July 12, 1960 KEIICHI SHINTAKU 2,944,509

HORN DEVICE

Filed April 17, 1959

Fig. 2.

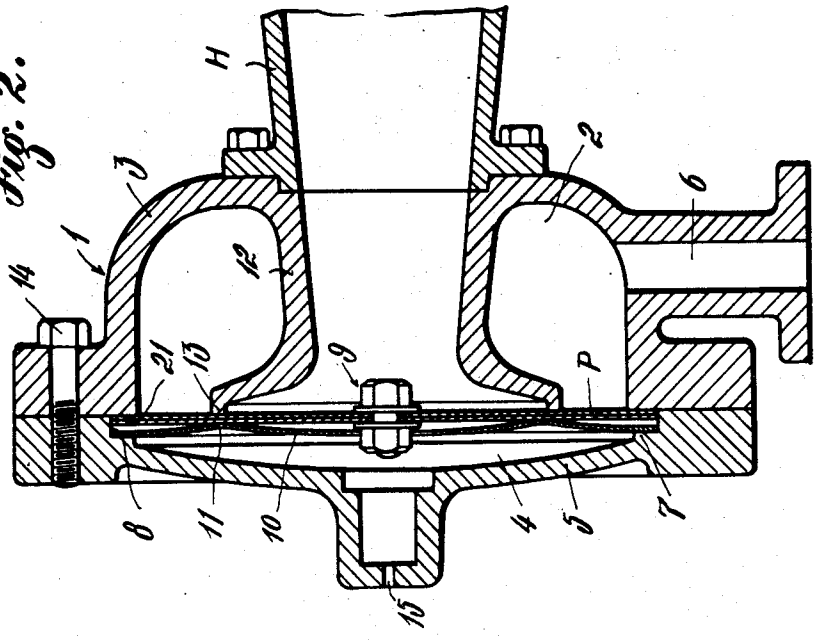
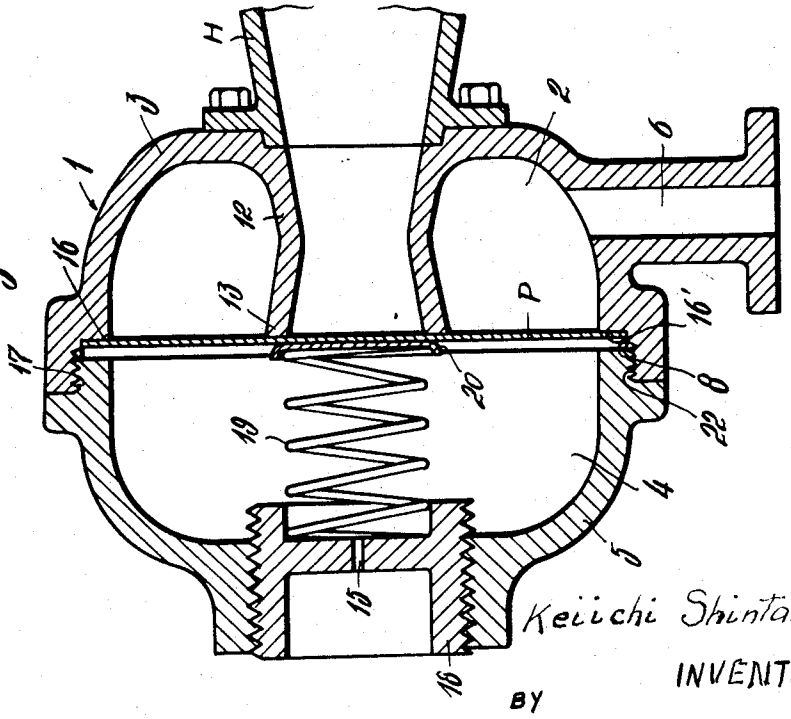


Fig. 1.



Keiichi Shintaku

INVENTOR

BY

Wenderoth, Lind & Ponack

Attys.

United States Patent Office 2,944,509 Patented July 12, 1960

2,944,509

HORN DEVICE

Keiichi Shintaku, 46, Masutsuka, Kashio, Takarazuka, Japan

Filed Apr. 17, 1959, Ser. No. 807,145

Claims priority, application Japan Sept. 10, 1958

1 Claim. (Cl. 116—142)

This invention relates to whistles and more particularly to improvements in whistles or phones of the type wherein a diaphragm is vibrated to convert pressurized fluid or working medium such as air, steam and the like acting thereon into acoustic energy and the sound so produced is transmitted to the outer air through a resonating horn so arranged and shaped to produce directional radiation.

