March 19, 1935. R. M. CRITCHFIELD 1,994,574

SOUND SIGNAL

Filed April 18, 1927

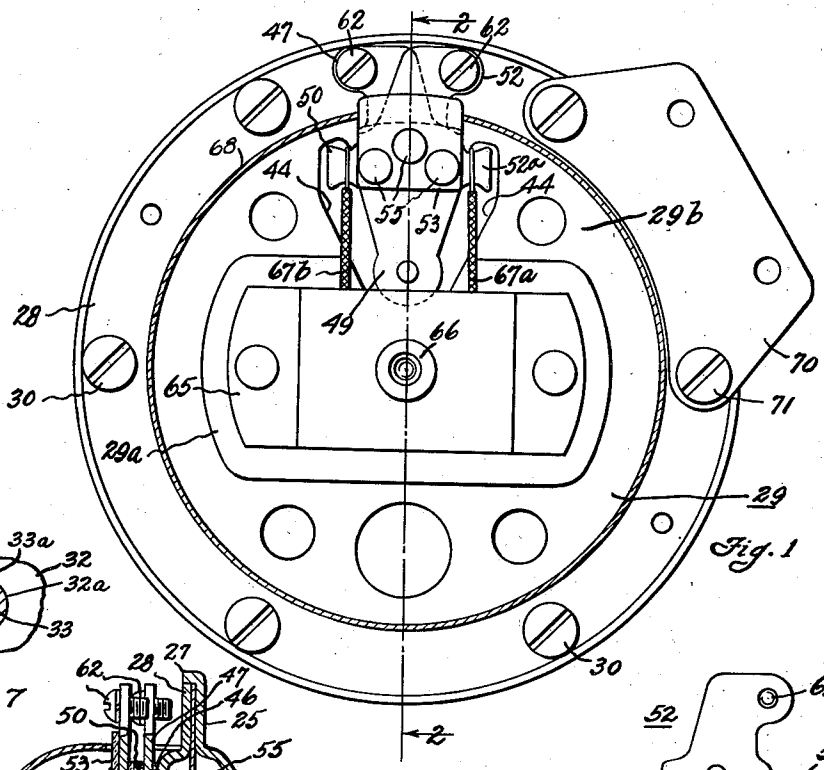



Fig. 1




Fig. 7

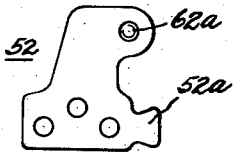



Fig. 3

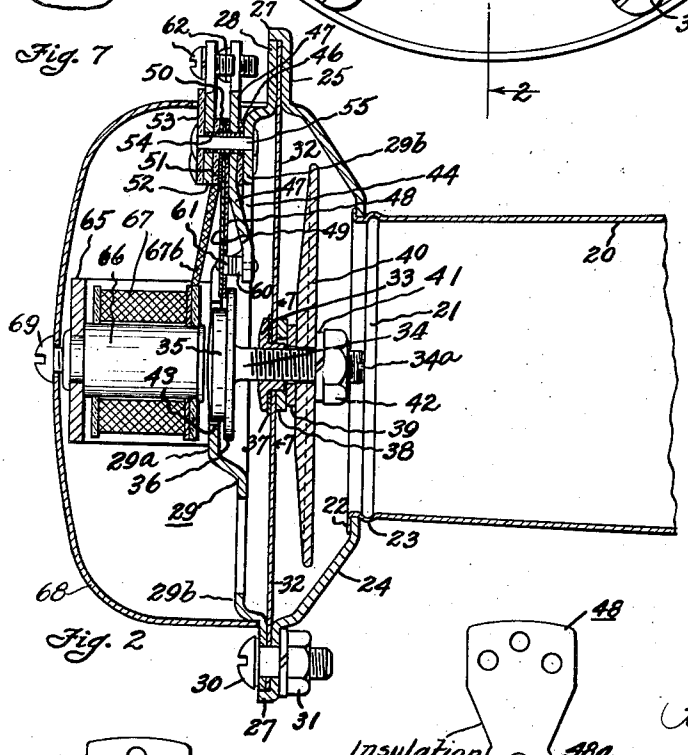



Fig. 2

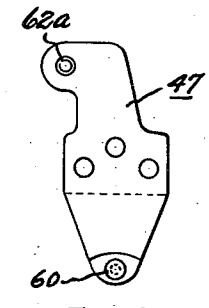



Fig. 4

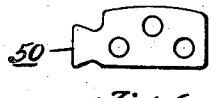



Fig. 6




Fig. 5

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## SOUND SIGNAL

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Application April 18, 1927, Serial No. 184,507

11 Claims. (Cl. 177—7)

This invention relates to improvements in electromagnetically operated sound signals for motor vehicles and the like, one of the objects of the invention being to simplify the construction of this type of signal in order to provide for economical production.

