Sept. 25, 1945. G. E. ATKINS 2,385,339

SIGNALING DEVICE

Filed Oct. 26, 1943 2 Sheets-Sheet 1

FIG. 1

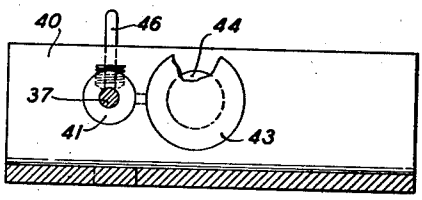

FIG. 2

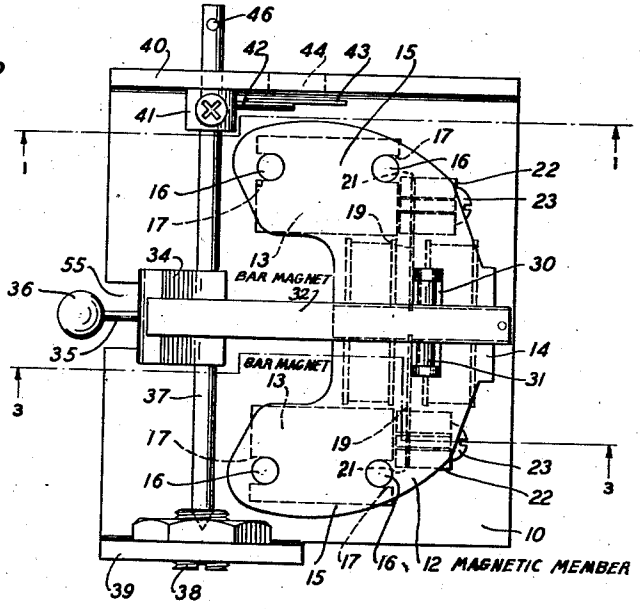

FIG. 3

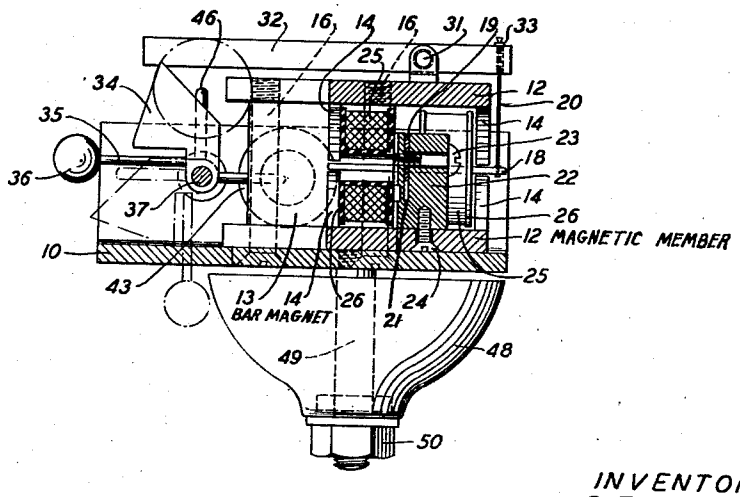

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FIG. 4

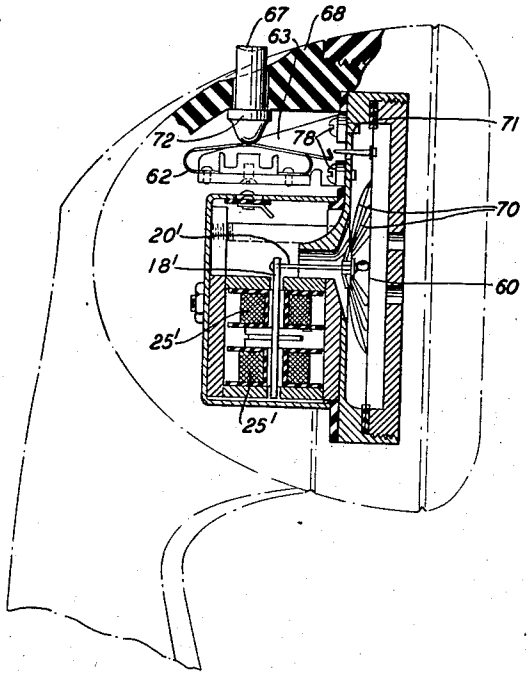


FIG. 5

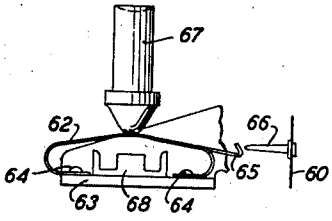


FIG. 6

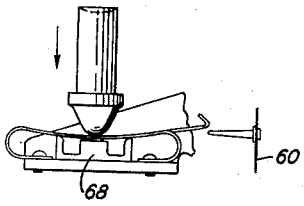
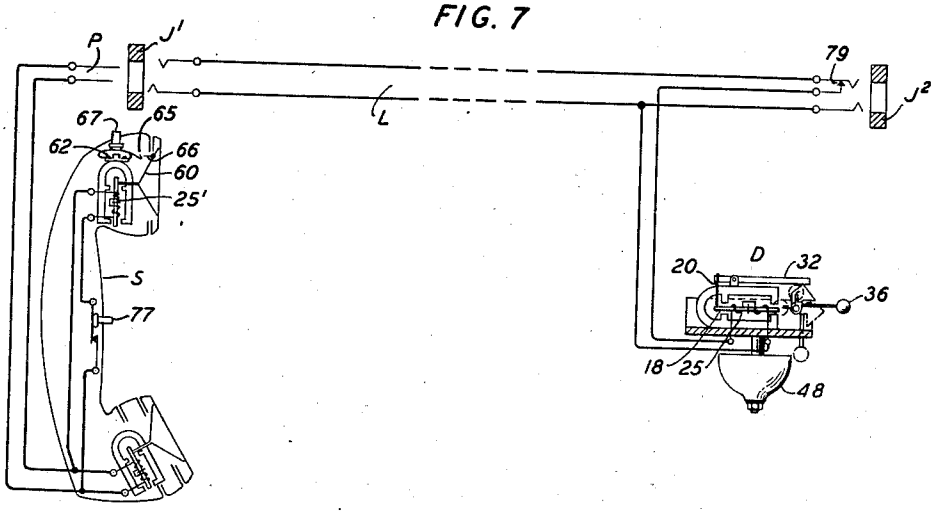


FIG. 7



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SIGNALING DEVICE

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Application October 26, 1943, Serial No. 507,705

9 Claims. (Cl. 177—334)

This invention relates to signaling devices and particularly to such devices as employed to generate and record telephone call signals in a sound powered telephone system.

Sound powered telephone systems are, in general, characterized by the absence of auxiliary power sources, such as batteries, for furnishing the power required for the transmission of speech signals. In such systems speech signals are generated in the coils of an electromagnetic sound powered unit comprising essentially a permanent magnet, a balanced armature and a diaphragm coupled to the armature. In a transmitter unit the diaphragm is acoustically actuated by speech signals impinging on the diaphragm and the armature is correspondingly vibrated in the field furnished by the permanent magnet to cause the generation of speech frequency currents in the coils. Conversely, in a receiver unit speech frequency currents applied to the receiver coils cause the armature and its coupled diaphragm to vibrate at the frequency of the incoming signals to produce audible speech signals.

