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Self priming centrifugal pump
Selbstansaugende Kreiselpumpe
Pompe centrifuge auto-amorçante

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US-A- 2 941 474

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Description

The present invention relates to a self priming centrifugal pump comprising a metal plate case with a substantially cylindrical shape defining internally thereof a pressure chamber with an inlet port and an outlet port, within this pressure chamber a rotatable impeller and a radial diffuser being arranged at an axial end thereof, an axial ejector device being located at the opposite axial end thereof, and an intermediate torus-shaped interspace being arranged in an intermediate position to direct the outlet flow issued by the radial diffuser backwards to the pressure chamber.

In the known pumps as above, the flow emitted by the diffuser and accelerated by the impeller has an outlet speed with a high rotational component. Thus, most of the air trapped in the pumped fluid is directed to the pressure chamber and passes through the ejector several times before being discharged through the outlet port, thereby lengthening the priming times of the pump.

US-A-2,941,474 discloses a centrifugal pump having a torus-shaped interspace which forms a vortex chamber with an annular central opening extending around the periphery of the ejector. The trapped air present in the fluid is subjected to a swirling action and is finally discharged through the outlet port in the pressure chamber without being previously separated. This arrangement is inadequate and does not afford significant reduction of the priming times.

The pumping apparatus described in the GB-A-1,201,721 and in the EP-A-401,670 comprises an interspace which is provided with a plurality of substantially radial blades adapted to counteract the rotational component of the fluid flow thereby promoting separation of air. Similarly the convey interspace applied to the pump described in the IT-A-1,225,597 is provided with a number of substantially radial blades which form recirculator channels, however this pump makes use of an axial diffuser which is arranged to face the impeller on the low pressure side thereof, and therefore the flow entering the recirculator channels has a speed direction with a relatively high rotational component. Moreover, the structure of these latter pumps is excessively complicated and brings about remarkable fluidodynamic losses.

The self priming centrifugal pumps known from the DE-A-3718273 and the EP-A-3023384 have an interspace with a single blade that offers the advantage of a lower complexity and reduced frictional losses. However, such interspace has a wall with one or more outlets for the fluid with relatively limited sizes which are located only in the upper half of the interspace wall. Thus, the trapped air tends to swirl and to be retained into the interspace thus elongating the priming times and reducing the efficiency of the pump.

One aim of the present invention is to eliminate the above mentioned drawbacks by providing a self priming centrifugal pump incorporating an ejector which is capable of operating with high efficiency and is very simple in structure.

This aim, these objects and others, which will become apparent to those skilled in the art, are achieved by a centrifugal pump according to claim 1.

Advantageously, the interspace is substantially tunnel-shaped and is formed by a pair of substantially frusto-conical and parallel walls extending inwardly with a conicity oriented towards the end of the case in the vicinity of the venturi tube.

Due to the presence of the single blade having a curved and smoothed shape, the rotational speed component of the fluid is effectively counteracted thus reducing the fluiddynamic losses. Moreover, because of the conical shape of the interspace and of the size of the annular passage, the air-liquid solution is not retained within the interspace and is promptly discharged through the outlet port.

Experimental tests have shown that the pump according to the invention achieves the stated objects to the extent it sets forth reduced priming times as well as a high fluidic efficiency. Additionally the pump has a relatively simple and inexpensive construction.

Further characteristics and advantages of the invention will become apparent from a reading of the detailed description of a preferred but not exclusive embodiment of a self priming centrifugal pump according to the invention, illustrated only by way of a non-limiting example in the accompanying drawings, wherein:

FIG. 1 is a partially sectioned side view of the pump according to the invention;

FIG. 2 is a cross-section view taken along the vertical plane II-II of FIG. 1;

FIG. 3 is a front view of the detail having the reference numeral 15 in FIG. 1.

With reference to the figures, the pump, generally indicated by numeral 1, comprises a case 2 made of a metal plate with a lateral wall 3 of substantially cylindrical shape and with a slightly outwardly bulged bottom wall 4. These walls are provided with inlet port 5 and outlet port 6 respectively which mount corresponding nozzles for connection with suction and pressure tubes.

