

United States Patent

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 [33] **Argentina**
 [31] **217,760**

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[54] **COUNTER-ROTARY PUMPS FOR CHEMICAL LIQUIDS AND PARTICULARLY DYES AND THE LIKE**
 3 Claims, 5 Drawing Figs.

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 415/72, 415/177
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 F01d 25/18
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 72, 68, 177, 71; 103/88, 89, 92, 94

ABSTRACT: The improvements in counter-rotary pumps for chemical liquids and particularly dyes and the like are characterized in that the blades which are integral parts of their rotors and substantially helicoidal and opposed, include respective flat surfaces which have a constant pitch. The form and placing of these blades constitute the basic means for the reversibility of the pump. Their respective carrier shafts are supported by individual bellmouths being in engagement with a block which, inserted between each bellmouth and each integral portion of the casing of the pump, constitute refrigeration and mounting jackets hydraulically sealing the passage of the said shafts.

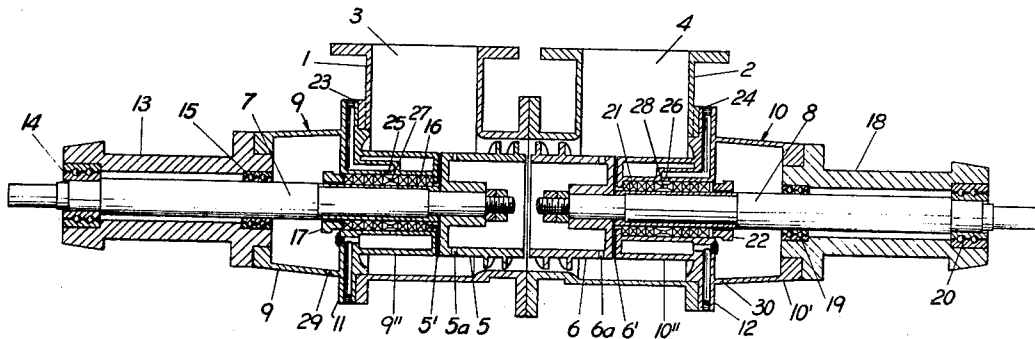


Fig. 1

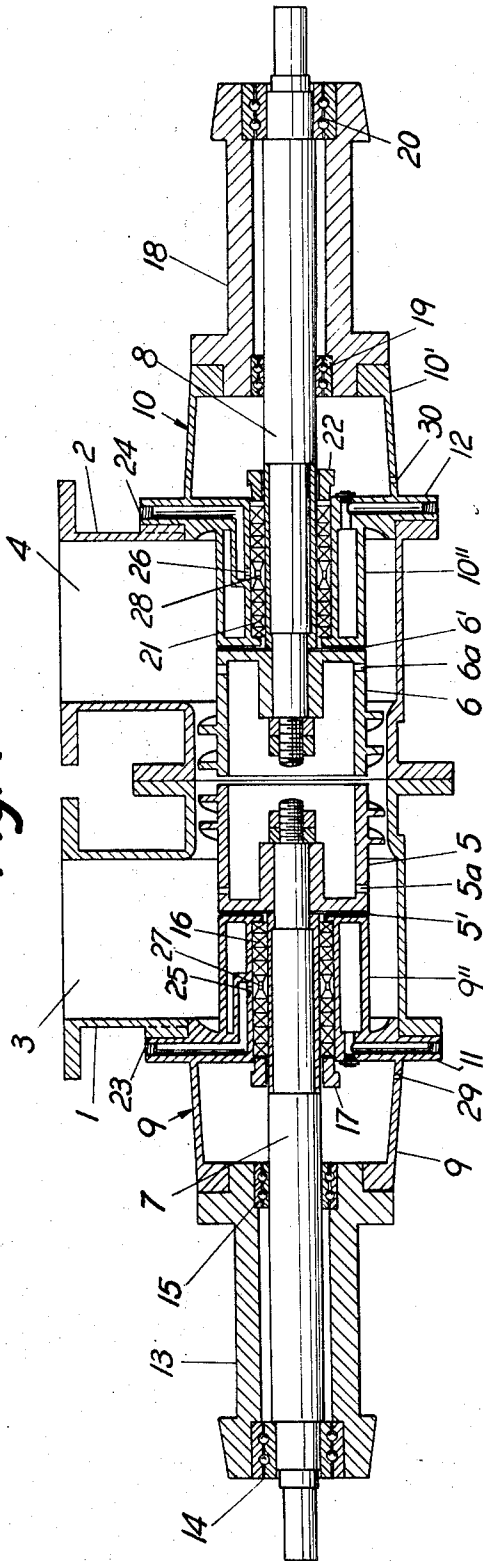


Fig. 2b

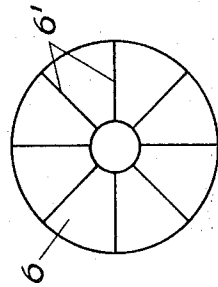


Fig. 2

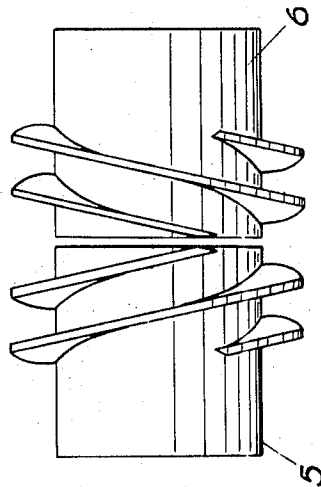
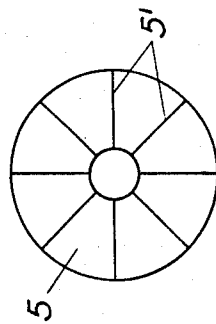


Fig. 2a



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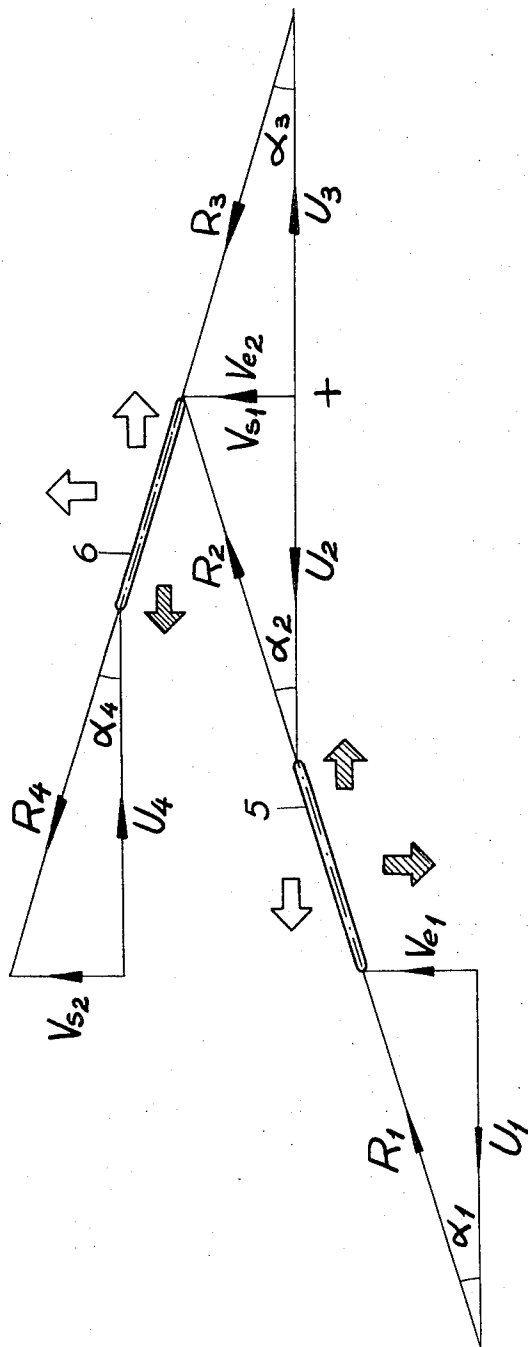
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Fig. 3



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COUNTER-ROTARY PUMPS FOR CHEMICAL LIQUIDS AND PARTICULARLY DYES AND THE LIKE

BACKGROUND AND SUMMARY

The invention refers to improvements in counter-rotary pumps for chemical liquids and particularly dyes and the like.

Installations for dyeing of fabrics in an autoclave comprise pumping equipment in which, as a rule, two main types of pumps are included, namely: the centrifugal pump with distributor and reversing piping, or else, the simple rotation axial pump, which, as is known, is provided with flat blade rotors and corresponding fixed steering blades.