Such systems are lacking in complete simplicity in that the transmission of telephone call signals requires the use of auxiliary batteries for the energization of the call indicator, particularly where it is desirable that the manifestation of an incoming call persist indefinitely and until such time as the call is answered at the called station. In a particular system of this character, a visual signal in the nature of an electronic tube is employed as a call indicator and responds to the transmission of an acoustic signal of a level higher than the level of speech signals to visually indicate the arrival of an incoming call. Such a call signal requires a biasing voltage, furnished by a battery, not only to effect its operation but also to maintain it locked operated until extinguished by some act on the part of the subscriber at the called station or of an operator at an exchange.

It is the object of this invention to provide an improved combined audible and visual signal device which functions without the aid of batteries or other auxiliary source of power to furnish a permanent call signal in a sound powered telephone system.

This object is attained in accordance with a feature of the invention by combining, in a unitary structure, a visual signal indicator, in the nature of an annunciator drop, and an audible signal device, in the nature of a vibratable gong, and by placing the operation of both devices under the single control of an ultra-sensitive electromagnetic system consisting essentially of a coil and a balanced armature system including pole-pieces, permanent magnet means for producing a flux between the pole-pieces and an armature vibratable in the air gap located between the pole-pieces.

More particularly, the combined visual and audible signal device of this invention embodies an electromagnetic system of the type defined above whose armature is loosely coupled to a latch bar and when vibrated causes the latch bar to release a gravity operated mechanism, which combines an annunciator drop signal, or target, and the striker for a vibratable sound emitting device in such a manner that the target is operated as a visual signal and the sound emitting device is simultaneously actuated as an audible signal.