Another object of this invention is to improve and simplify the construction of the magnetic circuit of the diaphragm motor with the idea of obtaining only such movement of the diaphragm as will be conducive to the production of the best tone.

My copending application Serial No. 112,269 filed May 28, 1926, granted December 25, 1928 as Letters Patent No. 1,696,625, describes a magnetic circuit of similar character intended to produce only natural movement of the diaphragm; and the present invention is an improvement thereon intended to accomplish the desirable results referred to by a simpler construction.

These and other objects are accomplished by providing an air gap between the armature and pole piece, which air gap is constructed and arranged to carry a part of the flux from the pole piece to the core, and so as to be less sensitive to variation in manufacture and assembly of the contributing parts. In perfecting the improvement, an annular pole piece has been brought into cooperation and combination with a flanged armature assembly, whereby two gaps are formed between the armature and pole piece, that include a cylindrical gap lying between the edges of the armature and the annular pole piece, and a flat annular gap lying between the annular pole piece and an overhanging flange of the armature. Introduction of the cylindrical gap to carry a part of the flux from the annular pole piece to the core makes it possible to decrease the distance between the annular pole piece and the core without danger of the flux passing directly from the pole piece to the core. As a further result the area, the length, and the average diameter of the annular gap between the annular pole piece and the armature flange may be substantially decreased without affecting the proper movement of the diaphragm to produce a good tone. Moreover, the magnetic circuit is made more effective to increase the blow of the armature upon the core.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawing, wherein a preferred form of embodiment of the present invention is clearly shown.

In the drawing:

Fig. 1 is a rear view of the horn with the cover removed.

Fig. 2 is a section taken along the line 2—2 of Fig. 1.

Fig. 3 is a detail view of a terminal plate.

Fig. 4 is a detail view of the contact carrying terminal plate.

Fig. 5 is a detail view of insulator for the resilient contact arm which is of the same shape as this insulator;

Fig. 6 is a detail view of a terminal clip; and

Fig. 7 is a fragmentary sectional view on line 7—7 of Fig. 2.

Referring to the drawing, the numeral 20 designates the projector of the horn, having a throat portion 21 provided with an outwardly extending, annular flange 22. Adjacent the flange, the projector has an annular ridge 23, thus providing an annular channel in which one edge of the dish-shaped projector collar 24 is secured. An outwardly extending annular flange 25 forms a seat upon which the diaphragm 32 rests, said diaphragm being held in position by an annular edge 27 formed on the flange 25. The annular flange 28 of the motor base 29 fits within the edge 27 and engages the diaphragm 32, which, like the flanges 25 and 28 is apertured to receive screws 30 cooperating with nuts 31 for clamping the edge of said diaphragm between the flanges 25 and 28.

The diaphragm 32 is provided with an aperture 32*a* (see Fig. 7) which is a segment of a circle in shape. The aperture 32*a* receives a flanged nut 33 having a flat 33*a* on its shank. The nut 33 cooperates with the threaded shank 34 of an armature which includes a head 35 having an annular flange 36. The shank 34 extends through a thin washer 37, the diaphragm 32, washers 38 and 39, a resonator disc 40, a lock washer 41 and threadedly through a nut 42. The shank 34 has a screw driver slot 34*a*. If the nut 42 is loosened the shank 34 may be turned to adjust the distance between the armature head 35 and the end of a magnet core 66.

The motor base 29 made of magnetic material is dished, providing two portions lying in different planes, relative to each other and to the flange 28 of the motor base. The outer portion is designated by the numeral 29*a* and the portion lying in a plane between the outer portion and the flange 28 is designated by the numeral 29*b*. An aperture 43 is provided in the portion 29*a*, a portion thereof being coaxial with the armature head 35 and of such size that said head,

lying within the aperture, as shown in Fig. 2, is spaced a slight distance from the edge of the aperture. The flange 36 of the head is greater in diameter than the aperture and extends over a part of the inner surface of the portion 29*a*. This flange is properly spaced from the said portion by adjusting the armature shank relative to the diaphragm insert. From the aforegoing it may be seen that a path of substantial capacity is provided for the magnetic flux passing between the motor base and armature head.