The known and typical whistles of this type comprise a vibrator having a diaphragm which is vibrated by pressurized working fluid such as compressed air or pressurized steam to convert its energy into acoustic energy, and a resonating and directional horn to transmit the sound produced by the vibrator to the outer air therethrough. Said vibrator comprises a casing, the interior of which is divided by the diaphragm into a back chamber and a pressure chamber to which is supplied the working fluid under pressure, said diaphragm being fixedly secured at its periphery to the inner wall of the casing. In the pressure chamber, there is arranged a throat member which communicates at the forward end with the horn and terminates at the other end in rear end edge which normally gas tightly engages the surface of the diaphragm. In operation, when pressurized working fluid is fed into the pressure chamber, the pressure therein is increased so that the diaphragm is flexed toward the back chamber. Thus the rear end edge of the throat member is disengaged from the diaphragm so that the working fluid escaping through the clearance formed therebetween into the interior of the throat member is discharged through the throat member and the horn outwardly. Thus, there occurs pressure drop in the pressure chamber so that the diaphragm returns to the original shape by its own resiliency and comes to gas-tightly engage again with the rear edge of the throat member. In this manner, the diaphragm repeats the flexing and returning (to the original shape) movement to produce a sound wave which is transmitted to the outer air or atmosphere through the resonating and directional horn.

It will be noted, therefore, that in the known devices the diaphragm is fixed at its peripheral marginal portions.

The present invention relates to novel improvements in the structure of such vibrator, particularly arrangement of a diaphragm, and is characterized by the fact that, in contrast to the known type, the diaphragm is not fixed at the peripheral marginal portion, but is adapted to make, as a whole or bodily, a reciprocative piston-like movement with its peripheral marginal portions loosely inserted in an annular recess formed in the inner wall of the casing. The reciprocating piston-like movement is distinguished from the flection movement of the known diaphragm.

According to my invention, the peripheral margin of the diaphragm is freely or loosely inserted in an annular recess formed in the inner peripheral wall of the casing body without being fixed or clamped therein. The diaphragm is in such a dimension that it is bodily movable

in the annular recess but there is substantially kept gas-tightness between the marginal edge of the diaphragm and the bottom of said recess.

A proper spring member is arranged to back up the diaphragm so that the diaphragm may normally be gas-tightly pressed against and engaged with the rear end edge of the throat member as well as the side wall of said recess. Means may be provided to adjust the elastic force of the spring member. The construction of the present invention may be otherwise substantially same as that of the cited conventional type.

In operation of such whistle of the present invention, when pressurized working fluid or gas is fed into the pressure chamber from a working fluid feeding device, the diaphragm will bodily be pressed against the resilient force of the spring member due to the increase in pressure in the pressure chamber and will be disengaged from the rear end edge of said throat member and the side wall of said recess, so that there is formed a clearance between the diaphragm surface and the end edge of the throat member. Thus, the pressure gas escapes through this clearance into the interior of the throat member and is discharged therefrom to the outer air or atmosphere through the horn communicating with the throat member. Thus, there occurs a pressure drop in the pressure chamber so that the diaphragm will be returned to the original or normal position by the action of the spring member and will come to engage again with the rear end edge of the throat member and the side wall of the recess. Thus the piston-like motion of the diaphragm will be repeated. It should be noted here that the diaphragm is not fixed or clamped at its peripheral margin at all and therefore its motion is a bodily reciprocating motion as of a piston as quite different from the conventional flection motion. The function and effect of this construction shall be explained in detail hereinafter.

The sound wave thus produced by the piston type vibrating motion of the diaphragm is introduced in the throat member and then is transmitted through the resonating directional horn to the outer air.

These and other features and advantages of this invention will be more fully understood from the following description made referring to the accompanying drawings in which;

Fig. 1 is a somewhat schematic partly broken longitudinal section of a whistle embodying the present invention,

Fig. 2 is a view similar to Fig. 1, but showing another embodiment of the invention.

Referring to the drawings, and particularly to Fig. 1, the whistle comprises a vibrator generally designated by the reference numeral 1 and a horn H. The casing of the vibrator 1 comprises a forward bowl-shaped member 3 defining a pressure chamber 2 and a cover 5 defining a back chamber 4. A working pressure inlet 6 is provided on the bowl-shaped member 3 and is connected with a working fluid feeding device (not shown). A shoulder 7 is formed on the inner wall of the cover 5 so that an annular recess or groove 8 may be formed as illustrated between the cover and the bowl-shaped member when they are assembled. It is needless to say that such recess may be formed by any suitable manner other than that shown. For example, the recess may be formed as shown in Fig. 2 as hereinlater described.

Before the back cover 5 is coupled to the bowl-shaped member 3, a diaphragm P is placed on the bowl-shaped member 3 as shown. When the cover and the bowl-shaped member are assembled together, said diaphragm P will form a partition between the pressure chamber 2 and the back chamber 4.

The diaphragm disk may be made of any proper material, such as, for example, Phosphor bronze, aluminium bronze, conventionally used in this type of whistle and may consist of one sheet or several laminated sheets. The one shown in Fig. 1 is a double type wherein two overlapped sheets are fastened together by folt and must means **9**.

A discal spring **10** is also inserted in the recess as shown. A circular ridge **11** is formed on the discal spring so as to resiliently press the diaphragm P forwardly. Said discal spring **10** is supported at its peripheral edge by the shoulder part **7** on the inner wall of said cover **5**.

