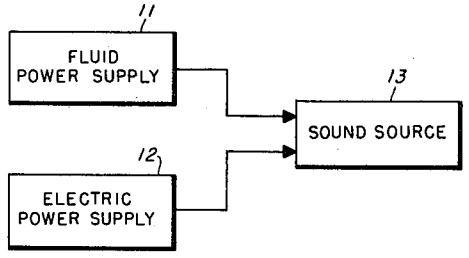
Dec. 28, 1965 L. R. PADBERG, JR 3,226,671

SOUND SOURCE

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FIG. 1



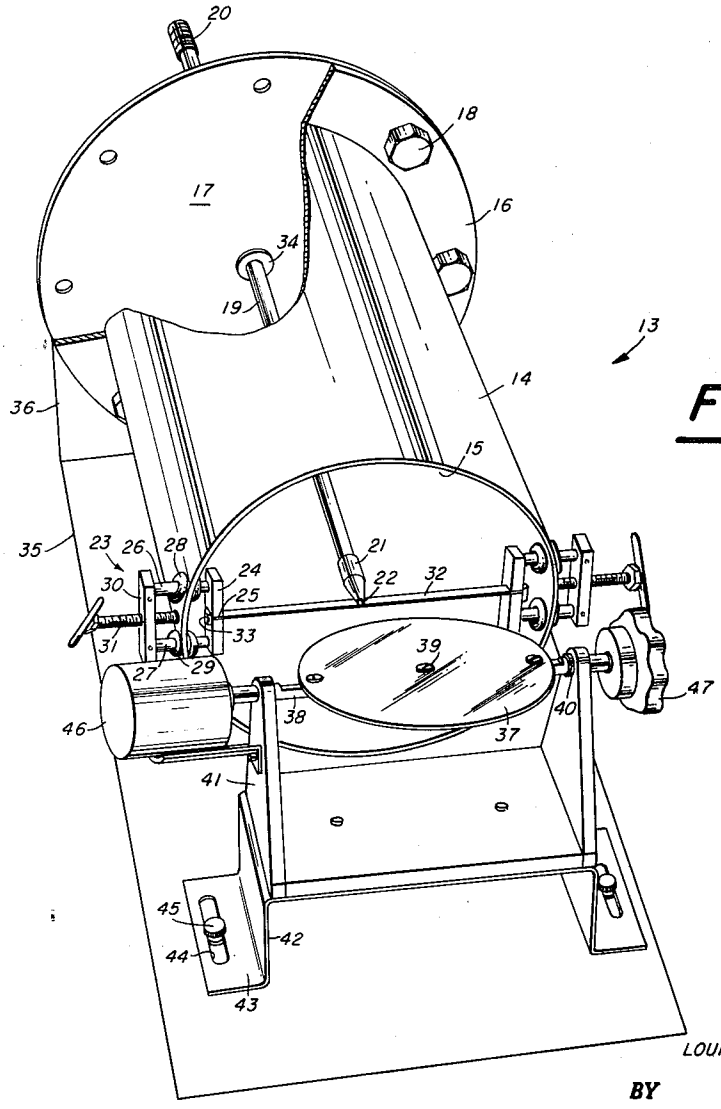


FIG. 2

INVENTOR.
LOUIS R. PADBERG, JR.

