H. F. SCHMIDT.

FLUID TRANSLATING DEVICE.

APPLICATION FILED SEPT. 14, 1914.

1,345,640.

Patented July 6, 1920.

2 SHEETS—SHEET 1.

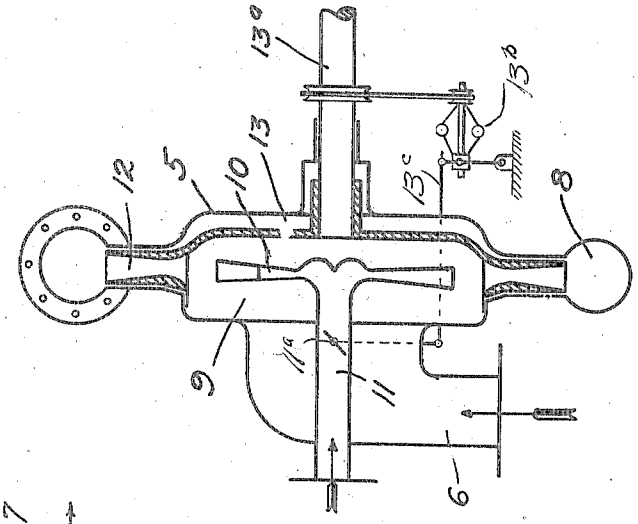


Fig. 2.

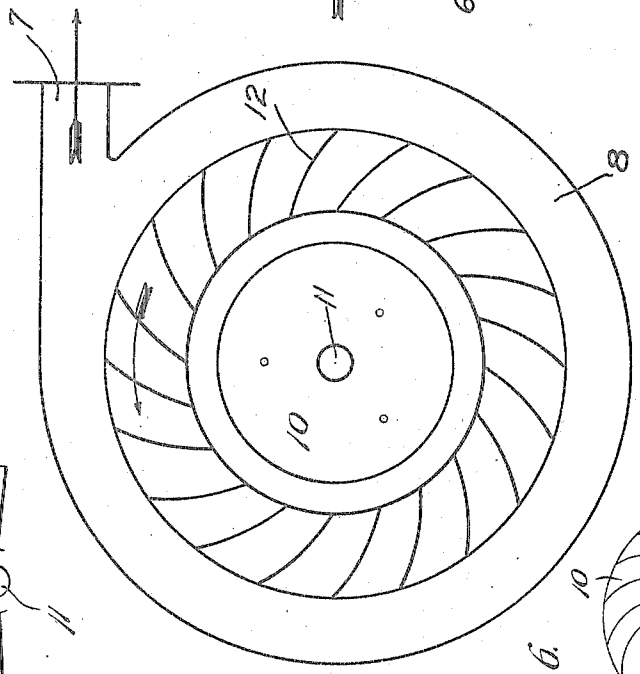


Fig. 1.

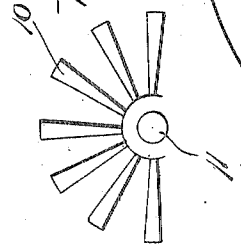


Fig. 5.

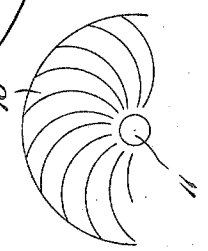


Fig. 6.

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2 SHEETS—SHEET 2.

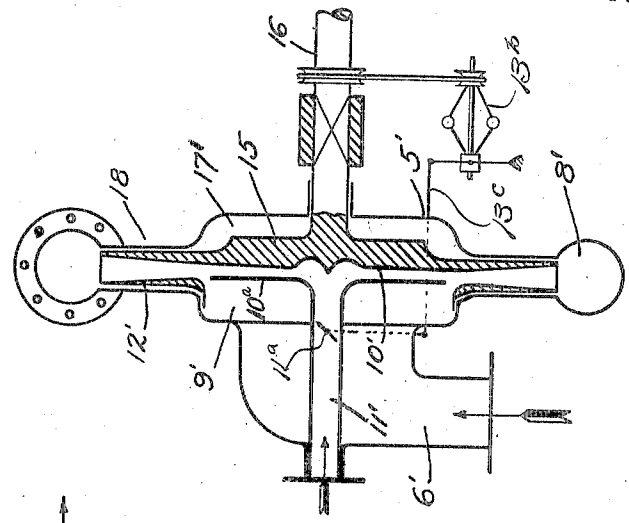


Fig. 4.

