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TELEPHONE SYSTEM

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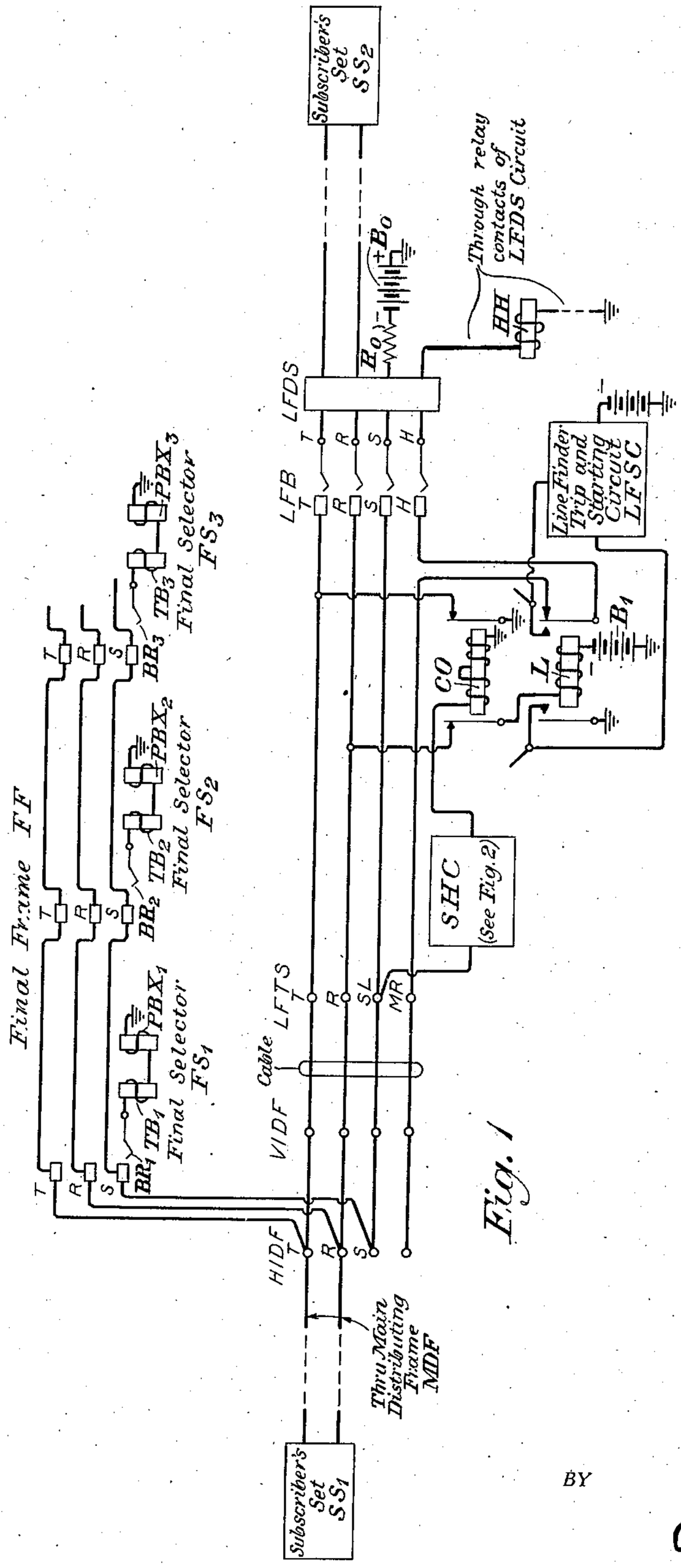

