

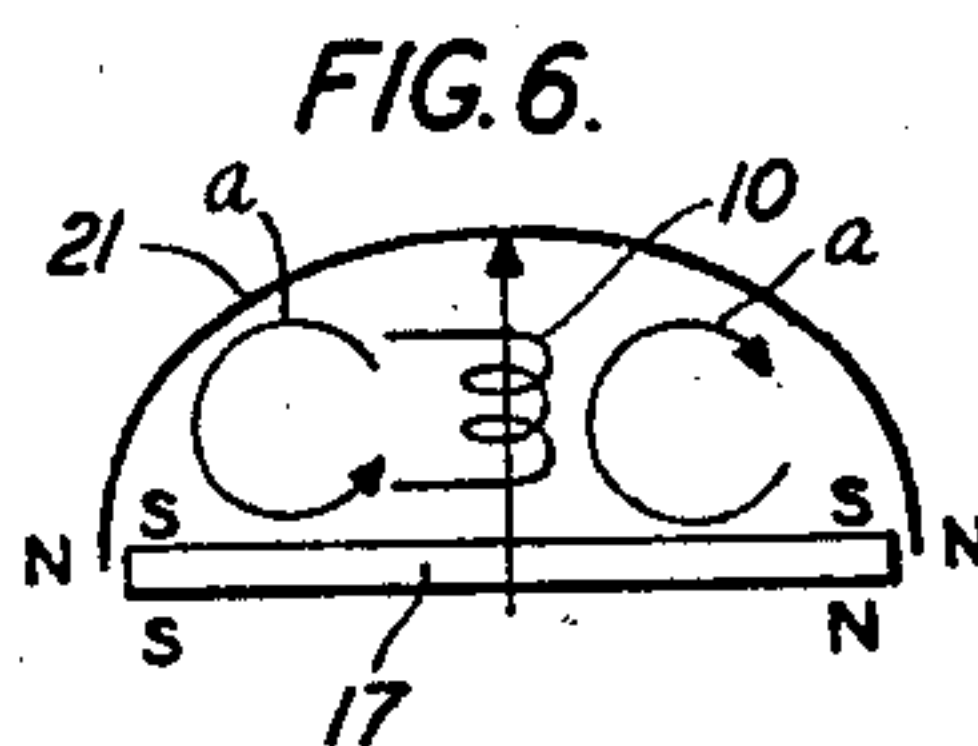
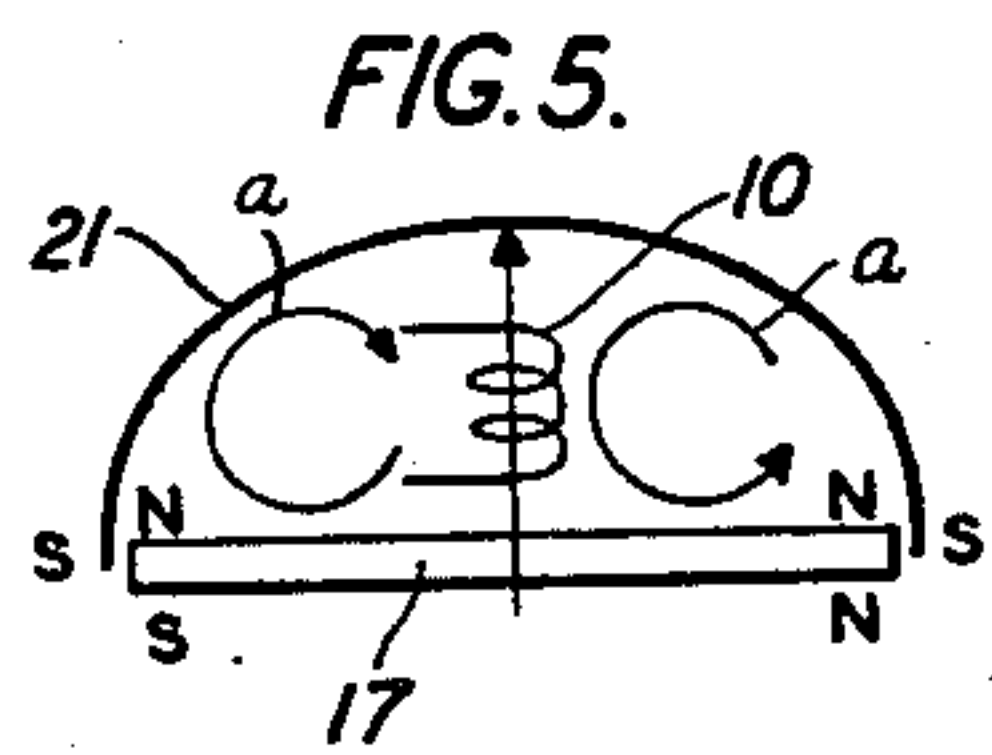
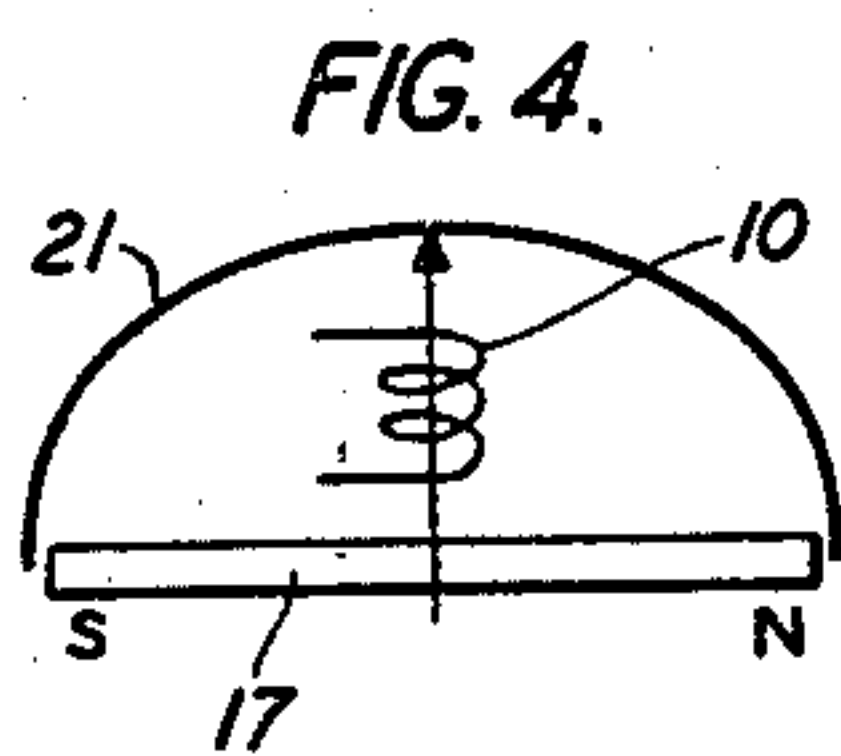
