No. 869,288. PATENTED OCT. 29, 1907.

N. BALDWIN.

SOUND AMPLIFIER.

APPLICATION FILED JUNE 21, 1907.

3 SHEETS—SHEET 1.

Fig. 4.

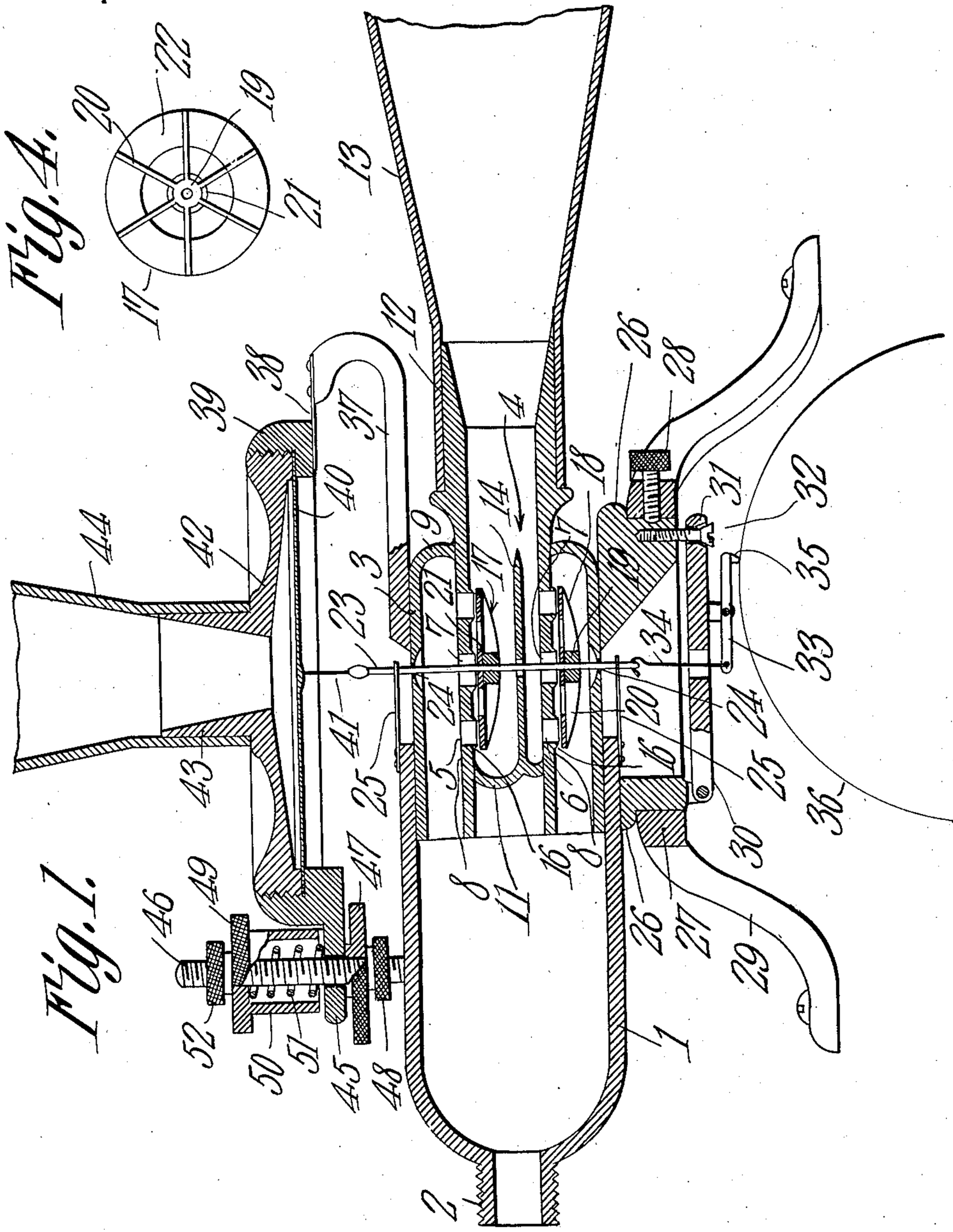

Fig. 1.

WITNESSES:

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No. 869,288. PATENTED OCT. 29, 1907.

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3 SHEETS—SHEET 2.

Fig. 2.