Fig. 1

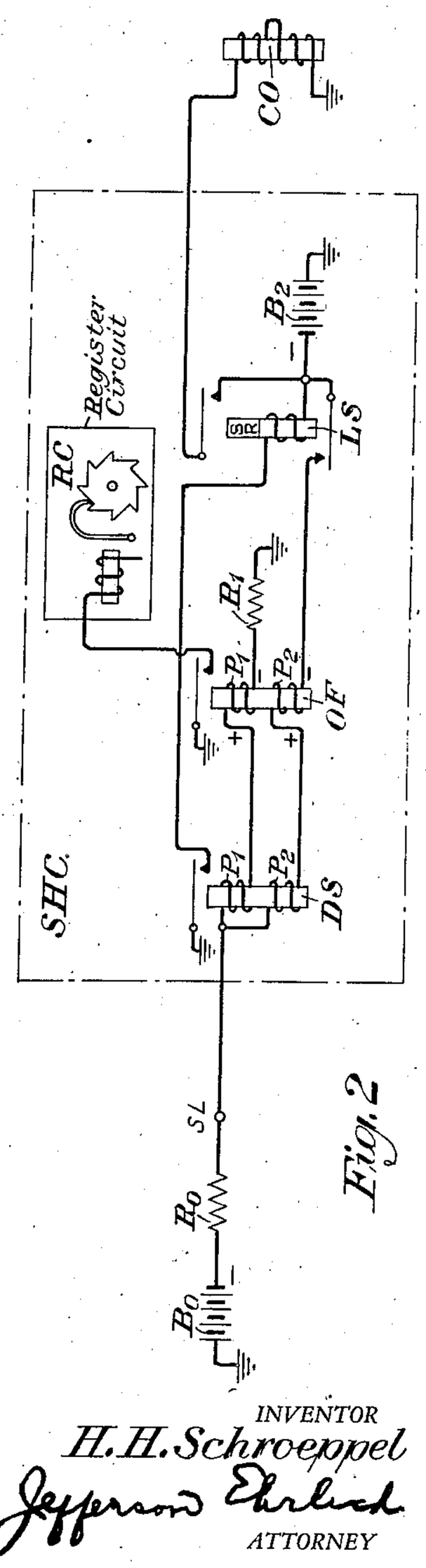

Fig. 2

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TELEPHONE SYSTEM

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This invention relates to telephone systems and more particularly to telephone systems of the panel type.

In panel telephone systems it sometimes happens that after a connection between a calling party and a called party has been completed a number of additional parties will simultaneously seek a connection to one of the busy parties, such as the calling party. Such a condition will arise where the calling party has one or more assigned lines but the traffic to the calling party is sometimes much heavier than the available lines can carry. Under such conditions the central office switching apparatus may act erroneously to connect some or all of the additional calling parties to a different line assigned to a party other than the one called. This will cause considerable annoyance not only to the calling parties who have been given the wrong number, but also to the party or parties who may receive such calls in error. It is an object of this invention to overcome the type of difficulty just referred to by providing improved apparatus to return a busy signal to a considerable number of calling parties who practically simultaneously endeavor to reach a busy party.

The central office switching failure responsible for the undesirable conditions above referred to arises from the simultaneous connection of the relays of a plurality of final selectors to a single sleeve terminal of the final frame associated with the busy party's line. The relay circuits of the different final selectors are connected effectively in parallel with each other from the same sleeve terminal and the parallel paths of these final selector relays receive reduced current from a common central office battery through a resistor of predetermined magnitude. If the relays of one final selector are connected to the final frame sleeve terminal the voltage available to the relays of but one final selector will be sufficient to satisfactorily control their operation. When the relays of several final selectors are bridged to the same sleeve terminal, however, the available voltage for controlling the operation of the groups of final selector relays will be insufficient for this purpose. Consequently the final selector relays will fail to operate properly. The up-drive mechanism controlled by these final selectors will therefore continue to hunt to the next line at the final frame to establish a telephone connection between that next line and the various calling parties. As the party connected to the next line is different from the one called by the various parties, the confusion above referred to will take place.

One of the primary objects of this invention is to modify the central office equipment of a panel type of telephone system so that when a plurality of parties are calling a busy party at about the same time, all of the calling parties will unfailingly be given a busy signal.

Another primary object of this invention is to prevent the erroneous connection of parties calling a busy party to still another party different from the desired party.

The objects and features of this invention will be more readily understood from the more detailed description hereinafter following when read in connection with the accompanying drawing in which Figure 1 shows the invention generally applied to part of the central office equipment of a panel type of telephone system, and Fig. 2 shows in simplified form only the parts of the central office equipment comprising the invention.

Fig. 1 shows as much of the central office equipment as is required to explain the invention. Here one of a number of subscribers having the telephone subscriber's set SS_1 desires to call the party having the subscriber's set SS_2. When the calling party removes the receiver from the switchhook of the subset SS_1, a line relay L will be operated over a circuit extending from ground on the right armature and the back contact of the cut-off relay CO through equipment including the T terminal of the line finder terminal strip LFTS, the vertical side of the intermediate distributing frame VIDF, the horizontal side of the intermediate distributing frame HIDF, the main distributing frame MDF, through the subset SS_1, then through equipment including the ring terminals R of the main distributing frame MDF, the horizontal side of the intermediate distributing frame HIDF, the vertical side of the intermediate distributing frame VIDF, the line finder terminal strip LFTS, then over the back contact and left armature of the cut-off relay CO, through the winding of line relay L, to grounded battery B_1. The operation of the line relay L serves to operate the line finder start and trip mechanism LFSC by the completion of an obvious circuit extending through the left armature and make contact of line relay L. The line finder mechanism LFSC starts the operation of apparatus to cause the line finder district selector circuit LFDS associated with the same line finder mechanism LFSC to hunt for the calling line to which the subset SS_1 is connected. After the

