United States Patent

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[54] **INDUCERS FOR CENTRIFUGAL PUMPS**
12 Claims, 3 Drawing Figs.

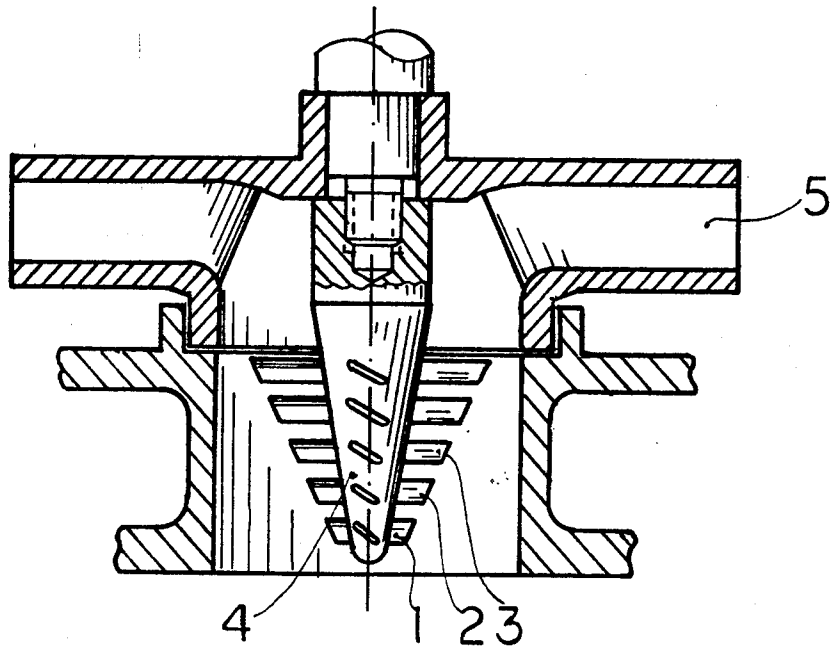
[52] **U.S. Cl.** **416/200,** 415/56, 415/59, 416/201
[51] **Int. Cl.** **F04d 19/02,** F01d 1/12, F04d 29/18
[50] **Field of Search** 103/115; 416/200, 201, 64; 415/56, 1, 59, 143

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Primary Examiner—Leonard H. Gerin

ABSTRACT: A centrifugal pump inducer composed of a number of blade sets with consecutively increasing diameters, each set of blades being capable of increasing the energy of the pumped fluid.



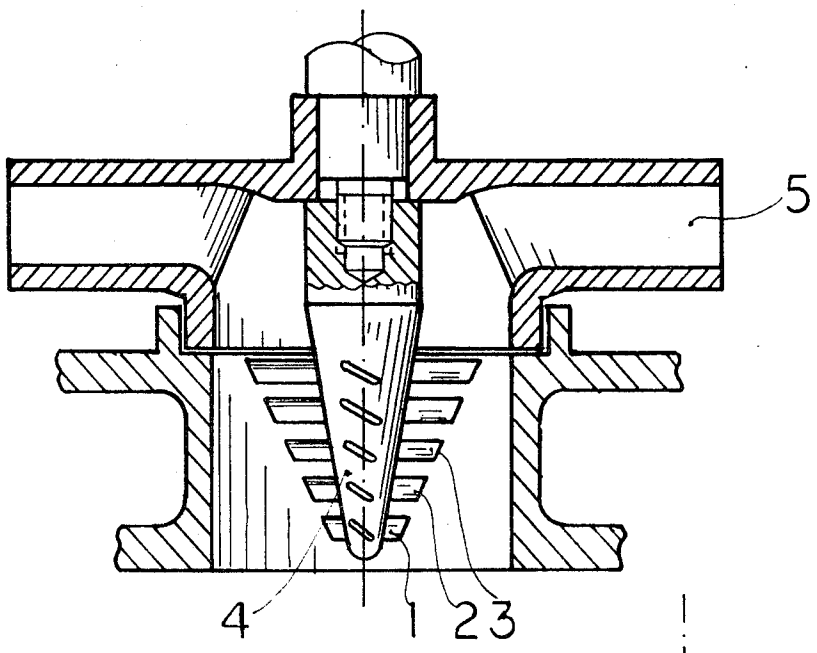


FIG. 1.

