June 23, 1931. O. C. HOVLAND 1,811,753

AUTOMATIC TELEPHONE SYSTEM

Original Filed Nov. 23, 1928 2 Sheets-Sheet 1

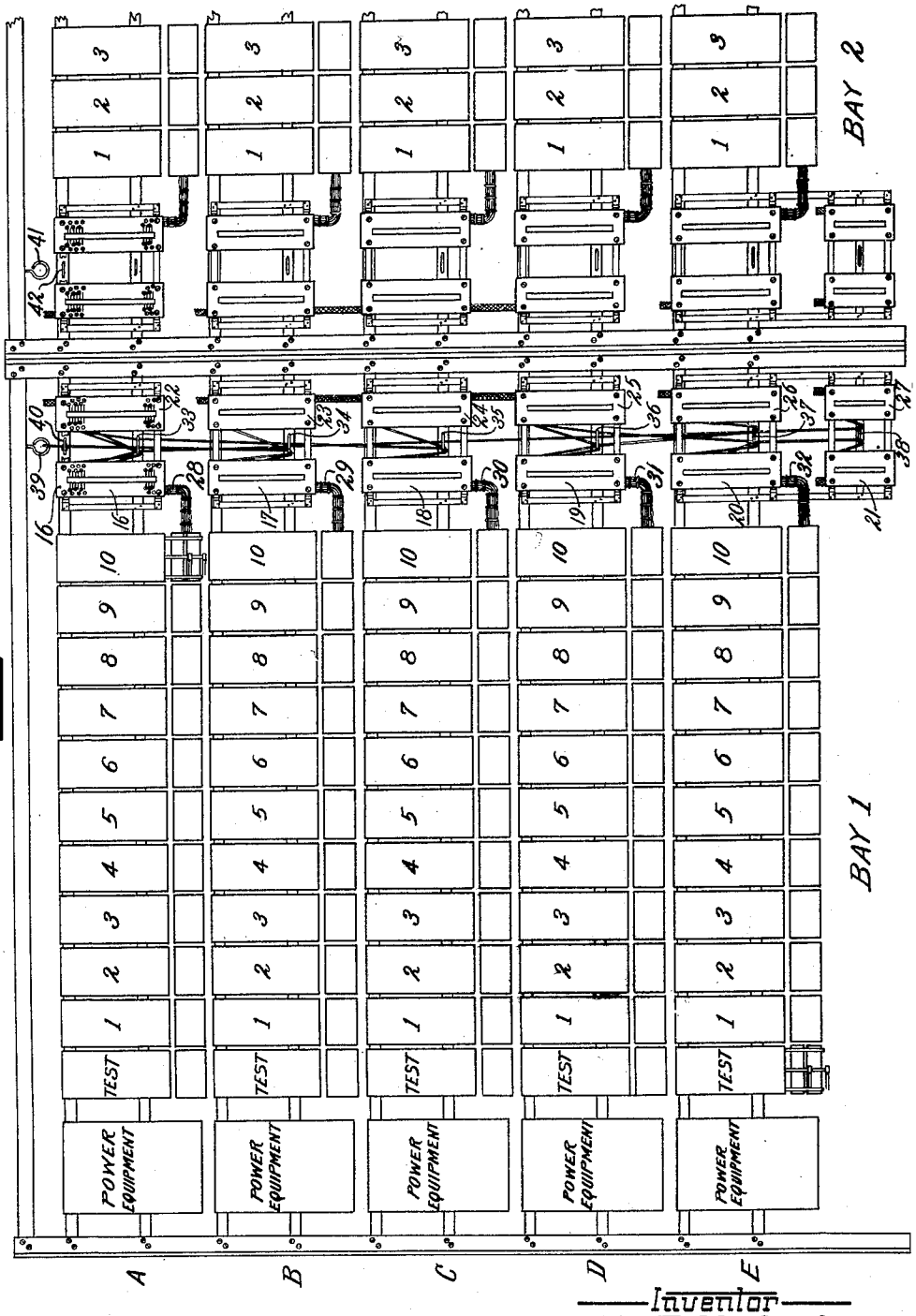


Fig. 1

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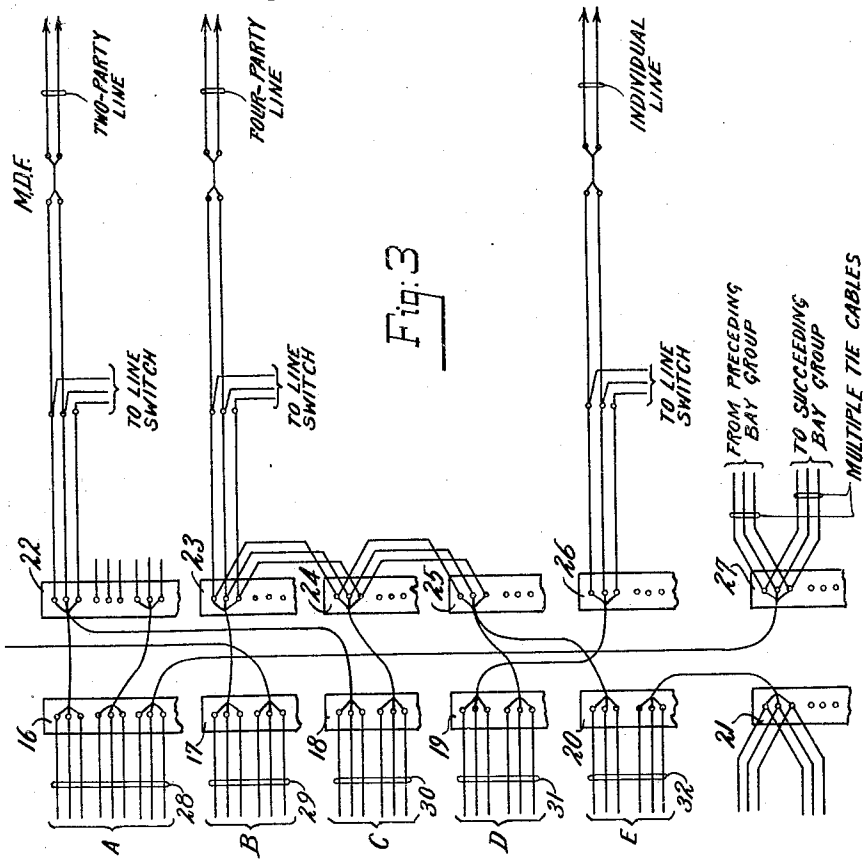


Fig. 3

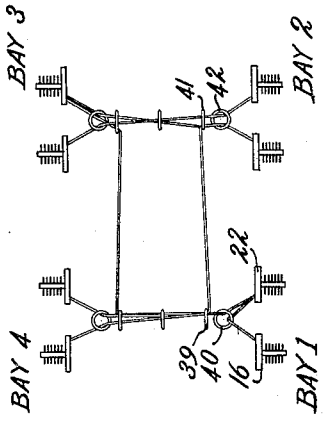


Fig. 2

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UNITED STATES PATENT OFFICE

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AUTOMATIC TELEPHONE SYSTEM

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The present invention relates to automatic telephone systems, but is concerned more particularly with cabling systems employed therein whereby the telephone lines of an automatic exchange and the calling and called terminals of such lines may be arranged without permanent association and with facilities for associating together lines, calling terminals, and called terminals in any desired combinations so as to provide for the flexibility found necessary to economy and convenience.

The above-mentioned facilities have been provided heretofore by an intermediate distributing frame in conjunction with the main distributing frame of the exchange, jumpers being run on the two frames to effect the desired combinations, and changes being made from time to time to take care of traffic variations and other changes as they occur.

When an intermediate distributing frame is used, in a system employing line switches on the calling terminals of lines and connectors to extend connections to the called terminals of the lines the connectors are ordinarily mounted separate from the line switches. The connectors are mounted in "shelves", a connector shelf consisting of a horizontally disposed mounting rack with ten regular connectors and a test connector mounted thereon, together with auxiliary apparatus on one end of the shelf, with a terminal block on the other end. The connector shelves are mounted one above the other on a mounting frame known as a connector "bay". The bays are usually five shelves high, or more, depending upon the height of the ceiling in the switch room. The banks of all the connectors of a single shelf are multipled together and a bank cable is run from the bank nearest the terminal block on the end of the shelf to the block, multipling the contacts of the connector banks with the pin terminals of the block. From the other end of the pins of the block a cable is run to the connector-bank side of the intermediate distributing frame (abbreviated I. D. F.). From the other side of the I. D. F. (the line switch side) cables are run to the line switch boards, while the cables from the exchange side of the main distributing frame (abbreviated M. D. F.) may be connected to the terminal blocks on the ends of the connector shelves, to either side of the I. D. F., or to the line-switch boards themselves, as may prove feasible or desirable in any particular case.

