Feb. 25, 1930. C. A. BOTTORFF 1,748,407

LOUD SPEAKER UNIT

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Fig. 1

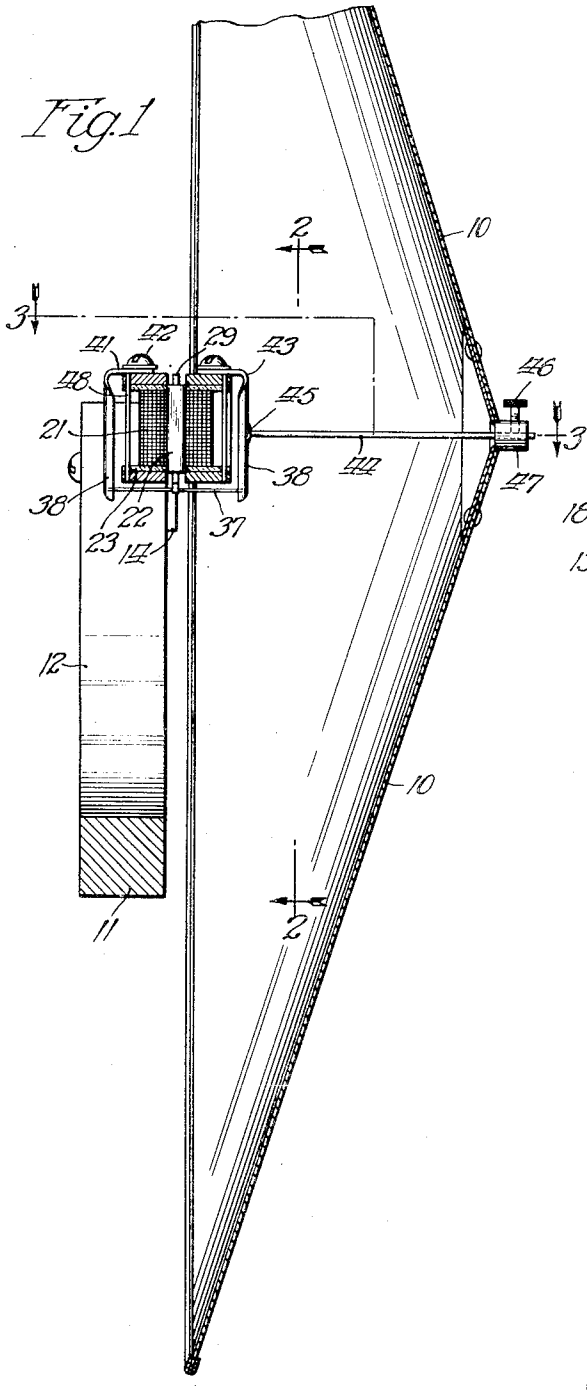
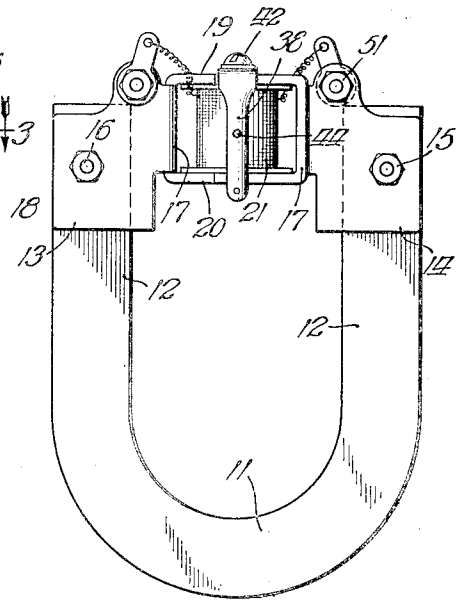