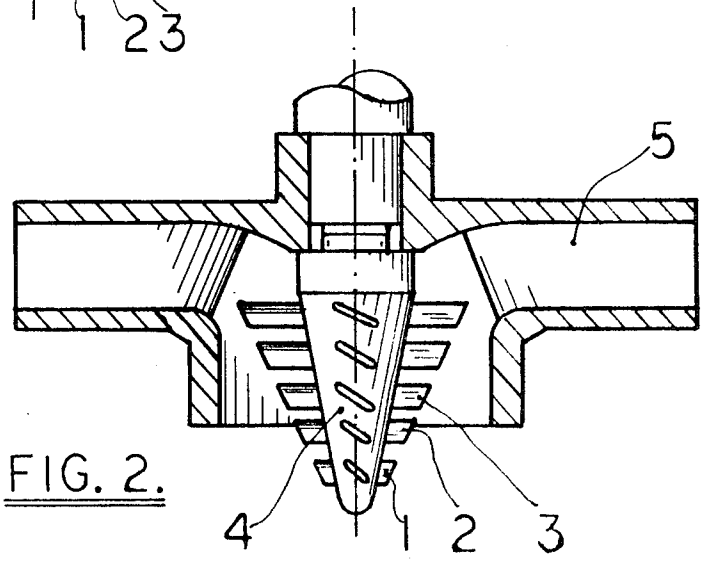


FIG. 2.

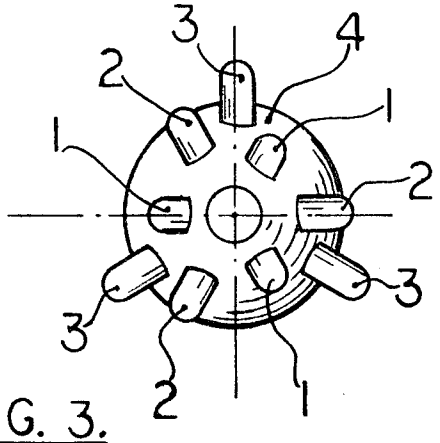


FIG. 3.

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INDUCERS FOR CENTRIFUGAL PUMPS

This invention relates to inducers for centrifugal pumps and is intended to help overcome some of the shortcomings which are usually encountered with conventional inducers.

Conventional inducers are, generally, axial or mixed-flow impellers with an high solidity of the blades and low blade angles. This type of inducers is subjected, often, to the following shortcomings:

a. It requires extra space ahead of the main pump impeller.

b. It often requires to be made of a greater diameter than the eye of the pump impeller. Conversely, if we make them of the same diameter as the eye of the impeller, we have to choose higher angles, to enable the inducer to handle the full capacity of the pump. An increase of the blade angles of the inducer, however, increases the NPSH requirements of the unit.

c. An increased diameter of the inducer increases the relative velocity between the outer tips of the blades and the liquid. This again increases the NPSH requirements of the inducer.

d. The conventional inducer has, usually, relatively long blades. This enables the vapor bubbles, which are created during cavitation, to collect in the long passages between the blades and to block off completely the passage of the liquid.

e. During partial cavitation, there may happen that cavities will form only in some of the passages. As this is usually an unstable condition, so these cavities will travel from passage to passage, giving rise to noise and vibrations.

f. The conventional inducer operates satisfactorily only over a very limited range of flow rates.

g. Each inducer has to be designed specifically for a given impeller, to be able to operate satisfactorily. Even in this case, the conventional inducer is capable to reduce the NPSH requirements only over a very limited range of flow rates, as pointed out under point (g).

The present invention is capable to eliminate, almost completely, the shortcomings listed under (a) to (c) inclusively. Besides this, it is capable to reduce significantly the shortcomings listed under (d) to (g) inclusively.

A schematical presentation of my invention is given in the drawing in which:

FIG. **1** is a schematical section of an arrangement in which the inducer is located ahead of the main pump impeller.

FIG. **2** is a schematical section of an arrangement in which the inducer is located, partially, within the eye of the impeller.

FIG. **3** presents the plan of an inducer provided with three sets of vanes, viewed from the direction of the incoming liquid.

The inducer consists, essentially, of an hub **4**, to which there is attached a series of sets of blades. The first three of these sets are denoted on the drawing by the numbers **1**, **2**, and **3**.

In practice, there may be more than three sets of blades or less, depending upon the duties for which a given inducer is designed.

The set number one is the set which comes first in contact with the incoming liquid. This set has the smallest diameter of all. The next set, marked by the number **2**, is of a somewhat greater diameter. The set marked **3** is of a greater diameter than the set marked **2**, and each subsequent set is greater than its predecessor.

