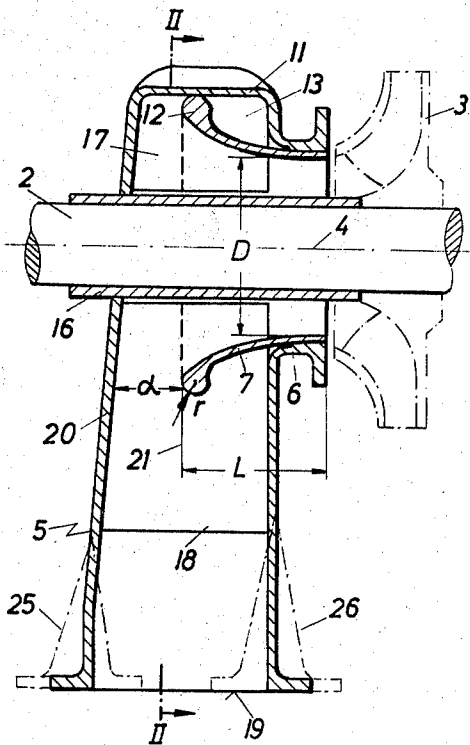


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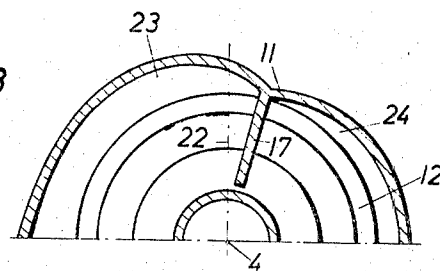
SUCTION BEND FOR CENTRIFUGAL PUMPS

Fig. 1



A technical drawing of a mechanical device, likely a pump or a valve, shown in a cross-sectional view. The device features a central vertical shaft (11) passing through a series of concentric rings or chambers (7, 12, 16, 17). The outermost ring is labeled 14, and the innermost ring is labeled 15. The shaft is supported by a base (19) and has a flange (18) at the bottom. The device is mounted on a frame (9) with vertical supports (10). The drawing includes various hatching patterns to indicate different materials or cross-sections.

Fig. 3



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SUCTION BEND FOR CENTRIFUGAL PUMPS
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12 Claims

ABSTRACT OF THE DISCLOSURE

The present invention relates to a suction bend for centrifugal pumps with inclined bend portion and with front and rear walls and with another bend portion merging with said inclined bend portion, said other bend portion being co-axial with the runner axis, while a funnel is provided which extends into said inclined bend portion and decreases in diameter in the direction toward the runner.

A suction bend according to the invention is characterized primarily in that the lateral wall portions which are located in spaced relationship to and opposite said funnel are on that funnel side which faces away from the inlet into the inclined bend portion to designed as to meet each other and to form a spur-shaped formation while together with said funnel defining fluid passages around a portion of said funnel.

The present invention concerns a suction bend for centrifugal pumps with a bend portion inclined preferably by 90° with regard to the runner axis and with a bend portion arranged coaxially with regard to said runner axis and merging with the inclined bend portion.

When designing suction conduits for pumps, one of the goals consists in so designing the suction conduit that at the entrance into the runner there will be assured a speed distribution of the flow as uniform as possible. More specifically, the local speeds over the entire entrance cross-section of the runner should have, as far as possible, uniform magnitude and uniform direction because any deviation from the rotation symmetry of the admission of fluid to the runner will result in an increased danger of cavitation and higher energy losses in the working flow.

With bent or curved suction conduits, i.e. with suction bends in which the admission of fluid has to be deviated shortly ahead of the runner by a certain angle, in most instances by 90°, it is particularly difficult to realize a locally and temporary uniform constant velocity distribution over the entrance cross-section of the runner. When passing through a suction bend of heretofore known construction, the flow not only changes its direction but also its mean velocity because the maximum velocity in the suction conduit admissible for avoiding too high frictional losses is in most instances considerably lower than the required entrance velocity into the runner.

The heretofore customary suction bends thus bring about a non-uniform admission of fluid to the runner. In this connection, reference may be had to the book by Pfeleiderer, "Die Kreiselpumpen," 1955, page 453, and also German Patent No. 608,451. It is known, for purposes of improving the admission of fluid to the runner, to provide ahead of the runner, a funnel which extends into the suction bend portion inclined to the runner axis and which tapers in the direction toward the runner. In this connection, reference may be had to the book, "Pompy Wirowe," by Szecepan Lazarkiewicz and Adam Tadeusz Trokolanski, Warsaw, 1959, page 213, and the book,

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"Centrifuge Compressor Stage," by T. B. Ferguson, London, 1963, page 112, Fig. 8.2. While by means of such a design improved results are obtained, the results, however, are not yet entirely satisfactory.

It is, therefore, an object of the present invention to provide an improved suction bend which will increase its efficiency and bring about a stable and uniform admission of fluid to the runner.

It is another object of this invention to provide a suction bend in which the velocities of the fluid will have practically uniform magnitude and the same axial direction over the entire entrance cross-section of the runner.