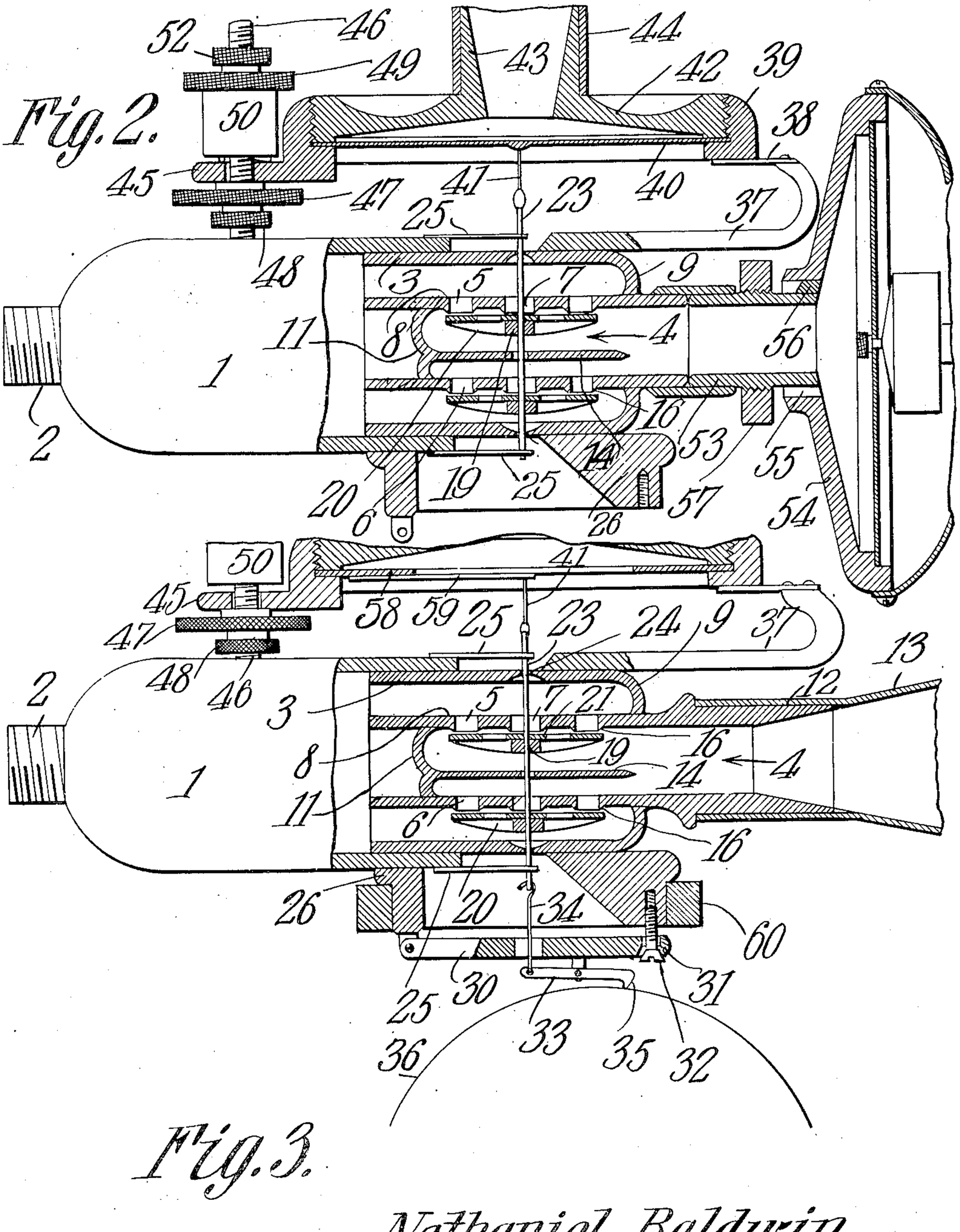

Fig. 3.

WITNESSES:

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3 SHEETS—SHEET 3.

Fig. 5.

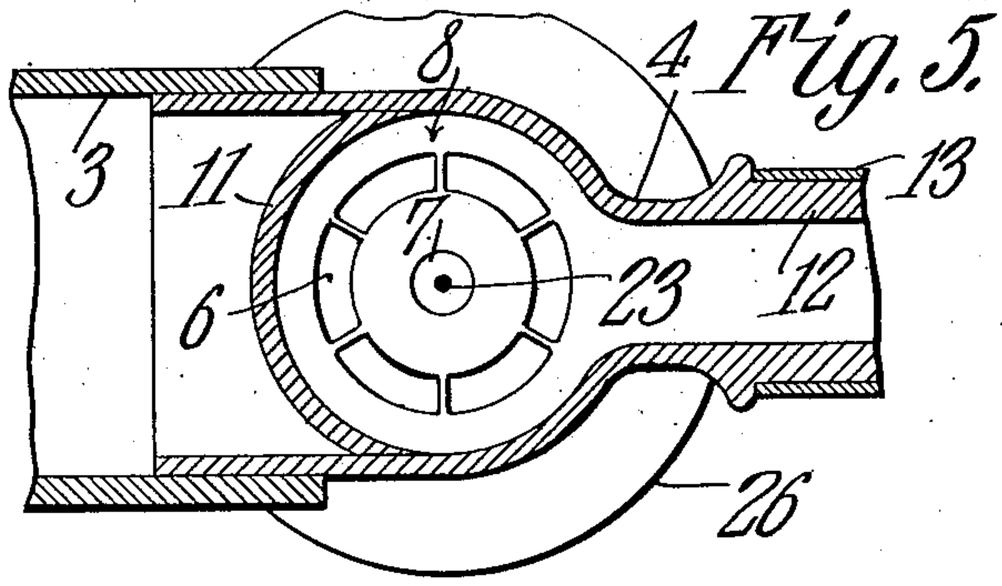


Fig. 6.