The usual arrangement having been set forth, the main object of the present invention may be stated as the production of a new and improved cabling system, and apparatus for use therein, whereby the intermediate distributing frame (I. D. F.) is eliminated while all its advantages are retained.

It may be stated briefly at this point that the object of the invention is attained by providing two terminal blocks (instead of one as when the I. D. F. is used) on the end of each connector shelf. The two blocks of a shelf are vertically disposed side by side and in vertical alignment with the blocks of the other shelves in the same bay. Jumper rings are placed between the blocks and on the supporting frame work, so that jumpers may be run between any one block and any other block of the same bay, or of an adjacent bay, while a pair of tie-cable blocks are provided below the blocks of the bottom shelf of each bay and in vertical alignment with the shelf blocks, so that jumpers may be run to the tie cable blocks in the same way as they are run to shelf blocks.

With this improved arrangement, the bank cable of a shelf terminates in the block adjacent to the last switch of the shelf, while a cable leads to the line switch board from the other shelf block. The cables to the M. D. F. may be run from the connector-bank blocks, from the line-switch blocks of the connector shelves, or from the terminals of the line-switch boards, depending upon local require-

ments or desires. The tie-cable blocks of the various bays are multipled together by cables running therebetween.

Other objects of the invention, for the most part incidental to the carrying out of the main object hereinbefore given, will appear as the description progresses.

Referring now to the drawings comprising Figs. 1–3, they indicate the connector-shelf distributing frame and show the way in which it may be used.

Fig. 1 shows bay No. 1 and a portion of bay No. 2 of a group of four bays of connectors, showing the jumper blocks and jumper rings of bays 1 and 2, together with a few jumpers.

Fig. 2 is a view of the jumper blocks of the four bays of the group as seen above, together with the jumper rings and a few jumpers, the remaining portion of the equipment of the four bays being omitted for the sake of clearness.

Fig. 3 is a circuit diagram showing typical interconnections between subscribers' lines, line switches, and calling terminals through the connector-shelf distributing frame of bay 1 of Figs. 1 and 2.

Referring now particularly to Fig. 1, this drawing, as above mentioned, shows bay 1 and a portion of bay 2 of a group of four bays. Bay 1 is provided with five shelves of connectors, there being eleven connectors in each shelf, a test connector and ten regular connectors. The banks of the connectors are all multipled together and a bank cable is brought from connector No. 10 to the left hand side of the associated one of the terminal blocks 16–20. The connectors and banks are not shown in detail, but the connectors may be of the type pictured in Fig. 50 and may have a circuit similar to that disclosed in Fig. 60 of the illustrations in the second edition of Automatic Telephony, a book by Smith and Campbell, published by McGraw-Hill Book Company, Inc., New York. The banks of all the connectors on any one shelf are wired together as shown in Fig. 57 of the above publication, while a bank cable leads from the nearest connector to the associated terminal blocks. The bank cables shown in Fig. 1 of the present drawings are numbered 28—32.

There is shown on the left hand end of each shelf an oblong space labeled "power equipment." This includes certain supervisory relays, fuses, and other miscellaneous apparatus. The cables incoming to the connectors from the selectors which have access to them are not shown in the drawing, but in practice they come down from cable runways above and are fastened on suitable supports just behind the left portion of the power equipment, a cable leading off on each shelf to the connectors mounted thereon.

Between each pair of the blocks 16—27 a jumper ring is mounted. Any jumper connecting with contacts in either block of a pair is passed through the ring in accordance with the usual practice. These rings are 33—38. The cables leading from the blocks other than the bank-cable blocks are shown in place, but broken off near the blocks for simplicity. In practice they extend up behind the framework to cable runways overhead.

At the top of the drawing the jumper rings 39—42 are shown and may be seen also in Fig. 2.

The auxiliary blocks 21 and 27 mounted below the lower shelf near the floor are provided to terminate cables that tie all similar blocks together in all bay groups and are known as tie cables. Certain of these contacts are not permanently connected at any point, while others may be connected for example to intercepting trunks so that the calling terminal of a subscriber's line may be disconnected from the line and connected to an intercepting trunk whenever this becomes necessary, as for example, in case of discontinued service, changed number, etc.