Another feature of the invention resides in mechanically coupling the sound emitting device with its operating unit whereby the unit functions, in response to the vibrations of the sound signal, as an inertia type transmitter to provide an answer-back signal in a sound powered telephone system.

In systems of the general character described above the call signal is initiated at a calling station either by shouting into the telephone transmitter or by slapping the transmitter mouthpiece. Either operation serves to compress the air in the cavity in front of the diaphragm with which such transmitters are equipped, causing the diaphragm to move back and swing the attached armature far off center in one direction. This action induces a surge of current in the coil surrounding the armature. The armature in snapping back overthrows center and induces a second surge in the coil in the opposite direction. In order to simplify the generation of such call signals the telephone handset employed in a system in which the combined visual and audible signal device of this invention is used to particular advantage, is equipped with a manually operable button which functions, through a plucking mechanism, to directly agitate the receiver diaphragm and thus generate, in the receiver coils, a call signal of sufficient intensity to actuate the combined visual and audible signaling device as a call indicator.

These and other features of the invention will be readily understood from the following description when read in connection with the accompanying drawings, in which:

Fig. 1 is a view of the ultra-sensitive signal device taken along the line 1—1 of Fig. 2, looking in the direction of the arrows, and shows the target, or drop which constitutes the visual signaling element;

Fig. 2 is a top plan view of the signal device;

Fig. 3 is a view of the signal device taken along the line 3—3 of Fig. 2, looking in the direction of the arrows;

Fig. 4 is an outline view of the receiver portion of a sound powered telephone handset showing

the diaphragm actuating mechanism and its operating button;

Figs. 5 and 6 are detail views of the diaphragm actuating mechanism showing the same in its normal and operated positions, respectively; and

Fig. 7 is a circuit diagram showing schematically a sound powered telephone handset located at the calling end of a line and the ultra-sensitive call signal device located at the answering end of the line.

The basic element of the signaling device shown particularly in Figs. 1, 2 and 3 and schematically in Fig. 7 is an electromagnetic system comprising essentially a coil and a balanced armature system including pole-pieces, permanent magnet means for producing a flux between the pole-pieces and a vibratile armature. This element is mounted on a base plate 10 preferably of a non-magnetic material such as brass and comprises a pair of substantially identical U-shaped magnetic members 12 and a pair of similar short bar magnets 13. Each of the magnetic members 12 comprises a pair of parallel pole tips or flanges 14 and arms 15 extending from opposite sides of the tips or flanges 14. The arms 15 abut opposite ends of the magnets 13 which space the members 12 in parallel relation, with the tips or flanges of one member 12 opposite and aligned with those of the other whereby two identical air gaps are formed. Like poles of the magnets 13 abut the same magnetic member 12 so that two magnetic circuits of substantially the same reluctance and magnetomotive force having a common branch through the pole tips 14 and the air gaps are formed.

The ends of the magnets 13 are ground so that air gaps of the desired length are formed between juxtaposed pole tips 14. The magnetic members 12 are securely clamped against the magnets 13 by non-magnetic bolts 16 which extend through apertures in the base plate 10. Preferably, the magnets 13 are provided with longitudinal grooves 17 as shown in Fig. 2, in which the bolts 16 are fitted and thereby position the magnets with respect to the plate 10.

Extending between the pole tips 14 with its ends located in the air-gaps between juxtaposed pole tips 14 is a magnetic armature 18 which is pivotally mounted at its center between non-magnetic supports 19 and has one end affixed to the connecting pin or rod 20. The supports 19, which may be, for example, phosphor bronze strips notched at their adjacent ends to engage the sides of the armature are fitted into slots 21 in parallel non-magnetic support blocks 22 and are locked in the slots as by screws or bolts 23. The blocks 22 in turn are affixed to the lower magnetic member 12 by screws 24 threaded into the blocks.

The armature 18 is encompassed by a pair of coils 25 carried by insulating forms or bobbins 26 positioned between the flanges or pole tips 14. Electrical connection may be made to the coils 25 through suitable conductors.