calling line is located, an idle trunk is found to connect the subset SS_1 of the calling party to the subset SS_2 of the called party through the terminating portion of the panel central office equipment (not shown).

It will be observed that the subset SS_2 of the called party is connected through the line finder-district selector circuit LFDS to the tip and ring terminals T and R of the line finder bank LFB and that these same terminals extend to the calling party's subset SS_1. It will also be observed that the line finder district selector LFDS connects a central office battery B_0 through resistor R_0 and through the sleeve terminal S of the line finder bank LFB to the sleeve terminal SL of the line finder terminal strip LFTS. The resistance R_0 is the effective impedance in series with the central office battery B_0. Inasmuch as the sleeve terminal S of the line finder bank LFB is connected to the sleeve terminal SL of the line finder terminal strip LFTS, the battery B_0 will be connected to the winding of the cut-off relay CO through resistor R_0 and through the circuit mechanism SHC, whereupon the cut-off relay CO will become operated. The mechanism of circuit SHC will be more fully described with reference to Fig. 2. The operation of relay CO will open the circuit to line relay L at the back contacts of the right and left armatures of relay CO, whereupon relay L will release. The release of relay L will release the line finder trip and start mechanism LFSC by opening the circuit thereto at the make contacts of the right and left armatures of line relay L.

It will be observed that when line relay L operates, it connects a ground to the line finder trip and start circuit LFSC through its left armature to cause the district selector LFDS to start moving up to find the calling line as already noted. Line relay L also connects battery through a resistance (not shown) in the line finder start and trip circuit LFSC to the hunt terminal H of the line finder bank LFB. When the H brush of district selector LFDS reaches terminal H, the battery from the line finder trip circuit described above causes the relay HH in the district selector LFDS to operate, stopping the up-drive. The district selector LFDS then applies battery B_0 through resistance R_0 through the circuit mechanism SHC to the winding of the cut-off relay CO, causing it to become operated. Although the circuit and mechanism designated SHC is shown in series with the cut-off relay CO, no such circuit or mechanism was used heretofore, the sleeve contact SL of the terminal strip LFTS being directly connected to the winding of relay CO.

It is noted that the tip, ring and sleeve contacts T, R and S, respectively, of the horizontal side of the intermediate distributing frame HIDF are connected to the multiple contacts T, R and S of the final frame FF associated with the calling line. When the line finder district selector LFDS reaches the position shown in the drawing, the battery B_0 will also be connected through resistor R_0 to the multiple sleeve contacts S of the final frame FF. The presence of battery potential on these sleeve contacts is intended to indicate to any other party calling the number of the subscriber's station SS_1 that that party is busy. This busy signal is returned by the final selector relay apparatus, as will now be briefly explained.

If the line connected to subset SS_1 is either an individual line or the last line of a private branch exchange group and has originated a call to another subscriber's set such as SS_2, then when another party (not shown) dials the number corresponding to subset SS_1, the brush BR_1 of the final selector FS_1 associated with the new calling party will engage sleeve contact S of the final frame FF as shown in Fig. 1. The relay PBX_1 of the final selector FS_1 will become operated and cause the final selector FS_1 to actuate mechanism to return a busy signal to the calling party. The operation of relay PBX_1 also stops the up-drive mechanism (not shown) of the final selector FS_1 and thereby prevents the connection of the additional calling party to any other line.

It will be seen that when the subset SS_1 is connected to the subset SS_2 as shown in the drawing, the grounded battery B_0 is connected to the sleeve terminal SL through resistor R_0. The sleeve terminal SL is in turn connected to ground over two parallel paths, one of which includes the winding of relay CO and the other the windings of relays TB_1 and PBX_1 of the final selector FS_1. The impedances of the two parallel paths are about the same (perhaps 1000 ohms each in existing installations) and the portion of the voltage of battery B_0 applied to the winding of relay PBX_1 will be sufficient to operate relay PBX_1 to stop the up-drive mechanism of final selector FS_1. The final selector FS_1 will therefore stop hunting and not overstep to the next subscriber's line.