Referring now to Fig. 3, which is a circuit diagram, a few typical jumper connections will be explained. It may be pointed out that the connector-shelf distributing frame is the one provided for bay 1 in Fig. 1, the blocks and bank cables being given the same numbers in both drawings. The main distributing frame M. D. F. is indicated to the right, while the connector-shelf distributing frame is indicated to the left, with the line-switch terminals indicated in the middle of the drawing. Three conductors extend from each set of terminals on the right-hand side of the connector-shelf distributing frame to the line switch terminals, while two conductors extend from there to the left hand side of the M. D. F. It will be understood, of course, that the conductor that stops at the line switch terminals and does not extend to the M. D. F. is the usual test conductor, or private normal conductor, as it is sometimes called. This conductor corresponds to the sleeve conductor used in manual practice. The other two conductors of the set of course are the talking conductors.

The upper line shown passing through the M. D. F. is a two-party line, as indicated by the label. The called terminals of one party are connected to the line by means of a jumper extending between the line terminals in block 22 and the upper indicated set of terminals in block 16, while the called terminals of the other party on the line are connected by means of a jumper extending to the line from the upper terminal set of block 18. Any suitable method of signalling may be employed, but it may be assumed for convenience that the so-called harmonic ringing method is used, in which case any one shelf of connectors having access to a party line is pro-

vided with a different frequency of ringing current than any other shelf of connectors having access to such line. When the line is a two-party line, no special multipling provisions are made and two jumpers are merely placed on the same set of terminals on the right hand side of the connector-shelf distributing frame.

In the case of four-party lines, it is considered that four jumpers on one set of terminals would be too many, for which reason three blocks on the line-switch side of the frame are multipled together, providing for 100 four-party lines, there being 100 contact sets per block. The blocks 23, 24, and 25 are shown multipled together in this manner. It is assumed that connector shelves B, C, D, and E are provided with four frequencies of ringing current, one frequency per shelf, in which case the called terminals of a party line may be secured by a jumper from each of the four shelves to one terminal or another of the same party line. Accordingly, the upper set of terminals of the block 17 is jumpered to the block 23; the lower set of the terminals of block 18 is jumpered to block 24; while a terminal set of block 19 and a terminal set of block 20 are jumpered to block 25, two sets of jumpers being placed on one terminal set in this case.

From the second terminal set of block 17, a jumper is run up through the jumper rings and is shown broken off at the top. This jumper may extend to a terminal block on any one of the other three connector bays of the group.

It will be noted that the upper terminal set of block 19 is cross-connected to the upper terminal set of block 26, which terminal set leads through the M. D. F. to an individual line.

The second terminal set of block 20 is jumpered to the upper terminal set of block 21. It may be assumed that the cable conductors leading from this terminal set of block 21 are connected with a trunk leading to the switchboard of an intercepting operator.

It will be noted that the third terminal set of block 16 is jumpered to the upper terminal set of block 27. It may be assumed that the corresponding terminal set on the corresponding block in a bay of some other group is cross-connected to the line-switch side of the connector-shelf distributing frame thereat, placing the call number of the lower indicated terminal set of block 16 on the line and line switch to which this number is connected by the jumper shown in Fig. 3 and by the jumper assumed to be run on the other bay. By means of these tie cables a limited number of shifts can be made from bay group to bay group as may be found expedient.

It may be pointed out that the cables shown in the drawing as running from the line-switch terminals to the M. D. F. may be run instead, if desired, from the jumper blocks on either side of the connector-shelf distributing frame to the M. D. F. Each way of connecting the M. D. F. cables has certain advantages and disadvantages, and the particular cabling plan used in any one installation may depend upon several factors, including the ratio of party lines to individual lines, etc.

As an example of the way in which the connector shelf distributing frame and the M. D. F. are used together, it will be assumed that the individual line shown in the lower left hand corner of Fig. 3 offers heavier outgoing traffic than formerly, with the result that the load on the line switch group has increased to such an extent that it is desired to give this line a line switch in another group. When this becomes necessary, the jumper at the M. D. F. is changed from the line switch to which the line now connects to the new line switch in another group, while the jumper on the connector shelf distributing frame is shifted to the terminals of the new line switch, leaving the old line switch vacant and ready for use by a line offering lighter outgoing traffic.

Although, in the foregoing description, the calling terminals of lines have been referred to, for convenience, as connected to or represented by line switches, it will be understood that finder switches may be used instead, in which case they seize the calling lines over the conductors which are labeled "To line switch" in Fig. 3, the line and cut-off relays, as well as the finder bank contacts, being connected to these conductors.

