

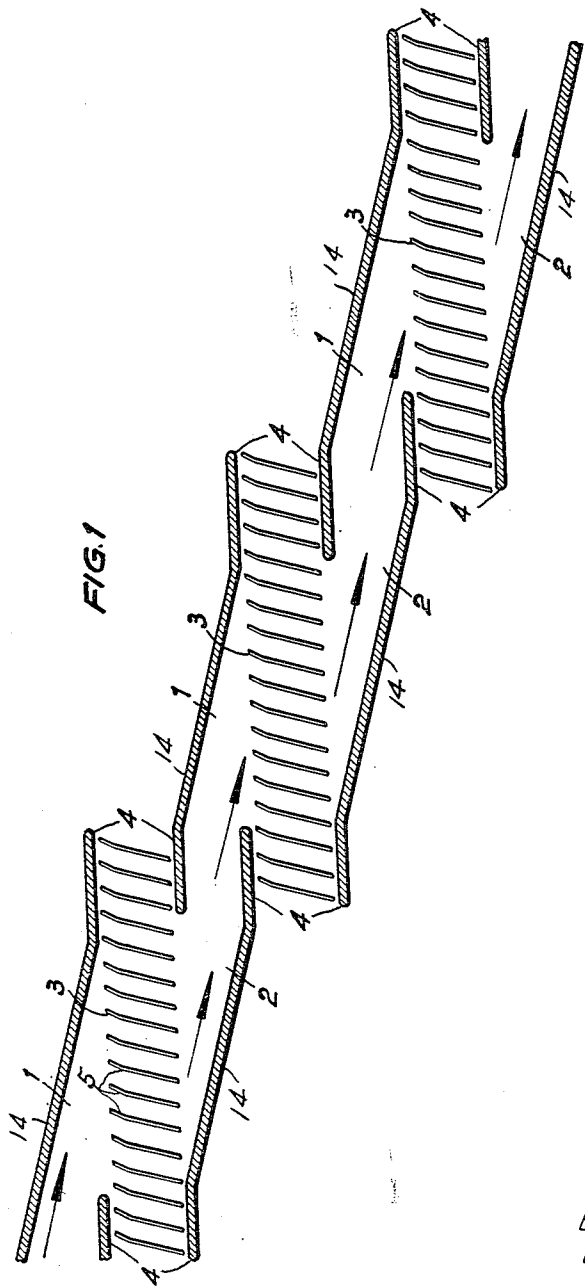
Dec. 18, 1956

E. ZEPP
ROTARY PUMP

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4 Sheets-Sheet 1



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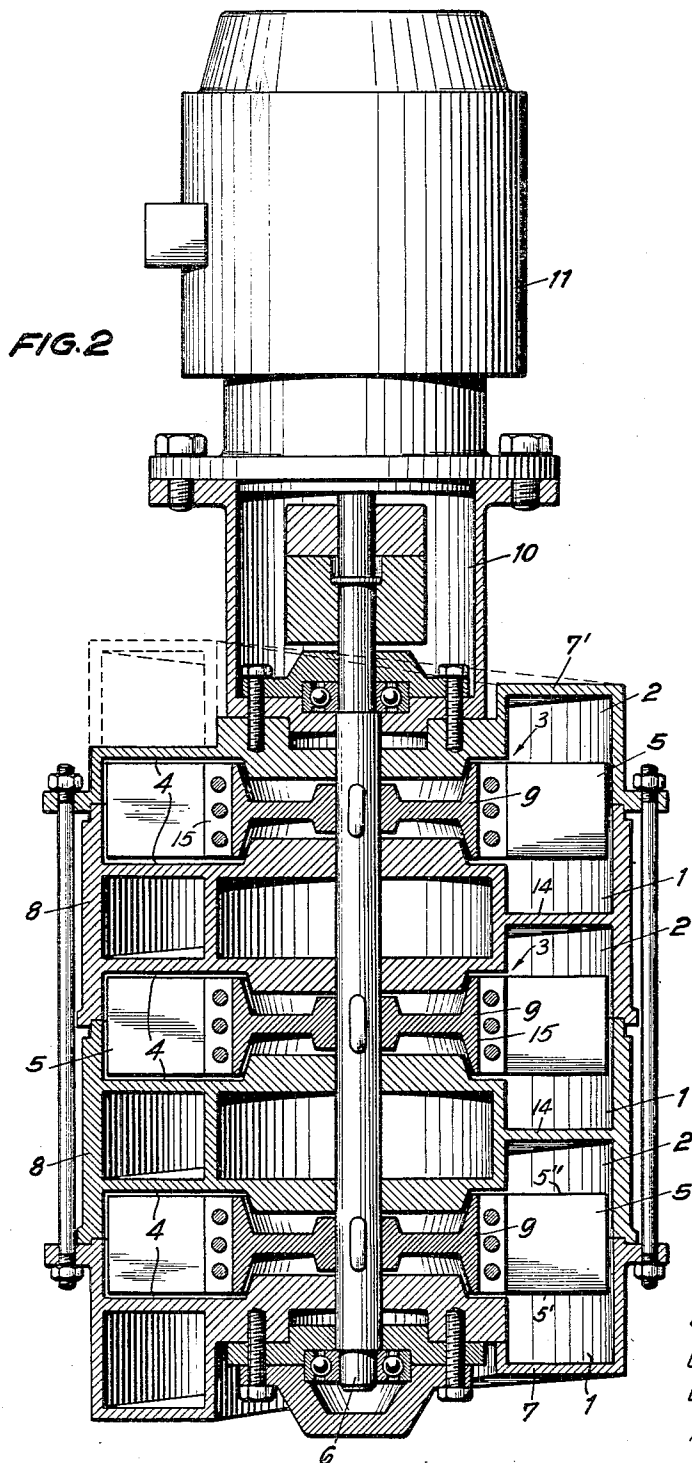
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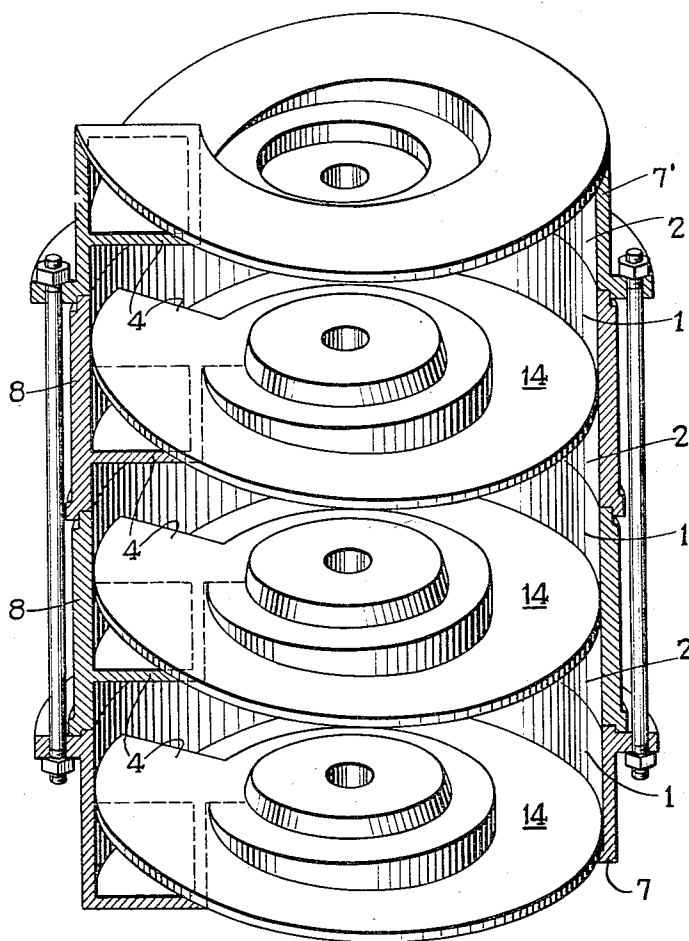
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Fig. 4.



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ROTARY PUMP

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5 Claims. (Cl. 103—93)

The present invention relates to a rotary pump for gases and liquids.

Conventional rotary pumps are very large when built for producing great pressure or suction and are particularly impractical in cases in which the amount of gas or liquid to be pumped is small relatively to the pressure to be produced. Such pumps must be over-dimensioned and their power consumption is too great for economic operation. Rotary piston pumps are capable of delivering small amounts of gas or liquid at great pressure and suction heads. Such pumps, however, wear out quickly and their use is limited.