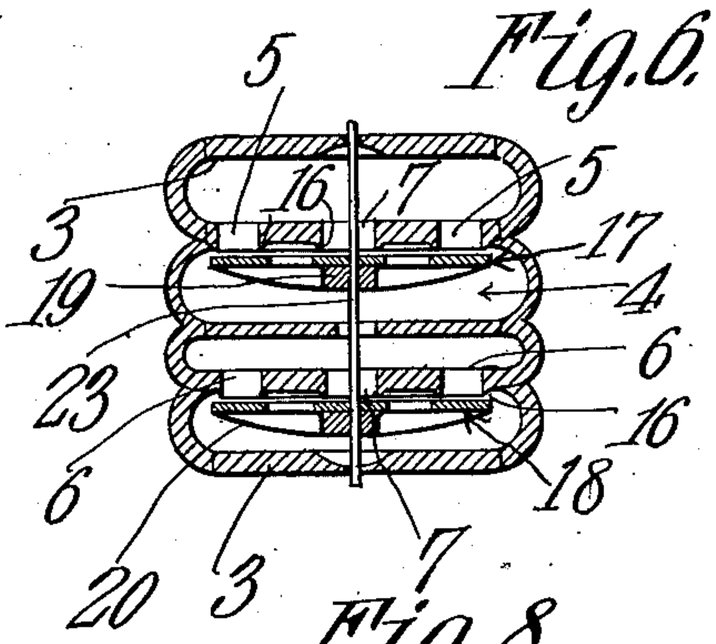


Fig. 7.

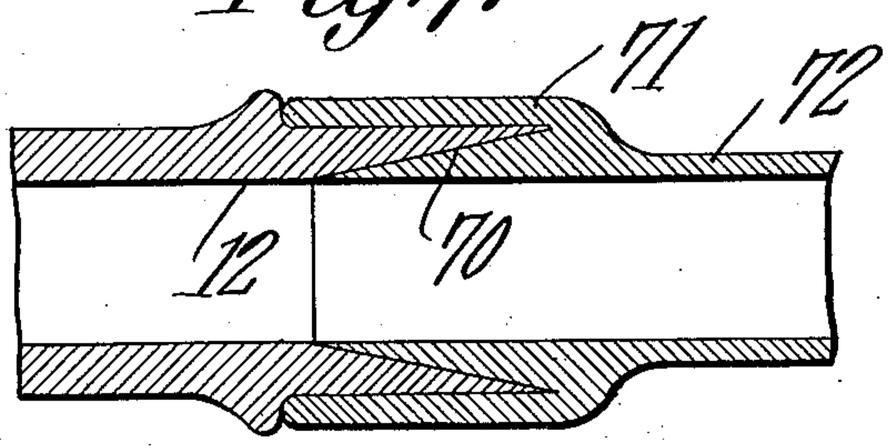


Fig. 8.

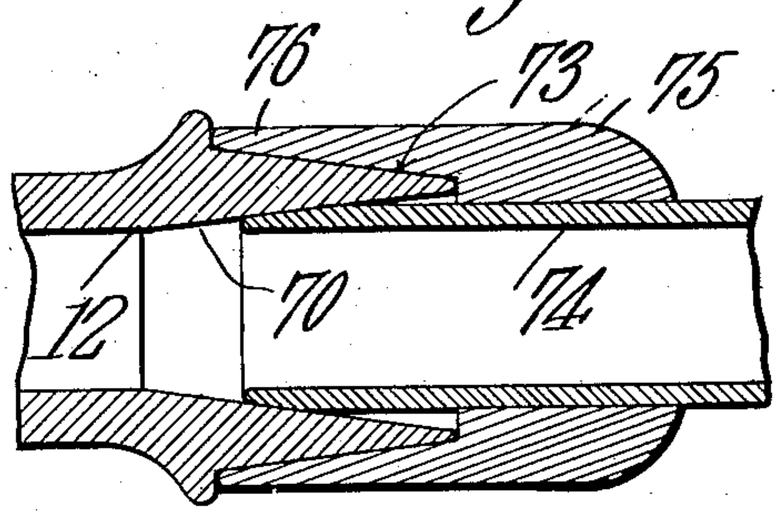


Fig. 9.