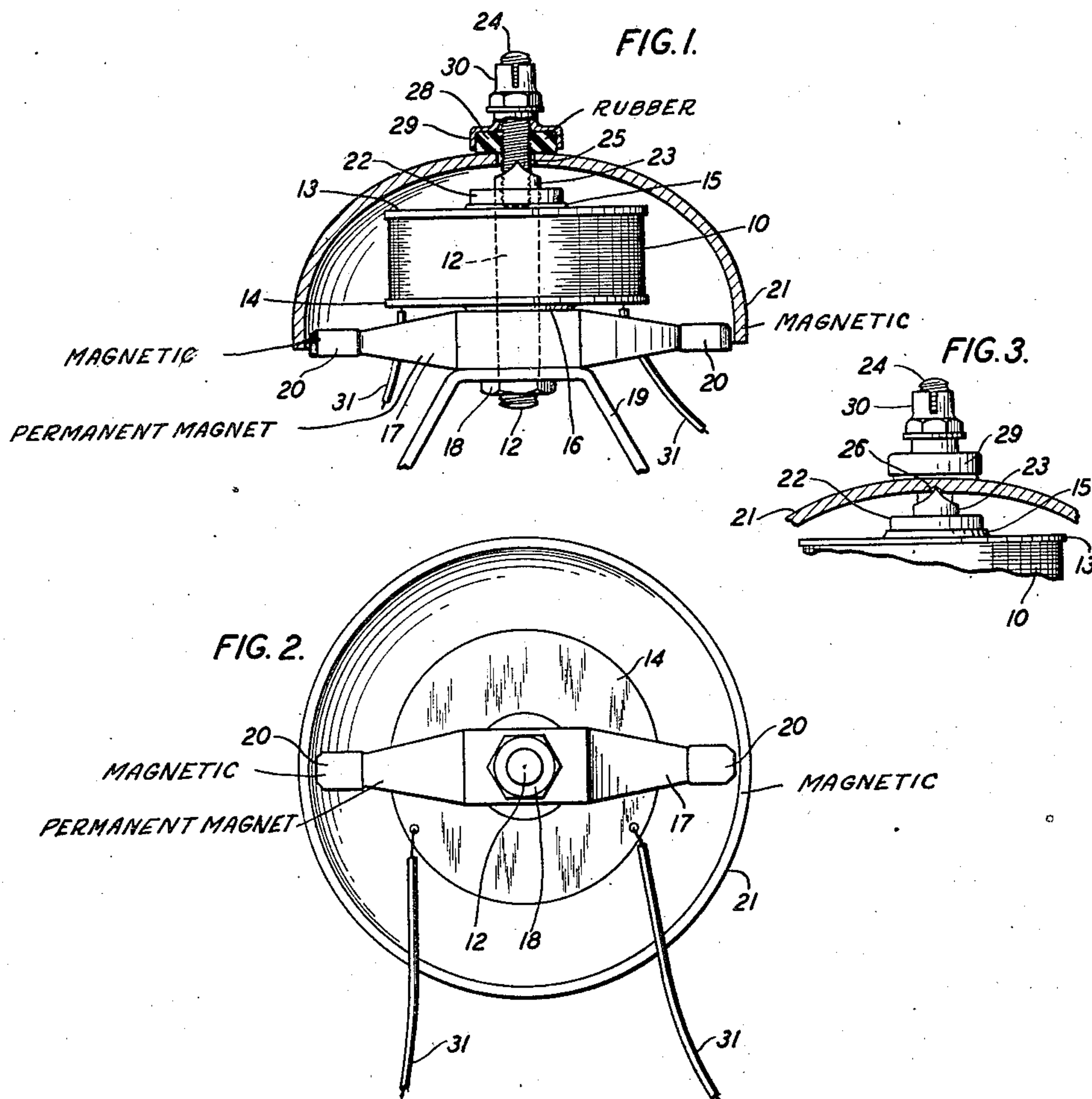
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AUDIBLE SIGNALING DEVICE

