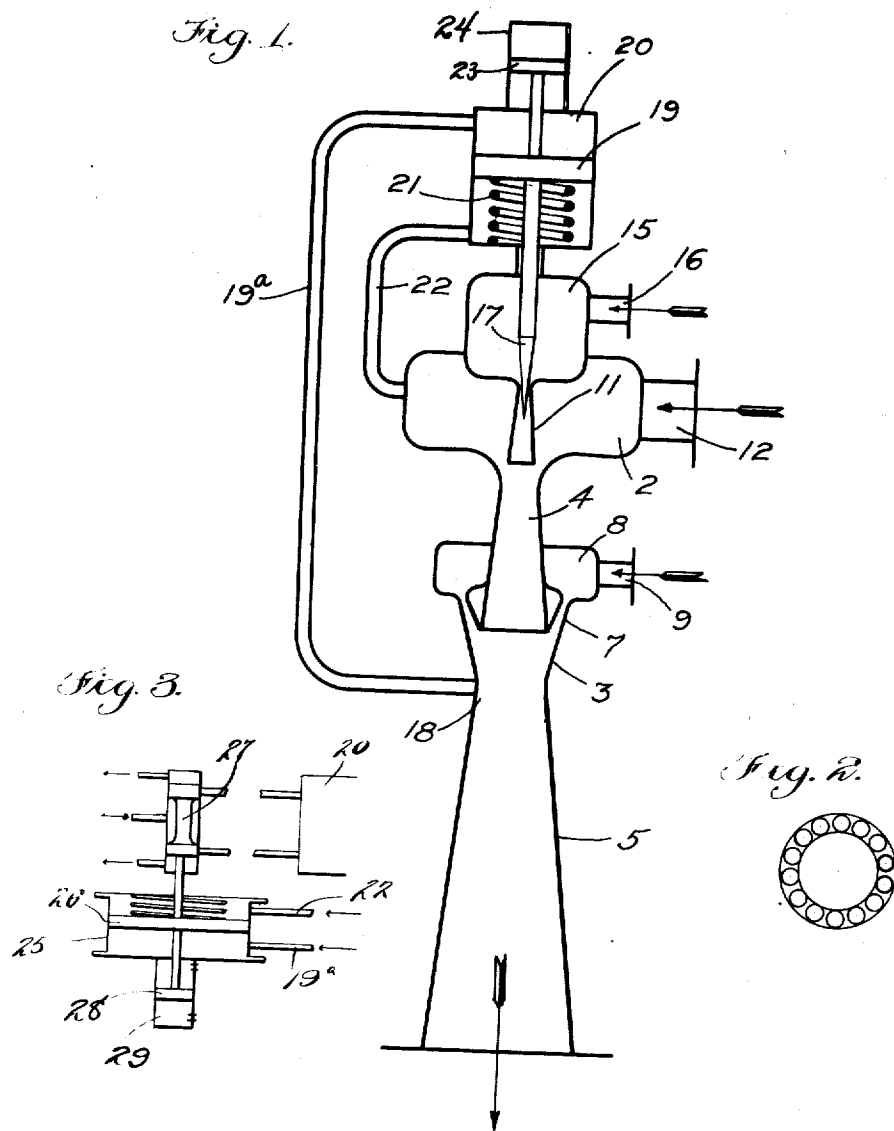


H. F. SCHMIDT.
 FLUID TRANSLATING DEVICE.
 APPLICATION FILED SEPT. 14, 1914. RENEWED DEC. 30, 1921.
 1,421,841.
 Patented July 4, 1922.



WITNESSES:
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UNITED STATES PATENT OFFICE.

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FLUID-TRANSLATING DEVICE.

1,421,841.

Specification of Letters Patent.

Patented July 4, 1922.

Application filed September 14, 1914, Serial No. 861,630. Renewed December 30, 1921. Serial No. 526,029.

To all whom it may concern:

Be it known that I, HENRY F. SCHMIDT, a citizen of the United States, and a resident of Swarthmore, in the county of Delaware and State of Pennsylvania, have made a new and useful Invention in Fluid-Translating Devices, of which the following is a specification.

This invention relates to fluid translating devices of the kinetic type; that is, devices employing the kinetic energy of the motive fluid in expelling the compressing fluid or medium from a region of lower to a region of higher pressure.

An object of the invention is to produce a fluid translating device or ejector in which means are employed for automatically varying the effective area of the fluid delivery passages in response to variations in the amount of fluid to be ejected or moved from a region of lower to a region of higher pressure.

These and other objects, which will be made apparent to those skilled in the art, throughout the further description of the invention, are attained by means of apparatus embodying the features herein described and illustrated in the drawings accompanying and forming a part of this application.