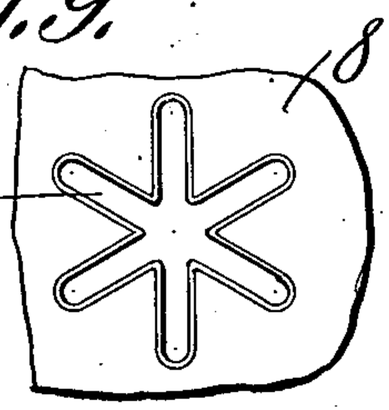


Fig. 11.

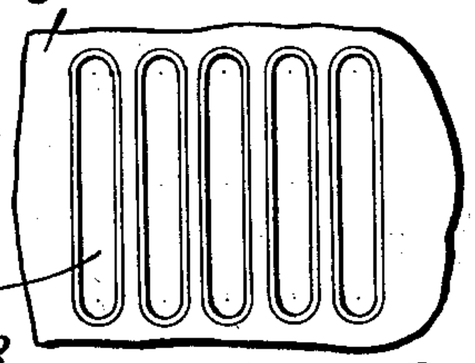


Fig. 13.

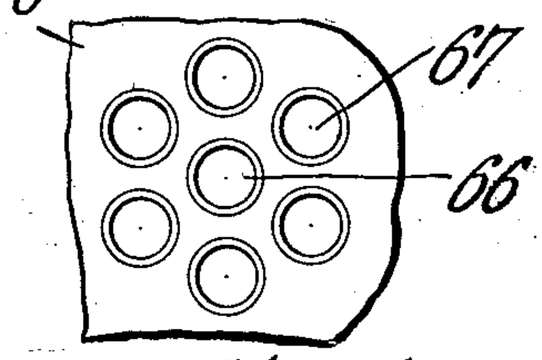


Fig. 10.

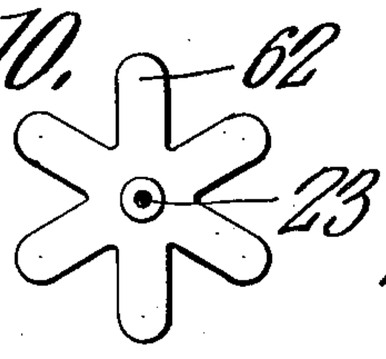


Fig. 12.

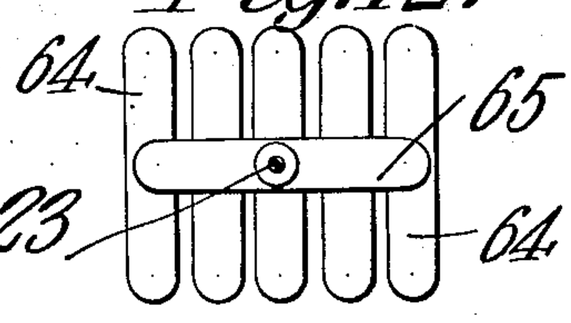
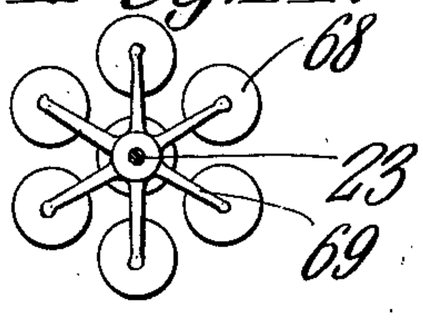


Fig. 14.



WITNESSES:

E. F. Edmonds

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Nathaniel Baldwin, INVENTOR.

By Cr Snow & Co.

ATTORNEYS

UNITED STATES PATENT OFFICE.

NATHANIEL BALDWIN, OF HEBER, UTAH.

SOUND-AMPLIFIER.

No. 869,288. Specification of Letters Patent. Patented Oct. 29, 1907.

Application filed June 21, 1907. Serial No. 380,145.

To all whom it may concern:

Be it known that I, NATHANIEL BALDWIN, a citizen of the United States, residing at Heber, in the county of Wasatch and State of Utah, have invented a new and useful Sound-Amplifier, of which the following is a specification.

This invention has reference to improvements in sound amplifiers of the type wherein the flow of a stream of fluid under pressure is modified by and in accordance with sound waves either produced directly by the original source of sound, or through the intermediary of a record of sounds, or through sound produced telephonically.

The invention is applicable as a telephone relay, whereby sounds weakly reproduced by a telephone receiver are greatly magnified or intensified or amplified and are then caused to act upon a telephonic transmitter, to be again reproduced by a suitable telephonic receiver at a distant point.

The invention is also applicable for the intensified and magnified reproduction of recorded sounds without appreciable loss of purity or quality of tone and with greatly increased volume. And the invention is likewise applicable for the megaphonic production of sounds of largely increased volume over and above the original source.

The invention is also adapted to the recording of sounds by greatly augmenting the sounds, which may then be recorded in the ordinary manner.