In the said type of simple rotation axial pump a hydraulic brake can be noticed and this brake lowers the performance and makes it necessary to increase the power fed by means of a driving unit. This negative feature is doubtlessly due to the fact that it has been impossible to achieve the ideal position corresponding to the hydrodynamic vectors. On the other hand, the centrifugal pump suffers from other drawbacks caused by the malfunction of the reversing valve.

Bearing in mind these known pumps and applying the physical principle of counter-rotation of blades it was possible to design the pump which is the object of this invention, and in which, with fewer rows of movable and fixed blades than there are in any simple rotation axial pump, the same pressure and volume of flow are achieved. Moreover, its performance, in proportion to the power which is being provided, is higher than that achieved with the known pumps using twice as much power. Also, its structure, apart from being compact, does not include, as in the case of simple rotation and axial pumps, steering blades in which, as a rule, shreds of the treated fabrics get caught which doubtlessly lowers the efficiency of the pump.

On top of these advantages and in compliance with a special object aimed at while designing the improved pump, its reversible quality becomes apparent thanks to the suitable design of the blades. The stresses to which the rotor carrying shafts are subjected were also borne in mind, as well as their cooperation with the liquid to be pumped which, in the majority of cases, registers considerable temperatures. Because of these temperatures the rotor carrying shafts are supported by refrigerated ad-hoc means which represent another special feature of the improved pump.

DESCRIPTION

In order to make this invention readily understandable the same will be described in connection with a preferred practical embodiment, illustrated in the accompanying drawings, in which:

FIG. 1 is a longitudinal sectional view of the improved pump;

FIG. 2 is a detail showing longitudinally and in an enlarged scale the rotors with their specially designed blades through which the pump becomes reversible;

FIG. 2a and 2b show the back surfaces of the rotors which include radially disposed relief grooves, as will be explained hereinafter, and

FIG. 3 is a theoretical vectorial illustration of the average values of the counter-rotation registered in the improved pump which is the object of this invention.

In these FIGS. identical reference numbers indicate identical or equivalent parts.

As can be appreciated from FIG. 1, the improved pump comprises a casing of the usual type constituted by two portions 1 and 2, joined to each other in juxtaposition by means of flanges, one of them being provided with an admission nozzle 3 and the other with an outlet nozzle 4 or vice versa. Both portions are orientable thanks to their coupling and therefore they can be joined as deemed suitable with the respective conduits of the pumping installation.

Already within the novel aspect of same, the said casing comprises a pair of adjacent rotors 5 and 6, with opposed helicoidal blades, in both cases having flat surfaces and a constant

pitch, mounted on respective coaxial shafts 7 and 8 which, in turn, are in operative engagement with corresponding motors which are not illustrated. Thanks to the configuration given to the said blades the purpose of making the pump reversible is achieved, because identical channels are formed driving the flow of liquid in either direction, according to the sense of the rotation of the pump.

The coaxial shafts 7 and 8 extend through respective blocks 9 and 10 provided with corresponding ring-shaped flanges 11 and 12, respectively, for fastening to the integral portions 1 and 2 of the casing of the pump. The said blocks are twin elements and comprise a body which, from its integral flange, is provided with a hollow portion, in the form of a truncated cone, and another hollow portion constituted by a jacket with a ring-shaped refrigeration chamber. In accordance with this structure, the block 9 is provided, at the inlet of its hollow portion 9' having the shape of a truncated cone, with a flange for fixing the bellmouth 13 carrying the respective bearings 14 and 15 supporting the shaft 7, and its opposed portion or jacket 9'' is mounted on the same shaft under insertion of a longitudinal packing 21 compressed, in turn, by the stuffing box 22.

The above mentioned refrigeration jackets 9'' and 10'' are obviously confined to a pertinent circle and hydraulically sealed, whereby a mixing of the refrigerant with the liquid to be pumped is adequately prevented. In order to achieve this hydraulic seal, the block 9 and its twin 10 provide the respective inlets 23 and 24 for water at pressure which, through the corresponding passages 25 and 26, are in communication with the respective seal inserted in each stuffing box and indicated with reference numbers 27 and 28. Any possible leakages through the packings are discharged through the openings 29 and 30 made in the portions 9' and 10' of the blocks.

