

952,567.

Patented Mar. 22, 1910.

2 SHEETS—SHEET 1.

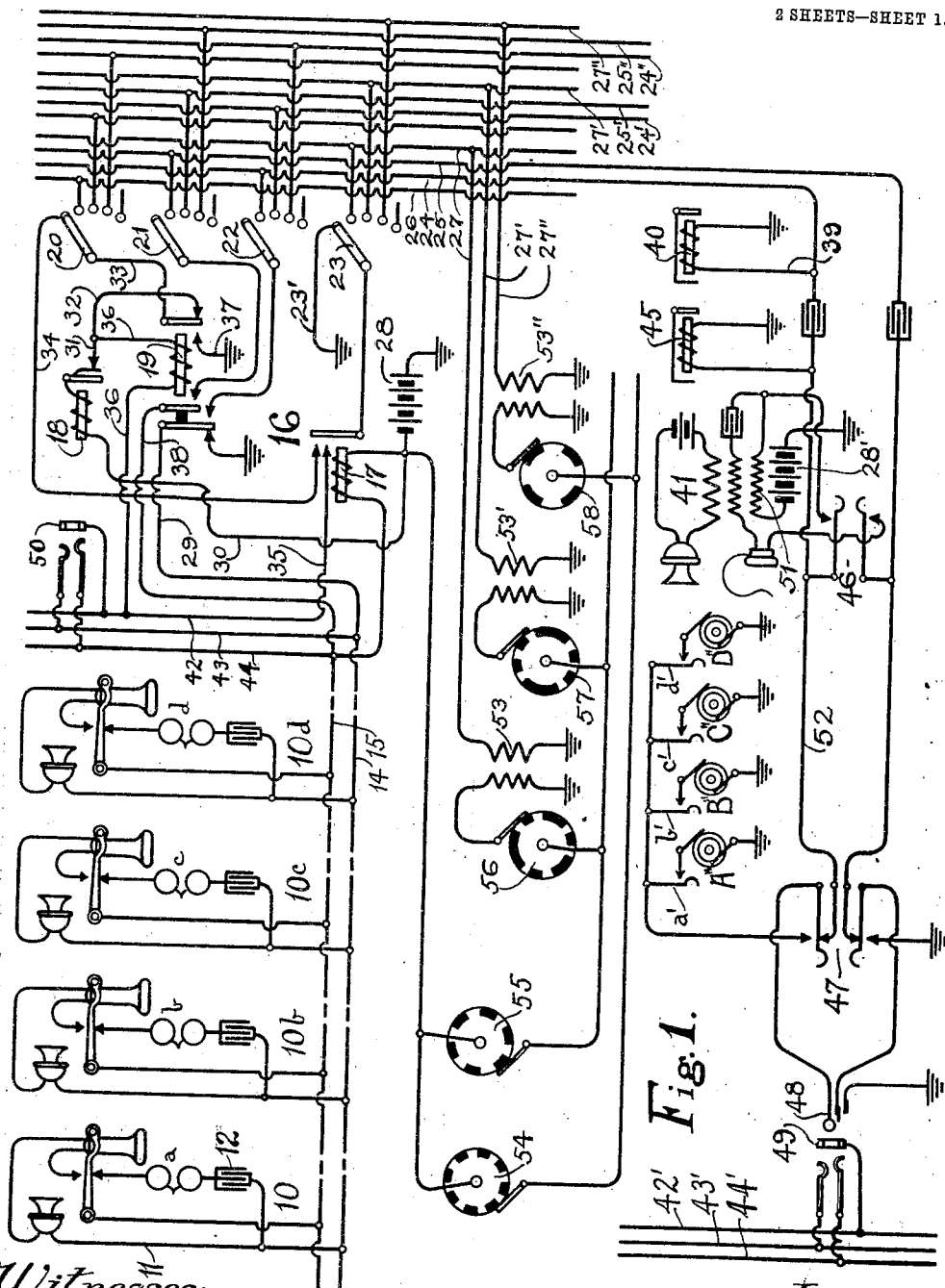


Fig. 1.

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TELEPHONE SYSTEM.
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2 SHEETS—SHEET 2.