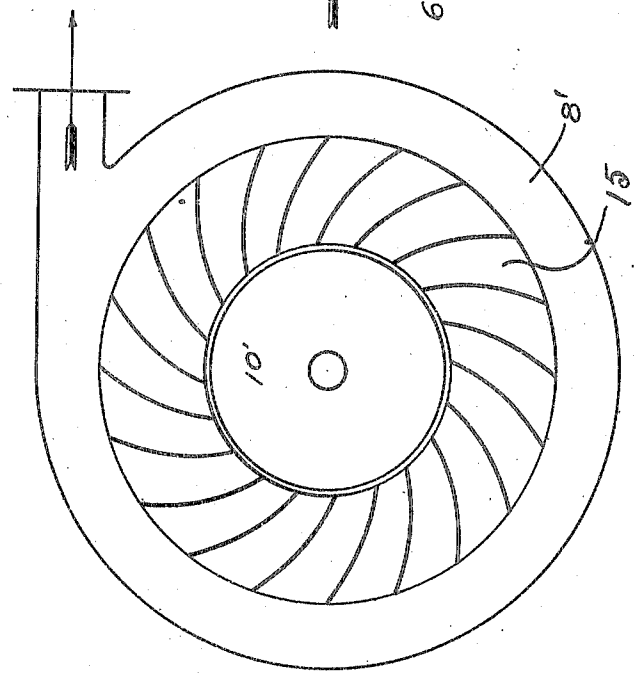


Fig. 3.

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UNITED STATES PATENT OFFICE.

HENRY F. SCHMIDT, OF PITTSBURGH, PENNSYLVANIA, ASSIGNOR TO WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, A CORPORATION OF PENNSYLVANIA.

FLUID-TRANSLATING DEVICE.

1,345,640. Specification of Letters Patent. Patented July 6, 1920.

Application filed September 14, 1914. Serial No. 861,638.

To all whom it may concern:

Be it known that I, HENRY F. SCHMIDT, a citizen of the United States, and a resident of Pittsburgh, in the county of Allegheny 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 in condensers 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 lower or higher pressure.

A further object is to produce a fluid translating device of the kinetic type in which a more stable and efficient means is employed in converting the kinetic into potential energy than has been heretofore employed in apparatus utilizing the kinetic energy of the fluid jet as the impelling or compressing agent.

A further object is to produce a fluid translating device in which positively operating means are employed for entraining the medium to be ejected and for combining it with the impelling medium.

A further object is to produce a fluid translating device, employing means for automatically varying the quantity of flow of the impelling medium to correspond to variations in the amount of medium to be compressed or ejected.

A further object is to produce a fluid translating device, employing the kinetic energy of the jet of impelling fluid in ejecting or compressing the fluid from a region of lower to a region of higher pressure, in which means are employed for storing a portion of the energy of the jet, so that the stored energy is available for overcoming momentary increases in resistance which may be encountered in performing the work of translation or compression.

A further and more specific object is to produce a fluid translating device, in which means are employed for performing the work of fluid translation or compression by the combination of the entraining action of the jet of impelling fluid and centrifugal compression in a rotary member which receives energy from the jet of impelling and impelled fluid and restores the energy to the fluid in accomplishing the centrifugal compression.

These and other objects I attain in a device 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 vertical sectional view of a device embodying my invention:

Fig. 2 is a diagrammatic transverse sectional view of the apparatus shown in Fig. 1;

Fig. 3 is a view corresponding to Fig. 1 of a modified form of my invention; and

Fig. 4 is a transverse sectional view of the apparatus illustrated in Fig. 3.

