March 11, 1969 B. B. BEEKEN 3,432,804

FLUID ULTRASONIC GENERATOR

Filed Oct. 25, 1966

Fig. 1

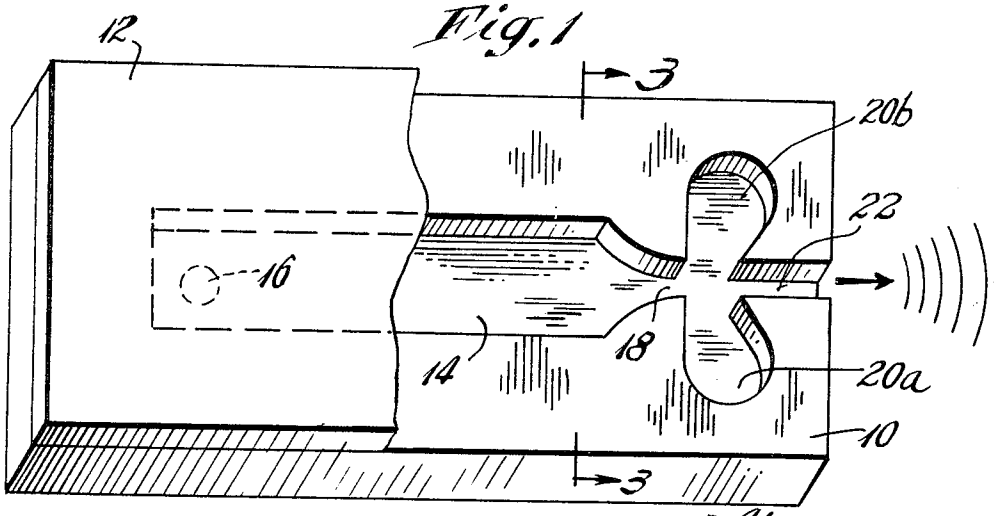



Fig. 2

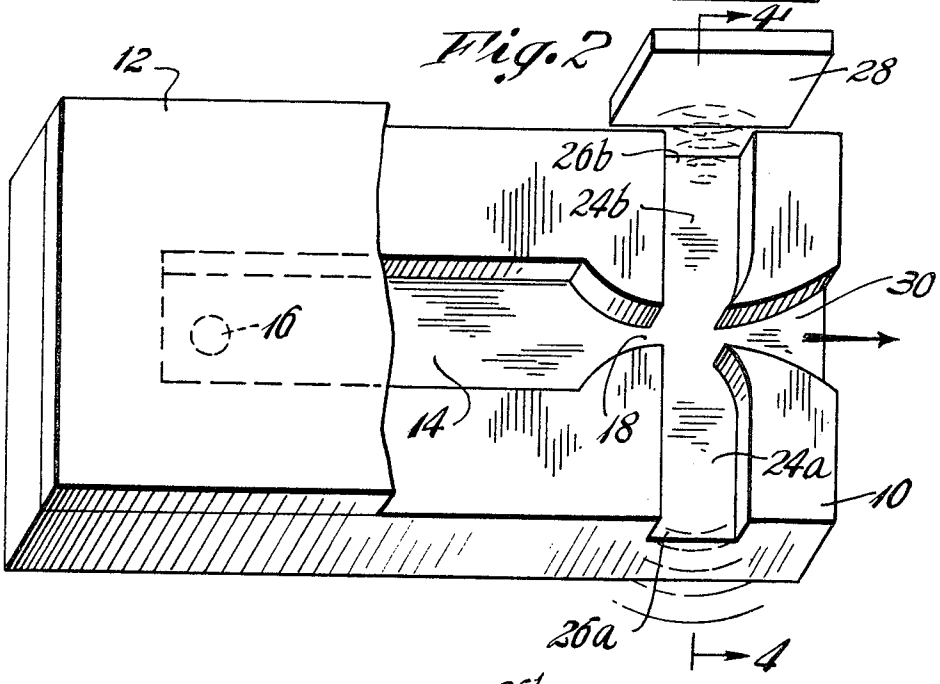



Fig. 3

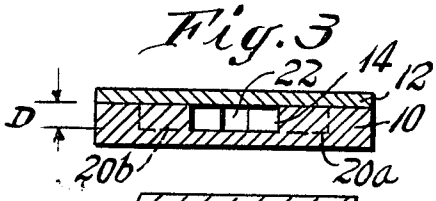



Fig. 4

Fig. 5

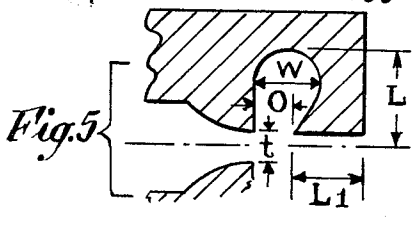
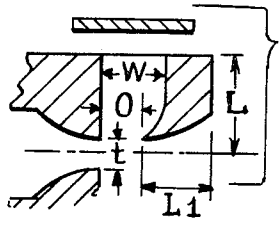



Fig. 6

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3,432,804

# FLUID ULTRASONIC GENERATOR

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Int. Cl. H04b 11/00

## ABSTRACT OF THE DISCLOSURE

A whistle device for generating wave energy in the ultrasonic frequency range. The device has a fluid inlet chamber terminating in a restricted throat, and an outlet channel spaced from the throat and of substantially the same width. Resonance cavities are disposed on opposite sides of the fluid stream with entrance orifices lying along the edge of the fluid stream flowing between the throat and the outlet channel to generate ultrasonic frequency vibrations in the fluid stream.

This invention relates to a device for generating sonic energy. It more particularly relates to a device for the generation of ultrasonic energy by means of a fluid.

It is an object of this invention to provide a fluid powered ultrasonic generator.

It is a further object to provide a fluid ultrasonic generator that may be easily constructed, is compact and may be operated under relatively low fluid pressure.

These and other objects of my invention will become apparent as the description thereof proceeds.

The invention consists of a device having a fluid supply chamber which feeds through a restricted orifice into at least one resonating chamber and to an outlet orifice. The resonating cavities may be closed or open. The ultrasonic energy is detected at the outlet orifice when the cavities are closed and at the cavity outlets when the cavtities are open.

The various relative internal dimensions of the device result in the generation of the ultrasonic energy.

The invention may be better understood by reference to the drawing which represent embodiments of the invention in which:

FIG. 1 is a perspective view of the device with a closed cavity, with the cover broken away to show the interior fluid passages or channels.