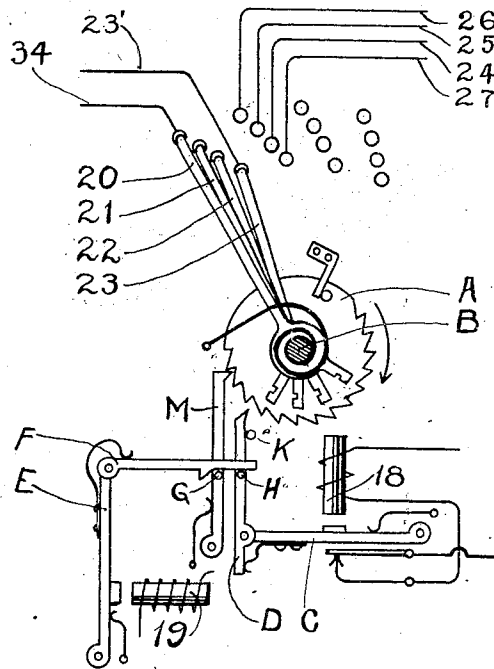


Fig. 2.

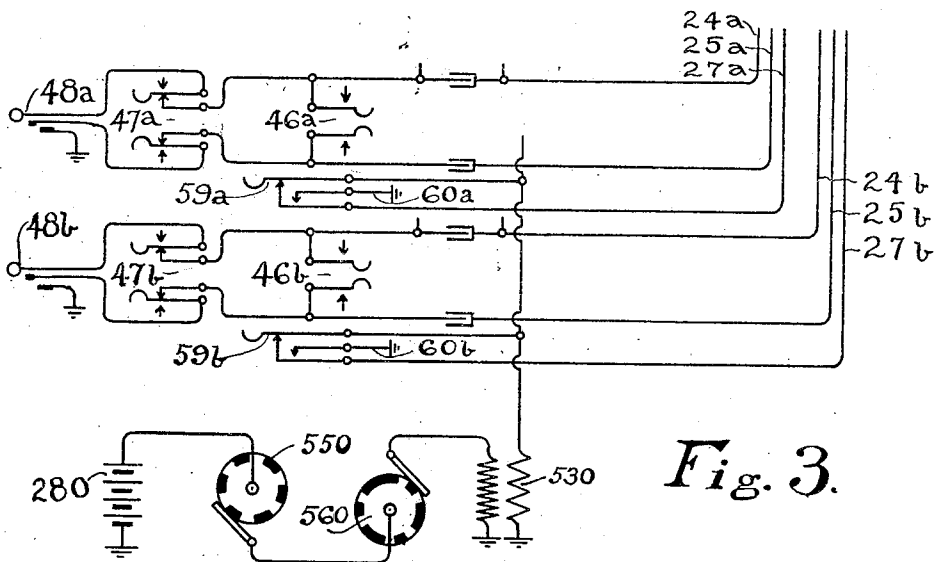


Fig. 3.

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UNITED STATES PATENT OFFICE.

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TELEPHONE SYSTEM.

952,567.

Specification of Letters Patent. Patented Mar. 22, 1910.

Application filed March 7, 1907. Serial No. 361,064.

To all whom it may concern:

Be it known that I, DAVID S. HULFISH, a citizen of the United States of America, residing at Chicago, county of Cook, and State of Illinois, have invented a new and useful Improvement in Telephone Systems, of which the following is a specification.

My invention pertains generally to telephone systems involving the operation of party-lines, but it is particularly applicable to telephone systems of the semi-automatic class wherein an automatic switch is provided for connecting calling lines to operators provided with connecting means for connecting the calling lines further to the desired lines.

My invention provides certain facilities for the operation of party-lines in a system of the class above identified, and has as its object the elimination of a disadvantageous detail in the operation of party lines in any system, but particularly in a semi-automatic system employing automatic Y-switches.

It will be seen that by the automatic action of a switching device in responding to a calling line and connecting that line to an operator, as is the function of an automatic Y-system, the identity of the calling line is not transmitted to the operator serving the line for that call, inasmuch as no provision for such identification has been made in devices heretofore provided for the automatic Y-service. The weakness of such a system becomes evident when a party at a station upon a party-line calls (by directory number only) for another station upon the same party-line; of course the calling line is made to give a busy test by the Y-switch connecting it to the operator, and when the operator endeavors to connect with the same line by her connecting means she finds it testing busy, and so reports to the calling patron; this results in the impossibility of connecting a party-line station for conversation with another station upon its party-line through the usual methods of automatic Y-switching, unless the calling patron advises the operator that the called station is upon the same line with the station originating the call.

I provide means in association with the Y-trunks and Y-switches to place upon the calling line such a distinctive busy-test con-

dition that the operator testing the line will recognize the test received upon the testing plug as being that given to the line by the answering equipment of the plug, thus identifying at once the reverting nature of the call, and enabling the operator to complete the connection properly and with the minimum of annoyance to the calling patron.

