THE COMMON-BATTERY TELEPHONE SYSTEM OF THE CITY OF NEW YORK.

Perhaps a few electrical engineers fully appreciate the scope of the improvements which have been made in telephony since the time when the telephone was first exhibited at the Centennial Exposition of 1876. But the great army of subscribers certainly know nothing of the brains and money which have been lavished upon the elaboration of a telephone system that has reached its highest development in the land of its birth. The transmitter and receiver are all that each subscriber sees; and these show but little of the change which has been wrought. One apparently trifling departure, however, which has of late been noticed in the subscriber's apparatus has told the telephone users of New York that an onward step has been taken; and that departure, the only public sign of this step, is the abolition of the magneto-generator used in calling the central office, and of the sub-station battery.

The system which has thus discarded the magneto-generator and the station-battery is technically known as the "common-battery system," for the reason that it centralizes the sources of energy hitherto distributed among the various sub-stations.

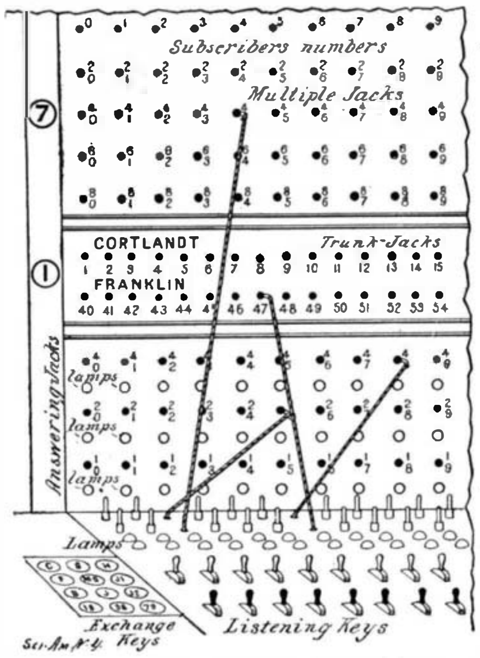
The change from the magneto to the common-battery system has rendered it necessary to reconstruct every telephone-exchange in New York—a reconstruction which has been effected without any inconvenience to the subscriber, even though new stations were added to the system at the rate of one thousand per month. Only on the completion of the new installation were the old boards abandoned.

The common-battery system employed throughout the United States is the result of the labors of many men, among whom may be mentioned Scribner, Hayes, Dean, O'Connell, McBerty, and Carty. It is not the purpose of this article to dwell on the technical features of the system; for they would be of interest only to electrical engineers and telephone experts and would require many numbers of the Scientific American to do them full justice. The labors of Scribner and his compeers must therefore give place to a cursory description of the working of an exchange—that portion of the system which is perhaps of most interest to those who use the telephone in the affairs of daily life.

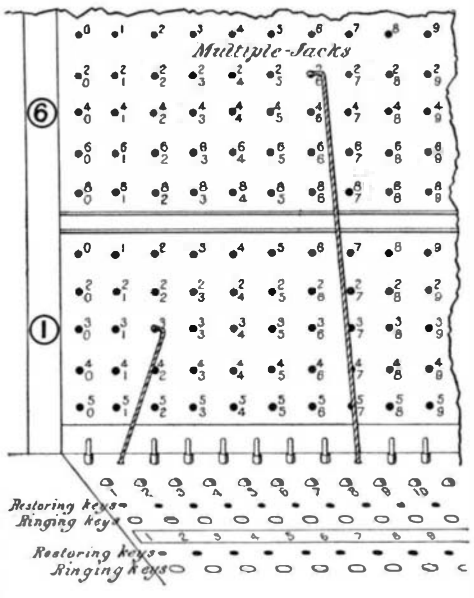
The telephone exchange which we illustrate is equipped with the most perfect apparatus that has yet been devised. Its long multiple switchboard meets the demands of some 5,300 subscribers' stations, the aggregate number of whose calls reaches a total of 41,000 per day.

The multiple switchboard in question is divided into two sections, known at the exchange, respectively, as the "A" board and the "B" board. It is the function of the operators of the "A" board to connect the subscribers of the exchange with each other or with lines, called "outgoing trunk-lines," leading to other exchanges. It is the function of the operators of the "B" board to connect the subscribers of other exchanges, whose calls are received on "incoming trunk-lines," with the subscribers of the particular exchange under discussion.

