lead of the party line. By means of this impulse the auxiliary relays (*Jb*, *Jc*, etc.) at the branch sets are disconnected as well as the relay J in the sending set. On the release of the relay J in addition to the selection circuit the holding circuit of the relay J1 is also interrupted by opening of the contact 40*j*.

On the selection of the digit "3" a selection current of the same duration as on the selection of the digit "2" but opposite in direction is sent out. After the selection of digit "3" the relays R1 and R2 are energized and also the relays R3 and R4 but not R5. Over contact 45*r*1 (in rest position) positive potential is therefore connected and a selection current flows from earth over contact 43*r*2, selection battery WB2, contact 48*j*1, 54*r*2, selection battery WB1, resistance Wi9, contact 45*r*1 (in its working position) 50*h*, 55*r*7, 43*r*6, 41*j*1, 8*j*, 9*p*, to the *b*-lead of the party line. The further operations for limiting the duration of the selection impulse are the same as previously described in the selection of the digit "2."

After sending out the medium length selection impulse the digits "4" and "5" are selected. In both cases the relays R2 and R5 in the storing relay are energized while the relays R3 and R4 remain in their rest position; the selection of the digit "4" or "5" is differentiated by the energizing of the relay R1 determining the direction of the selection current. When at the end of the selection operation ("4" or "5") the relay J1 is energized in the manner already described after the operation of the relays R6, R7 and J then since this time a relay R5 is already connected, immediately on the shifting of the contact 41*j*1 the selection current is connected to the *b*-lead of the party line, e. g., positive potential of the digit "5" over earth, contact 49*r*2, selection battery WB2, contacts 48*j*1, 54*r*2, selection battery WB1, resistance Wi9, contact 45*r*1, 50*h*, 44*r*5, 41*j*1, 8*j*, 9*p*, to the *b*-lead of the party line. Further by the operation of the relay J the relay H is connected again since by the opening of the contact 28*j*1 the short-circuit of the winding III is removed and by means of the contact 57*j*1 the circuit for this winding is closed: earth, battery ZB, relay R5, (winding I and II) and parallel resistance Wi5, relay H, (winding III), contact 31*r*5, 32*r*4, 56*r*7, 57*j*1, earth. The relay H operates and holds over its winding I in the following circuit: earth, battery ZB, resistance Wi3, relay H (winding I) contact 59*h*, 58*j*1, earth. Hence the contact 39*h*, 50*h* and 61*h* are opened and the contact 60*h* and 62*h* closed.

When the relay J1 operates, the relay R6 over contact 34*r*6 and the relay R7 are disconnected in the manner already described over contact 35*j*1. The release period of the two relays R6 and R7 are essentially increased however, from that occurring in the previous case (shorter selection impulse) since the winding II of the relay R6 is short-circuited by contact 33*r*3 and also the winding II of the relay R7 by contact 62*h* is connected in parallel only with part of the resistance Wi6. The selection period for the medium length charging impulse (e. g. 220 milli-seconds) is therefore determined by the period from the operation of the relay J1 to the release of the relay R7. The medium length selection impulse systems consist, however, not only of medium length charging impulse but also of a discharging impulse connected thereto. When, for instance, the relay R7 releases then by means of the shifting contact 55*r*7 the charging current is disconnected and now therefore since relay H is energized over the contact 60*h*, earth potential is laid to the *b*-lead of the party line.

Hence there begins a discharge of the condensers arranged in the branch sets of the party line, as will presently be described in more detail, so that the condensers at branch sets which are not required (with short call signals), which are completely charged together with the condenser on the desired branch set (with medium call signal), will pass over to a charged condition, which will no longer permit the corresponding switch relays to operate. The duration of this discharging period (e. g., 25 ms.) is determined by the released period of the relay R5 disconnected by the opening of the contact 56*r*7 which can be set by the corresponding resistance Wi5 situated in parallel to its winding II and by the release period of the relay J. After release of the relay R5 by the opening of the contact 63*r*5 the holding circuit for the relays J, *Jb*, *Jc*, etc., which after the shifting to its rest position of the contact 37*r*7 extends over resistance Wi7 and the contacts 40*j*, 63*r*5 and 37*r*7, is interrupted while by the closing of the contact 51*r*5 a release impulse for the relays (*Jb*, *Jc* etc.) is made at the branch sets over the transformer Tr in the manner already described. This relay immediately restores. Relay J then effects the disconnection of the relay J1 in the manner already described and the latter brings the relay H to release.

