Dec. 26, 1933. D. G. BLATTNER 1,941,073

PNEUMATIC SOUND REPRODUCER

Filed Aug. 12, 1931

FIG. 1

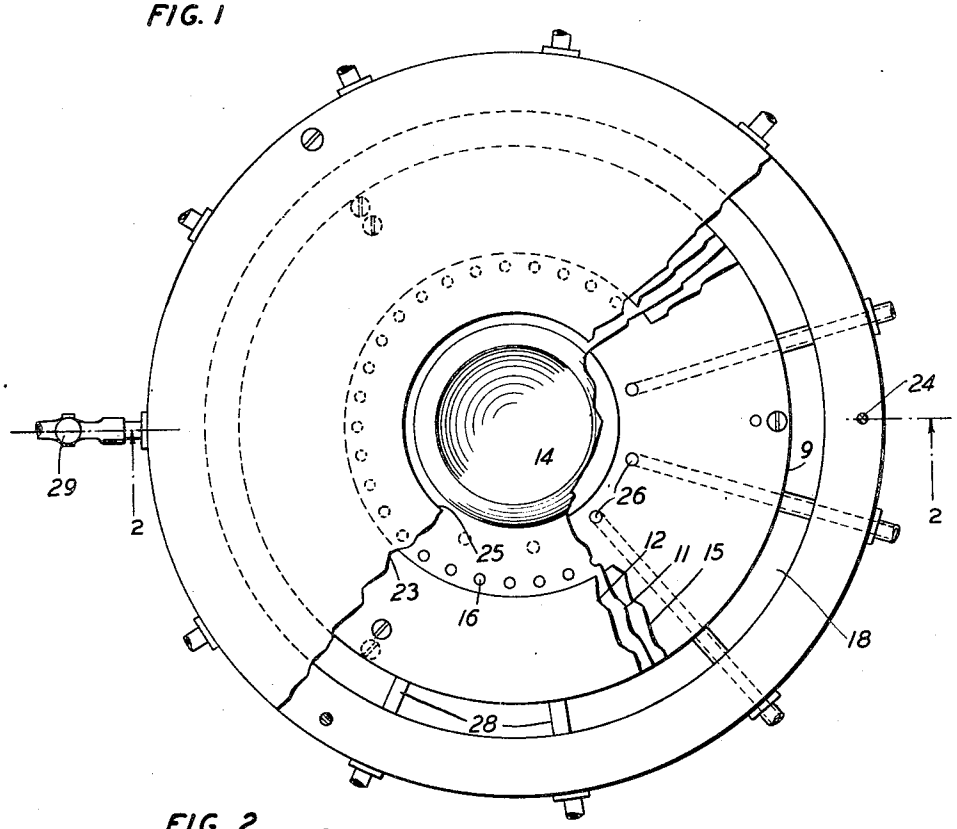


FIG. 2

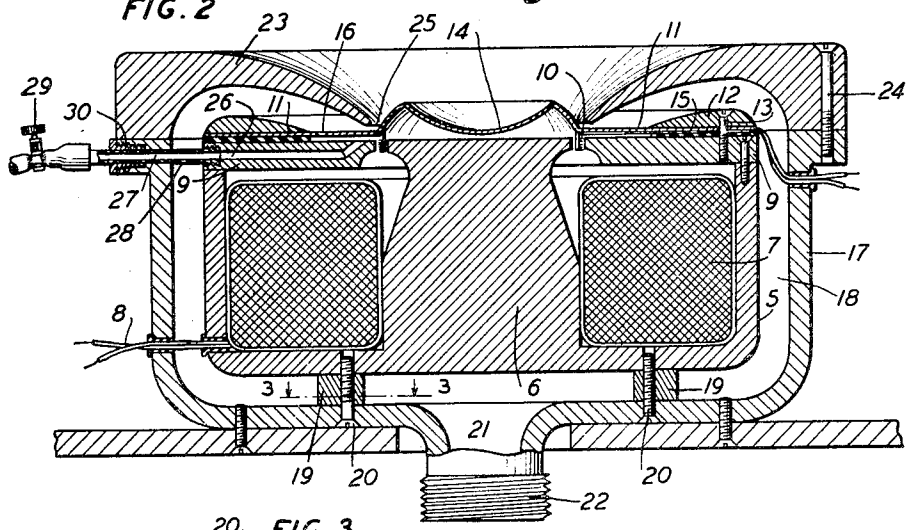
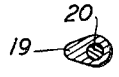


FIG. 3



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PNEUMATIC SOUND REPRODUCER

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13 Claims. (Cl. 179—108)

This invention relates to improvements in sound reproducing devices and particularly to such devices employing vibratory elements to modulate fluid streams for producing large volumes of sound.