BY

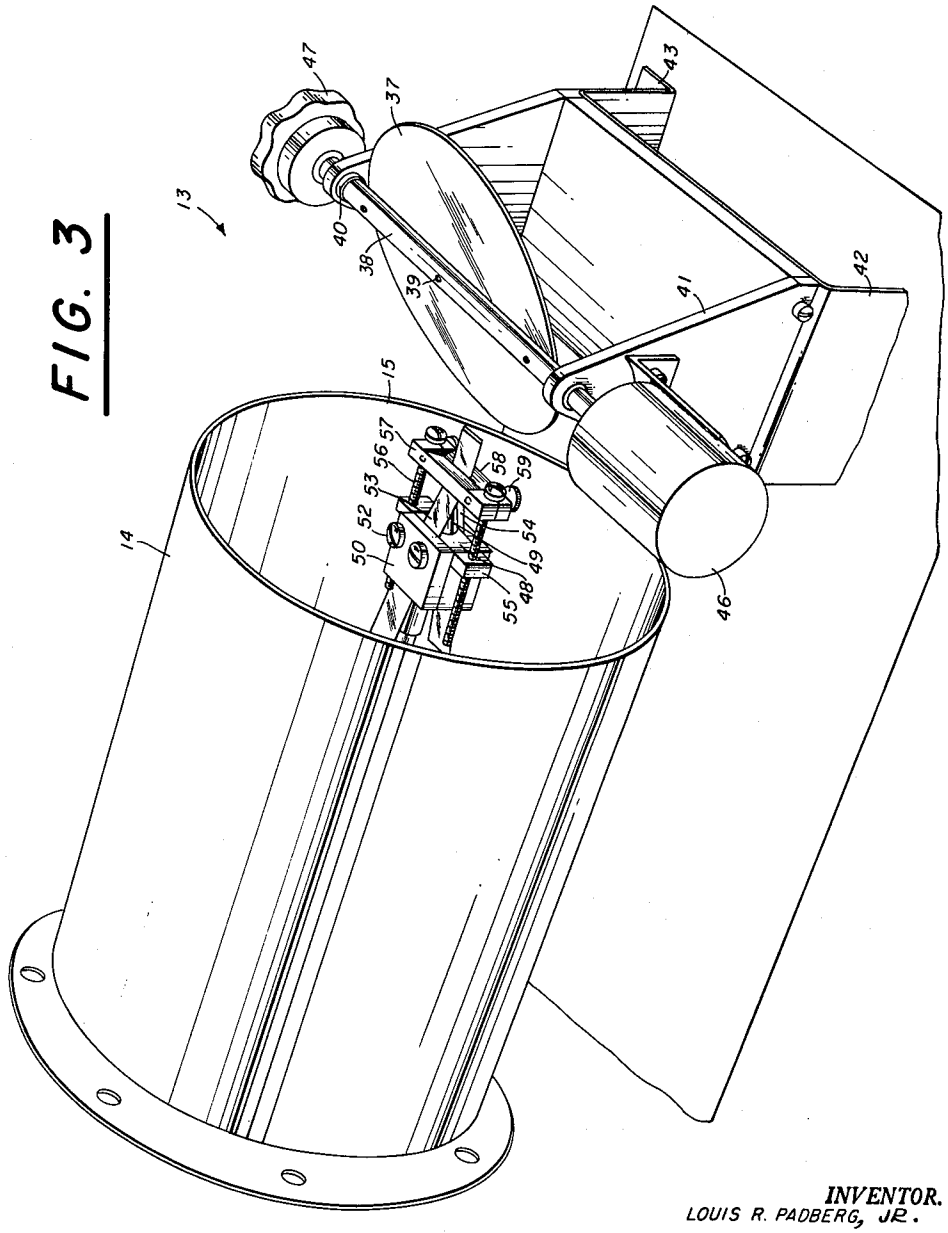
ATTORNEYS

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FIG. 3



INVENTOR.
LOUIS R. PADBERG, JR.

