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(54) Venturi pump

(57) A venturi pump comprising a throat member (14) defining a flow passage (16) including a throat region (16b), and at least one feed port (18) communicating with the throat region (16b), wherein a first part (24) of the throat region (16b) immediately downstream of the or each feed port (18) is of greater cross-sectional area than a second part (22) of the throat region (16b) immediately upstream of the or each feed port (18). The throat member (14) may take the form of an insert to be received within a flow passage (12) provided in a pump housing (10).

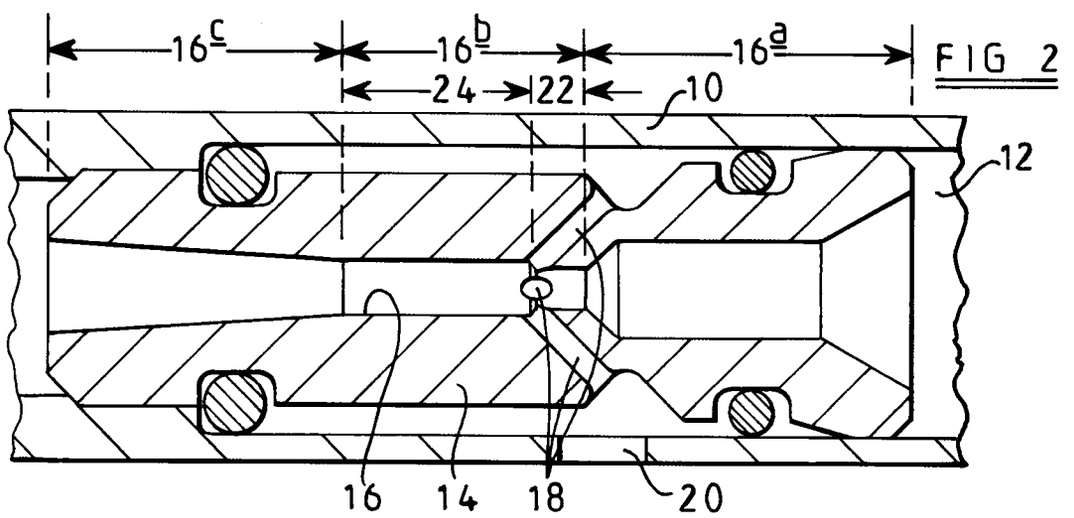

FIG 2

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Description

[0001] This invention relates to a venturi pump for use in drawing fluid along a passage or pipe.

[0002] Figure 1 illustrates a typical venturi pump arrangement which comprises a housing 10 defining a fluid flow passage 12. A throat member 14 is located within the passage 12, the throat member 14 including an axially extending through passage 16. The throat member 14 is shaped such that the passage 16 includes a first tapering region 16a in which the diameter of the passage 16 tapers from a maximum at the upstream end of the throat member 14 to a minimum adjacent a throat region 16b of the passage which is of uniform diameter. The diameter of the passage 16 gradually increases in a second tapering region 16c located downstream of the throat region 16b. A plurality of ports 18 communicate with the throat region 16b, the ports 18 communicating with an opening 20 which, in use, is connected to a passage or pipe through which fluid is to be drawn.

[0003] In use, fluid from an appropriate source flows along the passage 12. The presence of the throat member 14 reduces the area through which fluid can flow with the result that the velocity of fluid within the throat region 16b is greater than that within the part of the passage 12 upstream of the throat member 14. The increased velocity of fluid has the effect of reducing the static fluid pressure thus applying a vacuum to the ports 18 drawing fluid from the pipe or passage through the opening 20 and ports 18 to join the flow of fluid along the passage 12.

[0004] It has been found that when the rate at which fluid joins the flow of fluid along the passage 12 through the ports 18 is high, the magnitude of the vacuum drawn in the pipe or passage is small even when the fluid driving pressure applied to the passage 12 is high. It is an object of the invention to provide a venturi pump capable of drawing a vacuum of relatively high magnitude even when the rate at which fluid joins the flow of fluid along the flow passage of the pump is high.