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AUDIBLE SIGNALING DEVICE

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This invention relates to signaling devices and particularly to signaling devices of the type usually associated with the telephone set and which function to audibly indicate an incoming telephone call at a telephone subscriber's station.

With a view towards simplification and modernization of telephone subscriber's station equipment, those essential elements of the telephone set which formerly were housed in a separate container known as the "bell box" are now housed in the base of the telephone set. One of these essential elements is the audible signal device, or telephone ringer which functions, upon the application of ringing current to the subscriber's telephone line incident to the completion of a telephone connection to the subscriber's station, to emit an audible tone signal. While improvements have been made heretofore in the design of the telephone ringer with a view towards space conservation and weight reduction, further improvements in this direction are desirable in order to further reduce the over-all dimensions and weight of the telephone set.

It is the object of this invention to provide a simple, reliable and effective audible signaling device of relatively few parts, which occupies a minimum of space, and which is particularly suitable for housing in the base of the combined telephone set.

This object is attained in accordance with a feature of the invention by the adoption of a novel ringer design which obviates the necessity for the usual gong-striking clapper, and which otherwise lends itself to simplification of assembly and to mounting in a relatively small area. More particularly, the ringer of this invention contemplates the production of an audible signal by causing the sound-emitting element, or vibratile gong to oscillate relative to the poles of the controlling electromagnet so as to strike such poles alternately and thereby be caused to vibrate when the electromagnet is energized by alternating current. Structurally, the ringer of this invention comprises a coil-supporting electromagnet core, to one end of which is oscillatably mounted a cup-shaped gong in a manner such that the electromagnet is enclosed by the gong, and to the other end of which and at right angles thereto is fixed a bar-type permanent magnet so as to present oppositely polarized poles to diametrically opposed points on the rim of the gong. The gong thus is included as an essential element of the magnetic circuit of the ringer.

In operation, the flux generated by the electromagnet during each half cycle of applied alter-

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nating current alternately aids and opposes the permanent magnet flux in the air gaps between the diametrically opposed points on the gong rim and the poles of the permanent magnet, so that the gong oscillates and strikes the two permanent magnet poles alternately, thereby vibrating and producing an audible signal of pleasing tone and of adequate volume.