These and other objects and advantages of the invention will appear more clearly from the following specification in connection with the accompanying drawings, in which:

FIGURE 1 is a section through the longitudinal central plane for a suction pump bend according to the present invention;

FIGURE 2 is a section along the line II—II of FIGURE 1; and

FIGURE 3 is a portion of a section similar to that of FIGURE 2 of a modified suction bend.

A suction bend for centrifugal pumps with a suction bend portion inclined to the runner axis preferably by 90° and provided with lateral wall portions and with front and rear wall portions penetrated by the runner shaft and having a bend portion concentrically arranged to the runner axis and merging with the inclined bend portion while said bend portion which is concentrically arranged to the runner axis has a funnel tapering in the direction toward the runner, is characterized, according to the present invention, in that the lateral wall portions which are located opposite and in spaced relationship to said funnel meet with each other on that funnel side which is remote from the entrance to the bend, so that a spur or lobe formation is formed which extends at least within the marginal area of the large funnel opening to the outer wall thereon while defining a flow passage extending over a portion of the circumference of the funnel. In this way the flow is by the design of the bend divided practically into three portions. More specifically, one flow portion coming from the bend portion which is inclined to the runner axis flows directly into the funnel opening. The other two flow portions form an outer flow around a portion of the funnel extending into the inclined bend. These last two flow portions are by the flow passages passed around the funnel and flow around the funnel rim from the outside toward the inside. As experience has shown, a suction bend designed in this way brings about a flow at the runner entrance cross-section, the local velocity of which is directed in axial direction and the flow is considerably more stable and uniform than is obtainable with heretofore known suction bends.

In order further to improve the uniformity of the flow velocity around the funnel rim, the flow passages are preferably spirally designed, and the flow cross-sections of said passages decrease in flow direction at that funnel side which is remote from the flow admission to the bend. Advantageously, the decrease in the cross-section of the spiral-shaped flow passages is approximately proportional to the looping angle around the funnel.

With suction bends having a continuous runner shaft, it is advantageous to provide a rib on that side of the runner shaft which is remote from the inlet of the bend, said rib representing a radial extension of the lobe or spur. The said rib extends to the runner shaft or the protective sleeve therefor and also extends into the funnel in axial direction up to the narrowest portion thereof. In this way, the formation of turbulence and losses during intermixing of the partial flows will be avoided. With a symmetrical design of the flow passages it is advantageous to divide the flow already ahead of the runner shaft or the

protective sleeve thereof. To this end, a partition is provided on that side of the runner shaft which is located radially opposite the runner shaft or the protective sleeve therefor, and extends in the direction toward the inlet to the bend.

Generally, the flow passages are arranged symmetrically with regard to each other, and the ribs and/or the partition are arranged in the spiral plane of the bend.

If it is desired that the runner produces a twist or spin, for instance, for obtaining a better cavitation behavior, the flow passages are advantageously non-symmetrically arranged with regard to the longitudinal central plane of the suction bend.

According to a preferable design of the present invention, the plane of the largest funnel opening and the wall located opposite said largest funnel opening and pertaining to the inclined bend portion converge in the intermediate meridian section of the bend while forming an angle of from 5 to 20°, preferably 12°, in the direction toward the lobe or spur portion.

Tests have shown that optimum flow conditions can be realized when the axial funnel length is from 0.6 to 1.0, preferably 0.8 times as long as the smallest funnel diameter and if, furthermore, the funnel wall is reinforced by a bead while the rounding of the marginal bead has a radius of from 0.05 to 0.15, preferably 0.1 times the smallest funnel diameter.

Referring more specifically to the drawing, the suction bend illustrated therein comprises a bend portion 5 which is inclined approximately by 90° with regard to the axis 4 of the runner 3 mounted on the shaft 2. The suction bend furthermore comprises a bend portion 6 which is coaxial with the runner axis 4 and merges with the bend portion 5. The bend portion 6 has a funnel extending into the inclined bend portion 5, said funnel tapering in the direction toward the runner 3. The lateral walls 9 and 10 (FIG. 2) of the bend portion 5 which are located opposite the funnel 7 in spaced relationship thereto meet each other on that side of the funnel 7 which is remote from the inlet 19 to the bend while forming a lobe or spur 11. The said lobe or spur 11 extends to the bead reinforcement 12 of the funnel 7 and within the range of the funnel is in the form of a rib-shaped extension 13 extended to the outer funnel wall. The walls 9 and 10 confine spirally shaped flow passages 14 and 15 which extend around a portion of the funnel periphery while the cross-sections of said flow passages 14 and 15 decrease in flow direction on that side which is remote from the inlet of the bend. A rib 17 extending to the shaft protective sleeve 16 forms an extension of the spur 11 and extends within the funnel 7 approximately to the narrowest portion thereof. On that side of the shaft protective sleeve 16 which is located radially opposite said rib 17 there is provided a partition 18. From the entrance cross-section 19 in the flow direction, the wall 20 (FIG. 1) of the bend portion 5, which wall is located opposite the funnel opening, and the plane 21 of the funnel opening converge in the illustrated intermediate meridian section of the bend while forming an angle α of approximately 5°. The length L of the funnel 7 amounts in the present instance to about 0.8 times the smallest diameter D of the funnel, whereas the radius r of the bead-shaped funnel rim 12 amounts to about 0.07 times the diameter D.

