H. WAGNER.

METHOD AND APPARATUS FOR TRANSPORTING INCOMPRESSIBLE FLUID.

APPLICATION FILED DEC. 27, 1915.

1,253,548.

Patented Jan. 15, 1918.

2 SHEETS—SHEET 1.

Fig. 1.

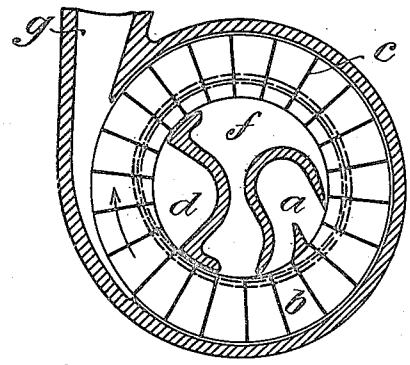


Fig. 2.

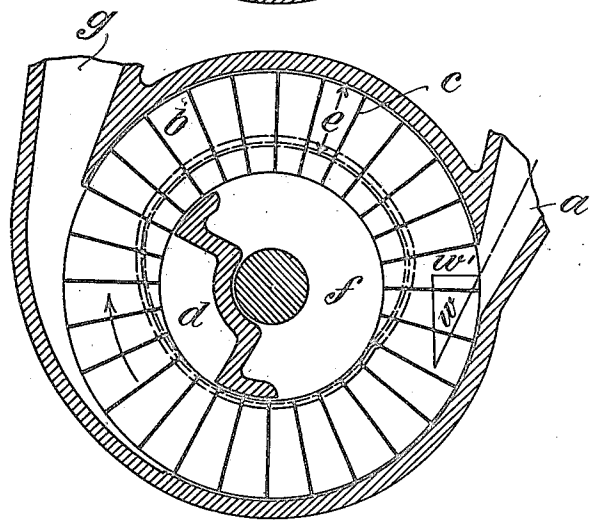
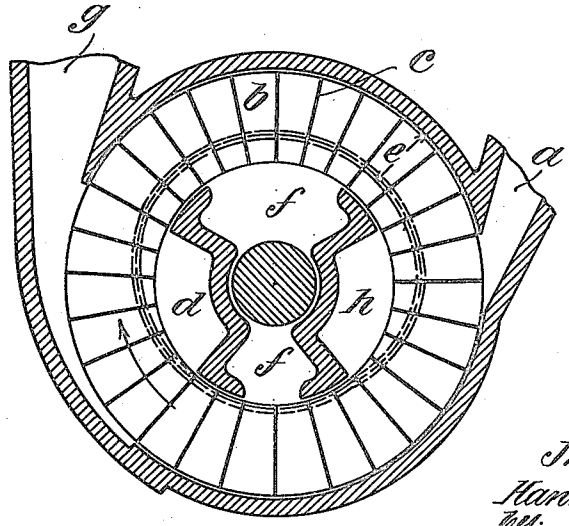


Fig. 3.



Inventor
Hans Wagner.
by:
Foster Freeman Watson & Coit
Attorneys

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2 SHEETS—SHEET 2.

Fig. 4.

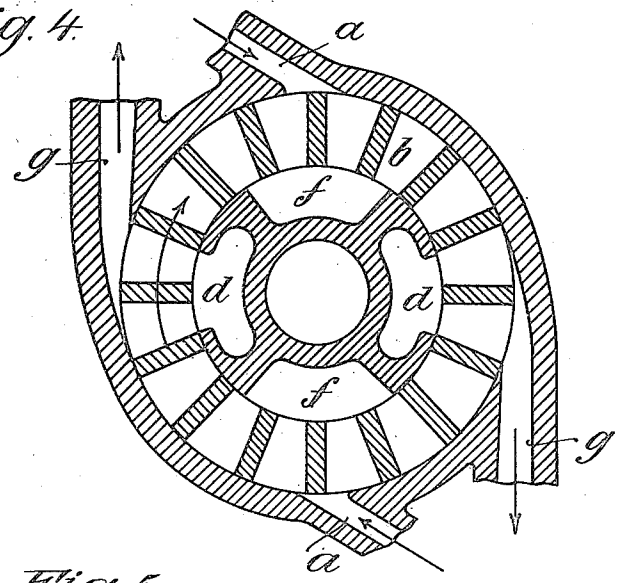


Fig. 5.