The invention comprises a valve interposed in the path of a stream of fluid under pressure, whether the same be air, or steam, or any other suitable fluid, of which air may be taken as an example, and this valve is so mounted as to be balanced in said air stream and thus offer no resistance except that of its own inertia to the forces tending to move the valve, which forces are in the form of sound waves whether produced directly from the original source, or through the intermediary of a sound record, or by a telephonic receiver. In fact, the valve may be operated by a direct connection to a suitable armature placed opposite the poles of a properly constructed telephonic receiver, so that the direct action of the sound waves may be entirely eliminated.

The invention comprises in addition to such a balanced valve other means necessary for the adaptation of such valve to the several purposes stated, and in order that the invention may be fully understood these various structures will be described in detail with reference to the accompanying drawings, forming a part of this specification, in which,—

Figure 1 is a sectional view through one form of the structure; Fig. 2 is a similar section, with parts in elevation, through another form of the structure; Fig. 3 is a view similar to that shown in Fig. 2, but illustrating a somewhat different type of structure from that shown in Fig. 2; Fig. 4 is a detail view of one of the valves; Fig. 5 is a horizontal longitudinal section through the air valve mechanism; Fig. 6 is a cross section through the same; Figs. 7 and 8 are modified forms of connection for the air and sound duct leading away from the valve; and Figs. 9 to 14 are modified forms of valves and valve seats.

There is shown in Fig. 1 a structure provided with means for reproducing recorded sounds with greatly enlarged volume, but the same structure may be used for other purposes, as will appear further on. There is shown a casing 1 having one end reduced and terminating in a threaded nipple 2 where there may be attached a pipe coming from a source of compressed fluid supply, such, for instance, as a reservoir of compressed air. While steam and other fluids under pressure may be used in connection with the present invention, for the sake of simplicity of description reference will be made hereinafter only to compressed air, with the understanding that such reference is to embrace any suitable fluid under pressure.

The casing 1 is open at the end remote from the nipple 2 and there receives another casing 3 fitting snugly into the casing 1, to which it may be secured in any suitable manner. This casing 3 contains a central chamber 4 on opposite walls of which are formed annular ports 5—6 and central to each of these ports another port 7. The annulus surrounding the port 7 is supported by suitable bridge pieces, as shown in Fig. 5. The walls 8 of the chamber 4 containing the ports, 5, 6 and 7 are suitably flattened so that the ports lie in true planes. That end of the casing 3 facing the nipple end of the casing 1 is open, as indicated, while the other end between the outer walls of the casing 3 and the chamber 4 is closed, as indicated at 9. The chamber 4 extends to a point about coincident with the open end of the casing 3 and there is closed by a wall 11, or otherwise, while the other end of the chamber 4 is continued beyond the end wall 9 and is ultimately formed into a cylindrical neck 12 for the reception of an amplifying horn 13, which may be of the ordinary type used in sound reproducing machines. All the corners of the chamber 4 are rounded so that there may be no sharp angles to give rise to hissing and other disturbing sounds.

Between the walls 8—8 of the chamber 4 is a longitudinal deflector plate 14 suitably mounted in the end wall 15. The purpose of this deflector plate will appear further on.

On the inner face of the wall 8 through which the port 5 and its corresponding port 7 extend and surrounding both of these ports are formed ribs 16 terminating in practically sharp edges, and on the outer face of the wall 8 through which the port 6 and its corresponding port 7

extend, and surrounding both of these ports, are other similar ribs 16, likewise terminating in sharp edges. These ribs 16 have their edges carefully machined to true planes, and adjacent to these ribs are mounted two valves 17—18, each composed of a central hub 19 from which radiate arms 20. The hub 19 carries a disk 21, and the arms 20 carry at their outer ends an annulus 22. The disk 21 and the annulus 22 constitute the valve faces, while the ribs 16 constitute valve seats. The disk 21 is of sufficient size to cover the port 7, while the annulus 22 is of sufficient size to bridge the distance between the ribs 16 and the corresponding port 5 or 6.

In order that the valve seats may be properly turned or machined, the several walls of the chamber 4 may be made of separate pieces, afterward soldered or brazed together or otherwise joined.

The two valves 17 and 18 are mounted upon a valve rod 23 extending centrally through the two ports 7 and also through a small perforation in the plate 14. This rod 23 likewise extends through small perforations 24 in the outer walls of the cylinder 3. The valve rod 23 is carried near each end exterior to the cylinder 3 by springs 25—25 fast at one end on the casing 1.

