

FLUID TRANSLATING DEVICE.

1,421,845.

2 SHEETS—SHEET 1.



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Patented July 4, 1922.

2 SHEETS—SHEET 2.

Fig. 2.

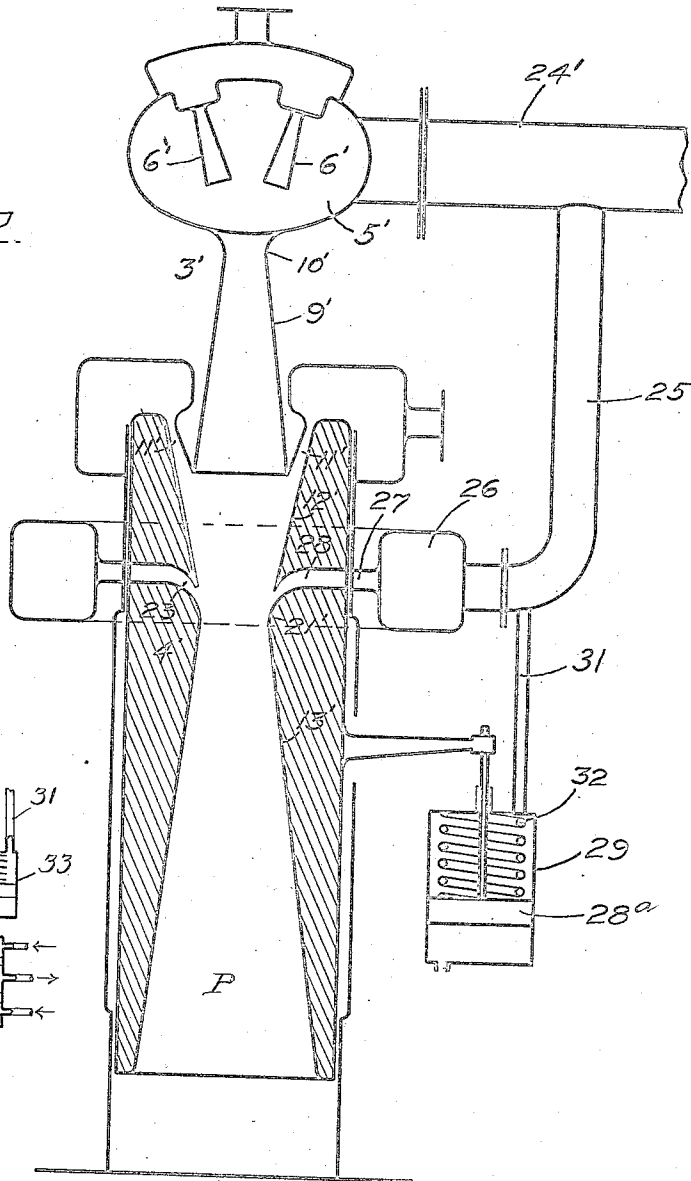
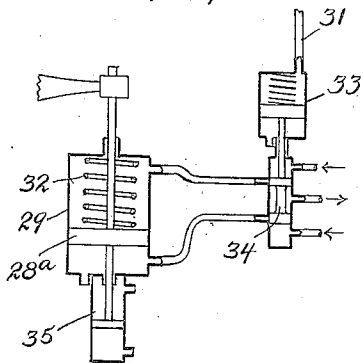


Fig. 3.



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FLUID-TRANSLATING DEVICE.

1,421,845.

Specification of Letters Patent.

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Application filed September 14, 1914, Serial No. 861,635. Renewed December 30, 1921. Serial No. 526,033.

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 and particularly to devices for maintaining a high vacuum within a condenser or similar apparatus.

An object of the invention is to produce a fluid translating device of the kinetic type in which means are employed for maintaining the operation of the device substantially constant for practically all varying conditions.