In order to send out a long selection impulse, the selection and the digits "60" or "70" *is* necessary. In both cases the relays R3, R4 and R5 are energized while over the connection of relays R1 and R2, the selection of the digits "6" or "7" is differentiated. When now after the

selection of the first digit (6 or 7) the dial runs back to its rest position and in the manner already described after operation of the relays R6, R7 and J, the relays J1 and H are connected, then on the closing of the contact 41*j*1 the selection current is immediately connected to the *b*-lead of the party line, but the holding circuit of the relay R6 is not interrupted as with a medium length selection impulse on the operation of the relay J1 since this relay holds in the following circuit: earth, battery ZB, relay R6 (windings I and II) contacts 34*r*6, 64*z* (2) relay Z (winding I) contacts 65*r*5, 66*r*4, 6*p*, earth. The relay Z which hitherto was short-circuited by the contact 35*j*1, is operated in this circuit at the first stage. In the meanwhile there follows the rotation of the dial for the purpose of selecting the second digit "0" characterizing a long impulse. Thus the contact *nk* is closed again; therefore the relay Z now comes to operate completely over its winding (II): earth, battery ZB, relay Z (winding II) contacts 12*z* (1), *nk*, earth. By the shifting of the contact 64*z* (2) over which the relay Z (winding I) holds in series with the resistance Wi11 after the opening of the contact *nk* in the second stage, the disconnection of the relay R6 held over contact 12*z* (2) is prepared. When after the running down of the dial (after the selection of the digit "0") the contact *nk* is opened again, the relay R6 restores and effects the disconnection of the relay R7 disconnecting the charging current in the manner already described over contact 36*r*6. The selection period for a long impulse (at least 1700 ms.) is therefore determined by the period from the operation of the relay J1 to the release of the relay R7 including the time for the rotation and running back of the dial on the selection of the second characterizing digit "0." Also a long selection impulse consists of a long charging impulse and then a discharging impulse of medium duration. After the release of the relay R7 there follows, namely over contact 55*r*7, the disconnection of the charging current and the connection of earth potential to the *b*-lead of the party line. There begins, therefore, the discharge of the condensers at the branch sets, the duration of discharge (about 200 ms.) is determined by the release period of the relays R3 to R5. On the release of the relay R7 the contact 56*r*7 is opened and thus the energizing circuit of the windings I and II of the relays R3 and R4. At first, however, only the relay R3 is released since the relay R4 holds with its winding III over the contacts 67*r*3 and 68*i*; only after the opening of the contact 67*r*3 does it release under the influence of the resistance Wi12. By means of contact 32*r*4 the holding circuit of the relay R5 is also interrupted so that this likewise releases. Over contact 51*r*5 as already described, the sending out of release impulses for the auxiliary relays J, *Jb*, *Jc*, etc. is brought about over the *b*-lead. The relays J1 and H release also in the manner already described.