However, if more and more parties are simultaneously calling the same party having the subset SS_1, the brushes BR_2, BR_3, etc., of the final selectors FS_2, FS_3, etc., corresponding to these additional parties will all engage appropriate sleeve contacts S of the final frame FF associated with the line of the subset SS_1. Consequently additional final selector relay circuits such as TB_2—, PBX_2, TB_3—PBX_3, etc., will simultaneously be paralleled to ground from sleeve contact SL (along with the previous path established to ground by relay CO). In prior art systems in which the circuit and mechanism SHC was not present, the additional parallel paths reduced the voltage from battery B_0 applied to the windings of relays PBX_2, PBX_3, etc., to such a low value that these relays failed to operate. The failure to operate these relays caused the up-drive mechanism of the corresponding final selectors to overstep to the next subscriber's line (not shown). The subset connected to the latter line was therefore rung in error. This situation produced confusion not alone for the party or parties rung in error, but also for the additional parties seeking to communicate with the busy party having subset SS_1. The prevention of overstepping of final selectors simultaneously testing a busy line is a primary feature of this invention and it is accomplished by inserting the apparatus SHC in the path between sleeve terminal SL of the line finder terminal strip LFTS and the winding of relay CO.

One form of circuit arrangement which is suitable for preventing or greatly reducing the occasions for overstepping on final selectors when they simultaneously reach a busy line, is shown in Fig. 2. Here the sleeve terminal SL of the line finder terminal strip LFTS of Fig. 1 is shown connected to two equal coils P_1 and P_2 of relay DS which is of the differential type. Coils P_1 and P_2 of relay DS are in turn connected to the windings P_1 and P_2, respectively, of the polar relay OF. The upper winding P_1 of relay OF is connected through a resistor R_1 to ground. The lower winding P_2 of relay OF is connected to the lower make contact of relay LS which is of the slow release

type. An auxiliary battery B_2 is connected to the winding of relay LS and through this winding to the make contact of relay DS. The cut-off relay CO—which is also shown in Fig. 1—is connected to the upper armature of relay LS. A message register RC may be controlled by the armature of relay OF as shown.

In responding to a call from a subscriber's station such as SS_1, the line finder district selector LFDS will connect battery B_0 through resistor R_0 to the sleeve terminal SL as already explained. Current from battery B_0 will then flow through resistor R_0, through winding P_1 of relay DS, through winding P_1 of relay OF, and through resistor R_1 to ground. No current will traverse the lower windings P_2 of relays DS and OF because the circuit from battery B_0 is open at the lower make contact of relay LS. However, relay DS will become operated by the current flowing through its upper winding P_1. The operation of relay DS will cause relay LS to operate, the operating circuit including battery B_2, the winding of relay LS, and the make contact and upper armature of relay DS. The operation of relay LS will cause the cut-off relay CO to operate over a circuit including battery B_2, the upper make contact and armature of relay LS, the winding of relay CO and ground. The operation of relay CO will perform the functions already described in regard to Fig. 1. The upper winding P_1 of relay OF is a biasing winding and the flow of current from battery B_0 through this winding is in such a direction that relay OF will remain unoperated. The registering mechanism RC will not operate due to the flow of current from battery B_0 through winding P_1 of relay OF.

The operation of relay LS already described connects battery B_2 to the sleeve terminal SL over a circuit including the lower armature and make contact of relay LS and the lower windings P_2 of relays OF and DS. These windings are of low resistance and their combined resistance is considerably smaller than the resistance R_1. The addition of the auxiliary battery B_2 to sleeve terminal SL is made through the resistance of the lower windings P_2 of relays DS and OF and this resistance—which may be, for example, 100 ohms or less—is considerably less than the resistance R_0 in series with battery B_0. Thus, batteries B_0 and B_2, which may have the same terminal voltage, are both connected to sleeve terminal SL at the same time. Moreover, the reduced resistance in series with battery B_2 will raise the potential of sleeve terminal SL and permit the connection of an increased number of final selector circuits such as FS_1, FS_2, etc., to terminal SL without causing these final selectors to overstep. Hence these final selectors will stop hunting when they reach the desired "busy" line.

