



Cross Section of Hand Set

## New Developments in the Telephone Art: No. 3

*Bell engineers triumph over many difficulties in designing the hand set telephone  
Condensed from an article by W.C. Jones and A.H. Inglis in The Bell System Technical Journal*

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A number of factors contribute to the difficulties involved in the design of a telephone hand set which gives as good service performance as a desk stand. The hand set transmitter, for example, not only is used in a wider range of positions but also is moved about much more frequently, so that wider variations are experienced in its characteristics.

Further difficulties are introduced by the close physical connection of the receiver and transmitter, in that "howling" tends to be set up. The handset has been developed so that it overcomes all these difficulties and is interchangeable with the desk stand in existing telephone plant without important reaction on either transmission or signalling performance.

When an attempt was made to use granular carbon transmitters with hand sets it soon became evident that a satisfactory design involved more than the mounting of the available types or transmitters and receivers on a common handle and that considerable development of the instruments, as well as the means for coupling them, would be required before a hand set suitable for general use was to be obtained.

One of the unique features of the new hand set transmitter is the fact that the carbon chamber is located in front of rather than in back of the diaphragm as has been customary in the past. By adopting this method of arrangement the carbon granules are held in intimate contact with the diaphragm in all of the positions in which the hand set is likely to be held, and uniform output and faithful reproductions of speech sounds obtained.

The diaphragm of the transmitter is made from thin duralumin formed into a truncated cone with radial stiffening ribs. This reduces the effective mass to about one-tenth that of the desk stand transmitter and provides sufficient rigidity to insure vibration as a unit throughout the frequency of interest. A number of impregnated paper rings, each approximately four thousandths of an inch in thickness, support the edge of the diaphragm.

The parts of the hand set receiver are assembled in a die-cast

aluminum housing, and form a unit which mounts in a threaded bushing in the handle in much the same manner as the transmitter unit. One connection to the winding is made through the threaded portion of the case, the other through a contact spring in the base. The cap and spring are made of phenol plastic and thoroughly insulate the metal parts so that the user cannot come in contact with any portion of the receiver which forms a part of the electrical circuit. The spacing ring also serves as a lock ring for holding the receiver on the handle. A grid in the cap prevents damage to the diaphragm from the projecting portions of the mounting. The layout of the holes in the grid is such that a dent in the diaphragm caused by inserting a pencil or other sharp objects through the grid, will not occur at a point over the pole faces and interfere with the operation of the receiver.

Particular effort has been made to proportion the hand set so that the transmitter mouthpiece may be as near as possible to the lips of the talker, thereby avoiding unnecessary transmitting loss. Care has been taken also to provide adequate clearance between his hand and cheek. In determining the proper dimensions of the handle and assembly, about 4,000 measurements of head dimensions were made. The subjects selected for these measurements included both sexes and the various races in about the proportion indicated by the census figures.

Undesirable variations in transmission and resistance with change in position, excessive carbon noise, and howling, all of which have heretofore presented serious obstacles to the adoption of a handset for general use, have been successfully overcome in the new design. It has been found practicable to use this hand set interchangeably with the desk stand in the existing telephone plant without important reactions on either transmission or signalling performance.

That the design, in addition, meets the desires of the public for the convenience of a hand telephone set is best evidenced by the steady increase in demand to more than one million a year at this time.