July 18, 1939. G. E. ATKINS 2,166,515

SOUND TRANSLATING APPARATUS

Filed Feb. 18, 1937 3 Sheets-Sheet 1

FIG. 1

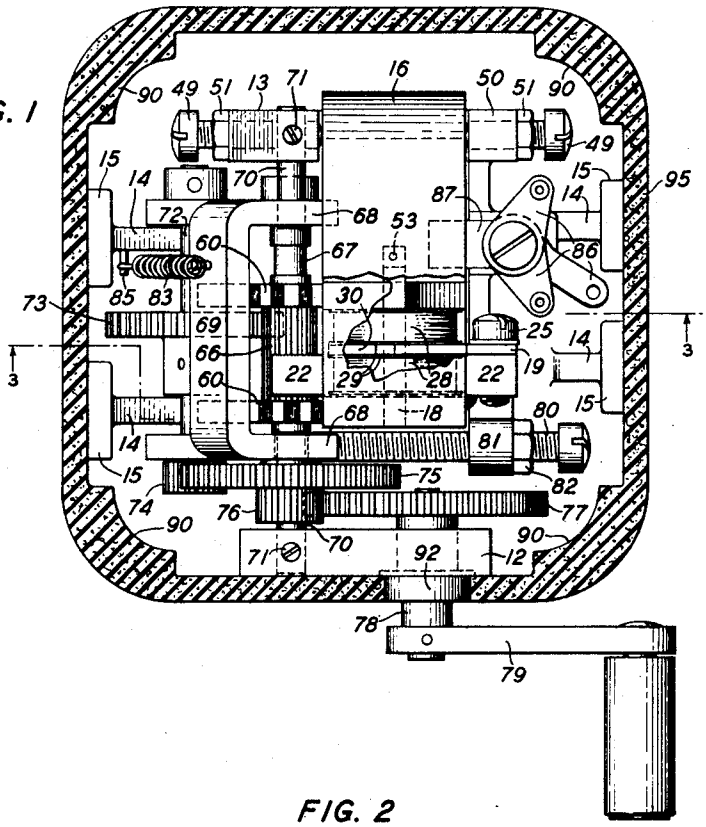
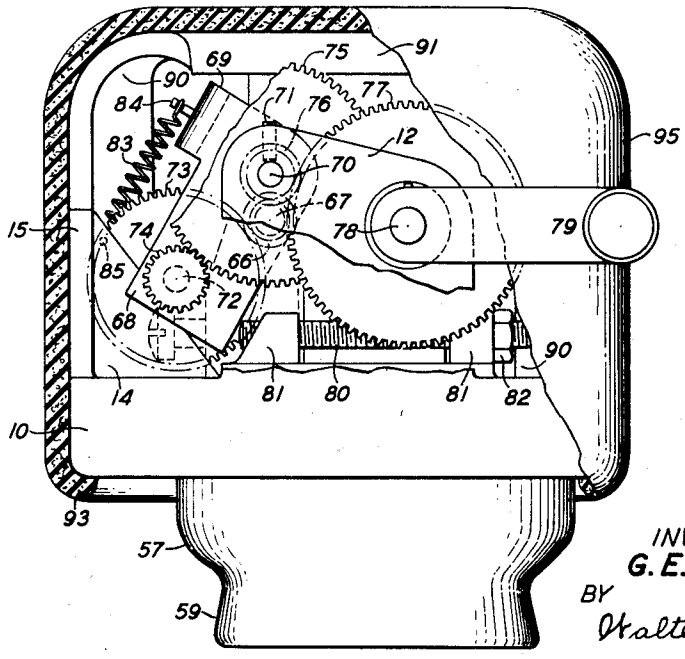


