

1,269,181.

Patented June 11, 1918.

5 SHEETS—SHEET 1.

Fig. 1.

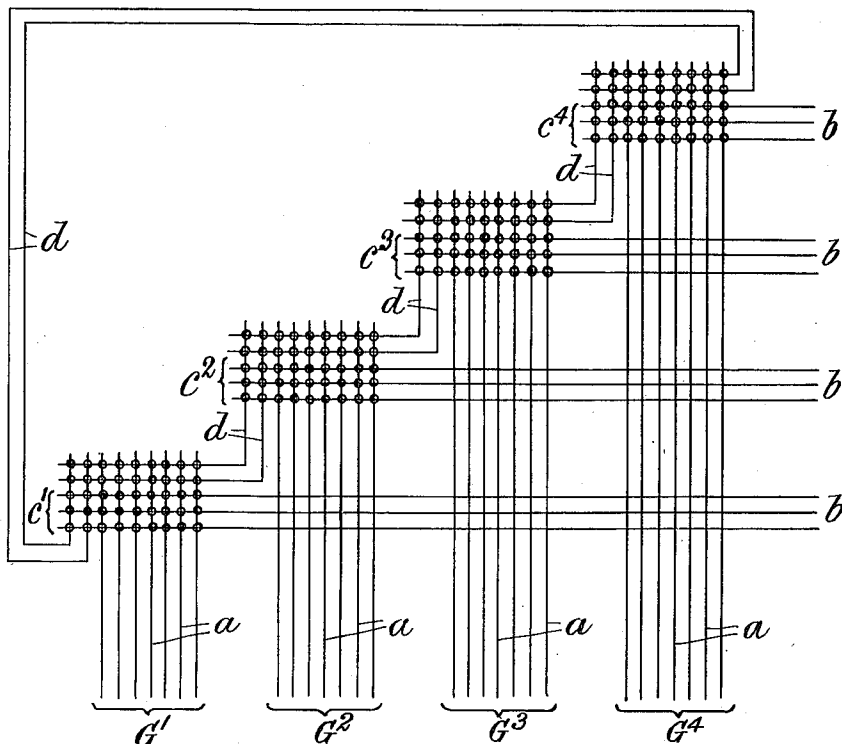
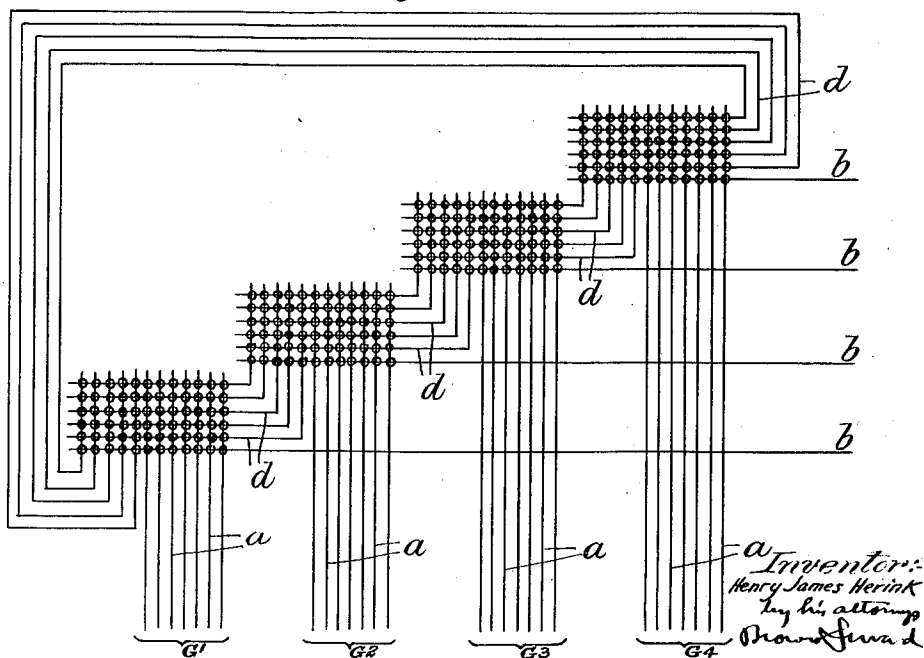


Fig. 2.

