Dec. 28, 1943. D. S. DEWIRE 2,337,875

TELEPHONE SYSTEM

Filed April 28, 1942 4 Sheets-Sheet 1

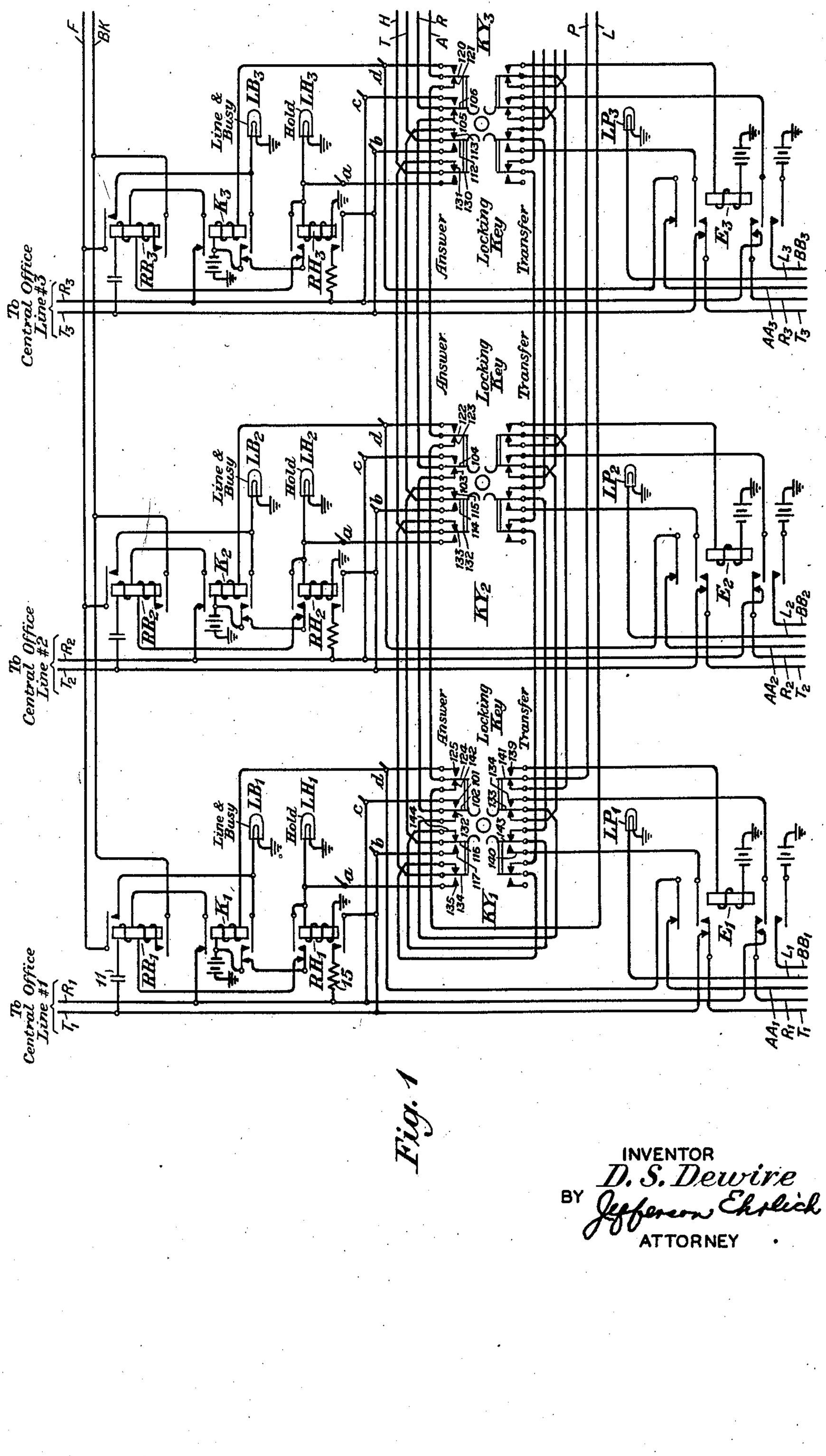

Fig. 1

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TELEPHONE SYSTEM

Filed April 28, 1942 4 Sheets-Sheet 2

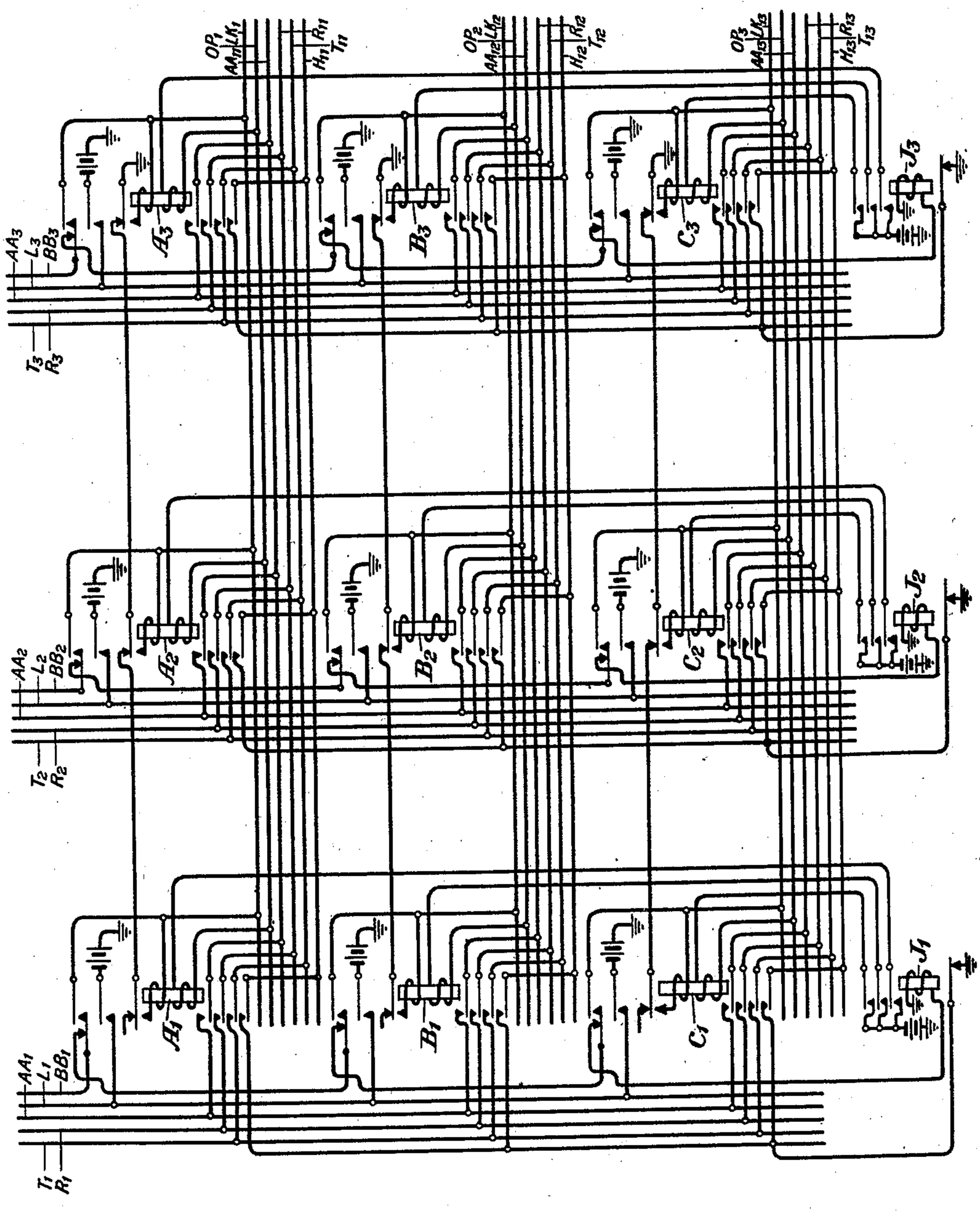