FIG. 2



INVENTOR
G. E. ATKINS
BY
Walter C. Kiesel
ATTORNEY

July 18, 1939. G. E. ATKINS 2,166,515

SOUND TRANSLATING APPARATUS

Filed Feb. 18, 1937 3 Sheets-Sheet 2

FIG. 3

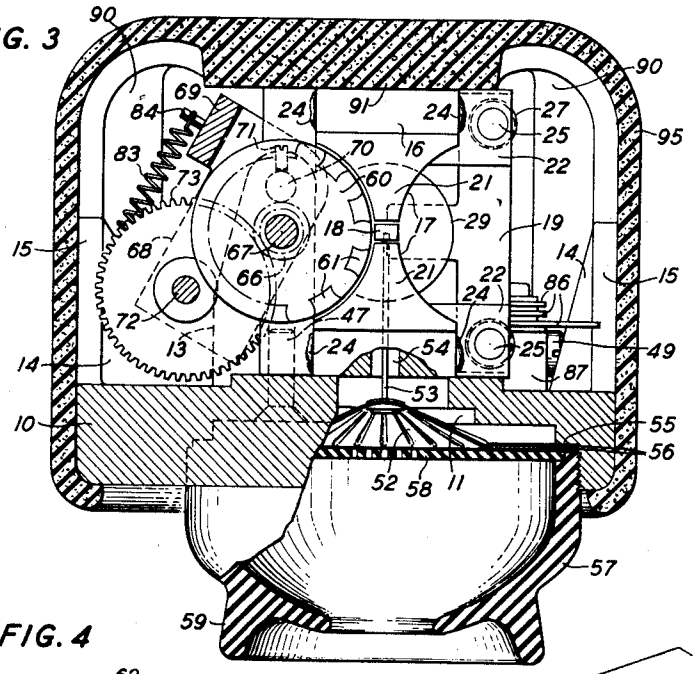


FIG. 4

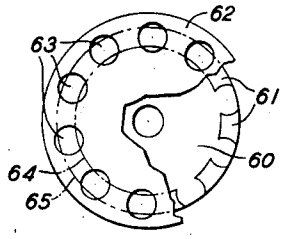


FIG. 5

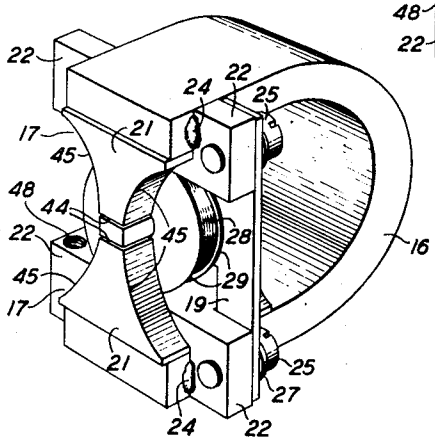
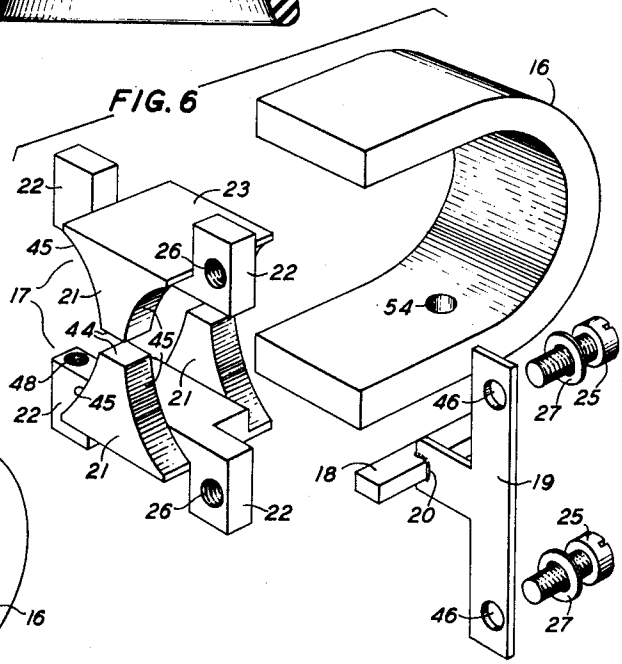