BY

ATTORNEYS

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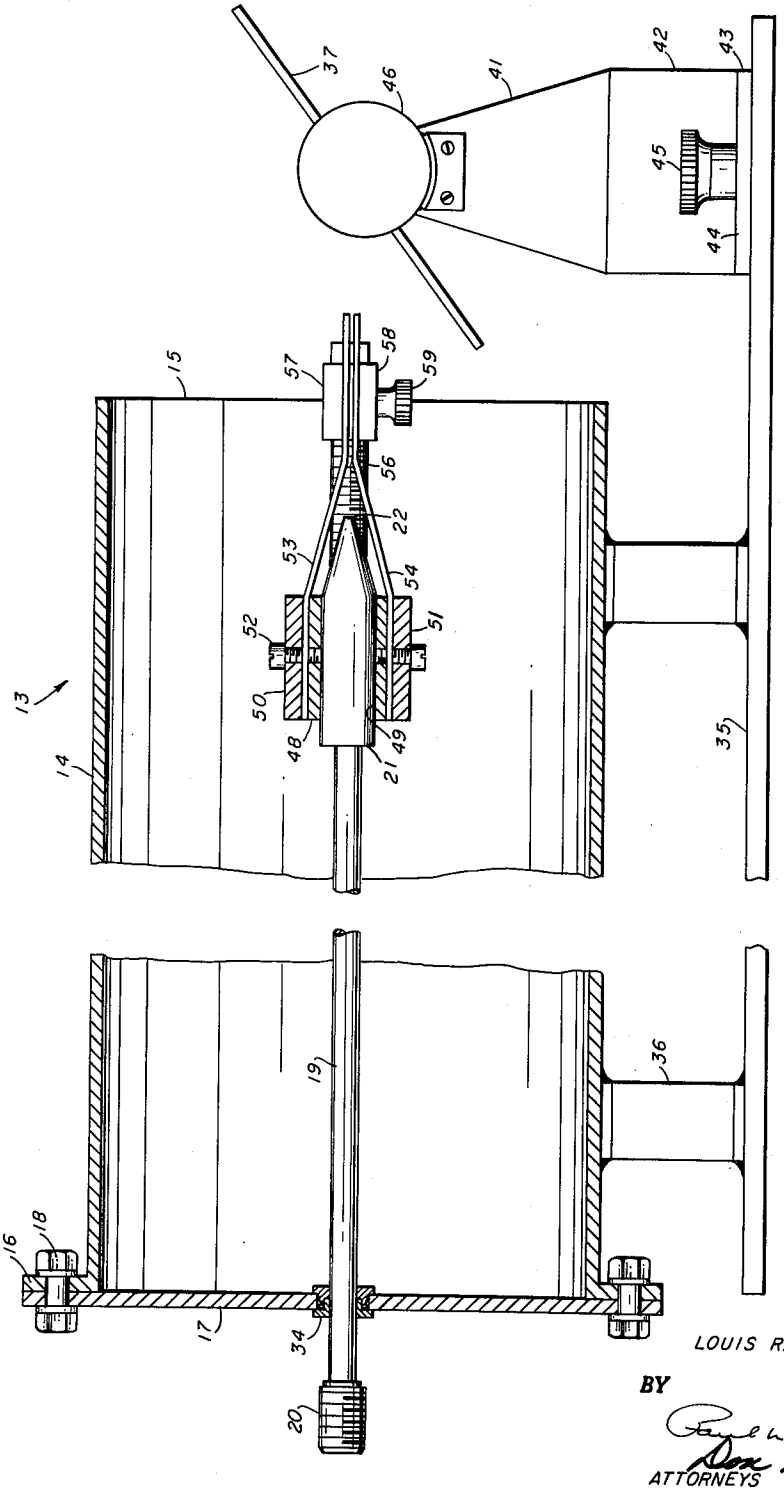


FIG. 4

INVENTOR.
LOUIS R. PADBERG, JR.

BY

ATTORNEYS

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3,226,671

SOUND SOURCE

Louis R. Padberg, Jr., 22 Rincon Vista Road, Santa Barbara, Calif.

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12 Claims. (Cl. 340—5)
(Granted under Title 35, U.S. Code (1952), sec. 266)

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.

The present invention relates in general to sound sources and in particular is a high intensity "Wolf Whistle" type sound generator especially suited for broadcasting acoustical energy throughout a subaqueous medium during sonar operations.

In the past, numerous sound sources which were adequate for many purposes have been developed. These sound sources, for example, have been used for musical, communication, echo-ranging, and other purposes, but, to date, a simple sonar sound source having the intensity and power required for optimum efficiency in sonar operations has not been developed to the complete satisfaction of those working in the field. However, the device of this invention does constitute an overall improvement over many of the sound sources employed in the sonar field in that it is exceedingly simple to construct, maintain, and operate and, furthermore, it produces sonic energy of an improved nature, the qualilative results of which are superior to those of the prior art for many operational purposes. It particularly overcomes some of the deficiencies of the prior art because of its improved power output per power input ratio and the unique type of sonic energy produced.