This description is accompanied by three figures.

Figure 1 shows the circuits of the central office equipment in an assumed semi-automatic central office whereby these results are attained, and shows details of one type of automatic equipment adapted for the operation of my invention; Fig. 2 shows mechanical details of a switch suitable for the device 16 of Fig. 1; and Fig. 3 shows an elaboration of detail where two or more trunks are given the same distinctive test.

In Fig. 1 is shown a party-line of four stations, having an automatic-Y-equipment labeled as a whole 16. This equipment 16 is taken largely from United States patent to Land, 818,540, April 24, 1906, the device of Land being but slightly modified by the addition of a fourth wiper, 23, in lieu of a direct ground for the armature of the relay 17. It will be noted that in the modification, the wiper 23 always connects the armature of relay 17 to ground, either directly as when in the position shown in the figure, or through a contact, a conductor and an induction coil winding, as from any of the remaining contact points accessible to the wiper 23. The wiper 23 may be made broad enough always to make connection with the next contact point before breaking connection with the preceding one. The modification of the device of Land, as shown in the figure herewith, is not required for direct or single party lines, but only for the multi-party lines entering the switchboard.

The operation of the line in calling will be evident from the following description: At 10 is shown a common battery substation telephone equipment of a well known type in which circuit through conductor 11 is closed for direct current when the hook is up, and circuit through a condenser 12 and a high-resistance ringer *a* is closed when the hook is down. This substation telephone

equipment is connected by conductors 14 and 15 with an automatic central office equipment pertaining individually to that line and indicated as a whole at 16. The line equipment 16 consists of an automatic circuit-selecting switch of any desired mechanical type, the associating operating magnets of said switch, relay armatures and contacts for said operating magnets, and an associated relay 17, not necessarily mechanically a part of said automatic switch. In said automatic switch, 18 is a magnet adapted to propel the moving part of the switch, and 19 is a magnet adapted to release said moving part for restoration to its normal position of rest through action of springs or gravity. 20, 21, 22, 23 are movable contact terminals or wipers attached to the moving part of said automatic switch and adapted to make contact with fixed terminals or waiting contacts, as those shown associated with conductors 26, 25, 24, 27, respectively. In mechanical design, the automatic switch mechanism of the equipment 16 may be of any desired form, a diagrammatic representation of the conditions required for this switch being shown in Fig. 2, in which the designating numerals given are those of Fig. 1, some further parts being designated by letters.

In Fig. 2, B is a shaft supporting insulated wipers 20, 21, 22, 23. A is a ratchet mounted upon the shaft B. C is an armature for magnet 18. D is a pawl pivoted upon armature C. K is a fixed pin guiding pawl D. H is a pin upon pawl D. M is a pivoted detent-pawl. G is a pin upon pawl M. E is an armature for magnet 19. F is a link pivoted upon armature E and having a hook projection to engage pin G, and a straight arm projection to be engaged by pin H.

In operation, successive energizations of magnet 18 will attract armature C successively, and thus cause driving pawl D to propel ratchet A one tooth for each such energization, the ratchet A being held in its determined position by detent-pawl M. Following thus, the energization of magnet 19 will attract its armature E, causing link F to pass forward until its hook projection passes over pin G, the ratchet A being detained by detent-pawl M during the continuance of the energization of the magnet 19. Upon deenergization of magnet 19 and consequent release of armature E and return of that armature by spring tension to its position of rest, link F retires to its normal position of rest, and in so doing its hook projection engages pin G on detent-pawl M and withdraws said detent-pawl from engagement with the ratchet A. Ratchet A therefore is released and therefore may return to its position of rest.

Upon the next energization of magnet 18 and consequent movement of armature C and pawl D, pin H engages link F and lifts it until its hook projection is lifted out of engagement with pin G, thus releasing detent-pawl M to act as previously described.

Referring again to Fig. 1, the step-by-step movement of the wipers 20, 21, 22, 23, causes them to make electrical connection successively with the waiting contacts shown adjacent thereto until connection is made with the waiting contacts of a trunk not already in use, when connecting relay 19 is energized, resulting in the stopping of the motion of the wipers and in the connecting of the line conductors 14 15 to the wipers 21 22. The waiting contacts of the automatic switch in equipment 16 are connected to a plurality of trunks, each trunk being equipped with keys and signals, as shown in the lower portion of Fig. 1, and terminating in a connecting plug, 48. The trunk talking conductors are two in number (indicated as 24 and 25) and they are multiplied through the waiting contacts of a plurality of automatic Y-switches pertaining to lines, the trunk-busy test conductor 26 and auxiliary conductor 27 also are multiplied through waiting contacts of those automatic Y-switches for purposes of busy test. Each trunk thus is accessible from a plurality of automatic switches, and each automatic switch has accessible a plurality of trunk circuits.

