July 7, 1936. J. R. POWER 2,046,698

SIGNALING DEVICE

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FIG. 3

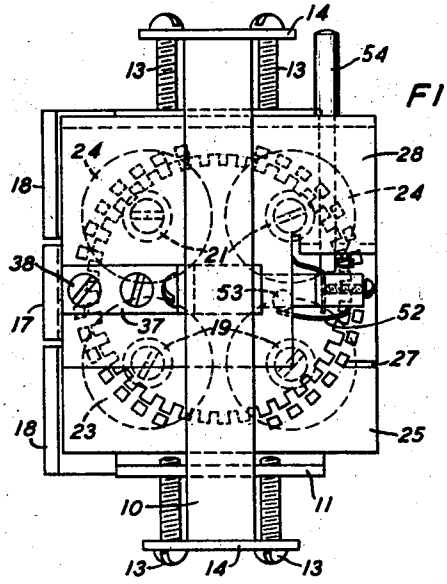


FIG. 4

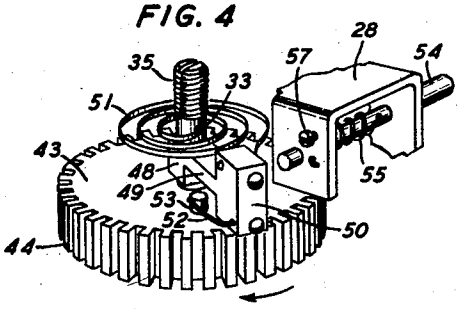


FIG. 2

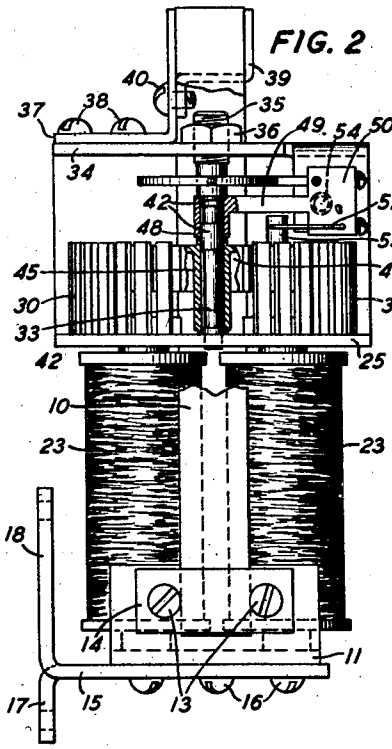
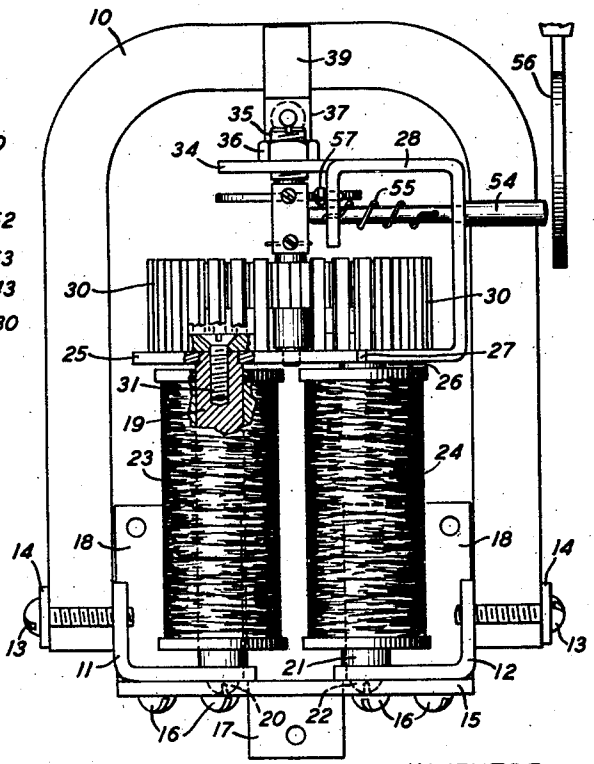


