United States Patent

Kopera

[15] **3,677,276**

[45] **July 18, 1972**

[54] INTERRUPTIBLE JET SENSOR

[72] Inventor: **Anthony Kopera,** Beltsville, Md.

[73] Assignee: **Bowles Fluidics Corporation,** Silver SPrings, Md.

[22] Filed: **Oct. 2, 1970**

[21] Appl. No.: **77,595**

[52] **U.S. Cl.** **137/14,** 137/83

[51] **Int. Cl.** **F15b 5/00,** G06d 16/00

[58] **Field of Search** 137/83, 82, 81.5, 14; 73/37.7

[56] **References Cited**

UNITED STATES PATENTS

2,919,712	1/1960	Markey	137/81.5 X
3,285,608	11/1966	Lyman	137/82 X

Primary Examiner—Alan Cohan

Attorney—Rose and Edell

[57] **ABSTRACT**

Object presence in a gap is detected by a fluid jet issued across the gap toward a sensor opening and interruptible by the object. Supply and outlet passages communicate with the sensor opening. Jet interruption permits supply passage fluid to exit from the sensor opening and aspirate the outlet passage. The uninterrupted jet impacts supply passage fluid just outside the sensor opening, producing a back pressure in the opening which directs supply passage fluid into the outlet passage. Supply passage fluid pressure is selected to prevent entry of the unblocked jet into the sensor opening, thereby assuring flow of only clean supply fluid through the outlet passage.