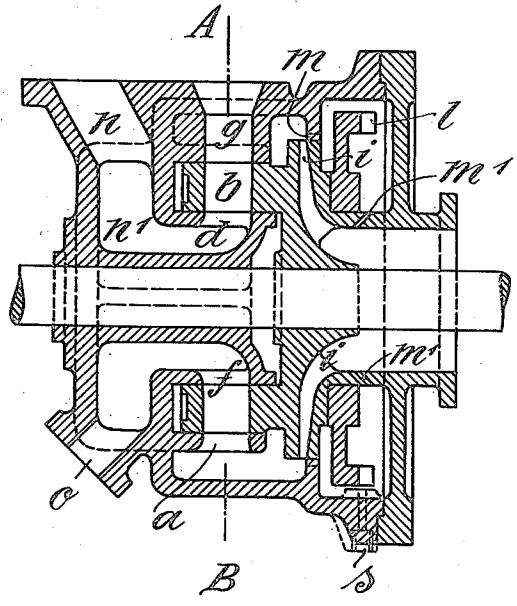
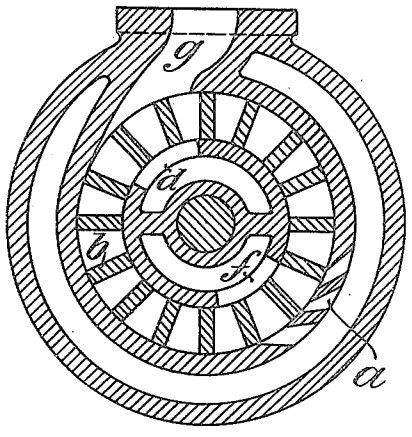


Fig. 6.



Inventor:
Hans Wagner.
by:
Foster Freeman Watson & Coit
Attorney.

UNITED STATES PATENT OFFICE.

HANS WAGNER, OF MAGDEBURG, GERMANY.

METHOD AND APPARATUS FOR TRANSPORTING INCOMPRESSIBLE FLUID.

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To all whom it may concern:

Be it known that I, HANS WAGNER, engineer, subject of the King of Prussia, residing at Magdeburg, Germany, Herderstrasse 4, have invented certain new and useful Improvements in Method and Apparatus for Transporting Incompressible Fluid, of which the following is a specification.

My invention relates to a method of transporting incompressible liquids in a turbine or a similar rotary engine, by means of gases or vapors, whose specific gravity is considerably lower, under high pressure, against a considerably higher pressure than the static pressure of the gas or vapor in question.

By the method of the present invention a rotary vane wheel or the like inclosed within a casing and filled with an incompressible liquid, such as water, is connected with the gas or vapor supply at some point of the inner or sidewise periphery of the vanes in such a way that the channels passing the point aforesaid, and filled with the said liquid, are placed under the full static pressure of the operative gas- or vapor-like medium.

There is no appreciable increase in speed or expansion of the gas or vapor employed as an operating medium. The fluid to be transported being incompressible no change in the volume thereof occurs. As such fluid is thrown into the discharge passage by the action of centrifugal force the chambers of the wheel are partly emptied at their inner ends and the driving medium enter such chambers at a velocity which corresponds exactly with the radial velocity of the fluid. According to the radial length of the vanes and to the speed of rotation of the wheel the liquid is subjected at the outer periphery of the wheel to any desired centrifugal pressure, to which is added, as the channels pass the point where the pressure medium is fed in, the pressure of said medium, and in consequence thereof it is possible to project the liquid from the outer periphery of the rotor into a distributing channel, constructed like the channels employed with centrifugal pumps, at a much higher pressure than the pressure of the operating medium.