As may be seen in FIG. 1 of the accompanying drawings, both rotors 5 and 6 are mounted with appreciable clearance in relation with the respective jackets 9'' and 10'' and are provided with corresponding diametrical grooves 5' and 6' (FIGS. 2a and 2b), through which and by centrifugal action the necessary relief is provided from the pressure which the pumping liquid exerts against the packings. It remains to be stressed furthermore that the rotors are hollow, due to which respective radial openings 5a and 6a are included for discharge of same by centrifugal action, when it is desired to wash the pump or to remove the impurities accumulated in its rotors.

Having thus described the structure of the improved pump, whilst its operation is obvious and requires no further details, reference will now be made to the theoretical vectorial representation of the physical principle of counter-rotation as applied to this pump. In accordance with the graphical illustration in FIG. 3, we have for the blade 5:

U_1 - average tangential speed at the inlet,

Ve_1 - axial speed of the fluid at the inlet,

R_1 - relative speed of the fluid with respect to the blade showing the admission inclination or angle α_1 ,

U_2 - tangential speed at the outlet,

R_2 - relative speed of the fluid at the outlet, or driving angle

α_2 , Vs_1 - speed at the outlet of the blade 5,

U_3 - tangential speed of counter-rotation,

Ve_2 - axial speed of the fluid at the inlet to the second blade which is equal to Vs_1 ,

R_3 - relative speed of the forced counter-rotation,

U_4 - tangential speed at the outlet from the second rotor,

R_4 - relative speed at the outlet,

Vs_2 - axial speed at the outlet.

Due to the condition imposed by the reversibility all the angles are substantially equal, which is achieved by making the blades 5 and 6 helicoidal and by giving them flat surfaces with a uniform pitch between the blades.

It should be borne in mind that the power absorbed by the first rotor 5 varies between 0.3 and 0.4 from the total power, while the second rotor, through the effect of the principles of

counter-rotation requires approximately 0.6 to 0.7 of the total power which, in this case, is indicated with the number 1.

I claim:

1. An improved, reversible, counter-rotating pump for dyes and other chemical liquids comprising

a first shaft having a first rotor mounted thereon, a second shaft coaxial with and facing said first shaft having a second rotor mounted thereon, said first and second rotors facing one another with a small gap therebetween, and each said rotor comprising a hollow cylindrical body open facing one another across said gap, each said hollow body having radial openings therethrough for discharge by centrifugal action;

means to drive said shafts and rotors in opposite directions including first driving means to turn said first shaft and first rotor, and second driving means to turn said second shaft and second rotor;

a casing about said rotors having a flanged first portion and a flanged second portion joined in juxtaposition by said flanges, a radially extending liquid intake nozzle on said first casing portion and a radially extending liquid outlet nozzle on said second casing portion;

a first bellmouth for supporting said first shaft and a second bellmouth for supporting said second shaft, a first hollow block about said first shaft between said first rotor and said first bellmouth and a second hollow block about said second shaft between said second rotor and said second bellmouth, each said block containing an annular refrigeration chamber surrounding its respective shaft with an annular space therebetween, means to hydraulically seal and pack each said shaft in the annular space

between the shaft and its respective said refrigeration chamber, each said refrigeration chamber of each said block being axially adjacent its respective said rotor with a small clearance therebetween and with radial grooves on each said rotor within the small clearance for the relief of pressure by centrifugal action; and

a first essentially helicoidal blade having a flat surface and a given constant pitch located on the outer cylindrical surface of said first rotor, and a second essentially helicoidal blade having a flat surface and said constant pitch opposite to the direction of pitch of said first helicoidal blade located on the outer cylindrical surface of said second rotor.

2. A pump in accordance with claim 1 wherein each said block has a truncated conical annular chamber adjacent to said refrigeration chamber and a central flange between said conical chamber and said refrigeration chamber, which central flange provides connection with said casing, said conical chamber having means for attachment to said adjacent bellmouth and a radial discharge opening for possible leakage of water from said means to seal and pack;

said means to hydraulically seal and pack comprising a packing material compressed by a stuffing box, a water intake opening and means to feed water under pressure to said packing material.

3. A pump in accordance with claim 1 wherein said first rotor absorbs approximately 0.3 to 0.4 of the total power supplied to the pump, while said second rotor absorbs approximately 0.6 to 0.7 of the total power.

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