March 19, 1935. G. E. ATKINS 1,994,630

COMMUNICATION AND SIGNALING APPARATUS

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FIG. 1

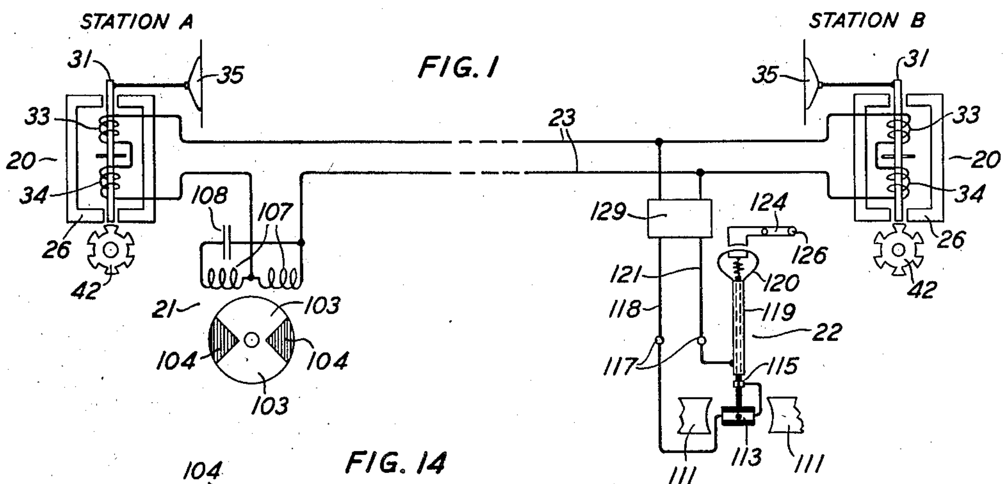

FIG. 14

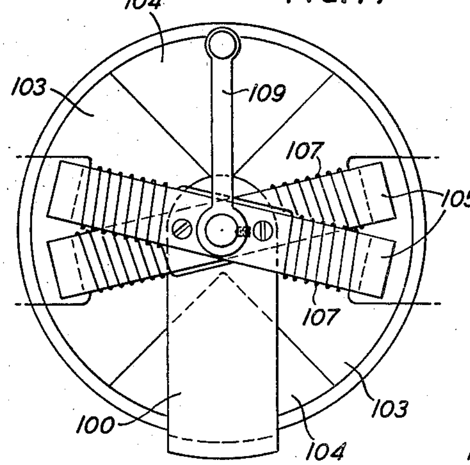

FIG. 16

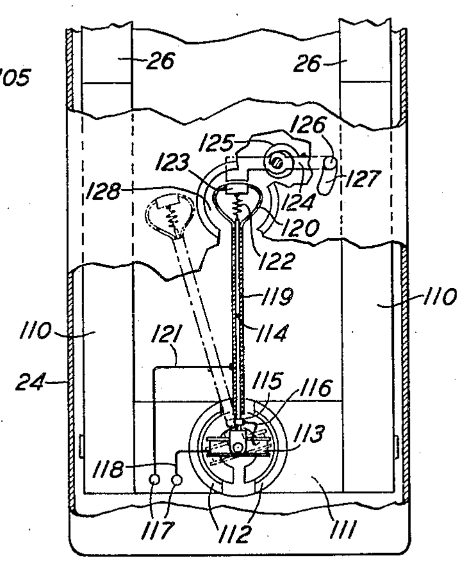

FIG. 15

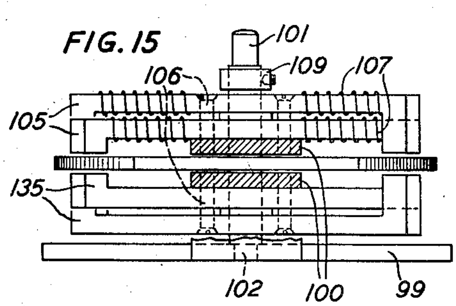

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FIG. 2

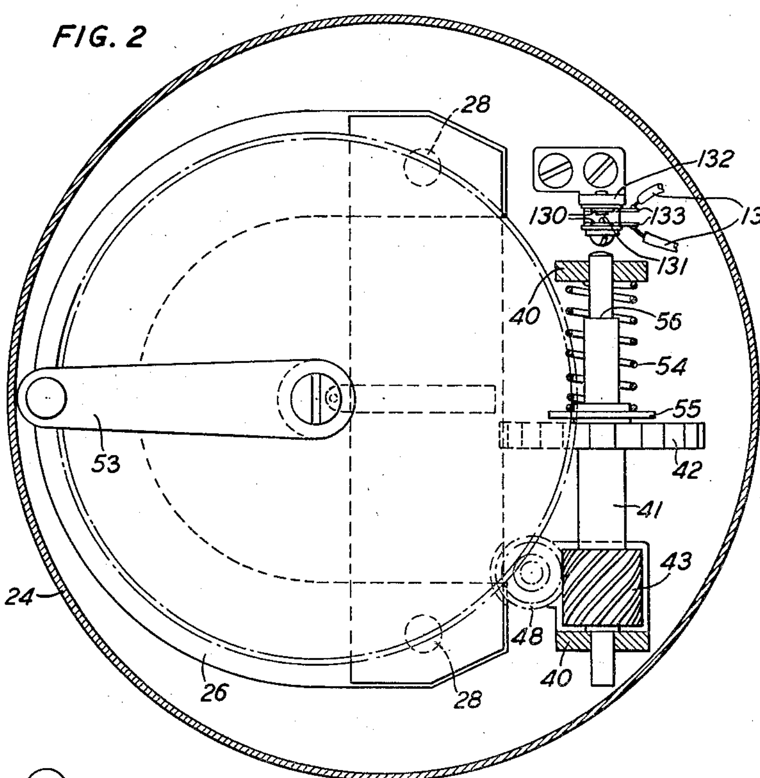

FIG. 3

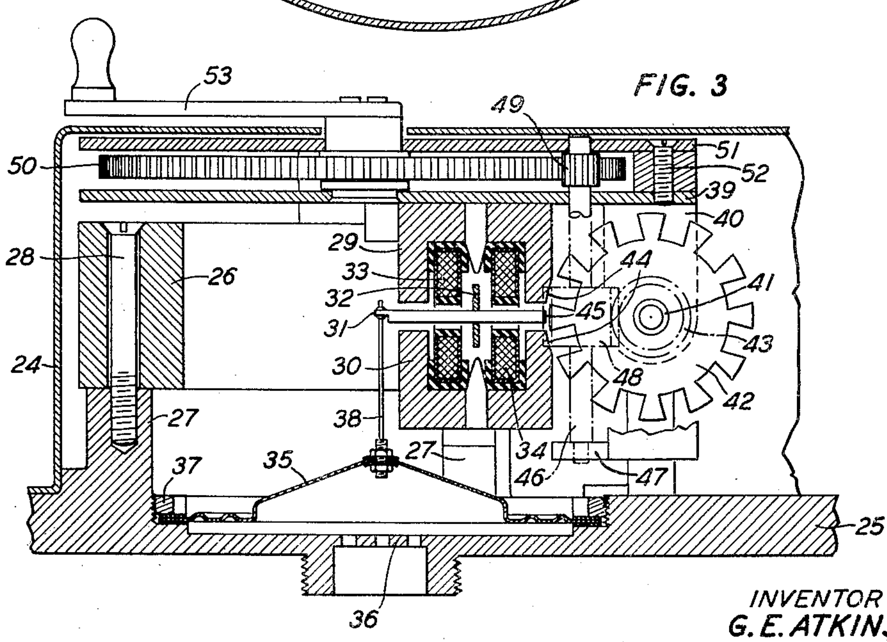