The action of the line equipment 16 in selecting a trunk not already in use is as follows: Upon the removal of the receiver from the hook at substation telephone 10, current flows from battery 28, through relay 17 and conductors 15, 11, 14, 29, and to ground, energizing relay 17 and attracting its armature. The energization of relay 17 gives path for current from battery through elements 30, 18, 31, 32, 33, 20, 34, 23, 23' and to ground, energizing actuating relay 18, which propels wiper 20 into connection with waiting test contact of the trunk 24 25; and wipers 21, 22 into connection with conductors 24 25, also wiper 23 into connection with conductor 27. The attraction of the armature of relay 18 has interrupted the circuit last described by breaking the connection between conductors 30 and 31; but this interruption has deenergized relay 18 and upon the release of its armature the previously described circuit is completed again as far as wiper 20. If at this time trunk 24 25 be already in use, a ground will be found upon test conductor 26 and circuit will be completed for battery 28 over conductors 30, 31, 32, 33, 20, 26, and to ground, energizing relay 18 and stepping wipers 20, 21, 22, 23 forward to the next trunk. This cycle of operations will repeat automatic-

ally, so long as wiper 20 finds a ground upon the test conductor of the trunk connected with, but as soon as a trunk is found whose test conductor, as 26, is not grounded, the circuit from the wiper 20 to ground will not exist, and current will flow from battery 28 over conductors 30, 31, 36, 35 and to ground, the conductor 36 including the winding of relay 19. The resistance of relay 18 is low, and the number of turns of the conductor 30 upon relay 18 is comparatively small, while the relay 19 is of high resistance, and the number of turns of conductor 36 upon relay 19 is comparatively large; furthermore, the spring tensions upon the armatures of those relays are capable of relative adjustment. In response to this current through relays 18 and 19 in series, relay 18 is not sufficiently energized to attract its armatures or to break its armature contact, while the relay 19 is energized to operate its armatures. Conductor 33 is removed from conductor 32, and placed in connection with conductor 37, thus placing a ground upon wiper 20 and upon test conductor 23, and thus upon the multiplied test contacts of the trunk 24 25, preventing the connection with that trunk of any telephone line through its equipment, such as 16; and reserving that trunk exclusively for the use of telephone line 14 15 and the substation telephone 10. The armatures of the relay 19 also have connected conductors 29 and 38 to wipers 21 and 22, and therefore to conductors 24 25. Current previously flowing from battery 28 to relay 17 and conductors 15, 11, 14, 29, and to ground, now flows through relay 17, conductors 15, 11, 14, 29, 22, 24, 39, signal 40 and to ground, without such interruption in changing as would affect relay 17. The energization of relays 17 and 19 therefore is continued, and calling visual signal 40 is displayed before the operator using equipment 41, indicating to her that a calling patron has been connected to the trunk served by the signal 40. The circuit conditions now existing and which will remain unchanged throughout the further promotion and continuance of the connection give a current from the battery 28 through the speech transmission devices of the substation 10 in series with the conductors forming windings of relay 17 between one side of the line and the grounded battery and the winding of visual signal 40. The relative resistances and impedances of relay 17 and visual signal 40 shall be such as to maintain proper balance of the line conductors and to supply proper current for speech transmission from the substation 10 without unduly detracting from speech transmission to or from substation 10. Conductors 42, 43, 44 and associ-

ated calling jacks provide for calls in which substation 10 is the called station to the connection. 65

A trunk equipment consists of visual signals 40 and 45, keys 46, 47, and plug 48, located in a switchboard accessible visually and manually to the operator using the equipment 41. 70

The trunk 24 25 from the Y-switch terminals to the plug terminal constitutes one connective device unit, corresponding to the cord pair of a manual switchboard, the calling, connecting or ringing plug being shown at 48 and the answering plug being displaced by the answering equipment constituted by the Y-switches, the action of any Y-switch corresponding electrically to the insertion of an answering plug by an operator. Obviously, it is immaterial in the application of my invention, whether the connective link circuits 24 25 terminate in the fixed or in the movable terminals of the Y-switches serving to connect with calling lines, or whether the answering be by manual means. 85