Fig. 2



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Fig. 3

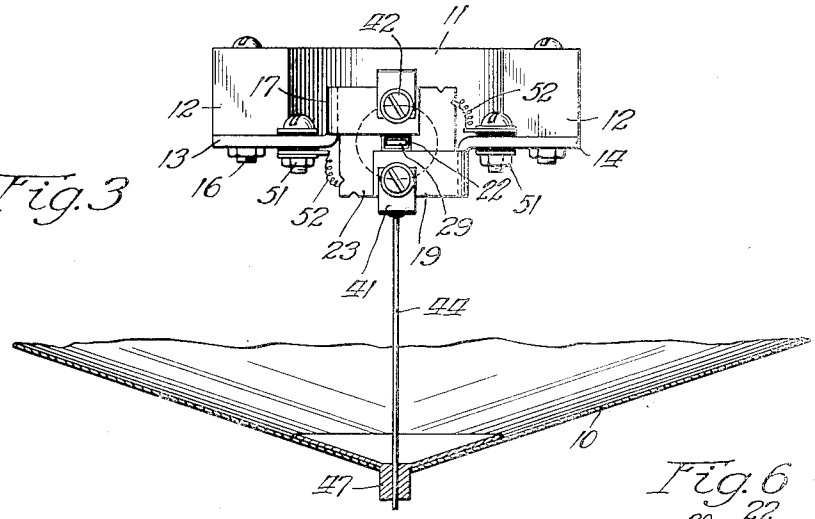


Fig. 6

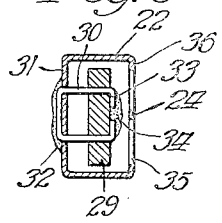


Fig. 4

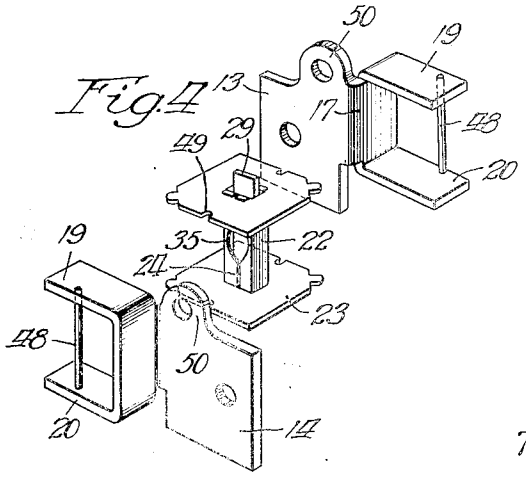


Fig. 5

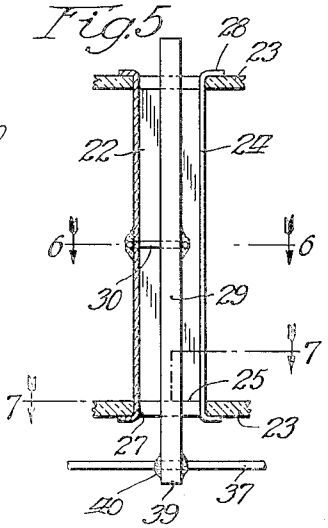
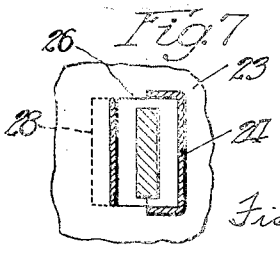


Fig. 7



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UNITED STATES PATENT OFFICE

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LOUD-SPEAKER UNIT

Application filed July 18, 1927. Serial No. 206,402.

The invention relates to improvements in loud speaker units. It is of particular value in connection with loud speakers of the "cone" type, although the construction may be employed in other types of telephones, the term "telephone" being used to include any electrical device designed to transform electrical current impulses or waves into sound.

The object of the invention is to provide a telephone unit of high efficiency, simple design, economical construction, quick accessibility, great durability, capable of being assembled cheaply, rapidly, and having the ability to withstand hard service.

In the drawings which illustrate a specific application of my invention to a cone speaker,

Fig. 1 is a vertical section through the structure, the supporting frame work being omitted,

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

Fig. 3 is a section taken on the line 3—3 of Fig. 1.

Fig. 4 is an explosion perspective showing the pole pieces and the spool in dissociated position.

