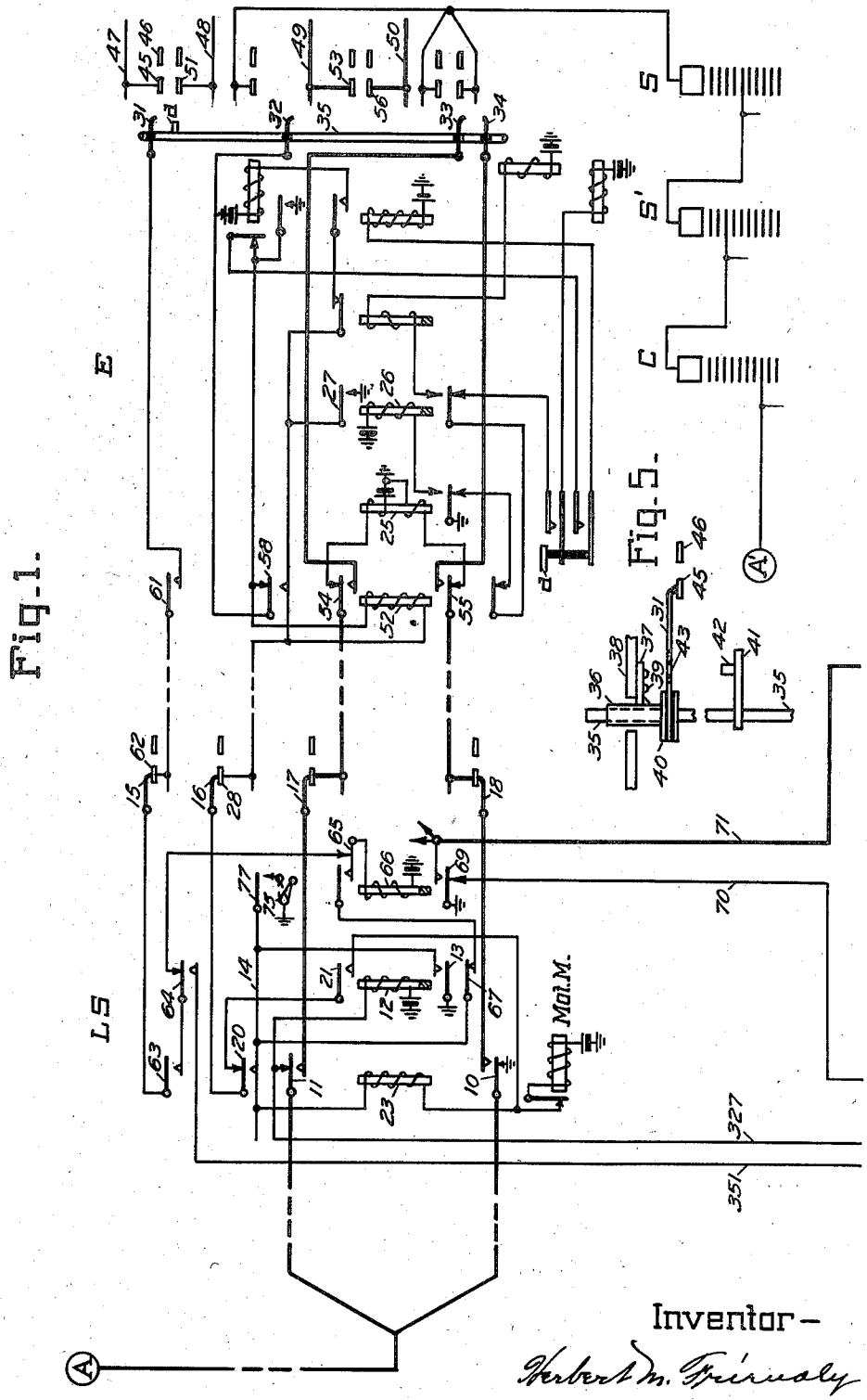
April 27, 1937. H. M. FRIENDLY 2,078,842

AUTOMATIC TELEPHONE SYSTEM

Filed Dec. 29, 1930 4 Sheets-Sheet 1



Inventor—

Herbert M. Friendly

April 27, 1937. H. M. FRIENDLY 2,078,842

AUTOMATIC TELEPHONE SYSTEM

Filed Dec. 29, 1930 4 Sheets-Sheet 2

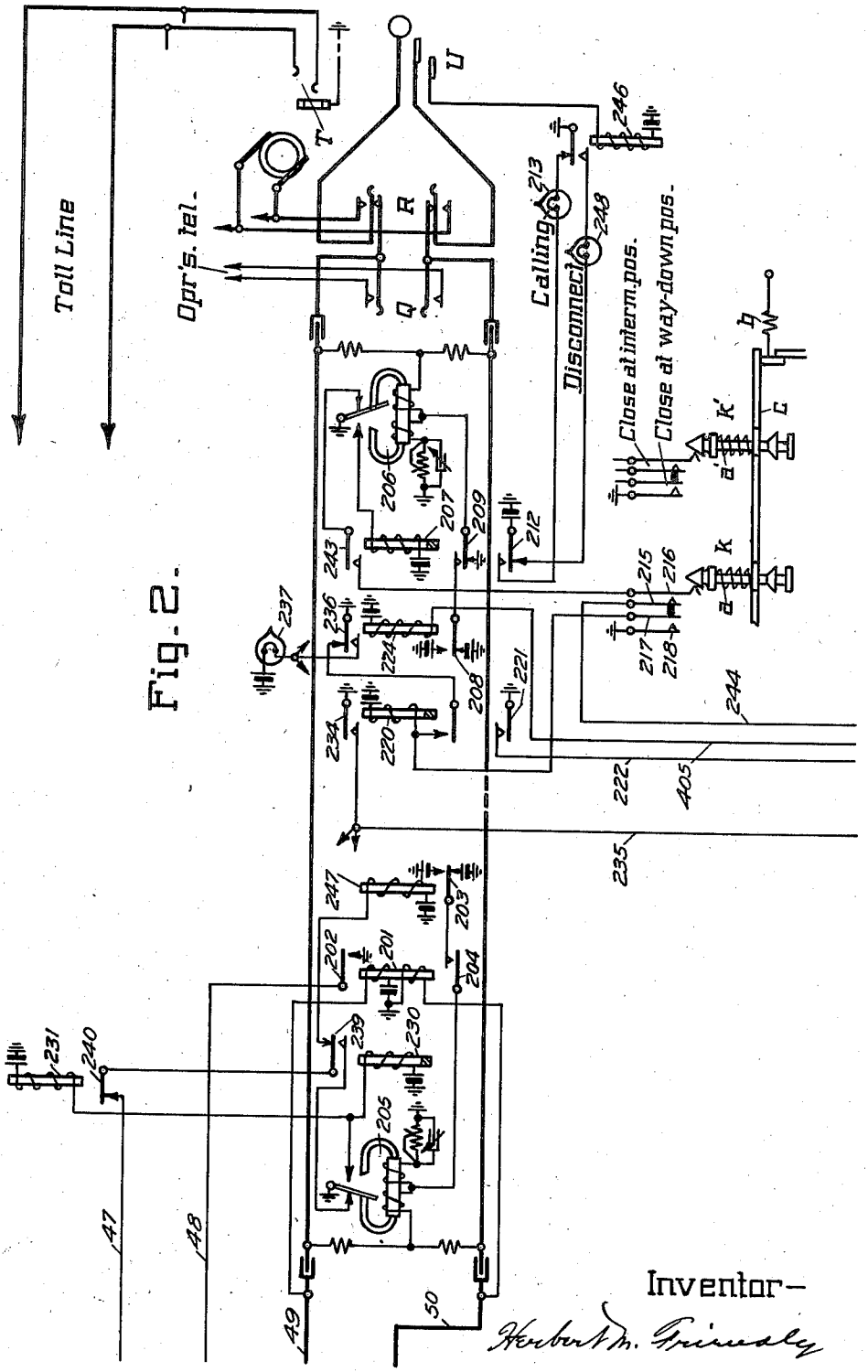


Fig. 2.