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FIG. 4

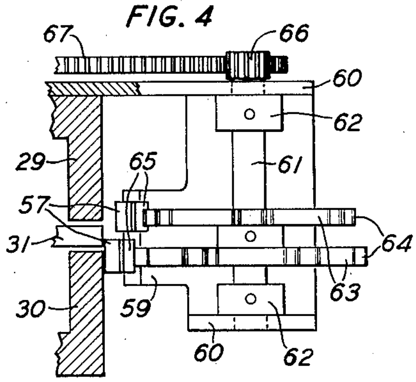


FIG. 7

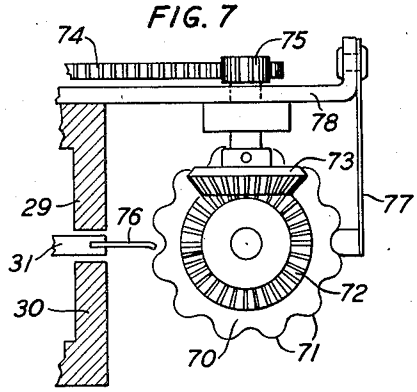


FIG. 5

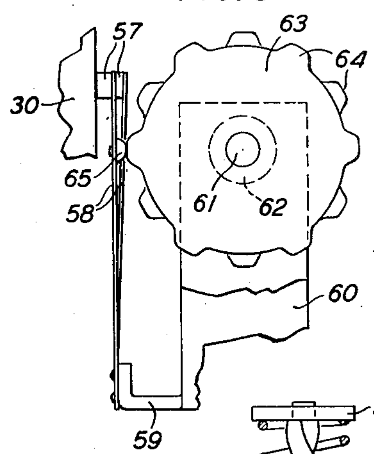


FIG. 8

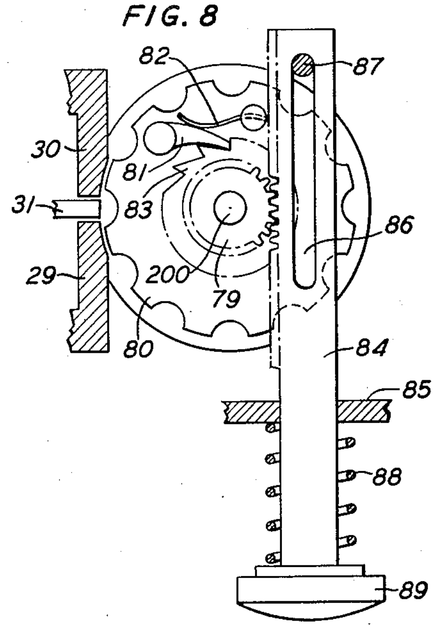


FIG. 9

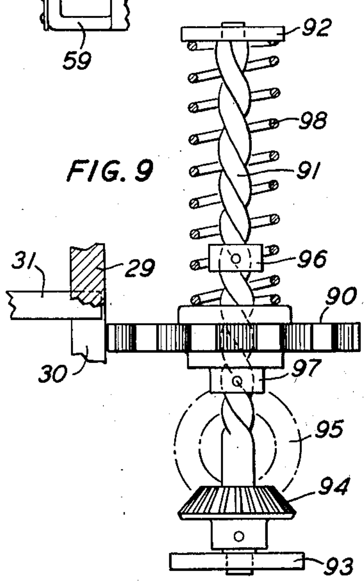
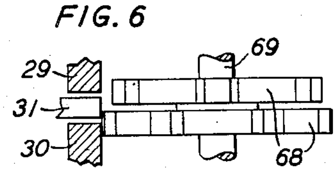


FIG. 6



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COMMUNICATION AND SIGNALING APPARATUS

