July 14, 1953 D. G. STAFFORD 2,645,198

SIGNAL HORN

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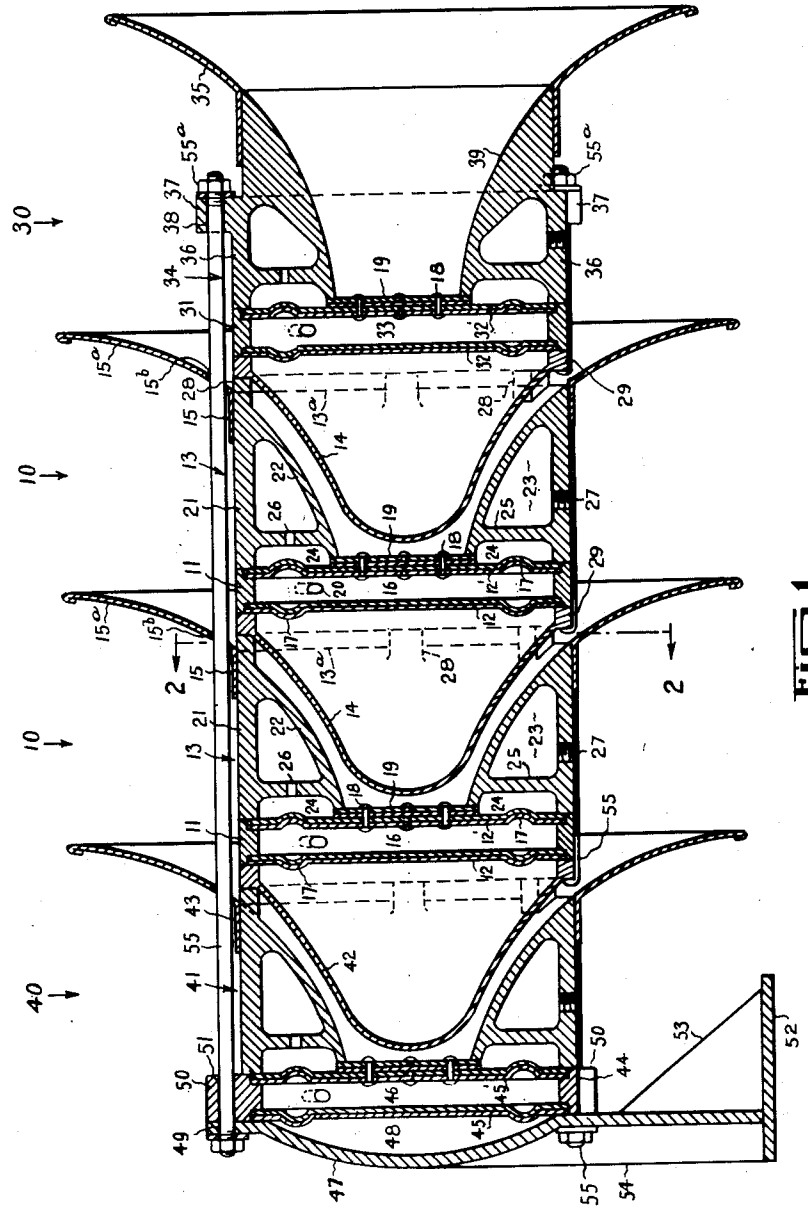


FIG. 1.

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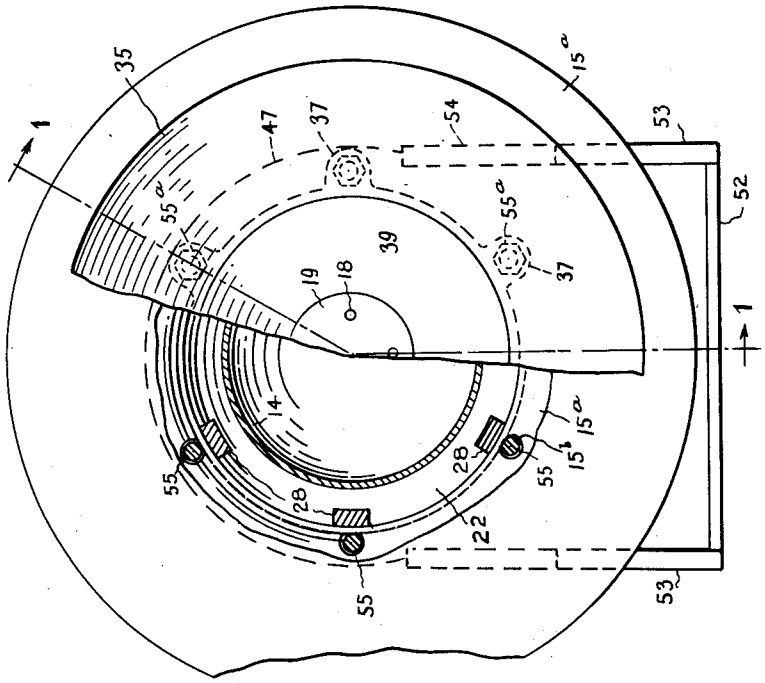