In response to the display of signal 40, operator at 41 presses key 46, which is adapted to remain in its depressed position until released by the hand of the operator. This places the operator at 41 in telephonic communication with the patron at the telephone 10. She asks for and receives his order. In the execution of the order she tests the jack 49; if the line be idle, the battery 28', which is the same battery as 28, finds its own potential upon the test ring of the jack and no audible signal is heard. The path from the battery to the tip of the testing plug is, battery 28', tertiary induction coil winding 51, key 46, conductor 52, ringing key 47, and to tip of plug 48; the path from the battery to the test ring of any idle jack is battery 28, conductor 30, relay 18, conductor 31, relay 19, conductor 36. The busy test condition of a line is with ground upon the test thimble, and for this reason the body of each connecting plug as 48 is grounded. 100 105 110

When any plug is inserted in a jack, as 50, the action of the automatic Y-equipment 16 is as follows: The insertion of a plug having a grounded body gives a circuit through elements 28, 30, 18, 31, 36, 19, 36, 50 and body of plug to ground; this, by the relation of relays 18 and 19 before described actuates relay 19 but not relay 18; relay 19 connects the talking conductors of the line to wipers 21 22, but these are open, on empty contacts, and relay 19 also takes the ground off of conductor 29 (or 43 or 14) thus permitting the desired station to be rung from the tip of the plug by a generator grounded upon the sleeve side. The plug 48 is shown equipped with key 47; the key 125

47 being in turn associated with keys a' , b' , c' , d' and generators A'' , B'' , C'' , D'' . Station 10 may be rung by inserting plug 48 into jack 50 and operating simultaneously keys 47 and a' ; station 10^b by keys 47 and b' , etc., the generators A , B , C , D being adapted to ring selectively signal bells a , b , c , d , respectively.

Passing to a consideration of disconnection, the two conditions are as follows: If the line were called by plug and jack 50, the removal of the plug would cause the deenergization of relay 19, and all parts are in their normal condition of disuse. If the line were calling, then by hanging the receiver upon the hook at substation 10 current flowing through conductors 11 and 39 is interrupted and the signal (as 40) is released. The breaking of circuit for direct current through substation 10 has deenergized relay 17 and by release of the armature of that relay has interrupted the current through relay 19, by the deenergization of which the mechanisms associated with its armature have effected the restoration of switch 16 as a whole to its position of rest. Upon the release of the signals 40 and 45, the operator will remove the plug from the jack. The action of the equipment when the tested line is not busy thus is understood. The nature of the audible busy test now will be studied.

When a line is busy by reason of a plug with grounded body being in one of its jacks, the audible test is a simple click from the tertiary 51 of the induction coil due to current from the battery 28' to the direct ground of the plug body. When the line is a single-party line, and the mechanism of the Y-device 16 is simplified by the omission of the wiper 23, and the substitution therefor of a direct ground upon the armature of the relay 17, as shown in Land, cited, then the test is similar, the path from the test thimble of the jack being through conductor 35 and contact of energized relay 17 to the ground upon the armature of relay 17. If, however, the line tested be a party line and it has called through a trunk equipped per my invention with distinctive audible-test device, as the trunk 24 25, then the test from jack 50 will be through conductor 35, contact and armature of relay 17, wiper 23, conductor 27 and induction coil winding 53 to ground, and the busy test will consist of the combination of the click from battery 28' and also any audible sound current generated in the winding 53. If the line 14 15 call through the trunk 24' 25', then the induction coil winding 53' is connected to the jack 50; if the line 14 15 call through the trunk 24'' 25'', then the induction coil winding 53'' is connected to the jack 50. Signal producing means for the

windings 53, 53', 53'', etc., are shown in the primary commutators 54 and 55, which produce audible tone currents of distinctly different pitches, and secondary commutators 56, 57, 58 which permit the passage of distinctive periods or groups of periods of the tone currents from 54 and 55. Thus, with 56, 57, 58 revolving uniformly as upon the same shaft, any line calling through trunk 24 25 would give from its jacks a test consisting of double tone pulsations continuously repeated; for trunk 24' 25' the pulsations would be triple; for trunk 24'' 25'' the pulsations would be single, and would be heard at a different frequency as well as at a different pitch. Other combinations may be worked out.