FIG. 1



INVENTOR
J. R. POWER
BY
Walter C. Kiesel
ATTORNEY

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SIGNALING DEVICE

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FIG. 5

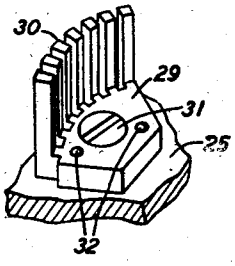


FIG. 6

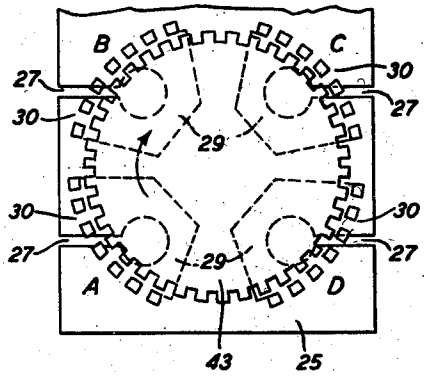


FIG. 7

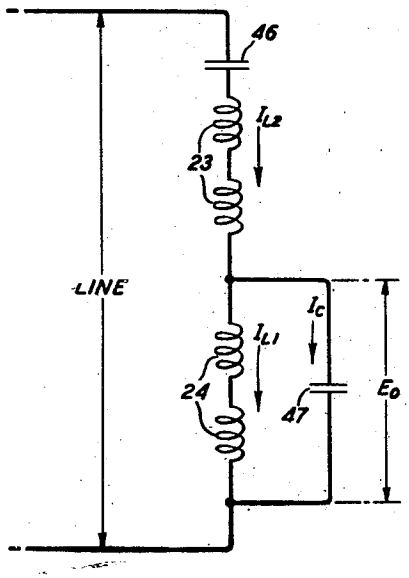
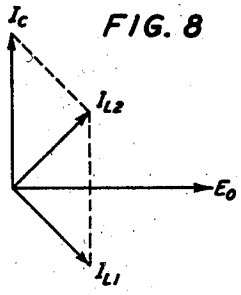


FIG. 8



INVENTOR
J. R. POWER
BY
Walter C. Kiesel
ATTORNEY

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UNITED STATES PATENT OFFICE

2,046,698

SIGNALING DEVICE

James R. Power, Madison, N. J., assignor to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York

Application September 28, 1932, Serial No. 635,163

9 Claims. (Cl. 177—7)

This invention relates to signaling devices and more particularly to alternating current ringers for telephone substations.

An object of this invention is to improve the efficiency and operating characteristics of signaling devices.

In one embodiment illustrative of this invention, an alternating current ringer comprises a synchronous motor adapted to be operated by the ringing current. A percussion member is loosely mounted upon the shaft of the motor and is disposed in operable relation to a clapper for actuating a signaling member such as a gong. The percussion member is connected to the shaft by a retractile spring and is associated with the rotor of the motor by a clutch, the operation of which is controlled by the retractile spring.

When an excitation or ringing current is applied to the motor, the clutch automatically locks the percussion member to the rotor so that the latter revolves with the rotor in one direction and tensions the retractile spring. When the energy in the spring has reached a predetermined amount, the clutch releases and the percussion member is revolved at high velocity in the opposite direction and impinges upon the clapper of the signaling member. The clutch thereupon again locks the percussion member to the rotor and the sequence of operations is repeated.

The motor and spring are preferably so designed that the rotor will revolve at a relatively low speed and that the signaling member will be actuated at relatively widely separated intervals.

The percussion member is also preferably so constructed that the point of striking of the member and the clapper is coincident with the center of percussion of the member.