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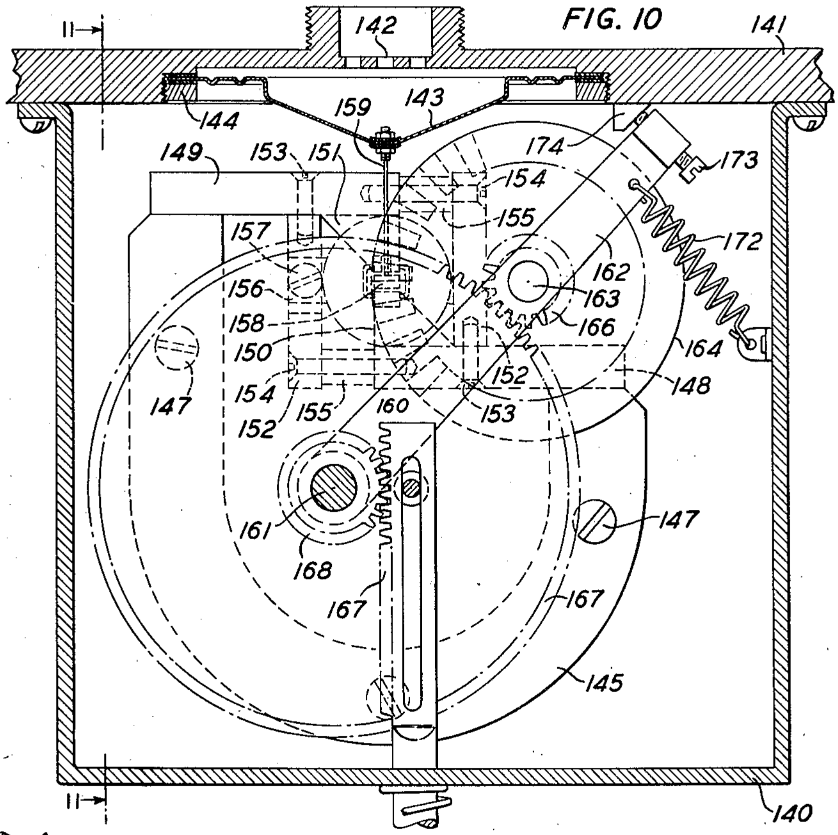
FIG. 10



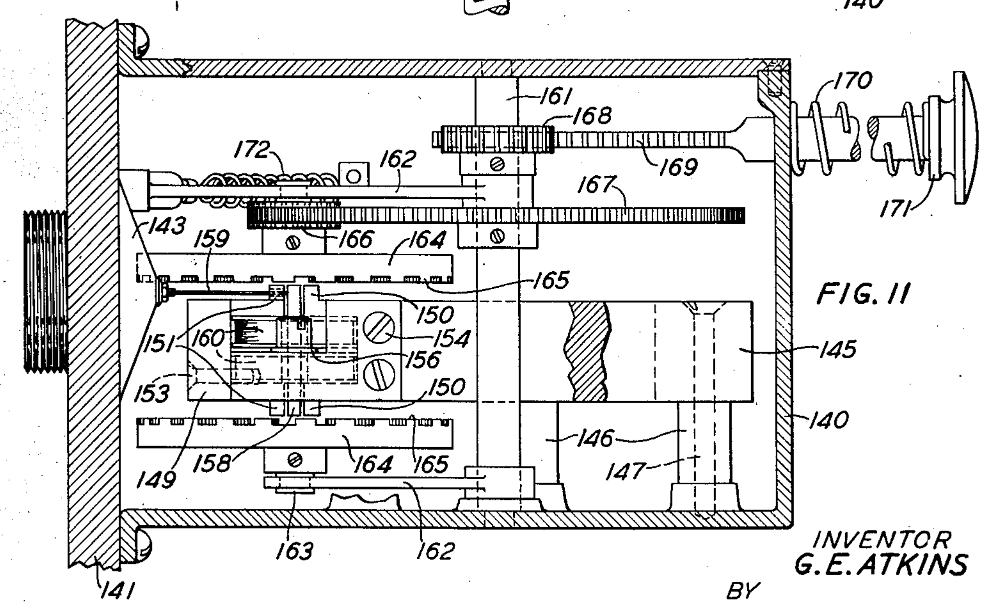


FIG. 11

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FIG. 12

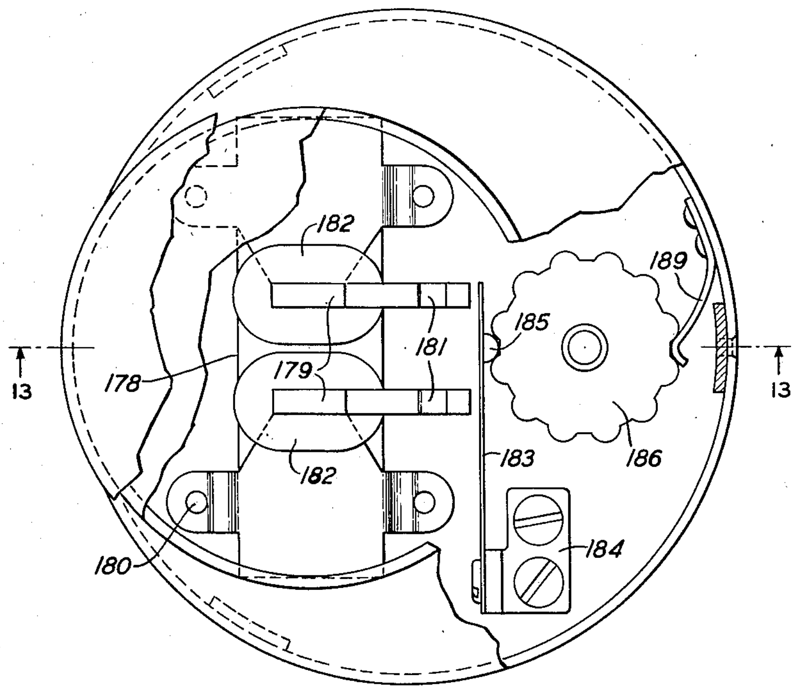
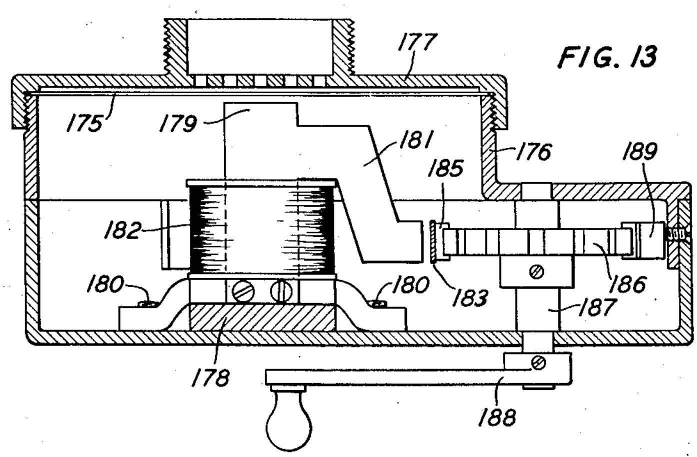


FIG. 13



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Patented Mar. 19, 1935

1,994,630

UNITED STATES PATENT OFFICE

1,994,630

COMMUNICATION AND SIGNALING APPARATUS

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Application June 16, 1933, Serial No. 676,042

16 Claims. (Cl. 179—1)

This invention relates to communication and signaling apparatus and more particularly to a combined telephone, signaling and signal indicating device for communication and signaling systems operable without batteries or similar sources of energy separate from the transmitting and receiving apparatus embodied in the systems.