Portion 29*b* of the motor-base is apertured at 44, being in fact an extension of the central aperture 43 as shown in Fig. 2. On the portion 29*b* is insulatingly mounted the circuit controller and its terminals. This circuit controller comprises the following elements arranged in superposed relation on the portion 29*b;* insulator 46, terminal plate 47 which supports the stationary contact 60, insulator lining plate 48 provided with an aperture 48*a* at its free end, resilient blade 49 of the same shape as part 48 and carrying the contact 61 extending through the aperture 48*a* and engaging the stationary contact 60, wire receiving clip 50, insulator 51, terminal plate 52 provided with a wire receiving portion 52*a* and insulating cover plate 53. All of these elements except plate 53 are apertured to receive insulating sleeves 54 which surround the rivets 55 which hold these parts in assembled relation. The resilient plate 49 and its insulating lining plate 48 extend into the path of movement of the armature so that the flange 36 will engage said insulating plate 48 to move the contact 61 out of engagement with the cooperating stationary contact when the armature is moved into its attracted position. Terminal plates 47 and 52 are each provided with wire attaching screws 62 at their outer ends the screw holes being shown at 62*a* in Figs. 4 and 5. The plate 47 is bent to extend into the aperture 44 so as to lie in the proper position for locating the contact 60 in engagement with the contact 61 when the armature flange 36 is held in unattracted position, by the diaphragm 32.

The motor-base 29 supports a yoke 65 of magnetic material to which the core 66 is attached so that the free end of the core is substantially coaxial with the armature shank and head. The core 66 is surrounded by an electromagnet winding 67 one end 67*a* of which is connected to the wire receiving portion 52*a* of the terminal plate 52, the other end 67*b* of which is connected to the wire receiving clip 50. The circuit between the terminal screws 62 is as follows: plate 47, contact 60, contact 61, blade conductor 49, plate 50, magnet coil end 67*b* magnet coil end 67*a*, terminal plate 52.

A cover 68 fits about the portion 29*b* of the motor base 29 and is held thereon by a screw 69 extending through an aperture in the cover and into a tapped hole in the core 66.

A horn mounting bracket 70 is secured to the flanges 25 and 28 by screws 71 used to clamp the diaphragm 32 between these flanges.

It will be noticed that the armature head 35 is substantially greater in diameter than the core 66 and that it is movable within the aperture 43 in the base portion 29*a* in closely spaced relation to the edge of the base portion, so that a portion of the armature head 35 substantially interrupts the direct line between the nearest parts of the core 66 and the pole piece 29*a*. Thus, though there may be some fringing out of the lines of flux between the core and pole piece, they will all pass over by way of the head 35. In so doing, the magnetic flux crosses two gaps between the part 29*a* and the armature namely, the cylindrical gap between the part 29*a* and the armature head 35 and the annular gap between the part 29*a* and the armature flange 36. The combined area of these two gaps is much greater than the area of the axial gap, or that gap between the head 35 and the core 66. Therefore the flux density across the axial gap between the head 35 and the core 66 is much greater than across the other two gaps. The magnetic pull across the cylindrical gap between the part 29*a* and the head 35 is at right angles to the movement of the head 35 and hence does not increase as the head 35 moves toward the core 66 nor does it contribute anything to the pull upon the diaphragm. A part only of the total flux in the circuit is directed across the annular gap between the part 29*a* and the armature flange 36, but this is available, due to the reduced width of the annular gap to materially aid the magnetic pull upon the armature and becomes most effective near the end of the stroke when the flange 36 approaches the part 29*a*, to increase the blow given by the armature to the core that causes the resonate disc to produce a good ringing tone. It will be observed, too, that the axial gap is less in width than is the width of the annular gap, so that the armature head always strikes the core member before the flange 36 can engage the part 29*a*. Due to the introduction of the cylindrical gap that is of narrow extent and of considerable relative area, and across which part of the flux between the armature and part 29*a* is directed, the flux crossing the wider annular gap of relatively great area will be ineffective to tilt the diaphragm out of its line of proper movement. There are a number of elements contributing to this result; one of which is that there is less total flux crossing the annular gap; another is that there is a small percentage of decrease in width of the gap for the same angle of tilt of the armature flange; and still another is, that there is a short moment arm through which the flux across the annular gap can operate to tilt the diaphragm.