Fig. 2.

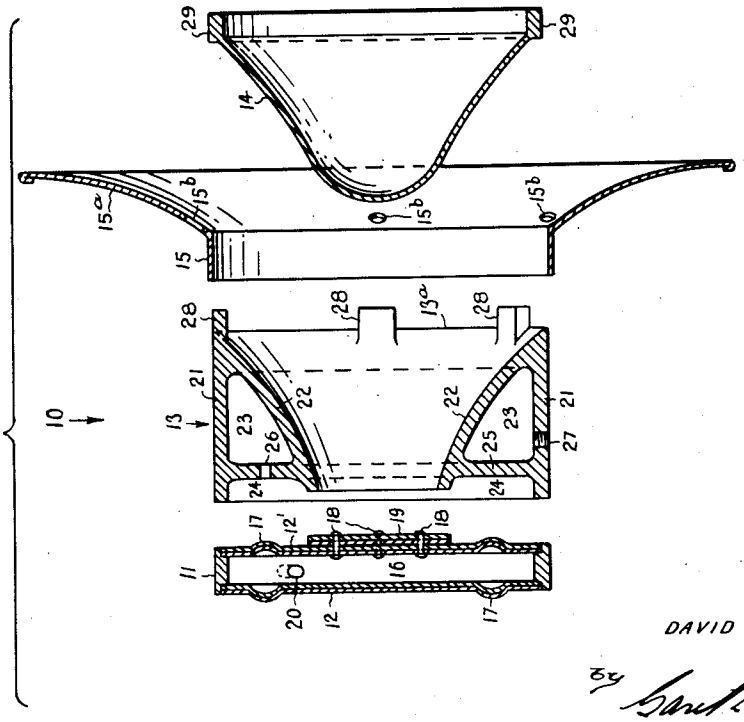


Fig. 3.

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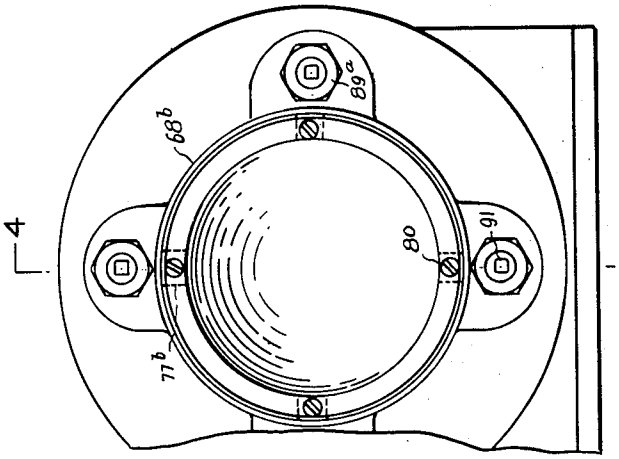


Fig. 5.

