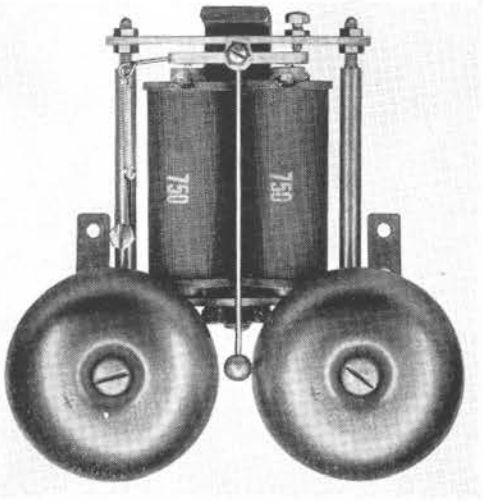


# The Station Ringer

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*Local Systems Development*

ONE of the secondary problems that confronted Bell after his first successful demonstration of the telephone was the provision of some means of attracting the attention of the person at the other end of the line. In his experimental work with Watson, Bell had shouted "Hello," or more commonly, the nautical "Ahoy" into the transmitter. In the first telephone installed for commercial service the calling signal was given by tapping on the diaphragm of the transmitter, first with a lead pencil, and then, when it was found that the former method was injurious to the diaphragm, with a device called a "thumper." Next came a vibrating reed device invented by Watson which sent a buzzing sound into the telephone of the called party.

None of these devices was entirely successful and consequently Watson undertook the construction of a bell signal. After starting work in the electrical shop of Charles Williams, Jr., in Boston, Watson had read a book called Davis' Manual of Magnetism. There he encountered a description of a "magneto shocking machine," which developed current by electro-magnetic induction. An adaptation of this machine gave a suitable generator for sending alternating current over a line, and Watson devised a polarized ringer to be operated by this current. Such a polarized ringer, of a design employed in the Bell System for many years, is shown in skeleton form in Figure 1. Two soft iron cores, fastened together with an iron yoke, called a heel iron, at one end, are each supplied with a winding. These windings are connected in series in such a way that current passing through them tends to make the free pole of one core north and of the other, south. Facing these two free ends of the cores is an armature mounted on a central pivot

so that it can be drawn toward only one core at a time. A rod fastened to this armature passes between the electro-magnets and carries on its end a clapper which, as the armature vibrates, strikes alternately two gongs mounted on the frame of the ringer. The gongs are adjusted so that when the armature is stationary and in its extreme position there is a slight clearance between them and the clapper, but the flexibility of the rod is sufficient to allow the inertia of the clapper to carry it into contact with the gongs as it vibrates.

The polarizing feature is obtained by mounting a permanent magnet, shaped in the form of a flat rectangular U, with its south pole firmly attached to the center of the heel iron and its north pole adjacent to the center of the armature as shown in the illustration. The flux from this permanent magnet causes the free ends of the soft iron cores to become south poles, and the two ends of the armature to become north poles, as indicated in the illustration. A current flowing through the windings in a direction tending to make the free end of the right hand core a north pole and that of the left hand one a south pole, produces a magnetic effect tending to weaken the right hand pole and to strengthen the left. As a result the left end of the armature will move toward the adjacent core end and the clapper will strike the right gong. A current in the opposite direction would reverse the action, and the left hand gong would be struck. An alternating current sent through the coils thus tilts the clapper back and forth and causes the familiar ringing of the telephone bell. Since the operation of the ringer depends on the interaction between the flux of the permanent magnet and that of the electro-magnets, the strength of the permanent magnet is an important factor in ringer design.

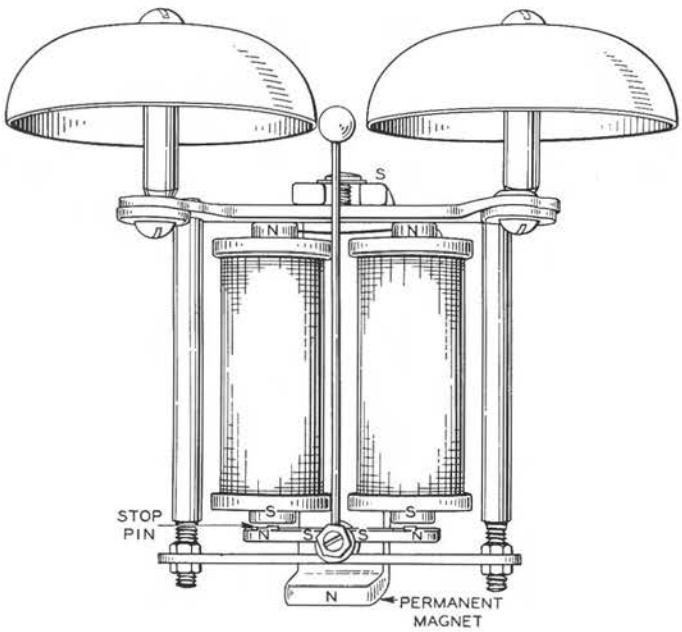


*Fig. 1—The polarized ringer may be operated with the gongs either above or below the electro-magnets. Stop pins, small discs of non-magnetic material, are fastened to the armature opposite the poles to prevent the armature and pole faces from coming into actual contact*

This general form of ringer, invented by Watson in 1878, is still used as a subscriber's calling signal. Hand-driven magnetos as a source of ringing current, however, are used only on rural lines. In large metropolitan offices central ringing machines, of the electromagnetic type, furnish the necessary power, which is applied

to the line by the operation of a ringing key, or automatically by a relay when a connection is made to the line.