FIG. 6



INVENTOR
G. E. ATKINS
BY
Walter C. Kiesel
ATTORNEY

July 18, 1939. G. E. ATKINS 2,166,515

SOUND TRANSLATING APPARATUS

Filed Feb. 18, 1937 3 Sheets-Sheet 3

FIG. 7

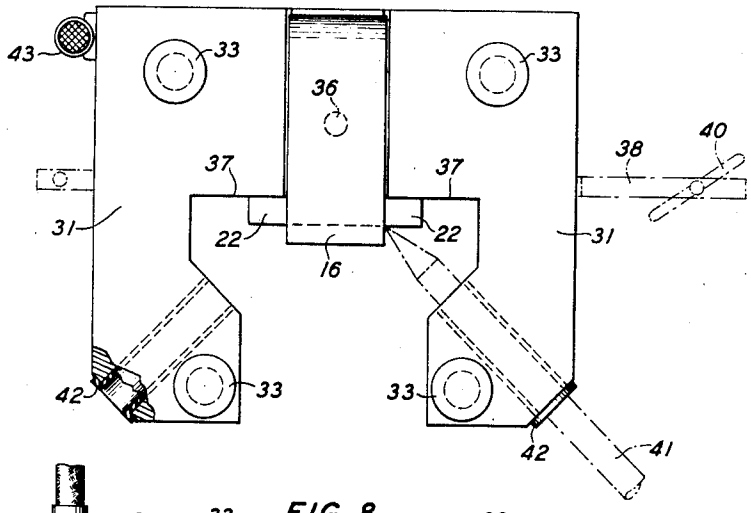


FIG. 8

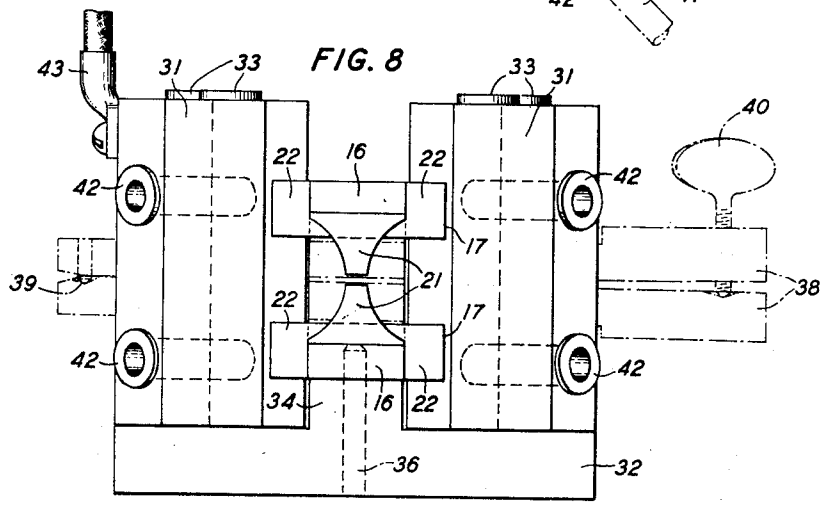
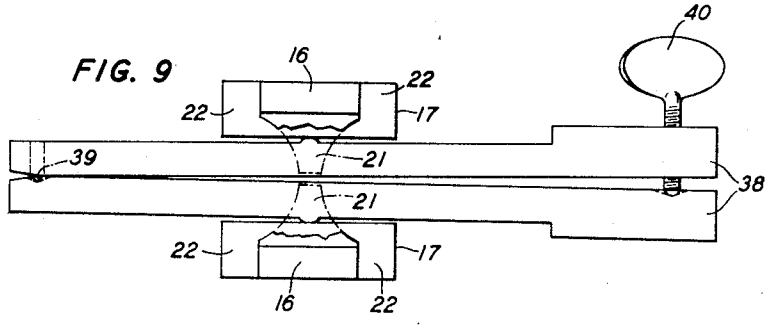


FIG. 9



INVENTOR
G. E. ATKINS
BY
Walter C. Kiesel
ATTORNEY

Patented July 18, 1939 2,166,515

UNITED STATES PATENT OFFICE

2,166,515

SOUND TRANSLATING APPARATUS

George E. Atkins, Glen Ridge, N. J., assignor to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York

Application February 18, 1937, Serial No. 126,422

7 Claims. (Cl. 171—209)

This invention relates to sound translating apparatus and more particularly to combined telephone and signaling devices for communication and signaling systems operable without batteries or similar sources of energy separate from the combined devices.