The end portion of the case remote from the bottom wall 4 shows a connecting flange 7 for connection with a support 8 of an electric motor 9. A fluid-tight partition wall 10 is interposed between the flange 7 and the support 8 and is centrally provided with bearings and wear rings mounted on the shaft 11 of the motor 9, and a bladed impeller 12 rigidly fixed to the end portion thereof.

A pressure chamber 13 is formed in the inner space of the case 2 between the lateral wall 3, the bottom wall 4 and the partition wall 10 to collect the pressurized fluid. A pair of walls 14, 15 of substantially frusto-conical shape are axially spaced to partition the pressure cham-
ber 13 into sub-chambers 13' and 13'', so as to form therein a funnel shaped interspace 16. The walls 14, 15 have an angle of conicity α ranging between 5° and 20° according to the wished axial acceleration of the fluid. The conicity angle α is preferably set at 10°.

The impeller 12 is rotatably supported within the sub-chamber 13'' and is encircled by a radial diffuser 17 having front apertures 18 adapted to impart to the fluid a minimum axial speed directed towards the sub-chamber 13'.

Moreover, a conventional ejector device 19 is arranged in the sub-chamber 13'' in substantially central position, such device comprising a venturi tube 20 adapted to supply a diffusion duct 21 which is, in turn, connected at one end thereof 21' with a suction port 5 and, at the opposite end 21'', with the suction eye 12' of the impeller 12.

Preferably, the frusto-conical wall 15 is unitary with the radial diffuser 17 and has a central portion 15' for supporting the end 21'' of the diffusion duct 21.

The frusto-conical wall 14 shows a central annular passage 22 provided with an outer collar 23 which forms a discharge aperture for the interspace 16, which aperture extends peripherally to the diffuser over 360°.

Advantageously, the frusto-conical wall 14 may be unitary with the outer wall of the diffusion duct 21 and is joined to this latter by means of a pair of webs 24, 25 extending in a vertical axial plane.

Alternatively, a second pair of webs 24', 25' may be provided in a substantially perpendicular plane to the first pair 24, 25. These webs have the ancillary function of aligning the outlet flow issued by the impeller through the central annular passage 22, to thereby promote regular feeding of the Venturi tube separation of air bubbles.

According to the invention, a single blade 26 is located in the interspace 16. Blade 26 is slightly curved to counteract the rotational speed component of the fluid leading the diffuser 17 and to entirely direct it towards the annular passage 22. More particularly, the blade 26 is disposed in the lower portion of the interspace 16 and extends from the outer periphery of the diffuser 17 up to the central area 15' of the partition wall 15 in correspondence of the outlet 22, to thereby upward direct the fluid containing the bubbles of air.

Thus, the fluid issued by the impeller is collected and pressurized by the diffuser 17, is further directed to the interspace 16 reducing its rotational speed component and finally is discharged in the sub-chamber 13 wherein it is completely deprived of rotational speed component and is smoothened by the longitudinal webs 24, 25. Because of this smoothening action, the trapped air in the fluid flows upward towards the outlet port so that the venturi tube is supplied in few seconds by air-free fluid.

The pump according to the invention is susceptible to numerous modifications and variations, all of which are within the scope of the inventive concept. All the details may furthermore be replaced with other technically equivalent elements, within the limits of the claims.

In practice, the materials employed, as well as the dimensions, may be any according to the requirements. Having thus described one particular embodiment of the invention, various alterations, modifications, and improvements will readily occur to those skilled in the art. Such alterations, modifications, and improvements as are made obvious by this disclosure are intended to be part of this disclosure though not expressly stated herein, and are intended to be within scope of the invention. Accordingly, the foregoing description is by way of example only and is not intended as limiting. The invention is limited only as defined in the following claims.

Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly, such reference signs do not have any limiting effect on the scope of each element identified by way of example by such reference signs.