A throat member **12** extends through the pressure chamber to diverge forwardly and is connected to the rear end of the horn H. The enlarged rear end edge **13** of the throat member **12** normally engages gas-tightly with the diaphragm P because of the fact that the latter is urged toward the throat member by means of the spring **10**. It will be understood that the end surface of the edge **13** is on the same plane as the side wall face **21** of the recess **8**.

The cover **5** may be fastened on to the member **3** by any proper means such as for example, bolts **14** as illustrated. When so assembled, the diaphragm P will be air-tightly pressed against the end surface of said rear end edge **13** and the wall surface **21** of the recess **8** by the force of the spring **10**.

Indicated with the numeral **15** is an air vent for the back chamber **4** to thereby properly adjust the back pressure in the back chamber.

The diameter of the diaphragm is such that the diaphragm may reciprocate within said annular recess **8** but that air-tightness may be substantially kept between the diaphragm edge and the bottom wall of said recess.

Thus, the diaphragm will be able to reciprocate like a piston within said recess during the operation of the whistle. The shape and size of the horn H may be properly selected. Any particular size and dimension are not the subject matter of the present invention.

Another embodiment of the present invention is illustrated in Fig. 2. This embodiment is different from that illustrated in Fig. 1 specifically in the manner of formation of the recess **8** and the type and arrangement of the spring member. That is to say, in the embodiment illustrated in Fig. 2, an annular shoulder **16** is formed on the inner peripheral wall of the bowl-shaped member **3** and an inner thread **17** is formed on the inner wall of the rear end part of said member **3**. An outer thread **22** adapted to engage with said inner thread **17** is formed on the outer periphery of the front end part of the cover **5** so that, when the cover **5** and the bowl-shaped member **3** are screwed together, an annular recess **8** may be formed as illustrated between the shoulder face **16'** and the front end surface of the cover **5**. The diaphragm P is loosely fitted in this recess. In this embodiment the diaphragm consists of one sheet. In the rear end part of the cover **5**, there is threaded a spring set screw **18** (which may be called stiffness adjuster) as well shown. An air vent **15** is formed in the member **18**.

A coil spring **19** is arranged in the back chamber **4** or the interior of the cover **5**. The rear end of said spring is supported on the member **18**. The forward end of the spring is made to act to press the diaphragm P against the rear end edge **13** of the throat member **12** and the side wall face **16'** of the recess **8** through a washer **20**. It will be understood that the resilient force of the spring **19** against the diaphragm **8** can be adjusted by varying the screwed depth of the member **18** in the cover **5**.

The operation of these embodiments is as already described and there will be no need of repeatedly explaining it. In short, the present invention is characterized in that the diaphragm is loosely inserted in an annular recess or groove formed on the inner wall of the casing and is normally pressed against the throat member by means of a spring so that when working fluid is fed into the pressure chamber the diaphragm may be bodily reciprocated axially of and within the annular recess like a reciprocating piston, as distinguished from the conventional flection movement of the known diaphragm which is fixed or clamped at the peripheral marginal portion.

The structure according to this invention has the following advantages as compared with the conventional type wherein the diaphragm is fixed at its marginal portion.

One advantage is in that the diaphragm of the present invention does not make a bending or flection movement so that the life time thereof is considerably longer than that of the conventional diaphragm.

Additional advantage of the present invention is in that the diaphragm is bodily moved so that the whole of the diaphragm is fully utilized in producing the sound energy, whereas in the conventional diaphragm the fixed marginal portions do not contribute to vibration so that the diaphragm is not fully utilized.

Still other advantage of the present invention is in that there are two independent factors, namely, the diaphragm and spring, to determine or control the sound characteristics so that the flexibility or latitude of the design is broad, whereas in the conventional type the diaphragm is marginally fixed there is only a single factor, or in other words, the sound characteristics are inherent to the diaphragm itself and there is no additional variable factor as compared with the construction according to this invention.

I claim:

A horn of the type having a resonating horn comprising a casing, a diaphragm arranged within said casing dividing the interior of the casing into a pressure chamber and a back chamber, a throat member arranged in said pressure chamber and communicating at the forward end with the resonating horn and normally being in gas-tight engagement at the rear end with the surface of the diaphragm, means for introducing working pressure into said pressure chamber, an annular recess formed on the inner wall of the casing and between the pressure and back chambers, said diaphragm being loosely inserted at its peripheral margin in said recess without being clamped, and a discal spring inserted at its peripheral margin in said recess, said spring having a circular ridge engaging the surface opposite to the surface for engagement with said throat member and pressing the diaphragm toward said throat member so as to normally effect gas tight engagement of said diaphragm with said throat member, said diaphragm being bodily reciprocated against and by the discal spring axially within said recess when the working pressure is introduced in said pressure chamber for operation.

References Cited in the file of this patent

UNITED STATES PATENTS

1,281,877	Teste	Oct. 15, 1918

FOREIGN PATENTS

764,113	France	Feb. 26, 1934
319,978	Italy	July 30, 1934