One object of this invention is to simplify batteryless telephone systems and the apparatus included therein.

In one embodiment of this invention, a telephone system comprises basically a pair of armature type electromagnetic sound translating devices interconnected by a two-wire line. Each of the sound translating devices is operable both as a receiver and as a transmitter and comprises a permanent magnet having juxtaposed pole-pieces, a vibratile armature having a portion disposed between the pole-pieces, and a coil encircling the armature and connected across the line. A diaphragm is mechanically coupled to the armature and is adapted to vibrate the armature in accordance with speech waves to induce an audible frequency current in the coil. Conversely, the diaphragm is vibratable by the armature in accordance with currents sent through the coil to reproduce speech and audible signals.

In order to impress a relatively strong call signaling current upon the line independently of the vibrations of the diaphragm, means are provided for periodically varying the reluctance of the magnetic circuit including the magnet and the armature whereby a signaling current is induced in the coil. In one form, a rotatable member of magnetic material having a slotted or undulatory periphery is disposed so that as the magnetic member rotates the periphery thereof passes in immediate proximity to the pole-pieces.

The rotatable magnetic member is mounted so that it is removed from proximity to the pole-pieces of the magnet when it is desired to transmit or receive speech or audible signals. To this end, the member may be mounted upon a slidable shaft engaged at one end by a spring which normally holds the shaft in such position that the member is removed from proximity to the pole-pieces of the magnet. The shaft may be rotated by a gear train including a pair of spiral gears one of which is mounted upon the shaft. The spiral gears are disposed so that the thrust thereof acts against the spring to move the shaft along its axis. The movement of the shaft resulting from this thrust is limited by a stop so that the magnetic member is brought into position in proximity to the pole-pieces of the magnet.

The invention and the features thereof will be understood more clearly and fully from the following detailed description with reference to the accompanying drawings in which:

Fig. 1 is a schematic diagram of a communication and signaling system of the general type comprehended by this invention;

Fig. 2 is a rear view of a combined telephone and signaling device illustrative of one embodiment of this invention;

Fig. 3 is a side view, partly in cross-section, of the device shown in Fig. 2;

Figs. 4 and 5 are fragmentary top and side views, respectively, of another embodiment of this invention in which the reluctance of the magnetic circuit including the magnet and armature is varied by the periodic vibration of magnetic members adjacent the armature and the pole-pieces of the magnet;

Fig. 6 is a fragmentary detail view of a modification of the device shown in Figs. 2 and 3, in which a pair of magnetic rotors are provided adjacent the armature and the pole-pieces of the magnet;

Fig. 7 is a detail view of another embodiment of this invention in which a signaling current is produced by periodic vibration of the armature;

Fig. 8 is a detail view of a modification of the device illustrated in Figs. 2 and 3 in which the rotor is actuated by a gear and rack;

Fig. 9 illustrates a spiral shaft and spring arrangement for moving the rotors of the device such as shown in Figs. 2 and 3 into contiguity with and away from the armature and the pole-pieces of the magnet;

Fig. 10 is a top view, partly in cross-section, of another embodiment of this invention in which a plurality of rotatable members are provided adjacent opposite ends of the armature for varying the reluctance of the magnetic circuit;

Fig. 11 is a cross-sectional view along line 11—11 of Fig. 10;

Fig. 12 is a top view of another embodiment of this invention illustrating the application of the invention to a device of the type including a magnetic diaphragm;

Fig. 13 is a side view in cross-section of the embodiment of the invention illustrated in Fig. 12;

Figs. 14 and 15 are plan and side views, respectively, of a call or signal indicating device suitable for use in a communication system of the general type illustrated in Fig. 1; and

Fig. 16 shows another call indicating device which is adapted to be formed as a unit with a combined telephone and signaling device of the general construction illustrated in Figs. 2 and 3.

Referring now to Fig. 1 of the drawings, the communication and signaling system comprises a plurality of stations, two of which are designated as stations A and B in the figure, each of the stations including a combined telephone and signaling device 20, and a call indicating device 21 or 22. The telephone and signaling devices 20 are interconnected by a two-wire line 23.

The device 20, in one form illustrated in Figs. 2 and 3, comprises a casing 24 having a faceplate 25 secured thereto. An electromagnetic translating unit, which may be of the construction disclosed in Patent 1,365,898, granted January 18, 1921 to Henry C. Egerton, includes a permanent magnet 26 which is secured to projections 27 on the faceplate 25 by screws 28, pole-pieces 29 and 30 for the magnet, and an armature 31 of magnetic material having one end extending between the pole-pieces 29 and 30. The armature 31 is pivotally mounted intermediate its ends on a support 32 and is encircled by a pair of coils 33 and 34 which are connected in series and across the line wires 23 as shown in Fig. 1.

A diaphragm 35 is secured to the faceplate 25 adjacent a perforated portion 36 therein, by a clamping ring 37, and is coupled to the armature 31 by a connecting link 38.

A plate member 39 is mounted on the magnet structure as by screws, not shown, and has a pair of depending parallel arms 40, which may be integral therewith. A shaft 41 extends loosely through the arms 40 and carries a multi-toothed rotor 42 of magnetic material and a spiral or helical gear 43. Although the rotor 42 has been shown as made of an integral piece of magnetic material, the body thereof may be non-magnetic and the teeth formed separately of magnetic material and secured to the body. The rotor 42 is of such dimensions that when rotated the periphery thereof passes in immediate proximity to the pole-pieces 29 and 30 and the end of the armature 31 between the pole-pieces. The pole-pieces and armature may be hollowed or rounded as at 44 and 45, respectively, to conform to the periphery of the rotor. The clearance between the rotor and the rounded portions of the armature and pole-pieces is preferably less than the clearance between the armature and each of the pole-pieces. For example, if the gaps between the armature and the pole-pieces are .010 inch, the clearance between the rotor and the hollowed or rounded portions 44 and 45 may be .002 inch. The width of each tooth is of the order of the width of the armature plus the width of the airgap between the armature and pole-piece. The spacing between the outer edges of adjacent teeth on the rotor may be slightly greater than the width of each tooth.