Fig. 5 is a fragmentary axial section through the spool.

Fig. 6 is a section taken on the line 6—6 of Fig. 5, and

Fig. 7 is a section taken on the line 7—7 of Fig. 5.

Referring to the drawings, 10 represents the paper cone of the speaker and 11 represents an elongated horseshoe magnet of the permanent type. The limbs or poles 12 of the horseshoe magnet 11 are parallel and project upwardly as shown best in Fig. 2.

The poles 12 of the permanent magnet are made with corresponding side surfaces in a common plane so as to furnish co-planar supports for the flanges of the pole pieces 13 and 14. These pole-pieces are duplicates of each other, comprise stampings of magnetic iron or steel and are rigidly secured to the magnet poles 12 by means of bolts 15 and 16. Each of the pole pieces 13 is made with an extension 17 turned down at right angles to the flange portion of the pole piece and the said extension 17 has its extremities also bent at right angles so that said ends form spaced limbs 19 and 20. It will be observed that because of the manner of assembly of the pole pieces opposite each other on the limbs 12 of the permanent magnet 11, the limbed portions of said pole pieces overlap slightly at their adjacent ends and said limbed portions are spaced apart a distance substantially equal to the thickness of the sheet metal of which the pole pieces are constructed.

The coil or winding 21 by which the unit functions is made of a barrel 22 and a pair of ends or heads 23. The heads 23 are made of sheet bakelite and the barrel 22 is of sheet brass, folded into the form of a rectangular tube, the edges of the sheet being slightly separated to form an open seam 24.

In order to hold the heads 23 rigidly on the barrel 22 and to prevent inward sliding movement of the heads on the barrel, the heads have rectangular apertures therein, the length of the apertures being less than the external major dimension of the rectangular cross section of the barrel as shown best in Fig. 7, so that the ends 25 of the short sides of the rectangular barrel will abut against the inner faces 26 of the heads.

The rectangular apertures in the heads are, however, as to their width or minor dimension made wide enough to slip over the projecting ends 27 of the sides of the rectangular barrel 22, said extensions or projections 27 being made long enough to extend beyond the exterior surfaces of the heads so that they can be bent over at right angles as shown at 28 to prevent outward movement of the heads on the barrel.

The barrel 22 serves as an enclosure and support within which the armature 29 is pivotally mounted to cooperate with the spaced overlapping portions of the limbs of the pole pieces. Said pivotal mounting of the armature comprises a length of resilient wire secured in one side of the barrel 22 at the center thereof. As shown best in Figs. 5 and 6, the length of wire being originally U-shaped, has its spaced legs 30 inserted through apertures drilled or punched in the side 31 of the barrel, said legs 30 also extending through apertures in the armature spaced to correspond with the

spacing of the legs 30. After the armature 29 has been positioned or blocked in the center of the barrel, the wire staple is locked by soldering to the side 31 as shown at 32 and by bending over the ends 33 as shown, said ends being subsequently soldered to the armature 29 as indicated at 34. Access is provided through an opening 35 in the side 36 of the barrel, said opening being preferably merely an enlargement of the slit 24. After the staple has been locked to the barrel and to the armature, the blocking is removed and the armature is then free to vibrate within the barrel.

One end of the armature 29 projects from the barrel merely a sufficient distance to properly cooperate with the limbs of the pole pieces. The other end of the armature is made somewhat longer and is drilled to accommodate a wire 37 which connects the depending ends of a pair of spaced phosphor bronze springs 38. Said wire 37 is secured to the projecting end 39 of the armature by means of solder 40 and it is similarly connected to the depending ends of the phosphor bronze springs 38.

Said phosphor bronze springs 38 are made with attachment lugs 41 which are secured to the upper limbs 19 of the respective pole pieces by means of screws 42. The springs 38 are preferably curved in cross section through the major portion of their length so that there will be no substantial flexing of the same except at points 43 adjacent to the attachment lugs 41.

