United States Patent

[11] **3,556,409**

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[33] **Sweden**
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[54] **FLUID CONTROL DEVICE**
12 Claims, 7 Drawing Figs.

[52] **U.S. Cl.** **239/433,** 137/81.5
[51] **Int. Cl.** **B05b 7/04**
[50] **Field of Search** 239/433, 265.23, 265.27; 137/81.5

[56] **References Cited**
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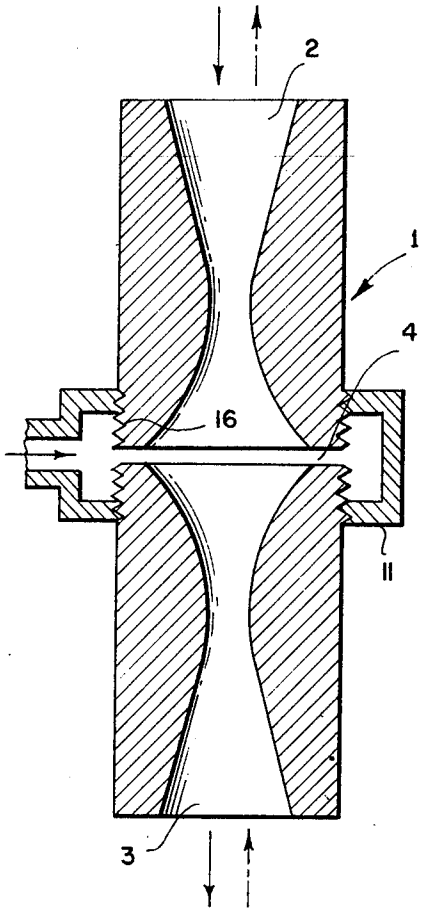
Attorney—Larson and Taylor

ABSTRACT: A fluidistor fluid control device comprising a plurality of channels such as Laval nozzles, each channel extending from a control jet inlet to an outlet, such that the direction of flow of fluid through the channel is dependent on the relative flow characteristics of the channels. These flow characteristics can be varied by varying the shape or size of the channels, or by applying a separate control fluid to the interior of one or more of the channels.



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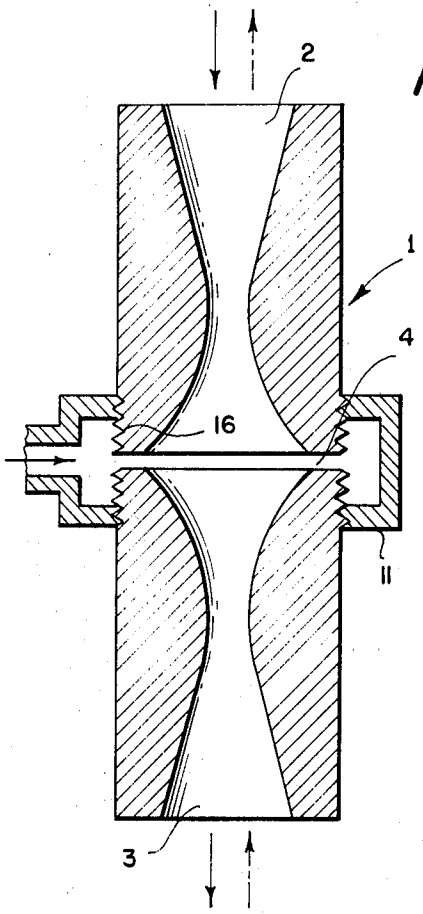
SHEET 1 OF 2