Claims

1. A self-priming centrifugal pump comprising a metal plate case (2) of substantially cylindrical shape forming a pressure chamber (13, 13', 13'') and provided with a suction inlet (5) and a pressure outlet (6), said pressure chamber (2) housing a bladed impeller (12) with a peripherally arranged diffuser (17), an axial ejector device (19) including a venturi tube (20), a torus-shaped interspace adapted to convey the emitted flow from the radial diffuser (17) towards the pressure chamber (13), said interspace having a central annular outlet passage (22) extending between a maximum and a minimum diameter all around said ejector device (19), a single blade (26) arranged in the lower portion of said interspace (16), said blade having a curved profile with an upwardly directed concavity extending from the peripheral region of the radial diffuser (17) up to a location of said central annular outlet passage (22) comprised between its maximum and minimum diameter in such a manner to counteract the rotational component of the fluid speed and to direct the flow upwardly towards the pressure outlet (16) to promote separation of air.

2. Pump according to claim 1, characterized in that said interspace (16) is substantially funnel-shaped.

3. Pump according to claim 2, characterized in that said interspace (16) is formed by a pair of substantially frusto-conical walls (14, 15) which are axially spaced and extend from the periphery to the center of said chamber (13) with an angle of conicity (α) oriented towards the bottom wall (4) of the case adjacent to the venturi tube.
4. Pump according to claim 3, characterized in that the said angle of conicity (α) of the transverse walls of said interspace (16) is comprised between 8° and 20° and is preferably equal to 10°.

5. Pump according to claim 1, characterized in that the ejector device (19) is joined to the frusto-conical wall (14) of said interspace at the low-pressure side thereof by means of at least one pair of diametral webs (24, 25, 24', 25') so adapted to align the outlet flow issued by the bladed impeller towards the venturi tube of the ejector device.

6. Pump according to claim 1, characterized in that the radial diffuser (17) is unitary with the frusto-conical wall (15) of said interspace (16) closer to the impeller (12).

7. Pump according to claim 6, characterized in that said frusto-conical wall (15) unitary with the diffuser (17) presents a plurality of front apertures (18) in correspondence of the leading edge of the blades thereof so as to impart to the fluid an axial component of predetermined value.

Patentansprüche

1. Selbstansaugende Zentrifugalpumpe, die ein im wesentlichen zylinderförmiges, eine Druckkammer (13, 13', 13'') bildendes, Metallplattengehäuse (2) umfaßt und mit einem Saugeinlaß (5) und einem Druckauslaß (6) versehen ist, wobei in der Druckkammer (2) ein Schaufelrad (12) mit einem am Rand angeordneten Diffusor (17), eine ein Venturirohr (20) einschließende Auswerfervorrichtung (19) und einen angepaßter torusförmiger Zwischenraum zum Beförderung von dem radialen Diffusor emittierten Flusses zu der Druckkammer (13) untergebracht sind, wobei besagter Zwischenraum einen mittigen ringförmigen sich zwischen einem maximalen und einem minimalen Durchmesser um der Auswerfervorrichtung (19) herum erstreckenden Auslaßkanal (22) und eine einzeln im unteren Teil des Zwischenraums (16) angeordnete Schaufel (26) aufweist, wobei diese Schaufel ein bogenförmiges Profil mit einer nach oben gerichteten Wölbung aufweist, die sich vom Rand des radialen Diffusor (17) her bis zu einem Bereich des, einen maximalen und einen minimalen Durchmesser aufweisenden, ringförmigen Auslaßkanals (22) in der Art und Weise erstreckt, daß sie zur Förderung der Luftabscheidung der Rotationskomponente der Flüssigkeitsbewegung entgegenwirkt und der Fluß nach oben in Richtung des Druckauslasses (6) führt.

2. Pumpe nach Anspruch 1, dadurch gekennzeichnet, daß der Zwischenraum (16) im wesentlichen trichterförmig ist.

3. Pumpe nach Anspruch 2, dadurch gekennzeichnet, daß der Zwischenraum (16) im wesentlichen durch ein Paar kegelstumpfförmige Wände (14, 15) gebildet ist, welche axial zueinander versetzt sind und sich vom Rand bis zur Mitte der besagten Kammer (13) mit einem Konizitätswinkel (α) orientiert in Richtung der Bodenwand (4) des anliegenden Gehäuses des Venturirohres, erstrecken.