A further object is to produce a fluid translating device employing the kinetic or velocity energy of the motive fluid delivered to it in transferring fluid from a region of lower to a region of higher pressure, which automatically adjusts itself to variations in the quantity of fluid conveyed, thus preventing fluctuations of pressure in either the region of higher or lower pressure.

These and other objects, which will be made apparent 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 drawings, Figure 1 is a diagrammatic sectional view of an ejector embodying my invention.

Figure 2 is a corresponding view of a modified form of apparatus embodying my invention.

Fig. 3 is a diagrammatic sectional view of a relay mechanism which may be employed in connection with the apparatus disclosed by either Fig. 1 or Fig. 2.

Fig. 4 is a sectional view of an arrangement of nozzles which may be employed in connection with the apparatus disclosed by either Fig. 1 or Fig. 2.

My invention broadly consists in providing an ejector in which means are employed for varying the effective area of the throat of the diffuser, which forms a part of the

ejector, in response to variations in the amount of fluid or other medium, to be ejected or compressed, delivered to the diffuser.

By the term, varying the effective area of the throat in an ejector, I mean providing some means for accomplishing in effect the results which would be accomplished by reshaping the walls of the throat to correspond to the varying conditions of fluid flow through the diffuser.

In Figure 1, I have illustrated an embodiment of my invention employing two ejectors operating in series, which are generally indicated by the numerals 3 and 4. The ejector 3 under normal conditions operates as an accelerating ejector and delivers the fluid or medium, to be ejected or compressed, to the ejector 4. The ejector 3, as illustrated, includes a combining and suction chamber 5, provided with a port 5^a, adapted to communicate with a receptacle to be evacuated, or with the region of lower pressure from which fluid is to be compressed, to a region of higher pressure. As illustrated, the ejector is also provided with a plurality of expansion nozzles 6, receiving motive fluid from a source of supply, through a port 7 and a communicating chamber 8. These nozzles are preferably inclined towards each other at their discharge end, so that they discharge jets of fluid through the combining and suction chamber 5 and into a diffuser 9, which communicates with the chamber 5 and forms a part of the ejector 3. The nozzles 6 are preferably so arranged with relation to each other that the streams of fluid discharged by them unite to form a single stream at the throat 10 of the diffuser 9.

As illustrated, the ejector 4 includes an annular row as shown in Fig. 4 or a single annular nozzle 11, which is located around the discharge end of the diffuser 9, and is adapted to discharge an annular stream of fluid through a converging diverging diffuser, shown as consisting of a converging combining tube 12, and an integrally formed diverging diffuser tube 13, the outlet of which communicates with the region of higher pressure, or with a receptacle or space into which it is desired to compress the fluid or medium from the chamber 5.

The nozzle 11, like each nozzle 6, is preferably an expansion nozzle, that is, a nozzle provided with diverging walls. Motive fluid is delivered to the nozzle 11 from a chamber 14, which is provided with an inlet port 15, adapted to communicate with a source of fluid under pressure.

As illustrated, the combining tube 12, the diffuser 13 and the outer annular wall of the annular nozzle 11 are formed integrally, or are secured together, and are movable to different positions in response to variations in the amount of fluid or medium to be compressed, for the purpose of varying the amount of fluid delivered through the nozzle 11. As illustrated, this is accomplished by providing an operating piston 15 for the movable portion of the ejector 4, which is located in a cylinder 16. The pressure existing in the chamber 5, or in the passage 24 communicating with it, is transmitted to one end of the cylinder 16, as for example, below the piston 15, by means of passage 17. The other end of the cylinder is exposed to any pressure above that existing in the chamber 5, such for example, as atmospheric pressure, and motion of the piston in response to a preponderance of atmospheric pressure over that below the piston is opposed by a coiled spring 18 shown as located in the cylinder and acting upon the piston.