As has already been mentioned at the beginning, a large number of branch sets can be connected to the company line; in the present embodiment the arrangement is such that the branch sets are divided into groups in such a manner that by a first selection impulse the group, and by a second selection impulse the desired subscriber himself, are characterized. By using 6 call elements (short, medium, long, either positive or negative) 36 call combinations are produced by group and individual selection. After the group selection it is of importance in the characterizing of a long impulse by 2 digits, to maintain energized the relays (*Spb*, *Jb*, *Gb* etc.) excited at the branch sets over the *a*-lead of the company line, in the pause up to the beginning of the next selection impulse. This is done by means of the relay Y energized in the first operation which connects the holding current to the *a*-lead over the following circuit: earth, battery, ZB, resistance Wi14, contact 74*y*, (1), 53*j*, 37*r*1, resistance Wi10, contact 10*p*, *a*-lead of the company line. Only on the selection of the individual characterizing digits does the relay Y come to operate on the second stage: earth, battery ZB, relay Y, contact 76*y* (1) 77*n*, 11*j*, 12*z*, *nk*, earth. In this way the holding circuit of the relay Y, existing after the opening of the contact *nk*, is opened over contact 72*y* (2) so that it also releases after the release of relay R6. The energizing of the relay Y in the second stage on the selection of 2 digits, e. g., "60" for characterizing a long impulse is prevented by the contact 12*z*1 in its working position. The relay Y always comes to release therefore only after the selection of the last characterizing digit.

After the selection of the desired subscriber the key A6 is pressed by the operator in the central station whereby the relay P is short-circuited over the contacts *ab* and 69*h* and releases. By the shifting of the contacts 9*p* and 10*p* the impulse sending device is disconnected and the line itself is switched through to the exchange jack again. The contact 6*p* opens and lights up the control lamp KL. The relays E and X remain energized over contact 1*x*. The operator now sends calling current to the desired subscriber.

At the end of the connection which the exchange operator has characterized in a manner not described in detail the jack contact K1*i* is opened by the withdrawal of the plug and thus the holding circuit of the relays X and E is interrupted. The relay X immediately restores; over contact 81*x* it forms a new holding circuit for the delayed release relay X and moreover connects the relay R2 in the following path: earth, battery ZB, relay R2 (winding III) contacts 61*h*, 78*j*1, 79*r*6, 80*e*, 81*x*, relay E (winding II) earth. The selection battery is therefore connected again to the *b*-lead of the party line and with positive potential: earth, contact 49*r*2, selection battery WB2, contact 54*r*2, selection battery WB1, contacts 47*r*2, 82*e*, resistance Wi15, contacts 80*e*, 81*x*, resistance Wi16, contacts 83*x*, 9*p* to the *b*-lead of the party line, locking relays (*Spb*, *Spc*, etc.) earth or subscriber's relays (*Ab*, *Ac*, etc.), earth. By this connection of the selection battery the locking relays (*Sp* at all branch sets are brought to release quickly and with certainty, as also are the subscribers' connecting relays A which are still energized so that the switching devices at all branch sets reach their rest positions in a reliable manner. Also in the central set the relays E still energized are disconnected by reversed current and by the opening of the contact 80*e* also disconnect the relay R2 and the release current.

The branch sets of the party line shown in Fig. 2 are with small differences constructed in the same way. These differences consist in the different value of the resistance W*g* (for group selection) and the resistance W*e* (for individual selection), and in the different arrangement of the earth connections to the one or other side of the condensers (C*g* and C*e*). In order to be

able to use the same construction for all branch set switching devices 6 connecting terminals (1 to 6) are provided in the switching devices for each branch set, which terminals serve for the connection of the corresponding resistance and earth. In Fig. 2, four branch sets are shown, which, as already elucidated at the beginning, can be selectively called by four different call digits (25, 360, 604 and 703).

On the selection of the subscriber Tb (with call No. 25) first a short impulse of negative direction and then a medium length impulse on positive direction, are sent out one after another. The switching operations are then as follows: When by the initiation of the selection operation in the exchange after the insertion of the plug over contact 9p (Fig. 1) negative potential is led to the b-lead of the party line. Then in each branch set the locking relay Sp comes to operate, e. g., in the branch set Tb over the b-lead of the party line, contact 1jb, relay Spb, earth. The relay Spb attracts and over its contact 2spb connects the auxiliary relay Jb to the a-lead of the party line. This relay Jb is only energized however, when shortly before the beginning of the connection of selection current to the b-lead in the exchange (Fig. 1) over contact 37r1 and resistance Wi1, the connection of the negative potential to the a-lead of the party line results. The relay Jb operates and over its contact 1jb connects the relay Spb from the b-lead to the a-lead of the party line. Further over contacts 3jb, 5jb and 7jb, the selection device (resistance Wgb and condenser Cgb) is connected to the b-lead of the party line. In the rest of the branch set in a corresponding manner, relays Jc and Spc or Jd and Spd, etc., are connected to the a-lead, and the selection devices to the b-lead of the party line.

