United States Patent

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[73] Assignee **The United States of America as represented by the Secretary of the Army**

[54] **NEGATIVE FEEDBACK FLUIDIC OSCILLATOR**
2 Claims, 2 Drawing Figs.

[52] **U.S. Cl.** **137/81.5**
[51] **Int. Cl.** **F15c 1/08**
[50] **Field of Search** 137/81.5

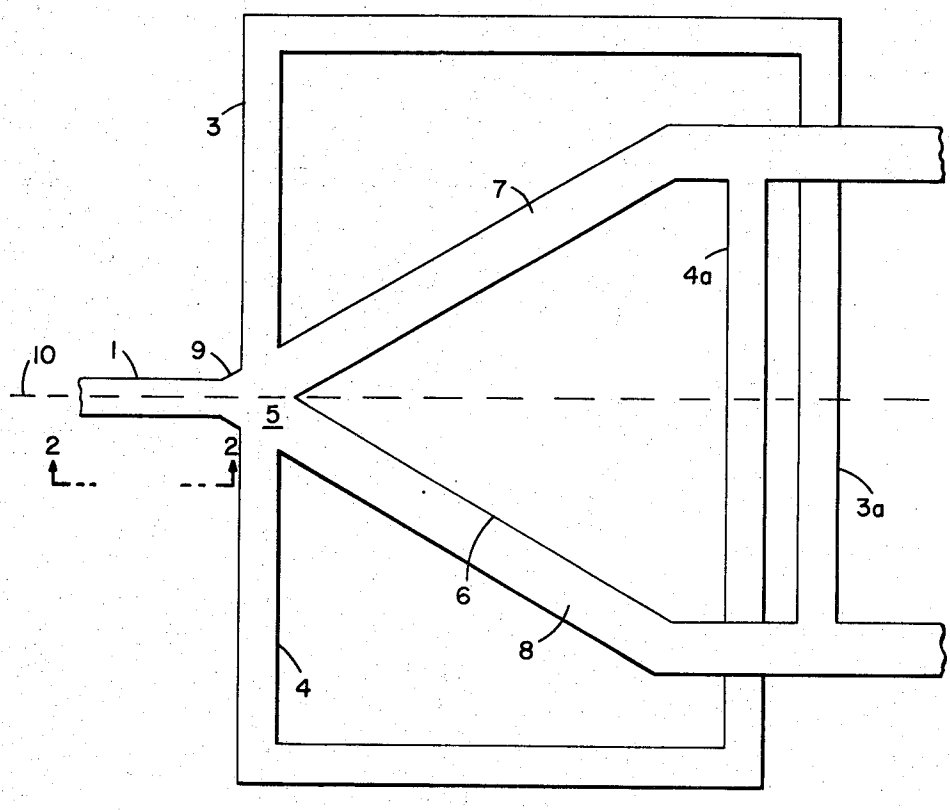
[56] **References Cited**

UNITED STATES PATENTS

3,185,166	5/1965	Horton et al.	137/81.5
3,444,879	5/1969	McLeod, Jr.	137/81.5
3,504,691	4/1970	Campagnuolo et al.	137/81.5

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ABSTRACT: A supersonic fluid power-jet flows into an overexpanded divergent nozzle. A control flow against one side of the jet splits, passes around, and impinges on the opposite side of the jet. The jet therefore is deflected in the direction from whence the control flow came, rather than being deflected in the normal opposite direction. Two output passageways are provided, one on each side of a longitudinal axis of the power-jet, with a control flow taken from each output. Each control flow is applied to the power-jet on an opposite side of the axis from the output from which the control flow is taken.



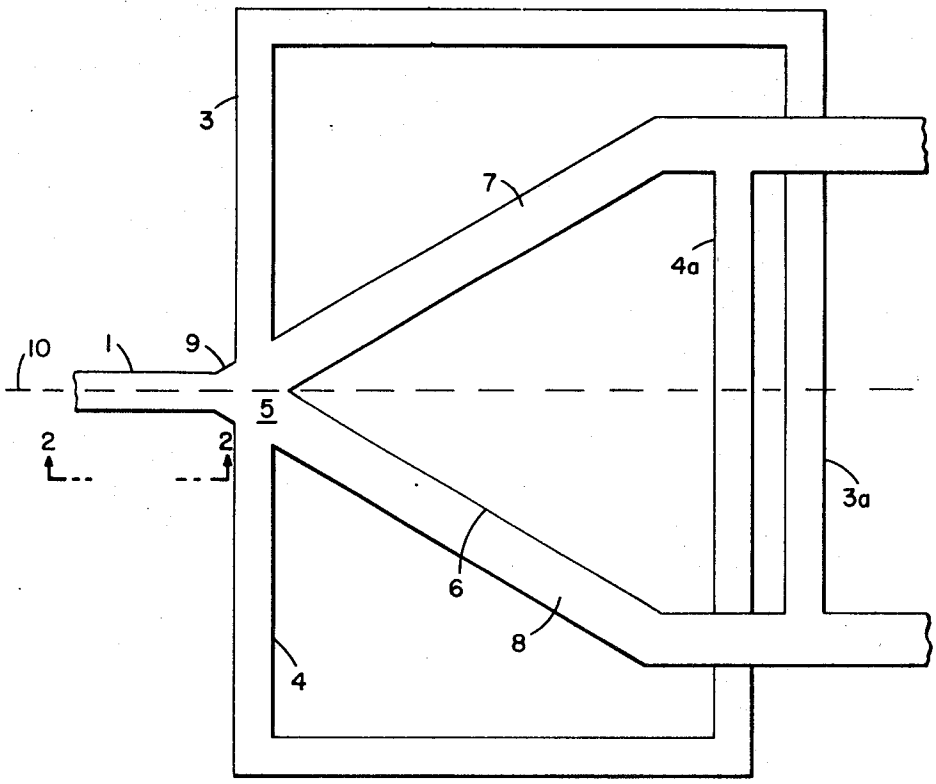


FIG. 1



FIG. 2

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NEGATIVE FEEDBACK FLUIDIC OSCILLATOR