I claim:

1. In a telephone system wherein subscribers' lines are each provided with calling terminals through which calls originating on the respective lines are handled and are provided with separate called terminals through which calls to the respective lines are handled by connector switches mounted on a mounting frame and having bank contacts connected to the said called terminals also mounted on said frame, said connectors being divided into groups, each group of said connectors being assigned to a separate group of called terminals, the banks of the connectors of a group being multipled together and connected by means of a "bank cable" to the associated called terminals, cable blocks mounted on said mounting frame, cable connections between the terminals of said cable blocks and the calling terminals of the lines, and facilities for running jumpers between the said called terminals and the terminals of said cable blocks.

2. A combination mounting frame and distributing frame for connector switches having facilities for mounting connector switches on said frame in horizontal rows,

the banks of the connector switches in the same row being multipled together and connected by means of a bank cable to a vertically disposed bank-cable terminal block at the end of the row, other vertically disposed terminal blocks mounted parallel to the bank-cable terminal blocks, cables leading from the last-mentioned terminal blocks to calling terminals of lines arranged to be accessible to the connectors mounted on said frame, and facilities for making suitable jumper connections between the bank-cable terminal blocks and the other terminal blocks.

3. In a switch mounting frame whereon connector switches are mounted in horizontal rows, one row above another and in the same vertical plane, a terminal block mounted at the end of each of said rows of connector switches, a bank cable leading from each row of switches to the adjacent terminal block connecting the bank contacts of the connector switches with the terminals in the block, another terminal block mounted adjacent each said terminal block, outgoing cables extending from said other terminal blocks, and facilities for connecting jumpers between the terminals of the first-named blocks and the terminals of the other blocks.

4. In a combined distributing frame and switch mounting frame, two sets of terminals mounted on said frame, facilities for running jumpers between the terminals of the two sets, groups of connector switches mounted on said frame and having banks of contacts, bank cables extending unbroken from the bank contacts of said connector switches to the first mentioned set of terminals, and subscribers' lines extending from the other of the two sets of terminals.

5. In a combined mounting frame and distributing frame for use in connection with connector switches arranged to complete calls to subscribers' lines, connector switches mounted on said frame and having contact banks multipled together in groups, terminal sets on said frame connected to said contact banks by unbroken cables, other contact sets on the said frame, and facilities for making jumper connections between the first-named contact sets and the other contact sets.

6. In a telephone system, a plurality of groups of connector switches, a terminal block mounted adjacent to each group, bank cables connecting from the banks of said connector switches to said terminal blocks, other terminal blocks mounted adjacent the first-mentioned terminal blocks, respectively, and facilities for running jumpers between the first-named terminal blocks and the said other terminal blocks.

7. In a telephone system, a plurality of groups of connector switches, a terminal block mounted adjacent to each group, bank cables connecting from the banks of said connector switches to said terminal blocks, an equal number of other terminal blocks mounted adjacent the first-mentioned terminal blocks, respectively, and facilities including jumper rings for running jumpers between the first-named terminal blocks and the said other terminal blocks.

8. In a telephone system wherein automatic switching apparatus is provided for effecting connections between calling subscriber lines and trunk lines and wherein connector switches are arranged to connect trunk lines to called subscribers' lines, said connector switches being mounted in groups, a bank-cable terminal block being provided for each group, a bank cable extending from the banks of each group to the associated terminal block, a calling-terminal block mounted adjacent to certain ones of said bank-cable terminal blocks, cables connecting said calling terminal blocks with the said mechanism which extends calls from calling subscribers' lines to trunk lines, and facilities for making jumper connections between the bank-cable terminal blocks and the calling-terminal blocks.

9. In a telephone system wherein connector switches are arranged to extend connections to called subscribers' lines through bank contacts, said connectors having their bank contacts connected together in connector groups, a group of terminals located adjacent to each connector group, cable connections between the connector banks and the adjacent group of terminals, other groups of terminals serving as the terminus for called subscribers' lines and mounted near the first named groups of terminals, and facilities for making jumper connections between the terminals of the first groups and the terminals of the second groups.

10. In a telephone system wherein connector switches are mounted in groups and the bank contacts of each group are connected in multiple, a terminal block adjacent to each group with cable connections between each terminal block and the adjacent group of connector banks, other terminal blocks mounted adjacent to the first-named terminal blocks respectively, facilities for making jumper connections between any one of the first named terminal blocks and any one of the other terminal blocks, and multiple connections between a plurality of said other terminal blocks whereby a plurality of terminals representing contacts in a plurality of connector groups may be multipled together through said jumper connections.