Fixed in any suitable manner to the upper magnetic member 12 is a bracket 30 having a pair of oppositely disposed upturned projections which are apertured to receive the rod 31. The rod 31 passes through a latch bar 32 and provides a pivot bearing therefor. At its right end, viewing Figs. 2 and 3, the bar 32 is provided with a bore or hole through which the free end of rod or pin 20 extends. The upper end of the rod 20 is flared slightly and is provided with a fixed collar 33 so that the rod 20 may experience an upward thrust, viewing Fig. 3, without influencing the latch bar 32 but when pulled downward it will cause the latch bar 32 to pivot on the rod 31 to cause its forward end to be raised.

The latch 32 is notched near its forward end to receive the upper edge of a weighted element 34 and to thereby retain the element 34 in its normal unoperated position shown in Fig. 3. The weighted element 34 has fixed thereto, in any suitable manner so as to project outwardly therefrom, a clapper rod 35 which carries at its end a striker 36. The element 34 is carried by and fixed to the rod 37 which has one end supported by a set screw 38 carried by an extension 39 of the plate 10 and its other end passing through an aperture in a similar oppositely disposed extension 40 of plate 10.

The rod 37 carries a collar 41 which is fixed to the rod and abuts the inner surface of the plate extension 40. Fixed to the collar 41 is a rod 42 which carries a target 43. The target 43 normally assumes a position directly in back of the circular hole 44 located in the plate extension 40. Near its outer end the rod 37 carries a pin or handle 46 which, as will be described hereinafter, is manually operable to reset the target.

Affixed to the under-side of the plate 10 is a gong 48 which may be secured to the bolt 49 by means of a nut 50. The bolt 49 itself is screwed into a threaded hole in the plate 10. By virtue of this mounting the gong is mechanically coupled to the electromagnetic unit for a purpose to be indicated hereinafter. The gong is so positioned relative to the clapper rod 35 and its striker 36 that when the weighted element is actuated, as will be described presently, the striker 36 contacts the gong causing it to vibrate. To permit the clapper rod 35 freedom of movement, the plate 10 is slotted at 55 and the inner edge of this slot is so disposed relative to the edge of the gong that the striker 36 statically clears the gong after having struck it, thus allowing undamped vibrations of the gong.

When the coils 25 are energized, the armature 18 is vibrated and through the loose coupling effected by the connecting rod 20 the latch bar is actuated and pivots about the rod 31. The forward end of the latch is thus raised causing the release of the weighted element 34 which rotates, under the action of gravity, with the rod 35 in a counter-clockwise direction as viewed in Fig. 3. The striker 36, accordingly, impinges against the gong 48 causing the latter to vibrate and emit an audible tone. The shaft 37 in rotating carries with it the target 43 so that it is removed from its normal position in back of the aperture 44. It will be understood that, in practice, a plurality of such devices would be mounted on a switchboard and the disappearance of the target would identify the particular line calling. If desirable the gong may be made common to a plurality of such devices to function as a common audible signal in conjunction with a plurality of individual line identifying visual signals.

In Fig. 4 there is disclosed a sound powered unit of substantially the same type disclosed in Figs. 2 and 3 and mounted in the receiver portion of a telephone handset. The unit disclosed in Fig. 4 distinguishes from that shown in Figs. 2 and 3 principally in that a diaphragm 60 is fixed to the connecting rod 20' in place of the latch bar 32. Suffice it to say that when the diaphragm is agitated, the armature 18' is vibrated causing an electromotive force to be gen-

erated in the coils 25'. As a means for agitating the diaphragm 60 there is disclosed a plucking mechanism comprising a reed spring 62 which is arched at its center and has each of its ends turned in and secured to the supporting bracket 63 by rivets 64 or by any other suitable means. At one end of the spring there is integrally formed a plucking finger 65. As shown in Fig. 5, the hooked end of the finger 65 is normally located opposite and below the end of a projection 66 fitted to the diaphragm 60. A button 67 which protrudes through an aperture in the handset casing 68, as shown in Fig. 4, has its operating end abutting the spring 62 at the apex of its arch. When the button is depressed by the thumb of the party employing the handset, the spring 62 assumes the position illustrated in Fig. 6. During the transition from normal to operated positions the inclined end of the plucking finger 65 is raised to the position shown in Fig. 6 and in moving to this position it passes over the edge of the projection 66 causing the diaphragm to be agitated. When the button 67 is released it is restored to normal by the action of spring 62 in resuming its normal unactuated condition. In snapping back to its normal position the finger 65 again agitates the diaphragm 60 through the projection 66.