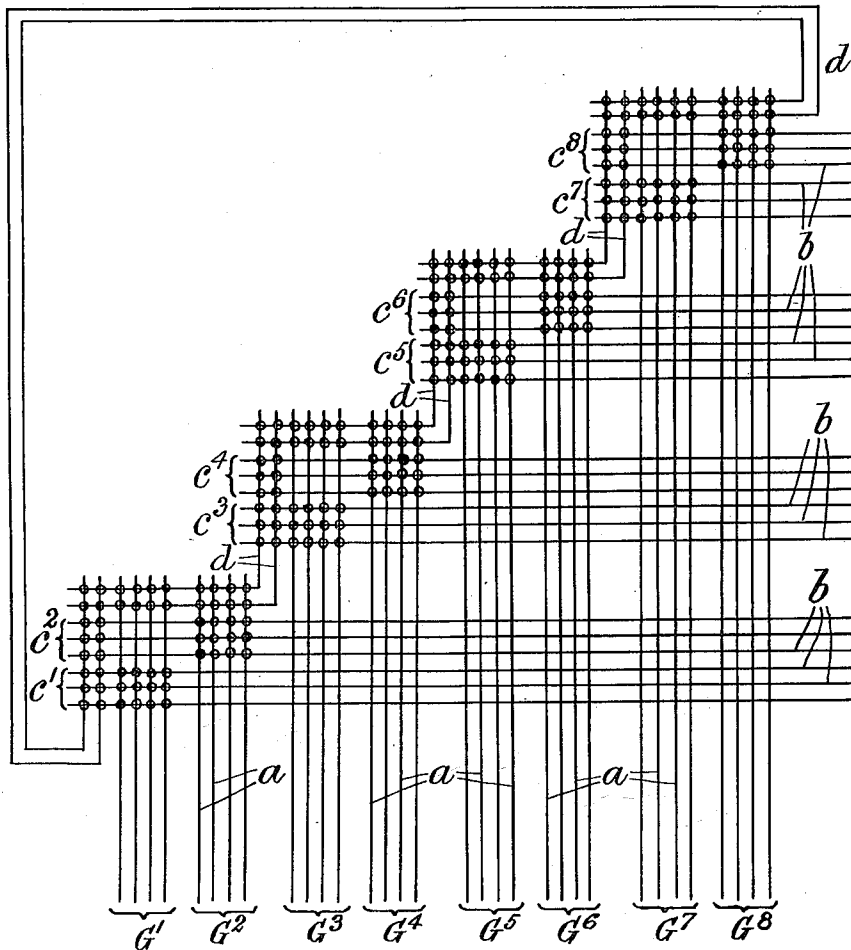


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1,269,181.

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 5 SHEETS—SHEET 2.

*Fig. 3.*



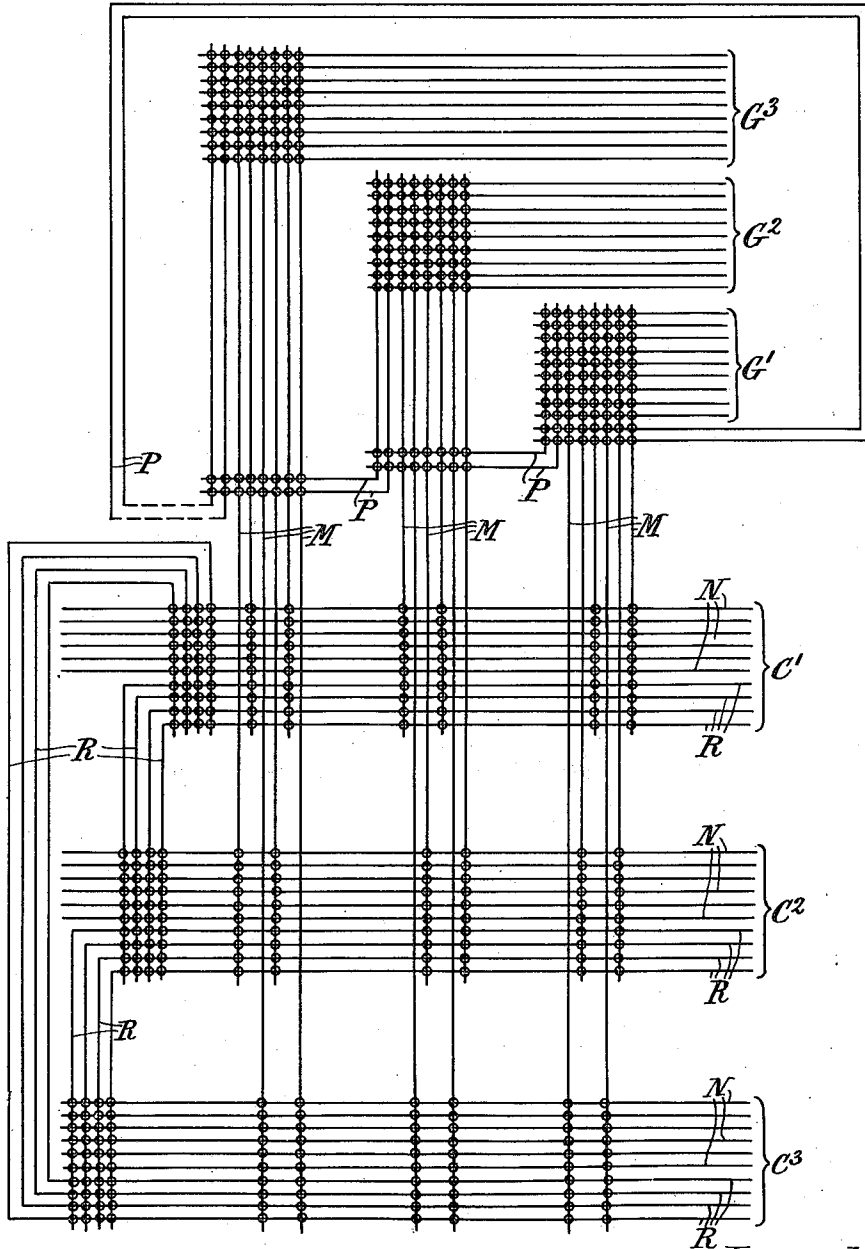
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TELEPHONE SYSTEM.  
APPLICATION FILED FEB. 8, 1916.