In the single sheet drawing I have illustrated diagrammatically in Fig. 1 a sectional view of an ejector apparatus embodying my invention.

Fig. 2 is a plan view of an arrangement of nozzles which may be employed in the apparatus illustrated in Fig. 1.

Fig. 3 is a diagrammatic sectional view of a relay mechanism which may be employed in connection with the apparatus illustrated in Fig. 1.

The apparatus illustrated includes a suction chamber 2, which communicates with a converging combining tube 3 through a diffuser 4. The combining tube 3 is shown as formed integrally with a divergent diffuser 5, which is axially alined with the diffuser 4. As illustrated, an annular series of nozzles, as shown in plan in Fig. 2, or a single annular nozzle 7 is shown surrounding the outlet of the diffuser 4 and so arranged as to deliver a stream or annular jet of fluid through the combining tube and into the

diffuser 5. The nozzle 7 communicates with a pressure chamber 8 which receives motive fluid from any source of fluid under pressure through a port 9. The nozzle 7 is provided with divergent walls and is so proportioned that it will expand motive fluid from initial pressure to the pressure normally existing in the combining tube 3.

In order to prevent upsetting, that is, a breaking down of the pressure at the outlet of the diffuser 5 to that in the combining tube 3 or in the suction chamber 2, I have provided means for delivering an auxiliary supply of fluid through the diffuser 4 and into the combining tube 3 when the amount of fluid issuing from the diffuser 4 and the nozzle 7 is insufficient to fill the throat of the diffuser 5.

This, and an additional function, which will hereinafter be described, is accomplished by means of an auxiliary fluid supply nozzle 11, which is axially alined with the nozzle 4 and is adapted to deliver varying quantities of motive fluid which are approximately inversely proportional to the quantity of medium entering the chamber 2 through the port 12, thus maintaining a substantially constant rate of flow through the diffuser 4 for all operating conditions.

The nozzle 11 receives motive fluid from a chamber 15, which communicates with a source of fluid existing at any pressure above that existing in the chamber 2, through a port 16. The delivery of fluid through the nozzle 11 is shown controlled by a needle valve 17, which is capable of moving automatically to admit more fluid to the nozzle as the pressure at the throat 18 of the diffuser 5 decreases.

In order to accomplish this automatic operation of the valve, I have shown it provided with a piston 19 which operates within a cylinder 20 in response to variations in pressure at the throat 18 of the diffuser 5. The upper or outer end of the cylinder is shown connected to the throat by means of a passage 19^a, and I have provided a coiled spring 21 for opposing motion of the piston 19 in response to the pressure transmitted through the pipe 19^a. In order that the pressure transmitted through the pipe 19^a may be capable of moving the piston 19, I connect the lower end of the cylinder with

the chamber 2 or any source of pressure which is normally lower than that existing in the throat of the nozzle, and I have shown a passage 22 connecting the lower end of the cylinder 20 with the chamber 2. By properly proportioning the tension of the spring 21, with relation to the area of the piston, it will be apparent that the valve 17 will move in response to variations in pressure within the chamber 2 and throat 18 and will deliver varying quantities of fluid in response to variations of pressure within the throat 18, or in response to variations in the amount of fluid or medium entering the diffuser, so as to maintain a substantially constant flow of fluid through the throat 18 of the diffuser.

I preferably construct the nozzle 11 and its controlling valve 17 so that the flow of fluid through it will never be entirely closed off, so that it will always aid in maintaining as great a difference in pressure between the chamber 2 and the outlet of the nozzle of the diffuser as is possible. With this arrangement, the nozzle 11 not only operates as a filling nozzle for the diffuser 5, but it also operates as an accelerating nozzle, since the motive fluid delivered by it accelerates the fluid or medium existing in the chamber 2, and also delivers it to the combining tube 3, where it is subjected to the action of the motive or impelling fluid or medium delivered by the nozzle or nozzles 7.

This function of the nozzle 11 is important, since the shock occasioned by the intermingling of the medium to be impelled and the impelling medium issuing from the nozzle 7, is materially reduced, and the efficiency of the apparatus is materially increased beyond what it would be if the nozzle 11 were not employed. This gain in efficiency results from the fact that the nozzle 11 delivers a relatively small amount of motive or impelling fluid as compared to the nozzle 7 and consequently the loss occasioned by the shock resulting from the entraining or intermingling of this fluid with the substantially quiescent fluid or medium of the chamber 2 is insignificant when compared to the energy rendered available by the combined nozzles. The efficiency may be still further increased by supplying the nozzle 11 with motive fluid at a lower pressure than that of the motive fluid supplied to the nozzle 7, since the velocity of the fluid issuing from the nozzle 11 will thereby be reduced and the losses occasioned by its impact with the medium in the chamber 2 will also be reduced.