Inventor—

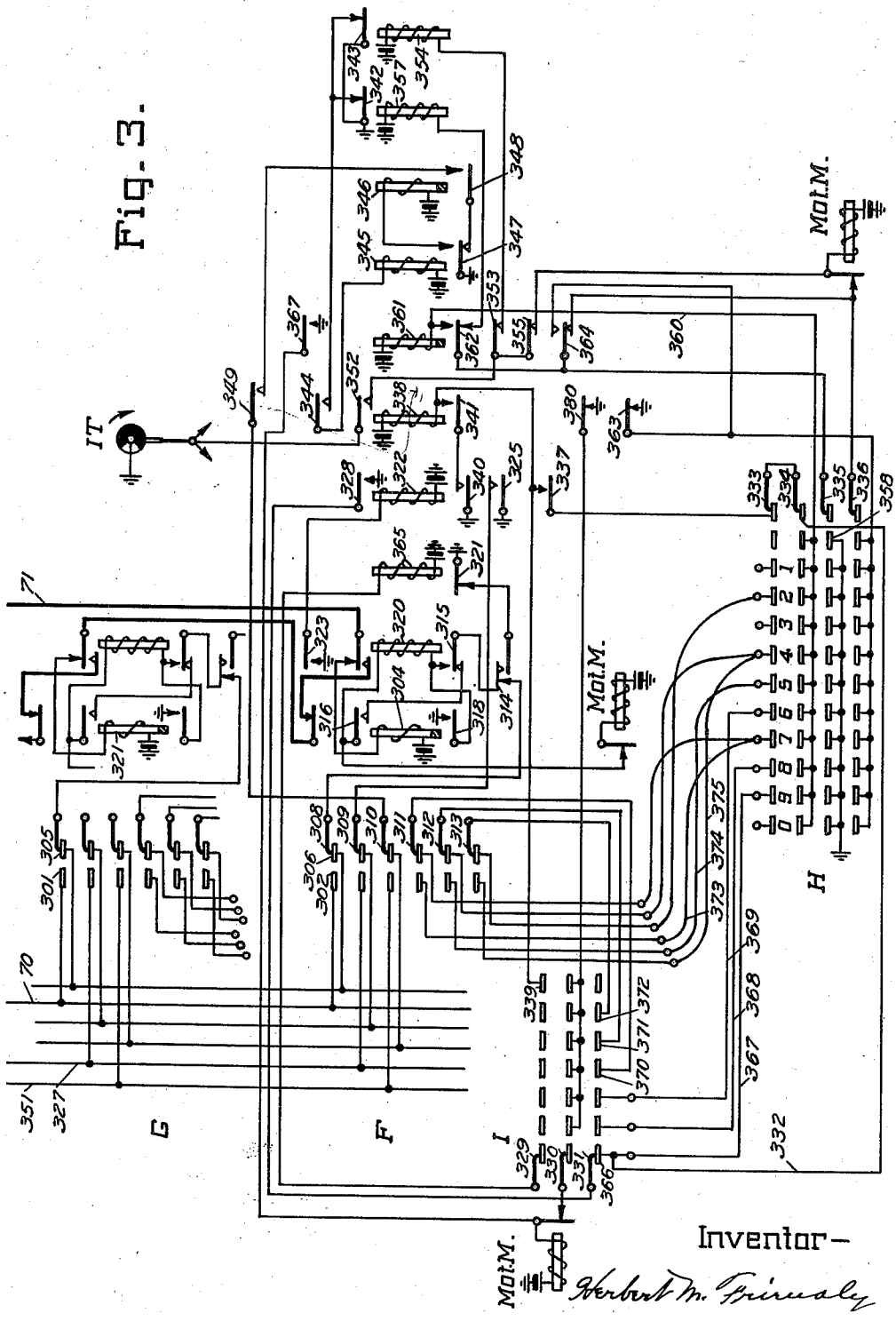
Herbert M. Friendly

April 27, 1937. H. M. FRIENDLY 2,078,842

AUTOMATIC TELEPHONE SYSTEM

Filed Dec. 29, 1930 4 Sheets-Sheet 3

Fig. 3.



Inventor—

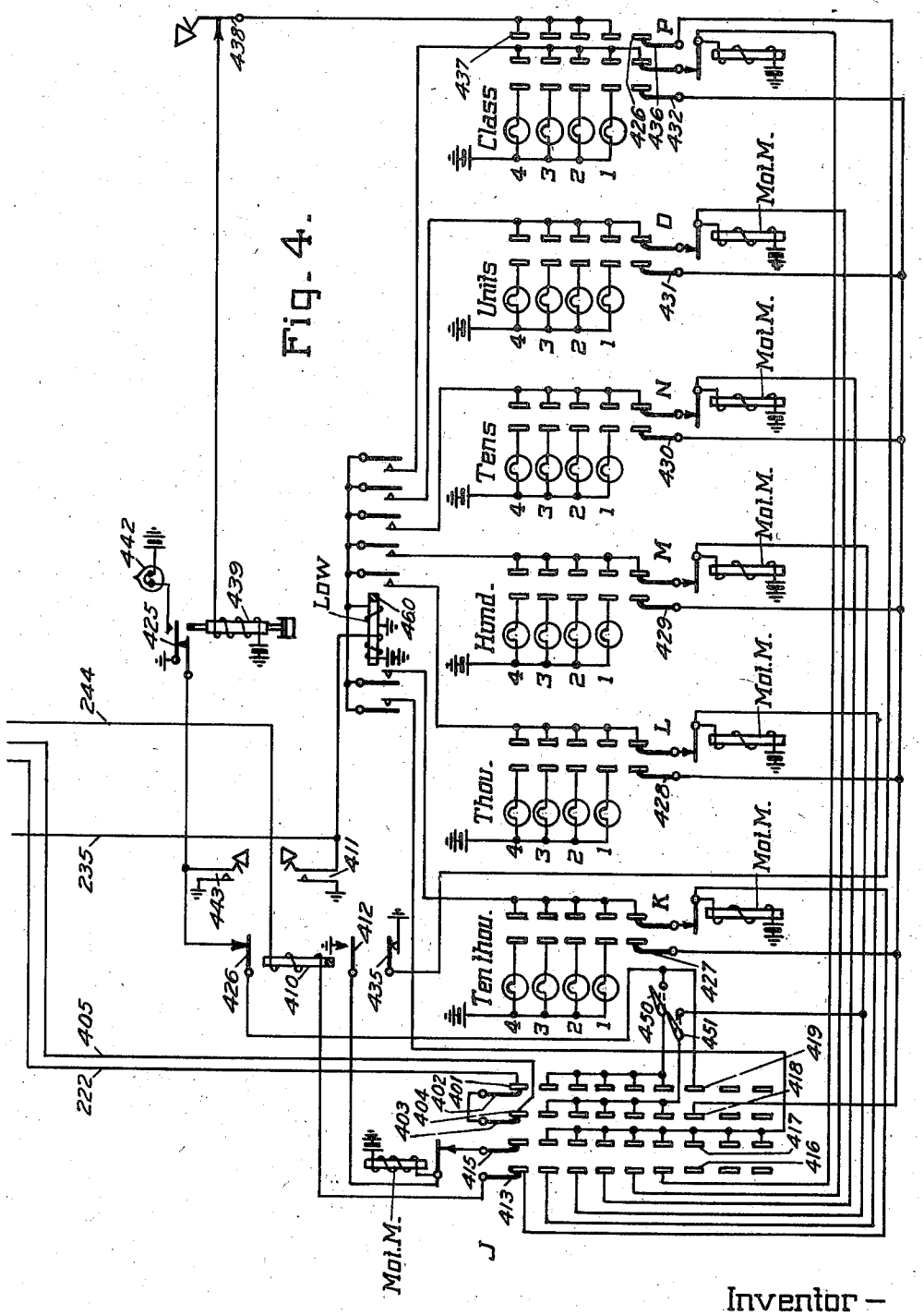
Herbert M. Friendly

April 27, 1937. H. M. FRIENDLY 2,078,842

AUTOMATIC TELEPHONE SYSTEM

Filed Dec. 29, 1930 4 Sheets-Sheet 4

Fig. 4.



Inventor—

Herbert M. Friendly

Patented Apr. 27, 1937 2,078,842

UNITED STATES PATENT OFFICE

2,078,842

AUTOMATIC TELEPHONE SYSTEM

Herbert M. Friendly, Chicago, Ill.; Milton S. Friendly and Central Republic Trust Company, executors of said Herbert M. Friendly, deceased, assignors, by mesne assignments, to Milton S. Friendly, Chicago, Ill., Oscar N. Friendly, Salt Lake City, Utah, and City National Bank and Trust Company, Chicago, Ill., as trustees

Application December 29, 1930, Serial No. 505,292

49 Claims. (Cl. 179—27)

Objects

An object of the present invention is to provide means whereby a calling subscriber in an automatic telephone exchange may initiate a call by removing his receiver and thereby cause the line switch individual to his line to operate and select an idle first selector, and thereafter operate the first selector by means of an automatic calling dial on his telephone to select a long distance operator's receiving trunk which terminates in a B operator's switching plug (U). A calling lamp 213 individual to the said plug will thereupon glow to indicate the call. The operator may then manipulate a listening key (Q) individual to the trunk and answer the call.

In accordance with the present invention, and the arrangements for carrying it into effect, the operator may, in order to identify the particular line calling, depress a key (*k*), contiguous to the said plug (U), and thereupon cause a finder switch (as F) at the originating end to operate and pick out the calling line, and by reason of the position assumed by the finder switch when it finds the calling line, set-up a stored condition in an impulse sender companion to finder switch (F) which will cause a train of impulse series to be sent over the trunk effective to a common call indicator lamp arrangement (shown in Fig. 4) at the operator's position that will, by means of glowing lamps, identify the number of the calling line. Moreover, a final series will be annexed to the telephone number train to apprise the operator, by glowing a specific lamp, of any one of a plurality of particular conditions attaching to the calling line. For example, that the particular line should not have charge service, or that some particular person must authenticate the request for toll service, as well as the kind of telephone line, perhaps.

The present invention then looks to an arrangement for enabling a random calling line to be specifically identified to a called operator, at the will of the operator, so that the operator will be assured that the calling party has not deceived her when placing the call, while at the same time informing the operator as to any special condition of the calling line. This arrangement therefore obviates the operator directively calling back to the calling line over a newly linked train of switches to assure herself that the calling party properly identified his line to her.

Drawings

With reference to the accompanying four sheets of drawings:—

Fig. 1 shows an automatic telephone A leading to a line switch LS, wherein the line switch has common access to a first selector E. The first selector E has common access to long distance receiving trunks and also to well known second selectors S.

Fig. 2 shows a long distance receiving trunk terminating in a B operator's switching plug U.