By properly proportioning the tension of the coiled spring, with relation to the area of the piston, the piston will move in response to variations in the pressure transmitted through the pipe 17, so as to proportion the delivery of motive fluid through the nozzles 11 in response to variations in the quantity of fluid or medium discharged from the diffuser 9, so that the throat 21 of the diffuser 13 will always be completely filled with fluid, thus preventing upsetting or a breaking down of the pressure at the outlet of the diffuser to that existing in the chamber 5.

The operation of the apparatus is as follows: The fluid discharged from the nozzles 6 entrains fluid or medium existing in the chamber 5 and moves it through a diffuser 9, in which the velocity of the combined fluid or media is partly reduced, thereby performing a portion of the work of translation from the chamber 5 to the outlet of the diffuser 13. The combined fluid or media discharged from the diffuser 9 is subjected to the entraining action of the motive fluid issuing from the nozzle 11, and is moved by the fluid into the throat 21 and through the diffuser 13, in which the work of translation is completed. When the amount of fluid or medium to be compressed is reduced to such an extent that the throat 21 is not completely filled with fluid, the piston 15 will operate to increase the open-

ing of the nozzle 11, thereby increasing the amount of motive fluid delivered for the purpose of more completely filling the throat 21 and aiding in maintaining a greater difference of pressure between the chamber 5 and the outlet of the diffuser 13.

In Figure 2, I have illustrated an apparatus in which means are employed for in effect shifting the effective throat of the ejecting device from one position to another, dependent upon the amount of medium to be moved. The apparatus illustrated in Figure 2, like the apparatus illustrated in Figure 1, includes two ejectors, generally indicated at 3' and 4', which under normal conditions operate in series in performing the work of translation from the region of lower to the region of higher pressure; and the throats 10' and 21' of the respective ejectors 3' and 4' are proportioned for the amount of fluid traversing them under normal conditions.

The ejector 3' includes a combining and suction chamber 5', delivery nozzles 6' and a diffuser 9', which delivers fluid to the combining tube 12' of the ejector 4'. This latter ejector includes an annular row, or a single annular nozzle 11', and a convergent divergent diffuser which may be described as a converging combining tube 12' and a diverging diffuser 13'. Ports 23 are located around the combining tube 12' at a point adjacent to the throat 21' of the diffuser 13'. These ports are adapted to communicate, under certain conditions, with the suction and combining chamber 5', through a pipe or passage 24', a pipe or passage 25, an annular chamber 26 and passages 27 and 28. These latter passages are movable with relation to each other, so as to control communication between the ports 23 and the pipe 24'. As illustrated, the combining tube 12', the diffuser tube 13' and the outer annular wall of the nozzle 11' are integrally formed or connected together and are movable for the purpose of controlling the discharge area of the nozzle 11' and communication between the passages 27 and 28. For this reason the passages 28 are so formed that they move with the outer annular wall of the nozzle 11'.

In carrying out my invention as embodied in the apparatus illustrated in Figure 2, I contemplate reducing the amount of fluid delivered through the annular nozzle 11' as the pressure in the chamber 5' diminishes, or as the amount of medium to be compressed is reduced. I also contemplate increasing the amount of fluid delivered through the nozzle 11' as the pressure in the chamber 5' increases, or as the amount of fluid to be compressed increases, and when a predetermined pressure is attained in the chamber 5', to place the ports 23 in communication with that chamber, so that the

two ejectors 3' and 4' will operate in parallel—with relation to the chamber 5'—in removing or compressing fluid from the chamber 5' to the pressure existing at the outlet of the diffuser 13'. This is accomplished by providing an operating piston 28^a, which is adapted to shift the combined tubes 12', 13' and the annular wall of the nozzle 11' in response to variations in the pressure existing in the chamber 5'. The piston 28^a is shown mounted within a cylinder 29, one end of which is placed in communication with the chamber 5' by means of a passage 31, and the other end of which is placed in communication with a source of higher pressure, such for example, as the atmosphere. Motion of the piston in response to the higher pressure is opposed by a coiled spring 32, which is shown as located in cylinder 29 and acting against the piston 28^a. By properly proportioning the tension of this spring with relation to the area of the piston, the piston will operate to vary the delivery of fluid through the nozzle 11' and will control communication between the ports 23 and the chamber 5' so as to maintain a substantially constant amount of fluid passing through the throat 21' of the diffuser 13'. By this arrangement, upsetting is prevented and the delivery of motive fluid is so proportioned that as the amount of fluid or medium to be compressed diminishes, the supply of motive fluid through the nozzle 11' will also be diminished.