Assuming, now, that the valves 17 and 18 are so adjusted, in a manner to be hereinafter described, that they are in proper relation to the ports 5, 6 and 7 and are equally distant from those ports but actually in very close relation thereto. A stream of air under pressure entering the casing 1 will flow through the ports 5 and 7 upon the valve 17, tending to force the same away from the corresponding ribs 16. At the same time the compressed air will tend to force the valve 18 against the ribs 16 surrounding the ports 6 and 7. There is therefore created a balance of pressure on these two valves and they will remain in indifferent positions with relation to the ports 5, 6 and 7 because of the equalized pressure and their fixed connection through the rod 23. Now, let it be assumed that the valve rod 23 is moved longitudinally in a direction to close the valves; it will be seen that the passage of air through the ports 5, 6 and 7 will be throttled to an extent commensurate with the closure of the valves. Now, again, suppose that the valve rod 23 is moved in a direction to move the valves away from their seats; it will, of course, be seen that there is a freer passage for the air through the ports 5, 6 and 7. During this time, the air pressure being equally distributed in a manner to tend to actuate the valves in opposite directions, the air pressure will have no effect whatever upon these valves to either open or close them, and, therefore, any force acting upon the rod 23 will meet no resistance except the inertia due to the weight of these valves, and this may be very small. If, now, the valve rod 23 receives impulses corresponding to sound wave vibrations, the valves 17 and 18 will participate in such vibration and will only offer such resistance as their weight may impose.

When the valves are actuated by sound vibrations the air stream flowing through the ports 5, 6 and 7 will be varied in accordance with these vibrations, with the result that sounds corresponding in the minutest particular to the vibrations imparted to the valves 17 and 18 will be produced, but with an intensity commensurate with the air pressure. Thus it is quite possible to produce from weak sounds or sound records where the recorded waves are of little amplitude, or from greatly attenuated electric impulses received telephonically, a volume of sound exceeding in intensity the original sound produced.

The casing 1 and casing 3 are supported upon an annulus 26, suitably shaped for the purpose, and this annulus may be carried by a ring 27 secured to the annulus by a set or thumb-screw 28 and provided with legs 29 fast to a fixed structure (not shown), or it may be seated in the carriage of a phonographic reproducing machine, as will hereinafter appear. Pivotally secured at one end to the annulus 26 is an arm 30, the other end of which is provided with a perforation 31 for the passage of a screw 32 engaging a nut formed in the annulus 26, so that the said arm may have a limited play to and from the annulus but may not move away therefrom to too great an extent. Secured to the arm 30 is a lever 33 connected at one end by a link 34 to the corresponding end of the valve rod 23, and at the other end carrying a reproducing stylus or jewel 35 arranged in operative relation to a cylinder 36 from which the record may be reproduced.

Secured to the casing 3 diametrically opposite the annulus 26 is a bracket 37 carrying one end of a spring 38, the other end of which is attached to a ring 39 in which is seated a diaphragm 40 attached to the valve rod 23 by a link 41 at the end of the valve rod remote from the point of connection therewith of the linl 34. The connection between the link 41 and rod 23 may be a soldered connection, so that there may be no lost motion at this point but still the rod and link may be easily disconnected when desired, by simply melting the solder. The diaphragm 40 is secured in the ring 39 by a follower 42 screwed into said ring, and this follower 42 is provided with a neck 43 receiving the small end of a horn 44, similar to the horns used on sound reproducing machines.

If it be desired to utter sounds into the horn 44 and have the same greatly augmented through the horn 13, it is then only necessary to introduce compressed air into the casing 1, when the several operations noted will be performed. If it is simply desirable to produce a megaphonic effect of sounds uttered into the horn 44, the cylinder 36 may be omitted and the stylus 35 and parts connected therewith up to the valve rod 23 are then disconnected, the link 34 being easily removed from the lower end of the rod 23 into which it is simply hooked. By this means a person speaking in an ordinary tone of voice may have his speech so magnified as to be heard at great distances, far exceeding the range of an ordinary megaphone.

In order to provide a delicate adjustment for the valves 17 and 18, the ring 39 is provided on the side opposite the spring 38 with an ear 45 through which extends a screw-threaded post 46 rising from the casing 1. Between the ear 45 and the casing 1 the post 46 carries an adjusting nut 47 back of which is a clamp nut 48, and on the side of the ear 45 away from the nut 47 the post 46 carries another adjusting nut 49 provided on one side with a sleeve 50 within which is a spring 51 bearing at one end against the ear 45 and at the other end against the adjusting nut 49. There is also provided a clamp nut 52 for the adjusting nut 49. By suitably manipulating the nuts 47 and 49 the ring 39 may be adjusted in such manner as to move the valves 17 and 18 to or from the seats formed by the ribs 16, and this adjustment

may be performed with great delicacy, due to the large size of the adjusting nuts and the long leverage between the spring 38 and the ear 45. This is by no means the only form of adjustment that may be used, for other adjusting means may be provided if found to be of sufficient delicacy for the purpose.

