(No Model.)

P. E. RAVEROT & G. A. HESS.

TELEPHONE EXCHANGE SYSTEM.

No. 569,470. Patented Oct. 13, 1896.

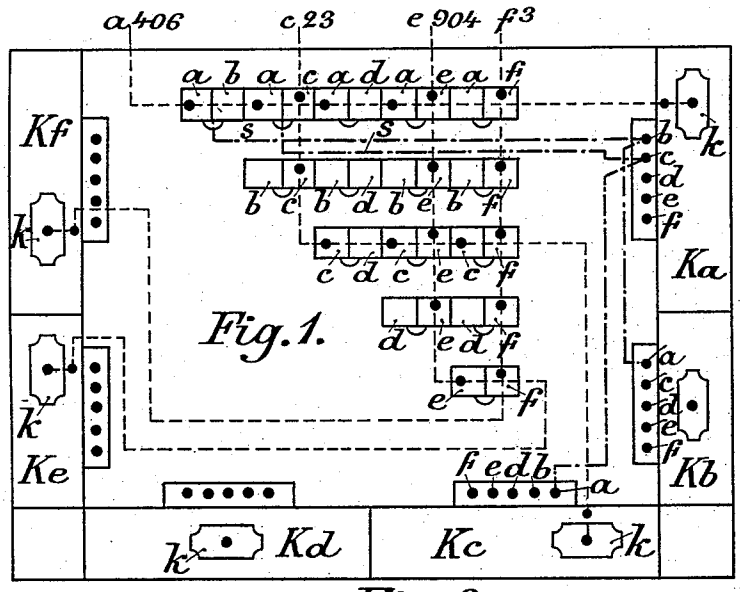


Fig. 1.

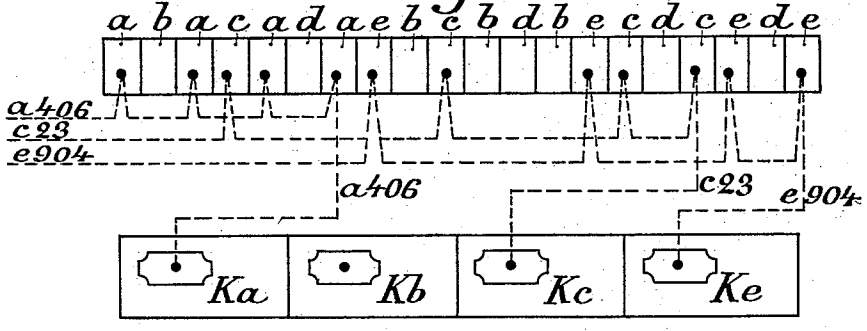
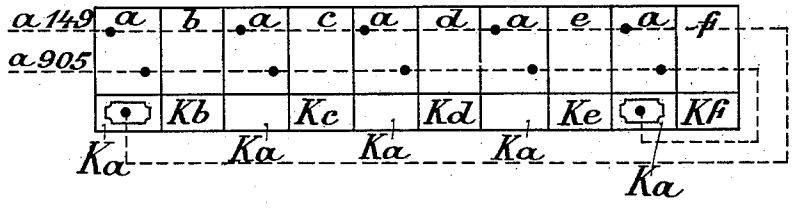


Fig. 2.

Fig. 3.



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TELEPHONE-EXCHANGE SYSTEM.

SPECIFICATION forming part of Letters Patent No. 569,470, dated October 13, 1896.

Application filed July 8, 1896. Serial No. 598,456. (No model.) Patented in France August 8, 1893, No. 232,019; in England April 30, 1894, No. 8,539, and in Germany June 2, 1895, No. 86,953.

To all whom it may concern:

Be it known that we, PIERRE EMILE RAVEROT and GEORGE ALBERT HESS, both citizens of the French Republic, residing at Paris, France, have invented a certain new and useful Improved System of Telephone-Exchange, (for which we have received Letters Patent in France, No. 232,019, dated August 8, 1893; in England, No. 8,539, dated April 30, 1894; and in Germany, No. 86,953, dated June 2, 1895;) and we do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to telephone-exchanges.

The invention consists in a new and improved system of disposing and connecting the different devices constituting the switchboard of what is ordinarily called a "telephone-exchange," which we propose to name "combination system."

Of the accompanying drawings, Figure 1 is a diagram showing the principle of the improved disposition and connection of the exchange-switchboard forming the subject of this invention. Fig. 2 is a diagram showing the disposition of switchboard, arranged according to this invention, as applied to practical working circumstances. Fig. 3 is a diagram showing a modified arrangement applicable to certain special purposes of exchange work.

In the accompanying drawings all dotted lines stand for wire connections or conductors. The round dots marked *a b c d*, &c., are supposed to represent the ordinary spring-jacks generally employed in exchange-switchboards.

The escutcheons marked *k* in the diagrams are meant to represent the drops, supposed to be constructed as is usual in exchange-switchboards.