Fig. 2

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Dec. 28, 1943. D. S. DEWIRE 2,337,875

TELEPHONE SYSTEM

Filed April 28, 1942 4 Sheets-Sheet 3

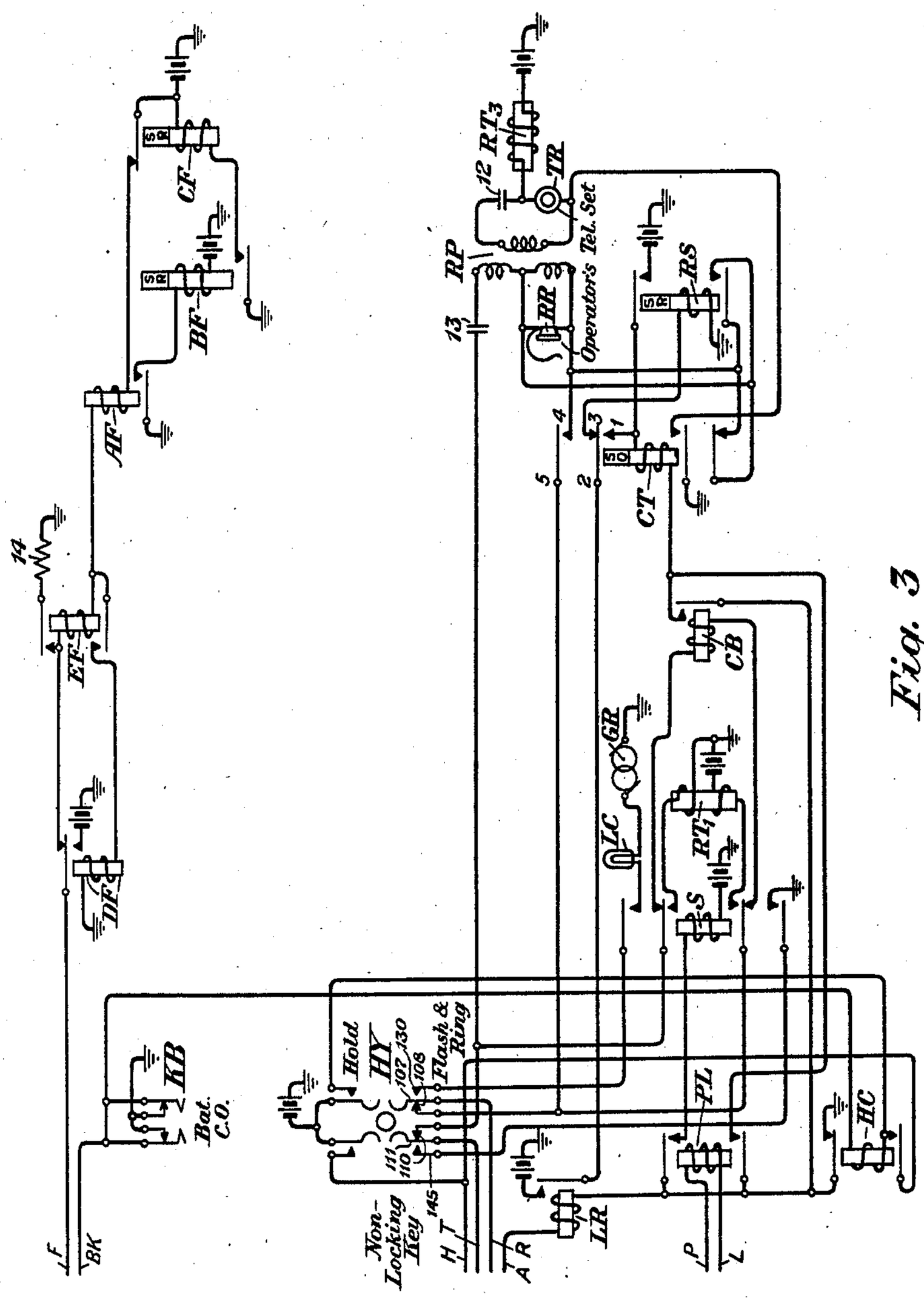

Fig. 3

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Dec. 28, 1943. D. S. DEWIRE 2,337,875