After relay LS operates to connect battery B_2 to the sleeve SL, battery B_2 will send current through both windings P_1 and P_2 of relay DS over a circuit including battery B_2, the lower armature and make contact of relay LS, the lower windings P_2 of relays OF and DS, the upper windings P_1 of relays DS and OF, resistor R_1 and ground. The effect of the current of battery B_2 on windings P_1 and P_2 of relay DS is such as to produce equal and opposing magnetic fields in the core of this relay and hence battery B_2 will not affect relay DS. The operating current for relay DS will ordinarily emanate from battery B_0, especially when only one subscriber's set is connected to the set SS_1, and this current will traverse the upper winding P_1. Relay DS should be designed to remain operated after relay LS operates even though the auxiliary battery B_2 is connected differentially with respect to the windings P_1 and P_2 of relay DS.

When additional final selectors such as FS_1, FS_2, etc., are connected to the circuit as shown, the current traversing the lower windings P_2 of relays DS and OF will increase and exceed the current traversing the upper windings P_1 of these relays. The magnitude of the current through the lower windings P_2 of relays DS and OF will be proportional to the number of final selector circuits simultaneously connected to the sleeve terminal SL. The magnitude of the current through the upper windings P_1 of relays DS and OF will decrease, and this current will be progressively smaller than that through the lower windings P_2 as more final selectors are added to the circuit. The relatively larger current flow through winding P_2 of relay OF will be sufficient to overcome the biasing effect of the current through its upper winding P_1, whereupon relay OF will operate. The operation of relay OF will cause the register RC to operate and thereby indicate that additional parties are attempting to reach the same party, simultaneously. The register RC will therefore provide a rough record of the number of times this overloaded condition of the circuit occurs.

In this regard it is pointed out that the relatively increased current through the lower winding P_2 of relay DS may also cause relay DS to release momentarily at the instant of change even while the subscribers' sets SS_1 and SS_2 are connected to each other. However, the relay LS is of the slow release type and it will not release during this brief interval.

When the line finder district selector circuit LFDS disconnects from the line extending to the subscriber's set SS_1 upon the completion of the call, the relay DS of Fig. 2 will release to release the relays LS and CO. Although relay LS has been described as a slow-release relay, its delay constant should be long enough to permit relay DS to reoperate upon the simultaneous connection of a number of final selectors to the circuit, as already described. But the relay DS should not be so slow as not to respond to the disconnection of the district selector LFDS. If relay LS were too slow, the auxiliary battery B_2 would remain connected to the sleeve SL and hence final selectors such as FS_1, FS_2, etc., would register busy conditions even when the subscriber's set SS_1 is idle.

The relay OF and the register mechanism RC controlled by it are required only for recording purposes as already mentioned. If no record of the busy condition is required, the relay OF and mechanism RC may be omitted if so desired.

The arrangement shown and described hereinabove has been found to operate satisfactorily in panel systems in which the cut-off relay CO has one terminal of its winding grounded as shown. 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 calling party's telephone set, a called party's telephone set, first and second sources of voltage, a frame having a plurality of tip, ring and sleeve contacts multipled to each other, means for connecting said calling party's telephone set to the

called party's telephone set, said means including means for simultaneously connecting said first source of voltage to the multiple sleeve contacts of said frame, a relay energized by said first source of voltage, and means controlled by said relay to connect said second source of voltage to the multiple sleeve contacts of said frame.

2. In a telephone system, the combination of a calling party's telephone set, a called party's telephone set, a frame having groups of tip, ring and sleeve contacts which are multipled to each other, the calling party's telephone set being connected to the multiple tip and ring contacts of said frame, a first source of voltage, a second source of like voltage, impedances in series with said first and second sources of voltage, the impedance in series with said first source exceeding the impedance in series with said second source, means responsive to the connection of the calling party's telephone set to the called party's telephone set to apply said first source of voltage to the multiple sleeve contacts of said frame, said means including a relay which is energized by current from said first source of voltage, said relay connecting said second source of voltage to the multiple sleeve contacts of said frame.

3. In a telephone system, the combination of a calling party's telephone set, a plurality of additional telephone sets, a frame having tip, ring and sleeve contacts which are multipled to each other, first and second sources of equal voltage, means responsive to the connection of said calling party's set to one of the additional telephone sets to apply the voltage of said first source to the multiple sleeve contacts of said frame, a plurality of selector circuits each of which is associated with one of said additional telephone sets, said means including a relay operated by current from said first source, said relay connecting the second source to the multiple sleeve contacts of said frame, said sources having impedances in series therewith which are of substantially different magnitude, a recording circuit, and means responsive to the simultaneous connection of the selectors of other of said additional telephone sets to the multiple sleeve contacts of said frame to operate said recording circuit.

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