FIG. 1



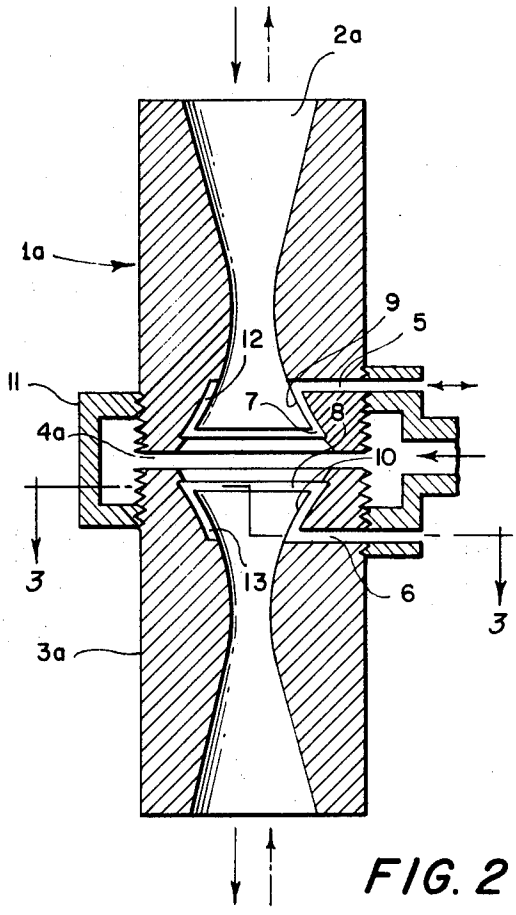


FIG. 2

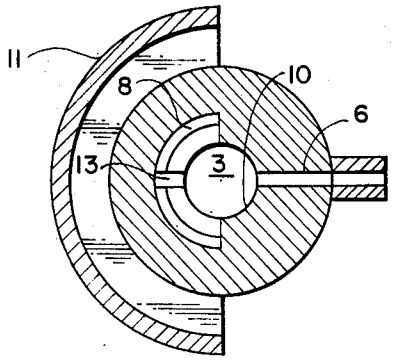


FIG. 3

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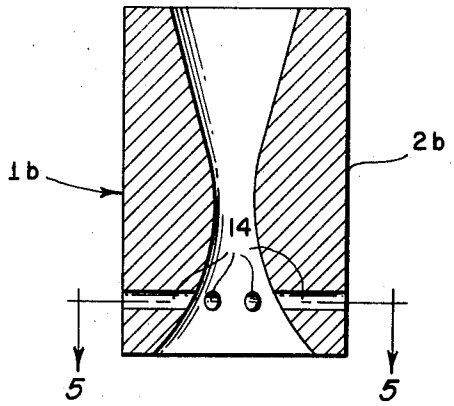


FIG. 4

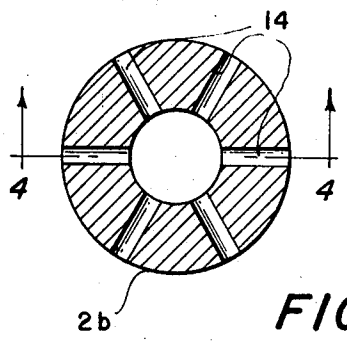


FIG. 5

FIG. 6

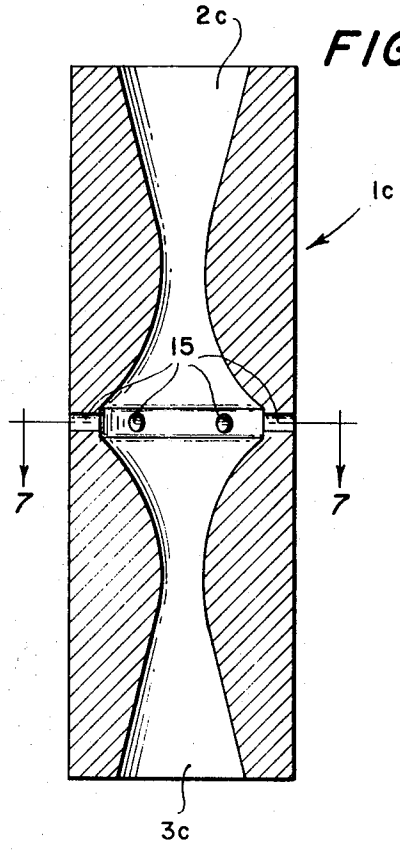
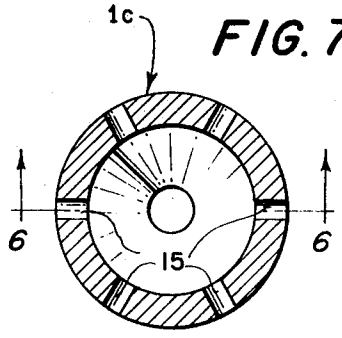


FIG. 7



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FLUID CONTROL DEVICE

BACKGROUND

This invention relates to fluid control devices; and in particular it relates to a wall locking type of device known as a fluidistor, the operation of which is based on the phenomenon known as the Coanda effect, meaning that the fluid stream through the device follows one of the walls of the channels without touching it. A known type of wall-locking fluidistor is formed as a Laval nozzle according to the French patent specification 1,210,899. Inside the Laval nozzle there is an inlet formed as a slot for the control jet. Owing to the Coanda effect, the control jet follows the inside wall of the nozzle towards the outlet. The control jet causes suction in the inlet of the Laval nozzle and a power stream is thus created. However, a disadvantage of the known type of wall locking fluidistor is that the direction of the power stream cannot be reversed.

Thus, there exists a need for an improved fluid control device of the wall-locking fluidistor type, which is simple to construct, dependable in use and in which the power stream can be easily reversed.