TELEPHONE SYSTEM

Filed April 28 1942 4 Sheets-Sheet 4

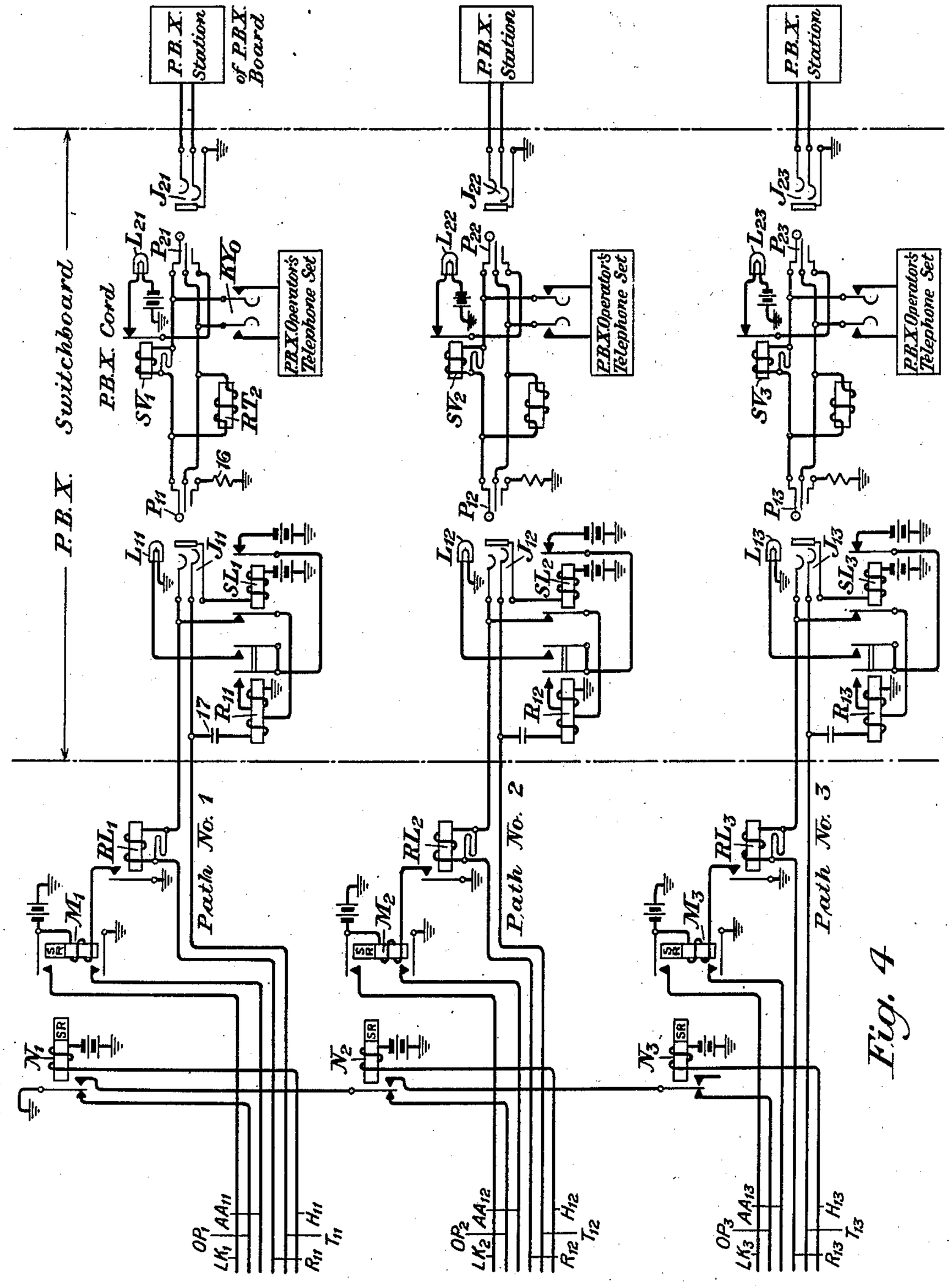

Fig. 4

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UNITED STATES PATENT OFFICE

2,337,875

TELEPHONE SYSTEM

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Application April 28, 1942, Serial No. 440,795

9 Claims. (Cl. 179—42)

This invention relates to telephone systems and more particularly to arrangements for transferring telephone connections, whereby connections extended to one point may be routed to another point.

The prior art contains a number of disclosures of telephone systems in which incoming telephone calls may be transferred from one called subscriber to another called subscriber. Generally such facilities are provided by special private branch exchange systems. The present invention contemplates a plurality of private branch exchange installations and an object of the invention is to transfer a call which arrives at one such private branch exchange installation to another such installation and especially where the two installations are in widely different localities. The present invention differs considerably from prior arrangements in several essential aspects, as will be pointed out hereinafter.

In order to more clearly understand this invention let it be assumed that a subscriber whose business is located in two widely different areas has two numbers published in the telephone directory, one for trunks terminated in an "order table" telephone installation in one of the areas and the other for a private branch exchange system located in the other area. An object of this invention is to provide means whereby incoming calls which are misrouted to the order table installation may be promptly transferred to the private branch exchange installation.

A primary object of this invention is to provide for the silent transfer of incoming calls received at one of the telephone installations to the other installation, whereby the calling party will be unaware that the transfer is being made and will be unable to hear any part of the conversation between the operators at the two installations.

Another object of this invention is to interconnect the order table installation with the private branch exchange or "P. B. X" installation by means of a plurality of paths and provide apparatus for automatically selecting one of the idle paths for completing the transfer of the incoming call. It is another object of this invention to employ relay apparatus to accomplish the automatic transfer operations.

It is another object of this invention to provide means at the order table installation to indicate to the operator thereat that the selection of one of the various paths to the P. B. X has been accomplished.

Another object of this invention is to provide apparatus for holding the calling party's line while the transfer operations are being performed and then to release the "hold" on the line after the transfer is completed.

Still another object of this invention is to prevent the simultaneous seizure of two or more of the paths to the P. B. X installation by any one of the lines which extend to the order table installation.

And it is a further object of this invention to prevent two telephone lines or trunks having incoming calls from being simultaneously connected to any one of the paths to the P. B. X.

These and other objects of this invention will be more clearly apparent from the more detailed description hereinafter following, when read in connection with the accompanying drawings in which Figures 1 to 4 illustrate one embodiment of the invention merely for illustrative purposes. In following the drawings Fig. 1 may be placed above Fig. 2 and Fig. 3 above Fig. 4, and then Figs. 1 and 2 placed at the left of Figs. 3 and 4, respectively.