A rod or shaft 46 extends loosely through the plate member 39 and a guide member 47 mounted on or integral with one of the arms 40 and is disposed at substantially right angles to the rod or shaft 41. The shaft 46 carries a helical or spiral gear 48 cooperatively disposed with respect to the gear 43, and a small gear 49 disposed adjacent the plate 39. The gear 49 is cooperatively associated with a large gear 50 mounted on a bearing extending between the plate 39 and a plate 51 secured to the plate 39 by screws 52, only one of which is shown. The large gear 50 is rotatable by a crank 53 coupled thereto.

A helical spring 54 loosely encircles a portion of the shaft 41 and extends between one of the arms 40 and a disc member or stop 55, and holds the rotor 42 out of alignment with the armature 31. Upon rotation of the gear 50 through the agency of the crank 53, the spiral gears 43 and 48 produce, as is known, a thrust which tends to move the shaft 41 in a direction along its axis. This thrust is utilized to move the rotor 42 into alignment with the armature 31, against the tension of the spring 54, the axial movement of the shaft 41 and hence the movement of the rotor 42, being limited by a shoulder 56 which engages the arm 40 thereadjacent when the rotor is in alignment with the armature 31. When rotation of the shaft 41 ceases the spring 54 moves the rotor away from the armature.

When the rotor 42 of the device at station A is revolved through the gear drive described hereinabove, the teeth thereon pass adjacent the hollowed or rounded portions 44 and 45 of the pole-pieces and the armature, and thereby vary the reluctance of the magnetic circuit including the magnet 26, pole-pieces 29 and 30, and the armature 31, so that the flux in the circuit varies periodically. Consequently, a current is induced in the coils 33 and 34 and flows over the line wires 23 to actuate the call or signaling indicating devices 21 and 22. The induced current also causes vibration of the armature 31 of the device 20 at station B connected by the line wires 23 so that an audible signal is produced at the station. The tone of the audible signal produced will, of course, depend upon the gear ratios employed, the number of teeth on the rotor and the speed of the crank. For example, if the ratio between gears 49 and 50 is 12 to 1, the ratio between the spiral gears 43 and 48 is 12 to 8, and the rotor 42 has 15 teeth, a 1000 cycle per second tone will be produced if the gear is rotated at a speed of about 4 R. P. S.

In another embodiment of this invention illustrated in Figs. 4 and 5, the reluctance of the magnetic circuit including the magnet 26, the pole-pieces 29 and 30, and the armature 31 is varied periodically by the vibration of magnetic members 57 which are disposed one adjacent each of the gaps between the armature and the pole-pieces. The magnetic members 57 are secured to the ends of resilient supports or springs 58 which are mounted on a support or stamping 59. The support or stamping 59 is formed with a pair of parallel arms 60 between which there extends a rotatable shaft 61 which is held in position by collars 62. A pair of spaced rotors 63 are mounted on the shaft and secured thereto, the rotors having a plurality of equally spaced peripheral projections or teeth 64 adapted to impinge upon knobs or buttons 65 mounted on the springs 58. The peripheral projections or teeth 64 on one of the rotors 63 are displaced angularly one half pitch from the projections on the other of the rotors. The shaft 61, and hence the rotors 63, may be rotated through a gear train including a small gear 66 mounted on the shaft 61 and a large gear 67 which may be revolved by a crank in the manner shown in the embodiment of the invention illustrated in Figs. 2 and 3.

In a modification of the embodiment of the invention, illustrated in Figs. 2 and 3, two magnetic rotors 68 (shown in Fig. 4) which may be of the same form as the rotor 42, are mounted on a shaft 69 which may be rotated through a gear train similar to that shown in Figs. 2 and 3. Each of the rotors 68 is disposed with its periphery adjacent one of the gaps between the pole-pieces 29 and 30 and the end of the armature 31 therebetween. The teeth on the two rotors 68 are displaced angularly one half pitch and the spacing between the outer edges of adjacent teeth on each rotor may be of the order of two times the thickness of the armature plus the width of a single tooth. An arrangement such as shown in Figs. 2 and 3 may be used to align and misalign the rotors 68 with the gaps between the armature 31 and the pole-pieces 29 and 30.

In still another embodiment of this invention, illustrated in part in Fig. 7, a signaling current may be induced in the coils 33 and 34 by mechanical vibration of the armature 31. A rotor 70 having a plurality of equally spaced peripheral projections 71 is rotated by a gear train including bevel gears 72 and 73 and a large and small gear 74 and 75, respectively. The projections 71 are adapted to impinge upon an extension 76 of the armature 31. Accidental rotation of the rotor may be prevented by a pawl member 77 mounted on a support or plate 78 attached to the pole-piece 29. The pawl member 77 also serves to position the rotor when at rest so that the extension 76 is midway between two of the teeth 71.

In place of a gear train, such as shown in Figs. 2 and 3, a gear and rack device, such as shown in Fig. 8, may be employed to revolve the rotor in any of the embodiments of the invention described hereinbefore. As shown in Fig. 8, a gear 79 and a rotor 80 are mounted loosely on a shaft 200, and are adapted to be interlocked by a pawl 81 mounted on the rotor 80 and actuated by a spring 82, and a ratchet 83 coupled to the gear 79. A reciprocal plunger or rack 84 for actuating the gear 79 extends through a support 85, which may be a casing similar to the casing 24 in Figs. 2 and 3, and is provided with a guide slot 86 into which a guide pin 87 extends. A helical spring 88 abuts against the support 85 and against a head 89 on the plunger or rack 84.

In Fig. 9 there is shown a device which may be utilized in place of the arrangement shown in Figs. 2 and 3 to align the rotor with the armature and the pole-pieces. The rotor 90, which may be of the same construction as the rotors shown in Figs. 2 and 3, is mounted upon a threaded shaft 91 extending between supports 92 and 93. The shaft 91 may be rotated through a gear train including bevel gears 94 and 95 and has secured thereon two stops or collars 96 and 97. A helical spring 98 encircles a portion of the shaft 91 and abuts against the support 92 and the rotor 90. When the shaft 91 rotates the rotor 90 moves along the shaft until it is in operative position with respect to the armature 31 and pole-pieces 29 and 30, whereupon its axial motion is arrested by the stop or collar 96. When rotation of the shaft 91 ceases the spring moves the rotor along the shaft and away from the armature 31.