The invention will be readily understood from the following detailed description when read in connection with the accompanying drawing, in which:

Fig. 1 is a side elevation of the ringer, with the gong or sound-emitting member and certain of the elements which serve to hold the gong in position shown in section;

Fig. 2 is a bottom plan view of the ringer with the mounting bracket omitted;

Fig. 3 is a fragmentary view of the upper portion of the ringer in which the gong is shown sectionalized on a line extending forwardly of the center line on which the gong in Fig. 1 is sectionalized, and illustrates the knife edge bearing upon which the gong oscillates; and

Figs. 4, 5 and 6 are schematic representations which illustrate the directions of the permanent magnet flux and of the flux produced by the electromagnet.

The electromagnet consists essentially of an energizing coil 10 fixed in any well-known manner to a core 12. The spool heads 13 and 14 of the coil 10 are each provided with a centrally disposed circular boss, or raised portion as shown at 15 and 16, which are apertured to permit the ends of core 12 to extend therethrough. A bar-type permanent magnet 17 is provided with a centrally located cylindrical hole which snugly accommodates the lower portion of the core 12. A nut 18, when screwed onto the lower end of the core serves to force the permanent magnet 17 against the boss 16 of the lower spool head 14. Interposed between the nut 18 and the lower face of the bar-type permanent magnet 17 is a bracket 19 by which the ringer may be mounted on the base of the container, such as the base of a telephone set, in which the ringer is to be housed.

The permanent magnet 17 is preferably bar-shaped and is disposed at right angles to the electromagnet core 12 so as to extend equidistant in each direction therefrom. At the outer extremities of the bar-type permanent magnet 17 are fixed, in any suitable manner, soft iron pole-pieces 20. The over-all length of the permanent magnet 17 is slightly less than the internal rim diameter of the gong 21 so as to provide air-gaps

between the pole-pieces 20 and the rim of the gong.

At its upper end the core 12 terminates in an integrally formed shoulder 22 and a centrally disposed integral cylindrical extension 23. When the nut 18 is screwed up on the threaded lower end of core 12 the shoulder piece 22 is drawn tightly against the boss 15 of the spool head 13. The extension 23 is internally threaded and is so formed as to present a knife edge at its upper end extending at right angles to the longitudinal axis of the core 12. A threaded shaft 24 of magnetic material is adapted to be screwed into the core extension 23 and, in effect, constitutes an extension of the core 12.

The cup-shaped gong 21 of magnetic material is provided, at its apex, with a cylindrical opening 25 of a diameter slightly larger than the diameter of the shaft 24 and is adapted to be slipped over the upper end of the shaft so as to rest upon the knife edge of the core extension 23, there being sufficient clearance between the shaft 24 and the internal periphery of the gong hole 25 to permit the gong to oscillate without interference from the shaft. As shown in Fig. 3, the under surface of gong 21, at its apex, is provided with an angular cut or groove 26 which is adapted to receive the knife edge of core extension 23 when the gong is placed in position. It is intended that the angle of the groove 26 be greater than the angle at which the knife edge is formed on the core extension 23 in order that the gong 21 will be free to oscillate on the knife edge. The groove 26 also serves to accurately position the gong 21 on the core extension 23.

When the gong 21 has been seated on the knife edge end of the core extension 23, a rubber washer 28 is slipped over the shaft 24 and a metal cap 29 placed over the washer. A self-locking split nut 30 is then screwed on the upper end of the shaft 24 to complete the ringer assembly. Lead-in wires by which the winding of coil 10 is connected to a source of current supply, or to terminals located in the base of a telephone set are shown at 31.

In operation, the coil 10 is energized by alternating current and the gong 21 is thereby caused to oscillate on its knife edge bearing so as to strike the pole-pieces 20 alternately. In this manner the gong is vibrated and emits an audible signal.

When the electromagnet is unenergized the gong 21 will occupy the position illustrated in Fig. 1, that is, it will rest fully on the knife edge bearing with diagonally disposed points on the gong rim in juxtaposed relation to the pole-pieces 20. If it is assumed, as indicated by Figs. 4, 5 and 6, that the permanent magnet 17 has been magnetized so that its left end assumes a south polarity and its right end assumes a north polarity, opposite polarities are induced at the corresponding juxtaposed points on the gong rim so that the tendency of one pole to attract the gong in one direction is counterbalanced by the same tendency of the other pole to attract the gong in the other direction. The gong therefore is maintained in a condition of balance. When alternating current is applied to the coil 10 the flux produced in the magnetic circuit including the gong 21 during the first half cycle will, depending upon its direction, aid the permanent magnet flux at one of the poles 20 and will oppose it at the other pole. Thus, the gong will be moved towards the pole 20 at which the two fluxes are in phase. During the next half cycle of alternat-

ing current, the direction of the flux set up by the electromagnet will be reversed with the result that the gong 21 will be moved in the opposite direction. The gong 21 accordingly is caused to oscillate on its knife edge bearing so that its rim alternately strikes the two poles 20. The gong thus vibrates and emits an audible tone. If desirable, any well-known means may be employed to minimize the possibility of sticking between the gong 21 and the poles 20. The material of the washer 28 is such as to offer a minimum of resistance to the gong in its oscillatory movement.