In the drawings three of a plurality of telephone lines or trunks Nos. 1, 2 and 3 having conductors T_1—R_1, T_2—R_2 and T_3—R_3, respectively, are shown extending from a central office (not shown) to the order table only one of which is shown (but others may be multipled thereto). The order table includes, among other things, three (or more) keys KY_1, KY_2 and KY_3 which correspond to the three incoming lines or trunks and are used by the order table operator to answer incoming calls or transfer them to a P. B. X at a distant point. The order table and the P. B. X are connected to each other by a plurality of paths or lines R_{11}—T_{11}, R_{12}—T_{12}, R_{13}—T_{13}, etc., one of which may be selected by the order table operator by operation of any of the keys such as KY_1 to its transfer position. After one of these paths has been selected by the order table operator, she may then give oral instructions to the P. B. X operator concerning an incoming call intended for one of the parties available through the P. B. X. The conversation between operators will be inaudible to the calling party. When the calling and called parties are connected to each other, the order table operator's telephone set will normally be disconnected from the parties' talking circuit, although the operator may monitor the connection if necessary.

When ringing current is received from any one of the many lines extending between the central office and the order table installation as, for example, when ringing current is received over con-

ductors T_1 and R_1 of line No. 1, the relay RR_1 will be operated, the operating circuit including conductor T_1, condenser 11, the upper winding of relay RR_1, the upper armature and back contact of relay K_1 and conductor R_1. Relay RR_1 will then be locked in its operated position over a circuit which includes battery, the make-before-break contact associated with the lower armature of relay K_1, the make-before-break contact associated with the upper armature of relay RH_1, the lower winding of relay RR_1, the lower armature and make contact of relay RR_1, conductor BK, the contacts of key KB and ground. The operation of the relay RR_1 will connect the lamp LB_1 to the conductor F for the purpose of flashing the lamp LB_1, as will now be described.

The operation of relay RR_1 causes relays EF and AF of the interrupter circuit to be operated, the interconnecting circuit including ground, lamp LB_1, the contact and upper armature of relay RR_1, conductor F, the armature of relay DF and its back contact, the winding of relay EF, the winding of relay AF, the armature and back contact of relay CF and battery. The operation of relay EF will cause this relay and relay AF to be held operated under control of relay CF through a circuit including ground, resistance 14, the upper armature, make contact and winding of relay EF, winding of relay AF, armature and back contact of relay CF and battery. The operation of relay EF will also cause relay DF to become operated by completing a circuit including ground, the winding of relay DF, the lower armature of relay EF and its make contact, the winding of relay AF, the armature and back contact of relay CF and battery. Relay DF will in turn cause lamp LB_1 to become lighted over a circuit which includes ground, lamp LB_1, the contact and upper armature of relay RR_1, conductor F and battery connected to the make contact of relay DF. The operation of relay AF will result in the operation of relay BF by the completion of the circuit from battery, through the winding of relay BF, through the armature and contact of relay AF to ground. Relay BF in turn will cause relay CF to become operated by completing a circuit from battery to the winding of relay CF through the make contact of relay BF to ground. The operation of relay CF will then cause relays AF, EF and DF to be released by opening the circuit of the windings of these relays, the latter circuit including the lower armature and make contact of relay EF. The release of relay DF will extinguish lamp LB_1. The release of relay AF will break the circuit to the winding of relay BF—which is of the slow release type—and this relay will later release. Upon the release of relay BF the circuit to relay CF will be interrupted, relay CF—which is also of the slow release type—being released thereafter.

If, after the cycle of operations just described is completed, the lamp LB_1 is still connected to the conductor F through the upper armature of relay RR_1—that is, if relay RR_1 remains operated—the cycle of operations already described will be repeated again and again until relay RR_1 releases. It will be observed that lamp LB_1 is lighted when relay DF is operated, and extinguished when relay DF is released. This flashing lamp will attract the order table operator's attention.

Upon observing the flashing lamp LB_1, the operator at the order table installation (who will be referred to also as operator No. 1) will answer the call by operating her key KY_1—which corresponds to the incoming line No. 1 conductors T_1 and R_1—to the upper or answer position. This will connect the conductors T_1 and R_1 of the line No. 1 to the telephone set of operator No. 1, as will now be described.

Immediately upon the operation of the key KY_1 to the answer position, the relay CB (in Fig. 3) will become operated, the interconnected circuit including the conductor R_1 to which battery is connected at the central office, contacts 101 and 102 of key KY_1, contacts 103 and 104 of key KY_2, contacts 105 and 106 of key KY_3, conductor R, contacts 107 and 108 of the key HY, the lower inner armature and back contact of relay S, the winding of relay CB, the upper inner armature and back contact of relay S, contacts 110 and 111 of key HY, conductor T, contacts 112 and 113 of key KY_3, contacts 114 and 115 of key KY_2, contacts 116 and 117 of key KY_1 to conductor T_1 which is grounded at the central office. Relays LR and K_1 are also operated over a circuit which includes ground at the upper back contact of the relay HC, the winding of relay LR, conductor A, contacts 120 and 121 of key KY_3, contacts 122 and 123 of key KY_2, contacts 124 and 125 of key KY_1, the winding of relay K_1 and battery. The operation of relay LR causes relay RS to operate over a circuit which includes battery connected to the make contact of relay LR, the back contact of the upper inner armature of relay CT, the winding of relay RS and ground. Relay RS then causes relay CT to become operated, the interconnecting circuit including battery connected to the upper make contact of relay RS, the winding of relay CT, the make contact of relay CB, the back contact of the upper armature of relay HC and ground. Relay CT then locks in its operated position, the locking circuit being completed through the upper inner make contact of relay CT and the make contact of relay LR to battery which is connected to the latter contact.

Upon the operation of relay CT the circuit extending to the winding of relay RS is opened, whereupon relay RS releases. It will be observed that before relay CT is operated, operator's telephone set receiver RR is short-circuited by the lower armature and back contact of relay CT so that no clicks will be heard by operator No. 1 while the ringing from the central office is being tripped. When relay RS operates, this short circuit is continued by the lower armature and make contact of relay RS. The short circuit around the receiver RR will be removed, however, as soon as relay CT operates and relay RS releases. The operator's transmitter TR will receive current when relay CT is operated, current being supplied over a circuit which includes battery connected through retard coil RT_3 to the upper terminal of transmitter TR, the transmitter TR and ground connected to the lower inner make contact of relay CT. The flow of current through the transmitter TR enables operator No. 1 to talk to the calling party connected to line No. 1 through the central office. The transmitter TR is connected to the repeating coil RP through a condenser 12, the other winding of the repeating coil being connected to line No. 1 through a condenser 13. The circuit interconnecting the latter winding of the repeating coil to the conductors T_1 and R_1 of line No. 1 includes contacts 110 and 111 of key HY, conductor T, contacts 112 and 113 of key KY_3, contacts 114 and 115 of key KY_2, contacts 116 and 117 of key KY_1, conductors T_1

and R_1, contacts 101 and 102 of key KY_1, contacts 103 and 104 of key KY_2, contacts 105 and 106 of key KY_3, conductor R, contacts 107 and 108 of key HY and the upper outer armature and make contact of relay CT. It will be observed that this talking circuit includes an armature of relay CT. This insures that the circuit of the calling subscriber will be completed only after relay CT has been operated.