FIG. 2 is a perspective view of the device with open cavities with a reflector at one cavity, with the cover broken away to show the interior fluid passages.

FIG. 3 is a cross-sectional view taken along the section line 3—3 of FIG. 1.

FIG. 4 is a cross-sectional view of the device of FIG. 2, taken along the section line 4—4 of FIG. 2.

FIG. 5 is a diagrammatic partial plan view of the device of FIG. 1 showing relative dimensions.

FIG. 6 is a diagrammatic partial plan view of the device of FIG. 2 showing relative dimensions.

Referring to the drawings, FIG. 1 shows an embodiment of the invention where the sonic device has closed resonance cavities.

The generator is constructed of two flat plates of any suitable material, a lower plate **10** into which the channels and cavities are cut, etched, molded and otherwise formed, and an upper cover plate **12** which serves to cover the channels. Plate **10** has a fluid supply channel **14** with a fluid inlet port **16** near one end. At the opposite end the air supply channel narrows to a constriction or throat **18**. Beyond throat **18**, resonance cavities **20***a* and **20***b* are spaced on each side. An outlet channel **22** leads out of the device. The outlet channel **22** has substantially the same width as the downstream end of the throat **18** with the result that the entrance orifices of the cavities **20***a* and **20***b* are substantially parallel in the direction of fluid flow and lie along the edges of the fluid stream between the throat **18** and the upstream end of the outlet channel.



It will be obvious the channels could be etched in the underside of the cover **12** instead of in the base **10** and that fluid inlet **16** can be in either base **10** or cover **12** as desired.

The design of the generator is such that the frequency of the acoustic output is primarily a function of its geometry and not the operating range of 0.5 to 3 p.s.i.g.

The cavity length L, measured from the center line of throat **18** is about one-half the wave length of the acoustic output frequency $\lambda$. For optimum performance, the cavity width W is about 3 times the throat width *t*. The cavity orifices O are about 1.5 times the throat width *t*. The depth D of the channels and cavities is equal to or greater than throat width *t*. The outlet channel length L, must be about one-half the wave length of the output frequency.