Although the ringers of today are like the Watson ringer in basic principle, they have been modified in many respects. Some of the changes have been made to improve the ringer, and others to adapt it to new circuit conditions. Most conspicuous of the additions made is that of a biasing spring and stop screw, shown in Figure 3. With the original ringer, and no current flowing, there was no force tending to hold the armature and clapper in any one particular position. A very small current flowing through the magnets was sufficient therefore to move the clapper against one or the other of the gongs. Since talking current was supplied by local batteries, which were disconnected when the receiver was on the hook, no potentials that might cause false signals were normally on the line.

With the advent of the common battery system, employing signals operated by the battery to attract the operator's attention when a subscriber wished a connection, a direct current potential was on the line at all times. A condenser was inserted in series with the ringer to prevent direct current from flowing through it, but any change in potential on the line, such as might be caused by a short circuit placed on the line by one operation of a switchhook, would release the charge from the condenser. This released charge might be sufficient to move the armature of the ringer and cause a false ringing tap.

By adding the biasing spring an external force was applied to the armature tending to hold it against the stop screw. With this arrangement current through the electromagnets in a direction tending to lift the right hand end of the armature can have no effect on the armature or clapper regardless of the magnitude of the current, because the armature is already held as far in that direction as it can go. Current in the opposite direction can operate the armature but only if it is strong enough to overcome the pull of the biasing spring. By poling the connections of

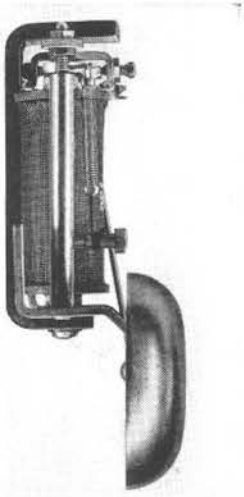

*Fig. 2—Side view of the new type of polarized ringer with biasing spring, showing arrangement of permanent magnet*

the ringer so that the discharge of the condenser tends to pull the armature against the stop screw, and by adjusting the biasing spring so that the condenser charging current is not strong enough to move the armature, false ringing taps are eliminated.

The presence of the biasing spring, however, tends to result in an inequality in the force acting on the armature in the two directions, since the spring assists the pull on the right and opposes that on the left. This inequality is overcome by setting the stop screw so that the air gap at the

left pole is a definite amount less than that at the right. As a result there is an increased magnetic pull from the left-hand electro-magnet and a decreased, from the right-hand, which compensates for the pull of the biasing spring.

Other improvements made from time to time, in the method of winding and insulating the wire and in the materials of both the core and the permanent magnet, have enabled the ringer to meet successfully all of the demands which present-day telephone service imposes upon it. The recent change* to the arrangement shown in the photograph at the head of this article and in Figure 2, has resulted in a considerable saving in space by mounting the gongs of the subscriber set parallel to the base instead of at right angles to it as previously. The operation of the ringer, however, is the same. It is a tribute to Watson's inventive genius that despite the many changes and innovations that have resulted from the development of the telephone system, the polarized ringer still remains as the standard subscriber's signal, with its fundamental principles of operation unchanged from the time it left his hands.

*RECORD, *October*, 1931, *p.* 43.

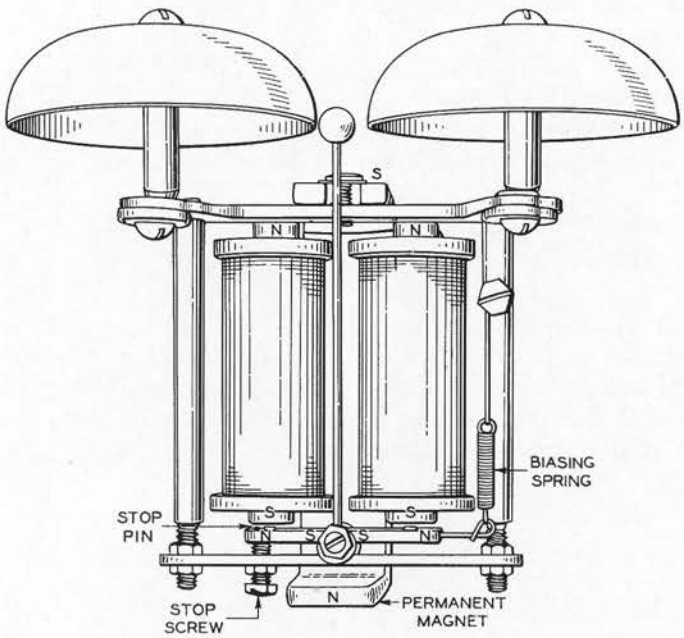


*Fig. 3—The polarized ringer with biasing spring and stop screw. To insure good ringing the gongs are adjusted so that the clapper ball does not rest on either gong when stationary, but under ringing conditions, the flexibility of the rod is sufficient to permit the ball to strike the gong*