Fig. 5 is a modification which may be employed in connection with my invention.

Fig. 6 is a further modification.

The apparatus illustrated in Figs. 1 and 2 as an embodiment of the present invention includes a stationary casing 5, provided with an inlet port 6, adapted to communicate with a receptacle to be ejected, or with a region of lower pressure. The casing is also provided with an outlet port 7, which is adapted to communicate with the region of higher pressure and which communicates with a pressure or collecting chamber 8, formed within the casing 5.

The port 6 communicates with a chamber 9 located centrally within the casing 5 and in which a single annular nozzle 10 or series of nozzles 10″ are located (see Figs. 5 and 6). The nozzle 10 or nozzles 10″ receive motive fluid through a passage 11, which projects into the chamber 9, and is adapted to communicate with any source of fluid under pressure. The nozzle or nozzles are preferably so arranged as to discharge an annular or disk shaped jet of fluid in a substantially radial direction and into an annular series of impeller vanes 12, which are mounted on a rotatable impeller 13, and are

located in the casing between the nozzle 10 or nozzles 10'' and the collecting chamber 8. The nozzle 10 or nozzles 10'' are preferably expanding nozzles so proportioned as to expand the motive fluid delivered to them to the pressure normally existing in the chamber 9, and they may be arranged so as to deliver the fluid radially, as before stated, (see Fig. 5) or in a substantially tangential direction as shown in Fig. 6. The fluid issuing from the nozzle or nozzles after passing through a portion of the chamber 9, enters the impeller vanes 12 and imparts a rotary motion to the vanes in the direction indicated by the arrow in Fig. 1. The fluid in passing through the chamber 9 and in entering the impeller vanes entrains fluid or medium, to be ejected, existing in the chamber 9 and consequently imparts velocity to it so that it enters the vanes 12 with the impelling medium.

Rotary motion is imparted to the combined fluid or media by the vanes 12 and the media are also subjected to the resultant centrifugal compression. The rotary impeller vanes also entrain medium from the chamber 9 and impart centrifugal compression to this fluid for the reasons above stated, thereby increasing the entraining efficiency of the fluid issuing from the nozzles 10.

The vanes 12 are so designed that they form in effect an annular series of diffuser tubes in which the pressure of the fluid traversing them is gradually increased independently of increase occasioned by the centrifugal compression, consequently the centrifugal compression and the velocity conversion are accomplished simultaneously. Moreover, the impellers are preferably so designed that the fluid issuing from the outlet end of the impellers, or into the collecting chamber 8, has but little absolute velocity, although the reactive force of the fluid so issuing is usefully employed in causing the rotation of the impeller.

With this arrangement it will be apparent that the work of overcoming the external pressure, that is, the pressure in the collecting chamber 8, is the combined work of the centrifugal compression and the velocity conversion in the rotating passages and that therefore the velocity of exit of the fluid from these passages will be proportional to the amount of work done. For this reason the speed of the impeller will vary slightly in response to variations in amount of combined media traversing the rotating passages, but it is unnecessary to provide speed responsive means for controlling the delivery of motive or impelling fluid, since the speed of the impeller will always be proportional to the amount of fluid traversing it. It will also be apparent that the rotary impeller will act as a fly wheel, due to its mass and therefore its inertia. It is a means for storing energy which is instantly available for overcoming momentary increases in resistance. Obviously it will prevent any tendency to upset as the centrifugal action of the impeller vanes will prevent a back flow of fluids.

While the speed of the impeller 13 is automatically controlled as above set forth, it may be desirable to employ a speed responsive governor 13^b driven by the mounting shaft 13^a of the impeller for controlling the delivery of motive fluid to the nozzle 10 by means of connecting links 13^c and a valve 11^a, so that the amount of motive fluid delivered is increased as the speed of the impeller slows down in response to a slight increase of pressure in the chamber 9, and is decreased as the propeller speeds up in response to a decrease in pressure within the chamber 9.