Assume now that station 10 calls, takes trunk 24 25 and asks the operator at 41 for station 10^a; the operator touches the body of jack 50 with plug 48, hears a tone test, holds the plug on the jack long enough to identify the test as being distinctive of the trunk associated with the plug 48; she knows thus that the party is calling for his own line and she plugs in over the test and rings the station desired; if necessary to ask the station calling to hang up the receiver to permit the ringing of the station called, the presence of the plug 48 in the jack 50 will hold the relay 19 energized, holding the wiper 20 on conductor 26, thus holding the busy test on the trunk 24 25 and preventing some other calling line from interfering with the proper operation of the connection.

The variations in distinctive tests required need not be carried to ridiculous nor prohibitive numbers. It is the plan of automatic Y-systems to divide the lines into groups of 100 to 1000 lines each and to provide for each line group a group of trunks. In any exchange, the party lines may be limited to a small proportion of such groups and those groups having no party lines need have no tone test. Further, where multi-party lines and single-party lines have access to the same trunks, the single-party lines may have the wiper 23 disconnected and the armature of relay 17 grounded, thus causing the tone test to be less frequently met, and reducing the confusion resulting from using the same tone test for a plurality of trunks. Further, the tone tests may be (and preferably so) identifiable only one tone test per operator, all of her trunks having the same identification tone test, instead of a different test for each trunk as shown in Fig. 1. This modification of my system is shown in Fig. 3. In Fig. 3, the two trunk plugs 48^a and 48^b are used by the same operator and the trunks of that operator are all supplied over conductors 27^a, 27^b, etc., with tone test through coil 530 from the commutator combination 550 560, that commutator

combination being distinctive for this operator, and she need consider no other identification test. When the operator encounters and recognizes her own tone-upon the plug 48^a in testing, she knows only that she is testing a line which has been answered by some one of her trunks, although not necessarily by trunk 24^a 25^a associated with plug 48^a. She then depresses the key 59^a associated with plug 48^a and tests again. The key 59^a removes conductor 27^a from the induction coil winding 530 and places it upon conductor 60^a directly to ground, thus taking the tone from the jacks of the line calling over trunk 24^a 25^a, and if upon second test the operator finds her tone gone from the jack of the line tested, the calling line and the called line are identified positively as being the same, and the operator completes the connection accordingly.

I may cite the modification of Fig. 3 as being the preferred form of my invention, inasmuch as it is the form of reduction to practice whereby the maximum convenience in result is attained with the greatest simplicity in design and operation.

It is stated frankly herein that the Y-device of Fig. 1, shown at 16, is taken from the prior art. In this connection I wish to state that the device of Land was not selected for any specific reasons of adaptability to my invention. Any of the many Y-devices known to the art may be modified to conform to the requirements of my invention. This statement is made broadly, and applies equally to Y-devices where the Y-device is individual to the line, as in Land, cited, and to Y-systems where the Y-device is individual to the trunk, as disclosed in British patent to Dunbar, 11,290 of 1905.

Having thus described my invention, what I claim as new and desire to secure by United States Letters Patent is:

1. In a telephone system, lines, switching devices for interconnecting said lines, and tone test devices connected normally with the answering equipment of said switching devices whereby the test received from a tested line through the connecting terminal of a switching device may disclose to some degree the identity of the switching device then associated through answering equipment with the tested line.

2. In a telephone system, lines, connective link circuits for interconnecting said lines, discriminative test devices connected normally with the answering elements of said connective link circuits, and means whereby the test received from a tested busy line may disclose to some degree the identity of the connective link circuit then associated through its answering elements with the tested line.

3. In a telephone system, lines, connective link circuits for interconnecting said lines, said link circuits being divided into groups, test devices associated with the answering equipment of each group of said connective link circuits, and means whereby the test received from a tested line through the test conductor of the tested line and from the answering terminals of a connective link circuit may disclose the identity of the group of connective link circuits comprising the connective link circuit then serving that line.

4. In a telephone system, lines, connective link circuits for interconnecting said lines, said link circuits being divided into groups, and tone test devices associated with the answering equipment of each group of connective link circuits whereby the test received from a tested line connected through said answering terminals may disclose the identity of the group of connective link circuits associated with the tested line through answering terminals.

5. In a telephone system, lines, connective link circuits for interconnecting said lines, said link circuits being divided into groups, a plurality of distinctive audible-tone-current-producing devices, one of said audible-tone-current-producing devices being associated with the answering terminals of each group of said connective devices, and means for connecting the distinctive tone of the link-circuit group to the test conductors of all lines connected with the answering terminals of link circuits of the group, whereby the test received from a tested line may disclose the identity of the group comprising the link circuit then serving that line through answering terminals, substantially as described.