Therefore, if the flange 36 is slightly closer to the part 29*a* at one point than at a point diametrically opposite, it is clear that the tendency to pull the diaphragm in a direction oblique to its axis will be very slight. This tendency will be overbalanced by the tendency of the core to attract the head in a direction at right angles to the plane of the diaphragm, particularly since the axial gap between the head 35 and the core 66 is shortest at the axis of these parts and carries the total flux, while the annular gap and the cylindrical gap each carry only a portion of the total flux. As a result, the pull upon the diaphragm is substantially always at right angles to the plane of the diaphragm. By pulling on the diaphragm only in a direction at right angles to its plane, the diaphragm is caused to vibrate in a natural manner and to produce sound vibrations pleasing to the ear. If the diaphragm were pulled from its center in a direction oblique to the normal movement of its center, it would set up vibrations producing a disagreeable noise.

While the form of embodiment of the present invention as herein disclosed, constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. In a sound signal the combination comprising, a motor base supporting a magnet motor,

a diaphragm supporting an armature to be actuated by the magnet motor, said base being apertured coaxially with the core of said magnet, said armature having a main head portion protruding through the said base in close juxtaposition to the magnet core and having a peripheral portion overlying a portion of the base adjacent said aperture, the air gaps between the magnet core, and armature head and between the base and armature flange being so evaluated as to shunt the major portion of the magnetic flux through the head of said armature during actuating of the magnet motor.

2. In a sound signal having a vibratory motor including a magnet and core, the combination comprising, a base apertured coaxial of the core of said magnet and providing a pole piece, and a flanged armature having a head portion disposed within and substantially filling said aperture, said armature having a flange overlying a portion of the base about said aperture, the air gap between the base and armature head portion being substantially constant such as to maintain substantially equal flux phenomena through that path during energization of said magnet motor, said apertured base and flanged armature providing means for shunting the magnetic flux in the return path through the head of said armature and distributing it over an air gap of considerable area.

3. In a sound signal having a magnet motor, a vibratile diaphragm, and an armature mechanically tied to the diaphragm for operating the same, the combination comprising, a field member overlying said motor and apertured coaxially of the core, said armature having a cylindrical head telescopically and centrally disposed in said aperture, the field member and armature head providing a tubular air gap of relatively small spacing, a flange secured to the armature head and extending over the body of the field member but spaced therefrom to provide an annular air gap of greater spacing than the tubular gap, the relation of the air gaps being such as to shunt the greater portion of the magnetic flux between the field member and the armature across the tubular gap.

4. In a sound signal, the combination comprising, a linearly movable armature having a substantially cylindrical head portion, said head portion having an arcuate end surface; an armature disc adjacent the head portion and concentric therewith; a magnet motor having a core and yoke providing flux paths for the motor magnet flux, said core having a surface adjacent the arcuate surface of the said head portion and substantially concentric therewith, said yoke having a substantially cylindrical opening within which said head portion is mounted and moves axially of the opening, said yoke having a surface adjacent said disc and spaced therefrom, said head portion and disc and the spaces between said yoke and head portion and yoke and disc being so proportioned that the major portion of the magnet motor flux in the return path crosses the space between the head portion and yoke to thereby diminish the magnetic pull on the armature head portion across the space between the yoke and armature disk.

5. In a sound signal of the vibratory type wherein a diaphragm forms the sole support for a movable armature, and in which a magnet motor is effective upon the armature to produce oscillation of the diaphragm, means for minimizing cocking of the diaphragm, said means including, an armature extension having a plane flange, a base plate fixedly supporting the motor and diaphragm, and apertured to receive the armature extension in closely spaced relation, said armature flange being of greater diameter than the aperture of the base plate to overlap a portion thereof, and means associating the base plate and armature assembly so that a greater flux density will obtain across the gap between the armature extension and base plate than across the gap between the armature flange and base plate.

6. In a sound signal having a magnet motor providing a core, a vibratile diaphragm, and an armature carried by and spaced from the diaphragm, the combination comprising, a substantially circular pole piece surrounding the armature in closely spaced relation and cooperating with the armature to complete a substantially continuous path of magnetic material for the motor flux path, a radially extending flange secured to the armature and greater in diameter than the pole piece to lay in spaced relation over an annular portion of the pole piece, the spacing of the pole piece and armature forming a cylindrical gap, and the spacing of the pole piece and flange forming a plane annular gap adjacent to and at right angles to the cylindrical gap, and the relation of the two said gaps being such that the cylindrical gap will be substantially of constant and of relatively dense magnetic flux, while the annular gap will be of variable and of relatively less dense magnetic flux, the flux across the annular gap increasing near one extreme of the armature travel to add to the force with which the armature strikes the core.