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5 SHEETS—SHEET 3.

*Fig. 4.*



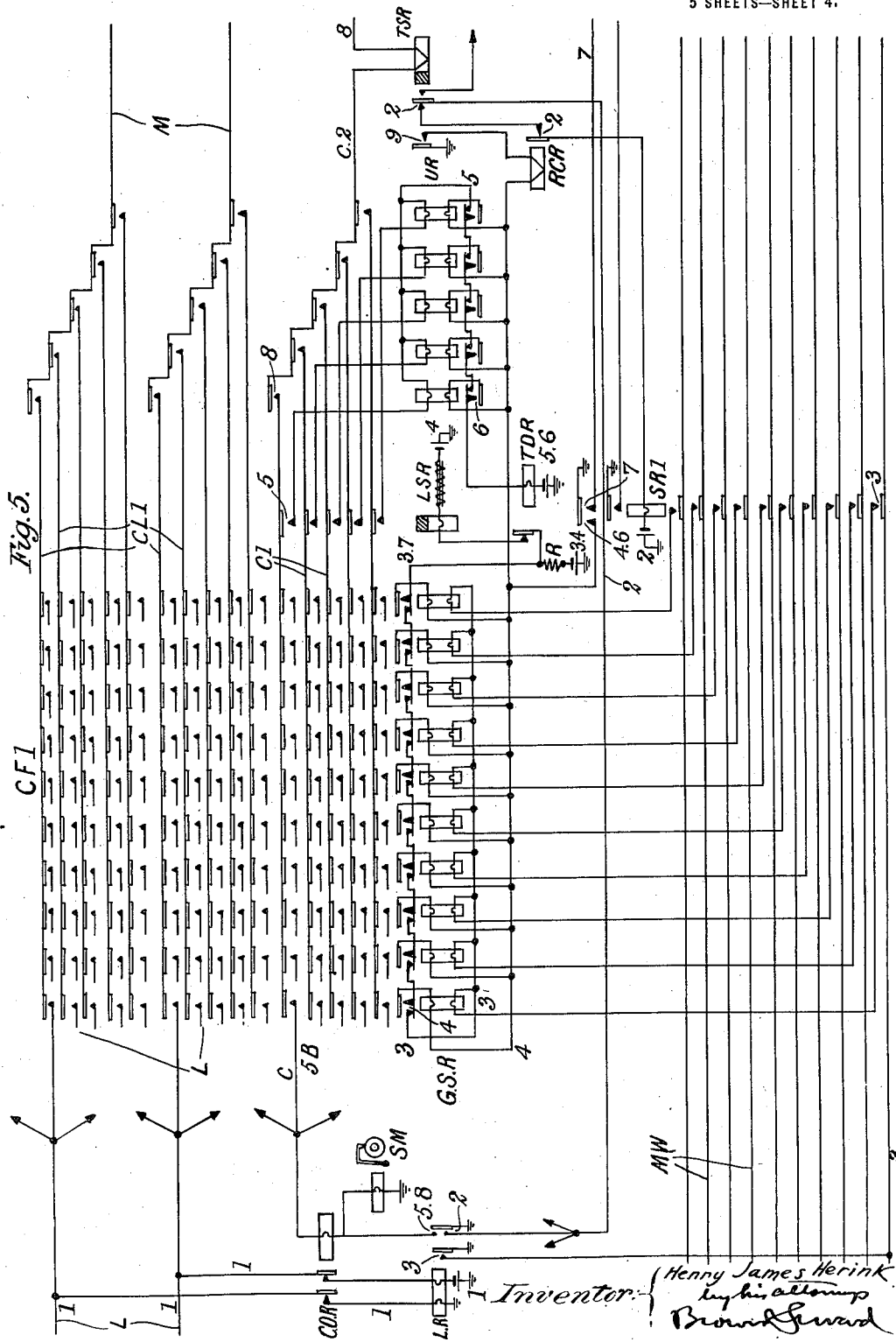
