New Magnetic Telephone

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Apparatus Development

TELEPHONES which had no source of energy other than the speaker's voice were the earliest commercial instruments. A diaphragm of soft iron served both as a collector of sound energy and as a means of varying the flux through a coil. Voice currents generated in this instrument were far less powerful than those given by the carbon-granule transmitter, which soon came to dominate the field. A magnetic transmitter, however, is simple, portable, and independent of current-supply, and it would be attractive for use in construction camps, warehouses and ships. Better knowledge of magnetic materials and structures has suggested that its output could be greatly increased by proper design.

In the magnetic telephone which is the outcome of recent development work in these Laboratories, a cone-shaped duralumin diaphragm is connected to one end of an armature which lies between the poles of a U-shaped permanent magnet. When sound waves strike the diaphragm the armature vibrates and varies the air-gaps between it and the pole-pieces of the magnet. This changes the reluctance of the magnetic circuit and induces voice-frequency currents in a coil which surrounds the armature but does not touch it. Conversely, when voice currents are imposed on the coil, the armature and diaphragm vibrate and reproduce speech. Thus, a single instrument serves alternately as transmitter and receiver.

Signalling current is generated at either end of the line by varying the reluctance of the magnetic circuit of the telephone instrument rapidly

enough to create an audio-frequency current. Near the ends of the armature are two discs with teeth of magnetic material; both discs are attached to the same spindle and mounted at the side of the magnet as shown in Figure 1. Their action is illustrated in Figure 3 where the parts are shown in their correct positions except that the two rotors have each been turned ninety degrees for clearness of illustration. The total gap from either pole-piece to the armature by way of the rotor tooth is substantially less than the distance between the pole-piece and the armature. Also, the rotors are displaced angularly so that the left rotor is in position to shunt the air gap between the north pole and armature when the right rotor shunts the gap between the south pole and armature, and vice versa. This makes the flux pass from the left end of the north pole-piece to the tooth of the left-hand rotor, thence, through the armature to the tooth of the other rotor, and to the right end of the south pole-piece. Similarly, when the rotors have progressed a little farther the flux goes from the right-hand north pole to the left-hand south pole through the armature. In this manner the flux through the armature is reversed periodically and an alternating current is induced in the coil. The rotors are driven from a hand crank through a gear train so that the frequency of the current is in the order of 1,000 cycles per second. This frequency lies not only within the peak of the response curve of the instrument but at a value where the human ear is relatively sensitive. The acoustic level of the signal is very much higher than that of the standard telephone ringer.

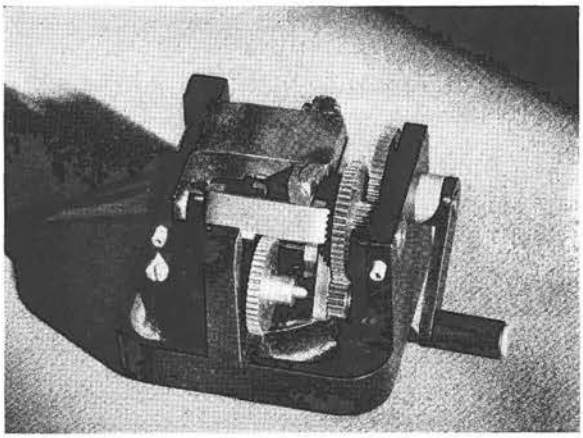

Fig. 1—The new magnetic telephones have a powerful permanent magnet. The diaphragm itself emits a siren-like tone to signal the person called

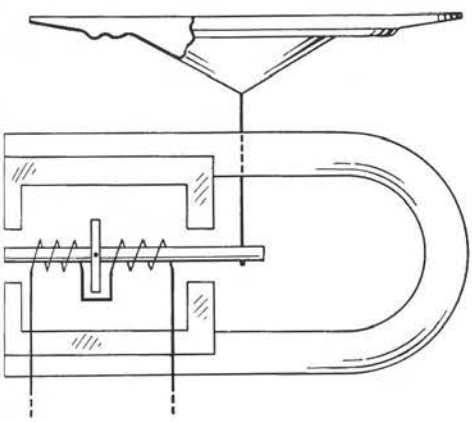

Fig. 2—The diaphragm is attached to a rocking armature similar to those used in certain types of loudspeakers

To obtain an efficient magnetic circuit with small lightweight parts, the magnet in the telephone structure was made of remalloy, a highly remanent material. Pole-pieces, armature and teeth of the rotors are made of permalloy; the teeth themselves are separated by non-magnetic material in order to reduce leakage.

A five-foot cord, the two conductors of which terminate in clips of conventional design, is provided to attach

the telephone to a permanent or a temporary line. A small leather carrying case with a shoulder strap is also available. The instrument itself is

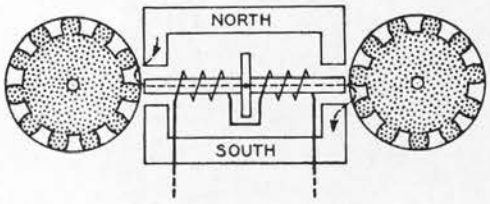

Fig. 3—The signalling current is generated by rotating two discs with teeth of magnetic material in the field of the telephone magnet

about three inches square and weighs less than two pounds.

A wall-type telephone embodies a transmitter which functions as a signal generator and reproducer, and a receiver which differs only in the lack of signalling facilities. Removing the receiver from its mounting transfers the telephone from the signalling to the talking circuit and, in order to prevent signalling under talking conditions, short-circuits the line when the signalling crank is turned. A switch is provided to connect the set to any of six outgoing lines. This telephone, being designed primarily for installation on shipboard, is watertight and is shown on page 282.

These new magnetic telephones are not intended for connection with Bell System private-branch exchange or central-office service but their quality and efficiency makes them useful for intercommunication service where compactness, independence of external power, and ease of installation are important.

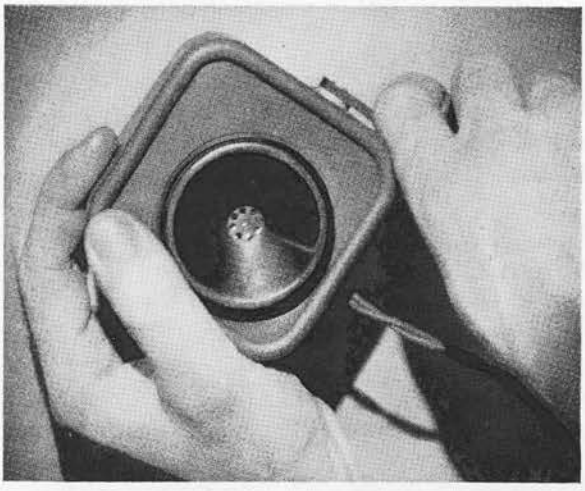

Fig. 4—The combined transmitter and receiver is three inches square and weighs less than two pounds