[0005] According to the present invention there is provided a venturi pump comprising a throat member defining a flow passage including a throat region, and at least one feed port communicating with the throat region, wherein the part of the throat region immediately downstream of the feed port is of greater cross-sectional area than the part of the throat region immediately upstream of the feed port.

[0006] As the part of the throat region immediately downstream of the feed port is of enlarged cross-sectional area, the flow of fluid through the feed port does not result in a significant increase in the static pressure of fluid flowing past the end of the feed port, thus a relatively large magnitude vacuum can still be drawn.

[0007] The throat member conveniently takes the form of an insert intended to be received within a flow passage provided in a housing.

[0008] The first and second parts of the throat region together define a step in the throat region, the or each feed port communicating with the throat region immediately downstream of the step or at positions which straddle the step.

[0009] The invention will further be described, by way of example, with reference to the accompanying drawings, in which:-

Figure 1 is a view of a known venturi pump;

Figure 2 is a view similar to Figure 1 illustrating a venturi pump in accordance with an embodiment of the invention;

Figures 3 and 4 are a perspective view and a sectional view, respectively, of a modification to the embodiment of Figure 2; and

Figures 5 to 8 are views similar to Figures 3 and 4 illustrating two alternative embodiments.

[0010] The venturi pump illustrated in Figure 2 is similar to that illustrated in Figure 1, and like reference numerals will be used to denote like parts.

[0011] In the arrangement of Figure 2, the first tapering region 16a is constituted by an upstream frusto-conical region, a region of substantially uniform diameter, and a downstream frusto-conical region which is adjacent the upstream edge of the throat region 16b. The throat region 16b is constituted by a first, upstream end 22 of relatively small diameter, and a second, downstream end 24 which is of diameter greater than the diameter of the upstream end 22. The first and second ends 22, 24 of the throat region 16b together define a step. The ports 18 communicate with the through passage 16 defined by the throat member 14 at positions which straddle the step, thus part of each port 18 opens into the first, upstream end 22 of the throat region 16b, each port 18 further including a part which opens into the second, downstream end 24 of the throat region 16b. Alternatively, the ports 18 may communicate with the through passage 16 defined by the throat member 14 immediately downstream of the step.

[0012] The downstream end 24 of the throat region 16b opens into the second tapering region 16c of the through passage 16 defined by the throat member 14.

[0013] In use, the opening 20 is connected to a pipe through which fluid is to be drawn. The flow passage 12 is connected to a source of fluid such that fluid flows along the flow passage 12 and through the passage 16 defined by the throat member 14. It will be appreciated that the flow of fluid along the flow passage 12 is at relatively low velocity upstream of the throat member 14, the velocity of the fluid increasing as it flows through the first tapering region 16a of the throat member 14. The velocity of the fluid flowing through the first, upstream end 22 of the throat region 16b is significantly greater than that within the flow passage 12 upstream of the

throat member 14, and as a result, the static fluid pressure at the ends of the ports 18 is relatively low. As the static fluid pressure at the ends of the ports 18 is relatively low, a vacuum is drawn in the pipe or passage connected to the opening 20, and fluid is drawn from the pipe or passage through the opening 20 and the ports 18, the fluid joining the flow of fluid through the passage 16 and the flow passage 12.

[0014] The second, downstream end 24 of the throat region 16b is of sufficiently large diameter relative to that of the first, upstream end 22 of the throat region 16b that the increase in quantity of fluid flowing through this part of the throat region 16b relative to the first, upstream end 22 thereof does not significantly increase the velocity of the fluid flowing through the throat region 16b. As the velocity of fluid flowing through the throat region 16b is not significantly changed by the addition of fluid thereto from the ports 18, a significant reduction in static fluid pressure can still be achieved at the opening 20, and hence a relatively large magnitude vacuum can be drawn in the pipe or passage connected to the opening 20, even when fluid flows through the ports 18 at a significant rate.