The E-shaped member 63 mounted on the bracket 63 has a central portion which serves as a stop for the button 67 and limits its downward movement. The two outer portions insure uniformity in the operations of the spring as well as correct action of the plucking finger 65 on the diaphragm projection 66. In locating the projection 66 on the diaphragm consideration must be given to the desired intensity of the call signal. In affixing the projection substantially midway between the corrugations 70 of the diaphragm 60 and its support at 71 the diaphragm is agitated sufficiently to produce a signal of average intensity. If a greater intensity is desired the point of attachment of the projection 66 would be closer to the corrugated portion of the diaphragm and further removed from the support 71.

The button 67 is provided with a collar 72 which abuts the rim of the aperture through which the shank of the button protrudes from the casing and is normally held in this position by the action of spring 62. The bracket 63 is secured to the receiver unit by screws 73.

Referring now to Fig. 7, the line L is shown terminating at two remotely separated points in jacks J^1 and J^2. The jack J^1 may be located at a calling station and the jack J^2 at a central switchboard. When it is desired to communicate with the central station over line L the party whose station is equipped with the handset S would connect the set to the line by inserting plug P into jack J^1 and then depress the button 67 and release it. The diaphragm 60 is thus agitated in the manner hereinbefore described and a corresponding current generated in the coils 25'. This current traverses the line L by way of the normal contacts of "push to talk" key 77 and the contacts of plug P and jack J^1 and energizes the coils 25 of the combined audible and visual signal D at the central office. The armature 18 vibrates at the frequency of the current traversing the coils and actuates the latch 32 in the manner previously described. The weighted member 34 is thereby released and falls, due to the action of gravity, to the position indicated by the dash-dot outline shown in Fig. 3. The gong 48 is struck by the striker 36 and the target 43 moved to an indicating position.

It will be observed that due to the loose coupling of the armature 18 and the latch 32 as effected by the connecting pin 20, the latch will be actuated on the first surge of current if of a polarity such as to cause the armature to pull the connecting pin 20 downwardly, viewing Fig. 3. However, if the first current surge is of the opposite polarity the pin 20 moves freely in the hole in the latch 32 and will function on the second current surge to actuate the latch. Thus it is unnecessary to polarize the call signal indicator so as to render it operative on a particular polarity of incoming current and no undue strain is placed on the armature or on the connecting pin should the polarity of the first current surge be such as to move the pin upwardly, viewing Fig. 3.

Due to the mechanical coupling of the gong with the call indicator unit the vibrations of the former when actuated are transmitted to the indicator unit causing it to function as an inertia type transmitter and the voltage resulting from the reverberations of the gong and induced in the coils 25 is transmitted back over the line L to the receiver of the telephone set S at which the call signal was initiated. The receiver unit responds to this voltage to produce an answer back signal as an indication that the call signal has been successfully recorded at the called station.

As previously described, the plate 10 is slotted at 55 to allow freedom of movement of the clapper rod 35 to and from its actuated position. The rod 35 when actuated strikes the back edge of the slot 55 and is designed to have sufficient weight and flexibility to continue in its movement towards and to strike the gong and then to come to rest in a position in which the striker 36 statically clears the gong. This static clearance precludes the striker resting against the gong and damping its vibrations after it has been struck.

After receipt of the combined audible and visual call signal, the operator at the central station would restore the signal unit to normal unoperated condition by rotating the hand lever 46 in a clockwise direction thereby rotating the shaft or rod 37 and the associated clapped rod and target to normal positions. In this position the edge of the weighted member 34 reengages the groove or slot near the outer end of the latch 32 and is thereby maintained in its normal restored position. The call may be answered in the usual well known manner.

After the calling subscriber has received the answer back signal, as above described, the button 77 may be actuated to effectively remove the coils 25' of the receiver unit from the line and the transmitter unit utilized for the transmission of speech signals over the line L.

The telephone set S has been illustrated as equipped with a plug ended cord for associating the set with the line L. It will be understood that the connection of the set to a line may be made by the regular switchhook contacts which are housed within the stand or cradle support usually provided for supporting the handset

It will also be understood that when the line L is seized at the central station in response to the actuation of the combined audible and visual signal device D the circuit to the coils 25 is opened at the jack contacts 79 to effectively

remove the coils from the line during the transmission of speech signals.

What is claimed is:

1. The combination, in a signalling device, of a sound emitting device, a striker therefor, gravity operated means for controlling the operation of said striker, a latch normally maintaining said gravity operated means in restrained position, and means for actuating said latch to release said gravity operated means comprising an electromagnetically operated device including a balanced armature, and means comprising a connecting pin loosely coupling said latch and said armature.