It will be appreciated that the magnitude of the signaling current produced by the structures described hereinbefore is dependent, among other factors, upon the degree to which the reluctance of a magnetic circuit to which the current coil is magnetically coupled, is varied. In some instances, for example in communication systems connecting the bridge and controlling stations on ships, a very loud signaling tone is desirable because of extraneous noises.

One structure particularly suitable for such systems is illustrated in Figs. 10 and 11, and comprises a casing 140 having a faceplate 141 secured thereto. The faceplate 141 is provided with a perforated portion 142 adjacent which a diaphragm 143 is disposed, the diaphragm being secured to the face plate by a clamping ring 144. An electromagnetic translating unit, which may be of the general construction disclosed in Patent 1,365,898, granted January 18, 1921 to Henry C. Egerton, is mounted within the casing 140 and comprises a J-shaped permanent magnet 145 which is secured to stubs 146 extending from a wall of the casing, by screws 147. The magnet is provided with pole-pieces 148 and 149 having polar extensions 150 and 151, respectively. The polar extensions 150 and 151 may be accurately spaced relative to each other, as described in detail in the aforesaid Egerton Patent 1,365,898, by adjustable members 152, each of which is secured to a corresponding one of the pole-pieces 148 and 149 by a screw 153 and to the other of the pole-pieces by screws 154 which extend through sleeves 155.

A support or fulcrum 156 is secured to the adjustable members 152 by screws 157, only one of which is shown, and carries an armature 158 the ends of which extend into the gaps between the polar extensions 150 and 151. The armature is connected to the diaphragm 143 by a link or rod 159. A pair of coils 160 are positioned between the polar extensions 150 and 151 and encircle the armature 158.

Vibrations of the diaphragm 143 are transmitted to the armature 158 through the link 159 and as a result a current is induced in the coils 160. Conversely, if a variable current is passed through the coils 160, the armature 158 vibrates and vibrations are communicated to the diaphragm. Hence, the device shown in Figs. 10 and 11 may be utilized as both a transmitter and a receiver.

A rotatable shaft 161 extends between two opposite walls of the casing 140 and has loosely mounted thereon a pair of rigid parallel arms 162. Another rotatable shaft 163 extends between the arms 162 and has secured thereto two rotors 164, of magnetic material, each having equally spaced extensions 165 projecting from one face thereof. Although the extensions 165 are shown as integral with the body of the rotors, they may be formed separate therefrom. For example, the body of the rotors may be of non-magnetic material, and the extensions may be of magnetic material and suitably secured to the body. The rotors are adapted to be revolved so that the extensions 165 on each rotor pass in immediate proximity to a corresponding end of the armature 158 and pair of polar extensions 150 and 151. The projections 165 on the two rotors 164 are spaced relative to each other so that, as illustrated in Fig. 11, when one of the projections 165 on the upper rotor in this figure is opposite the gap between one end of the armature and one of the polar extensions 151, one of the projections 165 on the lower rotor is opposite the gap between the other end of the armature 158 and one of the polar extensions 150. Thus, two airgaps in the magnetic circuit including the armature 158 and the polar extensions 150 and 151 are partially shunted simultaneously so that a relatively large change is produced in the reluctance of the magnetic circuit and a current of relatively large magnitude is induced in the coils 160.

The shaft 163, and hence the rotors 164, are adapted to be revolved through a small gear 166 secured on the shaft 163 and driven by a large gear 167 secured on the shaft 161. The shaft 161 may be revolved in turn through the agency of a gear 168 mounted thereon and a reciprocal rack 169 extending through a wall of the casing 140, a spring 170 being provided between the wall of the casing and a head or button 171 on the rack.

When the rack 169 is actuated, the shaft 161 and large gear 167 are rotated and the small gear 166 rides on the large gear so that the arms 162 are moved, against the tension of a spring 172, until the rotors 164 are in operative position with respect to the polar extensions 150 and 151 and the armature 158. At this point, the movement of the arms 162 is arrested by the contact of a screw 173 extending through one of the arms 162, upon a stop 174 on the faceplate 141. The projections 165 are then passed across the gaps between the ends of the armature 158 and the polar extensions 150 and 151, in the relation described hereinbefore, whereby a signaling current is induced in the coils 160. The spring 172 serves to hold the rotors 164 in a position remote from the armature and polar extensions after the signaling current is induced so that the device may then be utilized efficiently as a transmitter and receiver.

Although the gear 168 is shown as fixed to the shaft 161, it will be understood that it may be loosely mounted thereon and coupled to the gear 167 through a ratchet and pawl such as shown for example, in Fig. 8.

Figs. 12 and 13 illustrate another embodiment wherein the invention is applied to a sound translating device of the type employing a magnetic diaphragm. As shown in these figures, a diaphragm 175 of magnetic material is clamped at its periphery between the end of a casing 176 and a cover or cap 177. A magnet 178 having poles 179 is secured to the base of the casing as by screws 180. The poles 179 are provided with extensions 181 and are encircled by coil 182.

Vibrations of the diaphragm 175 in accordance with sound waves vary the reluctance of the magnetic circuit including the diaphragm and the magnet 178, 179, so that a current is induced in the coils 182. Conversely, a current of audio-frequencies passing through the coils 182 produces corresponding vibrations of the diaphragm 175.

A magnetic reed or spring 183 is secured to a bracket 184 mounted on a wall of the casing and is disposed adjacent the outer end of the polar extensions 181, and has mounted thereon a button 185. A rotatable member 186 having an undulatory periphery adapted to contact with the button 185, is mounted on a shaft 187 extending between opposite walls of the casing and carrying a crank 188. A spring pawl 189 is secured to the casing and engages the periphery of the rotatable member 186, the pawl being so positioned and formed that when the member 186 is at rest, the button 185 is positioned in a depression in the undulatory periphery of the member 186 and the reed or spring 183 is, therefore, remote from the ends of the polar extensions 181.