In Figs. 3 and 4 I have illustrated a modification of the invention in which automatic means are employed for varying the quantity of impelling or motive fluid delivered from the nozzle 10' in response to variations in the amount of fluid to be ejected from the chamber 9', or in response to variations in pressure existing in the chamber 9'.

This is accomplished, in the illustrated embodiment, by providing an impeller 15 on which the impeller vanes are mounted and which also forms one wall of the discharge nozzle 10'. The mounting shaft 16 of the impeller is so supported in its bearings that it is capable of moving longitudinally, so that the impeller can move toward or away from a stationary wall 10^a of the nozzle 10' in response to variations in fluid pressure in the chamber 9' and in a counter balancing chamber 17', which is located between the casing 5' and the impeller. This counter balancing chamber communicates with the collecting chamber 8' in any suitable manner, as for example, by means of a leakage passage 18, and consequently is subjected to substantially the pressure existing in the collecting chamber. With this arrangement, the quantity of motive fluid delivered by the nozzle 10' will be automatically varied in response to variations in pressure within the chamber 9', and consequently the device will operate to maintain a substantially constant pressure within the chamber 9' for varying amounts of fluid or medium admitted to the chamber through the port 6'.

In my copending application, Serial No. 861,630, filed September 14, 1914, and entitled "Fluid translating devices," I have illustrated, described and claimed an ejector in which means are provided for varying the effective area of a nozzle of the ejector in accordance with variations in the amount of fluid to be ejected, and in which means

are provided for varying the expansion ratio of the nozzle. The ejector described and illustrated is provided with a needle valve which extends through the steam inlet chamber into the throat of the nozzle and is controlled by a piston subjected on one side to the pressure of the fluid entering the ejector, and on the other side to the pressure of the fluids passing through the diffuser. Variations in the differential pressure acting on the piston cause the needle valve to move into or out of the nozzle, thereby changing the effective area and expansion ratio of the nozzle.

It will be understood that the devices illustrated as embodiments of my invention may be employed when compressible or non-compressible fluids are employed as the motive fluid, or when a compressible or non-compressible fluid is to be translated from a region of lower to a region of higher compression, and that consequently the term fluid is employed throughout the entire application in its broadest sense, except where the context of the structure included in the claims limits the meaning of the term.

It will also be apparent that while I have illustrated but two modifications of my invention, the apparatus is merely illustrative, and that various changes, modifications, substitutions and omissions may be made without departing from the spirit and scope of the invention.

What I claim is:

1. In combination in an apparatus of the character described, a chamber having an inlet port for medium to be compressed, means for discharging an annular jet of impelling fluid through said chamber, and means actuated by the jet, for entraining medium located within the chamber.

2. In combination in an apparatus of the character described, a chamber having an inlet port through which medium to be compressed is delivered, a fluid discharge nozzle for delivering an annular entraining jet of fluid within the chamber, and a rotatable impeller driven by the jet of fluid for entraining and compressing medium from the chamber.

3. In combination in an apparatus of the character described, a chamber from which fluid is to be exhausted, an expanding nozzle located within the chamber for discharging an accelerating and entraining jet of impelling motive fluid, and a rotatable impeller driven by the jet of fluid for entraining and withdrawing a substantially homogeneous mixture of fluid from the chamber and for acting upon the fluid of the jet and the entrained fluid withdrawn from the chamber.

4. In combination in an apparatus of the character described, a chamber from which fluid is to be exhausted, an expanding nozzle located within the chamber for discharging a jet of impelling fluid, and a rotatable impeller driven by the jet for withdrawing a substantially uniform mixture of impelling fluid and entrained fluid from the chamber and for occasioning a centrifugal compression of the uniform mixture of impelling and impelled fluid.