It is an object of the present invention to provide a rotary pump capable of delivering small amounts of gas or liquid at great pressure or suction heads, which pump is small and which is no more subject to wear than conventional centrifugal pumps.

The pump according to the invention comprises pump wheels designed for axial flow and receiving the matter to be pumped from and delivering it into annular coaxially arranged channels or conduits which are wedge-shaped in circumferential direction. The inlet and outlet conduits are preferably in axially symmetrically opposed position and so dimensioned that the total circumferential flow areas of the two conduits is the same at all radial sections of the two conduits. Overlapping of the ends of the suction and pressure channels at opposite sides of the pump wheels is of advantage.

Whereas conventional centrifugal pumps are usually so designed that they require a minimum of operating power when closed and a maximum when open, the operating characteristic of the pump according to the invention is opposite, i. e. its power consumption is smallest in open condition and greatest in closed condition. Though the pump according to the invention is rotary, its operating characteristic is that of a reciprocating pump. It closes the gap left by conventional rotary pumps for cases requiring great pressure or suction heads and small amounts of gas or liquid to be delivered and in which wear is objectionable.

The number of buckets of the wheels or impellers of the new pump is preferably proportionate to the pressure to be produced. The buckets are preferably at a right angle to the adjacent stationary annular inlet and outlet conduits. The suction or leading edges of the blades of the rotors are preferably bent in the direction of the circular travel of the blades. Cylindrical axial extensions may be provided at the outer diameter of the hubs of neighboring impeller wheels of a pump according to the invention so that a continuous cylindrical part is formed between the hubs of neighboring wheels, which part forms the inner wall of the stationary annular conduits between the impeller wheels. The outer surfaces of the hub extension may be threaded, singly or multiply, in a direction opposite to that of the flow of the medium through the pump.

Further and other objects of the present invention will be hereinafter set forth in the accompanying specifica-

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tion and claims, and shown in the drawing which, by way of illustration, shows what I now consider to be preferred embodiments of my invention.

In the drawing:

5 Fig. 1 is a schematic illustration of a three-stage pump according to the invention showing a development of the stationary annular inlet and outlet conduits and of the impeller buckets;

10 Fig. 2 is a diagrammatic longitudinal section of a three-stage pump according to the invention;

Fig. 3 is a diagrammatic longitudinal section of a modified three-stage pump according to the invention;

Fig. 4 is a perspective view into the interior of the pump according to the invention with the impellers removed.

Like parts are designated by like numerals in all figures of the drawing.

As seen in Fig. 1, the flow area of the annular inlet conduits or channels 1 diminishes like a wedge along the inlet of the impeller wheels provided with blades 5 having leading edges 5' and trailing edges 5'' in the same manner as the flow area of the annular outlet conduits or channels 2 increases like a wedge along the outlet of the impeller wheels. The flow area of the annular outlet conduits 2 is greatest at the point of transition into the following annular inlet conduit 1. The radial walls of connected outlet and inlet conduits have overlapping end portions 4 which are parallel to the planes in which the leading and the trailing edges of the blades 5 are located. The short overlapping portions 4 produce a valve effect between the wheel buckets and the conduits 1 and 2. This effect controls the hydraulic efficiency of the pump, and the clearance between the portions 4 and the wheels should therefore be as small as possible.

The pump operates as follows:

The air, gas, or liquid in the annular inlet conduits 1 formed by wall portions 14 assumes the same shape as the wedge-shaped annular conduits and is continuously milled off on one side of the wedge by the impeller wheel blades 5 which act like a milling cutter; the relatively low pressure at the inlet side of each pump wheel pulls on the medium in the inlet channels. The milled off parts of the medium are accelerated and pressed through the buckets into the annular outlet conduits 2 in which kinetic energy of the accelerated medium is transformed into pressure, causing the medium to flow into the following inlet conduit or channel 1, whereupon the process is repeated. The inlet or leading edge portions 5' of the blades 5 forming the wheel buckets are bent in the direction of the circular travel of the blades as seen in Fig. 1. The main portions of the blades 5 are at a substantially right angle to the wall portions 14 forming the conduit 1. The solid line arrows in Fig. 1 indicate the direction of flow of the pumped medium. The dotted line arrows in Fig. 1 indicate the direction of rotation of the blades 5.