Upon the operation of relay K_1 pursuant to the closure of key KY_1 to its answer position, the lamp LB_1 will then be changed from a flashing condition to a steadily lighted condition as a busy indication, the steady current being supplied to lamp LB_1 from the battery connected to the lower armature and make contact of relay K_1. The operation of relay K_1 will also cause relay RR_1 to release. It will be seen that relay K_1 controls both the operating and locking circuits of relay RR_1 by means of its upper and lower armature contacts, respectively. After the circuit between the calling subscriber connected to line No. 1 and operator No. 1 has been completed, operator No. 1 may then talk to the calling party and learn that the calling party desires to converse with some one who may be reached only through the P. B. X. In that case the operator will take steps to transfer the calling party to the P. B. X. which is, of course, located at a point distant from the order table.

Operator No. 1 will then operate her holding key HY, which is of the non-locking type, to its upper or "hold" position, at the same time leaving key KY_1 in its "answer" position. This will cause relay RH_1 to become operated, the operating circuit for relay RH_1 including battery connected to the upper left swinger of key HY, conductor H, the contacts 130 and 131 of key KY_3, contacts 132 and 133 of key KY_2, the contacts 134 and 135 of wey KY_1, the winding of relay RH_1 and ground. The operation of key HY to its "hold" position will further cause lamp LH_1 to be lighted over the same circuit except that lamp LH_1 may be substituted for the winding of relay RH_1. The operation of key HY to its "hold" position will also cause relay HC to be operated, the operating circuit for relay HC including battery connected to the upper right swinger of key HY, the winding of relay HC, the contacts of the key KB and ground. The operation of relay HC will open the ground connection to the windings of relays CT, LR and K_1 at the upper back contact of relay HC (the circuit to the winding of relay K_1 was previously completed over contacts of keys KY_1 to KY_3 and the upper armature and back contact of relay HC). The release of relay K_1 causes relay RH_1 to be locked in its operated position, the locking circuit for relay RH_1 including the upper armature and make contact of relay RH_1, the make-before-break contact associated with the lower armature of relay K_1 and battery. The operation of relay RH_1 connects a resistance 15 across the conductors T_1 and R_1 of line No. 1 to "hold" the line No. 1 until it is completely transferred to the P. B. X. The operation of relay RH_1 also causes lamp LH_1 to be kept lighted, the circuit for lamp LH_1 now including battery, the make-before-break contacts associated with the lower armature of relay K_1, the upper armature and make contact of relay RH_1, the lamp LH_1 and ground. The lamp LB_1 is extinguished upon the release of relay K_1. It will be observed therefore that the "hold" lamp LH_1 will be lighted to replace the previously lighted lamp LB_1. Thus the operator No. 1 will be provided with positive indicating means to indicate to her that she is holding line No. 1.

The operation of relay HC will also provide a locking circuit for that relay so that the LR and K_1 relays will be prevented from operating when the key HY is restored to its normal position. The locking circuit for relay HC includes the lower armature and make contact of relay HC, conductor H, contacts 130 and 131 of key KY_3, contacts 132 and 133 of key KY_2, contacts 134 and 135 of key KY_1, the upper armature and make contact of relay RH_1, the make-before-break contact of relay K_1 and battery.

In order to transfer the calling line No. 1 to the P. B. X, the operator No. 1 will first restore key KY_1 to its normal position. This will cause relay HC to be released, will open the operating circuit for relays K_1 and LR, and will disconnect the conductors T_1 and R_1 of line No. 1 from the telephone circuit of operator No. 1. Operator No. 1 will then operate key KY_1 so as to close its lower or "transfer" contacts. The operation of the key KY_1 to the "transfer" position will complete a connection from the order table to the P. B. X circuits, as will now be described.

The operation of key KY_1 to the "transfer" position will cause the windings of relays E_1, PL and LR to be connected in series with each other. The series circuit will include battery connected to the winding of relay E_1, the winding of relay E_1, contacts 139 and 141 of key KY_1, conductor P, the winding of relay PL, conductor L, contacts 142 and 124 of key KY_1, contacts 123 and 122 of key KY_2, contacts 121 and 120 of key KY_3, conductor A, the winding of relay LR, the upper armature and back contact of relay HC and ground. The operation of relay PL will cause the operation of relay S over a circuit including the winding of relay S and the battery connected thereto, the upper armature and make contact of relay PL and the upper armature and back contact of relay HC. The operation of relay LR will cause the operation of relay RS and CT and the subsequent locking of relay CT and release of relay RS as hereinbefore described, except that relay CT will operate and lock through the lower make contact of relay PL instead of through the make contact of relay CB. These operations prepare the telephone circuit for talking. The operation of relay E_1 will connect battery to the conductor BB_1 which extends to relay J_1 to ground, whereupon relay J_1 will become operated. The circuit for operating relay J_1 includes battery connected to the lower outer armature and make contact of relay E_1, conductor BB_1, the make-before-break contacts associated with the upper outer armatures of relays A_1, B_1 and C_1, the winding of relay J_1 and ground. The operation of relay J_1 will connect battery to the upper terminals of the lower or operating windings of relays A_1, B_1 and C_1 by means of the the three upper armatures respectively of relay J_1. One of the relays A_1, B_1 or C_1 will then be operated, the particular relay operated depending upon the conditions of relays N_1, N_2 and N_3 which are respectively associated with the three paths shown interconnecting the order table with the P. B. X. This will now be more fully explained.