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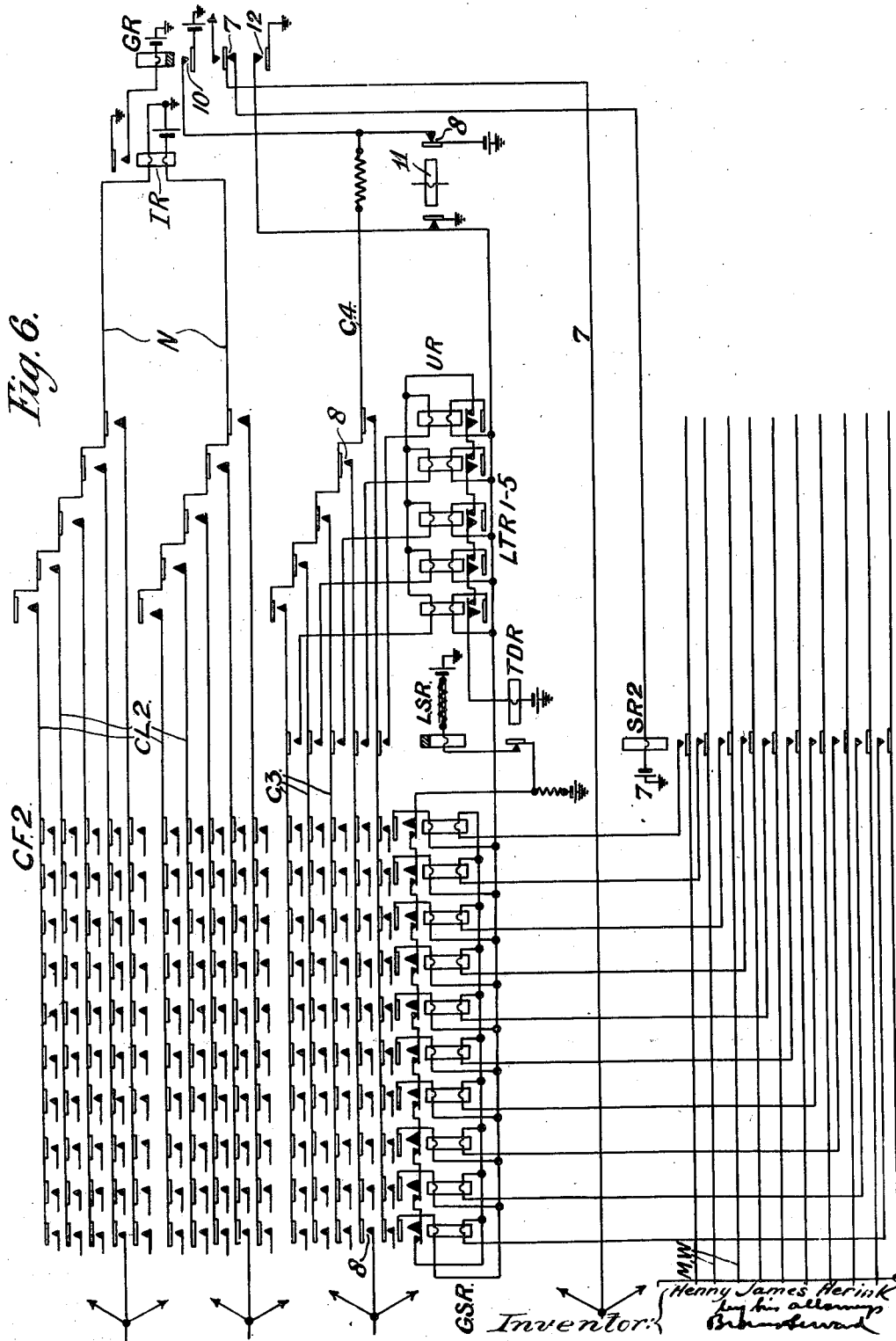
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5 SHEETS—SHEET 4.