Such combined devices, as disclosed and claimed for example in my Patent 1,994,630, granted March 19, 1935, may comprise an electromagnetic system including a magnet, an armature associated with the magnet and one or more coils magnetically coupled with the magnet and the armature. A diaphragm may be coupled to the armature and means, such as one or more rotors, for periodically shunting the air-gaps in the magnetic system, may be provided for varying the reluctance of the magnetic system and thereby inducing a signaling current in the coils.

One object of this invention is to expedite the manufacture of magnetic structures for sound translating apparatus and thereby to reduce the cost of such apparatus.

Another object of this invention is to simplify and to reduce the over-all dimensions of combined telephone and signaling devices.

A further object of this invention is to facilitate adjustment of the relative positions of the rotors and the magnetic structure in combined telephone and signaling apparatus.

In accordance with one feature of this invention, the pole-pieces of the magnet are fabricated separately from the magnet proper and are provided with channel-shaped portions for receiving the poles of the magnet and with portions for mounting the supporting trunnion for the armature. In the manufacture of the magnet structure the pole-pieces are seated upon the poles and held in engagement therewith. The pole-pieces are then arc-welded to the magnet and the structure is magnetized. Subsequently, the opposed ends of the pole-pieces are milled to provide the desired clearance therebetween and corresponding sides of the pole-pieces are machined to provide concentric arcuate surfaces with which the rotors are associated as described hereinafter.

In accordance with another feature of this invention, the pole-pieces of the magnet are provided with arcuate concentric sides of substantially the same radius as the rotors and the rotors are positioned with their peripheries adjacent and concentric with the arcuate surfaces of the pole-pieces.

In accordance with a further feature of this invention, the rotors are mounted upon a rockable yoke and means, such as a set screw and resilient member acting in opposition, are provided for adjustably tilting the yoke to position the rotors accurately with respect to the arcuate surfaces of the magnet pole-pieces and to maintain the rotors in such position.

The invention and the various 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 top view of a combined telephone and signaling device constructed in accordance with this invention, the housing being shown in cross-section and a portion of the magnet being broken away;

Fig. 2 is a side view of the device illustrated in Fig. 1, a portion of the housing being broken away to show the internal structure more clearly;

Fig. 3 is a side view in cross-section along line 3—3 of Fig. 1;

Fig. 4 is a detail view illustrating the fabrication and construction of the rotors embodied in the device shown in Figs. 1, 2 and 3;

Fig. 5 is a perspective view of the magnetic unit embodied in the device shown in Figs. 1, 2 and 3;

Fig. 6 is an exploded view in perspective of the magnetic unit illustrated in Fig. 5;

Figs. 7 and 8 are top and front elevational views respectively of the magnet and a jig employed in the fabrication thereof; and

Fig. 9 is a detail view illustrating the association of the magnet and a pole-piece spreader utilized in the manufacture of the magnetic unit.

Referring now to the drawings, the combined telephone and signaling device illustrated in Figs. 1, 2 and 3 comprises a face-plate 10, which may be substantially square in outline and of any suitable cast or machined material such as metal, having an opening 11 of stepped longitudinal section, and having also integral parallel arms or stanchions 12 and 13 arising from one surface thereof. The face-plate is provided with a plurality of ribs or brackets 14 adjacent opposite sides thereof, the ribs or brackets having relatively broad faces 15 coplanar with the adjacent sides of the face-plate.