I am aware that it is known to employ rotating vane-channels containing a gas or vapor like medium and passing in front of chambers or nozzles containing a similar operating medium with a view to compressing the first said medium. However according to these known methods the pressure of the gaseous medium to be transported will always be less than the pressure of the operating medium, as the gas- or vapor-like medium under higher pressure expands in the zone of pressure and mixes with the other mediums, and the centrifugal force of the gaseous mixture as well as of the transporting medium of similar character is far too low to obtain any appreciable increase of pressure and certainly not one substantially higher than the pressure of the operating medium.

The characteristic feature of the present invention is the utilization of the centrifugal force of an incompressible transporting medium to obtain an increase of pressure beyond the pressure of the gas- or vapor-like operating medium.

In the drawings annexed to this specification and forming part thereof, different modifications of an engine adapted to carry my invention into effect are shown.

In the drawings,

Figure 1 is a diagrammatic sectional view of one embodiment of the invention;

Fig. 2 is a similar view of another embodiment;

Fig. 3 similarly illustrates a slightly different form;

Fig. 4 is a diagrammatic sectional view of another modified form;

Fig. 5 is a longitudinal section through a pump of the character diagrammatically illustrated in Fig. 2; and

Fig. 6 is a transverse section, on the line A—B of Fig. 5.

Referring to Fig. 1, *a* is a chamber fed with an incompressible transporting liquid, such as water, by means of an auxiliary pump combined with the engine or separate therefrom, the chambers or channels *b* inclosed between the vanes *c* of the rotating wheel being filled with the liquid, which latter is then subjected, upon the engine having been started, to a centrifugal pressure corresponding to the speed of rotation and to the radial length of the vanes. The operating medium, such as steam of high tension, is fed into the chamber *d*, and its static pressure is transferred to the liquid in the channels or chambers *b* passing in front of the chamber *d* and which is already subjected to the centrifugal pressure before referred to. The sum of both pressures will be greatest at the outer periphery, where a

distributing channel g, constructed in accordance with the channels of rotary pumps, is arranged in front of the chamber d, the absolute velocity of the liquid projected into said distributing channel being further transformed into pressure within this channel. The expanded operating medium escapes into the chamber f.

The turning moment of the pump which is to be transmitted, corresponds only to that part of the total lift which is overcome by the centrifugal action of the liquid transported. A steam turbine for fresh or exhaust steam, an electromotor, or other suitable means may be employed for driving the new pump. In order to avoid a one-sided loading of the bearings, a plurality of driving medium chambers d and of distributing channels g may be distributed over the periphery of the wheel in a wellknown manner, and as illustrated in Fig. 4 of the drawings.

Instead of feeding the liquid to be transported into the center of the wheel, it may as well be fed into the wheel from outside, that is from its outer periphery. However, this must be effected under a pressure which will allow the water entering from outside to overcome the centrifugal force of the rotating ring of water as well as the pressure of the expanded operating medium in the exhaust chamber f and also the velocity required in order to assure an entrance of the water free of shocks.

I am aware that it is old to feed a pressure liquid into a wheel from its outer periphery, such as is done in all reaction turbines. However, by employing this wellknown mode of operation in a rotating wheel which has nothing in common, as far as its mode of working is concerned, with an ordinary turbine, an absolutely new and useful technical effect is obtained, this effect being characterized by the fact that the transporting water entering from the outer periphery of the rotating wheel is separated from the steam chambers arranged at the inner periphery of the vanes by the ring of water rotating with said vanes.