The arrangement of the improved switchboard is as follows: All subscribers are divided into a suitable number of groups named, respectively, *a b c d e f*, &c. Within each group every subscriber has a certain number, so that the subscribers of group *a* would be designated, respectively, by *a* 1 *a* 2 to *a* 1000 if every group is supposed to have a thousand subscribers.

The switchboard is divided into a number of sections which corresponds to the number of arithmetical combinations of any two of the existing groups that are possible. If, for instance, the number of existing groups of subscribers is n the number of sections would be $\frac{n(n-1)}{2}$. In the accompanying diagrams the number of groups assumed to exist is six, but it is to be understood that this number is only chosen as an example. Consequently in the diagram Fig. 1 the number of sections resulting is $\frac{6\times5}{2}=15$—viz., *ab ac ad ae af bc bd be bf cd ce cf de df ef*. The thousand wires coming in from the thousand subscribers assumed to form the group *a* are supposed to be run in multiple through the sections containing the letter *a*, every line being represented in each of these sections by a spring-jack. The thousand wires coming in from the thousand subscribers supposed to form the group *b* are supposed to be run in the same way through the sections containing the letter *b*, &c. It will be remarked that by this means it is possible to connect any two subscribers by selecting the section in which the two groups in which the two subscribers are located are combined. If, for instance, subscriber *a* 406 wishes to be connected to *f* 3 the section *af* is selected. If *c* 23 wishes to be connected with *e* 904 the section *ce* is selected, &c. If two subscribers belonging to one and the same group wish to be connected, the connection can be made in any section containing that group. For instance, any two subscribers belonging to group *a* can be connected by any of the operators working the sections *ab ac ad ae af*, &c.

Every single wire or conductor coming in from a subscriber after passing through all the sections containing the designation of the group to which the subscriber belongs and in every one of the said sections ending in a spring-jack bearing the number of the said subscriber is supposed to be carried onto an annunciator-drop *k* and thence to pass on to earth. Thus for every group of subscribers, besides the sections already described, a spe-

cial switchboard is provided, which contains the drops and earth connections afforded by the subscribers to call up the exchange. These drop-switchboards are marked K*a* K*b* K*c* K*d* K*e* K*f*, respectively, in the diagrams, Figs. 1 and 2. Besides the drops each of the said switchboards K*a* K*b* to K*f* contains a number of spring-jacks, each of which corresponds to one of the drops. Further, the switchboards contain each a number of spring-jacks corresponding to the number of groups of subscribers minus one. These latter spring-jacks are marked with the designations of the different groups. Thus the switchboard containing all the drops of the *a* group K*a*, in Fig. 1, is provided with spring-jacks *b c d e f*. The switchboard containing the drops of the *b* group will be provided with spring-jacks *a c d e f*. The switchboard containing the drops of the *e* group is provided with spring-jacks *a b c d f*, &c. Every one of these spring-jacks is connected by a special speaking-wire *s* with that section which belongs, first, to the group the drops of which are contained by the said switchboard the said spring-jack belongs to, and, secondly, to the group the designation of which is carried by that spring-jack. Thus the spring-jack *b* of the drop-switchboard K*a* is connected by a wire *s* to the section *ab*. The spring-jack *c* of the drop-switchboard K*a* is connected to section *ac*. The spring-jack *a* of the switchboard K*b* is connected with the section *ab*, &c. On the diagram Fig. 1 only a sufficient number of these connections are shown to clearly explain the arrangement, the other connections being left out, because by drawing all connections even for a very small number of subscribers the drawing would become such a network of lines that it is found more easy to expound the nature of this invention by drawing a few examples and stating the simple rules by which all the rest can be found. At the sections *a b*, *b c*, &c., the divers speaking-wires *s* are lead to the operator's receiver.

We wish it to be understood that all the elements of our improved system of telephone-exchange may be and preferably would be of the usual construction ordinarily employed in multiple switchboards. The same applies to all the accessory arrangements, such as the operator's transmitting and receiving apparatus, the clearing-out drops, the operator's cords, the divers spring-jacks, the earth connections, bells, &c. In fact, it will be perceived that any exchange based hitherto on the usual multiple system would be readily transformed into our novel system by simply altering the connections.

The whole arrangement is operated as follows: An operator is placed at every section, and a second operator is placed at every drop-switchboard. The drop-switchboards are preferably, though not necessarily, placed in the same room as the main switchboard containing the sections named *ab*, *ac*, *ad*, &c. When a subscriber calls up the exchange, the drop corresponding to his number within the group and attached to the switchboard corresponding to his group falls and the switchboard-operator puts it up, then enters a plug in the corresponding spring-jack, thereby attaching her receiver to his line and answers to his call. The subscriber then names the group to which his correspondent belongs, and the operator thereupon connects her speaking apparatus with the spring-jack on her switchboard marked with the designation of the group called for by the subscriber and calls up the operator working that section. It will be readily perceived that by this means the operator of the drop-switchboard by simply obeying the order of the subscriber automatically selects that section on the main switchboard in which the subscriber's and his correspondent's groups are combined. The operator of that section, being now connected with the subscriber and called up by the operator of the drop-switchboard and being informed by her which subscriber desires a connection, attaches her receiver to the spring-jack corresponding to the subscriber's number on her section and answers to his call. He then informs her with which number he wishes to be connected, whereupon she makes the connection in the usual way.