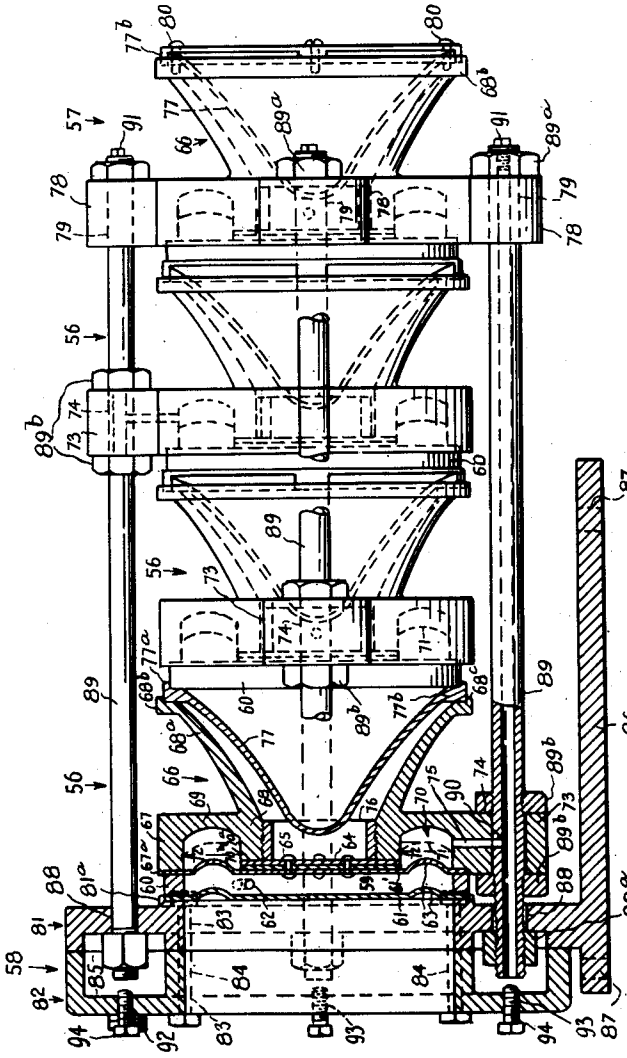


Fig. 4.

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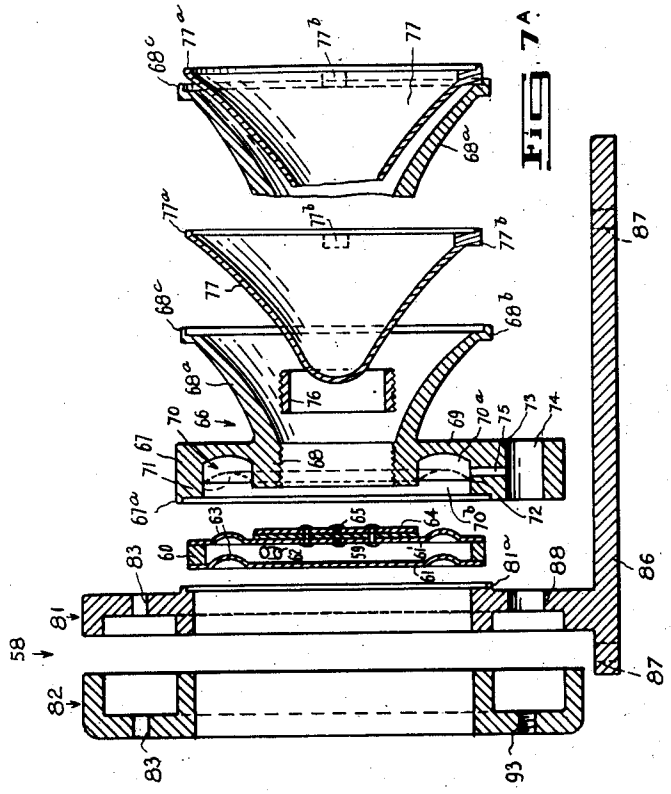


Fig. 7A.

Fig. 7.

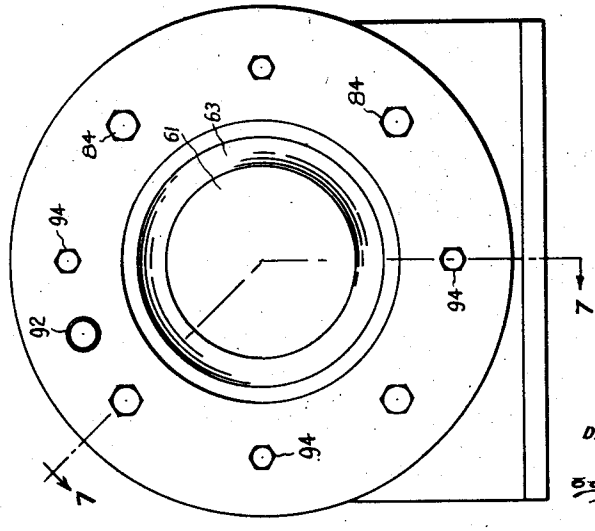


Fig. 6

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2,645,198

SIGNAL HORN

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Application March 27, 1951, Serial No. 217,715

11 Claims. (Cl. 116—142)

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This invention relates to a signal horn operated by means of compressed air or other working fluid.