BACKGROUND OF THE INVENTION

This invention is in the field of fluidic oscillators. Various types of fluidic oscillators are known, such as the sonic oscillator. Various other types of fluidic oscillators are shown in U.S. Pat. Nos. 3,204,652 of Sept. 7, 1965; 3,238,960 of Mar. 8, 1966; and 3,275,016 of Sept. 27, 1966. All of these patents employ one type or another of positive feedback. U.S. Pat. No. 3,024,805 of Mar. 13, 1962 shows an example of a fluidic amplifier employing negative feedback. As is well known, an electronic oscillator, which finds its analogy in a fluidic oscillator, must have positive feedback in order to operate. The usual fluidic oscillator likewise needs positive feedback, and the usual fluidic amplifier, if it uses feedback at all, uses negative feedback. One exception for amplifier feedback is found in U.S. Pat. No. 3,030,979 of Apr. 24, 1962, wherein an induction amplifier is shown. In the induction amplifier, the power-jet deflects toward the control flow, opposite to the usual deflection direction. The instant invention differs from the known fluidic oscillators by employing negative feedback, but without using induction amplifier techniques.

SUMMARY OF THE INVENTION

A fluidic oscillator using negative feedback is the invention. A supersonic power-jet of the oscillator passes through an overexpanded divergent nozzle. A control flow applied to the power-jet splits, passes around the jet, and impinges on the opposite side of the jet, rather than penetrating the jet. The power-jet is therefore deflected in the direction from whence the control flow comes, rather than the normal opposite direction. The control flows are taken from outputs opposite the sides of the power-jet to which they are applied.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a top plan view of the invention. FIG. 2 shows a partial side view of the invention taken in the direction 2–2 as shown on FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. 1 of the drawings shows a power-jet passageway 1 connected to a divergent nozzle 9. Control flow passageways 3 and 4 communicate with opposite sides of nozzle 9. The nozzle communicates with one end of a receiving chamber 5. Splitter 6 is at the opposite end of the receiving chamber and has output passageways 7 and 8 on opposite sides thereof. Connected respectively to passageways 7 and 8 are ends 4*a* and 3*a* of passageways 3 and 4.

In operation, a power-jet from passageway 1 enters one of output passageways 7 or 8. A corresponding control flow is thereby established in a respective one of passageways 4 or 3. The power-jet flow is supersonic. As can be seen in FIG. 2, an

expansion nozzle 11 exists between passageway 1 and conical nozzle 9. Nozzle 11 is overexpanded for the power-jet used. The power-jet is of such a flow rate that it does not expand sufficiently to fill the space between the upper and lower walls of 9 (as seen on FIG. 2). A control flow from one of passageways 3 or 4 enters nozzle 2, splits, passes around the power-jet, and impinges on the power-jet from the opposite side. The power-jet therefore moves in the direction from which the control flow comes. Obviously, this is in the opposite direction from the direction that a power-jet normally moves in response to a control flow. The power-jet then switches from one to the other of passageways 7 and 8, and a control flow is established in the corresponding one of control passageways 3 and 4. The oscillator oscillates at a frequency determined by the input (power-jet) pressure, volume, and by feedback geometry. The overexpanded divergent nozzle 11 may in fact be a standard ("off-the-shelf") item, but operating at a reduced pressure. A sufficient pressure reduction results in a power-jet which does not fill the vertical dimension of cone 9 (as seen in FIG. 2). Obviously, the power-jet does not fill cone 9 in its horizontal dimension (as seen in FIG. 1), in accordance with the usual fluidic practice.

It should be understood that passageways 3 and 4 need to be curved to pass around passageways 7 and 8. The output of the invention may be taken from either output passageways 7 and 8 or control flow passageways 3 and 4. As can be seen, the inventive oscillator is generally symmetrical about a longitudinal axis 10.

I claim:

1. A negative feedback fluidic oscillator having a longitudinal axis and including a power-jet passageway; an overexpanded divergent nozzle communicating with said passageway; a receiving chamber communicating at one end with said nozzle whereby a power-jet from said power-jet passageway attains a supersonic velocity in said receiving chamber; a spliter at the opposite end of said chamber; first and second output passageways on opposite sides of said spliter and said axis; first and second control passageways each having two ends, with one end of each of said control passageways communicating with a respective output passageway, and the other end communicating with said nozzle on an opposite side of said axis from the output passageway to which each of said one ends communicates, wherein said receiving chamber, said nozzle, and said other end of each of said control passageways have surfaces defined by two planes parallel to each other and to said axis, and wherein said power-jet expands to a size less than the distance between said two planes.

2. The oscillator as defined in claim 1, wherein said other ends of said control passageways communicate with said nozzle at a position along said axis to allow a flow in either one the control passageways to split and pass around said power-jet, and impinge on the power-jet from the opposite side, and thereby deflect the power-jet in the direction from whence the control came.