In Fig. 1 of the accompanying drawings the connections afforded for an example are shown. It is supposed that subscriber No. 406 of the group *a* wishes to speak to subscriber No. 23 of group *c*. *a* calls, and in consequence the drop No. 406 on the *a* group drop-switchboard falls. The operator at the *a* drop-switchboard inserts her speaking apparatus into No. 406's line and answers: "Here, exchange." The subscriber orders: "Group *c*." The operator inserts a plug in the spring-jack marked *c* of her switchboard, thus puts herself into connection with the operator of section *ac* of the main switchboard, calls up the operator of that section and announces to her the group and number of the subscriber who wishes to speak by saying, "*a* 406." The section operator connects her transmitter with the *a* 406 line by inserting one plug of the usual connecting-cord in that jack and takes the subscriber's order, being, as assumed at the outset, *c* 23. She then makes the connection by inserting the other plug of the connecting-cord in the jack *c* 23, and the two subscribers are left to speak.

Fig. 2 shows an example of the way in which the new system would preferably be arranged for the purpose of practical working. The distribution of the divers sections *ab ac ad*, &c., in rows below each other, as shown in Fig. 1, has only been chosen for the sake of greater clearness. For the purpose of practical work the sections would be preferably disposed in one row, one beside the other, similarly to the arrangements hitherto generally in use with so-called "multiple" switchboards.

From Fig. 2 it will be readily seen how the wire connections would be arranged to attain this end.

Referring to Fig. 2, it will be seen that the row of section-boards represents a row of jack-switchboards arranged in the following way: *ab*, *ac*, *ad*, *ae*, *bc*, *bd*, *be*, *cd*, *ce*, *de*. In this row it will be seen that every jack-board is combined twice with every other jack-board. For instance, the row commences *ab ac ad*. Here the letter *b* combines on its left and on its right side with the letter *a*, and likewise the letter *c* combines on its left and on its right side with the letter *a*. For the sake of economy this arrangement may be simplified by leaving out a certain number of the jack-boards, so that each group is placed only once at the side of each other group. If in the row *ab*, *a*, *cad*, *ae*, *b*, *cb*, *db*, *ecd*, *ced*, *e*, we leave out the marked letters, and add at the end the letter *a*, we get the following: *ab*, *cad*, *b*, *ecd*, *e*, *a*. In this row it will be seen that every letter is placed only once at the side of every other letter.

If the total number of subscribers is not very large, we arrange the switchboards containing the annunciator-drops in combination with the sections in which the actual connections are made. If this arrangement is preferred, the number of annunciator-drops is divided into a series of sections corresponding to the sections containing the designation to which the drop-switchboard corresponds and each section of drops is attached to the corresponding section-switchboard. This arrangement is shown in part in Fig. 3. Fig. 3 shows the section-switchboard containing the group designation *a*, and assuming every group to contain a thousand subscribers to every section would be attached two drop-switchboard sections containing each two hundred annunciator-drops and corresponding to the two groups combined in that section. The connection of the wires is shown in two examples, viz., *a* 149 and *a* 905. In this case the work of the operators, who, according to the arrangement shown in Fig. 1, were posted at the drop-switchboards, has to be done by the same operators who are posted at the sections in which the different groups are combined. Thus, if *a* 149 in Fig. 3 wishes to speak *f* 3, the operator at section *ab* would be called up by the subscriber, because *a* 149 has its annunciator-drop attached to the section *ab*. The operator at *ab* section, however, would not be able to make the connection, because she can only make connections between subscribers belonging to groups *a* and *b*. She would therefore have to order the operator at section *af* to take the subscriber's orders, and then the operation would proceed as above.

If the whole switchboard were too extensive to allow the single operators to talk to each other direct, speaking-wires *s* would have to be arranged between them. However, in this case it would be preferable to divide operations as described above.

Having now particularly described and ascertained the nature of our said invention and the manner in which the same is to be performed, we declare that what we claim is—

A system of connections for telephone-exchange switchboards based on the principle of arithmetic combinations, the subscribers of the exchange being divided up in groups *a b c d e* to *n*, each of which is represented in the exchange by jack-boards *aaa*, *bbb*, *ccc*, *ddd*, *eee*, with one jack for every subscriber of the group and those jack-boards being combined in pairs forming section-switchboards *ab*, *ac*, *ad*, *ae* to *an*; *bc*, *bd*, *be* to *bn*; *cd*, *ce* to *cn*; *de* to *dn*, the total number of said sections being $\frac{n\,(n-1)}{2}$.

In testimony whereof we have affixed our signatures in presence of two witnesses.

PIERRE EMILE RAVEROT.
GEORGE ALBERT HESS.

Witnesses:
GEORGES AUGUSTIN CLAUDY,
LEON AUGUSTIN BETNARD.