If the air streams flowing through the ports 5 and 6 and their corresponding ports 7 should enter the chamber 4 in opposite directions, there would be a likelihood of interference and the unbalancing of the two valves by the incoming air stream striking the back of the valve 17. In order to avoid this the deflector 14 is provided, so that these air streams are diverted toward the mouth of the chamber 4 without any possibility of the stream entering through the port 6 striking the valve 17 and thus tending to cause the closure of the valves.

Referring now, to Fig. 2, the structure therein shown is similar in most respects to that shown in Fig. 1, but the connections for reproducing recorded sounds are omitted and the amplifier 13 is also omitted. In the structure shown in this figure the chamber 4 communicates directly with a neck 53 carried by the casing of a microphonic transmitter 54 of known construction, the neck 53 taking the place of the ordinary mouthpiece of such microphone. There is this difference however, that the neck 53 is smaller than the opening in the cap of the casing 54, so that there is an annular opening 55 from the interior of the casing of the microphone 54 to the exterior thereof, while bridge pieces 56, suitably disposed, serve to center the neck 53 in the opening 55. A nut 57 serves to modify the open end of the passage 55 as may be desired.

Now, by screwing into the ring 39 an ordinary telephone receiver with the cap removed therefrom and the telephone-receiver diaphragm connected to the rod 23 by a link 41, electric impulses corresponding to sound waves coming over the line, even if greatly attenuated, will be sufficient to actuate the valves 17 and 18 so as to modify the air current entering the casing 3 and thus cause sounds of greatly magnified intensity to impinge upon the diaphragm of the transmitter 54, to be thereby transmitted to great distances. This provides a form of telephone relay of practical utility. By using a speaking diaphragm 40 with cap 42 and mouthpiece 44, all as shown in Fig. 2, the instrument is adapted to increase the power of the telephone transmitter, and this is an important adaptation of the invention.

In Fig. 3 the structure is similar to that shown in Fig. 1, except that the diaphragm 40 is replaced by an annulus 58 carrying a spring arm 59, radially disposed and connected by a link 41 to the rod 23. The structure shown in this figure is particularly adapted for the reproduction of recorded sounds with greatly augmented volume, and in this case the annulus 26 may be seated in the carriage of a phonographic reproducing machine. This carriage is conventionally represented at 60.

There are other adaptations of the invention which are not shown and need not be specifically mentioned, it being understood that the invention is adapted to be used in any connection where it is desirable to augment sounds, either as originally produced, or as transmitted through the instrumentalities comprised in the invention, or reproduced from a suitable record.

With the present invention several sound-augmenting mechanisms may be used in tandem, so that the augmented sound from one instrumentality may be caused to act upon the valve of the next one in order to correspondingly increase its amplitude of vibration, and so on through as many valves as may be desired. By this means it is possible to replace steam whistles or other signals by a series of two or three or more valves operated upon one by the other in order until the final resultant sound is many times the volume of the original sound. For this purpose the chamber 4 of one instrument such as shown in Fig. 1 may be connected directly to the neck 43 of the next instrument, and the chamber 4 of the second instrument to the neck 43 of the third instrument, and so on, with, if need be, increasing air pressure in the casing 1 of each succeeding instrument.

It may be noted that the sum of the circumferences of the ribs 16 will be great as compared with the dimensions of the valves; consequently, when a high air pressure is used slight movements of the valves will make a great change in the amount of air which passes through the ports. There is thus produced a resultant sound many times louder than would be produced by the original sound or the vibrations corresponding to sound waves.

It is also within the scope of the present invention to use the telephone receiver as described with reference to Fig. 2, and omit the stylus 35 and the parts directly coacting therewith, so that impulses telephonically received may be converted by the action of the compressed air and the valves, into sounds of greatly augmented volume which may be emitted through the horn 13 and be distinctly audible to large audiences.

If, in the structure shown in Fig. 2, the telephonic transmitter 54 be replaced by a phonographic recorder, a much greater amplitude of vibration, and, consequently, a much more pronounced record of the sounds will be made, or, because of the greater force acting upon the diaphragm of the reproducer, harder and more durable substances may be used for the recording face of the record tablet.

While I have described the valves as covering a central opening 7 and one concentric opening outside of the same, which for some results is quite sufficient, or even the opening 7 alone might be used, still for other results a number of concentric openings 5 and 6 may be necessary for the best effect. Also, the air pressure may be varied and the results obtained be correspondingly changed. Again, I may use various other forms of valves and valve openings. For instance, in Figs. 9 and 10 is shown a valve opening 61 wherein there are a number of radial extensions of the central opening and the valve 62 is correspondingly shaped. In Fig. 11 a number of single elongated openings 63 are shown arranged parallel to each other in a continuous series, and in Fig. 12 there is shown a number of elongated valves 64 connected by a bar 65 so as to match the openings 63. In Fig. 13 there is a central opening 66 and a circular series of openings 67 surrounding the same and equi-distant from the central opening, while a number of disk valves 68 correspondingly mounted upon a spider 69 may be opposed to these valve openings. It will be understood, of course, that the valves 62, 64 and 68 are connected together in pairs by the rod 23 as in the other figures of the drawings. From this it will be seen that the invention is not limited to any special

type of valve, but the valve systems may assume a great variety of forms in addition to those shown in the drawings.