If the relays N_1, N_2 and N_3 are in their released positions, then the relay A_1 will alone be operated in response to the operation of relay J_1. This is because the lower terminal of the operating winding of relay A_1 is then grounded over the conduc-

tor OP_1 and the back contact of the armature of relay N_1. The lower terminals of the operating windings of relays B_1 and C_1, will, however, remain ungrounded and, therefore, the relays B_1 and C_1 will remain released. Thus the relay A_1 corresponding to the first path to the P. B. X will be operated to the exclusion of other relays corresponding to the other paths extending to the P. B. X.

If relay N_1 is found operated and relay N_2 released at the time when relay J_1 is operated, then the relay B_1 becomes operated, the lower terminal of the operating winding of relay B_1 being grounded over a circuit including conductor OP_2, the back contact of the armature of relay N_2 and the make contact of the armature of relay N_1. In that case the relay B_1 will become operated.

On the other hand, if relays N_1 and N_2 are both operated and relay N_3 alone released, then the relay C_1 will be operated because the lower terminal of its operating winding will become grounded over a circuit which includes conductor OP_3, the back contact of the armature of relay N_3, the make contact of relay N_2, and the make contact of relay N_1.

If all three relays N_1, N_2 and N_3 are operated at the time when a call is received over one of the incoming lines, then in that case no path will be available for transferring the call to the P. B. X.

After one of the relays such as A_1, for example, operates, as already noted hereinabove, it will then release relay J_1. This is accomplished by opening the circuit to the winding of relay J_1 at the make-before-break contact of the upper outer armature of the relay A_1. Relay A_1 will also lock itself in its operated position over a circuit which includes battery connected to the lower outer armature of relay E_1, the conductor BB_1, the upper outer make contact of relay A_1, the upper or locking winding of relay A_1, the make contact of the inner upper armature of relay A_1, the back contact of the upper inner armature of relay A_2, the back contact of the upper inner armature of relay A_3 and ground.

If two incoming calls over, for example, lines Nos. 1 and 2 are being transferred simultaneously by two different order table operators at a time when, for example, relays A_1, B_1 and C_1 and relays A_2, B_2 and C_2 are in their released positions, a situation will be developed in which both relays A_1 and A_2 will be operated simultaneously. This is because both relays J_1 and J_2 become operated simultaneously in response to the operation of relays E_1 and E_2, respectively, all of which occurs pursuant to the operation of keys KY_1 and KY_2 to their "transfer" positions. But relays J_1 and J_2 release due to the opening of the circuits in series, respectively, with their windings at the make-before-break contacts associated with the upper outer armatures of relays A_1 and A_2. In that event only the relay A_2 can remain operated because its locking circuit will be completed through the upper inner make contact of the relay A_2 and the back contact of the upper inner armature of relay A_3. The locking circuit for relay A_1, although closed at the upper inner make contact of relay A_1, is opened at the upper inner back contact of relay A_2. The operation of relay A_2 thus prevents relay A_1 from being locked in its operated position. In other words, relay A_2 will remain operated because its locking circuit is completed; relay A_1 will become released because its locking circuit remains open due to the operation of relay A_2. Thus a double connection to a single path between the order table and the P. B. X is definitely avoided. This is an important feature of this circuit. Positive means are provided to restrict each path to the P. B. X to a single line from the central office.

Under the circumstances just noted, the release of relay A_1 will cause relay J_1 to become reoperated over the circuit previously described. Then relay B_1 or relay C_1 may be operated upon the reoperation of relay J_1 to connect the incoming line No. 1 to path No. 2 or path No. 3 extending to the P. B. X. Thus, when three operators at the order table operate their keys KY_1–KY_3 and cause relays A_1 to A_3 to become operated at the same time, only that relay will remain operated to complete a path to the P. B. X, which has the highest subscript, namely relay A_3. The other lines will be shifted to paths Nos. 2 and 3 controlled by the B and C (and other like) relays. The relays A_1 to A_3 therefore provide a so-called "horizontal lockout" or allotter circuit. This "horizontal lockout" or allotter circuit is employed to prevent two or more incoming lines from being connected to a single path extending to the P. B. X. Relays B_1 to B_3 provide another "horizontal lockout" or allotter circuit, and so on.

After relay A_1 operates and locks (relays A_2 and A_3 being released) and relay J_1 is released, then relay N_1 becomes operated. The operating circuit for relay N_1 includes the winding of relay N_1 and the battery connected thereto, conductor H_{11}, the lower outer armature of relay A_1 and its make contact, the lower armature and back contact of relay J_1 and ground. The operation of relay N_1 removes ground from the conductor OP_1. This renders path No. 1 to the P. B. X busy to other incoming lines from the central office. The operation of relay N_1 advances the ground connection to conductor OP_2 associated with path No. 2 extending to the P. B. X. The ground circuit to conductor OP_2 now includes the back contact of the armature of relay N_2 and the make contact and armature of relay N_1. It will be understood, of course, that after relay N_2 becomes operated in response to the release of relay J_2, path No. 2 likewise will be rendered busy to incoming telephone lines and the grounding circuit for conductor OP_3 associated with path No. 3 will be completed through the make contacts of the armatures of relays N_1 and N_2. The arrangement of relays N_1 to N_3 therefore provides a "vertical lockout" or allotter circuit which is employed to prevent the connection of more than one path to a single incoming telephone line such as line No. 1.

The operation of relay A_1 also closes a circuit to interconnect the operator at the order table with the operator at the P. B. X. The operation of relay A_1 connects battery at the second upper make contact of that relay over the conductor L_1 to the lamp LP_1 in order to light this lamp. This lamp is employed to indicate to the operator No. 1 that a path to the P. B. X has been selected. If all paths are busy the lamp LP_1 will not be lighted. The lamps LP_1—LP_3 are therefore employed to notify the various operators at the order table that a path has been selected for interconnecting the calling party on line No. 1 with the P. B. X.

When an operator at the order table observes that lamp LP_1 is lighted she will then operate the key HY to its "flash and ring" position. This is employed to transmit ringing current to the P. B. X as will now be pointed out.