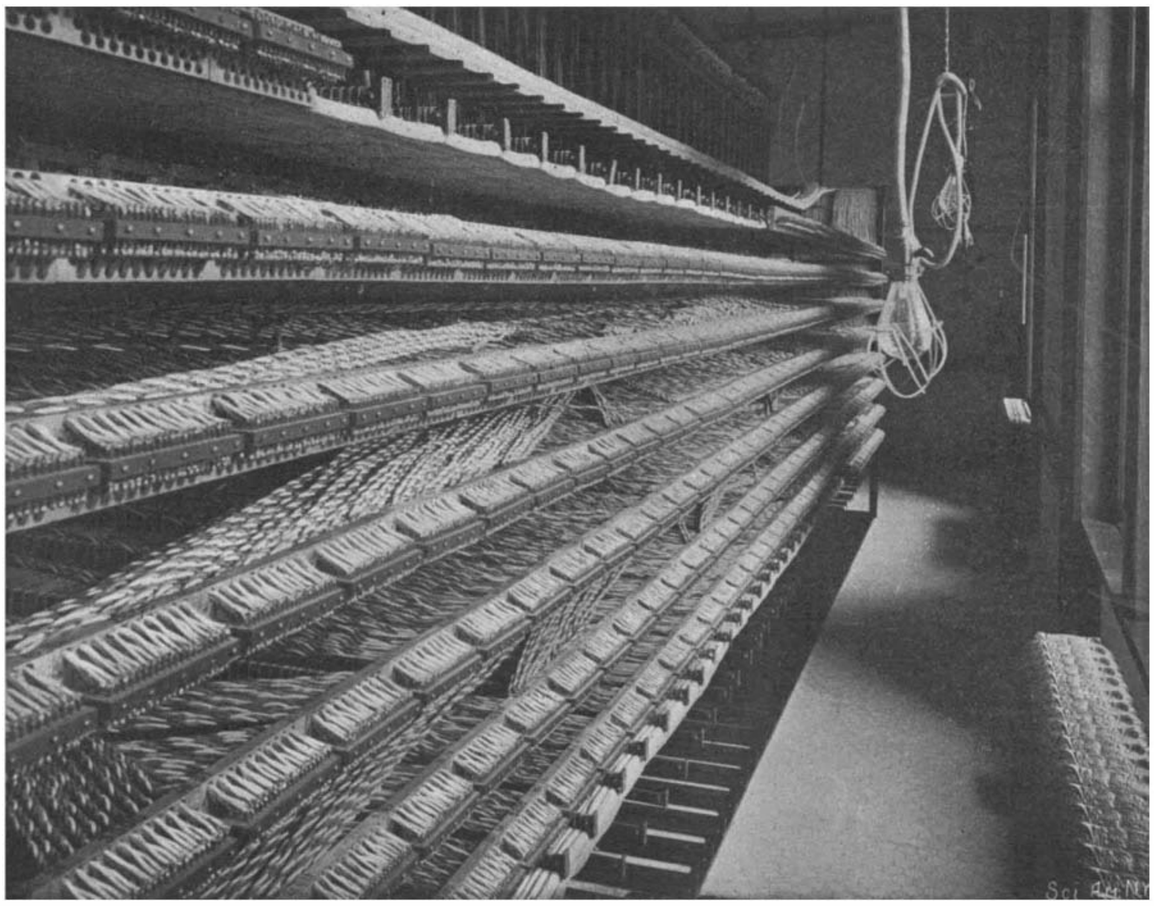
GENERAL VIEW OF THE MULTIPLE SWITCHBOARD OF A TELEPHONE EXCHANGE.



PANEL OF AN "A" BOARD IN DETAIL.



PANEL OF A "B" BOARD IN DETAIL.



INDIVIDUAL SUBSCRIBER WIRES.

Each operator of the "A" board controls seven vertical panels of the multiple switchboard, which panels are each sub-divided into small sections receiving one hundred sockets or "jacks," numbered to correspond with the sub-station lines leading to the exchange. Every operator can reach all the subscribers of the exchange. Beneath the multiple jacks the outgoing trunk-jacks for connecting subscribers of the exchange with subscribers of other exchanges are located. And beneath the trunk-jacks are "answering-jacks," which correspond with the stations of subscribers whose calls the operators must answer. A certain number of subscribers or "answering" jacks are assigned to each operator. Beneath each answering-jack is a small incandescent lamp, which flares up whenever the corresponding receiver at the station is taken from the hook, and is automatically extinguished when the operator connects with the answering-jack to answer the call. In addition to the lamps of the answering-jacks a "pilot-lamp" is used, which glows as long as any subscriber's lamp is alight. It is the purpose of the pilot-lamp to serve as an additional means of attracting the operator's attention to her subscribers' lamp, and to enable her to respond to the call of a subscriber whose lamp may have been burned out. On the horizontal board before each operator two sets of plugs with their cords are seated, in front of which are two series of lamps (supervisory lamps, they are termed) corresponding in number and arrangement with the plugs, and serving as signals to inform the operator when a called subscriber has answered and when she must disconnect two subscribers. Sets of ringing and listening keys complete the equipment of each "A" operator.

