Chairs for Telephone Operators

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Switching Systems Development

To the Bell System, supplying good equipment for use by Telephone Company employees is as important as supplying good service to customers. Nothing is neglected in designing the things employees use so that work can be performed efficiently and safely. A new operator's chair, developed to incorporate many improvements over older designs, should prove a welcome addition to the furniture used in Bell System telephone offices.

Chairs are important items of home or office furniture, and they can be well or poorly designed. A chair may be expertly adapted for its special use, or it may fail in one or more particulars. At Bell Telephone Laboratories, studies are made of posture, comfort and appearance, so that the chairs used by operators will tend to make their tasks easier and their working conditions more pleasant. The overall result will be a contribution to better service to the customer. Involved in these studies are both the mechanics of materials and the structure of the human body, and the goal is to produce a design that will be strong, durable, and well-proportioned posture-wise to support comfortably a person performing specific operations.

Switchboard operation requires that the operator sit at a level which gives her access to such equipment as customer lines and inter-office trunks located in the face of the switchboard as shown above and in Figure 1. The number of lines or trunks varies, depending on the type of service furnished, and the switchboards accordingly vary in height. The operator may have to reach to the right or left or upward to connect to these lines or trunks. In contrast, desk operation is somewhat different than switchboard operation, but the necessary movements of the operator are about the same. An information-desk operator may require access to records in front and at each side of her as shown in Figure 3. Figure 2 illustrates how a rate-and-route operator may have to reach upward for toll tickets filed in cabinets in front of her. To insure that these functions can be performed comfortably and efficiently, the seating must be ample and the seat height must be adjustable. The chair must be rugged and stable to give the occupant a feeling of safety as she moves about. These in general are the mechanical requirements, and in the design of chairs they can be engineered with reasonable accuracy.

The posture requirements are somewhat less definite. In medical parlance they are divided into "static" and "dynamic" conditions. The static condition occurs during the periods when the operator is sitting still, and in this case the chair design must provide the kind of support to cause the least amount of strain on the body muscles. The dynamic condition occurs while the operator is moving about, and the chair design should encourage the operator to assume the most efficient position for the necessary motions. These conditions are generally obtained by the proper relationship between the seat, the backrest and the foot rest or support for the feet. To attain a high degree of perfection in this respect would not be very difficult if the chair were built to order for a single person. However, chairs stay with the switchboard position, while operators are assigned to positions depending on traffic conditions, so that a girl may not necessarily occupy the same position at all times. Accordingly, the chair is designed to meet average body measurements of operators.

Experience with a current chair design or a possibility of economies in manufacture or maintenance may indicate that a change is desirable. Studies are then made to determine the desired characteristics of the new design. After the mechanical features have been resolved, substantial quantities of chairs are built and distributed for trial in various parts of the country. Trained people interrogate the operators, and on the basis of such information, design changes may be incorporated and additional trials made before final standardization.

The current standard operator chair is shown in Figure 4. There are four different switchboard keyshelf heights in use and, accordingly, there are four sizes of chairs: 18, 20, 24 and 28 inches from the floor to the seat in the chair's lowest position. In addition, there is a specially arranged 18-inch chair used primarily at information desks. All chair designs consist of two parts: an upper unit and a lower unit interconnected by means of a threaded spindle and a hub. This provides a simple mechanism for raising and lowering the seat. The same upper unit is also used for the four sizes of chairs. The lower units are alike in design but vary in height. The backrests have foam rubber pads upholstered with nylon cloth. Two types of seats are available: one has a foam rubber pad upholstered

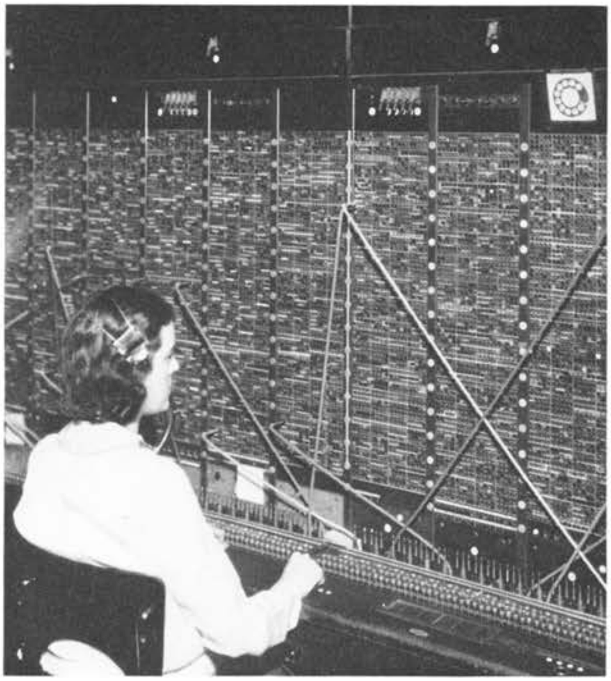

Fig. 1 — Operators must sometimes reach far out to make a connection, which requires good chair design. (Photograph, taken several years ago, shows operator using old type headset.)