11. In a telephone system wherein a plurality of shelves of connectors are mounted on a common frame with a connector-shelf distributing frame mounted on the same frame, another similar mounting frame adjacent the first frame, and jumper facilities including pumper rings whereby jumpers

may be run from contacts on one frame to the contacts on the other frame.

12. In a telephone system wherein connector switches are mounted in shelves and a plurality of shelves are mounted on a common frame with a connector-shelf distributing frame mounted unitary with the mounting frame, two of said mounting frames being disposed end to end, with two other frames parallel to the first two and spaced a short distance away, and jumper facilities including jumper rings so disposed that the jumpers may be run from contacts on any one of said frames to contacts on any one of the other three frames.

13. In a telephone system wherein connector switches are mounted in shelves and a plurality of shelves are mounted on a common mounting frame occupied also by a distributing frame, said distributing frame having jumper facilities whereby connections may be made from "bank-cable" terminal blocks to other cable terminal blocks mounted opposite the "bank-cable" terminal blocks, and tie cable terminals located in a block below the first named blocks, other similar mounting frames, and tie cables extending between the said tie cable block of the first frame and similar blocks on the other frames whereby group-to-group interconnections by means of jumpers may be made through said tie cable blocks and the interconnecting tie cables.

14. In a telephone system wherein connector switches are mounted in groups and wherein a plurality of groups are mounted on the same mounting frame with a separate terminal block for each group, a cable terminal block mounted opposite each of the first named terminal blocks with facilities for running jumpers between the two blocks and between blocks of the several groups mounted on the common frame, a special-service block having a special-service cable extending therefrom mounted below the above-mentioned blocks, and jumper facilities for running jumpers between the special service blocks and the other of said terminal blocks.

15. A combination switch-mounting frame and distributing frame having facilities for mounting automatic switches thereon in parallel rows, comprising a bank-cable terminal block at the end of each row of switches disposed at right angles to the row of switches, other terminal blocks mounted parallel to the bank-cable terminal blocks, cables representing lines accessible to said switches leading from the last-mentioned terminal blocks, and facilities for making jumper connections between said terminal blocks.

16. A mounting shelf for automatic switches having facilities for mounting a row of automatic switches thereon, facilities for mounting a block at the end of the row of switches to serve as a terminus for the cable connected to the multiply-connected banks of the automatic switches, additional facilities for mounting a second cable terminal block on said shelf, and facilities for running jumpers between said blocks.

17. In combination, a plurality of horizontally-disposed shelves of automatic switches, a cable terminal block mounted at the end of each shelf and arranged to terminate the bank cable of the adjacent shelf of switches, another cable terminal block mounted at the end of each shelf, and facilities for running jumpers between the several terminal blocks.

18. In combination, racks of switches in vertical alignment, a terminal block at the end of each rack, a bank cable terminating on each block, cable terminal blocks, means supporting said cable terminal blocks opposite said bank cable blocks, respectively, to form a distributing frame, and facilities for running jumpers between the opposite sides of said frame.

19. In combination, racks of automatic switches, a distributing frame comprising two vertical rows of blocks located adjacent the ends of said racks, bank cables terminating on the blocks of one of said rows, line cables terminating on the blocks of the other row, and facilities for running jumpers between said rows of blocks.

20. In combination, racks having switching apparatus mounted thereon, means for mounting said racks adjacent one another, a group of terminals secured to each of said racks serving as the terminus for conductors specific to the associated switching apparatus, other terminals serving as the terminus for other conductors, and facilities for running jumpers to said other terminals from any one of said groups of terminals.

21. In combination, racks having switching apparatus mounted thereon, a common mounting frame arranged to receive all the said racks of switches, a group of terminals secured to each of said racks serving as the terminus for conductors specific to the associated switching apparatus, other groups of terminals serving as the terminus for other groups of conductors, and facilities for running jumpers from any one of said terminal groups to any other one of said terminal groups.

22. In combination, two mounting frames, racks mounted on each frame, each rack having switching apparatus mounted thereon, a group of local terminals secured to each rack serving as the terminus for conductors specific to the associated switching apparatus, groups of cable terminals specific to the first mounting frame, groups of cable terminals specific to the second mounting frame, facilities for running jumpers between all the terminal groups of the first mounting frame, facilities for running jumpers between all the terminal groups associated with the sec-

ond mounting frame, and a group of tie-cable conductors connecting one of the groups of cable terminals of the first mounting frame to one of the groups of cable terminals of the second mounting frame.

In witness whereof, I hereunto subscribe my name this 21st day of November, A. D. 1928.

OLE C. HOVLAND.