Signal horns and alarms for factories, locomotives, boats, cranes, engines and the like commonly operate by directing compressed gas or vapor against a diaphragm which is thereby set into vibration and emits a signal. Difficulty has been experienced, however, in constructing a horn in which the signal is at once of the desired pitch, tone and intensity.

The main object of this invention is to provide a horn in which the characteristics of the sound produced may accurately be predetermined.

According to this invention, the pitch of the signal can be controlled by varying the pressure which is exerted by a body of suitable fluid against a flexible diaphragm. The desired intensity and tone is achieved by a novel arrangement of a plurality of such diaphragms.

In drawings which illustrate the invention, and in which the same reference numeral is used for the same part in the several views:

Fig. 1 is a longitudinal section of a signal horn constructed in accordance with this invention, the section being taken along line 1—1 of Fig. 2;

Fig. 2 is a front elevation, partly in section, of the signal horn shown in Fig. 1, the section being taken along line 2—2 of Fig. 1;

Fig. 3 is an exploded longitudinal section of a central unit of the signal horn shown in Figs. 1 and 2, the section again being taken along line 2—2 of Fig. 1;

Fig. 4 is a longitudinal side elevation, partly in section, of another form of signal horn, the section being taken along line 4—4 in Fig. 5;

Fig. 5 is a broken away front elevation of the signal horn shown in Fig. 4;

Fig. 6 is a rear elevation of the signal horn shown in Figs. 4 and 5;

Fig. 7 is an exploded longitudinal section of one unit and the head assembly of the signal horn in Figs. 4, 5 and 6, the section being taken along line 7—7 of Fig. 6; and

Fig. 7A is a broken away longitudinal section, taken along line 7—7, of a body member and deflector of the signal horn shown in Figs. 4–7.

The signal horn illustrated in Figs. 1 to 3 is made up of a plurality of identical central units, each generally indicated by reference numeral 10, and a front and rear unit 30 and 40 respectively. The front and rear units differ from the other units in certain respects and will be described separately.

Each central unit 10 comprises a shell or annulus 11 having opposed rear and front diaphragms 12 and 12′ respectively, a body member generally indicated by reference numeral 13, through which compressed gas or vapour is directed against the front diaphragm 12′, a deflector 14, and a flared sleeve 15 mounted on the body member 13, the deflector and sleeve serving to direct the gas or other working fluid out of the horn after it has actuated the diaphragms.

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The resilient diaphragms 12 and 12′ are each comprised of one or more discs hermetically sealed to the annulus 11, the diaphragms being set into grooves in the end faces of the annulus so as to lie flush with these end faces. A vibration chamber 16 is thereby formed in the annulus. The resilience of each of the diaphragms 12 and 12′ is increased by the impression in the diaphragm of a flexible ring portion constituted by a dished, annular ridge 17, a cross-section of the ridge 17 being in the shape of a substantially circular arc projecting outwardly from the chamber 16. Secured to the outer face of the front diaphragm 12′ by rivets 18 are one or more smaller discs 19 disposed concentrically with the diaphragm 12′. A radial hole 20 is provided in the annulus 11 so that a suitable fluid such as air, light oil, or grease, under slight pressure, can be admitted into the chamber 16, after which the hole 20 is plugged in any suitable manner.

Each body member 13 is an annulus of substantially triangular cross-section and is formed by a cylindrical wall 21 and a substantially conical inner wall 22 which meets the outer wall at a forward edge 13a. The inner wall 22 has a slight axial convexity defining a forwardly flaring, substantially frusto-conical, interior space. The annulur space between the outer and inner walls 21 and 22 is separated into a diffusion chamber 23 and a pressure chamber 24 by a radially disposed rib 25 in which a plurality of holes 26 are provided to connect the two chambers. A tapped hole 27, communicating with the diffusion chamber 23 through the outer wall 21, may be connected to a source of horn-actuating gas or other working fluid under pressure. A plurality of axially disposed lugs 28 are provided along the forward edge 13a of the body member. Each body member is positioned in front of one of the diaphragms 12′, the outer wall 21 being seated against the diaphragm 12′ at its outer periphery and the inner wall 22 being seated against the outermost of the smaller discs 19 at the outer periphery of the said outermost disc. Normally, therefore, the diaphragm 12′ seals one side of the pressure chamber 24.