5. Pumpe nach Anspruch 1, dadurch gekennzeichnet, daß die Auswerfervorrichtung (19) mit der niederdruckseitigen kegelstumpfförmigen Wand (14) des besagten Zwischenraumes durch Mittel von wenigstens einem Paar genau entgegengesetzter Stege (24, 25, 24', 25') verbunden ist, die so angepaßt sind, daß der vom Schaufenlrad herrührende Auslaßfluß auf das Venturirohr der Auswerfervorrichtung ausgerichtet ist.

6. Pumpe nach Anspruch 1, dadurch gekennzeichnet, daß der radiale Diffusor (17) mit der dicht am Schaufenlrad des besagten Zwischenraumes (16) befindlichen kegelstumpfförmigen Wand (15) verbunden ist.

7. Pumpe nach Anspruch 6, dadurch gekennzeichnet, daß die besagte mit dem Diffusor (17) verbundene kegelstumpfförmige Wand (15) eine Vielzahl von Vorderöffnungen (18) aufweist, die mit dem führenden Ende von deren Schaufeln korrespondieren, so daß die Flüssigkeit eine axiale Komponente von vorbestimmtem Wert erhält.

Revendications

1. Pompe centrifuge auto-amorçante comprenant un logement en plaque métallique (2) de forme sensiblement cylindrique constituant une chambre de pression (13, 13', 13'') et munie d’un orifice d’entrée d’aspiration (5) et d’un orifice de sortie de pression (6), la chambre de pression (2) renfermant une roue-hélice ou rotor à pales (12) avec un diffuseur (17) disposé périphériquement, un dispositif éjecteur axial (19) incorporant un tube Venturi (20), un espace intermédiaire toroidal apte à l’acheminement du flux émis par le diffuseur radial (17) vers la chambre de pression (13), cet espace intermédiaire comportant un passage d'orifice de sortie
annulaire central (22) s'étendant entre un diamètre minimum et un diamètre maximum tout autour du dispositif éjecteur (19), une seule pale (26) dispo- sée dans la portion inférieure de l'espace intermé- diaire (16), cette pale ayant un profil courbe avec une concavité dirigée vers le haut et s'étendant 5 depuis la région périphérique du diffuseur radial (17) jusqu'à l'emplacement du passage de l'orifice de sortie annulaire central (22) compris entre son diamètre maximum et son diamètre minimum de façon à contrecarrer la composante de rotation de la vitesse du fluide et diriger le flux vers le haut en direction de l'orifice de sortie de pression (16) pour faciliter la séparation de l'air.

2. Pompe selon la revendication 1, caractérisée en ce que l'espace intermédiaire (16) est sensiblement en forme d'entonnoir.

3. Pompe selon la revendication 2, caractérisée en ce que l'espace intermédiaire (16) est constitué par une paire de parois sensiblement tronconiques (14, 15) qui sont axialement espacées et s'étendent à partir de la périphérie vers le centre de la chambre (13) avec un angle de concivité (α) orienté vers la paroi de fond (4) de l'enveloppe contiguë au tube Venturi.

4. Pompe selon la revendication 3, caractérisée en ce que l'angle de concivité (α) des parois transversales de l'espace intermédiaire (16) est compris entre 5° et 20° et il est de préférence égal à 10°.

5. Pompe selon la revendication 1, caractérisée en ce que le dispositif éjecteur (19) est raccordé à la paroi tronconique (14) de l'espace intermédiaire sur son côté basse pression par au moins une paire de bras diamétraux (24, 25, 24°, 25°) adaptés de telle sorte à aligner le flux de l'orifice de sortie émis par le rotor à pales en direction du tube Venturi du dispositif éjecteur.

6. Pompe selon la revendication 1, caractérisée en ce que le diffuseur radial (17) est solidaire de la paroi tronconique (15) de l'espace intermédiaire (16) le plus proche du rotor (12).

7. Pompe selon la revendication 6, caractérisée en ce que la paroi tronconique (15) solidaire du diffuseur (17) présente plusieurs ouvertures frontales (18) en correspondance avec le bord d'attaque de ses pales de façon à transmettre au fluide une composante axiale de valeur prédéterminée.