[0015] Although the arrangement illustrated in Figure 2 contains four ports 18, it will be appreciated that the arrangement may be modified to incorporate a different number of ports 18, if desired. For example, Figures 3 and 4 illustrate an arrangement containing two ports 18, each port 18 being defined by a recess formed in the outer periphery of the throat member, the recesses being shaped such that the parts thereof defining the ports 18 open into the throat region 16b of the throat member 14 around the complete circumference of the part of the throat region 16b at the intersection of the first end 22 and the second end 24 thereof.

[0016] The throat member 14 illustrated in Figures 3 and 4 is designed to permit manufacture by injection moulding, and can be moulded as a single component using a reasonably small number of slides in the mould. The injection moulding process may be simplified further by manufacturing the throat member 14 in two separate pieces for example as illustrated in Figures 5 and 6 or in Figures 7 and 8.

[0017] In the arrangement illustrated in Figures 5 and 6, the throat member 14 is defined by a first, upstream component 14a which defines the first tapering region 16a and first, upstream end 22 of the throat region 16b, and a second, downstream component 14b which defines the second end 24 of the throat region 16b and the second tapering region 16c. As shown most clearly in Figure 5, the second component 14b of the throat member 14 includes three projections 14c which together serve to locate a frusto-conical end surface of the first component 14a such that the combination of the first and second components 14a, 14b and the projections 14c together define the ports 18 through which fluid is able to flow. As the ports 18 are located at the connection of the first and second components 14a, 14b, it will be appreciated that the ports 18 are aligned with the intersection between the first and second ends 22, 24 of the throat region 16b.

[0018] In the assembly illustrated in Figures 5 and 6, the first and second components 14a, 14b of the throat member 14 are conveniently secured to one another by axial clamping, or by friction welding, achieved by rotating the first and second components 14a, 14b relative to one another, or by using an appropriate adhesive.

[0019] Figures 7 and 8 illustrate an alternative arrangement in which the projections 14c are omitted, and instead projections 14d are provided on the first component 14a of the throat member 14. The projections 14d are arranged to be received within corresponding recesses or bores 14e formed in the second component 14b of the throat member 14. The projections 14d serve to correctly locate the first and second components 14a, 14b of the throat member 14 with respect to one another, and to secure the components 14a, 14b to one another. The components 14a, 14b may simply be secured together by being a press fit, or alternatively may be welded by ultrasonic welding in which the first and second components 14a, 14b are vibrated axially with respect to one another.

[0020] The venturi pumps described hereinbefore may be used in a variety of applications. For example, the venturi pumps may be used to draw fuel from a back leak line of a fuel supply system for a series of fuel injectors used in supplying fuel to a compression ignition internal combustion engine. In such an arrangement, the venturi pump may be driven by an appropriate flow of fuel through the fuel system, for example fuel flowing from the outlet of a transfer pump back towards a fuel reservoir, to the inlet of the transfer pump or to the cam box of a high pressure fuel pump. Alternatively, where a fuel system incorporates a lift pump, the fuel used to drive the venturi pump may be derived from the output of the lift pump. It will be appreciated that the venturi pump is also suitable for use in other applications. For example, the pump may be used for emptying water from ditches using mains water pressure to drive the pump, the mains water flowing along the flow passage 12 and the water removed from the ditch flowing through a pipe or passage to the ports 18 and joining the flow of water along the flow passage 12 and continuing therewith.

Claims

1. A venturi pump comprising;

   a throat member (14) defining a flow passage (16) including a throat region (16b), and at least one feed port (18) communicating with the throat region (16b),

   characterised in that a first part (24) of the throat

region (16b) immediately downstream of the or each feed port (18) is of greater cross-sectional area than a second part (22) of the throat region (16b) immediately upstream of the or each feed port (18).

2. The pump of Claim 1, wherein the throat member (14) takes the form of an insert to be received within a flow passage (12) provided in a pump housing (10).

3. The pump of Claim 1 or Claim 2, wherein the first and second parts (22,24) of the throat region (16b) together define a step in the throat region (16b), the or each feed port (18) communicating with the throat region (16b) at positions which straddle the step.