Fig. 2 — Rate-and-route operators must reach for files of toll tickets. Laboratories designed chairs provide required freedom of activity for this operation.

with nylon cloth, and the other uses natural cane stretched across a wooden frame. All of the supporting framework consists of steel tubing covered with polyvinyl chloride (PVC) plastic. The basic members are welded together, and the auxiliary parts are fastened with screws. To facilitate maintenance and insure a reasonable life of the chair, the seat, the backrest and the foot ring can be readily replaced.

Plastic-covered tubing for chairs is a Laboratory-pioneered development, and it is now rapidly being adopted for other industrial applications. The objective was to obtain a finish that would resist cracking and scuffing, present a smooth warm surface to the touch, and retain its appearance for many years. With the assistance of the Chemical Research Department, polyvinyl chloride was chosen as a suitable plastic material. Also, two important fabrication techniques had to be developed — a way of extruding PVC onto the metal tubing and a method of bending the tubing without buckling the plastic. In solving these problems, the Laboratories had the assistance of the Naugatuck Chemical Company, the Samuel Moore Company and the Sturgis Posture Chair Company. As finally worked out, the method is as follows: the plastic is extruded over 10-foot sections of steel tubing

Fig. 3 — A special "offset" chair is provided for information-desk operators for easy access to books.

which are later cut to the necessary lengths for the various parts of the chair. These pieces are then fed to a machine which bends them into the required shape.

On the chairs for switchboard use, the spindle supporting the seat is approximately in the center of the seat. On the specially arranged 18-inch chair for information-desk use, the spindle is attached approximately 2 inches back of the center. This is referred to as the "offset" chair, and it permits the front of the seat to move in a greater arc. An operator using the offset chair at an information desk, as in Figure 3, has easier access to books at her left and right as well as in front. To avoid excessive wear on the spindle threads because of the continual rotation from left to right, the mechanism on the offset chair transfers weight from the threads to a nylon bearing.

The color schemes are mahogany-brown and blue-green, or a combination of the two. The color combinations selected are based on advice of consultants whose business it is to study mass reaction to color styling on such items as house furniture and linoleums. The colors are also based on obtaining harmony with associated furnishings in telephone operating rooms. Switchboards are generally finished in mahogany, and desks are finished in either mahogany or gray.

In addition to operator comfort, job performance, economy of manufacture, and ease of maintenance, there is the problem of repair. Certain parts of a chair receive more wear than others, and arrangements are therefore made for replacement. Parts such as backrests, seats, foot rings and casters must be available for this, and the chair design is such as to permit replacements with a minimum of effort. In introducing new designs, every effort is made to keep the major items interchangeable with the older vintage of chairs. As an illustration of this principle, the upper unit of the present standard chair may be used with the lower unit of any chair still in use in the Bell System. This has proven economically sound over the years in that stock parts for all chairs are kept to a minimum and existing chairs can be rehabilitated at a nominal cost.

The question is often raised as to why new designs are necessary or desirable. The answer cannot be stated simply, but usually the need arises from a combination of events. Developments and changes that in the past have led to new chair designs are new materials, new industrial processes, changes in styles of women's clothes, medical discoveries, and psychological trends. For example, on early designs the backrest was made of wood and proved satisfactory until women began to wear shirtwaists that buttoned up the back. The buttons marred the painted surface of the backrest, and the wood stain came through and smeared the shirtwaists.

