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(54) Ejector pumps

(57) An ejector pump (26) comprises a main flow pipe (34) into which a flow of primary air (30) is discharged from an annular convergent/divergent nozzle (36). Primary air (30) is fed into a gallery (32) from a feed pipe (28) connected to a source of pressurised air and thence flows through the nozzle (36). By utilising a convergent/divergent nozzle (36) the primary air is accelerated to a very high velocity and is therefore able to entrain a large main flow through the pump.

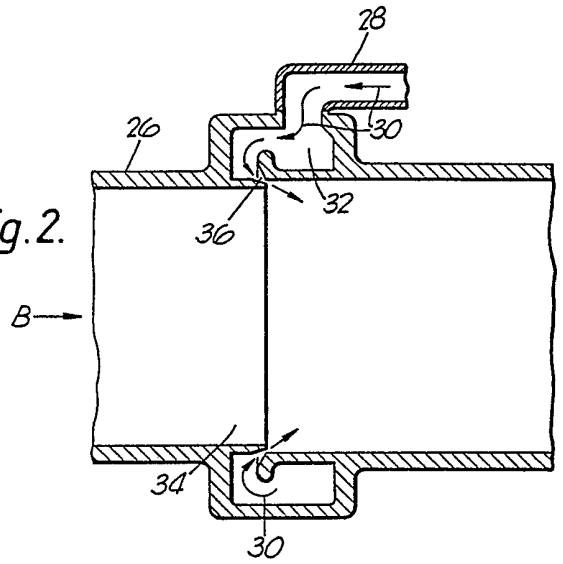

Fig. 2.

GB 2 185 533 A

The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.

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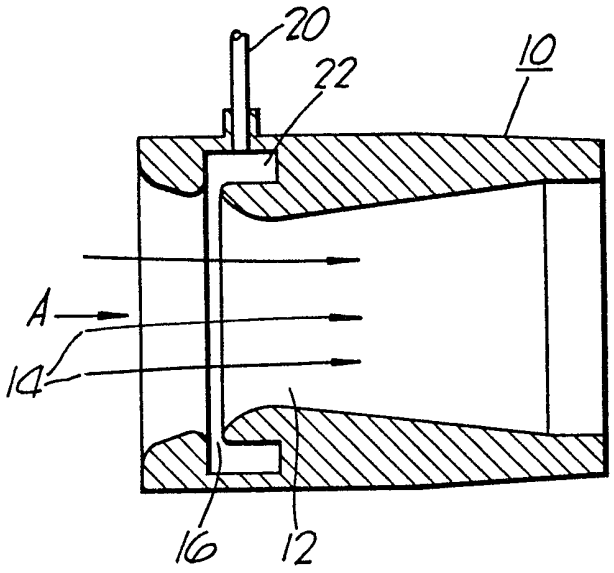

Fig.1.

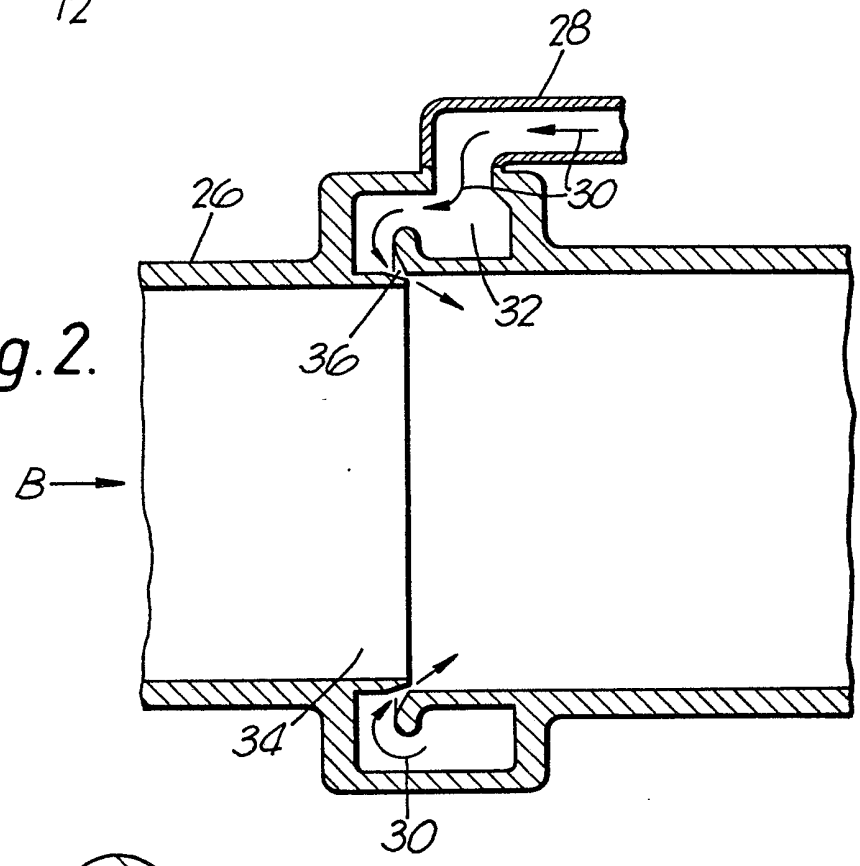

Fig.2.

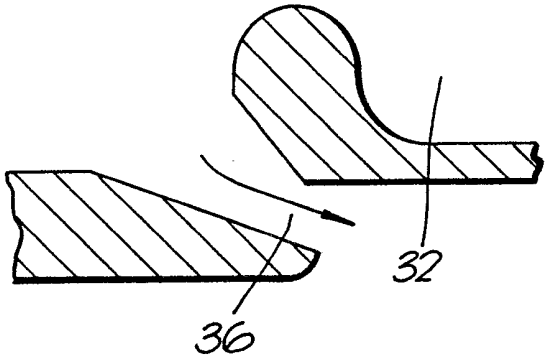

Fig.3.