In the drawing I have shown a steadying piston 23 for the valve 17, which operates in a manner similar to the operation of a dashpot and prevents immaterial fluctuations in pressure from affecting the operation of the valve. It will be understood that, under certain operating conditions, it may

be desirable to operate the valve 17 through the agency of a relay, in which case the pipes 19^a and 22 would communicate with the relay and the relay would control the delivery of actuating fluid to the cylinder 20. Under such conditions the steadying piston could be connected to either the valve or its controlling relay.

In Fig. 3, I have illustrated a related mechanism suitable for this purpose. As shown it consists of a relatively large cylinder 25 to each end of which one of the pipes 22 and 19^a from the ejector are connected. A piston 26 within the cylinder 25 is responsive to pressure variations as transmitted by the pipes 22 and 19^a and directly controls a pilot valve 27, which controls the delivery of actuating fluid to and from the cylinder 20. I have also shown the piston 29 of a dash pot 28 as operatively connected to the piston 26 to prevent a response on the part of the latter to minor and discontinuous pressure fluctuations.

While I have illustrated and described but one embodiment of my invention, it will be apparent to those skilled in the art, that the drawing is merely illustrative, and that various changes, substitutions, additions and omissions may be made in the apparatus without departing from the spirit and scope of the invention as set forth by the appended claims.

What I claim is:

1. In combination in an apparatus of the character described, a chamber to which medium to be compressed is delivered, an ejector device communicating with said chamber for receiving medium therefrom and for compressing it to a relatively high pressure, means for delivering impelling fluid to said device for accelerating the medium of said chamber before delivering it to said device and for delivering a stream of filler fluid to the diffuser of said device, and means for varying the amount of filler fluid delivered in accordance with variations in the amount of fluid to be compressed.

2. In combination in an apparatus of the character described, a chamber receiving fluid to be expelled, an ejector device communicating with said chamber for expelling medium therefrom, means for delivering a jet of filling fluid centrally to the diffuser of said device, and means responsive to variations in the amount of fluid to be expelled for varying the amount of filling fluid delivered.

3. In combination in an apparatus of the character described, a chamber receiving fluid to be expelled, an ejector device communicating with said chamber for expelling medium therefrom, and means responsive to variations in the amount of medium entering said chamber for delivering a stream of filling fluid to the diffuser of said device.

4. In combination in an apparatus of the character described, a chamber receiving fluid to be expelled, an ejector device communicating with said chamber for expelling medium therefrom, means for partially compressing the medium of said chamber and delivering it to said device and for delivering a stream of filling fluid to said device, and means for varying the amount of filling fluid delivered to compensate for variations in the amount of fluid expelled.
5. In combination in an apparatus of the character described, a chamber receiving fluid to be expelled, an ejector device communicating with said chamber for expelling medium therefrom, a nozzle for delivering a stream of filling fluid to said device, and means responsive to variations in pressure within said chamber for controlling the delivery of fluid from said nozzle.
6. In combination in an apparatus of the character described, a chamber receiving fluid to be expelled, a nozzle projecting into said chamber for delivering a stream of expelling fluid, and means responsive to variations in the amount of fluid to be expelled for varying the effective area of said nozzle.
7. In combination in an ejector, a mixing chamber from which fluid is to be expelled, a diffuser communicating with said chamber, a nozzle for delivering a stream of motive fluid into and through said chamber and diffuser, and means responsive to variations in the amount of fluid to be expelled for varying the effective area of said nozzle.
8. In combination in an ejector, a mixing chamber, a diffuser communicating with said chamber, a nozzle for delivering motive fluid into and through said chamber and nozzle, and a movable valve projecting into the throat of said nozzle for varying the effective area of the nozzle throat, to compensate for variations in pressure within said chamber.
9. In combination in an ejecting device, a mixing chamber from which fluid is to be expelled, a diffuser communicating with said chamber, a nozzle for delivering fluid into and through said chamber and diffuser, a second ejector communicating with the diffuser and means responsive to variations in the amount of fluid to be expelled for varying the effective area of the nozzle.
10. In combination in an apparatus of the character described, a passage from which medium is to be exhausted, a diffuser through which medium from the passage is expelled, a fluid delivery nozzle for delivering expelling fluid through the diffuser, and means responsive to variations in the amount of medium entering said passage for changing the expansion ratio of the nozzle by varying the relative positions of its walls.
11. In combination in an apparatus of the character described, a passage from which medium is to be exhausted, a diffuser through which medium from the passage is expelled, a fluid delivery nozzle for delivering expelling fluid through the diffuser, and means responsive to the pressure within said passage for increasing the delivery of fluid through said nozzle as the pressure within the passage increases.
12. In combination in an apparatus of the character described, a passage from which medium is to be exhausted, a diffuser through which medium from the passage is expelled, a fluid delivery nozzle for delivering expelling fluid through the diffuser, and means responsive to variations in the amount of medium entering said passage for decreasing the amount of motive fluid delivered to said nozzle, as the amount of medium entering the passage decreases.
13. In combination in an apparatus of the character described, a diffuser communicating with a suction port of the apparatus, a main delivery nozzle, an accelerating nozzle for delivering expelling medium through the diffuser, and means responsive to variations in the amount of medium entering the port for controlling the delivery of fluid to said accelerating nozzle.
14. In combination in an apparatus of the character described, a diffuser communicating with a suction port of the apparatus, a nozzle for delivering a jet of fluid through the diffuser to move medium entering the port through the diffuser, a fluid supply chamber communicating with said nozzle for delivering fluid thereto, a needle valve extending through said chamber, and adapted to project into the fluid receiving end of said nozzle to vary the area of the throat of the nozzle, and means responsive to variations in the amount of fluid entering said suction port for controlling the operation of said needle valve.
15. In combination in an apparatus of the character described, a passage from which medium is to be exhausted, a diffuser through which medium from the passage is expelled, a fluid delivery nozzle for delivering expelling fluid through the diffuser, a needle valve projecting into said nozzle and movable to vary the effective area of the nozzle, and means responsive to variations in the amount of medium entering the passage for controlling the operation of said valve.
16. In combination in an apparatus of the character described, a diffuser communicating with a suction port of the apparatus and through which medium entering the port is discharged, a nozzle for delivering expelling fluid through the diffuser, a second diffuser communicating with said first mentioned diffuser, means for delivering expelling fluid to the second diffuser, and a needle valve responsive to variations

