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## A New Multiple P.B.X.

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**A** REDESIGN of the various types of multiple private branch exchanges has been made to take advantage of newer methods of construction and other improvements, and to reduce the number of standards necessary to meet the service requirements. This has been accomplished by the development of a new multiple PBX, known as the 605-A, which, as it can handle up to 1500 lines, will meet most of the demands for multiple PBX service. It can be used in place of any of the three types now employed for installations up to this size and will serve also for use with long tie lines to other private branch exchanges as well as for local calls. With only one multiple board for smaller installations, the advantages of large quantity production will be realized and delivery periods will in general be shorter; in brief, all the advantages of using a stock article rather than a special one will accrue.

Private branch exchanges recently described in the RECORD\* have been of the non-multiple type, each station line being connected to only one jack. When one attendant is able to handle all the traffic, the jacks are all in the panel before her but when two attendants are required, they are divided and part placed on separate panels in front of each attendant. Not more than two attendants can be effectively used unless the jacks are mul-

tipled because each attendant must be able to reach any of the lines. This requirement led to the development of the multiple PBX. In these each line is connected in multiple to two or more jacks equally spaced down the length of the board so that all the lines may be accessible to every attendant.

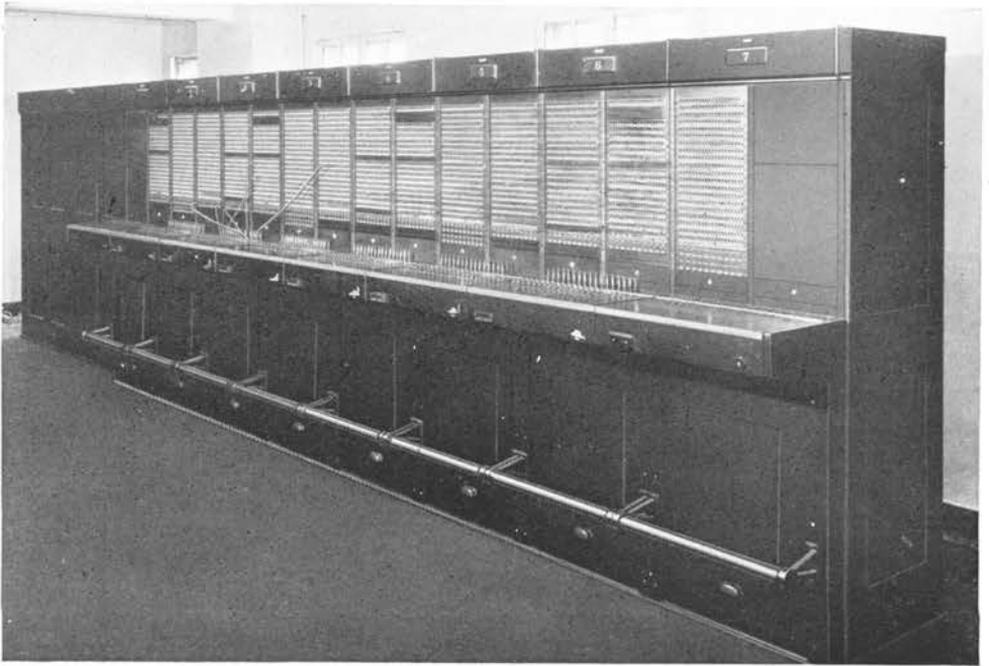
Early private branch exchanges of the multiple type were adaptations of central office switchboards, but later, multiple boards designed especially for PBX service were developed. Of these the earliest types were the No. 4 and the 600\*, each of which has a capacity of 640 station lines and 120 trunks. A board was also required a little later for the manual portion of a dial PBX and the 700 type was produced, incorporating those features required by this system.

Until recently, therefore, there have been these three multiple boards available for service; each developed to meet more or less particular demands and at different times. Each of the boards was designed to handle calls either between two PBX stations or between a PBX station and any other subscriber reached through a central office. With the increasing use of the PBX, however, there arose a demand for long distance tie lines between widely separated private exchanges operated by the same company. A large corporation, for example, might have its general offices in New York and a factory in Phila-

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\* July, 1928, pp. 363-365; August, 1928, pp. 399-402.

\* BELL LABORATORIES RECORD, Feb., 1929, p. 226.