In order that the neck 12 may be adapted to all the several structures intended to be carried thereby, it may be formed as shown in Fig. 7 wherein the inner surface of the outer end of this neck is tapered, as shown at 70, and receives a correspondingly socketed bell 71 having a continuation 72 which may carry the microphonic element 54, or the horn 13, or any other structure adapted to this portion of the machine.

In Fig. 8 is shown a somewhat different construction from that shown in Fig. 7, wherein the neck 12 has an inner tapered wall 70 and an outer tapered wall 73. Engaging the tapered wall 70 is the beveled end of a tube 74 which may constitute a portion of the microphone 54 or horn 13 or other part, while a sleeve 75 surrounding the tube 74 and secured thereto in anysuitable manner may have a tapered bell portion 76 receiving the tapered wall 73 of the end of the neck 12.

By means of the structures shown in Figs. 7 and 8, or some similar connection, the air valve structure may be adapted to receive interchangeably the microphonic element, or the horn, or a phonographic recorder, or, in fact, any acoustic element that may be adapted to the machine.

In the drawings there has been no attempt made to show the parts in accurate proportions, and it will be understood that the proportions may be varied from those shown in the drawings in accordance with the uses to which the instrument is to be put.

I claim:—

1. A sound-augmenting device comprising a conduit for fluid under pressure, two connected valves in said conduit for varying the flow of the fluid therethrough, one subjected to the fluid pressure on one side and the other subjected to an equal fluid pressure on the other side, and means for moving said valves to vary the flow of fluid through the conduit in accordance with sound-wave vibrations.

2. A sound-augmenting device comprising a suitable conduit for fluid under pressure, annular ports in said conduit, annular valve seats surrounding said ports, annular, balanced valves in operative relation to said valve seats, and means for moving said valves to and from the valve seats to vary the flow of fluid through the ports in accordance with sound-wave vibrations.

3. A sound-augmenting device comprising a two-part conduit for the passage of fluid under pressure, oppositely located ports constituting the means of communication from one part of the conduit to the other, two connected valves, one located in one part of the conduit and the other in the other part of the conduit in operative relation to the valve seats, and means for moving said valves in accordance with sound-wave vibrations.

4. A sound-augmenting device comprising a conduit adapted to receive fluid under pressure, another conduit interior to the first-named conduit, annular ports between the two conduits, valve seats bordering said ports, one set of seats extending into one conduit and the other set of seats extending into the other conduit, annular valves in operative relation to the valve seats, and means for operating said valves in unison to vary the flow of fluid through the ports in accordance with sound-wave vibrations.

5. A sound-augmenting device comprising a conduit for fluid under pressure, two connected valves in said conduit for varying the flow of the fluid therethrough and having opposed faces subjected to equal fluid pressure, elastic supports for the valves, and means for actuating said valves in accordance with sound wave vibrations.

6. A sound-augmenting device comprising a conduit for fluid under pressure, two connected valves in said conduit for varying the flow of the fluid therethrough and having opposed faces subjected to equal fluid pressure, elastic supports for the valves, and adjusting means for regulating the position of the valves.

7. A sound-augmenting device comprising a conduit for fluid under pressure, balanced valve mechanism for controlling the flow of fluid through the conduit, elastic supports for the valve mechanism, adjusting means connected to the valve mechanism, said means being elastically supported at one end and having a screw adjustment at the other end, and means for actuating the valves in accordance with sound-wave vibrations.

8. In a sound-augmenting device, a two-part conduit for fluid under pressure, two connected valves having the same phase of movement and one located in one part of the conduit and the other in the other part of the conduit and subjected to the flow of the fluid under pressure on opposite sides, a deflector in the part of the conduit receiving the fluid from the other part of the conduit and located to divert the incoming fluid away from the adjacent valve, and means for actuating the valve mechanism in accordance with sound-wave vibrations.

9. A means for reproducing recorded sounds comprising a conduit for fluid under pressure, a balanced valve mechanism therein for controlling the flow of the fluid through said conduit, phonographic reproducer mechanism connected with the said valve mechanism and adapted to be actuated by a sound record, and means connected with said fluid conduit at the exit end thereof for still further augmenting the sound produced, by the variation of the flow of fluid by the valve mechanism.

In testimony that I claim the foregoing as my own, I have hereto affixed my signature in the presence of two witnesses.

NATHANIEL BALDWIN.

Witnesses:
WM. WITT,
JAMES WITT.