9 Claims, 4 Drawing Figures

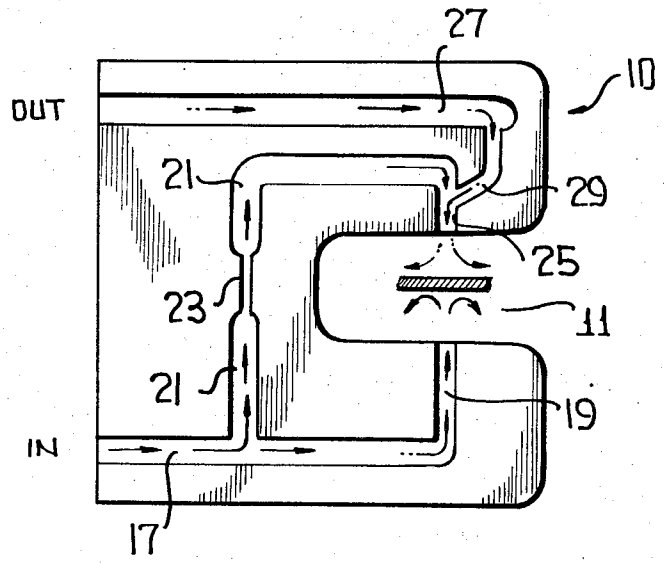


FIG.1

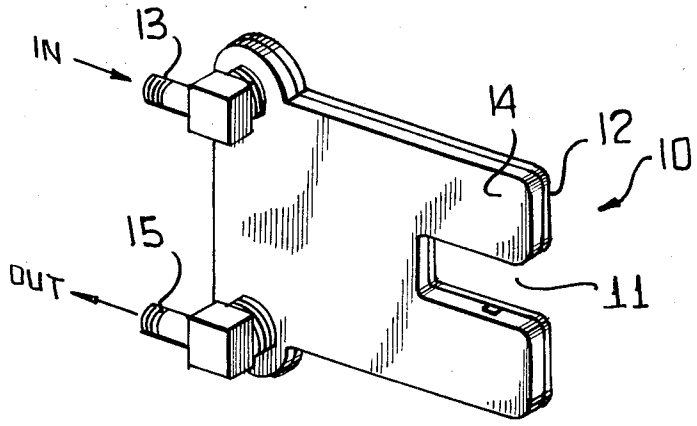


FIG.2

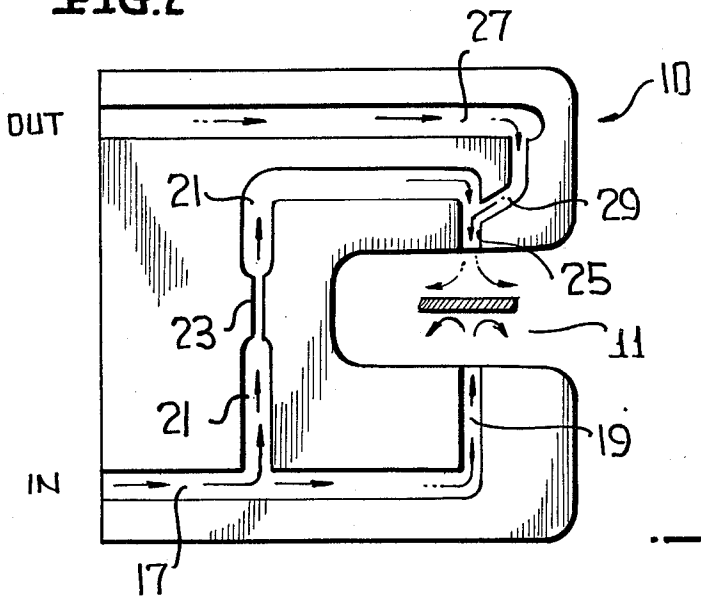
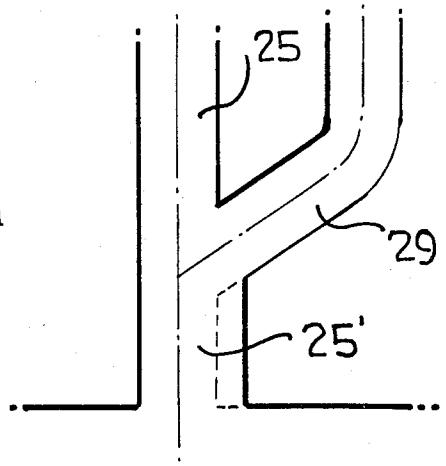


FIG.4



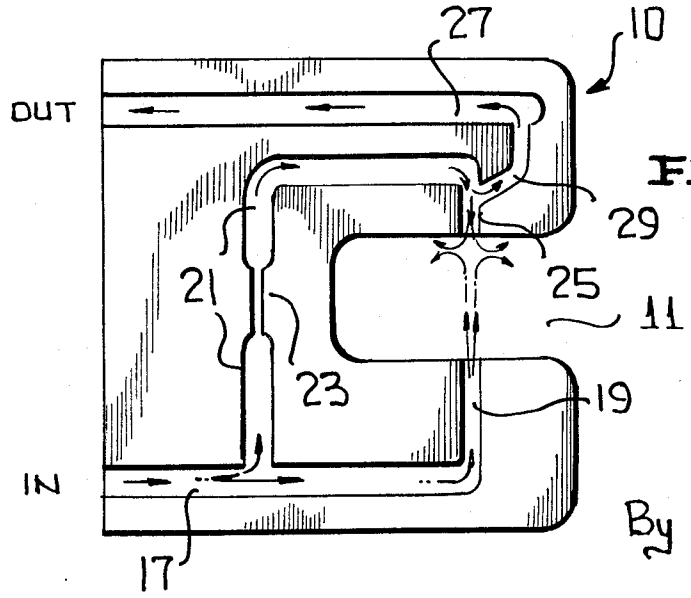


FIG.3

INVENTOR
ANTHONY KOPERA

By Hurwitz & Rose

ATTORNEYS

INTERRUPTIBLE JET SENSOR

BACKGROUND OF THE INVENTION

The present invention relates to object detection and more particularly to object detection by means of interruptible fluid jets.

Prior art interruptible jet sensors usually involve issuance of a jet across a gap toward a sensing port which communicates with an outlet passage. If an object is present in the gap the jet is blocked and the outlet passage pressure is low. If the jet is unblocked, it flows into the outlet passage to provide a high pressure therein.

A major disadvantage with prior art interruptible jet sensors results from the fact that the jet entrains dust, dirt particles, etc. from the atmosphere and carries it into the outlet passage. The particles tend to collect on the outlet passage walls, restricting and eventually blocking fluid flow therethrough.

It is an object of the present invention to provide an interruptible jet sensor wherein foreign particles are prevented from entering the sensor port.

SUMMARY OF THE INVENTION

In accordance with the principles of the present invention, the sensor port communicates with a fluid supply passage arranged to aspirate the outlet passage when the sensing jet is interrupted. The pressure of fluid in the supply passage is selected to prevent the uninterrupted jet from entering the sensor port. In this manner, impact of the jet against supply fluid occurs just outside the sensor port, creating a back pressure therein which in turn diverts the clean supply fluid into the outlet passage.