If now in the selection of the subscriber Tb a short-impulse in the negative direction is sent over the b-lead, then at all branch sets the condensers Cg are charged over the resistance Wg. Thus for example, the charging current at the branch set Tb extends over contacts 3jb, 4gb, resistance Wgb, terminal 3, terminal 1, contact 5jb, condenser Cgb, terminal 2 to earth. In view of the value of the resistance Wgb (for example 4000 ohms), the condenser Cgb is already charged at the end of the short selection impulse in such a manner that after the release of the contact 5jb, the negative charge can discharge over the group characterizing relay Gb. If now at the end of the selection impulse from the exchange the release impulse is sent out over the transformer Tr (Fig. 1) the relay Jb comes to release while the locking relay Spb remains energized over the contact 1jb shifted to the b-lead and the holding circuit connected to this over contacts 9p and 8j. By the release of the relay Jb the condenser Cgb discharges; the relay Gb operates therefore and closes contacts 6gb; thus it is connected to the a-lead of the party line and can remain energized since the direction of the discharging current (negative) of the condensers Cgb is determined by the direction of the current flowing from the exchange (Fig. 1) according to the group selection over resistance Wi14, contact 14y, (1), 53j, 37r1, resistance Wi10 to the a-lead of the party line. The auxiliary relays Jb, Jc, etc.), do not come to operate in this holding circuit.

At the branch set Tc with call No. 360 equivalent to short positive impulse and long negative impulse, by a short positive impulse the condenser Cgc is completely charged in the same way as the condenser Cgb. Through the other connection of the condenser Cgc after the shifting of the contact 25ic the positive charge of the condenser comes to discharge over the group relay Gc. Relay Gc also operates thereby; it cannot hold however, after the shifting of its contact 26gc and connection to the a-lead of the party line since the direction of the condenser discharging current (positive) is opposite to the direction (negative) of the holding current flowing over the a-lead of the party line.

At the branch sets (e. g., Td or Te) whose group characterization is a medium length of long impulse, the condenser (Cgd, Cge), since they are in series with high resistances (Wgd, Wge) of for example 500,000 ohms, are not yet brought to a charged condition making possible the operation of the corresponding group characterising relays (Gd, Ge) so that at these branch sets in general no effective energizing of the group characterizing relays (Gd, Ge) follows:

In the individual selection of the subscriber Tb (call number 25) which now takes place the group 2 only of the individual selection condensers (Ge) is influenced; at branch sets of the rest of the groups an influencing of the group selecting condensers (Cg) only takes place again. The operations in the individual selection are the same as in the group selection: i. e., before the selection current begins negative potential is connected to the a-lead of the party line, whereby the auxiliary relays (Jb, Jc, etc.) operate at all sets. In the branch sets of the selected groups the group connecting relays e. g., Gb, still remain energized however; these relays correspond in the individual selection to the auxiliary relays (Jb) in the group selection; i. e., they are connected before the selection current starts to flow and are disconnected by reverse current at the end of the selection.