Each of the deflectors 14 is substantially bell-

shaped with slightly flaring sides; the forward edge of the deflector is reinforced by a ring 29 of rectangular cross-section, disposed so that a continuation of the sides of the bell would pass through one diagonal of the rectangular cross-section of the ring. The deflector 14 is mounted in the conical interior of the body member 13, the lugs 28 of the body member abutting against the ring 29 on the deflector to maintain a predetermined spacing between the deflector and the interior wall 22 of the body member.

The sleeves 15 each consist of a hollow cylinder having a flared bell portion 15a at the forward end, and each sleeve is fitted over the outer surface of one of the body members 13 in such a position that the inner surface of the flared bell portion 15a forms a continuation of the flared inner surface of the wall 22 of the body member. Alternatively, the sleeve 15 may be integral with the body member 13. A ring of holes 15b are provided in the bell portion 15a to receive the fastening means which will be described later.

At the front of the horn is a front unit generally indicated by reference numeral 30, which has an annulus or shell 31 having diaphragms 32 and 32' forming a vibration chamber 33 which is identical with the chamber 16 in the central units 10. Unit 30 has a front body member, generally indicated by reference numeral 34, and a sleeve 35, the front body member and sleeve differing in several respects from the body members and sleeves in the central units 10. The outer wall 36 of the front body member 34 has a plurality of projecting lugs 37 in each of which is provided a hole 38 disposed parallel to the axis of the horn. The front body member 34 is preferably somewhat longer than the other body members so that its inner wall 39 has a more gradual taper. Its diameter is slightly reduced forwardly of the lugs 37 in order to make room for suitable fastening means, hereinafter described, against the lugs, and the diameter of the front sleeve 35 corresponds with the reduced diameter of the front body member. There are no lugs on the front body member corresponding to the lugs 28 on the other body members and no holes are provided in the flared bell portion of the front sleeve 35.

The rear unit, generally indicated by reference numeral 40, includes a body member generally indicated by reference numeral 41, a deflector 42 and a sleeve 43, respectively identical with the body member 13, the deflector 14 and the sleeve 15 in each of the central units 10. Unit 40 also includes an annulus or shell 44 having rear and front diaphragms 45 and 45' and forming a vibration chamber 46. In addition, the rear unit has a dished head member 47 which bulges rearwardly to provide a plano-convex chamber 48 between the head member 47 and the rear diaphragm 45 of the vibration chamber 46. A ring of holes 49 are arranged near the periphery of the head member 47, and the annulus 44 is provided with lugs 50 having holes 51 disposed parallel to the axis of the horn and registering with the holes 49 in the head member 47. The head member 47 is provided with a foot bracket 52 for mounting the horn; stiffeners 53 and 54 strengthen the mounting.

A plurality of end-threaded tension rods 55 constitute fastening means which extend longitudinally of the horn from the head member 47 to the front body member 34, and pass successively through the holes 49 in the head member 47, the lugs 50 in the annulus 44, the holes in the bell portions of the sleeves 43 and 15, and the lugs 37 in the front body member 34. Nuts 55a on the ends of the rods 55 secure the whole assembly together.

The operation of the horn will be described with reference to a central unit 10, it being understood that all units 10, 30 and 40 operate in the same way. Working fluid such as compressed air from a suitable supply (not shown) is admitted through the hole 27 into the diffusion chamber 23, and thence through the holes 26 to the pressure chamber 24. The pressure of the fluid causes the adjacent diaphragm 12' momentarily to move away from the inner wall 22 of the body member, the diaphragm carrying the smaller discs 19 with it. The pressure chamber 24 is thereby unsealed, and working fluid is permitted to escape. This reduces the fluid pressure, and the diaphragm moves back until fluid pressure again forces it away from the body member. Thus diaphragm 12' is set into vibration and the vibration is transmitted through the fluid in the vibration chamber 16 to the rear diaphragm 12. The actuating fluid escapes between the inner wall 22 and the discs 19 and passes out of the body member along the inner wall 22 and the flared bell portion 15a of the sleeve 15.

The flexible ring portion 17 in each diaphragm increases the life and flexibility of the diaphragm when it is set into vibration, and the discs 19 prevent wear on the portion of the diaphragm which is adjacent the body member. Any similar reinforcement or bearing surface on the diaphragm may, of course, be used instead of the discs 19. Each diffusion chamber 23 serves to collect any dirt, moisture or the like which is carried in by the working fluid. A uniform pressure on each diaphragm is created by diffusing the working fluid through the holes 26 into the pressure chamber 24. The deflectors 14 isolate successive units and by directing the spent working fluid outwardly prevent interference between the vibrations of the several vibration chambers 46, 16 and 33.