It is, therefore, an object of this invention to provide an improved acoustical energy generator.

Another object of this invention is to provide an improved sonar sound source.

Still another object of this invention is to provide a method and means of producing a unique high intensity sound.

A further object of this invention is to provide an improved method and means of broadcasting acoustical energy of predetermined fluctuating frequencies within an aqueous medium.

Another object of this invention is to provide a method and means of using mechanical feedback to generate in-phase sound waves.

A further object of this invention is to provide an improved method and means for producing a high power-high intensity sonic signal from a pair of interacting resonated devices.

Another object of this invention is to provide a rugged sound source that may be easily and economically manufactured and maintained.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in conjunction with the accompanying drawings in which like reference numerals designate like parts throughout the figures thereof and wherein:

FIG. 1 is a block diagram representation of the subject invention connected to its associated electrical and fluid power supply sources;

FIG. 2 pictorially depicts an exemplary preferred embodiment of the subject invention as having a tensioned-band type reed for generating the acoustical excitation energy;

FIG. 3 pictorially shows another preferred embodiment of the subject invention as having a pair of contiguously disposed flutter-type reeds for generating the acoustical excitation energy; and

FIG. 4 is a side view of the embodiment of FIG. 3 with some of the elements thereof illustrated in cross-section and some illustrated in pictorial form.

Referring now to FIG. 1, a system incorporating the sound source of this invention is shown as having a fluid power supply 11 and an electric power supply 12 which are connected as inputs to a sound source 13 for supplying the fluid power and electrical power thereto, respectively.

FIG. 2 depicts one of the preferred embodiments of sound source 13 disclosed herein as having a metallic tubular resonant chamber 14 having an open end 15 and a flanged end 16 with an end plate 17 attached thereto as by bolts 18 or by any other well-known conventional manner. Passing through an aperture in end plate 17 is a hollow tube 19 capable of having any predetermined fluid such as, for example, air or water flow therethrough. Attached to one end of said tube 19 is a fitting 20 adapted to be connected to a hose or conduit means (not shown in FIG. 2) which, in turn, is coupled to the aforesaid fluid power supply 11. On the other end of said tube 19 is a nozzle 21 that has an orifice 22 that is smaller than the inside diameter of tube 19.

Diametrically opposed at the end of chamber 14 which is open, there is mounted a pair of reed supports, each of which consists of a crossbar 24 having a slot 25 which is open to one of the side edges thereof and a pair of shafts 26 and 27 attached at each extremity of said crossbar in a direction normal to the longitudinal axis thereof. Said shafts respectively extend through a pair of rubber grommets 28 and 29 disposed in a complementary pair of holes located in the wall of resonant chamber 14. At the other end of shafts 26 and 27 is mounted another crossbar 30 having a hole in the center thereof containing screw threads. An adjustment screw 31 is threaded in the screw threads of crossbar 30 and is of such length as to contact the outside of the resonant chamber wall. Disposed within the slot is a thin metallic blade or reed 32 having end stops or beads 33 attached to the outer extremities thereof for contact with the outer face of each of the aforesaid crossbars 24. Although the aforementioned reed 32 is preferably disclosed herein as being a spring steel reed, it should be understood that any appropriate vibrating body or element may be substituted therefor without violating the spirit and scope of this invention because so doing would obviously be within the purview of the skilled artisan after he had the benefit of teachings herein presented.

The aforementioned hollow tube 19 extends through a hole in end plate 17 in such manner that it is securely mounted therein. Preferably, however, the securing of said tube 19 shoulde be accomplished by means of a packing gland 34 which permits tube 19 to be slidably moved therein in order to effect any desired tube length within resonant chamber 14.