in the amount of fluid entering the apparatus through the suction port for varying the expansion ratio of said nozzle.

17. In combination in an apparatus of the character described, a diffuser communicating with a suction port of the apparatus and through which fluid entering the port is discharged, a nozzle for delivering expelling fluid through the diffuser, a second diffuser communicating with the outlet of the first mentioned diffuser, means for discharging expelling fluid through the second diffuser, a valve projecting into said nozzle and movable to vary the effective area of the nozzle, and means responsive to variations in pressure at the inlet to said first mentioned diffuser and at the throat of the second diffuser for controlling the movements of said valve.

18. In combination in an apparatus of the character described, a chamber from which fluid is to be exhausted, a diffuser communicating with said chamber, a nozzle projecting into said chamber for discharging expelling fluid into and through said diffuser, a second diffuser communicating with the outlet of the first diffuser, means for discharging expelling fluid through the second diffuser, and a valve responsive to variations in the differential pressures between said chamber and the throat of the second diffuser for controlling the operation of said nozzle.

19. In combination in an apparatus of

the character described, a chamber from which medium is to be exhausted, a diffuser communicating with said chamber, a nozzle for delivering expelling fluid through said diffuser, a second diffuser communicating with the outlet of the first mentioned diffuser, means for discharging expelling fluid through the second diffuser means for controlling the delivery of motive fluid through said nozzle, and means responsive to variations in pressure within the second diffuser for controlling the operation of said nozzle controlling means.

20. In combination in an apparatus of the character described, a chamber from which medium is to be exhausted, a diffuser communicating with said chamber, a nozzle for delivering expelling fluid through said diffuser, a second diffuser communicating with the first diffuser, means for discharging expelling fluid through the second diffuser, a movable valve projecting into the throat of said nozzle, and means responsive to variations in pressure within the second diffuser for controlling the operation of said valve.

In testimony whereof, I have hereunto subscribed my name this 21st day of August, 1914.

HENRY F. SCHMIDT.

Witnesses:

C. W. MCGHEE,

E. M. MCCALLISTER.

Certificate of Correction.

It is hereby certified that in Letters Patent No. 1,421,841, granted July 4, 1922, upon the application of Henry F. Schmidt, of Swarthmore, Pennsylvania, for an improvement in "Fluid-Translating Devices," errors appear in the printed specification requiring correction as follows: Page 1, line 12, for the article "the" read *or*; page 4, line 42, claim 19, after the word "diffuser" insert a comma; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 8th day of August, A. D., 1922.

[SEAL.]

KARL FENNING,

Acting Commissioner of Patents.