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

Fig. 1 is a front view in elevation of a ringer constructed in accordance with this invention with parts broken away to show details of construction;

Fig. 2 is a side view, partly in section and partly broken away, to show the shaft and the bearings for the rotor;

Fig. 3 is a top plan view of the ringer shown in Figs. 1 and 2;

Fig. 4 is a perspective view showing the association of the rotor, percussion member and the clapper of the ringer;

Fig. 5 is an enlarged perspective view of one of the stator pole pieces;

Fig. 6 illustrates the relation of the rotor and stator segments;

Fig. 7 is a schematic view of the connections of the motor embodied in a ringer in accordance with this invention; and

Fig. 8 is a vector diagram showing the phase relation of the voltage and current in the stator of the motor.

Referring now to the drawings, an alternating current ringer illustrative of one embodiment of this invention, comprises a U-shaped permanent magnet 10 and flanged pole pieces 11 and 12 which are secured to the arms of the magnet by bolts 13 extending through clamping bars or bands 14. A non-magnetic plate 15, which may be of brass, is secured to the pole pieces 11 and 12 by bolts 16, and is provided with oppositely directed flanges 17 and 18 for mounting the ringer. A pair of magnetic cores 19 are secured to the pole piece 11 by bolts 20. Another pair of magnetic cores 21 are secured to the pole piece 12 by bolts 22 and extend parallel to the cores 19. Excitation coils 23 and 24 are mounted upon the cores 19 and 21 respectively, and are electrically connected in series as shown schematically in Fig. 7 so that the coils in each pair are of opposite polarity.

A non-magnetic plate 25, which may be of brass, is seated upon the adjacent ends of coils 23 and 24 and is provided with a plurality of apertures through which the cores 19 and 21 extend. The plate member 25 is further provided with a plurality of slots 27 to reduce eddy currents in the plate, and is formed with an inverted L-shaped bracket 26.

A plurality of magnetic members, one for each of the cores 19 and 21, are mounted upon the plate 25, and, as shown more clearly in Fig. 5, consist of a segmental base portion 29 and a plurality of milled teeth or segments 30 arranged on the arc of a circle. These magnetic members comprise the pole pieces of the stator of the motor. The base 29 of each pole piece is secured to the corresponding core by a machine screw 31 threaded into the core and is secured to the plate 25 by rivets 32.

A stationary shaft 33 extends between the plate 25 and an arm 34 on the flange 26, and is provided with a threaded portion 35 at one end which extends into a bore in the arm 34 and has threaded thereon a lock nut 36. A bracing bracket 37 is secured to the arm 34 by machine screws 38, and to the magnet 10 by a clamping

bracket 39 secured to the bracket 37 by a bolt 40. The shaft 33 is also provided with spaced enlarged portions 42 which form bearings for a rotor and a percussion member.

The rotor, as shown more clearly in Fig. 4, comprises a flat, circular disc 43 concentrically disposed within the teeth or segments 30 of the stator and provided with circumferential teeth or segments 44, the spacing of which is equal to the spacing of the teeth 30 of the stator. The disc 43 is provided with a tubular hub 45 which engages the bearings 42 on the shaft 33. The relative disposition of the segments on the rotor and on the stator is illustrated diagrammatically in Fig. 6 in which the four groups of segments on the stator pole pieces are designated generally as A and B connected to the coils 23, and C and D which are connected to the coils 24. As shown in this figure, the rotor and the stator are so correlated that when the stator segments in one group, such as group A, are in alignment with the adjacent rotor segments, the stator segments in the adjacent group having the same magnetic polarity, such as group B, are in alignment with the interstices between the corresponding rotor segments. Following the diagram in a clockwise direction, the stator segments in group C are advanced a quarter pitch with respect to the corresponding rotor segments and the stator segments in group D are displaced a quarter pitch behind the corresponding segments of the rotor.