4. The pump of Claim 1 or Claim 2, wherein the first and second parts (22,24) of the throat region (16b) together define a step in the throat region (16b), the or each feed port (18) communicating with the throat region (16b) immediately downstream of the step.

5. The pump of any of Claims 1-4, wherein the or each feed port (18) is defined by recesses formed in the outer periphery of the throat member (14) such that the or each feed port (18) communicates with the throat region (16b) around substantially the complete circumference of the throat region (16b).

6. The pump of any of Claims 1-5 wherein the throat member (14) is a unitary component.

7. The pump of any of Claims 1-5, wherein the throat member (14) is formed from a first, upstream component (14a) including the second part (22) of the throat region (16b) and a second, downstream component (14b) including the first part (24) of the throat region, the first and second components (14a,14b) being separate components.

8. The pump of Claim 7, wherein the first component (14a) of the throat member (14) carries projections (14c) which serve to locate a frusto-conical end-face of the second component (14b), the first component (14a), the second component (14b) and the projections (14c) together defining the or each feed port (18).

9. The pump of Claim 8, wherein one of the components (14a,14b) carries projections (14d) and the other component (14b,14a) has recesses (14e) formed therein for receiving the projections (14d) to secure the first and second components (14a) to one another.

10. A throat member insert for the venturi pump of any of Claims 1-9, the throat member (14) defining a flow passage (16) including a throat region (16b), characterised in that a first part (24) of the throat region (16b) to be located immediately downstream of a feed port (18) is of greater cross-sectional area than a second part (22) of the throat region (16b) immediately upstream of the feed port (18).