1,269,181.

Patented June 11, 1918.  
 5 SHEETS—SHEET 5.



# UNITED STATES PATENT OFFICE.

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## TELEPHONE SYSTEM.

1,269,181.

Specification of Letters Patent.

Patented June 11, 1918.

Application filed February 8, 1916. Serial No. 76,977.

*To all whom it may concern:*

Be it known that I, HENRY JAMES HERINK, a subject of the King of Great Britain, residing at Marconi House, Strand, London, England, have invented new and useful Improvements in Telephone Systems, of which the following is a specification.

It is a well known fact in telephony that the traffic variations of small groups of lines are relatively greater than the variations of large groups. The number of junction lines and apparatus required for carrying a given traffic is therefore, to a considerable extent, dependent on the grouping of the lines and the distribution of the calls.

The chief object of this invention is to reduce the number of such connecting means and to increase their efficiency.

Generally speaking, owing to the fact just mentioned, every attempt to increase the efficiency of the connecting means envisages some method of increasing the accessibility thereof. According to the present invention, this is effected by the use of so-called overflow lines or links so arranged that in case the outgoing junction lines of a group are all engaged, the connection can be extended through an overflow link to another similar group of the same switching stage, in which group such link has access to the junctions outgoing therefrom. Preferably the incoming overflow links are given the same connecting facilities as other incoming lines of the group and thus have access to the overflow links outgoing from that group, so that if all the outgoing junctions of this second group should also be engaged, the connection can be extended to a third group, and so on. Other features of the invention will be described with reference to the accompanying drawings, Figures 1, 2 and 3 of which are schematic representations of three different forms of the invention. Fig. 4 illustrates the invention as applied to a system using primary and secondary pre-selectors. Figs. 5 and 6 show actual circuits which are suitable for any of the arrangements described but more particularly for

that of Fig. 4, and in which the connections are established by means of relays only.

In Fig. 1, *a* are the incoming and *b* the outgoing lines of a switching stage. The incoming lines are divided into a number of groups  $G^1, G^2, G^3, G^4$ , each having access to a particular group  $C^1, C^2, C^3, C^4$  respectively of outgoing junctions, and also to a number of overflow lines or links *d*. The connecting possibilities between the various lines are marked by small circles in the crossing points. The outgoing links of one group enter into the adjacent group in the same manner as the other incoming lines of that group, and have the same connecting facilities as those lines. Thus, in case a calling incoming line of a group should find all outgoing junctions of that group engaged, connection is established with an idle overflow link. The calling line is thereby extended to the next line group in which it immediately appears as calling, and is connected to an idle outgoing junction. Should all the junctions of this second group be engaged, the connection is extended through a second overflow link to a third group, and so on.

By this arrangement of overflow links, every incoming line is given access to any group of outgoing junctions or, in other words, the outgoing junctions are made available to all incoming lines. Consequently the number of lines required for carrying the traffic is reduced, and the traffic carrying efficiency of the line is increased.

The invention is entirely independent of the kind of apparatus used for establishing the connection, and may be used in manual systems as well as in automatic and semi-automatic systems.

In a manual system, for instance, an A operator may be provided with one or more links leading to another A operator, so that in case all junctions belonging to one operator's position should be engaged, or if all B operators accessible from one operator's position should be busy, a calling line can be plugged on to another A position where the connection can be effected.

In automatic and semi-automatic systems, the invention is evidently applicable to pre-selecting and group-selecting stages. In a pre-selecting stage, the connecting apparatus is preferably of the call-finder type. Thus, in Fig. 1, all incoming lines of a group as well as the links incoming to that group may be multiplied, over call-finders associated with the outgoing junction lines, and with the outgoing links, the arrangement for selecting and starting an idle call-finder being such that no link is taken into use until all outgoing junctions of the group are engaged.