The operation of the key HY to the "flash and ring" position causes ringing current to flow from ringing generator GR through relay R_{11}. The interconnecting circuit includes generator GR, the lamp LC, the upper outer make contact of relay S, the contacts 130 and 107 of key HY, conductor R, contacts 106 and 105 of key KY_3, contacts 104 and 103 of key KY_2, contacts 102, 132, 133 and 134 of key KY_1, the lower inner make contact of relay E_1, conductor R_1, the second lower make contact of relay A_1, conductor R_{11}, the winding of relay RL_1, the back contact of the left armature of relay SL_1, the left or operating winding of relay R_{11}, the condenser 17, the conductor T_{11}, the third lower make contact of relay A_1, conductor T_1, the upper inner make contact of relay E_1, contacts 140, 143, 144 and 116 of key KY_1, contacts 115 and 114 of key KY_2, contacts 113 and 112 of KY_3, conductor T, contacts 111 and 145 of key HY, the lower outer armature and make contact of relay S, and ground. The operation of relay R_{11} in response to the ringing current from generator GR causes relay R_{11} to be locked in its operated position, the locking circuit including ground, the right or locking winding of relay R_{11}, the inner make contact of relay R_{11}, the right back contact of relay SL_1 and battery. The operation of relay R_{11} causes lamp L_{11} to be lighted to attract the attention of the P. B. X operator.

When the P. B. X operator observes that the lamp L_{11} is lighted she will then connect her cord to the jack J_{11} immediately below the lamp L_{11}. This will cause relay SL_1 to become operated, the operating circuit including the winding of relay SL_1 and the battery connected thereto, the sleeve contacts of jack J_{11}, and plug P_{11} and resistance 16 to ground. The operation of relay SL_1 releases relay R_{11} and extinguishes lamp L_{11} by opening the circuit to the locking winding of relay R_{11} and to lamp L_{11} at the back contact of the right armature of relay SL_1.

The connection between plug P_{11} and jack J_{11} also causes relay RL_1 to be operated, the operating circuit including the winding of relay RL_1, the tip contacts of jack J_{11} and plug P_{11}, the retard coil RT_2, the ring contacts of plug P_{11} and jack J_{11}, conductor T_{11}, the third lower make contact of relay A_1, the conductor T_1 which is connected to ground, conductor R_1 which is connected to battery, the second lower make contact of relay A_1, conductor R_{11} to the winding of relay RL_1. Conductors T_1 and R_1 are connected to ground and battery, respectively, through operated contacts of relay E_1 and the "transfer" portion of key KY_1, normal contacts of the "answer" portion of keys KY_1, KY_2 and KY_3, normal contacts of the "flash and ring" portion of key HY, operated contacts of relay S and windings of retard coil RT_1. The operation of relay RL_1 operates relay M_1, the circuit for operating relay M_1 including the battery connected to the winding of relay M_1, the make contact of relay RL_1 and ground. The operation of relay M_1 is employed to connect battery through its upper make contact to the conductor LK_1 which is connected to the locking winding of relay A_1, thereby holding relay A_1 operated after the key KY_1 is restored to its normal or neutral position.

The P. B. X operator may then operate the key KY_0 connected to her cord circuit in order to talk to the operator at the order table. The calling subscriber on line No. 1 will be unable to hear this conversation between the two operators because the circuit to the central office will be open at the inner make contacts of the relay E_1. This is a feature of this arrangement. By this arrangement the calling party will remain unaware that a switching operation has been performed and that instructions have been passed between operators to establish a path circuit to a party available through the P. B. X.

After receiving instructions from the operator at the order table, the P. B. X operator will then connect the plug P_{21} at the other end of her cord circuit to the jack J_{21} to add one of the P. B. X stations to the circuit. The ringing circuit to the P. B. X station is obvious to those skilled in the art and is not shown herein. After plug P_{21} engages jack J_{21}, lamp L_{21} will be lighted, the circuit for lamp L_{21} including battery connected to lamp L_{21}, the back contact of relay SV_1, the sleeve contacts of plug P_{21} and jack J_{21} and ground. When the P. B. X station handset is then lifted from its mounting, relay SV_1 will be operated, thereby extinguishing lamp L_{21}.

After receiving oral acknowledgment from the P. B. X operator that the call over line No. 1 is being completed, the order table operator will then restore her key KY_1 to its normal or neutral position. This will release relay E_1 by opening the circuit to its winding at the contact 139 of key KY_1. The release of relay E_1 will break the talking circuit to the operator at the order table at contacts 134 and 140 of key KY_1. The calling subscriber can then talk to the desired party at the P. B. X station free from any control by the operator at the order table. The order table operator may, however, monitor on the circuit by operating the key KY_1 to the "answer" position if she desires to do so. The calling subscriber is now connected to the P. B. X station through the make-before-break contacts of the upper and lower inner armatures of relay E_1. The important function of relay E_1 is to establish connections between the calling party on line No. 1 and the desired P. B. X station and at the same time remove all control of the circuit from the order table operator when the connections are completed.

The release of relay E_1 causes relay K_1 to become operated, the operating circuit for relay K_1 including battery connected to the winding of relay K_1, the upper outer armature and back contact of relay E_1, conductor AA_1, the lower inner make contact of relay A_1, conductor AA_{11}, the lower make contact of relay M_1 and ground. The operation of relay K_1 will open the locking circuit to relay RH_1 at the make-before-break contact of the lower armature of relay K_1, which will release relay HR_1 and extinguish the lamp LH_1 which previously indicated that the line No. 1 was being held by the order table operator. The release of relay RH_1 will also remove the shunt resistor 15 from the incoming line conductors T_1 and R_1. The operation of relay K_1 will also cause the lamp LB_1 to light steadily as a busy indication, as hereinbefore described.

It will be observed that the calling subscriber connected to the conductors T_1 and R_1 is now connected to one of the P. B. X stations over path No. 1 between the order table and the P. B. X. This circuit may now be traced from conductor T_1 through the make-before-break contact of the inner upper armature of relay E_1, conductor T_1, the third lower make contact of relay A_1, conductor T_{11}, the ring contacts of jack J_{11} and plug P_{11}, the ring contacts of plug P_{21} and jack J_{21}, the P. B. X station, the ring contacts of jack J_{21} and plug P_{21}, the winding of relay

SV_1, the tip contacts of plug P_{11} and jack J_{11}, the winding of relay RL_1, conductor R_{11}, the second lower make contact of relay A_1, to conductor R_1 over the lower inner-make-before-break contact of relay E_1. The circuit between the calling subscriber and the desired P. B. X station is now therefore held by the flow of current through the winding of relay RL_1 from the central office over the conductors T_1 and R_1. In this circuit the retardation coil RT_2 of the P. B. X operator's cord circuit is connected in parallel with the P. B. X station connected to the P. B. X operator's cord circuit. Moreover, the key KY_0 enables the P. B. X operator to monitor the circuit if she desires to do so.