Mounted upon the face-plate 10 is an electromagnetic structure, which may include a unit of the balanced armature type comprising, as shown more clearly in Figs. 5 and 6, a U-shaped permanent magnet 16, pole-pieces 17, a magnetic armature 18 and a resilient non-magnetic T-shaped support 19, the stem of the support being provided at one end with a slot 20 in which

the armature is affixed as by brazing. The pole-pieces 17 comprise parallel projections 21 and parallel arms 22 which, together with the base portion 23, form a channel for slidably receiving the poles of the magnet 16. The surfaces of the arms 22 and base portion 23 bounding the channel preferably are accurately machined so that they snugly engage the corresponding surfaces of the poles of the magnet. The pole-pieces 17 may be affixed to the magnet 16 in any suitable manner, preferably, however, by arc-welding as indicated at 24, so that the juxtaposed projections 21 have their broader faces substantially coplanar.

The T-shaped armature support 19 is supported upon two of the arms 22, as by machine screws 25 threaded into taps 26 in these arms, suitable split washers 27 being provided to maintain the support firmly locked to the arms 22.

A pair of coils 28 are disposed on opposite sides of the stem of the support 19 and encompass the armature 18, the coils having affixed thereto end discs 29 of insulating material, which may be adhesively secured to the pole-piece projections 21 and preferably are of such diameter that the peripheries thereof frictionally engage the opposed surfaces of the pole-pieces intermediate the projections 21. The coils may be maintained in parallel space relation by an insulating spacer 30, shown in Fig. 1.

In the fabrication of the magnetic unit described above, the unmagnetized U-shaped member 16 is mounted between the arms 31 of a jig, as shown in Figs. 7 and 8, the arms being of electrically conductive material, for example copper, and mounted upon and secured to a base 32 as by rivets or eyelets 33. The base 32 may be provided with a raised portion 34 forming a seat upon which the member 16 may rest and the member 16 may be centered with respect to the jig by a pin 36 adapted to fit in an aperture 54 in one arm of the member 16. The pole-pieces 17 are then slid into position along the poles of the U-shaped member until the arms 22 abut the surfaces 37 of the arms 31 and the outer faces of the pole-pieces are substantially flush with the ends of the U-shaped member 16. The pole-pieces may be held in intimate engagement with the U-shaped member by a suitable spacer or spreader which, as shown in Fig. 9, may comprise a pair of arms 38 pivoted one upon the other as indicated at 39 and separable to bear against the pole-pieces, as by a screw 40 threaded into one of the arms and bearing against the other.

Subsequently, welding electrodes 41, one of which is shown in Fig. 7, are inserted through insulating eyelets 42 in the arms 31 and the pole-pieces 17 are arc-welded to the U-shaped member 16, the jig itself serving as an electrode and being provided with a suitable terminal 43. The resulting structure is then removed from the jig and the tips 44 and sides 45 of the projections 21 are milled or machined to provide the desired clearance between the tips 44 and to make the corresponding sides 45 accurately concentric arcs.

The structure may then be magnetized and the armature 18, support 19 and coils 28 mounted in position, the apertures 46 in the support being slightly oversize to allow accurate centering of the armature between the pole-piece tips 44. Alternatively the armature may be mounted in position before the structure is magnetized.

It will be appreciated from the foregoing that the structure and fabrication of the magnetic unit greatly expedite the manufacture and reduce the cost thereof. The requisite clearance between the pole-piece tips is obtained easily and accurately determined and the alignment thereof and of other important portions of the pole-pieces is attained without the necessity of complex adjusting means and aligning devices.

The complete magnetic unit is affixed to the face-plate 10 as by a machine screw 47, shown in Fig. 3, which extends through the face-plate and is threaded into a suitable tap 48 in one of the arms 22 of the lower pole-piece 17. The unit may be locked in proper position by a pair of opposed, aligned set screws 49, one of which is threaded through a hub 50 integral with the face-plate 10 and the other of which is threaded through the support 13. Lock nuts 51 may be provided for preventing disengagement of the ends of set screw from the sides of the magnet 16.