As the set marked by the number **1** has a very small diameter, therefore its peripheral speed is also very small. This allows the set to handle liquids at considerably lower NPSH, than it is possible with an inducer which has a diameter equal to, or greater than the eye of the main pump impeller **5**.

The part of the liquid which was acted upon by the set **1** of the blades will gain a certain amount of energy. A part of this high-energy liquid will flow back into the suction line, but the remainder will mix with the rest of the incoming liquid, thus increasing the available NPSH of the liquid which enters the set **2** of the blades. Because of this increase in the available NPSH, the set **2** of the blades can now be made with a greater diameter than set **1**: without impairing the effectiveness of the inducer.

The same procedure is repeated when the liquid passes through the set **2** of the blades. Still more energy is added to the flowing liquid, thus increasing still more the available NPSH. The liquid can now be handled safely by the set **3** of the blades, which is of a greater diameter than set **2**.

This procedure can be repeated so many times, until the liquid acquires enough energy to be handled directly by the pump impeller **5**.

Of course, the efficiency of such as inducer, due to the great clearances between the vane tips and the walls of the casing, will be small. However, experience with the "Wemco" type sewage pumps shows us, that it is possible to attain acceptable efficiencies even in the case when there exists very great clearances between the blades and the casing. Besides this, an inducer is generally designed to perform only a small part of the total work which has to be performed by the inducer pump combination. Because of this, the low efficiency of an inducer will reduce only slightly the overall efficiency of the total pumping unit.

Comparing now the features of this invention with the shortcomings of the conventional inducers, we see that:

a. As there exist, generally, generous clearances between the blade tips and the casing, and as there exists a possibility to make the blades of this inducer much narrower than the blades of a conventional inducer, therefore the new inducer offers a considerably smaller obstruction to the flow of the liquid than a conventional inducer. This allows to place the inducer described in this specification partially, and sometimes even wholly, inside the eye of the pump impeller, as sown in FIG. **2**.

b. As the inducer described in this specification can be designed in such a manner, as to form only a small obstruction to the flow of the liquid, therefore there is no need to make the diameter of the passage, where the inducer is located, greater than the diameter of the eye of the pump impeller **5**.

c. As the first set of blades of this inducer can be made very small, therefore this inducer is capable to handle liquids at lower available NPSH than an inducer which outer diameter is equal, or even greater than the eye of the main pump impeller.

d. As the blades of each set can be made narrow, there is very little space available, where vapor bubbles could collect and shut off the flow of the liquid.

e. With narrow blades, there is less probability for vapor bubbles to clog up even a part of the passages. Besides this, any instabilities due to partial cavitation can be counteracted by designing each set of blades with a different number of blades. This can enable to eliminate any resonance in relation to the frequency of these instabilities.

f. As the inducer described in this specification is capable to add energy to the incoming liquid, without forcing it to flow through confined passages, therefore such an inducer may be applicable to a wider range of flow rates and to more pump sizes than a conventional inducer.

g. When we place such an inducer ahead of the impeller, then there exists a possibility to reduce the backflow of the liquid, by installing stationary vanes in the surrounding casing. Such blades are capable to increase the efficiency of this type of inducers.

I claim:

1. An inducer composed of a number of blade-sets with consecutively increasing diameters, arranged in such a manner, that the energy of the liquid which passes through any set is increased, before the liquid enters the consecutive set with the larger diameter.

2. An inducer as claimed under claim **1**, with sets of axial flow blades.

3. An inducer as claimed under claim **1**, provided with sets of mixed-flow blades.

4. An inducer as claimed under claim **1**, composed of a combination of axial flow and of mixed-flow blades.

5. An inducer as claimed under claim **1**, in which the casing is provided with additional stationary guide-vanes.

6. An inducer as claimed under claim 1, composed either of separate sets of blades jointed together, or consisting of one integral casting or forging, or as a unit fabricated by any other method or methods, or produced as one integral part of any regular pump impeller.

7. An inducer as claimed under claim 1, in which each set has the same number of blades.

8. An inducer as claimed in claim 1, in which different blade-sets may have different numbers of vanes.

9. An inducer as claimed under claim 1, mounted ahead of the eye of the impeller.

10. An inducer as claimed under claim 1, mounted partially or wholly within the eye of the impeller.

11. An inducer, as claimed under claim 1, used in combination with a pump impeller.

12. An inducer, as claimed under claim 1, used independently, without any additional pump impeller, and performing the duties of a pump impeller.