When a subscriber calls up the exchange, the pilot-lamp and the lamp of the corresponding answering-jack glow. The "A" operator inserts one of the disengaged plugs of the rear or answering series in that answering-jack and asks the number desired. If the number be that of a subscriber in the same exchange, the operator first taps the edge of the multiple-jack of the station wanted with the tip of the second plug forming part of the circuit which she intends to use. If the line is "busy" she gets a peculiar click in her receiver, a warning not to intrude. If the tapping does not betray a "busy" line, the plug is fully inserted. When the two plugs are in their respective jacks the two lines are connected and then the two corresponding supervisory-lamps show the state of affairs. The inner lamp, connected to the answering-cord, is out because the calling subscriber has his telephone off the hook; the second lamp remains alight until the called subscriber takes down his telephone, when it is automatically extinguished and the operator then knows that the two subscribers are in communication. If the called subscriber fails to answer, the one supervisory signal will glow until by persistent ringing the subscriber is made to respond. When a conversation has ended and both subscribers hang up their receivers, the supervisory signals both again glow, thus commanding the operator to disconnect the two lines.

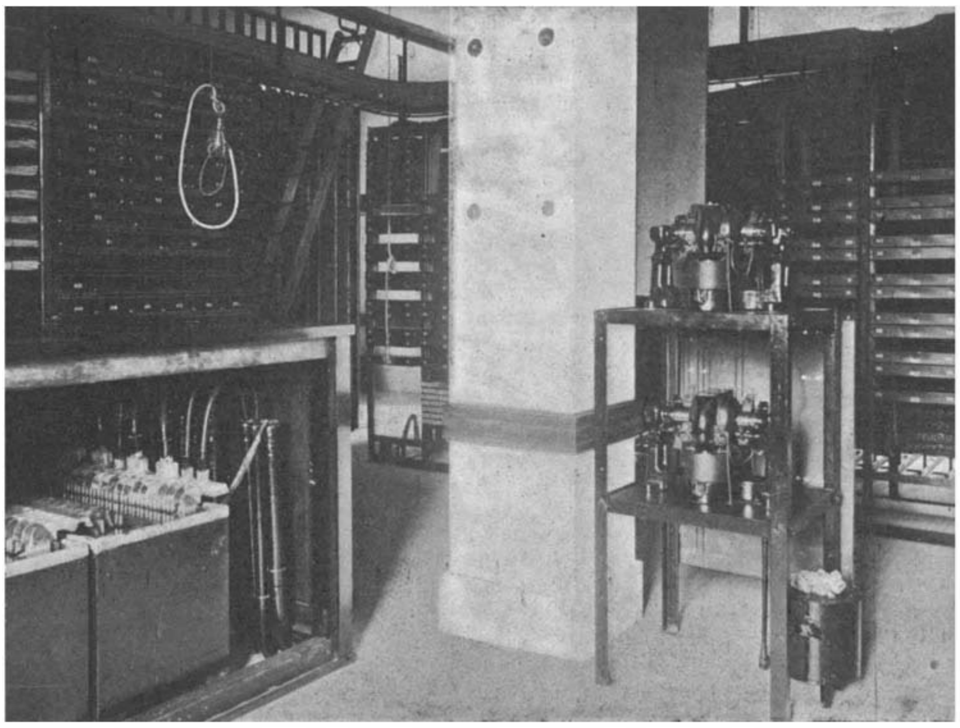
If the subscriber called for be in another exchange, the "A" operator, after having inserted an answering-plug in the jack of the calling subscriber and ascertained the number desired, presses a key to her left, which places her in communication with the desired exchange, informs the "B" operator there what number is desired, and inserts her connecting plug in the particular trunk-jack designated by number by the "B" operator of the other exchange. The desired connection is then completed at the second exchange after the usual "busy" test has been made. The supervisory lamp-signals are here again used to inform both operators when the lines are to be disconnected.