SUMMARY OF THE INVENTION

Thus, it is a purpose of this invention to provide a new and improved fluid control device of the wall-locking fluidistor type which is simple to construct, dependable in use, and in which the power stream can be easily reversed.

According to the present invention there is provided a housing having at least one inlet for the control jet input and at least two outlet channels, the walls of the channels being arranged such that the fluid selects one or the other of the outlet channels. The device further includes control means located either inside or outside of the housing for determining the direction of flow of the power stream. In the operation of this type of device, the control jet generates, by the ejector effect, a suction in the channel or channels that are not operating as outlet channels. The suction causes a power stream in the channel or channels, which power stream leaves the fluidistor, together with the control jet, through the outlet channel as a mixed fluid.

In one embodiment of the invention two Laval nozzles are arranged opposite each other with the control jet input inlet located between them.

The control jet inlet may be in the form of an annular slot or in the form of a plurality of a annularly arranged passages. Various means may be provided for changing the fluid characteristics of the individual channels. For example, the channels can be replaced by other channels of varying sizes and shapes. Alternatively, fluid flow passages may be provided for introducing additional control fluid into the interior of one or more of the channels to affect the fluid flow characteristics of the channel.

Thus, it is a purpose of this invention to provide a new and improved fluid flow device.

It is a further object of this invention to provide a new and improved wall-locking fluidistor wherein the direction of flow of the power stream can be easily reversed.

It is a further object of this invention to provide a new and improved fluid flow control device which is simple to construct and dependable in use.

Other objects and the attendant advantages of the present invention will become apparent from the detailed description to follow together with the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWINGS

There follows a detailed description of the preferred embodiment to be read together with the accompanying drawings. However, it is to be understood that this description and the accompanying drawings are provided for purposes of illustration and that the invention is capable of numerous modifications and variations apparent to those skilled in the art.

FIG. 1 is cross-sectional view showing a fluid control device constructed in accordance with the present invention.

FIG. 2 is a cross-sectional view showing another embodiment of the invention.

FIG. 3 is a sectional view taken along line 3–3 of FIG. 2.

FIG. 4 illustrates, in cross section, a modified construction of the control channel, and is taken along line 4–4 of FIG. 5.

FIG. 5 is a cross-sectional view taken along line 5–5 of FIG. 4.

FIG. 6 is a cross-sectional view illustrating still another embodiment of the invention, and is taken along line 6–6 of FIG. 7.

FIG. 7 is a cross-sectional view taken along line 7–7 of FIG. 6.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings, like numerals are used to designate like elements throughout; and the subscript *a*—*c* represent different embodiments of the invention.

FIG. 1 illustrates a first embodiment of the invention. There is shown a fluid control device **1**, comprising a pair of channels **2** and **3** which are suitably formed as **2** Laval nozzles in alignment with each other and directed away from each other. An inlet **4** is formed as an annular slot between the channels **2** and **3**. The control jet enters the central housing section **11** and enters the inlet **4**. The direction of further travel of the control jet is determined by the fluid characteristics of the nozzles **2** and **3**. For example, the nozzles can have inlets of different shapes or different areas, whereby the nozzle having the smaller area has a larger flow resistance.

The direction of flow may also be controlled by shutting off one of the nozzles **2** or **3** thereby forcing the fluid flow through the other nozzle; and this flow continues even after the first nozzle has been uncovered (assuming that the areas of the nozzles are otherwise such as to provide equal flow resistance).

In another mode of operation, a collapsible resilient bag (now shown) can be connected to one of the channels. Assuming that the fluid flows to this channel, the bag will then become filled with fluid. At a certain pressure in the bag, the fluid will change its direction and flow out through the other channel. The pressure at which this occurs depends on the dimensions of the channels. The ejector effect causes the bag to be emptied and a subatmospheric pressure appears again in the channel connected to the bags. The fluid is then again caused to change its direction and the bag is refilled.

The fluid control device can be provided with various control means for controlling the direction of flow through the channels. For example, as noted above, the channels may be constructed of different sizes and shapes. Moreover, as shown in FIG. **1**, the housing can be constructed in three sections, a central section **11** and two lateral sections containing the channels **2** and **3**. As illustrated by the numeral **16**, the channel members can be threadedly engaged in the central section **11** whereby the spacing between the channel and the inlet are individually adjustable, and whereby channels of various sizes may be screwed into place on either side of the central section **11**.