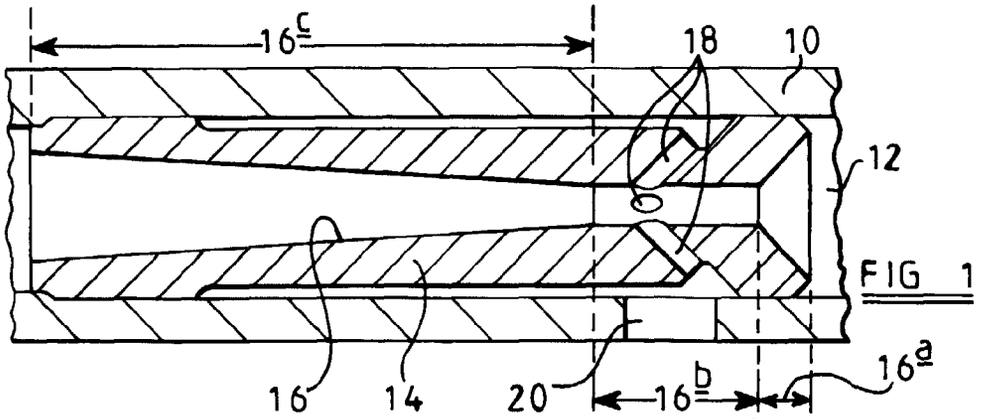


FIG 1

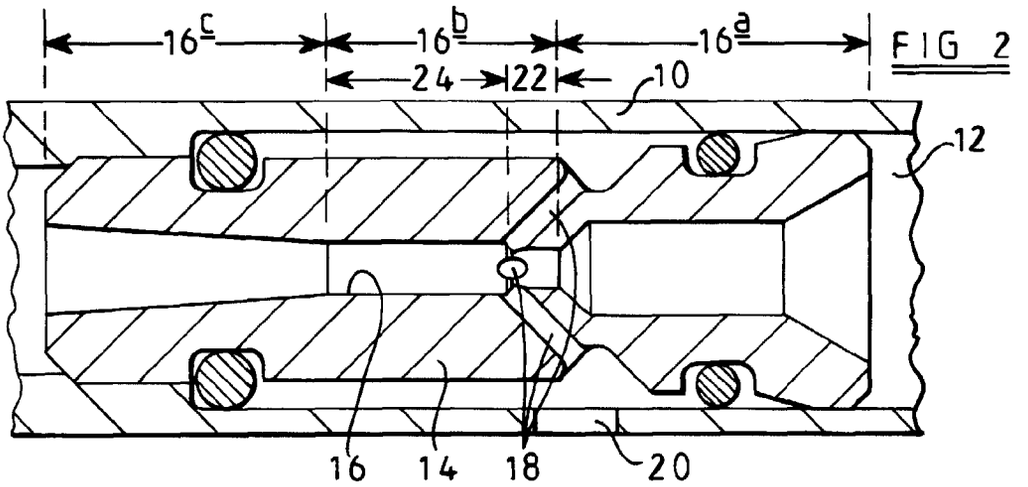


FIG 2

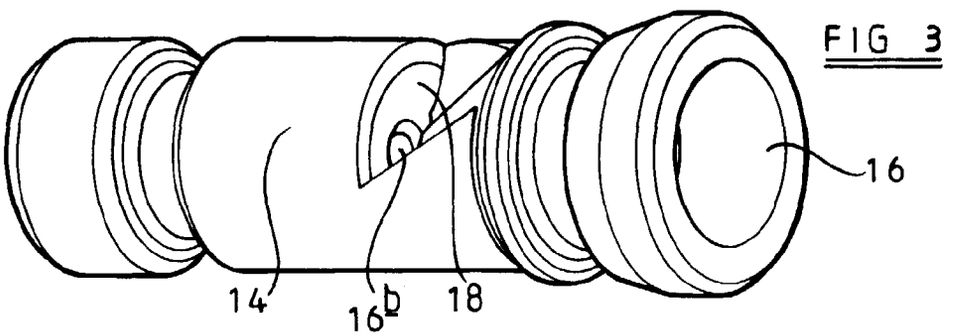


FIG 3

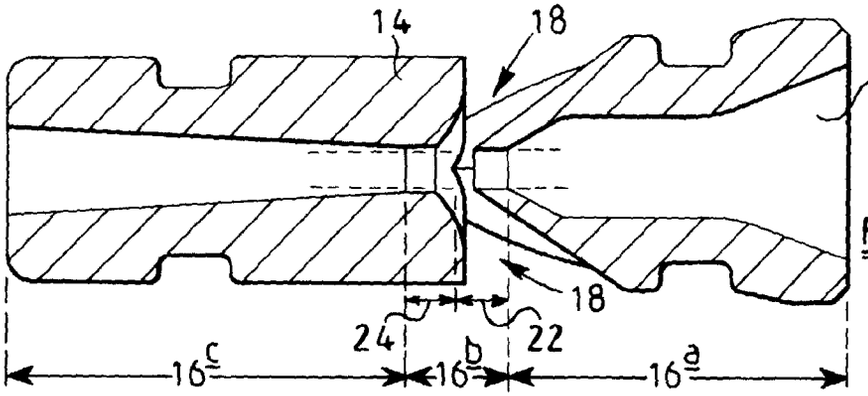


FIG 4

