Oct. 13, 1953 A. L. PITTINGER 2,655,566

EXPLOSION-PROOF ACOUSTIC DEVICE

Filed May 3, 1949

2 Sheets-Sheet 1

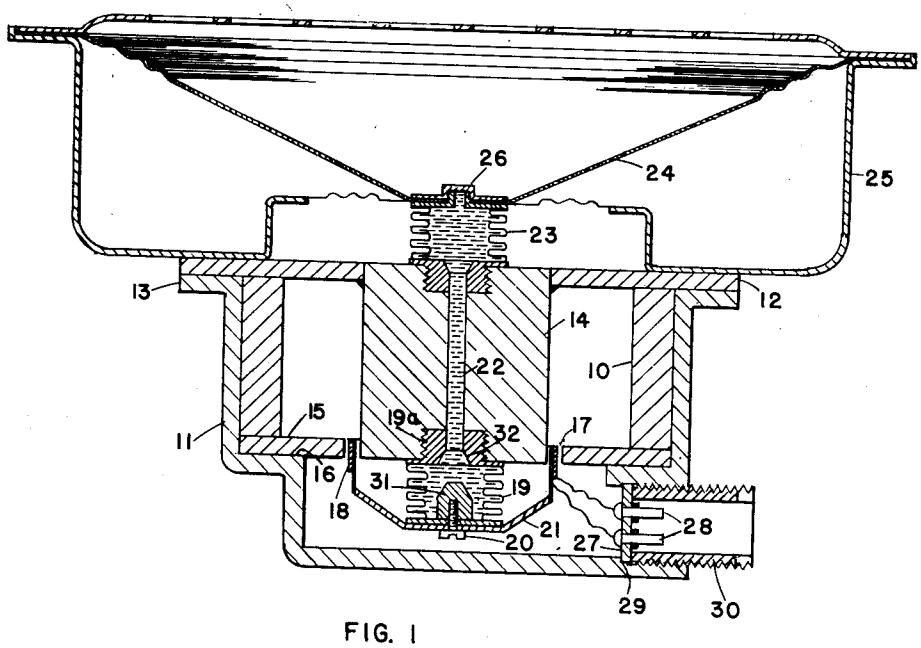


FIG. 1

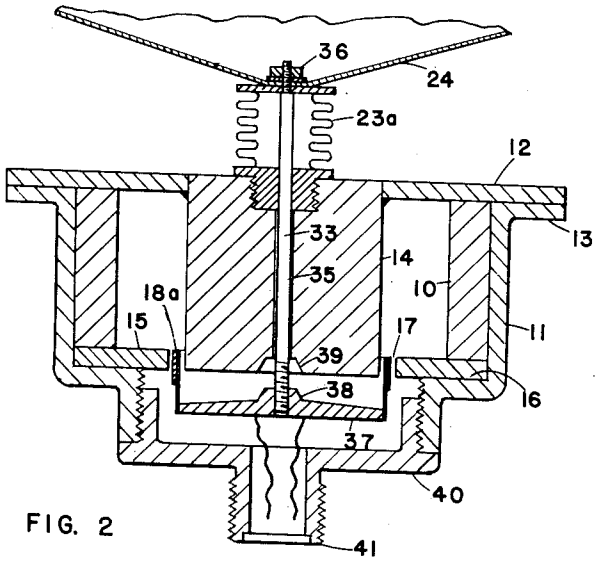


FIG. 2

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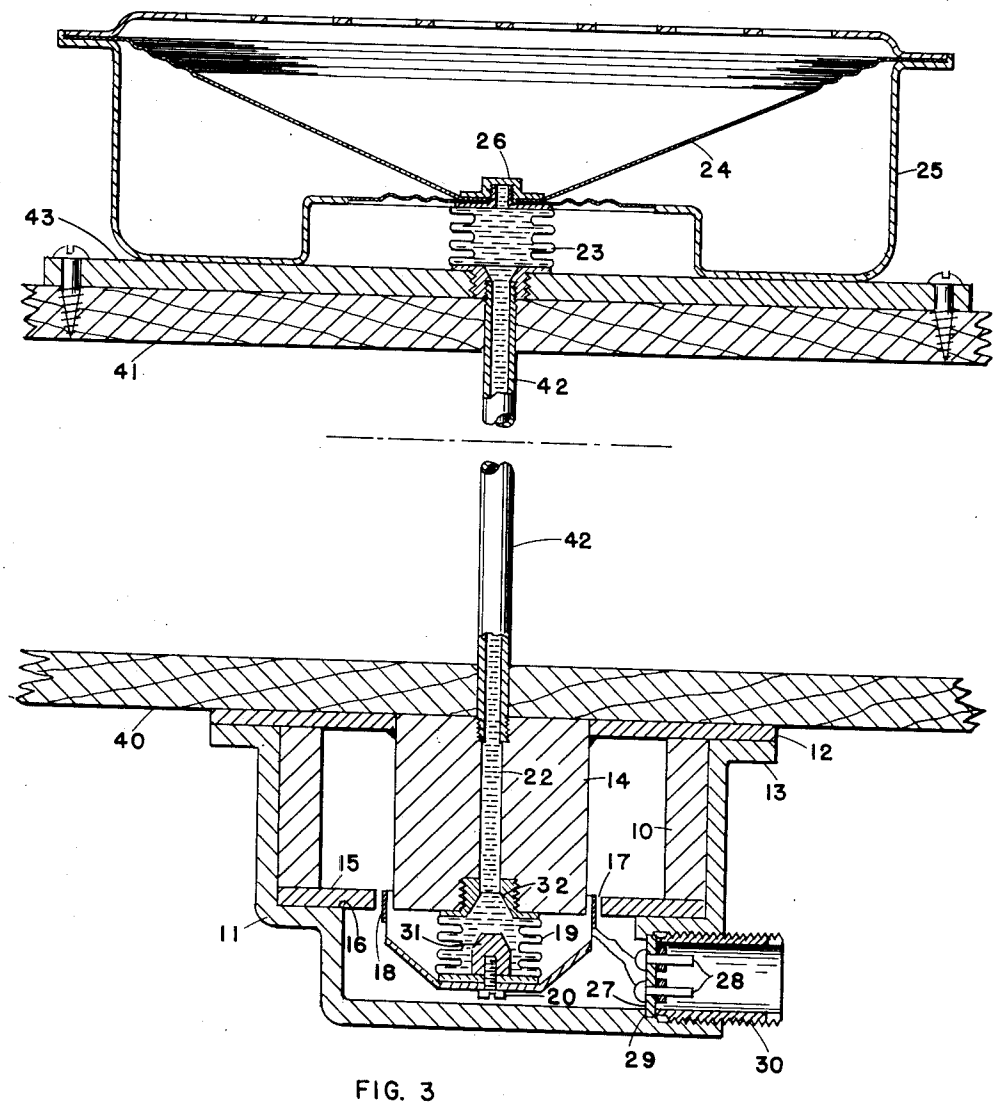


FIG. 3

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EXPLOSION-PROOF ACOUSTIC DEVICE

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Application May 3, 1949, Serial No. 91,207

9 Claims. (Cl. 179—115.5)

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This invention relates to transducers and more particularly to a new and improved construction thereof. The present invention has particular application to sealed transducers of the explosion proof type for use in hazardous areas.

In the design of apparatus for use in mines, powder magazines and similar installations where the atmosphere may be laden with dangerous gases, dust, vapors or liquids it is important that all electrical elements be shielded so that in the event there is any sparking in the electrical system, the resulting flame will be confined within the electrical instrument and cannot spread to the surrounding atmosphere. The problem of making such installations explosion proof without interfering with the efficiency or operation of such equipment is, of course, an extremely important consideration.