The selection current connected in the exchange after the selection of a characterizing digit "5" is of medium length and positive direction and flows over the b-lead of the party line for example to the branch set Tb over contacts 3jb, 8ab, resistance Web, terminal 6, terminal 4, contact 9gb, condenser Ceb, contact 10gb, terminal 5 to earth. On the charging impulse there follows a discharging impulse of about 25 ms. by which the condensers with short call numbers at the branch sets not required are made effective. The remaining charge of the condenser Ceb however, is sufficient to energize the relay Ab. The negative charge of the condenser Ceb produced by the positive potential of the charging current flows at the end of the selection current after the release of relay Gb brought about by the release current over winding II of relay Ab. Relay Ab therefore operates and closes its contacts 11ab so that it is connected to the b-lead of the party line over this contact and contact 1jb. The direction (negative) of the current flowing over the b-lead of the party line corresponds with the direction (negative) of the discharged current of the condenser Ceb so that relay Ab remains energized and effects a complete switching through of the connecting line of the subscriber Tb over contact 12ab. Since by the release impulse sent out in the selection impulse from the exchange the relays Gb and Ib release, only the locking relays (Spb, Spc, etc.), remain energized at all branch sets and at the required set the relay Ab as well. The required subscriber is now called from the central set.

If the subscriber Tb wishes to make a connection himself he operates his magneto whereby relay Ab comes to operate in the following circuit: earth, contact 14spb, relay Ab (winding I), the connecting line to the subscriber's set Tb and back, contact 13ab, earth. Relay Ab operates and cuts out contact 13ab and closes contacts 11ab and 12ab. Over earth, contact 14spb, relay Ab (winding I) contacts 12ab, 15spb, 3e, relay X (winding I), battery ZB, earth call data are given to the exchange which then release known call devices not described in detail.

After the request to the operator in the central set the construction of the desired connection follows:

The selection of the subscriber Tc follows by the selection of the characterizing digit "360" i. e., for group selection a short impulse of positive direction (3) and for individual selection a long impulse of negative direction (6) is sent out.

The subscriber Td has the characterizing digit "604" i. e., selection of the group by a long impulse of negative direction (60) and individual selection by a medium length impulse (4) also of negative direction.

The subscriber Te is called by the selection of the characterizing digit "703" i. e., by a long impulse of positive direction (70) and a short impulse (3) also of positive direction.

There only remains to give details of the selection operations at these branch sets; for this it suffices to say that on the selection of the subscriber Tc by the first short selection impulse the condenser Cgc is completely charged and discharges over group relay Gc. On the individual selection which follows a long impulse of negative direction is sent out by which condenser Cec is completely charged; by the succeeding discharge there follows a lowering of the charge to the branch set connected by the group selection in such a manner that only the branch sets characterized by a long impulse does a sufficient charge remain to control the connecting relay. The direction of the charging current then effects the cutting out at the branch sets in which the connecting relay is energized by the discharge current of the condensers.

At the branch sets Td and Te the group selection takes place by long impulses and the individual selection by short impulses. Since, however, the impulses have different directions only the individual selection devices at one of the two branch sets are connected at the same time.

What is claimed is:

1. In a telephone system, a party line serving a plurality of subscribers' stations, means for generating a train of impulses, and means controlled by said last means for transmitting over said line a station selecting impulse depending in duration upon the number of impulses in said train.

2. In a telephone system, a party line serving a plurality of subscribers' stations, means for generating a train of impulses, and means controlled by said last means for transmitting over said line a station selecting impulse depending in duration and polarity upon the number of impulses in said train.

3. In a telephone system, a party line having a plurality of subscribers' stations thereon, means for generating a plurality of trains of impulses, and means for transmitting over said line a plurality of station selecting impulses each depending in duration upon the number of impulses in one of said trains.

4. In a telephone system, a partly line having a plurality of subscribers' stations thereon, means for generating a plurality of trains of impulses, and means for transmitting over said line a station selecting impulse depending in duration upon the number of impulses in a plurality of successive ones of said trains.

5. In a telephone system as claimed in claim 4, means for varying the polarity of said station selecting impulse in accordance with the number of impulses in a particular one of said successive trains of impulses.

6. In a telephone system, a party line serving a plurality of subscribers' stations, means operated one or more times to generate one or more successive trains of impulses, means responsive to the first operation of said means for initiating the transmission over said line of a station selecting impulse depending upon said one or more trains of impulses, and means for preventing termination of the transmission of said station selecting impulse before the generation by said first means of the last of said trains of impulses.