In the specific embodiment shown, the stator and the rotor constitute a two-pole, two-phase synchronous motor, the electrical connections of the stator of which are shown schematically in Fig. 7. As shown in this figure, the coils 23 and 24 are connected in series across the line together with a series condenser 46 for blocking direct currents. The coils 24 are shunted by a condenser 47 so that as indicated vectorally in Fig. 8, the current I_{L2} through the coils 23 leads the current I_{L1} through the coils 24 by approximately 90 degrees. The coils in each pair 23 and 24 are so connected that when the magnetizing force of one coil of a pair aids that of the permanent magnet 10, the magnetizing force of the other coil opposes that of the magnet. When an excitation current is applied to the coils, the rotor advances in step automatically and revolves at a speed equal to that of the stator field divided by the number of rotor segments. Assuming a point in the current cycle corresponding to the position of the rotor shown in Fig. 6, that is, when the current is at a maximum in the coils connected to the segments of groups A and B and a minimum in the coils connected to the segments of groups C and D, and in such a direction that the magnetizing force due to the current in coil A aids that of the magnet 10, the rotor segments in juxtaposition to the stator segments of group A are in alignment and the torque effective between the rotor and the stator segments of group A has reached a maximum, while the torque effective between the rotor and the stator segments of group B is a minimum. The only flux between the rotor and the stator segments constituting groups C and D is that of the permanent magnet 10 so that the torques effective between the rotor and the segments of groups C and D are counterbalanced. At the end of the next succeeding quarter-cycle the rotor has revolved in a clockwise direction so that the rotor segments are in alignment with the stator segments in group C, out of alignment with the segments in group D, and one-quarter pitch out of alignment with segments of groups A and B. At this point, the torque effective between the rotor and the segments of group C has reached a maximum while the torque effective between the rotor and the stator segments of group D is a minimum. The torques effective between the rotor and the stator segments of groups A and B are counterbalanced. On succeeding quarter-cycles the torque between the rotor and the stator segments of group B first reaches a maximum and finally the torque between the rotor and the stator segments of group D reaches a maximum.

A percussion member is loosely mounted upon the shaft 33 and includes a hub 48 which rests upon one end of the hub 45 of the rotor, an arm 49, and an enlarged head or hammer 50. The percussion member is connected to the shaft 33 by a spiral torsion spring 51 and is detachably coupled to the rotor by a spring clutch consisting of a featherspring 52 which is secured at one end to the head or hammer 50 and is adapted to be engaged at its free end by a stud 53 secured to the rotor disc 43. A push rod or clapper 54 extends slidably through the arms of the L-shaped flange 28 and is connected to one of the arms by a helical spring 55. The push rod or clapper is adapted to be struck by the head or hammer 50 of the percussion member to actuate a signaling member such as a gong 56, a stop member such as a set screw 57 being provided to limit the stroke of the head or hammer.

Inasmuch as substantially the entire energy of the spring 51 is expended in rotating the percussion member, a high mechanical efficiency is obtained. In order to further insure a high efficiency, the percussion member is preferably so proportioned that the point of striking between the head or hammer 50 and the push rod or clapper 54 is coincident with the center of percussion of the percussion member and also so that the mass of the hammer 50 is equal to the mass of the clapper 54.

The sequence of operations in the device described is as follows: When an alternating voltage is applied to the line, the rotor advances in step with the stator field and revolves, in the clockwise direction. The stud 53 engages the featherspring 52 and locks the percussion member to the rotor. As the percussion member revolves with the rotor, the spiral spring 51 is wound up to store up energy. At a predetermined point, depending upon the physical constants of the springs 51 and 52, the force exerted upon the percussion member by the spiral spring 51 becomes sufficient to disengage the spring 52 from the stud 53, whereupon the percussion member is revolved at high velocity in a counter-clockwise direction so that the head or hammer 50 impinges upon the push rod or clapper 54 to actuate the gong 56. The rotor continues revolving in a clockwise direction so that the stud 53 again engages the spring 52 and the sequence of operations is repeated.

The motor may, of course, be so constructed that the signal gong will be actuated at desired intervals. For example, the ringer shown and described may be operated on a 20-cycle ringing circuit in which the ringing current is applied for two seconds at four-second intervals. The motor is designed to have a speed of one-half

revolution per second so that the signal gong is actuated at six-second intervals.