An object of this invention is to reproduce sound with great volume and purity of tone.

One of the features of the invention resides in combining a loud speaker and a pneumatic amplifier so that the fluid stream is modulated by and in accordance with the vibrations of the loud speaker diaphragm in order to produce a great volume of sound.

In accordance with another feature of the invention a part of the air stream is by-passed to the back of the diaphragm and fluid ducts are led therefrom to the open air, their exits being adjustable to control the balance of the diaphragm by controlling the pressure on the rear thereof.

Specifically, one embodiment of the invention provides a loud speaker of the electrodynamic type having a diaphragm, the marginal portion of which is perforated and covered by an annular plate spaced therefrom to form an air duct having an annular exit defined by the inner periphery of the plate and the diaphragm, and an annular pole piece having air ducts communicating with the chamber back of the diaphragm opposite the annular exit, these ducts being led through the outer wall of the case and terminated in valves for the purpose of controlling the pressure on the rear of the diaphragm.

Prior sound reproducing devices making use of a fluid stream such as air under pressure for obtaining a great volume of sound depend principally, if not wholly, upon the modulation of the fluid stream by a non-sound producing valve for their efficiency. These depend for their proper functioning upon maintenance of a high pressure and a high velocity fluid stream at the valve output which produce a hissing noise especially annoying at low intensities of sound.

In accordance with the present invention the fluid stream is modulated by the diaphragm of a loud speaker which is capable of producing a large volume of sound itself. Great volumes of sound may therefore be reproduced at a comparatively low gas pressure and thus practically eliminate the hissing.

Referring to the drawing Fig. 1 is a front view of a sound reproducer embodying the invention, parts being broken away to show more clearly the structure;

Fig. 2 is a cross-section through the axis of the reproducer on line 2—2 of Fig. 1; and

Fig. 3 shows a section on line 3—3 of Fig. 2 of a stream-line spacer or support for the reproducer unit, used to separate the receiver unit and the outer housing to form an air duct.

The loud speaker unit comprises a cup-shaped member 5 having a central pole piece 6 around which is disposed the magnetizing winding 7, provided with terminals 8 adapted to be connected to a source of direct current energy. The winding chamber is closed by an annular pole piece 9 surrounding the pole piece 6 to provide an air-gap for a vibrating coil 10 carried by a diaphragm 11 which is secured to the pole piece by means of a clamping ring 12 and screws 13. An annular spacer 15 is provided between the diaphragm 11 and the pole piece 9 to provide the necessary separation. The diaphragm 11 has a rigid central portion 14 and a flexible annular portion, the latter being provided with a plurality of holes 16 equally spaced circumferentially.

Surrounding the receiver unit above described is another cup-shaped casing 17, the inside dimensions of which are such as to provide an annular space or passage 18 around the unit by supporting it therein in any suitable manner such as by means of the spacers 19 and screws 20. In the bottom of the external casing 17 is an opening 21 terminating externally in a threaded nipple 22 suitable for connection to a fluid supply such as an air compression system, not shown. The spacers 19 are preferably stream-line in cross-section as shown in Fig. 3. Covering the receiver unit is an annular cap 23 secured to the casing 17 by means of screws 24. This cap between its inner and outer peripheries has an annular concavity forming with the clamping member 12 and the diaphragm a continuation of the passage 18 which terminates in a restricted annular opening 25 defined by the edge of the opening in the cap 23 and the diaphragm, at which opening the air stream is modulated by vibrations of the diaphragm, the rigid or central portion of which projects through the opening in the cap.

For the most efficient operation of a reproducer of this type the diaphragm should be balanced against the static or constant pressure of the fluid stream. For this purpose the air stream is divided so that part of it flows on each side of the diaphragm. The holes 16 which are provided for this purpose should have ample area such that the air flowing therethrough will maintain a pressure on the back side equal to the difference between the static and the dynamic air forces on the front side. To facilitate in balancing the diaphragm, the annular pole piece 9 is provided with a plurality of radial ducts or channels 26, the inner ends of which terminate in equally spaced holes substantially opposite the exit 25 between the cap 23 and the diaphragm. In the casing 17 are also a corresponding number of holes 27 through which the ducts 26 may be extended by means of tubes 28, the outer ends of which are provided with valves 29. In order to make an air-tight joint between the tubes 28 and

the casing glands 30 are provided. The back pressure on the rear of the diaphragm may be readily adjusted by means of valves 29.

The inner walls of the air duct leading to and especially in the proximity of the exit 25 are preferably stream-line in order to eliminate eddies in the air stream and prevent hissing noises. It will be noted that the structure herein described provides a chamber or conduit having a comparatively large cross-section in proximity to the modulating orifice 25. The velocity of the air is therefore comparatively low in this chamber which tends to prevent hissing noises at all intensities of sound.