7. An impulse sender for use in telephone or like systems, comprising, means operable a plurality of times in succession and effective upon the first operation to generate a train of impulses corresponding to some digit, means controlled by said impulses, if said digit is of a predetermined value, to initiate the transmission of another impulse and to render a subsequent one of said successive operations of said first means effective to terminate the transmission of said other impulse.

8. An impulse sender for use in telephone or like systems, comprising, means operable one or more times in succession and effective upon the first operation to generate a train of impulses corresponding to some digit, timing means, means controlled by said impulses, if said digit is of a certain value, to initiate the transmission of another impulse and to render said timing means effective to terminate said impulse after a predetermined interval of time, said last means effective, if said digit is of a different value, to initiate the transmission of said other impulse and to render a subsequent one of said successive operations of said first means effective to terminate the transmission of said other impulse.

9. An impulse sender for use in telephone or like systems, comprising, means for generating a train of impulses, means responsive to the termination of said generation of the train of impulses for initiating transmission of another impulse, and timing means for terminating the transmission of said other impulse after an interval dependent upon the number of impulses in said train.

10. An impulse sender for use in telephone or like systems, comprising, means for generating codes having different digital values, means responsive to the termination of the generation of one of said codes for initiating transmission of an impulse, and timing means controlled by said first means for terminating the transmission of said impulse after an interval dependent upon the digital value of said code.

11. An impulse sender for use in telephone or like systems, comprising, means for generating a train of impulses, a relay, means for varying the speed of response of said relay in accordance with the number of impulses in said train, and means controlled by said relay for transmitting an impulse dependent in duration upon the speed of response of said relay.

12. In a telephone system, an exchange, a party

line terminating at the exchange, a plurality of subscribers' stations on said line, a selector at each station, means at the exchange for transmitting over the line a station selection impulse and, shortly prior to said transmission of the impulse, conditioning all of said selectors to respond thereto.

13. In a telephone system, an exchange, a substation and a line therefor terminating at the exchange, means at the exchange for transmitting a signal over said line, a responsive device at the substation, and means at the substation controlled over the line from the exchange to connect said responsive device to the line to receive said signal a predetermined interval of time before said transmission of the signal.

14. A telephone system as claimed in claim 13, wherein said last means is also controlled over the line from the exchange to disconnect said responsive device from said line substantially simultaneously with the termination of the transmission of said signal.

15. In a telephone system, a substation and a line therefor, means for initiating the transmission of connecting current over the line and, after a predetermined interval of time, initiating the transmission of signalling current over the line, said connecting current and said signalling current thereafter being transmitted concurrently, a responsive device at said substation normally disconnected from said line, means at the substation controlled by said connecting current for connecting said device to said line to respond to said signalling current and for maintaining same connected to the line so long as said connecting current is transmitted thereover.

16. In a telephone system, a substation and a line therefor, means for initiating the transmission of connecting current over the line and, after a predetermined interval of time, initiating the transmission of signalling current over the line, said connecting current and said signalling current thereafter being transmitted concurrently, a responsive device at said substation normally disconnected from said line, means at the substation controlled by said connecting current for connecting said device to said line to respond to said signalling current and for maintaining same connected to the line so long as said connecting current is transmitted thereover, and means for terminating the transmission of said connecting current and said signalling current substantially simultaneously.

17. In a telephone system, a substation and a line therefor, means for initiating the transmission of connecting current over the line and, after a predetermined interval of time, initiating the transmission of signalling current over the line, said connecting current and said signalling current thereafter being transmitted concurrently, a responsive device at said substation normally disconnected from said line, means at the substation controlled by said connecting current for connecting said device to said line to respond to said signalling current and for maintaining same connected to the line so long as said connecting current is transmitted thereover, and means for terminating the transmission of said connecting current and, at substantially the same time, transmitting an impulse of disconnecting current over the line to control said last means to disconnect said device from the line.

18. A telephone system as claimed in claim 17, wherein said connecting current and said disconnecting current flow in opposite directions.

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