Resonant chamber 14 and its associated apparatus is preferably mounted on a base plate 35 having one or more supports 36.

At an adjustable distance from the open end 15 of resonant chamber 14 a variable deflector plate assembly is positioned. This assembly includes a deflector plate 37 mounted on a shaft 38 by means of screws 39 or any other suitable conventional connecting means. Shaft 38 is disposed within bearing holes 40 of brackets 41 in such manner that both said shaft and deflector plate may be rotated or not as desired. Brackets 41, of course, are so disposed as to have deflector plate 37 interposed therebetween and in the path of any acoustical energy emanating from the open end of resonant chamber 14. Brackets 41 are also integrally mounted on an inverted U-shaped bracket 42 having flanged ends 43 which act as feet that

rest upon the upper surface of base plate 35. Flanged end 43 each have an elongated slot 44 disposed therein in such manner that the entire deflector plate assembly may be moved nearer to the open end of resonant chamber 14 are further away therefrom as necessary to achieve any preferred operational objective. An adjustment set screw 45 is used to hold the flanged end of the aforesaid deflector plate assembly in rigid contact with base plate 35, thereby maintaining a given distance between reed 32 and deflector plate 37. Disposed on one of the aforesaid flanges 41, preferably on the outside surface thereof, is a waterproof reversible variable speed electric motor 46 which is also attached to one end of shaft 38 for rotation thereof. At the other end of shaft 38 is a knob 47 attached thereto for manual rotation of deflector plate 37 if desired.

Referring now to FIGS. 3 and 4, there is shown another preferred embodiment of sound source 13 which is substantially identical to the sound source disclosed in FIG. 2 except for the vibrating reed assembly. Therefore, all of the elements except those of the vibrating reed assembly are referenced by reference numerals which are the same as those used to designate their respective operable elements of the sound source illustrated in FIG. 2.

As is shown in FIGS. 3 and 4, the vibrating reed assembly and its associated support structure is mounted directly on the nozzle end of fluid supply tube 19. Actually, said reed assembly is mounted on said nozzle 21 in a snug fit arrangement effected by a split plate 48 with a thickness that is slightly less than that of the outside diameter of nozzle 21 at its thickest location. At the split of plate 48 there is disposed a pair of semicircular apertures which form a circular aperture when the ends thereof are placed together. Said aperture, of course, are so designed as to snugly fit about the outside surface of nozzle 21 without distorting the structural configuration thereof. Due to the abutment of split ends of said split plate 48, the upper and lower surface thereof remains a substantially continuous surface as far as the associated parts are concerned. Thus, a pair of reeds may be supported by said surface without being adversely affected by the slit. This support is achieved by means of upper and lower plates 50 and 51 which are bolted by means of bolts 52 to the aforesaid split plates 48. Thus, nozzle 21 and a pair of vibrational reeds 53 and 54 are sandwiched and clamped therebetween in a pressed fit assembly.

Although this particular arrangement for securely mounting the vibrational reed assembly to nozzle 21 is one of the preferred types disclosed herein. Any suitable arrangement which holds said reeds in their respective illustrated position would be satisfactory to achieve the operational objectives of this invention.

At the outer extremities of split plate 48 there are a pair of ears 55 each of which contain a threaded hole for having adjustable screw bolts 56 screwed therein. Spatially disposed from the orifice of nozzle 21 is a pair of bars 57 and 58 which are used to clamp reeds 53 and 54 together in such manner that there is room for them to vibrate against each other and said bars. Bars 57 and 58 are held together by means of screws 59 which are adjustable in order to allow adjustments of the proper space between reeds 53 and 54 from effecting any predetermined desired flutter frequency thereof. Bolts 56 extend through mating apertures of bars 57 and 58 in such manner that said bars are rigidly disposed and properly held together at some preferred distance from the end of nozzle 21 by screws 59 in order to effect optimum flutter characteristics of said reeds during any given operational circumstances.