Fig. 3 shows apparatus cooperative with the line switch LS in Fig. 1 and is used for sending identifying impulses corresponding to the calling line.

Fig. 4 shows apparatus cooperative with the circuits associated with the operator's switching plug U and is for receiving the identification impulses sent from the apparatus shown in Fig. 3.

Fig. 5 shows details of the "0" level individual wiper 31.

Equipment

The telephone A is of the well known automatic type.

The line switch LS is of the well known so-called rotary general class, modified in accordance with the present invention.

The first selector E if of the well known general class sometimes called a Powell selector, modified in accordance with the present invention; this modification concerning only the upper-most wiper 31 (and associated circuits thereof), which wiper is not rigidly fixed to the shaft carrying the three lower wipers. This uppermost wiper 31 sweeps only its cooperating, aligned bank terminals when the shaft is raised so that the three lower wipers align with the "0" (tenth) level, which is the upper-most level.

The switch elements F and G in Fig. 3 are mechanically of the finder-switch general class, having only the advance rotary movement well known in so-called rotary switches, modified in accordance with the present invention.

The switch elements H and I of the impulse sending device individual to finder-switch F are mechanically of the same general class as elements F and G, but modified in accordance with the present invention.

The switch elements J to P in Fig. 4 are mechanically of the same general class as elements F and G, but modified in accordance with the present invention. These switches J to P each have a "home" position to which its set of wipers return when not in use, while the switch elements F and G do not have a "home" position.

Operation

The following descriptions of assumed call op-

erations will serve to make the operation of the system understood.

When the calling party at telephone A removes his receiver a circuit will be closed from ground, springs 10, 11 and winding of slow-releasing relay 12, the latter said relay actuating. Spring 13 will apply ground to the release trunk 14. If the private wiper 16 of the group 15 to 18 is resting upon a busy-grounded bank terminal this will cause this busy-ground to be applied through springs 20 and 21 to the winding of the motor magnet, incidentally short-circuiting the switching relay 23. This will cause the motor magnet to operatively energize to interrupt its energizing circuit and thereby cause the wipers 15 to 18 to successively step-advance until the wiper 16 fails to receive busy-ground, whereupon the winding of relay 23 becomes in a series path with the winding of the motor magnet, to the release trunk, the relay 23 operating, while the motor magnet, due to its marginal adjustment, remains inert. If it is assumed that the bank terminal upon which the wiper 16 is shown resting is the one upon which it is resting when the stated actuation of relay 23 takes place, the calling line will thereupon become in series with the windings of the line relay 25 in first selector E, the latter said relay actuating. Slow-releasing release relay 26 will be operatively energized in a local circuit of line relay 25. Ground is applied through spring 27, bank terminal 28, wiper 16, spring 20 to conductor 14. The relay 12, although deenergized by the attraction of spring 11, sustains to maintain the ground to the release trunk 14 from the spring 13 until the spring 27 has had time to attract and apply ground to the release trunk 14 from ahead.

The last described operations took place responsive to the calling party removing his receiver. Let it be assumed that the digit 0 (consisting of ten open impulses) is now sent from the calling dial of the automatic telephone A to call the long distance operator. Responsive to the said operation of the dial, the selector E will operate in the well known manner and align its wipers 32, 33 and 34 with the "0" (tenth) level of bank terminals.

Special "0" level wiper

The wiper 31 is permanently aligned with the "0" level, and therefore is not carried fixedly on the shaft 35, with the wipers 32, 33, and 34. Wiper 31 is carried revolvably in an insulated groove on a fixed sleeve 36, the latter having a bracket 37 for securing it to the fixed frame member 38 by means of the screws 39. The wiper 31 revolves between the insulated shoulders 40 on the sleeve 36, and is therefore insulated from the sleeve. That is, the wiper 31 is free to revolve concentric with the shaft 35, carried by the sleeve 36. The shaft 35 passes through a longitudinal, concentric bore in the sleeve, which does not affect the movement of the shaft, as the bore through the sleeve is large enough in diameter to permit the shaft to move. That is, the sleeve may serve as a steadying bearing for the shaft, or the shaft may pass through the sleeve freely.

The shaft 35 carries an arm 41 rigidly attached to it. This arm carries a finger-pin 42 which registers with a hole 43 (extending through the wiper 31) when the shaft is at normal or is stepping up vertically. The finger-pin 42 moves out of registry with the hole 43 when the wipers 32 to 34 rotate-in at levels below the "0" level. It is thus clear that although the wiper 31 normally rests in the position indicated in the drawings, only when the shaft 35 is raised to the "0" level position will the finger-pin 42 cooperate with the hole 43, and under which condition when the shaft 35 there rotates-in and the private wiper 32 tests the long distance trunks of the "0" level, the wiper 31 will be correspondingly moved over its cooperating bank terminals as 45 and 46. Then, when the shaft 35 restores, the wiper 31 will be carried back to its normal position shown in the drawings, and the shaft will fall vertically to its normal position, leaving the wiper 31 in the normal position shown in the drawings. It will thus be noted that the arm 41 must raise ten levels in order to have the finger-pin 42 cooperate with the hole 43 in the wiper 31. The object of the special arrangement whereby the wiper 31 only moves when the wipers 32 to 34 operate with respect to the "0" level is to obviate employing dummy bank terminals cooperative with the wiper 31 at levels 1 to 9, or by leaving dead space aligned with wiper 31 at each level.

Further operation—Calling the long distance operator

Going back to the condition ensuing responsive to the calling party initiating a call by removing his receiver, wherein relays 25 and 26 actuated, it will now be assumed that the calling party desires to place a long distance call, and accordingly dials digit 0. The selector E will operate in the well known manner of so-called Powell selectors and align wipers 32 to 34 with the "0" level and there rotate-in and select the first idle trunk 47 to 50 of the 0 level, having in mind that the wiper 31 of the present invention will rest upon a bank terminal 47 companion to the bank terminal 51 upon which the private wiper 32 will be resting.

When the switching relay 52 actuates in effecting the seizure of the trunk 47 to 50, a circuit can be traced from grounded battery, upper winding of relay 201, conductor 49, bank terminal 53, wiper 33, spring 54, wiper 17, spring 11, telephone A, spring 10, wiper 18, spring 55, wiper 34, bank terminal 56, conductor 50, lower winding of relay 201 to ground, the relay 201 actuating. Spring 202 now applies ground over conductor 48, bank terminal 51, wiper 32, spring 58, bank terminal 28, wiper 16, spring 20 to conductor 14. The said ground is applied through spring 202 back to conductor 14 before the spring 27 has had time to retract, so that there is no lapse of ground on the release trunk including conductor 14.

Positive battery is now applied from ground through springs 203 and 204 to the center point of the winding of the polarized relay 205 of the duplex circuit organization, effective to move the grounded armature of polarized relay 206 to the left, operatively energizing the slow-releasing relay 207. Negative battery is now being applied from ground through springs 208 and 209 to the center point of the winding of polarized relay 206, in lieu of ground through the resting contact of spring 209 as normally exists. This will be to no operative effect upon relay 205. That is, changing the ground to negative battery applied to the center point of the winding of relay 206 will be to no operative effect to relay 205 beyond more strongly attaching its armature to the left.

Calling lamp

The attracted condition of spring 212 causes the calling lamp 213 to glow. The operator upon noting the glowing of the lamp 213 will respond to the call by manipulating the listening key Q,

individual to the trunk, thereby connecting her telephone to the heavy conductors leading back to the calling telephone, whereupon she may orally communicate with the calling party.

Verifying calling line

However, it is assumed that before the operator extends the call through the agency of the trunk plug U to a desired one of a plurality of toll lines through its individual jack T, she desires to verify and positively identify the calling line, although the calling party may have orally informed her. This verifying the operator may do, as will appear, without the calling party being aware of the verification, and without delaying the completion of the call. It is accomplished by control back over the trunk line involved in the extension of the call to the operator's plug.

The operator has keys *k* and *k'*, one key individual to each of the plurality of trunks, for the purpose of initiating the verification of the calling line. This verification may take place before the call is extended to a toll or other line jack as T by the plug U, or it may take place at any time before the calling party abandons the call.

The keys *k* and *k'* have a way-down position and an intermediate position, and a normal position as shown in the drawings. When key *k* is operated to the way-down position the corresponding springs 215—216 make first, at the intermediate position, and then the springs 217—218 also make at the way-down position. When the operator removes the depressing pressure the key will return by compression spring action (springs *a* and *a'*) to the intermediate position, where it will lock by the well known shift-plate action in which coil spring *b* shifts the shift-plate *c* to the locking position. The springs 215—216 will be in engagement, and the springs 217—218 will be disengaged under the last stated condition. In case another key *k'* is depressed the first movement will cause the shift-plate *c* to unlock the key *k*, before held locked so that the shift-plate is free to lock the last key *k'* when the last said key moves to the intermediate position, in the manner as before described. Shift-plate key locking and unlocking mechanisms as referred to are well known.

Thus, to verify the calling line, the operator will depress the key *k* of the trunk corresponding to the particular plug U concerned to the way-down position, and then release it, whereupon it will retract to the intermediate, locked position. The springs 215—216 will engage and remain so. The springs 217—218 will be engaged only while the key is in the way-down position.

When the springs 217—218 engage, ground on spring 218 is applied to energize the slow-releasing relay 220. Grounded spring 221 applies its ground over conductor 222, bank terminal 401, wipers 402—403 in the home position, bank terminal 404, conductor 405 to the winding of relay 224, the latter said relay actuating.