SPECIFICATION

Improvements in or relating to ejector pumps

This invention relates to an ejector pump of the type wherein a flow of primary air is adapted to induce a much larger flow of secondary air without the use of moving mechanical parts.

There is known pump apparatus for inducing a flow of gas without the use of any moving parts. The apparatus may comprise a tubular flow inducing unit having an internal venturi defining a main flow stream through the unit. A primary flow of air is caused to enter the venturi through a circumferentially extending slot in the venturi. The primary flow adhere to the inner surface of the venturi by the coanda effect and thereby entrains a much larger main flow through the duct. Such apparatus and variations thereof is more particularly described in UK Patent 2077356B to Clifford N Beck.

A drawback of the known type of ejector pump is the limit to the amount of flow that can be entrained for a given size of pump. The entrained flow rate is proportional to the primary flow rate which itself is limited by the coanda being lost due to separation.

It is an object of the invention to provide an improved ejector pump which has a greater flow capacity for a given size of pump.

The invention will now be described by way of an example with reference to the accompanying drawings in which:

Figure 1 depicts an ejector pump of the known type,

Figure 2 depicts a pump constructed in accordance with the present invention, and,

Figure 3 shows a more detailed view of part of the structure of the pump in Figure 2.

Referring to Figure 1, an ejector pump 10 of the type known in the art comprises a venturi 12 through which a main flow of air 14 is induced to flow. A circumferentially extending inlet port 16 is provided in the venturi body and a flow of primary air 18 is pumped through a supply pipe 20 and into a gallery 22, and thence through the port 16 and into the venturi. The primary air is entrained into the venturi in the direction of arrow A. A main flow of air is entrained into the venturi in the direction of arrow A by the primary air. The main air flow rate is substantially proportional to the flow rate of primary air. If the primary flow is increased beyond a certain figure the performance of the pump will deteriorate due to separation of the primary flow.

Referring to Figures 2 and 3 there is shown an ejector pump 26 according to the present invention. The pump 26 comprises a feed pipe 28 which supplies primary air 30 to a gallery 32 which extends circumferentially round a main flow pipe 34. The pump further comprises an annular convergent/divergent nozzle 36 through which primary air 30 flows from the gallery 32 into the main flow pipe 34. Apparatus not shown is provided for supplying a flow of primary air to the feed pipe, such apparatus may comprise a mechanical pump.

In operation, the feed pipe 28 supplies primary air 30 to the gallery 32 and thence primary air 30 is discharged into the main flow pipe from the annular convergent/divergent nozzle 36 in the direction of arrow B in Figure 2. The coanda effect is not utilised. Instead, the convergent/divergent nozzle is shaped and dimensioned with respect to the pressure ratio across it to accelerate the primary air to the highest possible velocity. For maximum efficiency it is desirable to avoid overexpansion or underexpansion of the flow. Underexpansion of the flow would not exploit the full potential of the primary flow pressure and underexpansion would cause shock losses and thereby reduce performance. Isentropic flow is therefore the optimum flow regime of the primary air through the nozzle. The primary flow discharging into the main flow pipe 34 causes a main flow to be entrained through the pump 26 in the direction of arrow B. The difference in velocity between the primary air and the surrounding air sets up a shear force which accelerates the surrounding and deaccelerates the primary air. To reach equilibrium a main flow through the pump is thereby created. Furthermore, the local static pressure of the fast moving primary air will be less than ambient pressure and will therefore aid entrainment.

After the primary flow has deaccelerated and the main flow has accelerated such that there is a uniform velocity downstream from the nozzle 36 a diffuser may be added to reduce the velocity of the flow and increase the static pressure up to ambient conditions.

In this specification air has been described as the working fluid although the invention is equally applicable to any fluid.

CLAIMS

1. An ejector pump, comprising structure defining a main flow path through the pump, means for introducing a flow of primary working fluid into the main flow path including convergent/divergent nozzle structure for accelerating the primary working fluid and thereby causing the main flow through the pump.

2. An ejector pump as claimed in claim 1 wherein the means for introducing the primary working fluid into the main flow path includes at least one feed pipe communicating at a first end with a source of pressurised working fluid and at a second end with a gallery disposed around the main flow path defining structure.

3. An ejector pump as claimed in claim 1 or claim 2 the convergent/divergent nozzle structure comprises an annular convergent/divergent nozzle shaped and dimensioned to accelerate the working fluid to a velocity in excess of the local speed of sound.

4. An ejector pump as claimed in claim 2 and claim 3 wherein the convergent/divergent nozzle structure is adapted and positioned to communicate between the gallery and the main flow path and to direct the flow of primary working fluid in the direction of main flow through the pump.

5. An ejector pump as claimed in any one of the preceding claims wherein the structure defining a main flow path comprises a tubular pipe adapted to

receive means for introducing the flow of primary working fluid into the pipe.

6. An ejector pump as claimed in any one of the preceding claims wherein the main flow through the pump is caused by entrainment of the main working fluid and the main working fluid is further entrained by the effect of the reduced static pressure of the primary fluid as it is discharged from the convergent/divergent nozzle structure.

7. An ejector pump as claimed in any one of the preceding claims wherein the pump further comprises a diffuser section of the main flow path at a location downstream of the convergent/divergent nozzle structure; the diffuser being constructed and arranged to retard the velocity of the main flow and thereby increase the static pressure.

8. An ejector pump as claimed in any one of the preceding claims wherein the working fluid is air.

9. An ejector pump substantially as described herein with reference to Figures 2 and 3.

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