As shown diagrammatically in Fig. 1, visual call or signal indicating devices such as 21 and/or 22 are provided at each of the stations, the devices being operable by currents induced in the coils of the telephone and signaling devices 20 in the manners described hereinbefore.

The indicator 21, as shown more clearly in Figs. 14 and 15, comprises a base or support 99 having a pair of spaced parallel arms 100 thereon. A rod or shaft 101 extends loosely through the arms 100 and is provided with a reduced end portion 102 fitting loosely in an aperture in the base 99. A disc is mounted on the shaft 101, and includes a pair of conductive sectors 103 and a pair of non-conductive sectors 104, which may be of colored paper or the like. Two pair of angularly displaced magnetic members or pole-pieces 105 and 135 are secured to the arms 100, as by screws 106, and are disposed on opposite sides of the disc 103, 104. A pair of coils 107 encircle the pole-pieces 105 and may be connected in series with each other and with one of the line wires 23 as indicated in Fig. 1, a condenser 108 being connected across the coils. A crank arm or reset 109 is mounted on the shaft 101 and is rotatable therewith.

When the coils 107 are energized, the disc 103, 104 revolves in accordance with well known principles, until the non-conductive sectors 104 are between the ends of the pole-pieces 105, the position of the sectors indicating that another station is calling the station at which the indicator is located. With the disc at rest in this position no motional energy is expended so that during the conversaton between the two stations the coils 107 constitute a small impedance in the line. Upon the completion of the conversation the disc 103, 104 may be rotated through the agency of the crank arm or reset 109 until the conductive sectors 103 are brought between the ends of the pole-pieces 105.

The indicating device 22, is adapted to be constructed as a single unit together with a telephone and signaling device of the general construction shown in Figs. 2 and 3. As shown more clearly in Fig. 16, the indicating device 22 comprises a pair of magnetic poles 110 which may be extensions of the poles of the magnet 26 (Figs. 2 and 3), and a pair of pole-pieces 111 having hollowed or grooved substantially semi-cylindrical ends 112. A coil 113 is pivotally mounted between the pole-pieces 111 and has connected thereto a lightweight rod or needle 114 of insulating material, which has mounted thereon a metallic collar 115. The collar 115 is connected to one end of the coil 113 by a conductor 116. The other end of the coil is connected to one of terminals 117 by conductor 118. An elongated tubular sleeve 119 of conductive material, having an enlarged end portion 120, is slidably mounted on the needle or rod and is connected to the other of the terminals 117 by a conductor 121. A helical spring 122 is connected to one end of the rod or needle 114 and to a magnetic member 123 mounted within the enlarged end portion 120, the spring being of insufficient stiffness to support the sleeve 119 so that the latter normally rests upon or abuts against the collar 115. A magnet 124 is pivotally mounted within the casing 24 and has connected thereto a torsion spring 125. The magnet 124 may be rocked from the exterior of the casing 24 by a projection 126 extending through an aperture 127 in a wall of the casing.

As was described hereinbefore, the sleeve 119 normally abuts against the collar 115 so that the coil 113 is connected across the line wires 23 through a suitable rectifier 129, the normal position of the coil, rod, and sleeve being as shown in dotted outline in Fig. 12. When a signaling current is passed through the coil 113, the coil and associated elements swing into the position shown in full lines in Fig. 12, the enlarged end portion 120 of the sleeve 119 coming in juxtaposition to a window 128 in a wall of the casing 24. When the sleeve 119 is in this position, the magnet 124 acts upon the magnetic member 123, and the sleeve 119 is drawn along the rod 114 and toward the magnet so that the contact between the sleeve and the collar 115 is broken and the coil is cut out of the circuit during the conversation between the two stations. After the completion of the conversation, the magnet 124 may be rocked through the agency of a projection 126 so that the magnet is removed from the magnetic member and the coil 113 and sleeve 119 return to the original position, that is, the position shown in dotted outline in Fig. 12.

Although the indicating device 22 has been described as forming a unitary structure with a combined telephone and signaling device such as shown in Figs. 2 and 3, it will be understood, of course, that it may be fabricated as a separate unit. It will be understood also that although two different indicating devices have been illustrated in the system shown in Fig. 1, the indicating devices at both stations A and B may be of the same construction.

If desired, the end thrust of the rotor shaft, such as the shaft 41 in a device of the construction shown in Figs. 2 and 3, may be utilized to shunt or cut out the visual indicating device at the calling station. For example, as shown in Fig. 2, a pair of leaf springs 130 having contacts 131 thereon may be mounted on an insulating block 132 secured to the casing 24. The springs may be connected through terminals 133 and conductors 134 across the lead wires of the device 21 at station A in Fig. 1. When the rotor 42 at station A is revolved to signal station B, the thrust of the shaft 41 closes the contacts 131 and shunts the indicating device out of the signaling and talking circuit.

Alternately the contents 131 may be connected in series with one of the lead wires 117 and 121 for the indicating device 22 and be normally closed. The springs 130 are then so disposed that when the rotor 42 at station B is revolved the end thrust of the shaft 41 opens the contacts to cut the indicating device out of the signaling circuit.

Furthermore, it is to be understood that although several specific structural embodiments of the invention have been shown and described, many modifications may be made therein without departing from the scope and spirit of this invention as defined in the appended claims.

What is claimed is:

1. In combination, means including a magnet forming a magnetic circuit, a coil magnetically coupled with said circuit, means for varying the reluctance of said circuit to induce a speech frequency current in said coil, separate means including a magnetic member for varying the reluctance of said circuit to induce a signaling current in said coil, and means holding said magnetic member in loose magnetic coupling with said magnet, said last mentioned means being operable where said separate means is actuated to move said magnetic member into close magnetic member into close magnetic coupling with said magnet.

2. A combined telephone and signaling device comprising a magnet having spaced pole-pieces, a magnetic armature adjacent said pole-pieces, a stationary coil magnetically coupled to said armature, a diaphragm connected to said armature, and means for varying the reluctance of the magnetic circuit including said magnet and said armature to induce a signaling current in said coil.

3. A combined telephone and signaling device comprising a magnet having juxtaposed pole-pieces, a magnetic armature adjacent said pole-pieces, a coil magnetically coupled to said armature, a diaphragm connected to said armature, a member having an undulatory magnetic peripheral portion in proximity to said armature and one of said pole-pieces, and means for rotating said member to vary the reluctance of the flux path between said one pole-piece and said armature.