As shown in Fig. 2, impeller wheels 3 individually comprising a wheel body or hub portion 9 having a peripheral portion 15 and blades 5 extending substantially radially therefrom are mounted on a shaft 6 between annular inlet and outlet conduits 1 and 2, respectively, which are formed in the cylindrical pump casing by means of spiral-shaped interior wall portions 14. The wall portions 14 are individually opposed to the leading edges 5' and to the trailing edges 5'' of the blades 5 and are individually wound around the rotation axis of the shaft 6 in helices whose generatrices are at a right angle to the cylindrical inside surface of the pump casing. The casing comprises end portions or covers 7 and 7' and intermediate portions 8. The illustrated pump has three stages, each stage having one pump wheel. By increasing the number of wheels and intermediate por-

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tions 8, any desired number of stages may be produced. The wheel bodies or hub portions 9 and blades 5 may be produced separately. A motor 11 may be mounted on a lantern 10 provided on the end portion 7'.

Whereas in Fig. 2 the individual wheels 3 are separated or spaced by suitable stationary portions of the intermediate parts 8, they may be separated by cylindrical portions or extensions 12 of the peripheral portions of the hub portions 9' as shown in Fig. 3. These extensions are tightly interconnected and may form a continuous and solid cylindrical wheel body. In that case, the interior wall portions 14' of the intermediate parts 8' separating the conduits 1 and 2 extend as closely as possible toward the extensions 12 so that the annular clearances 13 between the wall portions 14' and the extensions 12 are small. In order to reduce the losses caused by the clearances 13, the outer surface of the extensions 12 is threaded, the hand of the threads 16 being opposite to that of the helixes in which the interior wall portions 14' are wound around the shaft 6. The threads on the extensions 12 tend to return gas or liquid escaping through the clearances 13.

While I believe the above described embodiments of my invention to be preferred embodiments, I wish it to be understood that I do not desire to be limited to the exact details of design and construction shown and described, for obvious modifications will occur to a person skilled in the art.

What is claimed is:

1. A rotary pump for gases and for liquids comprising a rotatable shaft, a pump wheel having a hub portion mounted on said shaft and having a peripheral portion, a plurality of blades mounted on and extending outwardly from said peripheral portion substantially radially of the rotation axis of said shaft and affording flow of the medium to be pumped in a direction substantially parallel to the rotation axis of said shaft, said blades having leading edges positioned in an imaginary plane which is at a right angle to the rotation axis of said shaft, said blades having trailing edges positioned in an imaginary plane which is at a right angle to the rotation axis of said shaft and spaced from the plane in which said leading edges are positioned, and a pump casing surrounding said pump wheel, said casing having a cylindrical outer wall portion whose interior surface is adjacent to said blades, said casing having interior wall portions opposed to said leading edges and to said trailing edges and being individually wound around the rotation axis of said shaft in helixes whose

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generatrices are at a right angle to the interior surface of said cylindrical wall portion for forming an inlet channel and an outlet channel for the medium pumped by said pump wheel.

2. A rotary pump as defined in claim 1 in which said blades are at a substantially right angle to said interior wall portions.

3. A rotary pump according to claim 2 in which the end portions of said blades which portions include the leading edges of the blades are bent in the direction of rotation of said blades.

4. A rotary pump for gases and for liquids comprising a rotatable shaft, a plurality of pump wheels, each of said wheels having a hub portion mounted on said shaft and having a peripheral portion, a plurality of blades mounted on and extending outwardly from said peripheral portion substantially radially of the rotation axis of said shaft and affording flow of the medium to be pumped in a direction substantially parallel to the rotation axis of said shaft, said blades having leading edges positioned in an imaginary plane which is at a right angle to the rotation axis of said shaft, said blades having trailing edges positioned in an imaginary plane which is at a right angle to the rotation axis of said shaft and spaced from the plane in which said leading edges are positioned, and a pump casing surrounding said pump wheels, said casing having a cylindrical outer wall portion whose interior surface is adjacent to said blades, said casing having interior wall portions opposed to said leading edges and to said trailing edges and being individually wound around the rotation axis of said shaft in helixes whose generatrices are at a right angle to the interior surface of said cylindrical wall portion for forming inlet channels and outlet channels for the medium pumped by said wheels, the peripheral portions of said hub portions being cylindrical and abutting in axial direction against each other.

5. A rotary pump according to claim 4 in which the outside of said hub portions is provided with threads whose hand is opposite to that of the helixes in which said interior wall portions are wound around said shaft.

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