It will be apparent that instead of employing the piston 28^a and its cooperating cylinder for the purpose of varying the discharge of fluid through the nozzle 11' a relay valve or some more sensitive apparatus may be employed which will operate in response to the variations in the pressure within the chamber 5', to control the operation of a more powerful motor operatively connected to the combining tube 12', the diffuser 13' and annular nozzle wall 11'. In Fig. 3, I have illustrated such a mechanism. As shown the pipe 31 is connected to a cylinder 33, similar to the cylinder 29 in every respect except that the piston rod extends through the bottom of the cylinder, instead of the top, and is connected to a pilot valve 34. The pilot valve 34 is adapted to control the delivery of actuating fluid to and from the cylinder 29 so as to cause the piston 28^a to move in response to variations in pressure in the pipe 31. I have also shown a dash pot 35 connected to the piston 28^a for preventing a response on the part of the latter to minor and discontinuous pressure fluctuations. It will also be apparent that while I have shown but two embodiments of my invention, it will be understood that the apparatus is merely illustrative and that various changes, substitutions, omissions and addi-

tions may be made without departing from the spirit and scope of the invention as set forth by the appended claims.

In my copending application, serially numbered 861,630, filed September 14, 1914, and entitled "Fluid translating devices," I have illustrated and claimed an ejecting apparatus consisting of a diffuser communicating with the source of medium to be expelled, a nozzle for delivering expelling or motive fluid into and through the diffuser, and means responsive to variations in the pressures encountered within the ejector of the amount of medium to be ejected for varying the effective area of the nozzle. The apparatus therein illustrated is a two stage ejector in which the first stage includes the motive fluid delivery nozzle and the diffuser above described, and the second stage includes a diffuser and an annular nozzle or annular series of nozzles for delivering expelling or motive fluid into and through the second diffuser. The second diffuser communicates with and receives fluid and medium expelled from the first mentioned diffuser.

In my copending application serially numbered 861,633, filed September 14, 1914 and entitled "Fluid translating devices," I have illustrated, described and claimed a single stage ejecting device communicating with a source of medium to be expelled, and a nozzle for delivering expelling or motive fluid through the diffuser. The nozzle is capable of movement toward and away from the inlet end of the diffuser and this movement is controlled by pressure variations within the ejecting device. Means are also disclosed and claimed for varying the effective throat of the movable nozzle in response to variations in the pressures encountered within the apparatus.

In my copending application serially numbered 861,634, filed September 14, 1914, and entitled "Fluid translating devices," I have illustrated, described and claimed an ejecting device provided with a passage from which a medium is to be exhausted communicating with a diffuser through which the medium from the passage is expelled. A fluid delivery nozzle delivers expelling fluid through the diffuser and a means responsive to variations in the amount of medium entering the passage is provided for controlling direct communication between the diffuser and the passage. I have further illustrated and claimed a two stage ejector in which both stages are provided with inlet members capable of being placed in communication with the source of medium to be expelled. The first stage is shown in open communication with the source of medium to be expelled, whereas the second stage is provided with ports located substantially at the throat of its converging diverging diffuser and communicating with the source of me-

dium to be expelled through a passage which in effect forms a bypass around the first stage. This passage is provided with a valve which operates in response to variations in pressure at the throat of the second stage diffuser and therefore controls the delivery of medium to be expelled to the ports of the second stage diffuser.