The pitch of the note emitted from each diaphragm can be varied by controlling the pressure of the fluid in the vibration chamber; this is much more convenient than the usual method of making a careful selection and adjustment of vibrating discs. The tone of the note emitted by a vibrating diaphragm can be controlled by varying the separation between the deflector 14 and the inner wall 22 of the body member. The latter adjustment, effected by changing the length of the lugs 28, also affects the volume of the note. Further control of volume is achieved by varying the number of the central units 10.

A modified form of signal horn according to the invention is illustrated in Figs. 4 to 7, and comprises a plurality of similar central units, each generally indicated by reference numeral 56, a front unit generally indicated by reference numeral 57, and a head assembly generally indicated by reference numeral 58.

Each central unit has a vibration chamber 59 formed by a shell or annulus 60 having opposed rear and front diaphragms 61 and 61' respectively. As in the embodiment shown in Figs. 1 to 3, each annulus has a hole 62 for filling the vibration chamber with suitable fluid, the diaphragms have flexible ring portions 63, and the front diaphragm 61' has a pair of smaller discs 64, secured by rivets 65, to provide a bearing surface.

Also in each central unit is a body member generally indicated by reference numeral 66.

Each body member comprises an outer ring 67 integrally connected along its forward edge by a radially disposed rib 69 to an inner cylindrical wall 68. The inner wall 68 flares forwardly as at 68a. When the body member is positioned in front of one of the diaphragms 61', the outer ring 67 seats against the diaphragm 61' at its outer periphery, and the inner wall 68 seats against the outermost of the smaller discs 64 at its periphery. The ring 67 has a peripheral lip 67a for locating the annulus 60 with its diaphragm 61' adjacent the body member. The diaphragm thereby seals a chamber generally indicated by reference numeral 70 and formed by the ring 67, the rib 69, and the wall 68. The chamber 70 is divided into a diffusion chamber 70a and a pressure chamber 70b by a screen 71. The screen 71 is a dished ring of any suitable mesh material, sprung into circular grooves 72 in the inner surface of the ring 67 and in the outer cylindrical surface of the wall 68. Each ring 67 has a radially extending lug 73 through which is provided a hole 74, disposed parallel to the axis of the horn, to receive means hereinafter described for fastening the units together and supplying them with working fluid. A smaller radial hole 75 joins the hole 74 and the diffusion chamber 70a. The inner cylindrical surface of the wall 68 is tapped so that a threaded ring 76 may be inserted adjacent the wall and concentric with it, and may be screwed rearwardly beyond the end of the wall if the discs 64 become worn, in order to ensure a good bearing contact with the discs. The forward flaring portion 68a of the wall terminates in a flange 68b having a peripheral lip 68c.

A bell-shaped deflector 77, having slightly flaring sides, has a lip 77a around its forward edge and a plurality of radial spacer lugs 77b extending back from the forward edge. When the deflector is mounted in the conical interior of the body member 56, the lugs 77b abut against the flange 68b of the body member to maintain a predetermined spacing between the deflector and the wall 68a. The lip 68c on the body member assists in locating the deflector with respect to the body member, and the lip 77a on the deflector serves similarly to locate the annulus 60 of the next unit so that its rear diaphragm 61 is adjacent the deflector.

At the front of the horn, the front unit 57 is the same as the central units, except that its body member 66 has additional radially extending lugs 78, with holes 79 parallel to the axis of the horn to receive the fastening means described hereinafter, and its deflector 77 is secured to the body member by screws 80 passing through the lugs 77b and into the flange 68b of the body member.

The head assembly 58 at the rear of the horn comprises a supporting ring generally indicated as 81 and an annular cover generally indicated as 82. Both the supporting ring 81 and the annular cover 82 are U-shaped in cross-section and have alignable holes 83 for securing the ring and cover together, by means of through-bolts 84, to form an annular supply chamber 85. The inside diameters of the supporting ring and cover are substantially the same as that of the shells or annuli 60 of the central units, and the supporting ring has a circular lip 81a for locating an annulus 60 with its rear diaphragm 61 adjacent the ring. The supporting ring has a foot bracket 86 having holes 87 for supporting the horn.