After the conversation between the calling party and the party at the P. B. X station is completed and the handset of the P. B. X station is restored to its mounting, the relay SV_1 will then release. The release of SV_1 will light lamp L_{21} by completing the circuit to L_{21} at the back contact of relay SV_1.

Upon observing this lighted lamp the P. B. X operator will then disconnect the plugs P_{11} and P_{21} of her cord circuit from the jacks J_{11} and J_{21}, respectively. When this happens the sleeve relay SL_1 will be released and relay RL_1 will also be released. The release of relay RL_1—which, as previously noted, controlled the circuit between the calling party and the P. B. X station—will release relay M_1 by opening the circuit of the winding of relay M_1 at the make contact of relay RL_1. The release of relay M_1 will then disconnect battery at its upper armature from the locking winding of relay A_1 whereupon relay A_1 will release, and will also cause relay K_1 to be released by opening the circuit in series with the winding of relay K_1 at the lower make contact of relay M_1. The release of relay K_1 will then extinguish the lamp LB_1 by breaking the circuit to this lamp at the lower make contact of relay K_1. The release of relay A_1 will release relay N_1. The relays and circuits corresponding to line No. 1 will be returned to their normal conditions both at the order table and at the P. B. X and the arrangement will be thereby prepared for another incoming call.

While the arrangement has been described for establishing connections between the line No. 1 and one of the P. B. X stations, similar circuits and methods of operation are involved in establishing connections between any of the other lines and any of the other P. B. X stations.

While this invention has been shown and described in certain particular arrangements merely for the purpose of illustration, it will be understood that the general principles of this invention may be applied to other and widely varied organizations without departing from the spirit of the invention and the scope of the appended claims.

What is claimed is:

1. In a telephone system, the combination of a central office, a group of lines extending from said central office to a subscriber's premises at a first location, a plurality of circuits interconnecting said premises at said first location with the subscriber's premises at a second location remote from the first location, means controlled by the operator at the subscriber's premises at said first location to connect any one of said incoming lines through one of said circuits that is idle to the subscriber's premises at the second location so that the calling party may talk with the called party at the second location, said means including switching apparatus including a relay having contacts arranged to open the circuit between the incoming line to which the calling party is connected and the circuits to which the operators at said first and second locations to prevent the calling party connected to the incoming line from hearing the conversation between the operators at the two premises.

2. In a telephone system, the combination of a plurality of incoming lines extending from a central office to a subscriber's premises at a first location, a plurality of paths interconnecting said premises at said first location with the subscriber's premises at a second location which is remote from the first location, means controlled by the operator at the first location to connect automatically any one of said incoming lines to one of said paths to the subscriber's premises at the second location without permitting the calling party connected to said incoming line from hearing the conversation between the operators at said first and second locations, said means including means to select only one of said paths that is idle to the exclusion of all other paths.

3. In a telephone system, the combination of a plurality of incoming lines extending to a subscriber's premises at a first location, a plurality of paths interconnecting the subscriber's premises at the first location and the subscriber's premises at a second location which is different from the first location, means controlled by the operator at the first location for selecting only one of said paths that is idle to which one of the incoming lines may be connected, means to prevent the calling party on the incoming line from hearing the conversion between the operators at the two subscribers' premises and means to apprise the operator at the first location that an idle path has been selected.

4. In a telephone system, the combination of a plurality of incoming lines, a plurality of receiving circuits at a subscriber's first premises, a P. B. X at the subscriber's second premises which are located at a point remote from the first premises, said P. B. X having a plurality of telephone stations, and means for transferring an incoming line connected to one of the receiving circuits at the first premises to one of the P. B. X stations without the calling party hearing the conversation between the operators at both premises.

5. In a telephone system, the combination of a plurality of incoming telephone lines, a plurality of receiving circuits at a subscriber's first premises, a P. B. X having a plurality of stations located at the subscriber's second premises which are remote from the first premises, means for transferring an incoming line connected to one of the receiving circuits at the first premises to the P. B. X without the calling party hearing the conversation between the operators at both premises, and means to prevent more than one incoming line from being connected to any one P. B. X station.

6. In a telephone system, the combination of a plurality of incoming telephone lines connected to a subscriber's first premises, a P. B. X having a plurality of stations located at the subscriber's second premises which are remote from the first premises, a plurality of paths interconnecting the first premises with said P. B. X, means controlled by the operator at the first premises for transferring an incoming line to one of said paths that is idle for connection to one of the P. B. X stations without the calling party hearing the con-

versation between the operators at the first premises and at the P. B. X.

7. In a telephone system, the combination of a plurality of incoming telephone lines connected to a subscriber's first premises, a P. B. X located at the subscriber's second premises which are remote from the first premises, a plurality of paths interconnecting the two premises, a single switch controlled by the operator at the first premises, means responsive to the operation of said switch for selecting one of the idle paths between the premises for connecting an incoming line thereto, means controlled by said switch to prevent the calling party from hearing the conversation between the operators at the two premises over the selected path, and means for preventing a second incoming line from being connected to the same path to which the first incoming line is connected.

8. In a telephone system, the combination of a plurality of incoming telephone lines extending to a subscriber's first premises, a P. B. X located at the subscriber's second premises which are remote from the first premises, a plurality of paths interconnecting both premises, a switch controlled by the operator at the first premises, means responsive to the operation of said switch to select one of the idle paths for connecting an incoming line thereto and to prevent the party connected to the incoming line from hearing the conversation between the operators at said first and second premises, and means responsive to the selection of an idle path to indicate at the first premises that one of said paths has been made available for the transfer of an incoming line.

9. In a telephone system, the combination of a plurality of incoming telephone lines connected to a subscriber's first premises, a P. B. X located at the subscriber's second premises which are remote from the first premises, a plurality of paths interconnecting both premises to any one of which an incoming line may be connected under the control of the operator at the first premises, means controlled by the operator at the first premises for selecting one of the idle paths and for indicating at the first premises that an idle path has been selected, means to prevent more than one incoming line from being connected to the selected path, means to prevent two paths from being simultaneously connected to a single incoming line, and means to prevent the party connected to an incoming line from hearing the conversation between the operators at said first and second premises.

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