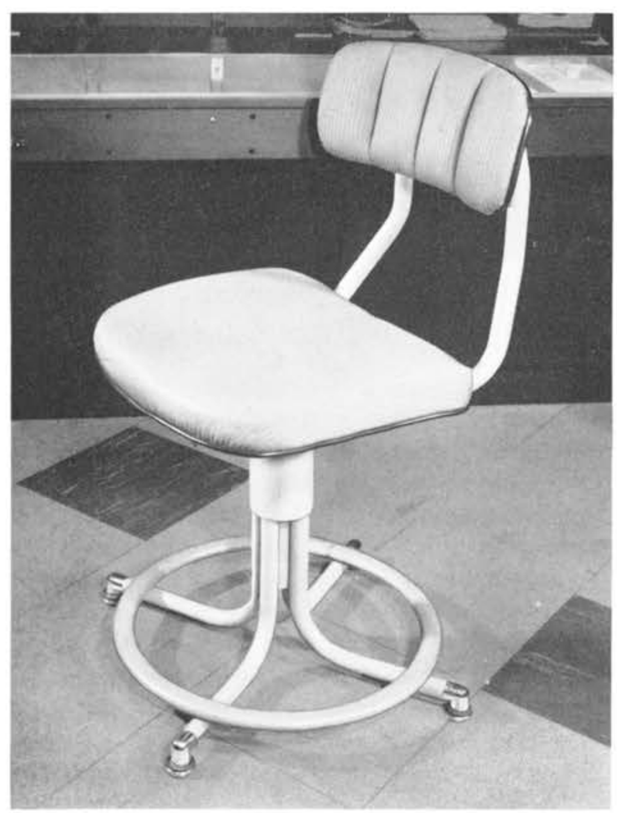

Fig. 4 — The present standard operator chair, in four heights and in a special "offset" model.

The result was a design change to use backrests of molded bakelite. This change eventually resulted also in cost savings. The raw material was a little more costly and there was an initial expenditure for molds, but the result was fewer parts to assemble. As styles often do, this one faded out of the picture after several years but the new backrest was retained.

Another illustration of how chair design is affected by extraneous events is the change in floor wax for linoleums in central offices. Originally, the chair rest or caster on the bottom of each leg was made of bakelite and was designed to provide generous load distribution and thus prevent indentations in the linoleum. It also had to permit sliding the chair – but not too easily – because the inadvertent movement of a chair while an operator was reaching a distant jack in the switchboard multiple might cause an accident. However, for floor-maintenance reasons it was found desirable to change to an improved floor wax, and with the new wax the coefficient of friction was somewhat greater than with the old. This resulted in sticking between the bakelite casters and the linoleum, and as a result, new steel casters were designed to obtain the right degree of freedom.

Changes in design will undoubtedly continue for combinations of the reasons given above, and the tendency of such changes is to provide better seating or to reduce the cost of the product. New materials and new industrial processes generally tend to reduce costs, and by adopting them when they prove sound, the ultimate overall costs are kept at nominal levels.

THE AUTHOR

W. W. Brown received a B.S. degree from M.I.T. in 1921. He joined the Western Electric Company Engineering Department at 463 West Street which later became Bell Telephone Laboratories. After short training periods with the New York Telephone Company in central office maintenance and with the Western Electric Company in central office installation he was assigned to the engineering group engaged in equipment design. In the period preceding World War II he was engaged in the design of switchboards, information desks, local test desks, and No. 1 crossbar. During the war he took part in the development of crew trainers for Navy PBM and Army B24 planes. Since the war he has taken part in the development of No. 5 crossbar, the 23 operating room desk, time-of-day equipment and chairs for telephone operators and supervisors.

New High-Power Transistor Announced By Laboratories Engineers

An experimental silicon power transistor, capable of providing an output of five watts at ten megacycles, either as an oscillator or an amplifier, has been developed at Bell Laboratories under the sponsorship of the Joint Services. Details of this development were revealed in a talk prepared by J. C. Iwersen, J. T. Nelson, and F. Keywell of the Device Development Department, and delivered by Mr. Iwersen at the National Conference on Aeronautical Electronics in Dayton, Ohio, on May 15.

Unilateral gain in excess of 20 db and a collector efficiency of better than 40 per cent have been achieved in the construction of this device. The unit is a p-n-i-p diffused emitter and base transistor, in which a near-intrinsic or "neutral" layer of silicon separates the collector from the other elements. Introduction of an intrinsic layer to improve the high-frequency performance of transistors was announced by the Laboratories in 1954.

Alpha cutoff is about 100 mc per second, and some laboratory samples have provided as much as one watt output when used as a 100-mc oscillator. Input and output impedances are on the order of 20 ohms and 300 ohms, respectively.

Original design objectives have been met in the laboratory models and development work on this unit is continuing. Steady improvements in the diffusion process, packaging, and other features are expected to result in a transistor which is reliable and relatively easy to manufacture.