Parallel to the axis of the horn, the supporting ring 81 has a plurality of holes 88 which communicate with the supply chamber 85. A plurality of end-threaded tension rods or pipes 89 constitute fastening means which extend longitudinally of the horn, each pipe passing through a hole 88 in the supporting ring, through the hole 74 in the lug 73 of an associated central unit 56, and through a hole 79 in a lug 78 of the front unit 57. Nuts 89a at each end of the rods secure the units together. Each pipe is slightly enlarged in diameter where it passes through the hole 74 in the lug 73 of its associated central unit, and the pipe has a hole 90 perpendicular to its axis and alignable with the small radial hole 75 in the body member of the associated central unit to connect the interior of the pipe with the diffusion and pressure chambers of the unit. On either side of the lug 73 the pipe 89 is threaded, and nuts 89b are provided to ensure an airtight connection between the pipe and the associated central unit of the horn. A similar connection with one of the pipes is provided for the front unit 57. The front ends of the pipes are normally closed by threaded plugs 91.

The supply chamber 85 is provided with a suitable inlet 92 for connection to a supply of working fluid (not shown). Working fluid is thus admitted into the supply chamber and passes through the pipes 89 into the diffusion and pressure chambers of the horn.

It will be seen that, as so far described, the modified form of the horn differs principally from the embodiment shown in Figs. 1–3 in the provision of the threaded rings 76, the screens 71 which replace the ribs 25, and in the provision of pipes 89 which serve to supply working fluid from the supply chamber 85 as well as to hold the units of the horn together. The mode of operation of the modified form is similar to that of the embodiment shown in Figs. 1–3.

In the cover 82, a plurality of tapped holes 93 are aligned with the pipes 89, and threaded plugs 94 in the holes 93 may be screwed down into the supply chamber 85 to partially or completely obstruct the passage of working fluid into one or more of the pipes. Thus, control of volume is easily achieved, and any unit can readily be tested by shutting off the others. A clogged pipe can be cleared by removing the plug 91 at its front end and blowing the pipe out.

It is thought that the construction and use of the invention will be apparent from the above description of the various parts and their purpose. It is to be understood that the form of the invention herewith shown and described is to be taken as a preferred example of the same and that various changes in the shape, size and arrangement of parts may be resorted to, without departing from the spirit of the invention or the scope of the subjoined claims.

What I claim as my invention is:

1. A horn comprising a shell having a vibration chamber closed by a resilient diaphragm, a static body of fluid in the vibration chamber, a body member adjacent the diaphragm, the body member having an annular pressure chamber normally sealed by the diaphragm and a diffusion chamber in communication with the pressure chamber through a plurality of openings provided around the pressure chamber, and means for directing a working fluid under pressure into the diffusion chamber and through the openings creating uniform pressure in the pressure chamber against the diaphragm whereby the working fluid will repeatedly cause the diaphragm momentarily to unseal the pressure chamber, providing a re-

peated release of fluid pressure in the pressure chamber and causing the diaphragm to vibrate.

2. A horn comprising a shell having a vibration chamber closed by a resilient diaphragm, a static body of fluid in the vibration chamber, a body member adjacent the diaphragm, the body member having a pressure chamber normally sealed by the diaphragm, a diffusion chamber in the body member adjacent the pressure chamber, a screen separating the diffusion chamber and the pressure chamber, and means for directing a working fluid under pressure into the diffusion chamber, through the screen and into the pressure chamber, whereby the working fluid will exert pressure on the diaphragm and repeatedly cause the diaphragm momentarily to unseal the pressure chamber, providing a repeated release of fluid pressure in the pressure chamber and causing the diaphragm to vibrate.

3. A horn comprising a shell having a vibration chamber and a resilient diaphragm, a fluid in the vibration chamber, a body member having a pressure chamber adjacent the diaphragm and a hollow central passage, the pressure chamber having a wall separating the pressure chamber from the hollow central passage, the body member also having a ring around the hollow central passage and bearing against the diaphragm, means for directing a working fluid under pressure into the pressure chamber and against the diaphragm repeatedly to separate the diaphragm from the ring and provide a release of fluid pressure in the pressure chamber by flow of working fluid into the hollow central passage, thereby causing the diaphragm to vibrate, and means for advancing the ring towards the diaphragm when the diaphragm becomes worn.