The number of outgoing junctions and the number of links of each group are, of course, immaterial to the invention, and may be any number consistent with the traffic requirements. For instance, there may be only one outgoing junction *b* allotted to each group of incoming lines *a*, as shown in Fig. 2, the remaining outgoing lines being links arranged in the manner described.

By reducing the number of junctions individually allotted to each group of incoming lines, and at the same time increasing the number of links, the total number of outgoing junctions required is reduced, whereas the total number of switches is increased. The relation between the number of outgoing junctions and the number of links, which gives the best result from an economical and a technical point of view, is therefore dependent on the traffic conditions of the plant or the part of the exchange to which the system is to be applied.

The distribution may be further improved by so arranging the links that those associated with each particular group have access to different groups of outgoing lines, in which case any link is preferably marked as engaged as soon as the outgoing lines accessible to it are all engaged. A calling subscriber is then automatically connected with a link over which he can have access to an idle outgoing line.

Fig. 3 illustrates another form of the invention according to which the links can be better utilized by arranging them in common to two or more groups of incoming lines. Each group of outgoing junctions is then preferably adapted to carry only about the normal outward traffic of the associated groups of incoming lines, while the links common, for instance, to two groups of incoming lines are sufficient to carry the peak loads of both associated groups. As the peak loads of the two groups may differ in time and only rarely occur at the same time, it is obvious that this arrangement allows a reduction of the total number of links.

In the drawing, the links common to two groups are shown to have access to two adjacent groups of outgoing junctions as well as to the appertaining links, but it is evident

that the links may be otherwise distributed without departing from the invention. Thus, a group of links may have access to one or more groups of junctions but not to other links.

Fig. 4 shows the invention as applied to the pre-selecting stages in systems in which the connection with a trunk leading to the first digit stage is established in a known manner over primary and secondary pre-selectors. The switches may be of any kind, but the scheme shown is particularly designed for relay switches of the call-finder type.

1,000 subscribers' lines may be divided into 20 groups *G* of 50 lines, and may have access to 51 trunk lines *N* over intermediate junctions *M*. The trunks are arranged in three groups *C*<sup>1</sup>, *C*<sup>2</sup> and *C*<sup>3</sup> of 17 trunks each. Each group of subscribers' lines has access to six junctions *M* and two links *P*. A primary call-finder is associated with each such junction and link, and the subscribers' lines of each group are multiplied over the appertaining call-finders. The links outgoing from one group are multiplied over the primary call-finders of the junctions and of the links of the adjacent group. The junctions *M* are multiplied over secondary call-finder switches associated with the trunks *N*, in such a manner that the various junctions available to each group of subscribers' lines have access to different groups *C* in rotation. Associated with each group of trunks *N* are four links *R*, each connected with a secondary call-finder adapted to operate exactly as the call-finders of the trunks to find a calling junction *M*. The links of one group are multiplied over the call-finders of the adjacent group of trunks and overflow links, as shown in the drawing.

The operation of the switches will now be described with reference to Figs. 5 and 6, in which *L* is a subscriber's line, *M* an intermediate junction, *N* a trunk line leading to the first digit stage, *CF*<sup>1</sup> a primary call-finder and *CF*<sup>2</sup> a secondary call-finder.

Each call-finder consists of 10 groups switching relays *GSR* and 5 unit relays *UR*, the group relays being adapted to connect a particular group of 5 subscribers' lines *L* or intermediate junctions *M* respectively to a corresponding number of connecting lines *OL*, and the unit relays being arranged to connect the junction *M* or trunk *N* with which the call-finder is associated, to one of said lines *OL*.

By lifting the receiver, the calling subscriber closes a line circuit 1 through his line relay *LR*, which operates and causes the energization of relay *SR*<sup>1</sup> over circuit 2. *SR*<sup>1</sup> connects all group switching relays *GSR* with the marking wires *MW*, thereby closing a circuit 3 through the operating wind-

ing of the group relay GSR corresponding to the 5-group to which the calling subscriber belongs. The relay GSR in question operates and cuts itself in a locking circuit 4 containing a locking winding of said relay and break contacts of other group relays located between the battery and the group relay in question. This arrangement of the locking circuits of the group relays evidently prevents more than one group relay being energized at the same time if two or more calls originating in different 5-groups should occur simultaneously. The locking circuit at first also includes a relay LSR connected in parallel to a resistance R, whereby the third wires CI of the connecting links CLI are connected to the corresponding unit relays UR. A circuit 5 is therefore closed through the cut-off relay COR of the calling subscriber, third wire CI and an operating winding of the unit relay corresponding to the calling subscriber. Said unit relay energizes and locks itself over a circuit 6 containing a relay TDR which cuts off relay LSR.