BRIEF DESCRIPTION OF DRAWINGS

The above and still further objects, features and advantages of the present invention will become apparent upon consideration of the following detailed description of specific embodiments thereof, especially when taken in conjunction with the accompanying drawings, wherein:

FIG. 1 is a view in perspective of an interruptible jet sensor according to the present invention;

FIGS. 2 and 3 are diagrammatic illustrations of respective operating modes of the sensor of FIG. 1; and

FIG. 4 is an enlarged partial view in plan of an alternative embodiment of the sensor of FIG. 1.

DESCRIPTION OF PREFERRED EMBODIMENTS

Referring to FIG. 1 of the accompanying drawings, a sensor 10 has an outline contour which defines a generally U-shaped gap 11. Pressurized fluid, for example, air, is received through a fitting 13 and causes a fluid jet to be issued across gap 11. In the manner to be described below, interruption of the jet by an object in gap 11 provides a relatively low pressure at an output fitting 15. When the jet is uninterrupted a relatively high pressure appears at fitting 15.

Referring now to FIGS. 2 and 3, inlet fitting 11 supplies the pressurized fluid to a primary supply passage 17 which feeds a nozzle 19 terminating at one side of gap 11. A portion of the pressurized fluid in primary supply passage 17 is also fed to secondary supply passage 21 which includes a flow restrictor 23 and which feeds another nozzle 25 terminating directly across gap 11 from and in alignment with nozzle 19. The termination of nozzle 25 defines the sensor port or opening of the unit.

An outlet passage 27 terminates at one end at output fitting 15 of FIG. 15. The other end of outlet passage 27 is fed from an output nozzle 29 which terminates angularly at nozzle 25. More specifically, nozzle 29 terminates at an angle of about 30° relative to nozzle 25 and at a location upstream of the sensor port.

The pressurized fluid supplied to primary supply passage 17 is filtered and substantially free from dirt and other foreign particles. The pressure of the supply fluid is such to cause a sensing jet to issue from nozzle 19 generally toward the sensor opening at nozzle 25. When an object is disposed in gap 11 between nozzles 19 and 25, as illustrated in FIG. 2, the sensing jet is blocked. Fluid supplied to secondary supply passage issues into gap 11 via nozzle 25 and, in the process, entrains fluid from outlet passage 27. Consequently, a relatively low or slightly negative pressure appears in outlet passage 27 when the sensing jet is interrupted by an object.

When no object is present in gap 11, as illustrated in FIG. 3, the sensing jet is uninterrupted and impinges against fluid issued from nozzle 25. The size of restrictor 23 in secondary supply passage 21 is chosen so that the total pressure of fluid supplied to nozzle 25 from secondary supply passage 21 is equal to or just slightly greater than the total pressure of the sensing jet at the sensor opening (i.e. — at the termination of nozzle 25). This prevents the sensing jet (and its entrained impurities) from ever entering nozzle 25. However, the flow balance condition achieved at the sensor opening between the jet and the secondary supply fluid creates a back pressure in nozzle 25 which diverts secondary supply fluid into nozzle 29. This fluid increases the pressure in outlet passage 27 to a relatively high level.

By preventing sensing jet fluid from entering the outlet passage and assuring that only the filtered secondary supply fluid is permitted to flow in the outlet passage, the device of the present invention minimizes the possibility of contamination of an output device connected to the outlet passage. Such an output device may be, for example, a fluidic OR/NOR gate such as the type described in U.S. Pat. No. 3,340,885.

Sizing of flow restrictor 23 must take into account the loading effect of an output device connected to output passage 27 as well as the total pressure of the sensing jet at the sensor opening. The greater the flow required by the output device, the lower is the pressure of the secondary fluid supplied to the sensor port from passage 21. If the secondary supply fluid pressure drops to low, sensing jet fluid will be permitted to enter nozzle 25 and outlet passage 27. To avoid this, restrictor 23 must be increased in size if the output device requires a larger flow than originally contemplated.

I have found that the following dimensions are satisfactory for a sensor with a 0.25 inch gap wherein all passages are rectangular in cross-section:

passages 17, 21, 27	0.062" wide × 0.062" deep
restrictor 23	0.024" wide × 0.028" deep
nozzle 19	0.040" wide × 0.040" deep
nozzle 25	0.050" wide × 0.040" deep
nozzle 29	0.020" wide × 0.040" deep

It should be noted that nozzle 29 is wider than nozzle 19. This permits improved pressure recovery of the sensing jet at the sensor port, a feature which is advantageous in view of the tendency of the sensing jet to disperse while traversing gap 11. It is possible to provide for improved jet pressure recovery at the sensing port without enlarging nozzle 29 in its entirety. This is illustrated in FIG. 4 wherein nozzle 25 is narrower upstream of its intersection with nozzle 29 than downstream thereof at region 25'. The widening at downstream region 25' is effected by cutting back the nozzle wall through which nozzle 29 communicates. The advantage of this arrangement is that the narrower upstream portion of nozzle 25 presents a relatively high impedance to reverse flow, thereby providing more secondary supply fluid to the outlet passage.