*Fig. 1—A front view of the 605-A PBX*

delphia and perhaps other factories in still different cities, and between these different private exchanges direct tie lines were wanted to expedite interplant communication.

Whenever this condition had to be met, which was quite frequently, special tie-line positions for the board had to be engineered because long distance tie lines require special equipment. These tie-line positions constituted, in reality, a fourth type of multiple PBX, and their special nature caused delays in installation.

Certain minor differences between the types of boards, which existed because they had been designed at different times or for various purposes, were, of course, readily standardized with the new PBX. It was comparatively easy to select one size of frame to replace the earlier multiplicity of sizes; one size of jack could be made to serve for the two sizes used pre-

viously and so standardize this feature; even the magnetic busy signals which had been used with all the tie lines and trunks could, with a moderate amount of engineering, be replaced with lamps to attain uniformity of appearance and operation. There were, however, two points of difference between the older types that required much thought and ingenuity to reduce to a single form. One was difference in voltage of the power supply required for the various types of boards. Manual boards are operated at a voltage low enough to allow charging over wires from the central office building whereas dial-type boards required 48 volts to operate the switches. The other point was differences in the cord circuits used for ordinary and for long distance tie line calls.

In front of an attendant at a PBX is a double row of plugs, one directly

behind the other. One pair, a front plug and a rear one directly behind it, is used to complete each connection. To the cords attached to these plugs, relays and miscellaneous equipment are connected, making up rather complicated circuits. The equipment used on cords for tie line calls is necessarily different from that required for local calls and has necessitated two types of cords; higher battery voltage is provided in the talking circuit to offset the greater attenuation of the longer lines and many other circuit and equipment details exist which need not be considered here. To avoid this necessity of two types of cords in a new board was thus one of the major design problems.

The solution\* was obtained by placing in the tie line circuit the equipment that was necessary only for tie line calls and leaving in the cord circuit only that which was suitable for all types of calls. To make this possible, the tie lines were divided at each end and run into two jacks, each of which was multiplied throughout the board. One of the jacks is used when a call, originating at the PBX at the distant end of the tie line, terminates at the local PBX and the other when it is to be extended via another tie line through to another PBX. This scheme supplies 48 volt battery to the PBX station for a terminating call and makes a simple metallic connection between tie lines. It requires one manner of operation when the call is a terminating one and another method when it is a through call. The connection of tie lines to other tie lines is of course not ordinarily contemplated at regularly established rates because of transmission limitations. Where tie lines are

specifically designed to meet the transmission requirements they are subject to additional charges for any added equipment or special circuit arrangements which may be required.

The other main obstacle to a uni-



*Fig. 2—A rear view of the new board shows the compact grouping of the relays on their steel supporting structure and the accessibility of the multiple*

versal board was the difference in voltage requirement for the diverse classes of service. The 600 and 604 types of board both normally used low voltage batteries, but if they were equipped for long distance tie lines, 48 volts was required for transmission in addition. All dial apparatus used with boards of this size, however, is designed to operate on 48 volts so that the 700 PBX was arranged for this

\* First used with the No. 3 Toll Board, BELL LABORATORIES RECORD, June, 1927, page 337.

voltage. Relays and equipment used with the boards had to be designed for the voltage with which they were to be used.

By employing a type of relay recently made available, however, it was found possible to design circuits that would operate on any voltage from 32 to 50. When the board is to be used as the manual part of a dial PBX a 48 volt battery is required and a charging plant is installed at the PBX to maintain the voltage. For all other conditions a lower voltage battery is installed which may be charged either from the central office or from its own local charging plant. This wide range of operating voltage, which is a rather difficult accomplishment, satisfactorily solved the multivoltage requirement for PBX's.

In addition to the improved circuit

features the new board incorporates the latest structural advantages. It has a complete inner frame of steel divided into separate upper and lower units, the upper being designed for two twelve-inch panels. The outer woodwork has a walnut finish in order to harmonize better with present day office furniture and woodwork, and the keyshelf is of black phenol fibre which presents a hard durable surface almost immune to scratching. A canvas curtain to prevent noise due to the swaying of the cords is also used with the new board.

The results of several trial installations have been so favorable that the manufacture of the new board is now being placed on a production basis and the 605 board will soon be used for practically all multiple-switchboard requirements up to 1500 lines.



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—*New York Sun*, October 14, 1929