As seen from the drawing, the locking circuits of relays UR are arranged in a manner similar to those of relays GSR, so that only one of the unit relays can be kept energized if two or more calls occur simultaneously in the same 5-group. Consequently, double connections are effectively prevented.

The connection is now extended to the intermediate junction M. In the mean time a secondary call-finder has been operated by the closure of circuit 7 including a relay SR<sup>2</sup> of the secondary call-finder similar to SR<sup>1</sup>. The secondary call-finder operates in the same manner as the primary call-finder and connects the junction M in question to the appertaining trunk N.

Upon the completion of the connection with the trunk, a third wire circuit 8 is closed extending over the whole connection and including a relay TSR, which switches the starting circuit 2 on to the next idle primary call-finder. At the same time the circuit of SR<sup>1</sup> is opened and the locking circuits of the switching relays GSR and UR are branched to earth through a relay RCR and a contact 9 of relay TSR, whereby said relays are maintained energized and cut into dependence of the calling subscriber for the purpose of release of the call-finder. By the closure of the third wire circuit also the cut-off relay COR of the calling subscriber is energized, whereby the line relay LR is cut off and the short circuit of the meter SM is opened to allow the meter to be operated in the ordinary way by increase of current in the third wire.

The subscriber's line circuit is now closed through an impulse relay IR which operates and energizes a guarding relay GR, the lat-

ter switching the starting circuit 7 on to the next idle secondary call-finder. GR also branches the third wire circuit 8 to battery over contact 10, the other branch being then opened by a relay 11, whereby the third wire circuit is brought under the control of the calling subscriber.

When the calling subscriber replaces his receiver, IR and GR deenergize, the latter opening the third wire circuit at contact 10 and the locking circuits of the switching relays of the secondary call-finder at contact 12, whereby the call-finders are released and restored to normal condition, the primary call-finder being released through the deenergization of relay TSR.

As will be seen from the above description the invention is principally independent of the construction of the switches, only the means for distributing the calls are such that the overflow switches are not taken into use until all outgoing junctions or trunks of the group in question are engaged. Practically, of course, it is desirable for the switches to be of a quick-acting type, as the connection between the subscriber's line and an idle trunk must be completed in the short interval between the lifting of the receiver and the actuating of the dial.

Having regard to this fact the expediency of relay switches is obvious, as such switches operate almost instantaneously, but mechanical switches may also be used with advantage.

What I claim is:—

1. In a telephone system, the combination of a plurality of groups of incoming lines, a plurality of groups of outgoing lines, each incoming group having access to an outgoing group particularly associated with it, links adapted to connect the incoming lines of one group to the outgoing lines of another group and call-finder switches associated with the outgoing lines and each having access to the corresponding group of incoming lines and to a link associated with another group of incoming lines.

2. In a telephone system, the combination of a plurality of groups of incoming lines, a plurality of groups of outgoing lines, each incoming group having access to an outgoing group particularly associated with it, links adapted to connect the incoming lines of one group to the outgoing lines of another group, call-finder switches associated with the links and having access to the incoming lines of the appertaining group as well as to the overflow links of an adjacent group, and call-finder switches associated with the outgoing lines and each having access to the corresponding group of incoming lines and to a link associated with another group of incoming lines.

3. In a telephone system, the combination

- of a plurality of calling lines, a common line and a switch comprising a set of relays and adapted to connect a calling line to the common line, the number of calling lines being  
5 greater than the number of relays and the circuit of said relays being controlled in such a manner that when a plurality of the relays is energized one only can be maintained energized.
- 10 4. In a telephone system, the combination of a plurality of calling lines, a common line and a switch comprising two sets of relays and a single relay adapted to extend a set of wires common to one set of relays to the other set, the number of calling lines being  
15 greater than the number of relays and the circuit of the relays of the two sets being controlled in such a manner that when a plurality of the relays in either set is energized one only in either set can be maintained energized.

HENRY JAMES HERINK.