The advantages resulting therefrom for the lifting of water by means of steam under high tension are the following: First of all the water flowing from the outer periphery into the wheel does not come in touch with steam at any point, and therefore no steam will be drawn into the channels between the vanes, so that the specific weight of the rotating water remains unaltered. Furthermore by entirely filling the vane-chambers from outside with water the exhaust steam still present within said chambers can be pressed inside into the steam exhaust, this being possible even at the highest temperatures the water may assume, the exhaust steam being free to escape in a central direction through the channels. It is further unnecessary to free the exhaust steam from the water entering the channels between the vanes by condensation, and in consequence thereof the water before entering the outer circumference can be preheated to a temperature which is still higher than the temperature corresponding to the exhaust pressure. Thus for instance the water might be preheated to the boiling limit of the temperature in question; for instance, in the case of an entrance pressure of three atmospheres, to 130 degrees C.

A rotary pump working according to this method is illustrated in Figs. 2, 5 and 6. Referring to the diagrammatic view (Fig. 2) it will be seen that the ring of water e circulates together with the channels b of the vane-wheel c. The live steam chamber d and the exhaust steam chamber f are arranged within the rim of vanes. They are separated by the rotating water from the water to be transported or lifted which is fed from the nozzle a to the outer periphery. If p is the steam pressure within the exhaust chamber, p' the centrifugal pressure, w the velocity of the water escaping from nozzle a, then it is necessary that the water fed into nozzle a be under a pressure equal to

$$p+p'+\frac{w^2}{2g}$$

The entrance diagram is preferably chosen so that the direction of the ends of the vanes is in accordance with the relative entrance speed w, when the normal quantity is to be lifted. Of course the vanes and especially their ends may be constructed in such a manner as to allow energy to be transmitted from the vanes to the water and vice versa.

In front of the live steam chamber d the water fed into the outer periphery of the wheel at a escapes under a pressure exceeding the live steam pressure, the velocity thereof being further partly transformed into pressure within the enlarged distributing channel g. The exhaust steam from the pump can be led away from the chamber f and be utilized for any suitable purpose. In many cases however it is desirable to have the exhaust steam completely absorbed by the water to be lifted or transported in order to utilize the exhaust temperature for increasing the temperature of the transporting medium. Thus it will be desirable in a number of cases to lift water preheated in any suitable manner to from 90 to 100 degrees C. on high pressure. This can be done easily by the embodiment of the invention illustrated in Figs. 2, 5 and 6. It is however not possible to introduce into this water the steam escaping from the channels and stuffing boxes of the rotary engine into the chamber f because, as stated before,

the pressure of the water to be transported and admitted to the rotary engine must exceed the pressure resulting from the centrifugal force of the rotating water, the pressure corresponding to the entrance speed and the exhaust pressure in the chamber *f*.

However the pressure of the entering water can be made independent of the exhaust pressure within chamber *f* by arranging near the inner circumference of the wheel, opposite to the water inlet *a*, an auxiliary chamber separated from the exhaust chamber *f*, said auxiliary chamber being connected with a space of lower pressure such as the atmosphere. In consequence thereof the water entering the wheel in front of this auxiliary chamber need only have a pressure in excess of the combined centrifugal pressure and the velocity pressure. The pressure within the exhaust steam chamber *f* can be far higher and it is therefore possible to introduce this exhaust steam into the water and to condense it even when the temperatures of the preheaters are high. If for instance the auxiliary chamber is under ordinary pressure and an entrance pressure of 2.5 atmospheres is required for the water in accordance with the dimensions of the wheel and the steam pressure within the exhaust steam chamber *f* is kept for instance at 3.5 atmospheres, the exhaust steam may be introduced at this pressure into the water which is preheated to about 100 degrees C. before it enters the wheel. The temperature of the water can be as high as the boiling temperature of 138 degrees. The exhaust steam of the pump can also be utilized for heating the water beyond 100 degrees C. A small part of the exhaust steam will be lost through the stuffing boxes and will pass through the inner parts of the rim of vanes, which are free of the ring of water, into the auxiliary chamber *h*. However, this small quantity of steam can be utilized, like the exhaust steam of all other steam pumps, for preheating the water at the place where the pressure of the water does not yet exceed the atmospheric pressure.