Briefly, the principle of operation of the subject invention is as follows:

Under certain circumstances, a sympathetic resonance may occur between a tone generating means such as a vibrating string or reed and the sound box of a musical instrument. The resulting effect is usually undesirable due to its high intensity, unmelodious, screech-like sound which causes it to be considered unpleasant to the human ear. Because such sounds are not intentionally made by the musician, and inasmuch as they ordinarily are beyond the control thereof, they have been defined in physics textbooks as a "wolf-tone."

Such a tone, although undesirable in the musical field, is useful in certain acoustical operation such as, for example, in sonar operations, because it may be efficiently produced and employed to move various and sundry media subject to presure wave differentials such as sea water, fresh water, or other aqueous mediums. Hence, the unique structure constituting this invention has been constructed for the purpose of intentionally generating such wolf-tone sounds at predetermined varying, fluctuating, or constant frequenices as desired.

In this case, the vibrating member which originally generates the frequency desired is the metallic reed element or elements.

In the embodiment of FIG. 2, this is depicted as a single metallic blade that is stretched with a predetermined tension across the inside diameter of the resonant chamber. Obviously, due to the disclosed reed support members, the tension thereof may be manually adjusted by screws 31 to obtain the tautness and, hence, the tonal pitch desired. The reed is energized or vibrated by passing air, water, or any other appropriate fluid over it from a properly positioned nozzle. Of course, the power of energization of said reed will vary with the pressure and velocity of the fluid jet flowing from the orifice of the nozzle and the manner in which it strikes the reed. However, since these parameters are all adjustable, it would be obvious for the artisan to make the proper design selection thereof which would suit any size and type sound source of the disclosed types being used, as well as the circumstances under which they are to operate.

Resonant chamber 14 is sympathetically excited by the vibrating member and when the two are in resonance, a substantial sound level will be attained. Relative positioning of said vibrating member and resonant chamber, of course, should be such as will produce optimum power efficiency due to maximum acoustical transfer and interaction therebetween. Accordingly, the positioning thereof should be adjustable and regulated in accordance with the inherent characteristics of each that are involved.

At an adjustable distance from the aforementioned vibrating reed-resonant chamber assembly, the rotatable deflector plate is positioned. At a certain critical angle thereof, the sound emanating from the open end of the resonant chamber will be reflected as mechanical or acuostical feedback into the resonant chamber in phase therewith. The result is a greatly increased acoustical output energy level.

Depending on operational circumstances encountered, said deflector may be positioned manually and constantly secured to produce the frequency preferred. Or, in the alternative, it may be rotated at any preferred speed and direction by properly controlling the reversible, variable-speed motor attached to one end of the shaft upon which it is mounted. So doing causes a fluctuating tone to be generated which is desirable for some applications.

The embodiment of the subject invention illustrated in FIGS. 3 and 4 work in essentially the same manner as the embodiment of FIG. 2. A high-speed jet of fluid from the nozzle energizes a pair of contiguously disposed reeds instead of a single reed to initiate the generation of sonic energy. Otherwise, the operations are the same.

In this disclosure, only metallic spring blade type reeds are shown as the vibrating sound generators. But, it should be understood that many types of vibrating means such as, for instance, vibrating rods, strings, bars, balls, etc., may be employed without violating the scope and spirit of this invention, since so doing would obviously be well within the purview of one skilled in the art after he had the benefit of the teachings herein presented.

Obviously, many modifications and variations of the present invention are possible in the light of the above teachings. It is, therefore, to be understood, that within the scope of the appended claims, the invention may be practiced other than as specifically described.

What is claimed is:

1. A sound source comprising in combination, a resonant chamber, means disposed within said resonant chamber for generating acoustical energy therein for effecting vibratory excitation thereof, and means disposed external of said resonant chamber in the path of said generated acoustical energy for reflecting same back thereto in phase with the vibration thereof.