6. In a telephone system, lines, connective link circuits for interconnecting said lines, said link circuits being divided into groups, a plurality of distinctive-audible-tone-current-producing devices, one of said audible-tone-current-producing devices being associated with the answering terminals of each group of said connective link circuits, means for connecting the distinctive tone of the link-circuit group to the test conductors of all lines connected with the answering terminals of link circuits of the group, whereby the test of a busy line connected through such answering terminals may reveal the identity of the link-circuit group, and further means for varying the audible quality of the test from any selected trunk.

7. In a telephone system, lines, connective link circuits for interconnecting said lines, said link circuits being divided into groups, a plurality of distinctive-audible-tone-current-producing devices, one of said audible tone-current-producing devices being associated with the answering terminals of each

group of said connective link circuits, switching devices associated with the talking conductors of said lines and link circuits and adapted to carry currents for producing the distinctive tone of the link-circuit group to the test conductors of all lines connected with the answering terminals of link-circuits of the group whereby the test of a line so connected may reveal the identity of the link-circuit group, and further means for determining in the link-circuit group the identity of the link circuit connected through answering terminals with the tested lines.

8. In a telephone system, lines, connective link circuits for interconnecting said lines, said link circuits being divided into groups, test devices associated with the answering equipment of each group of said connective link circuits, means whereby the test received from a tested line through the connective terminal of a link circuit may disclose the identity of the group of connective link circuits associated through answering equipment with the tested line, and further means whereby the particular connective link circuit of the disclosed group may be identified.

9. In a telephone system, lines, connective link circuits for interconnecting said lines, said link circuits being divided into groups, a device giving distinctive audible tone test for the answering terminals of each group of said connective link circuits whereby the tone test received from a tested line may disclose the identity of the group of connective link circuits associated with the tested line through answering terminals, and further means whereby the identity in the disclosed group of the individual connective link circuit connected through answering terminals with the tested line may be determined.

10. In a telephone system, lines, connective link circuits for interconnecting said lines, said link circuits being divided into groups, a device associating a distinctive busy test with the answering terminals of each group of said connective link circuits and through the answering terminals of the link circuit being associated also with the test conductor and test terminals of any line connected with the answering terminals of a connective link circuit, whereby the test received from a tested line through the test conductor of the line may disclose the identity of the group of connective link circuits associated through answering equipment with the tested line, and further means for changing the observable nature of the test of any link circuit of a group whereby the particular link circuit of the group may be identified.

11. In a telephone system, lines, trunks, automatic Y-switches connecting trunks and calling lines, each of said lines having talking conductors and a test conductor, each of

said trunks having talking conductors and an auxiliary conductor, a source of distinctive test currents, said source being connected to the auxiliary conductors of a group of said trunks, and said Y-switches having switching terminals whereby when the talking conductors of any line and trunk are connected through a Y-switch the test conductor of the line and the auxiliary conductor of the trunk are connected together also.

12. In a telephone system, lines, trunks, automatic Y-switches connecting trunks and calling lines, each of said lines having talking conductors and a test conductor, each of said trunks having talking conductors and an auxiliary conductor, a plurality of sources of distinctive tone currents, said sources being connected to the auxiliary conductors of groups, respectively, of said trunks, and said Y-switches being adapted to connect the test conductor of a line and the auxiliary conductor of a trunk when the talking conductors of the line and the trunk are connected through the Y-switches.

13. In a telephone system, lines, trunks, automatic Y-switches connecting trunks and calling lines, each of said lines having talking conductors and a test conductor, each of said trunks having talking conductors and an auxiliary conductor, a source of distinctive tone-test currents, said source being connected to the auxiliary conductors of a group of said trunks, and means in said Y-switches for superimposing the tone test of the auxiliary conductor of a trunk upon the normal busy test of the test conductor of a line when the talking conductors of any line and trunk are connected through a Y-switch.

14. In a telephone system, lines, trunks, said lines having talking and test conductors, and said trunks having talking and auxiliary conductors, a source of distinctive tone-test currents, said source being connected to the auxiliary conductors of said trunks, and Y-switches adapted to connect a trunk to a calling line, the Y-switch being adapted to connect at the same time the talking conductors of the trunk and line and the auxiliary conductor of the trunk to the test conductor of the line whereby the tone is superimposed upon the normal test condition of the line, and means associated with each trunk for removing the tone test from the auxiliary conductor of that trunk and thus from the test conductor of the answered line.