FIGS. **2** and **3** illustrate another embodiment of the invention **1***a* having channels **2***a* and **3***a* joined together at a central section **11***a* and having formed therebetween an annular inlet slot **4***a*. In this embodiment the control means comprises control passages **5** and **6**, located in the channel members **2***a* and **3***a* respectively, which passages communicate with passages **12** and **13** respectively, which in turn communicate with annular slots **7** and **8** respectively. By means of these passageways the fluid flow characteristics of the nozzles **2***a* and **3***a* and hence the direction of flow of the incoming control jet, are controlled either by feedback fluid from one of the channels or by an additional fluid from an exterior source.

FIGS. **4** and **5** illustrate another embodiment of the invention, **1***b*, wherein the passageways **5** and **13** and the annular

slot 7 in the member 2*a* are replaced by a plurality of annularly arranged openings 14. Of course the same modification could concurrently be made in the other channel member 3*a*.

In still another embodiment of the invention, 1*c* as shown in FIGS. 6 and 7, the fluid control device is constructed as one elongated member wherein the central section 11 is eliminated and the control jet enters the device through a plurality of annularly arranged openings 15. Of course in this embodiment, either of the channels 2*c* or 3*c* could also be provided with the type of control means as illustrated in FIGS. 2 through 5.

The illustrated embodiments of the invention show two channels aligned with each other. However, it is clearly within the context of the present invention to provide any number of outlet channels. The plurality of outlet channels need only extend outwardly from a common control jet inlet point. For example, a plurality of channels may be arranged like spokes about a central control jet inlet opening, whereby the relative flow characteristics of the various channels would determine to which channel the control jet flowed.

Although the invention has been described in considerable detail with respect to preferred embodiments, it should be apparent that the invention is capable of numerous modifications and variations apparent to those skilled in the art without departing from the spirit and scope of the invention.

I claim:

1. A fluid control device comprising a housing having at least one inlet for a fluid control jet input, at least two channels each being a Laval nozzle, the two Laval nozzles arranged opposite each other on opposite sides of the said inlet, each channel in fluid communication with the said inlet at one end, the other end of each channel being an outlet end, such that the channel into which the control jet flows from the inlet is dependent upon the relative flow characteristics of the channels.

2. A fluid control device according to claim 1 wherein the inlet is formed as a plurality of openings arranged annularly between the channels.

3. A fluid control device according to claim 1 wherein the inlet is formed as an annular slot between the channels.

4. A fluid control device according to claim 1 wherein at least one of said channels includes a control passage arranged to direct fluid directly into its respective channel for affecting the flow characteristics of that channel.

5. A fluid control device according to claim 4 wherein said control passage terminates in an annular passage in its respective channel.

6. A fluid control device according to claim 4 wherein said control passage comprises a plurality of separate passages extending through the housing and terminating in its respective channel.

7. A fluid control device according to claim 1 including means for mounting the channels such that the distance between them can be varied.

8. A fluid control device according to claim 7 wherein said means for mounting further permits at least one of said channels to be removed and replaced by another channel of a different size, whereby the relative areas of the channels can be varied.

9. A fluid control device comprising a housing having at least one inlet for a fluid control jet input, a plurality of channels, each channel in fluid communication with the said inlet at one end, the other end of each channel being an outlet end, each of said channels being Laval nozzles such that the channel into which the control jet flows from the inlet is dependent upon the relative flow characteristics of the channels, the inlet being formed as a plurality of openings arranged annularly between the channels.

10. A fluid control device comprising a housing having at least one inlet for a fluid control jet input, a plurality of channels, each channel in fluid communication with the said inlet at one end, the other end of each channel being an outlet end, each of said channels being Laval nozzles such that the channel into which the control jet flows from the inlet is dependent upon the relative flow characteristics of the channels, the inlet being formed as an annular slot between the channels.

11. A fluid control device comprising a housing having at least one inlet for a fluid control jet input, a plurality of channels, each channel in fluid communication with the said inlet at one end, the other end of each channel being an outlet end, each of said channels being Laval nozzles such that the channel into which the control jet flows from the inlet is dependent upon the relative flow characteristics of the channels, at least one of said channels including a control passage arranged to direct fluid directly into its respective channel for effecting the flow characteristics of that channel, said control passage terminating in an annular passage in its respective channel.

12. A fluid control device comprising a housing having at least one inlet for a fluid control jet input, a plurality of channels, each channel in fluid communication with the said inlet at one end, the other end of each channel being an outlet end, each of said channels being Laval nozzles such that the channel into which the control jet flows from the inlet is dependent upon the relative flow characteristics of the channels, and including means for mounting the channels such that the distance between them can be varied, and wherein said means for mounting further permits at least one of said channels to be removed and replaced by another channel of a different size, whereby the relative areas of the channels can be varied.