What I claim is:

1. In combination in an apparatus of the character described, an ejector for expelling fluid, a second ejector receiving the impelling and the impelled fluid from the first ejector, and means responsive to pressure variations within the suction chamber of the first ejector for controlling the delivery of impelling fluid to the second ejector.

2. In combination in an apparatus of the character described, a passage receiving fluid to be ejected, an ejector communicating with said passage and adapted to expel fluid from the passage to a second ejector, a second ejector receiving the fluid transmitted from the first ejector, and means, responsive to variations in the mount of fluid received, for proportioning the delivery of motive fluid to the second ejector.

3. In combination in an apparatus of the character described, a passage receiving fluid to be ejected, an ejector for expelling fluid from said passage, a combining tube for receiving fluid from said ejector, a diffuser communicating with said combining tube, means for delivering a jet of impelling fluid into the combining tube and the diffuser, and means for controlling the fluid delivery means in response to variations in the amount of the medium entering said passage.

4. In combination in an apparatus of the character described, a passage receiving fluid to be compressed, means for partially compressing fluid from said passage, and an ejecting device for receiving fluid from said means, and means responsive to variations in the amount of fluid entering said passage, for controlling the operation of the ejecting device.

5. In combination in an apparatus of the character described, a passage from which medium is to be compressed, a diffuser through which medium from said passage is adapted to pass, a fluid delivery nozzle for delivering impelling fluid through said diffuser, and means responsive to variations in the amount of medium entering said passage for shifting the position of said diffuser relatively to said nozzle.

6. In combination in an apparatus of the character described, a passage from which medium is to be expelled, means for partially compressing medium withdrawn from said passage, a diffuser into which said means discharges, a motive fluid nozzle for delivering motive fluid into and through the diffuser, and means responsive to varia-

tions in the amount of medium entering said passage for controlling the delivery of motive fluid through said nozzle, and direct communication between ports formed in said diffuser and said passage.

7. In combination in an apparatus of the character described, a passage from which medium is to be exhausted, a movable diffuser having a port formed therein and communicating with said chamber, a nozzle for delivering expelling fluid into and through the diffuser, and means whereby movement of the diffuser controls said port.

8. In combination in an apparatus of the character described, a passage from which medium is to be exhausted, a diffuser movable in response to variations in pressure within said passage, and having a port therein controlled by the movements thereof for controlling direct communication between said diffuser and said passage, and a nozzle for delivering motive fluid through said diffuser.

9. An ejector comprising a passage from which motive fluid is to be ejected, a diffuser communicating with said passage and movable to different longitudinal positions, and a nozzle for delivering motive fluid into and through said diffuser.

10. In combination in an ejector, a motive fluid delivery nozzle, and a diffuser movable to different positions to vary the area of said nozzle.

11. An ejecting apparatus comprising a chamber from which medium is to be exhausted, means for partially compressing the medium, means for completing the compression of the medium, and means responsive to pressure variations within said apparatus for imposing the entire work of compression on one of said compressing means.

12. In combination in an apparatus of the character described, an ejector communicating with a source of fluid to be ejected, a second ejector receiving the fluid discharged from the first ejector and means responsive to variations in pressure conditions for controlling the delivery of motive fluid to the second ejector.

13. In combination in an apparatus of the character described, a passage from which medium is to be exhausted, means for partially compressing medium received from said passage, a diffuser receiving the partially compressed medium from said means and movable to establish direct communication with said passage other than through said means.

14. In combination in an apparatus of the character described, a convergent divergent diffuser having an opening formed near the throat thereof and movable longitudinally to control the effective area of said opening.

15. In combination in an apparatus of

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the character described, a passage from throat and the delivery of motive fluid 10
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fuser communicating with said passage and In testimony whereof, I have hereunto
having a port formed near the throat there- subscribed my name this 21st day of Au-
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sage, motive fluid delivery nozzles for de-
livering motive fluid into and through said
diffuser, and means for moving said dif-
fuser to control the effective area of said

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Witnesses:

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