With the advent of public address systems in factories, warehouses, etc., a particular problem has arisen in connection with the design of loudspeakers for such systems especially where the devices are to be used in industries where the aforementioned hazardous conditions are present.

The conventional phenolic diaphragm speakers do not meet the rigid safety requirements for such installations. This is true even though the electrical elements may be mounted in a closed speaker housing with the peripheral edge of the speaker cone in sealed engagement with the housing to provide an airtight construction. Since the diaphragm must of necessity be of relatively light material, on the order of 3 to 5 thousandths of an inch in thickness, there is always danger that the diaphragm may crack and thus admit gases into the area surrounding the electrical elements. If this should occur any sparks developing in the electrical elements could spread the flame to the surrounding atmosphere and set off an explosion.

The present invention may be used with particular advantage in overcoming the dangers and defects inherent in the conventional loudspeakers for such use and may be installed with complete safety regardless of the fact that the surrounding atmosphere may be laden with gases or substances of an explosive nature.

It is an object of the present invention to provide a sealed transducer.

A second object is to provide a novel linkage between the acoustical and electrical elements of a transducer.

Still another object of the present invention is to combine a sealed construction with a novel

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linkage adapted to operate through such sealing arrangement.

An additional object is the provision of an explosion proof transducer which may be used with safety under hazardous conditions.

A further object is the provision of means for automatically sealing off a portion of the transducer at the instant an explosion occurs.

These and other objects and attendant advantages will be readily apparent from the following description taken in conjunction with the accompanying drawings in which:

Fig. 1 is an axial sectional view illustrating one embodiment of the present invention;

Fig. 2 is a fragmentary view similar to Fig. 1 illustrating a modified form of the present invention; and

Fig. 3 is a view similar to Figs. 1 and 2 and showing a modification permitting the operating parts to be spaced apart a substantial distance.

Referring now to the drawings wherein like reference characters refer to identical parts the present invention is disclosed in connection with its application to the permanent magnet type of loudspeakers. In the embodiment shown in Figs. 1 and 2 the permanent magnet may comprise cylinder 10 of "Alnico" or other suitable material positioned in the cavity of a nonferrous cup-shaped housing 11 with a soft iron disc 12 contacting the upper end of the cylinder 10 and extending over the open end of the housing 11 to provide a closure therefor. This disc 12 may be suitably secured in sealed relation to a flanged face 13 on housing 11 to prevent the entrance of dirt, gases or moisture into the housing cavity. A soft iron core 14 may be affixed to disc 12 as by welding or other well known means so that the core depends downwardly into the housing cavity and is positioned centrally of the "Alnico" cylinder bore. A second soft iron disc 15 resting on an annular ledge 16 in the lower portion of the housing and in contact with the lower end of the "Alnico" cylinder has a central aperture to provide a magnetic flux gap 17 adjacent the lower end of core 14 thereby completing the magnetic field.

Referring now especially to Fig. 1 it will be noted that a voice coil 18 is mounted on a flexible bellows 19 with the coil positioned in the flux gap. The bellows may be a "Sylphon" bellows or a flexible diaphragm of the aneroid type and, in the embodiment illustrated, one end of the bellows is secured to the lower end of core 14 as by threaded bushing 19a and its other end is secured by screw 20 or other suitable means to

voice coil carrying cup 21. An axial bore 22 extending longitudinally through core 14 connects the hollow interior of the aforementioned bellows with a similar flexible bellows 23 affixed to the upper end of the iron core member. A speaker cone 24 supported at its rim by speaker casing 25 may be attached at its center to the upper bellows unit 23 by a flanged nut 26 as illustrated. As can be seen the hollow interior of the upper and lower flexible bellows members and the bore provide a closed chamber between the voice coil and the speaker cone. This chamber may be filled with a fluid such as a hydraulic oil or a gas and sealed. This fluid then provides the connecting linkage between voice coil 18 and speaker cone 24. Thus, as the electrical impulses energize the voice coil and impart movement thereto, the fluid in the chamber will transmit the movement to the speaker cone where it is translated into sound waves.