4. A combined telephone and signaling device comprising a magnet having juxtaposed pole-pieces, a magnetic armature extending between said pole-pieces, a stationary coil encircling said armature, a diaphragm mechanically coupled to said armature, and means for periodically varying the reluctance of the flux paths between said armature and said pole pieces whereby a signaling current is induced in said coil.

5. A combined telephone and signaling device comprising a magnet having juxtaposed pole-pieces, a magnetic armature having an end portion extending between said pole-pieces, a coil encircling said armature, a diaphragm coupled to said armature, a magnetic member having an undulatory portion in proximity to said end portion and said pole-pieces, and means for actuating said member to pass said undulatory portion adjacent said end portion and said pole-pieces whereby the reluctance of the magnetic circuit including said armature and said pole-pieces is varied to induce a signaling current in said coil.

6. A combined telephone and signaling device comprising a magnet having juxtaposed pole-pieces, a magnetic armature having an end portion extending between said pole-pieces, a coil encircling said armature, a diaphragm coupled to said armature, a rotor having a plurality of spaced magnetic peripheral projections, disposed edgewise in immediate proximity to said end portion and said pole-pieces, and means for revolving said rotor so that said projections pass adjacent the gaps between said end portion and said pole-pieces whereby the reluctance of the magnetic circuit including said armature and said magnet is varied periodically to induce a signaling current in said coil.

7. A signaling device comprising a magnet having spaced pole-pieces, a magnetic armature extending between said pole-pieces, a coil magnetically coupled to said armature, a rotor having an undulatory magnetic portion, positioned remote from said armature and said pole-pieces, and means for simultaneously revolving said rotor and positioning said undulatory portion in immediate proximity to one of said pole-pieces and said armature.

8. A signaling device comprising a magnet having juxtaposed pole-pieces, a magnetic armature having an end portion extending between said pole-pieces, a coil magnetically coupled to said armature, a shaft adjacent said magnet, a magnetic rotor fixed on said shaft having an undulatory periphery and disposed remote from said pole-pieces and said end portion, and means including spiral gears for revolving said rotor, one of said gears being coupled to said shaft, said gears being disposed so that the thrust thereof moves said shaft axially to bring the periphery of said rotor into immediate proximity to said pole-pieces and said end portion of said armature.

9. A combined telephone and signaling device comprising a magnet, having juxtaposed pole-

pieces, a magnetic armature having an end portion extending between said pole-pieces, a coil magnetically coupled to said armature, a diaphragm connected to said armature, a shaft adjacent said magnet, a rotor having an undulatory magnetic peripheral portion, fixed on said shaft, yieldable means for positioning said rotor remote from said pole-pieces, and means including spiral gears for revolving said shaft, one of said gears being fixed to said shaft, said gears being disposed so that the thrust thereof moves said shaft axially against the action of said yieldable means to position the periphery of said rotor in immediate proximity to said end portion and said pole-pieces.

10. A signaling device comprising a magnet having juxtaposed pole-pieces, a magnetic armature extending between said pole-pieces and forming a plurality of gaps therewith, a coil magnetically coupled to said armature, and means including a plurality of magnetic members adjacent said gaps for periodically bridging each of said gaps to vary the reluctance of the magnetic circuit including said armature and said magnet.

11. A combined telephone and signaling device comprising a magnet having juxtaposed pole-pieces, an armature having an end portion between said pole-pieces and forming a pair of gaps therewith, a coil magnetically associated with said armature, a diaphragm coupled to said armature, a pair of rotors disposed each with its periphery adjacent a corresponding one of said gaps, and means for revolving said rotors, each of said rotors having spaced magnetic peripheral projections adapted to pass in immediate proximity to the end portion of said armature and one of said pole-pieces, the projections on the two rotors being angularly displaced so that when a projection on one rotor is in alignment with one of said gaps, the corresponding projection on the other rotor is out of alignment with the other of said gaps.

12. A signaling device comprising a magnet having juxtaposed pole-pieces, an armature havin an end portion extending between said pole-pieces, a circular member having an undulatory magnetic periphery and disposed edgewise to said pole-pieces and the end portion of said armature, said end portion and said pole-pieces having rounded portions shaped to conform to the periphery of said magnetic member, the clearance between said member and said rounded portions being less than the clearance between said end portion of said armature and said pole-pieces, and means for revolving said magnetic member.

13. In combination, a sound translating device including a diaphragm and an armature coupled to said diaphragm, signaling means including a stationary coil magnetically associated with said armature, an indicating device having a magnetically operable actuating element, and a single magnet magnetically coupled to said armature and to said actuating element.

14. In combination, a magnet having spaced poles, a plurality of pairs of pole-pieces magnetically associated with said poles, an armature adjacent one pair of said pole pieces, a diaphragm coupled to said armature, a stationary coil magnetically associated with said armature, means for varying the reluctance of the magnetic circuit including said armature and said one pair of pole-pieces to induce a signaling current in said coil, and an indicating member having an actuating element operatively disposed with respect to another pair of said pole-pieces.

15. In combination, a magnet having a pair of juxtaposed pole-pieces, an armature extending between said pole-pieces, a coil magnetically coupled to said armature, a magnetic member having an undulatory portion adapted to be passed in immediate proximity to said pole-pieces and said armature, whereby the reluctance of the magnetic circuit including said armature and said pole-pieces is varied to induce a current in said coil, means for actuating said magnetic member, an indicating device including an actuating coil, an electrical connection including contact members, between said coils, and means actuable by said first means to operate said contact members.

16. In combination, a magnet having spaced poles, a plurality of pairs of pole-pieces for said poles, an armature extending between one pair of said pole-pieces, a coil magnetically coupled to said armature, a diaphragm connected to said armature, a shaft adjacent said magnet, a rotor fixed on said shaft and having an undulatory magnetic peripheral portion, said rotor being normally positioned remote from said armature and said one pair of pole-pieces, means for simultaneously revolving said rotor and positioning it with its periphery in immediate proximity to said armature and said one pair of pole-pieces, an indicating device having an actuating coil operatively disposed with respect to another pair of said pole-pieces, an electrical connection including contact members, between said coils, and means actuable by said first means to operate said contact members.

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