15. In a telephone system, lines, each having talking conductors and a test conductor; trunks, each having talking conductors and an auxiliary conductor, said trunks being divided into groups; a source of tone-test currents, said source being connected to the

auxiliary conductors of a group of said trunks; Y-switches adapted to connect a trunk with a calling line by connecting the talking conductors of the trunk to the talking conductors of the line and the auxiliary conductor of the trunk to the test conductor of the line, and manual means associated with each trunk for removing the tone from the auxiliary conductor of that trunk, substantially as described.

16. In a telephone system, lines, each having talking conductors and a test conductor; trunks, each having talking conductors and an auxiliary conductor, said trunks being divided into groups; a source of tone-test currents, said source being connected to the auxiliary conductors of a group of said trunks, through manually operated switches individual to each of the trunks of the group; means associated with the manually operated switches of the trunk equipment whereby by the operation of the manually operated switch associated with the auxiliary conductor of the trunk the nature of the audible test upon the auxiliary conductor of the trunk may be modified; and Y-switches connecting trunks to calling lines, the Y-switches being adapted to connect the talking conductors of the trunk to the talking conductors of the line and the auxiliary conductor of the trunk to the test conductor of the line.

17. In a telephone system, lines, trunks, test current devices giving identification test conditions for groups of said trunks, and Y-switches connecting trunks and calling lines and impressing upon the test conductor of a connected line the identification test peculiar to the group of trunks containing the trunk connected to the line.

18. In a telephone system, lines, trunks, test current devices giving audible-tone identification tests for groups of said trunks, and Y-switches connecting trunks and calling lines and impressing upon the test conductor of a connected line the audible tone identification test of the group to which the connected trunk belongs.

19. In a telephone system, lines, trunks, test current devices giving audible-tone identification tests for groups of trunks, Y-switches connecting trunks and calling lines and impressing upon the test conductor of a connected line the audible tone identification test of the trunk group to which the connected trunk belongs, and means individual to each trunk for removing from the trunk its identification test.

20. In a telephone system, lines, trunks, test current devices giving identification tests for groups of said trunks consisting of distinguishably different audible-tone currents upon conductors pertaining to the trunks, Y-switches connecting trunks and

calling lines and impressing upon the test conductor of a connected line the audible tone identification test of the trunk group to which the connected trunk belongs, and a manually operated key individual to each trunk for removing from the trunk its identification test.

21. In a telephone system, lines, plugs adapted to connect with said lines and carrying a busy test potential to the test conductor of the line connected with, Y-switches adapted to connect with said lines and carrying a busy test potential to the test conductor of the line connected with, and a tone test device superimposing a tone test upon the test given to a line by the connection through a Y-switch.

22. In a telephone system, lines, plugs adapted to connect with said lines and carrying a busy test potential to the test conductor of the line connected with, and Y-switches adapted to connect with said lines and carrying a busy test potential to the test conductor of the line connected with, said plugs and said Y-switches giving audibly different tests.

23. In a telephone system, lines, connective links, test plugs, and answering-terminal identification test devices whereby the answering terminal of a connective link connected with a line may be identified to some degree by tests by any testing plug at any calling terminal of the line.

24. In a telephone system, lines, switching links, test plugs, and an audible-signal answering-terminal identification test device whereby the answering terminal of a switching link connected with a line may be identified to some degree by tests by any testing plug at any terminal of the connected line.

25. In a telephone system, lines, switching devices for interconnecting said lines, said switching devices being arranged in groups, tone test devices associated with the answering terminals of said switching devices and superimposing a tone test upon the normal test of a busy line when the line is connected through the answering terminal of a switching device, said tone test varying distinguishably with different groups of switching devices, whereby the group of the connecting switching device may be identified by tests from any terminal of the line.

26. In a telephone system, a connective device; a busy-test device normally associated with said connective device whereby the testing member of said connective device may receive from the answering member of said connective device a predetermined test audible to the telephone operator; and a test-changing key separate from the listening key for changing the test when thus audible to the operator.

27. In a telephone system, a connective de-

vice; a busy-test device normally associated with said connective device whereby the testing member of said connective device may receive from the answering member of said
5 connective device a combined-click-and-tone test audible to the telephone operator; and means for removing the tone from the test when thus audible to the operator.

Signed by me at Chicago, county of Cook, and State of Illinois, in the presence of two 10 witnesses.

DAVID S. HULFISH.

Witnesses:

J. M. MUNISTON,
HARRIET L. SMITH.