Referring to Figs. 5 and 6 a steam turbine rotor *l* is employed as the driving means for the pump, said rotor being actuated by steam supplied by a nozzle *s*. An auxiliary pump *i*, constructed as an ordinary rotor, conducts the water to be lifted or transported to the main pump *b* through passages *a* at the external periphery thereof.

Fresh steam is introduced into chamber *n'* through pipes *n* and through the port *d* acts upon the water rotating with the pump or rotor *h*. The rotary action of *b* causes a further increase of pressure to the water flowing through the outlet *g* so that the water can be lifted against a pressure exceeding that of the steam.

In order that the water supplied by auxiliary pump *i* can penetrate through passages *a* into the main transporting rotor *b* the diameter of rotor *i* must be greater than the diameter of rotor *b*. The diameter of the steam turbine rotor *l* must be greatest with regard to good steam utilization. The three rotors *b*, *i* and *l* are built together to a common rotor in such manner that the latter increases stepwise beginning from main rotor *b*. By means of this arrangement the above requirements are fulfilled, on the one hand, and on the other, a simple rotor, which may be easily assembled and dismounted laterally, is obtained.

The turbine exhaust passes into the water to be transported through separating chambers *m* and *m'*, under suitable excess pressure. The uncondensed exhaust from rotor *b* as well as the separated steam passes into space *f*, from which it is conducted off by pipes *o*.

In the modification shown in Fig. 3 the water is fed into the outer circumference in front of the auxiliary chamber *h* separated from the exhaust steam chamber *f*, and the exhaust from this chamber is admixed with the water, placed under corresponding pressure and preheated to a suitable temperature, before it enters the wheel. When the wheel is rotating in the direction of the arrow, the chambers inclosed between the vanes and filled through nozzle *a* pass the live steam chamber *d* and the water is lifted in the channel *g* under a total pressure exceeding the steam tension.

I claim:—

1. The method of transporting incompressible fluid by means including a gaseous or vaporous driving medium under pressure which comprises subjecting the fluid to the action of the driving medium while it is being rotated, whereby the pressure of the driving medium is supplemented by the centrifugal force generated in the rotating fluid body and the latter can be moved against a pressure exceeding that of the driving medium.

2. A pump comprising a casing provided with suitable fluid supply and discharge passages, a body rotatably arranged within the casing and having chambers adapted to successively communicate with said supply and discharge passages as it rotates, and means for delivering a gas or vapor like driving medium to the chambers in communication with the fluid discharge passage, whereby the fluid will be expelled from said chambers under the combined centrifugal pressure imparted by the rotating body and the pressure of the driving medium.

3. A pump comprising a casing provided with fluid supply and discharge passages, a rotor within the casing having a series of peripheral pockets or chambers adapted to successively communicate with the said fluid

supply and discharge passages as the rotor turns, and means for delivering a gas or vapor like driving medium under pressure to the inner ends of the pockets or chambers in communication with the fluid discharge passage for the purpose described.

4. A pump comprising a casing provided with suitable fluid supply and discharge passages, means for subjecting fluid to the action of centrifugal force to increase the pressure thereof as it passes from the supply to the discharge passages of the casing, and means for supplementing the increased pressure on the fluid due to centrifugal force as the fluid passes into the discharge passage.

5. A pump comprising a casing provided with suitable fluid supply and discharge passages, means for subjecting fluid to the action of centrifugal force to increase the pressure thereof as it passes from the supply to the discharge passages of the casing, and means for additionally increasing the pressure on the fluid adjacent the discharge passage by subjecting it to the action of a gas or vapor like medium under pressure.

6. A rotary pump comprising an impeller having radial vanes, a casing inclosing said vanes, a central but eccentric chamber for introducing water between the vanes, a central but eccentric steam nozzle for introducing steam into said vanes, a central steam exhaust, and a water exhausting and distributing channel at the periphery of the vanes and opposite the steam nozzle.

In testimony whereof I affix my signature in presence of two witnesses.

HANS WAGNER.

Witnesses:
CARL RINKE,
HANS ROGEN.