It will be noted that unless the wipers of the switch J is in the home position as drawn, the circuit for energizing the relay 224 cannot be closed through the wipers 402—403. It will appear presently that when the switches J to P are restored through the agency of relay 410, the fact that switch J has its wipers in the normal or home resting position will insure that the other switches K to P have their wipers in the said normal or home position, because extra rotating space is provided for switch J wherein its wipers will always have to pass over more bank terminal spaces in restoring to its said normal position than will have to be passed over by any of the switches K to P, regardless of the setting thereof. That is to say, there will be ten digit lamps and corresponding bank positions, and a home bank position for each of the switches K to P, while when the switch J has its wipers positioned six steps ahead of home position (corresponding to the number of series employed), there will be not less than ten steps to be advanced over to the home position. Thus, when the switch J has returned to its home position, the other switches K to P will have had ample time to have returned to their respective home positions, as shown in the drawings.

It will be noted, in this connection, that the wipers of the switches J to P remain in the position last set until directively restored by the operator depressing key 411, or by the operator depressing a key *k* or *k'* way-down to cause its corresponding relay as 220 to actuate in the manner described. Spring 234 applies its ground over conductor 235 to energize the left-hand winding of relay 460. The springs of the latter said relay are applied to ground through the low-resistance right-hand winding of the latter said relay. The motor magnet of any of the switches J to P which have the wipers in off-normal position will be caused to operate to restore the corresponding wiper sets to normal position by interrupter action over obvious circuit paths. The relay 460 will remain actuated as long as any switch J to P has its wipers in off-normal position and has its motor magnet energized in the interrupter action by way of restoring the wipers.

It will be noted that until the wipers of the switch J have restored to the home position, the circuit for energizing the relay 224 cannot be closed. Moreover, in case the operator removes the depressing pressure immediately, or before the relay 224 has actuated because of the off-normal condition of the switch J, the relay 220 will be held locked to the grounded spring 236 of relay 224. Then, when the wipers of switch J have restored to the home position and relay 224 actuates from ground received from spring 221 via wipers 402—403, the relay 220 will deactuate consistent with its slow-releasing characteristic, followed by the deactuation of relay 224 resultant to the retraction of spring 221. However, it will be noted that even if relay 224 is actuated only for a brief time consistent with the slow-releasing characteristic of relay 220 under the condition that the operator momentarily depressed the key *k* way-down and the switches J to P thereupon restore, this brief time will be sufficient for the relay 205 to move its armature to the right-hand contact where it will remain until relay 224 deactuates.

During the time relay 224 is actuated, the lamp 237 will glow to indicate that the identification of the calling line operation has been initiated from the operator's end, the latter said lamp not glowing until the switch J has restored and the relay 205 has been given its operating impulse from the attracted spring 208 of the relay 224 operating the lamp 237. The lamp 237 may be common to a plurality of plugs U. So when the operator depresses a key as *k* to the way-down position, and possibly releases it immediately, she will know by the glowing of the lamp 237 that the operation has been effective and that the identification of the calling line will be made consistent with the operation of the

apparatus at the calling end in due time, as will appear presently.

Returning to the condition ensuing when the relay 224 actuated, and remembering that the relay 207 is actuated, positive battery is being applied through springs 208 and 209 to the center point of the winding of the polarized relay 206, operatively effective to the polarized relay 205 over the obvious simplex path of the trunk talking conductors, the windings of the relays 205 and 206 being connected corresponding to the well known duplex telegraph relation. The grounded armature of relay 205 will move to the right-hand contact, causing the slow-releasing relay 230 and the quick-acting relay 231 to actuate. There will be no other operative effect resultant to the actuation of relay 205. However, at such time as the operator removes the depressing pressure from the key *k* (or the switch J restores its wipers to the home position, in case it had its wipers in off-normal position and a momentary depression of key *k* was made), wherein it will restore to its intermediate position, the relay 220 will deactuate, consistent with its slow-releasing characteristic. The latter will cause relay 224 to deactuate and restore the negative battery to the center point of the winding of relay 206, whereupon the armature of relay 205 will return to the left-hand contact as shown in the drawings. The latter cannot ensue until the operator has removed the depressing pressure from the key *k*.

The armature of relay 231 immediately retracts, while the armature of relay 230 sustains for a time consistent with its slow-releasing characteristic, and during this time ground from the armature of relay 205 is applied through springs 239, 240, conductor 47, bank terminal 45, wiper 31, spring 61, bank terminal 62, wiper 15, springs 63 and 64, make-before-break spring 65 to the winding of relay 66, the latter said relay actuating and locking by way of spring 67 to the grounded conductor 14.

Grounded spring 69, in attracting, removes the normally existing bar ground from conductor 70 and the bar bank terminals as 301 and 302 of the switches G and F, respectively, and applies this ground to the start conductor 71. Assuming that finder switch F is idle, the ground on conductor 71 will energize the slow-releasing relay 304.

Class of system

Before proceeding with the operations resulting from the grounding of start conductor 71, it will be pointed out that the exampled telephone system is a so-termed five-pull or five-digit, automatic system of the Strowger general class, wherein trunks from the levels below the 0 level of first selector E, the first level, for example, extend to second selectors S of the so-called Powell type, or other suitable type, and the latter in turn having access to similar third selectors S' which have access to connectors C, which latter have access to a group of one hundred subscribers' lines, each terminating in a telephone as A'. These second and third selectors and a connector as would be employed in a call to a subscriber's line are shown in the lower portion of Fig. 1. The second selectors S may lead from a random level 1 to 9 of the first selector E and other selectors of its group in common.

The calling lines of which the leading to telephone A' may be one, are divided into groups of any suitable number as may be commonly accessible from the line finder switches G and F. The latter said finder switches are of the single plane forward movement type, but it will be understood that any suitable type of line finder switch may be employed; having vertical and rotary movements, for example. That is, the line finder switch has wipers (the three lower ones) for setting up a stored condition, while the upper three wipers are cooperative with bank terminals which are individual to the respective line switches of the calling lines. It is therefore immaterial what type of line finder is employed that will satisfy the condition wherein when the start conductor is energized one of the finders will hunt for and seize the set of six bank terminals corresponding to the line switch which caused the said energized condition of the start conductor and at the same time remove the ground bar from the corresponding set of terminals, so that the finder will seize when such (un-barred) terminal is encountered by the test wiper of the finder switch. The relays at the right of relay 320 are auxiliary to the finder switch F but individual thereto. The switches H and I are individual to finder switch F. It will thus appear that apparatus auxiliary to finder switch G has been omitted, but it will be understood that the switches F and G, and respectively associated apparatus and impulse sender are similar. There may be more switches like F and G and associated apparatus, or there may be only switch F and still meet the objects of the present invention, but the operation of the present invention will then be limited as to the traffic that can be handled by the switch F and its individually associated impulse sender including switch elements H and I.

Normally, the bank terminals as 301—302 and 305—306 are applied to ground on springs corresponding to 69. When a spring corresponding to 69 attracts responsive to the operator depressing a key as *k* under the condition set forth, the start conductor 71 is thereby grounded and the corresponding guard terminals as 301—302 are ungrounded. The five bank terminals aligned below the bank terminal 301 (and also terminal 302) are individual to the line switch LS, and each set of six bank terminals swept by the wipers of switch F belong to a different line switch as LS. The same holds for switch G, but wherein only the upper three terminals of the sets of terminals are duplicated in multiple on the two switches F and G. The lower three terminals of the sets are individual to the respective switches F and G and their individual corresponding switches as H and I.

Returning to the condition wherein the start conductor 71 became grounded, causing the relay 304 to actuate, and having in mind that bank terminal 306 (also 305) will be grounded and bank terminal 302 (also 301) will be ungrounded. Ground will be applied from bank terminal 306, wiper 308 of set 308 to 313, make-before-break spring 314, springs 315 and 316 to the winding of the motor magnet. Spring 318 applies ground to the lower winding terminal of relay 320, but this winding is short-circuited by the described ground applied through spring 316. The motor magnet will operate its interrupter contact and cause the wipers to be step-advanced as long as wiper 308 receives ground from a cooperating bank terminal. However, bank terminal 302 is ungrounded, so that when the wiper 308 advances to this terminal the short-circuit is removed from the winding of relay 320 and

it operatively energizes in series with the motor magnet, while the motor magnet remains inert due to its marginal adjustment. Relay 304 will deactuate consistent with its slow-releasing characteristic, the start conductor 71 now being continued to the winding of relay 321 of finder switch G.

Relay 320 locks to ground on spring 321. Relay 322 actuates, energized from ground applied through spring 323. Spring 325 applies ground through wiper 309, cooperative bank terminal, conductor 327 to the winding of relay 12 in line switch LS, the latter said relay again actuating for the purpose of unlocking relay 66, to place ground from spring 69 on bank terminal 301 to guard the corresponding set of bank terminals of the switch G, it being noted that the latter said ground is applied by the time the start conductor 71 is continued to the winding of relay 321 in view of the slow-releasing characteristic of relay 304.

Only provided the wipers of switches H and I are in the normal, home positions, as shown in the drawings, will the ground be applied through spring 328, wiper 331 of set 329 to 331, conductor 332, wipers 334 and 333 of set 333 to 336, spring 337 to the winding of relay 338, the latter said relay actuating. This ground will also appear on bank terminal 339 of switch I. Relay 338 is now locked by ground applied through springs 340 and 341, so that the latter said relay will remain actuated as long as relay 320 remains energized.