7. In a sound signal having a magnet motor providing a core, a vibratile diaphragm, and an armature carried by the diaphragm and actuatable by the motor to strike the core, the combination comprising, means causing all of the magnetic flux to pass between the core and armature, means for completing a substantially continuous path of magnetic material for the return flux, and means for distributing the return flux over a plurality of gaps so that there will be little tendency to actuate the diaphragm in a direction other than normal to the plane of the diaphragm, said distributing means comprising a pole piece included in the return flux path closely disposed and equally spaced about the armature to form a cylindrical gap, and a flange on the armature overlapping the pole piece and spaced therefrom to provide an annular gap adjacent and at right angles to the cylindrical gap, the cylindrical gap carrying a larger portion of the return flux between the armature and pole piece, whereby the annular gap may be reduced in width to provide an added pull to the diaphragm during actuation without effecting the proper movement of the armature in striking the core.

8. In a sound signal of the vibrator type the combination comprising, a mounting plate apertured to provide a pole piece, a magnet motor including a core member attached to the pole piece to form a magnetic path, a diaphragm supported by the plate, a flanged armature carried by the diaphragm and having a main body portion disposed within the plate aperture to provide a tubular air gap of substantially constant magnitude, while the flange projects over the adjacent portion of the plate to provide an annular air gap of varying magnitude, the armature body being immersed in the flux path between the core member and pole piece, the relation of said air gaps being such as to reduce the reluctance of

said magnetic path, by shunting a small portion of the return flux across the gap of varying magnitude in aiding relation to the magnetic pull upon the armature, and shunting a major portion of the return flux across the gap of substantially constant magnitude.

9. In a sound signal of the vibrator type the combination comprising, a mounting plate apertured to provide a pole piece, a magnet motor including a core member attached to the pole piece to form part of a magnetic path, said core member being disposed on one side of said pole piece and substantially concentric to the aperture therein, a diaphragm, an armature supported by the diaphragm and having a portion centered within the aperture of said pole piece forming an axial gap with the core and a tubular gap of close spacing with the aperture wall, and a flanged portion extending over the pole piece forming an annular gap of greater spacing than the tubular gap, means to concentrate the pulling force of said magnet motor at the axis of said core member, the relation of the tubular and the annular gaps being such as to distribute the greater portion of the return flux across the tubular gap so that only a lesser portion of the return flux will be effective across the annular gap and in aiding relation to the pull upon the armature.

10. In a sound signal of the vibrator type the combination comprising, a mounting plate apertured to provide a pole piece, a magnet motor including a core member attached to the pole piece to form a magnetic path, a diaphragm supported by the plate, an armature carried by the diaphragm to be immersed in the flux path between the core member and pole piece, and having a head portion centered in and closely surrounded by the plate aperture to form a tubular air gap, and also having a flanged portion overlapping an annular portion of the mounting plate to form a plane-like air gap substantially at right angles to and adjacent to the tubular air gap, and means to confine the magnetic flux between the core and armature at the axis of said core, the relation of said head and flange with the pole piece providing means to divert the return path of said magnetic flux across a plurality of gaps, so that only a portion of the return flux is ineffective to assist the magnetic pull upon the armature.

11. In a sound signal of the vibrator type the combination comprising, a mounting plate apertured to provide a pole piece, a magnet motor including a core member attached to the pole piece to form a part of a magnetic path, an armature having a head portion insertable through said pole piece to lie in closely spaced relation and concentric with the wall of said aperture and a flange portion joining the head portion to extend radially over the pole piece about the aperture, so that the pole piece and armature portions will complete a substantially continuous path of magnetic material for the magnetic circuit and provide two angularly associated air gaps between the armature and pole piece, a diaphragm supporting the armature and maintaining it substantially coaxial of the pole piece aperture, means to concentrate the magnetic flux between the core member and armature at the axis thereof, the relation of the pole piece and armature portions being such as to direct the return flux across the angularly associated and adjacent air gaps, so that the gap between the armature head and pole piece will have the greater flux density and be of substantially constant value, and so that the gap between the pole piece and flange portions will be of lesser flux density due to the relative cross section and areas of both gaps.

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