While I have described and illustrated one specific embodiment of my invention, it will be clear that variations of the details of construction which are specifically illustrated and described may be resorted to without departing from the true spirit and scope of the invention as defined in the appended claims.

I claim:

1. A sensor comprising:

a fluid supply passage terminating in a sensor port and arranged to flow pressurized fluid through said sensor port;

an outlet passage interruptible with said sensor port and positioned to be aspirated by said pressurized fluid flowing through said sensor port;

nozzle means for issuing a fluid jet toward said sensor port when unblocked;

wherein the pressure of said pressurized fluid at said sensor port is sufficiently high to impinge against said jet proximate said sensor port and prevent fluid from said jet from entering said outlet passage while diverting part of said pressurized fluid into said outlet passage.

2. The sensor according to claim 1 wherein said sensor port includes a longitudinal axis and wherein said outlet passage intersects said sensor port at an angle of approximately 30° relative to said sensor port whereby to permit efficient aspiration of fluid from said outlet passage by said fluid flowing through said sensor port.

3. An interruptible jet sensor comprising:

a body having a contour wherein two sidewalls define a gap therebetween, one of said sidewalls having a sensor port defined therein and opening into said gap;

means for issuing a fluid jet generally across said gap toward said sensor port;

supply means for issuing supply fluid from said sensor port at sufficient pressure to balance said jet proximate said sensor port and prevent inflow of fluid from said jet into said sensor port, thereby providing a relatively high pressure in said sensor port; and

output means for sensing said relatively high pressure at said sensor port, said output means comprising a fluid passage disposed at an angle with respect to said sensor port to permit said supply fluid to aspirate fluid from said fluid passage whenever said fluid jet is blocked from impinging against said supply fluid.

4. An interruptible jet sensor comprising a body having defined therein:

an open gap area;

a first fluid passage arranged to receive pressurized fluid;

a nozzle arranged to receive pressurized fluid from said first fluid passage and issue a fluid jet across said gap;

a second fluid passage arranged to receive pressurized fluid from said first fluid passage, said second fluid passage including a flow restrictor;

a second nozzle terminating across said gap from said first nozzle and arranged to receive pressurized fluid from said second fluid passage and issue same into said gap;

an outlet passage terminating at said second nozzle and arranged to be aspirated by fluid issuing into said gap from said second nozzle and to receive fluid from said second nozzle when the pressure in said gap is greater than ambient;

wherein the size of said flow restrictor is chosen such that for a predetermined pressure of fluid applied to said first fluid said jet and fluid issued from said second nozzle achieve a flow balance sufficiently proximate said second nozzle to thereby increase the pressure in said second nozzle above ambient.

5. The sensor according to claim 4 wherein said second nozzle has a larger cross-section than said first nozzle.

6. The sensor according to claim 4 wherein said second nozzle is wider at its downstream end than its upstream end, said upstream and downstream ends being separated by the termination of said outlet passage.

7. The sensor according to claim 4 wherein said outlet passage is disposed at an angle of approximately 30° relative to said second fluid passage at said second nozzle to permit efficient aspiration of fluid from said second nozzle whenever said fluid jet is blocked from impinging against fluid issued from said second nozzle in said open gap area.

8. The sensor according to claim 1 wherein said second nozzle is wider downstream of the intersection with said outlet passage than upstream thereof.

9. The method of sensing the presence of an object in a gap comprising the steps of:

issuing a fluid jet across said gap toward a sensor port;

issuing fluid from said sensor port at a pressure sufficient to create a flow balance with the uninterrupted jet proximate the sensor port, said flow balance creating a back pressure in said sensor port sufficient to prevent jet fluid from entering the sensor port, and

sensing the presence of an object interrupting said jet in said gap by sensing the absence of said back pressure in said sensor port the step of sensing comprises aspirating a fluid outlet passage communicating with said sensor port when said jet is interrupted and supplying fluid from upstream of said sensor port to said outlet passage when said jet is uninterrupted.

* * * * *