What is claimed is:

1. A sound translating arrangement comprising a vibratory member, a magnet having a magnetic air-gap, a current conducting coil disposed therein and secured to said vibratory member, and a housing for said elements, the inner wall of said housing forming a fluid passageway with said magnet, said housing being provided at its lower portion with a fluid inlet opening and at its upper portion with a downwardly projecting portion whose extremity forms with the vibratory member an outlet from the fluid passageway.

2. In a sound reproducer and amplifier of the type in which a fluid stream is to be modulated in accordance with the sounds to be reproduced, a housing having a fluid inlet opening, a magnet disposed in said housing and spaced from the inner wall thereof to form a fluid passageway, said magnet having a magnetic air-grap a movable member and a stationary member in spaced relation, said fluid passageway terminating in the opening formed by said members, a current conducting coil disposed in said air-gap and secured to said movable member, and means for producing a fluid flow through said passageway.

3. In a sound reproducer, a magnet having a magnetic air-gap, a movable member supported by said magnet, a housing within which said magnet is disposed in spaced relation to the inner wall thereof to form a fluid passageway, said housing having a fluid inlet opening, a stationary member associated with said housing and extending over the peripheral portion of said movable member to form therewith a constrictable outlet for said fluid passageway, and a current conducting coil disposed in said air-gap and secured to said movable member.

4. A sound reproducer and amplifier as claimed in claim 2 in which the bounding surfaces of the fluid passageway are stream-lined.

5. A sound reproducing system comprising a diaphragm, a cup-shaped housing having a fluid inlet opening, a magnet having a magnetic air-gap, said magnet disposed in said housing in spaced relation to the inner wall thereof to form a fluid passageway, a current conducting coil immersed in said air-gap and secured to said diaphragm, an annular member secured to said housing and having a curved surface in spaced and juxtaposed relation to said diaphragm and forming therewith an outlet for said fluid passageway, and means to produce a fluid flow from said passageway.

6. In a reproducer and amplifier as claimed in claim 2, means for maintaining equal fluid pressures on each side of the movable member, said means comprising a plurality of fluid outlets in the peripheral portion of said movable member and a fluid duct extending through the magnet and housing to the atmosphere.

7. A sound reproducer comprising a sound transmitting diaphragm, electromagnetic means for actuating said diaphragm in accordance with sound wave vibrations, an annular cap for said diaphragm and forming therewith a passage for a fluid stream, said passage decreasing in area radially toward the center of said diaphragm.

8. A sound reproducer comprising a diaphragm, electromagnetic means for actuating said diaphragm in accordance with the sound to be reproduced, and an annular cap for said diaphragm and defining therewith an annular passage for fluid streams, said passage having a restricted but unobstructed annular exit defined by the inner edge of said cap and said diaphragm, the fluid stream being modulated at said exit by the vibrations of said diaphragm.

9. A sound reproducer comprising a diaphragm having a plurality of openings circumferentially disposed near the periphery thereof, electromagnetic means for actuating said diaphragm in accordance with the sound to be reproduced, a cap for said diaphragm having an opening therein exposing the center of said diaphragm to free air and forming with the marginal portion thereof a passage for a fluid stream, the exit of which is defined by the edge of the opening in said cap and said diaphragm.

10. A sound reproducer comprising a diaphragm having a plurality of openings circumferentially disposed near the periphery thereof, electromagnetic means for actuating said diaphragm in accordance with the sound to be reproduced, a cap for said diaphragm having an opening therein exposing the center of said diaphragm to free air and forming with the marginal portion thereof a passage for a fluid stream, the exit of which is defined by the edge of the opening in said cap and said diaphragm, and a plurality of conduits communicating with the rear of said diaphragm, said conduits having a combined cross-sectional area at least as large as said exit.

11. The combination of an electromagnetic loud speaker having a diaphragm capable of producing sound vibrations of great intensity with a pneumatic amplifier having an annular member the opening in which forms with said diaphragm an exit for a fluid stream directed radially toward the center of said diaphragm, and modulated thereby.

12. In a pneumatic amplifier a diaphragm having a central raised portion, electromagnetic means for actuating said diaphragm in accordance with the sound to be reproduced, and a cover in spaced relation to said diaphragm and forming therewith a duct for a fluid stream, said cover having a central opening into which the raised portion of said diaphragm projects.

13. In a pneumatic amplifier a diaphragm, electromagnetic means for actuating said diaphragm in accordance with the sound to be reproduced, and a perforated cap in spaced relation to said diaphragm and forming therewith an annular duct for a fluid stream, the circular sections of said duct decreasing in area toward the perforation in said cap.

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