In operation, a fluid is fed through inlet **16** into fluid channel **14**. The fluid passes through throat **18**, passes resonating cavities **20***a* and **20***b*. The acoustic energy is detected at outlet channel **22**.

The embodiment of FIG. 2 is generally similar to that of FIG. 1 and consists of a base plate with the channels formed in it and a cover plate **12**. A fluid supply channel **14** is formed in base **10**, and a fluid inlet **16** is provided at one end of channel **14**. At the opposite end of channel **14**, it narrows to throat **18**. On each side of throat **18** are located cavities **24***a* and **24***b*. Cavities **24***a* and **24***b* are open at their outer ends **26***a* and **26***b* respectively. A reflector **28** may be used at one cavity opening to reflect the sonic energy to the other cavity and thereby increase the energy output at that cavity.

A fluid outlet **30** is provided beyond cavities **24***a* and **24***b*. Outlet **30** is shaped differently than outlet **22** of the embodiment of FIG. 1. This is done to minimize impedance. However, as with the previous embodiment, at least the upstream end of the outlet channel **30** has substantially the same width as the downstream end of the throat **18** with the result that the entrance orifices of the cavities **24***a* and **24***b* are substantially parallel in the direction of fluid flow and lie along the edges of the fluid stream between the throat **18** and the upstream end of the outlet channel.

The generator of FIG. 2 has an acoustic output energy of about 10 times that of the closed cavity type shown in FIG. 1. It also has the characteristic of broader ranging from 0.5 to 6 p.s.i.g. fluid pressure for producing the fundamental frequency at which point the second harmonic appears. The output is greatest at one of the cavity openings **26***a* or **26***b* rather than in the direction of the air stream.

The ultrasonic energy may be detected at both cavity openings **26***a* and **26***b*. As an alternative, a reflector **28** may be spaced from one opening **26** as shown at **26***b*, to reflect the sonic energy to the other channel **26***a*, the spacing will be such that the reflected sonic waves will be in phase with the sonic waves in cavity **26***a* and therefore increased sonic energy may be detected at cavity opening **26***a*. It will be understood that the reflector could be at cavity opening **26***a* and the sonic energy detected at cavity opening **26***b* if desired.

In the device of FIG. 2, the cavity lengths L are about one half the wavelength of the acoustic output $\lambda$, and the cavity width W is about 3 times the throat width *t*. The cavity orifices O are about 1.5 times the throat width *t*. The depth D of the channel cavities is equal to or greater than the channel width *t*. The flow output orifice

30, as previously indicated is designed to minimize flow impedance.

Although the device has been shown with a plate having channels and cavities formed in it and a flat cover plate, it will be understood that the only requirement is that the channels and cavities be present. It would, of course, be possible to work grooves in both plates and place the plates together to form closed channels.

While I have disclosed certain specific embodiments and preferred modes of practice of my invention, it will be understood that this is solely for the purpose of illustration, and that various changes and modifications may be made in the invention without departing from the spirit of the disclosure or the scope of the appended claims.

I claim:

1. A fluid powered ultrasonic generator comprising,

a fluid supply chamber,

an inlet to said fluid supply chamber adjacent one end thereof,

a throat at the opposite downstream end of said fluid supply chamber,

resonance cavities on each side of said throat and downstream thereof, the entrance orifice of each said cavity being about 1.5 times the width of said throat and the width of each said cavity being about 3 times said throat width, and the cavity length being about a multiple of one half the wave length of the acoustic output frequency,

and a fluid outlet channel downstream from said cavities and said throat, at least the upstream end of said output channel being substantially equal to said throat width, the entrance orifices of said cavities extending from the downstream end of said throat to the upstream end of said outlet channel and lying along the edges of the fluid stream flowing therebetween.



2. The ultrasonic generator of claim 1 wherein said cavities are closed, and the length of said fluid outlet channel is about .5 times the wave length of the acoustic output frequency.

3. The ultrasonic generator of claim 1 wherein said cavities are open.

4. The ultrasonic generator of claim 3 comprising in addition means to reflect the sonic energy at one of the cavity openings to the other cavity.

5. Apparatus as defined by claim 1 wherein said outlet channel diverges from said upstream end thereof.

6. Apparatus as defined by claim 1 wherein the outer end of one of said cavities is effectively blocked while the outer end of the other of said cavities is open.

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U.S. Cl. X.R.

116—137; 137—81.5; 181—.5