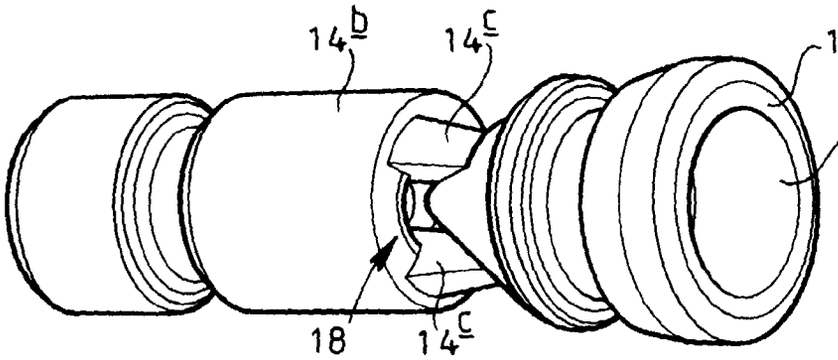


FIG 5

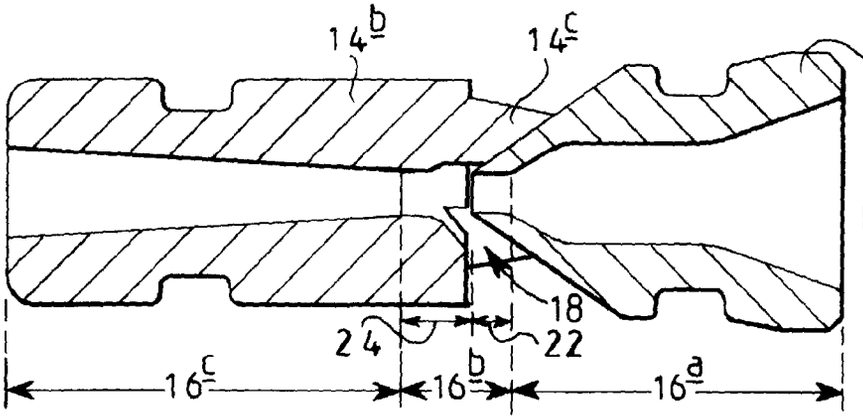
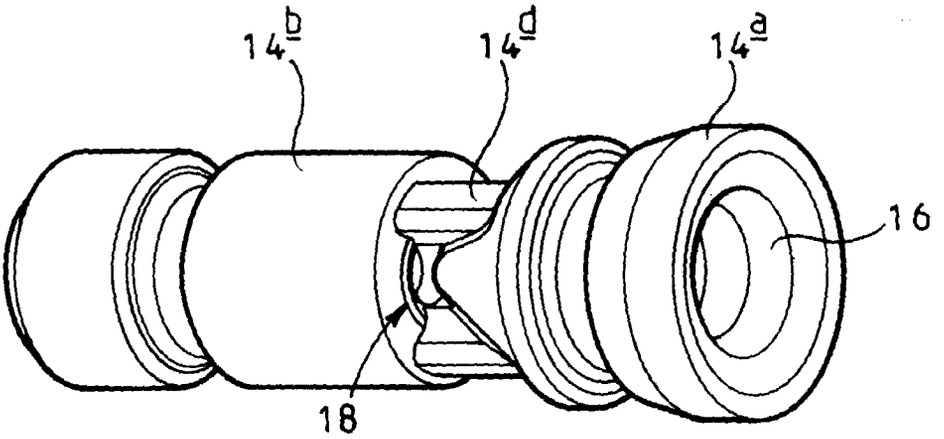


FIG 6

FIG 7



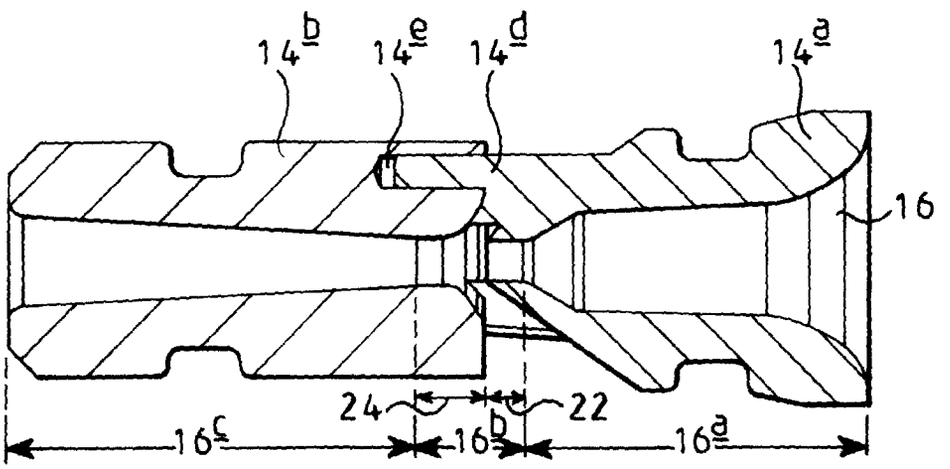


FIG 8