The "B" board of every exchange is provided with multiple-jacks arranged in panels similar to those of the "A" board, so that each "B" operator can reach all the subscribers of the exchange. No answering-jacks are provided; nor are any required, since the operators at the "B" board merely connect other exchanges with called subscribers. Only one set of plugs (incoming trunks in this instance) and one set of supervisory lamps are needed, for the reason that the connections are half completed at the calling exchange. Ringing-keys are provided, which when depressed ring the called station's bell at regular intervals until the subscriber takes down his telephone, when the ringing-key automatically resumes its normal position. A line of auxiliary keys corresponding in number with the ringing-keys is also provided, the depression of one of these keys serving to restore a ringing-key to its normal position when a subscriber absolutely fails to answer. Each operator of a "B" board answers the calls from one exchange. The "A" operator at the calling exchange, after having answered a subscriber, speaks to the "B" operator over a service wire and instructs her what number is desired. The "B" operator designates what disengaged trunk-line should be used by the "A" operator and then inserts the correspondingly numbered incoming plug of her "B" board in the multiple-jack of the station called for, the usual "busy" test having first shown that the line is free. The glowing of the supervisory signal in the circuit of the particular incoming trunk-line used and of the supervisory signal on the board of the calling "A" operator, indicate when disconnection is to be made.

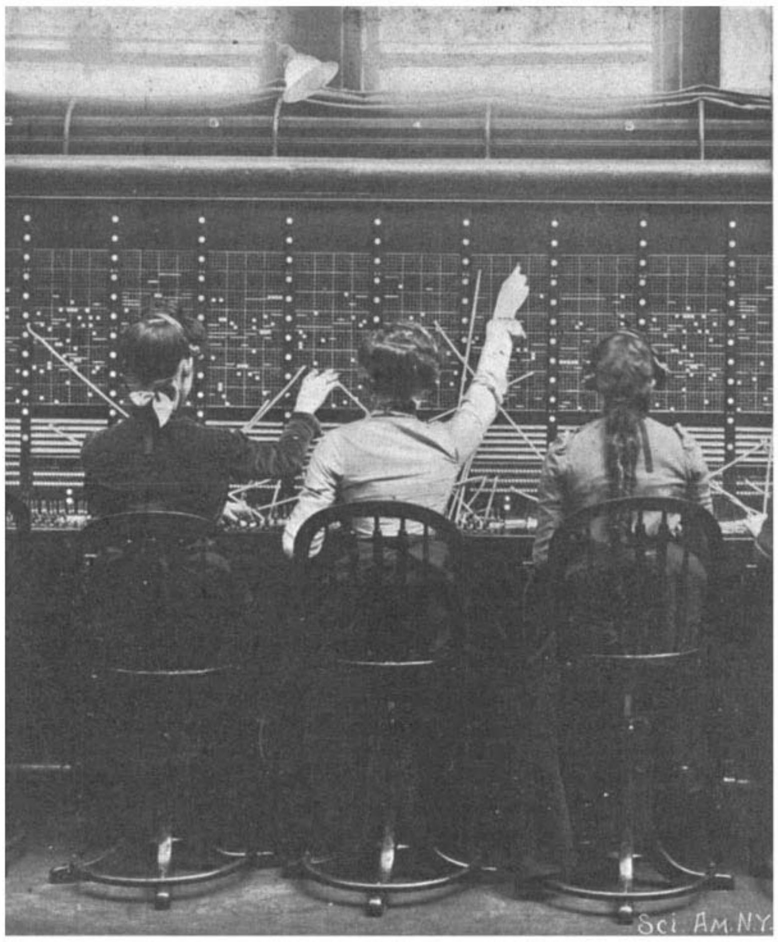
The boards are so arranged that the work of each operator is reduced to a minimum. Only a second is required to ascertain whether or not any given subscriber of the exchange is "busy;" a few more seconds suffice to notify a calling subscriber whether any other station in New York and vicinity is "busy;" a minute or two is all that is required to gather similar information from Boston, Philadelphia, or other outlying towns.

The multiple switchboard is the most expensive and at the same time most efficient central office apparatus ever invented. Its cost is about $1,000 per foot; its elements are numbered by millions. The addition of a number of multiple-jacks to a board means an addition not to one section of the board alone, but to every section; for it is the primary purpose of the multiple board to enable each operator to have within her reach all subscribers' lines connected with the exchange. The multiplying of jacks entails enormous expenditures. But the price of this increase is not the only outlay which may be lavished upon an exchange. So rapid and so radical are the advances made in telephonic communication that an exchange may often be entirely refitted to incorporate a new improvement. Next year's telephone exchange is almost certain to reveal some departure from this year's apparatus. The changes may be slight. They are costly. But they increase the efficiency of the system; and for that reason alone the end justifies the means.

