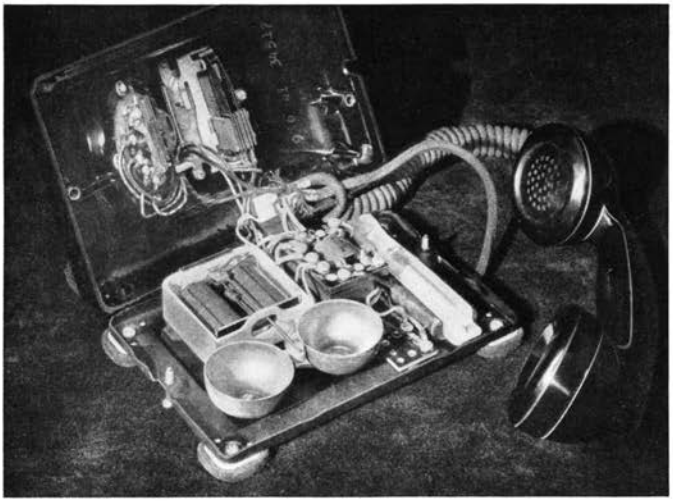

# Small Ringer for Combined Subscriber's Set

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LIMITED space in the new combined telephone sets necessitated the development of a much smaller ringer than those previously in general use. In it were incorporated other features including a gong of better tone; also coils of higher impedance to permit using a smaller condenser and to make the ringer suitable for parallel operation of extension ringers and on multiparty lines.

The new ringer is similar in principle to earlier designs.* Two gongs and a polarized magnet with balanced armature, to which is attached a clapper, constitute the main structure. Alternating current vibrates the armature and strikes the clapper against the gongs. The armature oscillates on a shaft bearing and is held, when not vibrating, against a stop by a cantilever biasing spring made of phosphor bronze wire. Proper choice of the mass and stiffness of the clapper assembly makes the velocity with which the clapper strikes the gongs, and hence the sound output, independent of the ringer input over the range encountered in practice.

Polarizing flux is supplied by a U-shaped magnet M, Figure 1, of chrome steel, which has its two ends welded to a soft iron heelpiece. The north pole is at the bottom of the U and the south pole is at the bridged upper end. Thus the two legs are magnetically in parallel. The permanent magnet is of such strength that it produces an average flux density of about 1300 gauss in the air gaps between the armature A and the cores.

The cores are connected in series,

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aiding for a flux path from the armature through one coil, then through the heelpiece and back by way of the other coil to the armature. Flux from the ringing current is superimposed on the biasing flux and alternately strengthens or weakens each arm relative to the other. This makes the armature and clapper vibrate. If the current is not actually reversed but only drops to zero, the armature is returned to normal by the biasing springs. The ringer thus operates either on alternating current or on pulses in the direction to oppose the pull of the spring. Pulses in the opposite direction tend to hold the magnet tighter against the upper stop, pin P1 of Figure 1.

Minimum operating current is determined by the torque per unit of current and by the bias supplied by the spring. In older ringers bias was continuously variable and required adjustment by the installer on a trial and error basis. The new ringer has three notches, N, Figure 1, into which the free end of the biasing spring can be slipped. The spring itself has been carefully adjusted during manufacture to just operate the ringer on slightly over three milliamperes with the end of the spring in the middle notch. This adjustment suffices for over eighty per cent of the installations. The remaining twenty per cent are taken care of by the low and high notches. Bias prevents false operation of ringers connected from one side of the line to ground when ringing voltage is applied to the other side of the line. It also prevents audible tapping when dials of telephones are operated.

To obtain high impedance at voice frequencies and thus permit its use on party lines with grounded ringing, the ringer was designed with permalloy cores. This construction also gives a high inductance at the twenty-cycle ringing frequency which reduces the size and cost of the series condenser required. Because of war needs, the cores are now being made of magnetic iron; tolerance margins permit this on most circuits.

Smaller gongs had to be used to fit the allotted space in the new ringer but a more efficient motor element allows them to be struck hard enough to produce as much sound output as the larger gongs of the older ringers. When two gongs are sounded together the effect is more pleasing if

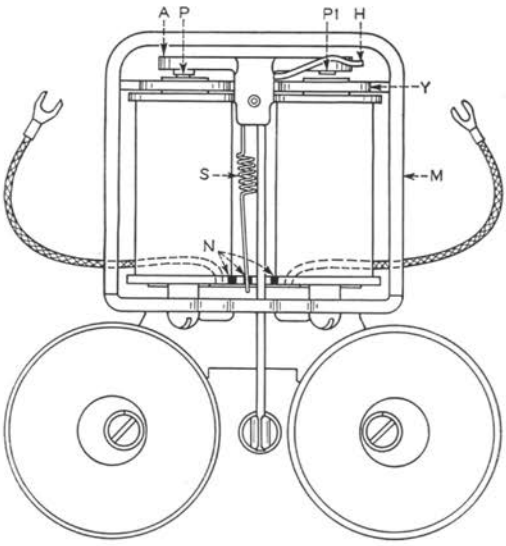


*Fig. 1—Polarizing flux is supplied by a U-shaped magnet of chrome steel. Flux from the ringing current superimposed on this makes the armature and clapper vibrate. A stroke limiter* H *adjusts the intensity of the sound; the biasing and restoring force of the spring is controlled by the notches* N

they differ by one of the simpler musical intervals, such as the major third or fifth. In the new ringer the major third, which corresponds to a frequency ratio of five to four, was chosen. The sound power radiated drops off rather rapidly with these small gongs for pitches lower than 1600 cycles per second. This frequency was therefore chosen for the lower pitched gong and 2000 cycles for the other one. An interval of a fifth would have placed the higher pitched gong at 2400 cycles per second which is well beyond the region of maximum hearing sensitivity for many people. Sounds of this higher frequency are also attenuated more in passing through partitions and passages.

When a gong is struck, a series of overtones is produced as well as the fundamental. For a simple gong of uniform thickness such as that in the new ringer, the loud overtones bear the frequency ratios of about 2.7 and 4.8 to the fundamental. The overtones actually carry many times as much power as the fundamentals.

Since sounds of low pitch are transmitted and heard better than higher ones, it is desirable to increase the power radiated at the fundamental frequencies of the gongs. The 101A gong attachment has been provided for this purpose. It is a modified form of Helmholtz resonator mounted inside the gong to increase the coupling to the air. This resonator raises the fundamental by about 17 db, thus making it approximately equal in intensity to the overtones. The total sound output increases only about two db, but this suffices generally for installations requiring more output than is furnished by the unresonated gongs and is valuable in most cases of hearing loss.

When the normal ringer with unresonated gongs is too loud for small homes and offices, an adjustment is provided on its armature to limit the stroke. This stroke limiter, H, Figure 1, is a rod attached to the armature so that it strikes a lug on the ringer frame when bent toward it. With short strokes the clapper strikes the gong at a lower velocity and less sound is produced.

The B1A ringer was designed to serve many different installations but there are certain classes of service for which it is not suitable. Other ringers such as the B2A, for two-party message rate service, and the B3A ringer with a vacuum tube, have been designed around the frame of the B1A to use as many of its piece-parts as possible. All of these ringers can be mounted in the set interchangeably and all are known as "B" type ringers.