4. A horn comprising a shell having a vibration chamber and a resilient diaphragm, a bearing surface on the diaphragm, a fluid in the vibration chamber, a body member having an annular pressure chamber adjacent the diaphragm and also having a hollow central passage and a cylindrical wall bearing against the bearing surface of the diaphragm and separating the pressure chamber from the hollow central passage so that the pressure chamber is normally sealed by the diaphragm, means for directing a working fluid under pressure into the pressure chamber whereby the working fluid will exert pressure on the diaphragm and repeatedly cause the diaphragm momentarily to unseal the pressure chamber providing a repeated release of fluid pressure in the pressure chamber and causing the diaphragm to vibrate, a ring adjacent the wall and concentric with it, and means for advancing the ring beyond the wall and against the bearing surface of the diaphragm when the bearing surface becomes worn.

5. A horn comprising an annulus, a vibratable diaphragm secured over each end of the annulus to form a closed vibration chamber, a static body of fluid in the vibration chamber, a body member having a pressure chamber normally sealed by one diaphragm, and means for directing a working fluid under pressure into the pressure chamber whereby the working fluid will exert pressure on the said diaphragm and repeatedly cause the said diaphragm momentarily to unseal the pressure chamber providing a repeated release of fluid pressure in the pressure chamber and causing the said diaphragm and thus the body of fluid and the other diaphragm to vibrate.

6. A horn comprising a pair of shells each having a vibration chamber and a resilient diaphragm, a body of fluid in each of the vibration chambers, means for directing a working fluid under pressure against the diaphragm of one of the shells to cause the said diaphragm to vibrate, and a body member mounted between the said shells and having a pressure chamber adjacent the diaphragm of the other shell, the body member having means for directing a working fluid under pressure into the pressure chamber and against the diaphragm of the said other shell to cause its diaphragm to vibrate.

7. A horn comprising a plurality of shells mounted in spaced relation, each shell having a vibration chamber and a resilient diaphragm, a body of fluid in each of the vibration chambers, and a plurality of body members located between the shells, each body member having a pressure chamber adjacent a diaphragm and means for directing a working fluid under pressure into the pressure chamber and against the diaphragm to cause the diaphragm to vibrate, a plurality of deflectors located between the shells for directing the working fluid out of the horn.

8. A horn comprising a plurality of spaced apart shells, each shell having a vibration chamber and a resilient diaphragm, a body of fluid in each of the vibration chambers, a plurality of body members, each body member having a pressure chamber adjacent a diaphragm, and a plurality of tension rods holding the body members adjacent the diaphragms, the tension rods having passages in communication with the pressure chambers for directing a working fluid under pressure into the pressure chambers and against the diaphragms to cause the diaphragms to vibrate.

9. A horn comprising a plurality of spaced apart shells, each shell having a vibration chamber and a resilient diaphragm, a body of fluid in each of the vibration chambers, a body member between each pair of shells, each body member having a pressure chamber adjacent a diaphragm, a plurality of tension rods holding the body members adjacent the diaphragms and having longitudinal passages in communication with the pressure chambers, a supply chamber for working fluid at one end of the tension rods and from which working fluid is supplied under pressure through the rods into the pressure chambers and against the diaphragms to cause the diaphragms to vibrate, and means for regulating the supply of working fluid from the supply chamber into each of the rods.

10. A horn comprising a pair of annuli, each annulus having a resilient diaphragm secured over each end of the annulus to form a vibration chamber, a body of fluid in each of the vibration chambers, a body member separating the said annuli and having a central passage, a deflector mounted in the said central passage in adjustable spaced relationship with the body member, the body member bearing against a diaphragm and having a pressure chamber adjacent the said diaphragm, and means for directing a working fluid under pressure into the pressure chamber and against the said diaphragm repeatedly to separate the said diaphragm from the body member and permit the working fluid to escape from the pressure chamber into the central passage, thereby causing the said diaphragm to vibrate, variation of the spacing between the body member and the deflector causing variation in the tone of the horn.

11. A horn comprising a pair of annuli, each annulus having a resilient diaphragm secured

over each end of the annulus to form a vibration chamber, a body of fluid in each of the vibration chambers, a body member bearing against a diaphragm of one of the annuli and having a pressure chamber adjacent the said diaphragm and a conical central passage, a bell-shaped deflector mounted adjacent a diaphragm of the other annulus and extending into the conical central passage in adjustable spaced relationship with the body member, and means for directing a working fluid under pressure into the pressure chamber and against the adjacent diaphragm repeatedly to separate the said diaphragm from the body member and permit the working fluid

to escape from the pressure chamber into the conical central passage and thence out of the horn.

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