At the time the relay 338 actuated, a circuit was closed from ground, springs 342 and 343 in parallel, spring 344 to the winding of relay 345, the latter said relay actuating. Slow-releasing relay 346 is now energized in a local circuit of relay 345, so that a circuit is prepared from the resting contact of attracted spring 347, springs 348 and 349, wiper 310, conductor 351, springs 64, 63, wiper 15, bank terminal 62, spring 61, wiper 31, bank terminal 45, conductor 47, springs 240 and 239 to the winding of relay 247, the winding of the latter said relay not being at present energized.

The ground interrupter IT revolves at the rate of approximately twelve times per second, so that ground impulses are applied through the spring 352 and thence through spring 353 to the winding of relay 354, and also through spring 355 to the motor magnet of switch H in parallel, at the rate corresponding to the revolutions of the interrupter IT, or approximately twelve times per second.

Relay 357 will have its spring 342 retracted until the wiper 335 of the switch H moves to bank terminal 358, when the relay 357 will become energized so that the relay 345 will thereafter respond to the open impulses from the interrupter IT, the relay 346 sustaining actuated, so that, after the wiper 335 has advanced to bank terminal 358 the spring 347 on relay 345 will send one impulse through springs 348, 349, wiper 310, conductor 351 for each step of the wipers of the set 333 to 336, until the wiper 333 encounters ground, as will appear presently. At the time the wiper 333 encounters ground this ground will be applied through wiper 334 and the cooperating bank terminal, conductor 360 to the winding of slow-releasing relay 361, the latter relay actuating and locking through the spring 362, wiper 335 to ground on the cooperating bank terminal, this locked condition ensuing until the wiper 335 returns to the home position, in the manner as will appear presently.

When the spring 362 attracts, it deenergizes the relay 357, so that spring 342 retracts to maintain the closure of the circuit path energizing relay 345. The circuit path to the winding of relay 354 is opened at spring 353 and the circuit path to the winding of the motor magnet of switch H is opened at spring 355, so that the latter said motor magnet will not be driven further by the impulses from the source IT. However, ground applied through wiper 335, spring 364, is applied through wiper 336, interrupter armature to the winding of the motor magnet, the latter said magnet operating to advance the wipers 333 to 336 to the home position. At the home position the locking ground for the relay 361 is removed, so that it will deactuate consistent with its slow-releasing characteristic to introduce a predetermined minimum space between the series of impulses sent over the conductor 351, and the next succeeding series that will then follow, since the same conditions exist as existed before the terminated series started, the succeeding series will follow in like manner, assuming that relay 365 has not yet actuated following the last series, in the manner as will appear presently.

It is pointed out that when the relay 361 actuated to terminate the first impulse series, ground was applied through spring 367 to the motor magnet of switch I, preparatory to causing the wipers thereof to advance one step when the relay 361 deactuates following the return of the wipers of switch H to the home position.

The detailed operation of effecting the impulse series with particular correspondence to the calling line concerned and the position assumed by the finder switch F will be taken up later. Suffice it to say here that a train of impulse series numerically corresponding to the line found by the finder switch F, followed by a classification series will be sent over the conductor 351, effective to the relay 247 in Fig. 2.

The relay 247 will therefore effect an operation corresponding to the train of impulse series received by it, its spring 203 correspondingly changing the polarity of the battery applied to the center point of the relay 205, effective to correspondingly retracting the armature of relay 206 to the right to send impulses through spring 243, springs 216—215 to conductor 244.

Returning to the operation of the impulse sending mechanism in Fig. 3, it is pointed out that the calling lines extending to group of line switches, of which switch LS is one, and with which lines the finder switches F and G cooperate, are assumed to belong to the 986 hundred group. That is, in the 6 hundred of the 8 thousand of the 9 ten-thousand block of numbers. Therefore, regardless of which particular line of this hundred is the calling line to be identified, the first three digits of the number will be 986. The next two digits will correspond to the particular line of the hundred group that is calling. The last (sixth) digits series will identify the classification of the line in any desired respect, and therefore may be the same for any number of the lines of the hundred group.

The calling line leading into line switch LS is assumed to be line number 98675 wherein the classification is "4". The line corresponding to the terminal set upon which the set of wipers 308 to 313 of the finder switch F is shown resting is 98674, wherein the classification is "2".

It was described how the relay 361 actuated and locked when the wiper 333 encountered ground, and thus terminated the series of impulses. This ground will be first encountered on the terminal corresponding to digit 9 due to the fact ground from attracted spring 328 is applied through wiper 331, bank terminal 366, fixed jumper 367 to the digit 9 bank terminal cooperative with wiper 333. That is, the spring 347 on relay 345 will have sent a series of nine ground impulses to conductor 351, effective to relays 247 and 206 in Fig. 2 and 410, wiper 413 to the motor magnet of switch K in Fig. 4, when wiper 333 encounters ground on the digit 9 bank terminal.

It was also described how the wipers 329 to 331 of switch I advanced one step following each impulse series sent by relay 345, due to the retraction of armature 367, said wipers advancing upon the deenergization of the corresponding motor magnet.

In view of the foregoing, it will be clear that the second series will constitute eight impulses, the ground encountered by wiper 333 being applied through jumper 368 to the digit 8 bank terminal. In the same manner the third series will constitute six impulses, the ground encountered by wiper 333 being applied through jumper 369 to the digit 6 bank terminal. The jumpers 367, 368 and 369 may be fixed or permanently run jumper conductors. Moreover, the latter said jumpers are concerned in each train of series for the 986 hundred group. However, three specific jumpers are employed for the last three series of each train. The wiper 331, as it progresses to successive bank terminals 370, 371 and 372 correspondingly apply ground through wipers 311, 312 and 313 and jumpers 373, 374 and 375 to digit bank terminals 7, 5, 4, respectively.

From the foregoing, it will be clear that responsive to the actuation of relay 66, primarily responsive to directive operation by the operator depressing key *k*, the finder switch F will hunt for and seize the calling line corresponding to the said relay 66. Thereupon the sending apparatus individual to the switch F will send a train of series 9—8—6—7—5—4, effective to relay 206 in Fig. 2, there being a space between each said series to permit the slow-releasing relay 410 to deactuate. Had the calling line been the one corresponding to the set of bank terminals upon which the wipers 308 to 313 are shown resting (there being no home position for the wipers of switches F and G), the last three series of the train would then be 7—4—2 in place of 7—5—4. Assuming that the switch F has access to one hundred sets of bank terminals, each set would cause the corresponding calling line to be identified by two sets of three series each, two of which series of the second set will correspond to the numerical position of the line in the hundred group while the last series will identify the class. The first set of three series identifies the hundred group. Of course, in place of the switch F having access to one hundred lines, it may have access to a fewer number, say twenty-five lines. In the latter case there would be four such switches as F for one hundred lines and wherein in each instance the set constituting the first three digit series will be the same for all trains with reference to the one hundred lines, and, on the other hand, the switch F may have access to one thousand lines.

It is obvious that the switch G need not be installed, and moreover, more than two such switches may be related in the indicated chain relation, so that in the event the switch F is busy with a call when the relay corresponding to 66 of another line is actuated, the next finder switch as G will operate to find the said another line and transmit to the operator the identification of the line.

So, it will be particularly noted, in the exemplary system, that the switch F (or G) determines only the last three series of the train, the first three series of the train being fixed in the companion switch I, there being a specific switch as I (and also H) for the switch F.

When the wiper 329 of switch I advances following the sending of the last series of the train, ground on bank terminal 339 is applied through wiper 329 to the winding of relay 365, the latter said relay actuating. This removes the locking ground from relay 320 and it will accordingly deactuate, followed by the deactuation of relay 322 and the relay 338. Ground applied through armature 380 will cause the wipers of the switch I to advance to the home position as shown in the drawings by interrupter action from the ground received through wiper 330.

Ground now applied through spring 363 will cause the wipers of the switch H to advance to the home position, as shown in the drawings, by interrupter action from the ground received through wiper 336. The wipers of switch F remain where last set until its operation in finding a line is again initiated. If the same line as last identified is to be next identified, the finder switch will forthwith seize without hunting, responsive to the actuation of the relay corresponding to 66 applying ground over the common start conductor 71.

Operator may cause identification to be repeated as often as desired

It will be clear that the operator after causing the switch F (or G) to operate to find the calling line, and then cause a train of identification impulse series to be sent and restored to idle condition, can in the same manner cause the switch F to perhaps again hunt for and reseize the calling line and again send or repeat the same train of identification series as first sent. This may be done as often as desired.

In this connection, it will be noted that if there is no available finder switch when the relay as 66 is actuated, obviously there will be no impulse train sent to identify the line thereupon. However, when a finder switch of the calling line group becomes available it will be thereupon caused to find the line corresponding to the said relay as 66 and the identification train thereupon sent.

Calling party abandons call

It will be noted that if the operator causes the relay as 66 to actuate and lock in the manner described, and before the finder switch as F has operated to find the calling line, the calling party abandons the call by hanging up, the switches will be restored to normal and relay 66 will unlock. This will place ground on the bar conductor 70 and remove ground from the start conductor 71, causing the finder switch in the hunting operation to stop.