The vibrations transmitted to the armature 29, wire 37, and springs 38 are transmitted to the center of the cone 10 by means of a rod or wire 44, one end of which is soldered or otherwise secured at 45 to the center of one of the springs 38, while the outer end of said wire 44 is secured by means of a screw 46 in a hub 47 suitably mounted at the apex of cone 10.

An important feature of the invention resides in the manner by which assembly of the structure is rapidly and conveniently effected and in the ability of the various parts of the structure to accommodate themselves to mechanical inaccuracies and particularly inaccuracies in the relative positions of the pole pieces 13 and 14. It is well known that where permanent magnets are employed, it is necessary to do the machine work on same prior to the hardening and tempering process which may result in a slight warping or other distortion. To secure these desirable features, the spool is supported by and positioned in the pole pieces in the following manner:

Referring for example, to Figs. 1 and 4, it will be seen that the limbs 19 and 20 of each of the pole pieces are spaced apart to straddle and fit over the spool so that the latter cannot move or slide between the limbs 19 and 20 in a direction parallel with the spool axis. The spool is positioned as to other movement by means of the dowel rods 48 which extend through apertures drilled in the limbs 19 and 20 of the pole pieces and between the latter parallel with the axis of the spool. Said rods 48 are spaced radially from the axis of the spool and on opposite sides of the latter so as to avoid the winding 21 and fit in small notches 49 in the opposite edges of the heads 23.

It will be seen therefore, by inspection of the figures that when the parts are placed in proper assembled position, if there happen to be any slight inaccuracies of any of the parts of the structure, which would cause offsetting of the pole pieces, i. e. a displacement of their relative positions in a direction parallel to the flanges 13, the only result will be a slight pivotal action of the spool on the dowel rods 48 at a distance slightly less than the distance which is theoretically desired, when the pole pieces are bolted to the limbs of the permanent magnet, the dowel rods 48 will serve to clamp the spool rigidly and prevent any movement of the spool in a direction lateral of the spool axis.

Each of the pole pieces is formed with an apertured lug 50 to serve as a support for the insulated binding posts 51, to which the terminals 52 of the spool winding are connected in a well known manner.

The duplex arrangement of the springs 38 has some advantages over the ordinary simple single spring arrangement of former devices of this character. I have found that with punched springs the characteristic of the spring when flexed from its normal position in one direction, differs substantially from the characteristic of the spring when it is flexed in the other direction from normal position. For this reason, a punched spring has a variable characteristic throughout its range of movement between its extreme positions of flexing. In the construction herein shown this difficulty, which is found to interfere somewhat with the tone of the instrument, is overcome by employing two punched springs on opposite sides of the armature, the springs being reversed in position so that the variations in the spring characteristic of the respective springs cancel each other.

The duplex spring arrangement also furnishes a somewhat better support than if a single spring is used and it enables somewhat more flexible springs to be employed than in the case of a single spring. The parts are also more easily held in position.

It will be seen that the unit is constructed of a comparatively small number of parts and such parts are of simple form capable of being constructed rapidly and economically. The assembly of the structure may be effected with corresponding ease and economy and

without the necessity of employing special high priced skilled operators.

The details of construction being illustrative of only a single form of the invention, the scope of the invention should be determined by reference to the appended claims which are to be construed as broadly as possible, consistent with the state of the art.

I claim as my invention:

1. In a telephone, the combination of a magnet, a winding, a spool for said winding, having a tubular barrel with heads rigidly mounted on said barrel, an armature pivotally mounted within the barrel and having its ends protruding therefrom, pole pieces respectively mounted on the poles of the magnet and each provided with a pair of limbs spaced to include, fit over the ends of, and serve as a support for the spool, the limb portions of said pole pieces extending inwardly from the respective poles of the magnet into mutually overlapping relation, said overlapping pole pieces being spaced properly to co-operate magnetically with the ends of the armature, and means carried by said limbs having pivotal engagement with said spool ends for locking the spool against movement laterally relative to the axis of the spool, said pivotal engagement serving to facilitate mounting of the coil and pole pieces on the poles of said magnet with the axis of the spool properly positioned relative to the pole pieces.