Instead of the symmetrical design of the flow passages 14 and 15 as illustrated in FIG. 2, said passages may also be designed non-symmetrically in order to obtain a pre-rotation with regard to the longitudinal central plane 22 of the suction bend. Such an arrangement is shown in FIG. 3 with the flow passages 23 and 24. The rib-shaped spur extension 13, which is not visible in this figure, and the rib 17 will in this instance extend from the spur 11 radially with regard to the central axis 4 of the runner while forming an angle with regard to the longitudinal central plane 22.

The partition 18 illustrated in FIGS. 1 and 3 is not

necessary under all circumstances. At any rate, it is dispensed with in the non-symmetrical design of the flow passages 23 and 24 of FIG. 3.

Instead of the illustrated relatively straight design of the bend portion 5, the latter may also, for reasons of space, be curved away from the runner or toward the runner as indicated by the dot-dash lines 25 and 26 in FIG. 1.

It is, of course, to be understood, that the present invention is, by no means, limited to the particular constructions shown in the drawings, but also comprises any modifications within the scope of the present invention.

In particular, a bend according to the invention is applicable not only for centrifugal pumps but may advantageously also be used for blowers or pump turbines. With pump turbines, the advantages of the invention, especially when operating the device as pump, are obvious, but also when operating the device as turbine, the design of the bend according to the invention will not be disadvantageous.

What we claim is:

1. A suction bend for centrifugal pumps, which comprises: housing means having a first section with front and rear walls and also having lateral walls, said front and rear walls being provided with axially aligned bores for receiving therein the runner shaft of a centrifugal pump, the bore in said front wall having a greater diameter than the bore in said rear wall, said housing means also comprising a second section including a suction opening having its axis arranged at an angle with regard to the axis of said bores, funnel-shaped tubular means extending through the bore in said front wall and flaring from said front wall in the direction toward said rear wall, said lateral walls within the area of said funnel-shaped means meeting each other approximately at the largest diameter area of said funnel-shaped means on that side thereof which faces away from said inlet opening while creating a spur-shaped formation and together with a portion of said funnel-shaped means respectively defining flow passage means extending on opposite sides of and partially around said funnel-shaped means.

2. A suction bend according to claim 1, in which said flow passage means are spirally shaped, while the cross section of said flow passage means decrease in the direction toward said spur-shaped formation.

3. A suction bend according to claim 2, in which the said decrease in cross section of said flow passage means is approximately proportional to the looping angle of said flow passage means around said funnel.

4. A suction bend according to claim 1, which includes: shaft means extending through the bores in said front and rear walls and in spaced relationship to and through said funnel-shaped means, and rib means extending from said spur-shaped formation in radial direction with regard to said funnel-shaped means into the vicinity of the outer periphery of said shaft means and in axial direction of said funnel-shaped means to the narrower portions thereof.

5. A suction bend according to claim 4, which includes partition means located on that side of said shaft means which is radially opposite said rib means and extending from an area in the vicinity of the periphery of said shaft means in the direction toward said suction opening.

6. A suction bend according to claim 4, in which said flow passage means are symmetrically arranged with regard to each other, and in which said rib means is located in the central plane of said suction bend.

7. A suction bend according to claim 5, in which said flow passage means is symmetrically arranged with regard to each other, and in which said partition means is located in the central plane of said suction bend.

8. A suction bend according to claim 7, in which for purposes of bringing about a pre-twist of the fluid ahead of the runner to be mounted on the runner shaft said flow passage means are non-symmetrically arranged with regard to the longitudinal central plane of the suction bend.

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9. A suction bend according to claim 1, in which the plane of the largest opening of said funnel-shaped means and the respective rear and front walls of said suction bend which are located opposite said palne define in the median meridial section of the bend an angle of from 5-20° while conveying in the direction toward said spur-shaped formation.

10. A suction bend according to claim 1, in which the axial funnel length equals approximately from 0.6-1.0 the smallest diameter of said funnel.

11. A suction bend according to claim 1, in which the larger diameter end portion of said funnel-shaped means is reinforced by a rounded bead having a rounding radius of from 0.05-0.15 times the smallest diameter of said funnel-shaped means.

12. A suction bend according to claim 1, in which said suction opening has a cross section at least approximating an ellipse.

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820,439
1,269,063
1,269,063

5/1906 Ray ----- 103-103
6/1918 De Laval ----- 103-111
6/1918 De Laval ----- 103-111

FOREIGN PATENTS

217,495 1/1910 Germany.
869,779 3/1953 Germany.
307,399 3/1929 Great Britain.
455,092 1/1928 Germany.

HENRY F. RADUAZO, *Primary Examiner.*

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103-103

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References Cited

UNITED STATES PATENTS