5. In combination in an apparatus of the character described, a chamber from which fluid is to be exhausted, an expansion nozzle located within the chamber for delivering an annular, disk-shaped jet of impelling fluid through said chamber and to an impeller, and an impeller communicating with the chamber for receiving and compressing the impelling and the entrained fluid received by it.

6. In combination in an apparatus of the character described, a chamber from which fluid is to be exhausted, a nozzle located within the chamber for delivering impelling fluid thereto, an impeller driven by the fluid issuing from the nozzle for entraining and withdrawing fluid from the chamber, and means, responsive to variations in pressure within the chamber, for proportioning the delivery of fluid through the nozzle.

7. In combination in an apparatus of the character described, a chamber from which fluid is to be exhausted, a nozzle located within the chamber for delivering impelling fluid thereto, an impeller driven by the fluid issuing from the nozzle for entraining and withdrawing fluid from the chamber, and means for proportioning the delivery of fluid through the nozzle in response to variations in the amount of fluid to be compressed delivered to said chamber.

8. In combination in an apparatus of the character described, a chamber from which fluid is to be exhausted, a nozzle located within the chamber for delivering impelling fluid thereto, an impeller driven by the fluid issuing from the nozzle for entraining and withdrawing fluid from the chamber, and means for proportioning the delivery of fluid through the nozzle in response to variations in the speed of the impeller.

9. In combination in an ejector, a chamber from which fluid is to be exhausted, a plurality of radial expansion nozzles for delivering jets of entraining and impelling steam across the outer portion of the chamber, and an impeller for receiving the mixture of steam and fluid, said impeller being provided with vanes forming energy conversion passages and upon which the jets act to rotate the impeller and to increase the compression of the mixture of steam and fluid by centrifugal force.

10. In combination in a steam actuated ejector, an inlet chamber, a nozzle for expanding steam to substantially the pressure existing in the inlet chamber and for delivering it at high velocity across the cham-

ber, and an impeller actuated by the jet for receiving and further compressing the fluids entrained by the jet, said impeller having vanes therein and being of sufficient mass to act as a flywheel and to prevent upsetting of the ejector by reason of the centrifugal action of the revolving vanes.

11. In combination in an apparatus of the character described, a casing having a chamber formed therein for receiving fluid to be expelled, an expansion nozzle for discharging an annular disk-shaped jet of impelling fluid through the chamber, a rotatable diffuser located within the casing receiving said jet of impelling fluid and the fluid impelled thereby, and a collecting passage located within the casing and receiving the fluid discharged from the impeller.

12. In combination in an apparatus of the character described, a casing having an inlet port for fluid to be expelled and an outlet port, a mixing chamber located within said casing and communicating with the inlet port, a collecting chamber located within the casing and communicating with the outlet port, a rotatable diffuser between said chamber, and means located within the mixing chamber for expanding motive fluid to substantially the pressure existing within the mixing chamber and for discharging the fluid so expanded in the form of an annular disk-shaped jet through the mixing chamber and into the rotatable diffuser.

13. In combination in an apparatus of the character described, a stationary casing having an inlet port for fluid to be compressed and an outlet port, a mixing chamber located within the casing and communicating with the inlet port, a collecting chamber within the casing and communicating with the outlet port, a rotatable diffuser located within said casing between said chambers, and means located within the mixing chamber for expanding fluid to substantially the pressure existing in the chamber and for discharging the fluid so expanded in the form of a whirling disk shaped jet into and through said diffuser.

14. In combination in an apparatus of the character described, a casing having an inlet and an outlet port, a mixing chamber located within the casing and communicating with said inlet port, a collecting chamber located within the casing and communicating with the outlet port, a rotatable impeller located between said chambers, and stationary means located within the mixing chamber for expanding motive fluid to substantially the pressure normally existing in said chamber and for discharging the fluid so expanded in the form of a whirling disk-shaped jet into and through said impeller.

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

HENRY F. SCHMIDT.

Witnesses:
C. W. McGHEE,
E. W. McCALLISTER.