A diaphragm 52 is mounted in the opening 11 in the face-plate 10 and is coupled to one end of the armature 18 by a driving pin 53 extending through an aperture 54 in the magnet 16. The peripheral portion of the diaphragm 52 may be clamped against a shoulder or seating surface 55 in the face-plate 10, together with suitable washers 56, by a combined ear-piece and mouthpiece 57, which is threaded to the face-plate. Disposed adjacent the outer surface of the diaphragm is an apertured plate 58 which also is clamped to the face-plate 10 by the combined ear-piece and mouthpiece 57. The latter, together with the plate 58, forms a chamber in communication with the diaphragm, providing the stiffness reactance requisite for good speech transmission, and preferably is provided with an outer annular portion 59 adapted to be placed against the ear of a user of the telephone and thereby to seal the ear acoustically from the atmosphere.

The magnetic unit and the diaphragm, it will be understood, constitute both a transmitter and a receiver. That is to say, when the armature 18 is vibrated by the diaphragm in accordance with speech waves impinging upon the diaphragm, audio frequency currents are induced in the coils 28; conversely when currents of audio-frequency are passed through the coils 28, the armature vibrates to actuate the diaphragm.

In order to produce a signaling current in a line connected to the coils 28, the reluctance of the magnetic circuit including the magnet 16, pole-pieces 17 and armature 18 may be varied periodically. This may be accomplished through the agency of a pair of rotors 60 having magnetic portions 61 adapted to partially shunt the gaps between the armature 18 and the pole-piece tips 44, the rotors being of approximately the same radius as the arcuate sides 45 of the pole-pieces.

Preferably, the outer face of each of the magnetic segments is of a circumferential width equal to the thickness of the armature 18 plus the thickness of one of the air-gaps between the armature and the tips 44 of the pole-pieces and the two rotors are so related angularly that when the magnetic segments on one shunt the gap between one of the pole-pieces 17 and one end of the armature 18, the segments on the other rotor shunt the gap between the other of the pole-pieces and the other end of the armature.

The rotors may be fabricated, for example, as illustrated in Fig. 4, from circular discs 62 of magnetic material. The disc is first provided with a plurality of equally spaced apertures 63 and a

large diameter central aperture, the periphery of which, as indicated by the broken line 64, intersects the apertures 63. The various apertures are then sealed with a non-magnetic material, such for example, as a phenolic condensation product. Subsequently, the peripheral portion of the disc 62 is milled to a radius indicated by the line 65. The resulting structure, as shown in Fig. 3, comprises a plurality of equally spaced magnetic segments embedded in a non-magnetic disc, a particular feature thereof being that magnetic leakage between adjacent segments and hence undesired shunting of the air gaps is substantially prevented.

The rotors 60 may be frictionally fitted on reduced shoulders, not shown, on a pinion 66 which is mounted on a shaft 67 extending between the arms 68 of a U-shaped or yoke member 69. The yoke member 69 is pivotally mounted upon pins 70 carried by and extending inwardly from the supports 12 and 13 and locked thereto as by set screws 71. Another shaft or axle 72 is carried by the yoke member 69 and has mounted thereon a driving gear 73, which meshes with the pinion 66, and also a second pinion 74. The latter pinion is engaged by a driving gear 75 mounted on one of the pins 70 and having affixed thereto a third pinion 76 which is driven by a gear 77 mounted on a shaft 78 journaled in the support 12 and rotatable by a crank 79. This gear train, it will be seen enables relatively high speed rotation of the rotors 60 with moderate speeds of rotation of the crank 79. For example, the rotors may have eleven magnetic segments each and the various gears and pinions constituting the gear train may be of such relative diameters and the teeth thereof may have such pitches that a 1000 cycle per second current will be induced in the coils 28 when the crank 79 is rotated at a speed of approximately two revolutions per second.

The position of the rotors 60 with respect to the adjacent arcuate sides 45 of the pole-pieces 17 may be adjusted accurately so that the desired clearance between the rotors and these sides and the armature obtains, by an elongated set screw 80 which is threaded through suitable hubs 81, preferably integral with the face-plate 10, and abuts one of the arms 68 of the yoke 69, as shown clearly in Fig. 2. A suitable lock nut 82 may be provided to prevent accidental variations in the adjustment. Firm engagement between the end of the set screw 80 and one of the arms 68 may be maintained by a spring 83 fixed at one end to a pin 84 on the yoke 69 and at the other end to a pin 85 extending from one of the webs or brackets 14, as shown clearly in Figs. 1 and 2.