Operator may identify calling line although calling party has abandoned the call

However, in order to prevent the latter said restoration of the switches in the event the calling party abandons the call, in the manner last before

referred to, the grounded switch-arm 75 is provided. By moving the switch-arm 75 into the dotted position, the make contact cooperative with the spring 77 is applied to ground. With this set condition existing, it will be noted that the operator when wishing to identify a line causes the relay 66 to actuate and lock to the conductor 14, the release trunk is at the same time locked to ground, out of control of the calling party. That is, the calling party cannot, by hanging up his receiver, cause the conductor 14 to become ungrounded or restore the switches.

There will be only one way for the connection to be automatically broken down, and that is to cause the relay 12 to actuate to open the locking ground for the relay 66 and thereafter deactuate to remove the ground applied from spring 13. The latter can only be accomplished by applying ground over conductor 327 from the spring as 325 of the finder switch F, the conditions of which operation has been detailed. Thus, the finder switch as F must first find the calling line corresponding to the relay as 66 which is locked, and then the impulse sending apparatus individual to the finder switch must operate to send the entire identification train wherein the wiper 329 must receive ground from bank terminal 339 to actuate the relay 365 so that relay 320 will unlock to deenergize the relays 322 and 12, so that ground applied from spring 13 will be removed from the conductor 14. That is, when relay 66 is locked, when switch-arm 75 is in the dotted position, it can be unlocked only by actuating relay 12, wherein the spring 13 of relay 12 will apply ground to the conductor 14 before the relay 66 has had time to retract its spring 77, due to the slightly slow-releasing characteristic of relay 66, so that ground will be maintained on conductor 14 until relay 12 deactuates following the completion of the impulse identification train, although the spring 77 retracts following the actuation of relay 12. The operator is assured receiving identification of the calling line regardless of anything the calling party does if the relay 66 has been energized, in the event switch 75 has been set to its dotted position.

In this connection, it will be understood that the latter feature has uses in telephone systems, other than specifically mentioned in connection with long distance service. For example, it may be employed to prevent a calling party from breaking down the connection after calling a line by control over the called line and moreover to immediately identify the calling line to the party supervising the called line.

The operation of the system, with respect to the switch arm 75 function enables fewer finder switches as F being employed for each group; in fact one such switch will usually suffice, because in case a finder switch is not immediately available when the relay 66 is energized, the set-up condition will endure until a finder switch is available. If for some reason the operator after causing the energization of the relay 66, causes the call register apparatus at her switchboard to be disconnected from the trunk and the identification train is sent at this time, she may reconnect the call register apparatus at any time by means of key as *k* while the connection endures and again cause the energization of the relay 66 to cause a resending of the identification train in due time.

Operation of call indicator at operator's position

Referring now to the operation of the call indicating apparatus at the operator's position, the impulses received by relay 206 and sent by its armature through spring 243, springs 216—215, conductor 244, are effective in the following manner: The first series of the train, and in fact each series of the train, causes the slow-releasing relay 410 to actuate and sustain over the lapse between the impulses of the series, deactuating at the termination of the respective series. Each time the relay 410 actuates spring 412 applies ground to energize the motor magnet of switch J, and when each of the respective series terminates the motor magnet will retract its armature to drive the wipers a step in advance.

The first series of impulses applied through the wiper 413 will correspondingly operate the motor magnet of switch K to step its wipers as many steps in advance as there are impulses in the series effective to it.

The second series of impulses applied through the wiper 413 will correspondingly operate the motor magnet of switch L to step its wipers as many steps in advance as there are impulses in the series effective to it.

In the same manner, the last four series of the train of six series will be successively effective to the switches L, M, N, and P, respectively.

The switches K to P are shown having a home bank terminal set upon which the wipers are shown resting, and four off-normal bank terminal sets and lamps corresponding thereto. However, it will be understood that in practice there would be ten off-normal bank terminal sets and corresponding lamps, each lamp representing the numerals from 1 to 0, starting with the first off-normal set. The number of bank terminal sets and lamps has been curtailed in the drawings in order to make the drawings and disclosure as simple as is consistent with being readily comprehensive.

From the foregoing, it will appear that responsive to the sending of the train of six series, 8—9—6—7—5—4, the wipers of the switchs K to P will be resting upon bank terminal sets numerically corresponding to this train. The wipers 413, 415, 403 and 402 will now be resting on bank terminals 416 to 419, respectively, following the deactuation of the motor magnet, following the last (sixth) series of the train of series. Ground from spring 425 will now be applied through spring 426, bank terminal 419, wipers 402—403, bank terminal 418 to wipers 427 to 432 in multiple, and to the respective bank terminals these wipers 427 to 432 are resting upon, to glow the corresponding digit lamps, and the classification lamp associated with switch P. Under the stated condition the said lamps associated with the switches K to P will indicate the number 896754, wherein the first five digits represent the number of the calling line and the last digit 4 denotes the classification of the said line, and which may refer, for example, to the fact that credit for long distance calling is denied the particular line.

It is thus clear that following the setting of the switches K to P wherein the wipers of switch J step to the bank terminal set 416 to 419 the six lamps will coincidently start glowing indicative of the calling line number and classification.

Call indicator lamps extinguish in predetermined time

At this time ground is applied through spring 435, wiper 436, bank terminal 437, key spring 438 to the winding of the slow-actuating dash-pot relay 439. In a predetermined time, suitable for

the operator to observe the glowing lamps, the spring 425 will be raised from its drawn position to open the energizing path of the lamps indicating the calling line and classification thereof, and energize the lamp 442 to indicate that the switches K to P are set, but that the current has been disconnected from the indicator lamps. In case the operator has not yet observed the glowing lamps when the current was cut off from them, the operator may by operating key 443 reenergize the lamps and sustain them in their glowing condition as long as desired. On the other hand, the operator may depress key 438 and prevent the relay 439 from operating to deenergize the lamps associated individual to the respective switches K to P, until such time as she is ready to have this ensue.

Call indicator lamps may be caused to glow successively

In this connection, it will be noted that by moving the switch-arms 450 and 451 to their dotted positions, the lamps individual to the switches K to P representing the set position of the wipers of the respective switches will be caused to glow successively as the switches are set, in place of all at one time following the setting of the last switch P, when the wipers of switch J then move to the set of bank terminals 416 to 419.

Operator may at will automatically restore switches J to P

The operator may restore the switches J to P to their home positions as shown in the drawings by momentarily depressing the key 411, causing the relay 460 to actuate so that the right-hand winding thereof will be energized to maintain the armatures attracted until no more current for energizing the various motor magnets in their interrupter action in restoring the switches to the home position is drawn through the right-hand winding of the relay 411.

Operation of supervisory lamps

The operator may allow the switches to remain in the set position with the lamp 442 glowing after the digit lamps and the classification lamp of the switches K to P extinguish. However, at such time as the operator depresses a key *k* to the way-down position, in the manner described to verify a calling line, the attracting spring 234 will thereupon initiate the restoration of the wipers of the switches J to P and this restoration must take place, as has been referred to, before the circuit for energizing the relay 224 can take place in initiating the new verification of the calling line.

The calling lamp 213 will remain glowing until the plug U is inserted into a jack as T, or if the plug is not inserted, until under the condition that the relay 66 becomes in its deactuated condition. This is because the relay 207 is sustained actuated. However, when the selector E has restored from the long distance trunk, the relay 207 will, in due course because of obvious circuit paths being opened, retract its spring 212, and the lamp 248 will glow. The latter is assuming that the plug U has not been inserted into a jack T whereby the relay 246 would be energized from the sleeve of the jack. If the plug U is inserted into a jack as T, the actuation of the relay 246 operates to extinguish the lamp 213. If the calling party hangs up his receiver the relay 207 will in turn deactuate and cause lamp 248 to glow as a disconnect signal. The operator may now remove the plug U from the jack T and the circuits are in condition for receiving a new call.

I claim:—

1. In a telephone system, a plurality of lines, an operator's called line, switch mechanism for extending connection from a random calling one of said plurality of lines to the called line, a calling signal operated responsive to the call to indicate the call, and common identifying means operated at will by the operator irrespective of control over said calling line for sending a specific identification of said calling line over the call extension to the operator's called line.

2. In a telephone system, a plurality of lines, an operator's called line, switch mechanism for extending connection from a random calling one of said plurality of lines to the called line, a calling signal operated responsive to the call to indicate the call, and common identifying means operated at will by the operator irrespective of control over said calling line for sending a specific identification of said calling line number to the called line.

3. In a telephone system, a plurality of lines, an operator's called line, switch mechanism for extending connection from a random calling one of said plurality of lines to the called line, a calling signal operated responsive to the call to indicate the call, and common identifying means operated at will by the operator by control applied over the call extension for sending a specific identification of said calling line over the call extension to the operator's called line wherein said control bears no specific relationship to the identity of the calling line.

4. In a telephone system, a plurality of lines, an operator's called line, switch mechanism for extending connection from a random calling one of said plurality of lines to the called line, a calling signal operated responsive to the call to indicate the call, and common identifying means operated by operator control applied over the called line for sending a specific identification of the said calling line number over the called line wherein said control bears no specific relationship to the identity of the calling line.

5. In a telephone system, a plurality of lines, an operator's called line, switch mechanism for extending connection from a random calling one of said plurality of lines to the called line, a calling signal operated responsive to the call to indicate the call, means responsive to operator control operated irrespective of control over said calling line for sending specific identification impulses of said calling line over the call extension, and register mechanism at the operator's position for registering the calling telephone number for recording said identification, said register mechanism being common to said lines.