Remarkable as the technical achievements in modern telephony undoubtedly are, it cannot be denied that New York owes its admirable telephone service largely to the admirable organization of the exchanges. Each exchange has its highly-trained corps of operators and chief operators who answer calls and make connections with a celerity not always appreciated; its supervisors who see to it that the operators do their work promptly and aid them if necessary; its monitors, seated at properly-equipped desks, assisting the operators in making difficult connections; its manager, who is the commander-in-chief of this regiment of operators, supervisors, and monitors; and its wire-chief, whose business it is to superintend the technical department.



THE STORAGE BATTERIES AND A SECTION OF THE REPEATING-COIL RACK.



A PORTION OF THE "A" BOARD, SHOWING MULTIPLE-JACKS, OUTGOING TRUNK-JACKS, ANSWERING-JACKS, AND PLUGS.

Distortion in Lantern Slides and Its Cure.

When one sees a lantern show at the present time, one cannot but be reminded of the general superiority of the slides as compared with those produced a decade or so ago. Not that the commercial slides are so much better, but because those now made by amateurs are infinitely superior to the dense black-and-white things that used to be considered good enough to show at the time to which we refer. This superiority, in a great measure, is due to the excellence of the plates now supplied, specially for transparency work. Till these were on the market the amateur had, perforce, to be content with the ordinary plates that were intended for negatives. At times, however, one does see slides shown that, though in all respects photographically perfect, are marred by the distortion of perpendiculars. This is most unpleasant to the eye when seen upon the screen, particularly if the lines happen to come in close proximity to the edges of the mask, and that is rectangular. This distortion of convergence, it is needless to say, is caused through the camera not being placed level when the negatives were taken. This might easily have been avoided if the camera had been used on a stand, but not so easily if it were held in the hand, notwithstanding that it might be provided with spirit or other levels. Again, it is often impossible to obtain the whole of a high building in a picture unless the camera is pointed upward, and comparatively few hand cameras are furnished with a swing back, or rising front, which would enable the distortion caused by the tilting to be avoided. Even if the hand camera were provided with a swing back it is doubtful if the novice would always employ it with sufficient judgment to obviate the convergence of the lines, for the image, as seen on the finders, does not always coincide with what is included in the negative.

If the camera is provided with a rising front, with sufficient rise to avoid the trouble, we are met with the difficulty that the majority of hand cameras are supplied with lenses that are only capable of fairly covering the plate when they are fixed at its axis, and, if they are raised much beyond that, the lower corners of the negative suffer. The case would be different if all cameras were provided with lenses of the anastigmatic type, which have a great covering power, and even illumination over a wide field. Although the lines may be out of the perpendicular in the negative, there is no reason why they should be in lantern slides made from them, for the evil may be corrected.

Supposing we have a negative of a building in which the lines converge toward the top, owing to the camera being pointed upward when it was taken in order to include the whole of the subject in the picture. Now, what we have to do to render the perpendiculars parallel is to enlarge the upper portion of the image and reduce the lower portion, then we shall get the picture as it should be. This, of course, can only be done when the slides are made by camera printing. If we put the negative in the dark slide of a camera with a swing back, and adjust it so that the top of the negative is nearer the lens than the bottom, and the image is received on the ground glass of a second camera placed in front of it, the perpendiculars will be seen corrected, provided, of course, that a suitable slope be given to the negative in the swing back, and that is easily adjusted. But it will be obvious that, as one portion of the negative is nearer the lens than the other, all parts will not be in sharp focus with its full aperture, therefore it must be considerably stopped down in order to get all portions sharp. The best method of obtaining that in practice is to first sharply focus the center of the picture with a medium stop, and then put in the smallest one with which the lens is provided.

If the negative requires a very great slope to correct the distortion, it may be found impossible, even with the smallest stop, to get all parts sharply defined. In that case it will be advisable to make the correction indirectly, making a transparency in which the convergence is but partly cured and then from that adopting the same means, making a new negative, which may then, if desired, be used for contact printing. If this procedure is found necessary, the transparency should be more fully exposed and made denser in the development than if it were to be used direct as a lantern slide.

As some may not have a second camera, or one with a swing back, then an ordinary copying camera, such as is used for lantern-slide making, may be utilized by fixing the negative in the camera in a sloping position. This may easily be done with the aid of a wedge-shape strip of wood or a couple of wedge-shape pieces of cork, adjusted so that, while one end of the negative is in the rabbet of the holder, the other is kept the required distance away by the wooden wedge or the corks, as the case may be. This extemporized arrangement is readily secured in position with a few drawing pins. When the slope necessary for the negative is very great, it will be a good plan to place a piece of ground glass an inch or two from it, at the back, so as to insure its even illumination, which, in some circumstances, might not otherwise be attained.—The British Journal of Photography.