Fig. 4 illustrates schematically the condition which prevails when the ringer coil 10 is unenergized and assumes the left-hand end of the permanent magnet 17 to be the south pole and the right-hand end to be the north pole. Under this condition, as explained above, the gong 21 is in a condition of balanced equilibrium.

Fig. 5 illustrates the condition which prevails when the coil 10 is energized by current in such a direction as to cause the resulting flux to traverse the paths indicated by the arrow-headed lines *a*. Under this condition the alternating current flux tends to neutralize or oppose the permanent magnet flux in the left air-gap and to aid the permanent magnet flux in the right air-gap with the result that the gong 21 is caused to swing in a clock-wise direction so that its rim strikes the right-hand pole of the permanent magnet 17 and is caused to vibrate.

In Fig. 6 the condition which prevails when the direction of current in coil 10 is reversed is illustrated. Under this condition the permanent magnet flux in the right air-gap is opposed by the flux set up by the alternating current while in the left air-gap it is aided by the alternating current flux. Thus, the gong is moved in a counter-clockwise direction so that its rim strikes the left-hand pole of the permanent magnet 17. Thus, for each complete cycle of alternating current, the gong strikes each of the permanent magnet poles once, striking such poles alternately. Continued application of alternating current to the coil 10 causes the gong 21 to oscillate on its knife edge bearing so that its rim repeatedly strikes the poles 20 of the permanent magnet 17 alternately. The gong is thus caused to vibrate and to emit a pleasing sound signal of adequate intensity.

It is apparent from the foregoing description that the ringer of this invention is simple of design, occupies a minimum of space, may be assembled expeditiously, and lends itself particularly for mounting in the base of the well-known combined telephone set.

What is claimed is:

1. An audible signaling device comprising an electromagnet having a coil-supporting core provided at one end with a knife edge, a permanent magnet fixed to the other end of said core and disposed at right angles thereto, and a concave vibratable member of magnetic material oscillatably mounted on the knife edge end of said core in telescopic relation to said electromagnet.

2. An audible signaling device comprising an electromagnet having a core provided at one end with a knife edge, a bar-type permanent magnet fixed at its center to the other end of the core of said electromagnet so as to extend at right angles in either direction therefrom and having oppositely disposed poles, a vibratable member of magnetic material oscillatably mounted on the knife edge end of said core so as to present diagonally disposed points to the poles of said permanent magnet, and means including an energiz-

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ing coil for said electromagnet for causing said vibratable member to oscillate and strike the poles of said permanent magnet alternately.

3. An audible signaling device comprising an electromagnet having a coil-supporting core provided at one end with a knife edge, a cup-shaped gong of magnetic material oscillatably mounted on the knife edge end of said core so as to enclose said electromagnet, and a bar-type permanent magnet fixed at right angles to the other end of said core so as to present poles of unlike polarity to diametrically opposed points on the rim of said gong.

4. In an electrically-operated audible signaling device, a fixedly mounted electromagnet having a core and a winding, a vibratable member of magnetic material oscillatably mounted on one end of said core and magnetically associated therewith, and a bar-type permanent magnet fixed to the other end of said core so as to present poles of unlike polarity to diametrically opposed points on said vibratable member, whereby said vibratable member is caused to oscillate about its

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mounting and to strike the poles of said permanent magnet alternately when the winding of said electromagnet is traversed by alternating current.

5. An audible signal device comprising in combination, a vibratable sound-emitting device of magnetic material and an electromagnet having a core, a permanent magnet fixed to one end of said core and disposed at right angles thereto, and means including the other end of said core for oscillatably supporting said vibratable sound-emitting device in telescopic relation to said permanent magnet.

6. An audible signal device comprising in combination an electromagnet having a coil-supporting core, a permanent magnet mounted on one end of said core, and a gong of magnetic material oscillatably mounted on the other end of said core so as to enclose said core and said permanent magnet, said core, permanent magnet and gong constituting the magnetic circuit of the electromagnet.

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