Suitable terminals 86 for the coils 28 may be mounted on and insulated from a protuberance 87 integral with the face-plate 10.

The apparatus, with the exception of the crank 79, described hereinabove may be enclosed in a housing 87, which preferably is of long life soft rubber. The corners of the soft rubber housing 87 may be reinforced by internal ribs 90, which have one end bearing against the inner surface of the face-plate 10, and the base thereof may be provided with thickened portions 91 adapted to bear against the magnet 16. Three sides of the housing bear against the support 12 and the wide surfaces 15 of the webs or brackets 14 and are held against deformation thereby. One of these sides is provided with an aperture closely fitting a hub 92 on the shaft or axle 78 and forming a water-tight seal therewith. The rim 93 of the housing fits over and bears against the front of the face-plate 10.

The various elements of the combined telephone and signaling device, it will be seen, may be fabricated expeditiously in a compact unit of a size, for example 3" x 3" x 2½" convenient for portable use.

Although a specific embodiment of the invention has been shown and described, it will be understood that this embodiment is but illustrative and that various 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. A signaling device comprising means including a magnet and pole-pieces therefor forming a magnetic circuit, said pole-pieces having substantially parallel faces, concentric arcuate sides and juxtaposed tips, a coil magnetically coupled to said circuit, an armature extending substantially normal to said faces and cooperatively associated with said tips, and means for varying the reluctance of said circuit to induce a current in said coil comprising a rotor concentric with said arcuate sides and having spaced magnetic portions, said rotor being substantially parallel to said faces and having its axis substantially parallel to the longitudinal axis of said armature.

2. A signaling device comprising a magnet, a pair of juxtaposed pole-pieces for said magnet each having a pair of parallel trapezoidal projections tapering toward and terminating in pole tips, one side of each projection being arcuate from adjacent the pole tip, corresponding arcuate sides of said pole-pieces being substantially concentric and the pole tips of one pole-piece being opposite the pole tips of the other, an elongated armature extending between said pole tips and substantially normal to said projections, a coil associated with said armature, and a pair of rotors each disposed substantially concentric with one pair of said corresponding sides and at right angles to the longitudinal axis of said armature, each of said rotors having a magnetic peripheral portion.

3. A signaling device comprising a magnetic circuit including a magnet having juxtaposed pole-pieces, a coil associated with said magnet, a yoke member, pivot means supporting said yoke member intermediate its ends, a rotor mounted on said yoke member and having magnetic portions adjacent said pole-pieces, and means for tilting said yoke member about said pivot means to adjust the clearance between said rotor and said pole-pieces.

4. A signaling device comprising a magnet having juxtaposed pole-pieces, an armature in cooperative relation with said pole-pieces and forming air-gaps therewith, a coil magnetically coupled to said magnet, a rotor having a magnetic peripheral portion adapted to partially shunt at least one of said air-gaps, a rockable support for said rotor, and means for tilting said support to adjust the position of said rotor with respect to said one air-gap.

5. A signaling device comprising a magnet having juxtaposed pole-pieces, said pole-pieces having concentric arcuate sides, an armature extending between said pole-pieces, a coil associated with said magnet, a rotor substantially concentric with said arcuate sides and having spaced magnetic peripheral portions in proximity thereto, a pivoted support for said rotor, and adjustable means engaging said support for rocking

said support about its pivot to accurately center said rotor with said arcuate sides.

6. A signaling device comprising a magnet, juxtaposed pole-pieces each including spaced parallel projections having arcuate sides and pole tips, the corresponding arcuate sides of said pole-pieces being substantially concentric, a rockable support, a pair of coaxial rotors mounted on said support and having spaced magnetic peripheral portions, each of said rotors being in substantial alignment with a pair of said corresponding arcuate sides, and means for tilting said support to position said rotors coaxially with said arcuate sides.

7. A signaling device in accordance with the next preceding claim comprising resilient means acting in opposition to said tilting means and urging said rotors toward said arcuate sides.

GEORGE E. ATKINS.