Although a specific embodiment of this invention has been shown and described, modifications may be made, of course, 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 a rotor adapted to revolve in one direction only, means for revolving said rotor in said one direction, signaling means, an actuating member for said signaling means, a clutch connecting said actuating member to said rotor, and elastic means fixed at one end and fixedly coupled to said actuating member and operable when stressed to a predetermined degree to release said clutch and to revolve said member in the direction opposite to that of said rotor to actuate said signaling means.

2. A signaling device comprising a stationary member, a rotor, a mass member, a clutch for connecting said rotor and said mass member, signaling means, an elastic body coupled to said stationary member and attached to said mass member, and means for revolving said rotor and said mass member in one direction whereby energy is stored in said elastic body, said elastic body being operable to automatically release said clutch and to revolve said mass member in a direction opposite to the rotation of said rotor to actuate said signaling means, said clutch being operable upon continued rotation of said rotor in said one direction to reconnect said mass member and said rotor.

3. A signaling device comprising a shaft, a rotor and a percussion member rotatable on said shaft, signaling means associated with said percussion member, a torsion spring fixed at one end and connected to said percussion member and adapted to be stressed by rotation of said member, a clutch for locking said percussion member to said rotor, and means for revolving said rotor, said clutch being automatically releasable by a predetermined stress in said spring whereby said percussion member is operated to actuate said signaling means and being operable upon continued rotation of said rotor in said one direction to recouple said percussion member to said rotor.

4. A signaling device comprising a shaft, a rotor and a percussion member rotatable on said shaft, signaling means, a spring member secured to said percussion member and frictionally engaging said rotor, means for revolving said rotor and percussion member in one direction, and a retractile spring secured to said shaft and to said percussion member, adapted to be stressed by rotation of said member in said one direction, said retractile spring being effective when stressed to release said spring member from said rotor and to revolve said percussion member in an opposite direction to actuate said signaling means.

5. A signaling device comprising a motor including a shaft, a rotor mounted upon said shaft, a percussion member rotatable on said shaft, a spiral spring secured to said shaft and to said member, a stud carried by said rotor, a cantilever spring having one end secured to said member and the other end engaging said stud, said spiral spring being operable when stressed by rotation of said member in one direction to disengage one end of said cantilever spring from said stud and to revolve said member in an opposite direction, and signaling means actuable by said member.

6. A signaling device comprising a motor having a stator and a rotor revolvable in one direction only, a mass member adjacent said rotor, signaling means, means for coupling said mass member to said rotor, and an elastic member fixed at one end and connected to said mass member and adapted to be tensioned by rotation of said mass member and rotor in said one direction, said elastic member being effective when stressed to release said coupling means and to revolve said mass member in opposition to the rotation of said rotor to actuate said signaling means.

7. An alternating current ringer comprising a frame, a motor including a stator mounted on said frame, a stationary shaft supported on said frame, a rotor mounted on said shaft, a percussion member rotatable on said shaft, a signal gong, a spiral spring connected to said member and to said shaft adapted to be tensioned by rotation of said member and rotor in one direction, and a clutch for locking said member to said rotor, said clutch being operable by a predetermined stress in said spiral spring to release said percussion member from said rotor to actuate said gong and being also operable upon continued rotation of said rotor in said one direction to relock said member to said rotor.

8. A signaling device comprising a shaft, a rotor pivoted on said shaft, means for revolving said rotor in one direction, a percussion member pivoted on said shaft, a clutch connecting said rotor and said member, means operable to release said clutch and revolve said member in the direction opposite to that of said rotor, said clutch being operable to reconnect said rotor and said member upon continued rotation of said rotor in said one direction, and signaling means adapted to be struck by said member.

9. A signaling device comprising a signal gong, means including a rotatable member for actuating said gong, and means for revolving said member periodically in opposite directions including a motor having a rotor adapted to revolve in one direction only, a clutch for connecting said rotor to said member upon rotation of said rotor in said one direction, and spring means having a fixed portion and attached to said member and adapted when stressed by rotation of said rotor in said one direction to release said clutch, whereby said member is disconnected from said rotor, and to revolve said member in the opposite direction.

JAMES R. POWER.