2. The device of claim 1 wherein said resonant chamber is a hollow cylinder with a closed end and an open end.

3. The device of claim 1 wherein said means disposed within said resonant chamber for generating acoustical energy therein for effecting vibratory excitation thereof comprises a tube adapted for transporting a pressurized fluid therethrough, nozzle means mounted on the end of said tube for increasing the velocity of said fluid as same is ejected therefrom, a pair of adjustable supports each of which is mounted at diametrically opposed positions on the aforesaid resonant chamber, and a vibratable reed suspended between said pair of supports in such manner as to be adjusted in tension and frequency of vibration, said reed being disposed in the path of the fluid ejected from said nozzle.

4. The device of claim 1 wherein said means disposed within said resonant chamber for generating acoustical energy therein for effecting vibratory excitation thereof comprises, a hollow tube adapted for transporting a pressurized fluid therethrough, nozzle means mounted on the end of said hollow tube for increasing the velocity of said fluid as same is ejected therefrom, a pair of vibratory reeds contiguously disposed with each at a position spaced from the end of said nozzle and in the path of the fluid ejected therefrom, said reeds being curved in such manner as to extend from said fluid path to a position on opposite sides of said nozzle respectively, and means interconnecting said nozzle and said reeds for supporting those portions thereof extending on the opposite sides of said nozzle in a substantially fixed relative position therewith.

5. The device of claim 4 further characterized by a first bar contacting one of said pair of reeds opposite the side thereof disposed in the path of said ejected fluid, a second bar contacting the other of said pair of reeds opposite the side thereof disposed in the path of said ejected fluid, means interconnecting each of said pair of bars for maintaining same in substantially predetermined relative positions, and means connected between the aforesaid reed supporting means and said pair of bars for spatially maintaining said bars a predetermined distance from said nozzle.

6. A wolf whistle sound source comprising in combination, a hollow cylindrical resonant chamber, vibrating means disposed adjacent to one end of said hollow cylindrical resonant chamber for generating sonic energy, means connected to said vibrating means for adjusting the frequency thereof within predetermined limits, and a rotatable planar disc disposed external of said hollow cylindrical resonant chamber in the path of said sonic energy for reflecting a portion of said energy into said chamber.

7. The device of claim 6 further characterized by means connected to said rotatable sonic energy reflecting means for manually rotating same to any predetermined fixed position.

8. The device of claim 6 further characterized by means effectively connected to said rotatable sonic energy reflecting means for adjustably positioning same at any predetermined distance from the aforesaid hollow cylindrical resonant chamber.

9. The device of claim 6 further characterized by motor means effectively connected to said rotatable sonic energy reflecting means for rotating same at any predetermined speed.

10. A sound source comprising in combination, a resonant chamber, vibration means disposed adjacent to one end of said resonant chamber, means spatially disposed from said vibration means for energizing same in such manner as to effect generation of predetermined frequency acoustical energy, means connected to said vibrating means for adjusting the frequency thereof within predetermined limits, and rotatable means spatially disposed from said resonant chamber for reflecting said acoustical energy back into said chamber.

11. A method of producing a wolf tone comprising the steps of vibrating a reed for generating acoustical energy, resonating a chamber with the acoustical energy generated by said vibrating reed, and reflecting a portion of said acoustical energy back into said chamber in phase with the resonance frequency thereof after it has emanated therefrom.

12. A method of broadcasting sonar signals within an aqueous medium comprising the combined steps of energizing a chamber at its resonance frequency with predetermined acoustical energy, reflecting a portion of said acoustical energy back into said chamber in a predetermined variable phase relationship with the resonance frequency thereof after it has emanated therefrom, and submerging said chamber within the aforesaid aqueous medium while said portion of acoustical energy is being reflected back thereinto.

References Cited by the Examiner

UNITED STATES PATENTS

1,113,400	10/1914	Baumgartner	116—137
1,540,023	6/1925	Kollinek	116—137
2,462,862	3/1949	Guthner	116—147

OTHER REFERENCES

L. R. Padger, Jr., Novel Sound Sources. NEL Report 990 U.S. Navy Electronics Las., San Diego, California, October 17, 1960, pages 60–61.

CHESTER L. JUSTUS, *Primary Examiner.*

J. W. MILLS, G. M. FISHER, *Assistant Examiners.*