The electrical wires connecting the voice coil in circuit with the source of electrical energy may enter the housing through an explosion proof conduit connection including a circular disc 27 of insulating material having a pair of binding posts 28 extending therethrough so that the desired connections can be made to the posts on each side of the disc. This disc may be clamped between an internal ledge 29 in the threaded opening of the housing and the end of a threaded conduit coupling 30 thus providing a seal at the conduit connection.

As illustrated a valve plunger 31 may be mounted so as to project upwardly within the interior of the lower bellows 19. This valve plunger is in alignment with a valve seat 32 formed in the threaded bushing 19a. It will be seen that a fire, spark or explosion occurring within the housing 11 is prevented from escaping through bore 22 to the outside of the speaker since any pressure developed in the housing from such a cause would tend to compress the bellows and close the valve.

The construction shown in Fig. 2 is similar to that shown in Fig. 1, however, in this instance the voice coil 18 and the speaker cone 24 are linked by a rigid shaft 33 axially movable in bore 35 and extending at each end beyond the core 14.

The upper portion of shaft 33 projects through a flexible bellows 23a affixed to the upper end of the soft iron core and is threaded to receive a nut 36 for securing the apex of the speaker cone to the shaft for movement therewith.

A disc shaped coil support 37 threaded onto the lower end of shaft 33 supports voice coil 18a in magnetic flux gap 17.

Threaded into the lower end of housing 11 is a substantially cup-shaped closure 40 having a threaded extension 41 adapted to receive a suitable explosion proof conduit coupling (not shown) through which may pass the voice coil leadin wires.

In the embodiment shown in Fig. 2 the safety valve comprises a valve face portion 38 formed integral with disc 37 and movable upwardly to cooperate with the valve seat 39 formed in the lower end of iron core 14.

Thus, should an explosion occur within the housing cavity the resulting flame could not escape to the outside atmosphere for the pressure on the undersurface of support 37 would tend to move valve face 38 into sealing engagement with valve seat 39 closing bore 35.

In some installations it may be desirable to locate the electrical unit of the transducer at a distance from the hazardous atmosphere, as behind a wall of the room where the hazardous conditions are present, or in a room adjacent thereto. Such an arrangement is shown in Fig. 3, where, it will be noted, the sealed housing 11 containing the electrical elements is secured to one face 40 of a wall or partition and the speaker cone assembly is secured to the other face 41 of such wall. The arrangement is similar to the embodiment illustrated in Fig. 1 but includes a fluid conduit 42 of the required length extending through the wall or partition and around corners if necessary to connect the voice coil bellows 19 and the speaker bellows 23.

As shown such a construction may include an auxiliary plate 43 affixed to the wall 41 as by threaded screws to provide a suitable mounting base for the speaker cone housing 25 and flexible bellows 23 as shown.

If housing 11 is located a distance from the speaker cone unit, conduit 42 may consist of two sections of tubing one of the sections being threaded into soft iron core 14 and the other section threadedly connected to flexible bellows 23. The sections may be joined by a suitable coupling (not shown) and a bleed valve may be inserted in the fluid line if desired.

It will be apparent from the foregoing description that the present invention may be used with particular advantage not only in hazardous areas but also wherever the atmospheric conditions are such that dust, dirt or moisture might enter the area surrounding the electrical elements and thus interfere with the efficient operation of the transducer.

Although the embodiment which has been illustrated and described herein relates to the application of the invention to transducers of the permanent magnet type, it is to be understood that it is not intended to limit the invention to that particular type of transducer. For it will be apparent to those skilled in the art that the invention broadly includes a novel linkage arrangement for connecting acoustical and electrical elements and for sealing such constructions.