2. In a telephone, the combination of a magnet, a winding, a spool for said winding, having a tubular barrel with heads rigidly mounted on said barrel, an armature pivotally mounted within the barrel and having its ends protruding therefrom, pole pieces respectively mounted on the poles of the magnet and each provided with a pair of limbs spaced to include, fit over the ends of, and serve as a support for the spool, the limb portions of said pole pieces extending inwardly from the respective poles of the magnet into mutually overlapping relation, said overlapping pole pieces being spaced properly-to co-operate magnetically with the ends of the armature, and means respectively provided on the spool and the pole pieces for positioning the axis of the spool.

3. In a telephone, the combination of a magnet, a winding, a spool for said winding, having a tubular barrel with heads rigidly mounted on said barrel, an armature pivotally mounted within the barrel and having its ends protruding therefrom, pole pieces respectively mounted on the poles of the magnet and each provided with a pair of limbs spaced to include, fit over the ends of, and serve as a support for the spool, the limb portions of said pole pieces extending inwardly from the respective poles of the magnet into mutually overlapping relation, said overlapping pole pieces being spaced properly to cooperate magnetically with the ends of the armature, and means respectively provided on the spool and the pole pieces for positioning the axis of the spool and locking the latter against rotation.

4. In a telephone, the combination of a magnet, a winding, a spool for said winding, having a tubular barrel with heads rigidly mounted on said barrel, an armature pivotally mounted within the barrel and having its ends protruding therefrom, pole pieces respectively mounted on the poles of the magnet and each provided with a pair of limbs spaced to include, fit over the ends of, and serve as a support for the spool, the limb portions of said pole pieces extending inwardly from the respective poles of the magnet into mutually overlapping relation, said overlapping pole pieces being spaced properly to cooperate magnetically with the ends of the armature, and means respectively provided on the spool and the pole pieces for poistioning the axis of the spool and locking the latter against rotation, said axis positioning means comprising separate parts spaced radially in opposite directions from the axis of the spool and each permitting a pivotal movement of the spool on each pole piece around said part, thereby to permit assembly of the structure with the pole pieces at different distances apart.

5. In a telephone, the combination of a permanent magnet, provided with pole pieces, an armature adapted to vibrate between said pole pieces, a winding surrounding the armature, two similar springs each secured to one of the pole pieces, and straddling the winding, and means connecting the armature and the ends of the springs for causing said last mentioned three parts to move in the same direction.

6. In a telephone, the combination of a permanent magnet provided with pole pieces, an armature adapted to vibrate between said pole pieces, a winding surrounding the armature, two similar L-shaped springs oppositely disposed with their limbs substantially parallel, extending over outside of and at opposite sides of the winding and being secured to the pole pieces, and inextensible means connecting the end of said armature and the ends of the springs for causing said last mentioned three parts to move substantially in line and in the same direction.

7. In a telephone, the combination of a permanent U-shaped magnet, an electric coil unit including an armature, and means for mounting said coil unit on said magnet comprising a pair of like pole pieces, respectively including flange portions adapted to be positioned against coplanar faces of the respective poles of said magnet, each pole piece having a limb offset laterally from the plane of its flange and extending in the direction of the latter for supporting said coil unit, the respective limbs of said pole pieces extending

into mutually overlapping relation and serving as extensions of the respective poles of said magnet between which extensions said armature is actuated.

8. In a telephone, the combination of a magnet, a winding, a spool for said winding including a tubular barrel and heads mounted on said barrel, a pivotally mounted armature extending through said barrel and having its ends protruding therefrom, pole pieces respectively mounted on the poles of said magnet and each provided with a pair of limbs spaced to include, fit over the ends of and serve as a support for the spool, the limb portions of said pole pieces extending inwardly from the respective poles of the magnet into mutually overlapping relation, said overlapping pole pieces being spaced to cooperate magnetically with the ends of the armature, and means carried by said pole pieces for engaging peripheral portions of said spool heads for positioning the axis of the spool.

July 15, 1927.

CHARLES A. BOTTORFF.