6. In a telephone system, a plurality of lines, an operator's called line, switch mechanism for extending connection from a random calling one of said plurality of lines to the called line, a calling signal operated responsive to the call to indicate the call, means operated by operator control applied over the called line for sending a specific identification of the said calling line over the called line wherein said control bears no specific relationship to the identity of the calling line, and register mechanism at the operator's position for registering the calling telephone number for recording said identification, said register mechanism being common to said lines.

7. In a telephone system, a plurality of lines,

an operator's called line, switch mechanism for extending connection from a random calling one of said plurality of lines to the called line, a calling signal operated responsive to the call to indicate the call, and means responsive to operator control operated irrespective of control over said calling line for sending impulses constituting a specific identification of said calling line number over the call extension.

8. In a telephone system, a plurality of lines, an operator's called line, switch mechanism for extending connection from a random calling one of said plurality of lines to the called line, a calling signal operated responsive to the call to indicate the call, and means responsive to operator control operated irrespective of control over said calling line for sending impulses constituting a specific identification of the said calling line number to the called line.

9. In a telephone system, a plurality of lines, an operator's called line, switch mechanism for extending connection from a random calling one of said plurality of lines to the called line, a calling signal operated responsive to the call to indicate the call, and means responsive to operator control operated by control applied over the called line for sending a specific identification of the said calling line over the called line wherein said control bears no specific relationship to the identity of the calling line, said identification constituted of impulses specific to the said calling line.

10. In a telephone system, a plurality of lines, an operator's called line, switch mechanism for extending connection from a random calling one of said plurality of lines to the called line, a calling signal operated responsive to the call to indicate the call, and means for sending a specific identification code of impulses corresponding to the calling number over the connection, responsive to operator control over the connection, the said code corresponding to and depending upon which one of said plurality of lines is the calling line.

11. In a telephone system, a plurality of lines, an operator's called line, switch mechanism for extending connection from a random calling one of said plurality of lines to the called line, a calling signal operated responsive to the call to indicate the call, means responsive to operator control operated irrespective of control over said calling line for sending a specific identification code of impulses corresponding to the number of said calling line over the call extension, and a recording means on the called line for registering said code and for retaining said registration.

12. In a telephone system, a plurality of lines, an operator's called line, switch mechanism for extending connection from a random calling one of said plurality of lines to the called line, a calling signal operated responsive to the call to indicate the call, an impulse sending device, means for automatically setting said impulse sending device to send a plurality of impulses in accordance with said random one of said lines responsive to control applied over the connection without regard to the particular line calling, and operator controlled means for causing the impulse sending device to send impulses over the connection in accordance with the said setting.

13. In a telephone system, a plurality of lines, an operator's called line, switch mechanism for extending connection from a random calling one of said plurality of lines to the called line, a calling signal operated responsive to the call to indicate the call, an impulse sending device, means for automatically setting said impulse sending device to send a plurality of impulses in accordance with said random one of said lines responsive to control applied over the connection without regard to the particular line calling, and operator controlled means for causing the impulse sending device to send impulses over the connection in accordance with the said setting, and a receiving device on the called line responsive to said impulses which will indicate what specific one of said lines is said random calling line.

14. In a telephone system, a plurality of lines, a calling random one of said lines, an operator's called line, a finder switch, switch mechanism for extending connection from said calling random line to the called line, a calling signal operated responsive to the call to indicate the call, a register, means controlled by the operator for causing the finder switch to operate to hunt for and identify the said calling line, and means governed by the position assumed by the finder switch when identifying the calling line for setting up a condition in the impulse sending device for sending a train of impulses with specific correspondence to the number of said calling line.

15. In a telephone system, a plurality of lines, a calling random one of said lines, an operator's called line, a finder switch, switch mechanism for extending connection from said calling random line to the called line, a calling signal operated responsive to the call to indicate the call, a register, means controlled by the operator for causing the finder switch to operate to hunt for and identify the said calling line, means governed by the position assumed by the finder switch when identifying the calling line for setting up a condition in the impulse sending device for sending a train of impulses with specific correspondence to the number of said calling line, and means for rendering the finder switch subject to new use responsive to the train of impulses being completed while the extended connection thereafter remains extended.

16. In a telephone system, a plurality of lines, an operator's called line, switch mechanism for extending connection from a random calling one of said plurality of lines to the called line, a calling signal operated responsive to the call to indicate the call, operator controlled means operated irrespective of control over said calling line for sending impulses corresponding to a specific identification of said calling line number over the call extension, and means for annexing to said identification impulses of the calling line impulses corresponding to the characteristic of the said calling line.

17. In a telephone system, a plurality of lines, an operator's called line, switch mechanism for extending a random one of said lines to the called line, a calling signal operated responsive to the call to indicate the call, a register associated with the called line, and an impulse sending means the operation of which is initiated thereafter by operator control from the called line over the call extension for thereafter sending impulses in accordance with the number of the line calling to operate the register for disclosing which particular one of said lines is the calling line.

18. In a telephone system, a selective switch, levels of bank terminals each level swept by a wiper common to said levels, and one of said levels swept by said common wiper and also by a wiper specific to said one level wherein the latter said level has outgoing lines employing an additional conductor over the number outgoing from first

said levels, the bank terminals of said conductors of the lines being specifically swept by the latter said wiper.

19. In a telephone system, a selective switch, levels of bank terminals of said switch, a shaft of said switch, wipers carried by said shaft, means for setting said shaft so that the wipers carried thereby will align with any desired level and then sweep the bank terminals of said level, and a wiper of said switch operated by the shaft at only a single one of its levels of bank terminals, wherein the latter said level has outgoing lines employing an additional conductor over the number outgoing from first said levels, the bank terminals of said conductors of the lines being specifically swept by the latter said wiper.

20. In a telephone system, the method of straight-forward trunking from a random calling line of a group of lines to an operator's trunk wherein after the call has been extended to the operator's trunk the operator may by applying common control over the extension to the said trunk thereby cause specific impulses according to the calling telephone number to be sent over the extension to a register associated with the trunk, the impulses adapted to operate the register for causing it to disclose to the operator which particular one of the group of lines is the calling line and wherein the operator may extend the calling line by way of the operator's trunk to a called subscriber's telephone line either before or after the operator has applied the common control to identify the particular calling line.

21. In a subscriber's telephone system, a plurality of telephone lines, a trunk line at an operator's position, means for extending a call from a calling one of said lines to the trunk line terminating at the operator's position, a calling signal operated responsive to the call to indicate the call, an indicator at the operator's position, and step by step automatic switch mechanism controlled from the operator's position back over the trunk line to automatically operate the indicator for verifying the telephone number of the calling line.

22. In a subscriber's telephone system, a plurality of telephone lines, a trunk line at an operator's position, means for extending a call from a calling one of said lines to the trunk line terminating at the operator's position, automatic switch mechanism controlled from the operator's position back over the trunk line for automatically verifying the telephone number of the calling line, and means whereby the operator may repeat such identification as often as desired.

23. In a subscriber's telephone system, a plurality of telephone lines, a trunk line at an operator's position, means for extending a call from a calling one of said lines to the trunk line terminating at the operator's position, a calling signal operated responsive to the call to indicate the call, an indicator at the operator's position, step by step automatic switch mechanism controlled from the operator's position back over the trunk line to automatically operate the indicator for verifying the telephone number of the calling line, and means whereby the operator may effect such identification at any time before the calling party abandons the call.

24. In a subscriber's telephone system, a plurality of telephone lines, a trunk line at an operator's position, means for extending a call from a calling one of said lines to the trunk line terminating at the operator's position, a calling signal operated responsive to the call to indicate the call, step by step automatic switch mechanism controlled from the operator's position back over the trunk line for automatically verifying the telephone number of the calling line, and means whereby the operator may effect such identification although the calling party has abandoned the call.

25. In a subscriber's telephone system, a plurality of telephone lines, a trunk line at an operator's position, means for extending a call from a calling one of said lines to the trunk line terminating at the operator's position, a calling signal operated responsive to the call to indicate the call, an indicator at the operator's position, step by step automatic switch mechanism controlled from the operator's position back over the trunk line to automatically operate the indicator for verifying the telephone number of the calling line, and means whereby the operator may thereafter extend the calling line to a desired called line by way of the trunk line.

26. In a telephone system, subscribers' telephone lines, operators' lines terminating at an operator's position, intermediate automatic switch mechanism for interconnecting a calling one of the subscribers' lines with an idle operator's called line, a calling signal operated responsive to the call to indicate the call, a calling number register mechanism at the operator's position including step by step switch mechanism, means for operating said mechanism by step by step advance to visually indicate to the operator the complete telephone number of the calling line, and means for connecting the calling line over the operator's called line with a called subscriber's telephone line.

27. In a telephone system, telephone lines, operators' lines terminating at an operator's position, automatic switches for extending a calling one of said lines to an operator's line at the operator's position, a calling signal operated responsive to the call to indicate the call, calling number step by step operated register mechanism at the operator's position, and means controlled by the operator for operating said register mechanism to visually indicate to the operator the complete telephone number of the calling line.

28. In a telephone system, telephone lines, operators' lines terminating at an operator's position, automatic switches for extending a calling one of said lines to an operator's line at the operator's position, a calling signal operated responsive to the call to indicate the call, calling number register mechanism at the operator's position, an impulse sending mechanism for sending a plurality of impulses to identify the calling telephone number for operating said register mechanism to visually indicate to the operator the complete telephone number of the calling line, and means for extending the calling line over the connected operator's line to a called subscriber's line.