It should be understood, of course, that the foregoing disclosure relates to only a preferred embodiment of the invention and that numerous modifications or alterations may be made therein without departing from the spirit and scope of the invention as set forth in the appended claims.

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

I claim:

1. In a transducer containing a sealed voice coil, and a speaker diaphragm spaced from said coil, a first bellows fixed to the voice coil, a second bellows fixed to the diaphragm, and a fluid filled conduit connecting the interior of said first bellows with the interior of said second bellows to transmit relative movement therebetween.

2. In a transducer containing a voice coil, a speaker diaphragm and a magnetic core between said coil and said diaphragm, said core having a bore therethrough, a first resilient hermetic sealing means connected between said coil and one end of said core and defining a first chamber, and a second resilient hermetic sealing means connected between said diaphragm and the other end of said core and defining a second chamber, said bore connecting the interior of the first chamber with the interior of the second chamber.

3. In a transducer containing a voice coil, a speaker diaphragm and a magnetic core between said coil and said diaphragm, said core having a bore therethrough, a first bellows between said coil and one end of said core, and a second bellows between said diaphragm and said core, said bore connecting the interior of said first bellows with the interior of said second bellows.

4. In a transducer containing a sealed voice coil, a speaker diaphragm spaced from said coil and a magnetic core adjacent said coil, a first bellows between said coil and one end of said core, a second bellows affixed to said diaphragm, and a conduit providing a passageway through said core and connecting the interior of said first bellows with the interior of said second bellows.

5. In a transducer containing a voice coil a speaker diaphragm and a magnetic core between said coil and said diaphragm, said core having a bore therethrough, a first bellows fixed at one end to said coil and at the other end to said core, and a second bellows fixed at one end to said diaphragm and at the other end to said core, said bore connecting the interior of said first bellows with the interior of said second bellows.

6. An explosion proof speaker comprising a voice coil, a speaker diaphragm spaced from said voice coil, means defining a flux gap for receiving said voice coil including an elongated magnetic conduit extending between said coil and said speaker diaphragm and a housing, means in said conduit to move the speaker diaphragm in response to movement of the coil, and hermetic sealing means resiliently connecting said conduit and said diaphragm and adapted to hermetically seal said voice coil from the speaker diaphragm.

7. An explosion proof speaker for use under hazardous atmospheric conditions comprising, means defining a flux gap including a housing and an elongate pole piece in the housing, a voice coil disposed in said flux gap adjacent one end of the pole piece, a speaker diaphragm outside the housing and spaced from the opposite end of the pole piece, operating means extending through said pole piece and linking the voice coil and the speaker diaphragm for movement together, and hermetic means for sealing said operating means relative to said pole piece so as to prevent access of hazardous atmosphere along said operating means and to said voice coil.

8. An explosion proof loud-speaker for use under hazardous atmospheric conditions comprising, means defining a flux gap including a housing and an elongate pole piece in the housing, a voice coil disposed in said flux gap and movable adjacent one end of the pole piece, a diaphragm outside the housing and substantially spaced from the opposite end of the pole piece, means extending through said pole piece and linking the voice coil to the diaphragm for the transmission of sound impulses thereto, and hermetic sealing means between said diaphragm and said pole piece for isolating the voice coil from the speaker so that explosive gases may not reach the voice coil and be ignited thereby.

9. In an explosion proof loud-speaker, means providing a magnetic circuit including an elongate magnetic core, a magnetic housing surrounding said core and defining with one end portion of said core an annular flux gap in said magnetic circuit, a voice coil disposed in said flux gap at said one end portion of the core, a speaker diaphragm mounted outside said housing in spaced relation to the other end portion of said core, resilient sealing means defining a flexible chamber between said opposite end portion of the core and said diaphragm, said core being provided with a through passageway communicating with said chamber, means in said through passageway transmitting motion between said voice coil and said diaphragm, and means carried by said voice coil adapted to close said through passageway responsive to explosion pressure within the housing.

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