2. The combination, in a combined audible and visual telephone call indicating apparatus, of a sound emitting device, a target indicator having a normal display position, a striker for said sound emitting device, a rod supporting said target indicator and said striker, a weighted element carried by said rod and adapted, when released, to rotate said rod to cause said striker to actuate said sound emitting device and said target indicator to be moved from its normal position, a latch normally engaging said weighted element and holding it in a restrained position, and means for actuating said latch comprising an electromagnetic system including a balanced armature, and a connecting pin fixed to one end of said armature and loosely associated with said latch.

3. The combination defined in claim 2 wherein manually operable means is mounted on said rod for restoring said striker and target indicator to normal positions.

4. The combination, in a call indicator, of a sound emitting device, a striker therefor, and an electromagnetic system for actuating said striker including a base-plate, an electromagnetic unit mounted on said base-plate comprising a pair of permanent magnets having oppositely disposed juxtaposed pole-pieces, an armature pivotally mounted at its mid-point so that its extremities extend into the air-gaps effected by said juxtaposed pole-pieces, a coil encircling said armature responsive to alternating current for vibrating said armature, means controlled by said armature, when vibrated, for causing said striker to actuate and vibrate said sound emitting device, and means mechanically coupling said sound emitting device to said electromagnetic unit whereby said unit functions in response to the vibrations of said sound emitting device as an inertia type transmitter and a current, corresponding in frequency to the frequency of vibration of said sound emitting device, is developed in said coil.

5. In combination, an armature, an electromagnetic unit comprising a coil and a magnetic circuit including air-gaps in which said armature vibrates upon the application of alternating current to said coil, said unit being vibratable relative to said armature to cause a current of a frequency, corresponding to the frequency at which said unit is vibrated, to be developed in said coil, and means for vibrating said unit relative to said armature comprising a vibratable sound emitting device mechanically coupled to said electromagnetic unit, and means for vibrating said sound emitting device.

6. In combination, an armature, an electromagnetic unit comprising a coil and a magnetic circuit including air-gaps in which said armature vibrates upon the application of alternating current to said coil, said unit being vibratable relative to said armature to cause a current of a frequency, corresponding to the frequency at which said unit is vibrated, to be developed in said coil, and means for vibrating said unit relative to said armature comprising a vibratable sound emitting device mechanically coupled to said electromagnetic unit, and means for vibrating said sound emitting device comprising a striker controlled by said armature.

7. The combination, in a combined audible and visual signaling device, of a vibratable sound emitting device, an annunciator target having a normal display position, a striker for vibrating said sound emitting device, common means supporting said striker and said annunciator target, gravity operated means for controlling the operation of said common means, means comprising a latch for maintaining said gravity operated means in a normal restrained position, and means for actuating said latch to cause the release of said gravity operated means whereupon said striker engages said sound emitting device and said annunciator target is moved from its normal position, comprising a vibratable armature, alternating current responsive means for vibrating said armature, and means loosely coupling said armature and said latch.

8. In combination, in a signaling device, a vibratable sound emitting device, means for actuating said sound emitting device, an electromagnetic unit including a coil and a vibratable armature, said coil being responsive to alternating current for vibrating said armature, means responsive to the vibration of said armature for causing said actuating means to vibrate said sound emitting device, and means mechanically coupling said sound emitting device and said electromagnetic unit whereby the vibrations of said sound emitting device are transmitted to said electromagnetic unit to cause the generation in said coil of a current of a frequency corresponding to the frequency of vibration of said sound emitting device.

9. In a combined audible and visual call indicating apparatus, a vibratable gong, a striker for vibrating said gong, a target, a rotatable rod fixedly supporting said striker and target, gravity operated means for rotating said rod to cause said striker to strike said gong and said target to assume a signal displaying position, said gravity operated means being fixed to said rod, a latch normally engaging said gravity operated means so as to hold said rod in a restrained position, and means for actuating said latch to release said gravity operated means and thereby cause said rod to be rotated comprising an electromagnet having juxtaposed flux producing permanent magnet poles, an armature mounted at its midpoint so that its extremities assume positions between juxtaposed poles of said electromagnet whereby said armature is normally held in a condition of balance by the permanent magnet flux, and a coil encircling said armature and responsive to alternating current to cause said armature to oscillate, and means coupling said armature and said latch in such a manner that said armature when actuated in one direction moves independently of said latch and when moved in the opposite direction functions to actuate said latch.

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