29. In a telephone system, telephone lines, operators' lines terminating at an operator's position, automatic switches for extending a calling one of said lines to an operator's line at the operator's position, a calling signal operated responsive to the call to indicate the call, calling number register mechanism at the operator's position, an operator's key at the operator's position, and means controlled by said key for automatically selecting the terminals of the calling line and transmitting a plurality of impulses which identify the calling telephone number for

operating said register mechanism to visually indicate to the operator the telephone number of the calling line.

30. In a telephone system, telephone lines, operators' lines terminating at an operator's position, automatic switches for extending a calling one of said lines to an operator's line at the operator's position, a calling signal operated responsive to the call to indicate the call, calling number register mechanism at the operator's position, said register mechanism including rows of visual indicators, there being as many rows as there are digits in the telephone numbers, and ten indicators in each row, and means for automatically transmitting impulses which identify the calling telephone number for operating only one of the ten indicators in each row to visually indicate to the operator the telephone number of the calling line.

31. In a telephone system, telephone lines, operators' lines terminating at an operator's position, automatic switches for extending a calling one of said lines to an operator's line at the operator's position, a calling signal operated responsive to the call to indicate the call, calling number register mechanism at the operator's position, said register mechanism including rows of visual indicators, there being as many rows as there are digits in the telephone numbers, and means controlled by the operator for automatically transmitting impulses which identify the calling telephone number for operating an indicator in each row to visually indicate to the operator the telephone number of the calling line.

32. In a telephone system, telephone lines, operators' lines terminating at an operator's position, automatic switches for extending a calling one of said lines to an operator's line at the operator's position, a calling signal operated responsive to the call to indicate the call, calling number register mechanism at the operator's position, a switch for automatically seizing the terminals of a calling line operated at will from the operator's position, and an impulse sending mechanism operated according to the telephone number of such seized calling line terminals for transmitting impulses according to a seized calling line for operating said register mechanism to visually indicate to the operator the complete telephone number of the calling line.

33. In a telephone system, telephone lines, single plug ended operator's cord circuits, switch mechanism for extending connection from a calling one of said lines to incoming terminals of an idle operator's cord circuit, a calling signal operated responsive to the call to indicate the call, automatic step by step switch mechanism thereafter operable at the will of the operator for connecting with terminals of the calling line and identifying to the operator the telephone number of the calling line, and means for extending the calling line over the operator's cord circuit by connecting the plug terminal to a called subscriber's line.

34. In a telephone system, telephone lines, single plug ended operator's cord circuits, step by step selector switches for interconnecting a calling line with incoming terminals of an idle cord circuit to extend the calling line to such cord circuit, a calling signal operated responsive to the call to indicate the call, and means whereby the operator may identify the telephone number of the calling line, said means comprising a number indicator before the operator and automatic step by step mechanism controlled at the will of the operator for seizing terminals of the calling line and operating the number indicator to identify the number of the calling line.

35. In an automatic telephone and toll system, telephone lines, selector switches, other selector and connector switches for extending a calling line to a called line, a toll operator's cord circuit, means for operating a first said selector from a calling device of the calling telephone line to extend the calling line to incoming terminals of an idle toll operator's cord circuit, a calling signal operated responsive to the call to indicate the call, a number indicator, and means associated with the toll operator's cord circuit for operating said number indicator to indicate the telephone number of the calling line, said means including automatic switch mechanism controlled by the operator for seizing terminals of the calling line with impulse mechanism controlled thereby for operating the number indicator to register the telephone number of the calling line.

36. In a telephone system, a plurality of telephone lines each having an arbitrary designation, a plurality of operators' positions, means for connecting a calling telephone line to one of said operators' positions, a calling line test circuit for selecting said calling telephone line, means for connecting said test circuit with any one of said operators' positions, and means responsive to the connection of said calling telephone line with said operators' position to the connection of said calling line test circuit with said position and the selection of said calling telephone line by said calling line test circuit for visibly indicating the arbitrary designation of said calling line at said position.

37. In a telephone system, a plurality of telephone lines each having an arbitrary designation, a plurality of operators' positions, means for connecting a calling telephone line to one of said operators' positions, a calling line test circuit for selecting said calling telephone line, means for connecting said test circuit with any one of said operators' positions, and means responsive to the selection of said calling telephone line by said calling line test circuit and to the connection of said calling line test circuit with said position to which said calling line was extended for indicating the arbitrary designation of said calling line.

38. In a telephone system, a plurality of telephone lines, a calling line test circuit for selecting a calling line, a plurality of operators' positions, means for extending a calling line to one of said positions and means responsive to an operation of said operator's position for causing said calling line test circuit to select said calling line and to render said calling line test circuit unresponsive from other of said operators' positions while selecting said calling line.

39. In a telephone system, a plurality of telephone lines each having an arbitrary designation, a calling line test circuit comprising a plurality of multi-contact relays, a test conductor for each of said plurality of telephone lines extending to contacts of said multi-contact relays, an operator's position, means for connecting a calling telephone line to said operator's position, means for operatively connecting said calling line test circuit with said position, and means responsive to the connection of said calling line with said operator's position and said calling line test circuit with said position for operating the multi-contact relay in said calling line test circuit which contains the test conductor of said calling line for

visibly indicating the arbitrary designation of said calling line at said operator's position.

40. In a telephone system, a plurality of telephone lines each having an arbitrary designation, a calling line test circuit comprising a plurality of multi-contact relays, a test conductor for each of said plurality of telephone lines extending to the contacts of said multi-contact relays, an operator's position, means for connecting a calling telephone line to said operator's position, a lamp indicating device at said operator's position, and means responsive to the connection of said calling line with said operator's position and the selection of said calling line by said calling line test circuit through the identification of its associated test conductor for operating said lamp indicating device for indicating the arbitrary designation of said calling telephone line at said operator's position.

41. In a telephone system, a calling line having an arbitrary multi-symbol designation, an identifying conductor for said line, means for changing the electrical status of said conductor, and a calling line test circuit for selecting said calling line through said identifying conductor comprising a plurality of circuits electrically altered in response to said change of electrical status, and means responsive to each of said circuits for recording each of said symbols of said arbitrary designation.

42. In a telephone system, a plurality of telephone lines each having an arbitrary designation, a plurality of operators' positions, a calling line test circuit for selecting a calling telephone line, means for connecting a calling telephone line to one of said operators' positions and for connecting said test circuit with any one of said operators' positions, and means responsive to the connection of said calling telephone line with said operator's position, to the connection of said calling line test circuit with said position and the selection of said calling telephone line by said calling line test circuit for visibly indicating the arbitrary designation of said calling line at said position.

43. In a telephone system, a plurality of telephone lines each having an arbitrary designation, a plurality of operator's positions, a calling line test circuit for selecting a calling telephone line, means for connecting a calling telephone line to one of said operator's positions and for connecting said test circuit with any one of said operators' positions, and means responsive to the selection of said calling telephone line by said calling line test circuit and to the connection of said calling line test circuit with said position to which said calling line was extended for indicating the arbitrary designation of said calling line.

44. In a telephone system, a plurality of telephone lines each having a multi-digit designation and a class of line designation, an identifying conductor for each of said lines, means for impressing an electric potential on the associated identifying conductor of a calling line, and a calling line test circuit including a circuit responsive to said electric potential and a register responsive to said circuit for recording therein each of the digits and the class of line designation of said calling line.

45. In a telephone system, a plurality of telephone lines, a calling line test circuit for selecting a calling line, a plurality of operators' positions, means for extending a calling line to one of said positions and means responsive to an operation of said operator's position for causing said calling line test circuit to select a calling line and to render said calling line test circuit unresponsive from other of said operators' positions than the one to which said calling line is extended.

46. In a telephone system, a plurality of telephone lines, a calling line test circuit for selecting a calling line, a plurality of operators' positions, means for extending a calling line to one of said positions and means responsive to an operation of said operator's position for causing said calling line test circuit to select said calling line and to render said calling line test circuit unresponsive from other of said operators' positions as soon as said calling line has been initially selected.

47. In a telephone system, a plurality of telephone lines, a plurality of calling line test circuits for selecting a calling line, a plurality of operators' positions, means for extending a calling line to one of said positions and means responsive to an operation of said operator's position for causing one of said calling line test circuits to select a calling line, to render said calling line test circuit unresponsive from other of said operators' positions than the one to which said line is connected, and to render the other of said calling line test circuits responsive to the other of said operators' positions.

48. In a telephone system, a plurality of telephone lines each having an arbitrary designation, a calling line test circuit comprising a multi-contact relay, a test conductor for each of said plurality of telephone lines extending to contacts of said multi-contact relay, an operator's position, means for connecting a calling telephone line to said operator's position, means for operatively connecting said calling line test circuit with said position, and means responsive to the connection of said calling line with said operator's position and said calling line test circuit with said position for operating the multi-contact relay, and means at said operator's position and controlled by said test circuit for visibly indicating the arbitrary designation of said calling line at said operator's position.

49. In a telephone system, a plurality of telephone lines each having an arbitrary designation, a calling line test circuit comprising a multi-contact relay, a test conductor for each of said plurality of telephone lines extending to the contacts of said multi-contact relay, an operator's position, means for connecting a calling telephone line to said operator's position, a lamp indicating device at said operator's position, and means responsive to the connection of said calling line with said operator's position and the selection of said calling line by said calling line test circuit through the identification of its associated test conductor for operating said lamp indicating device for indicating the arbitrary designation of said calling telephone line at said operator's position.

HERBERT M. FRIENDLY.