

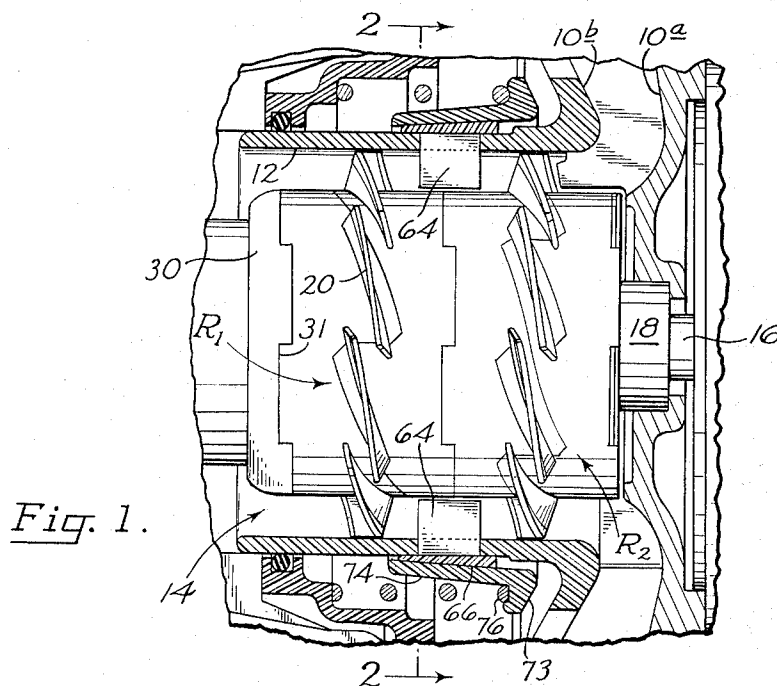
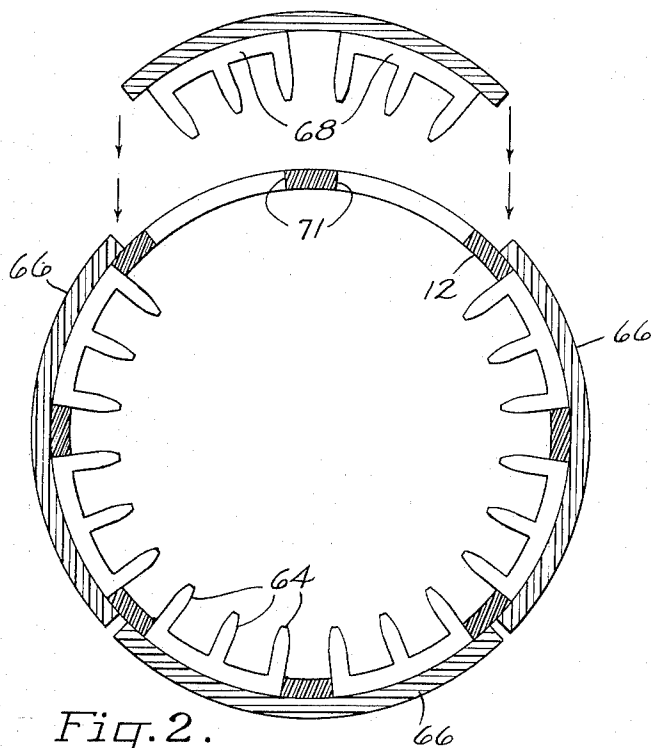
March 22, 1966

M. FREY
PUMP IMPELLER

3,241,493

Filed May 4 , 1964

2 Sheets-Sheet 1



Max Frey
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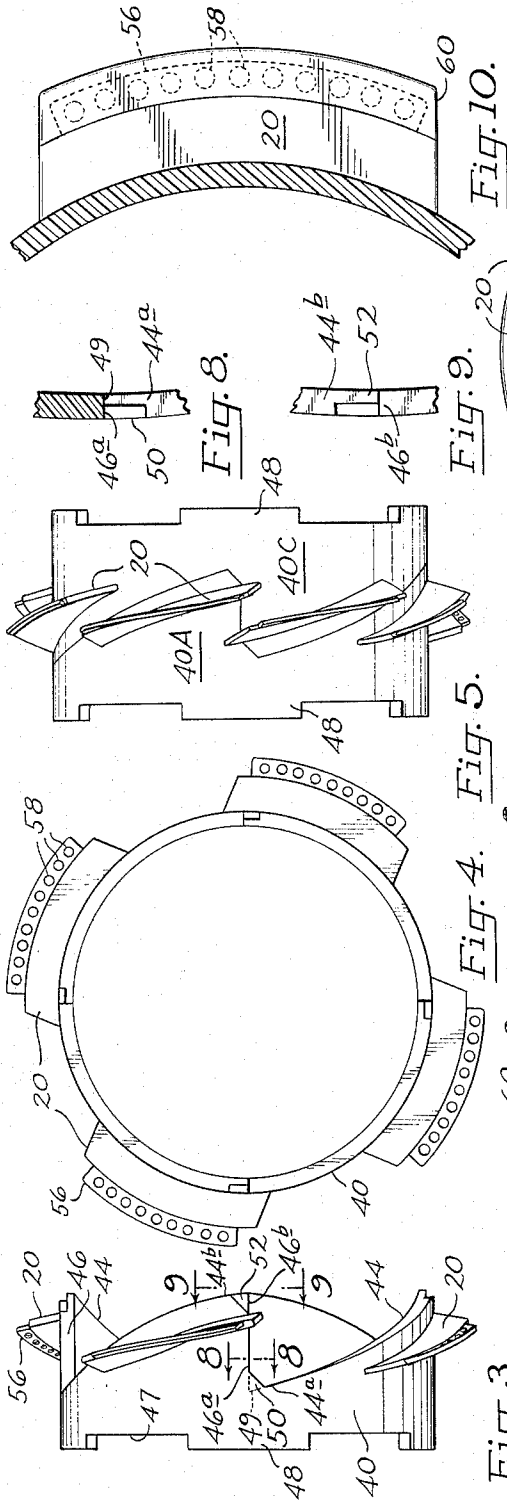
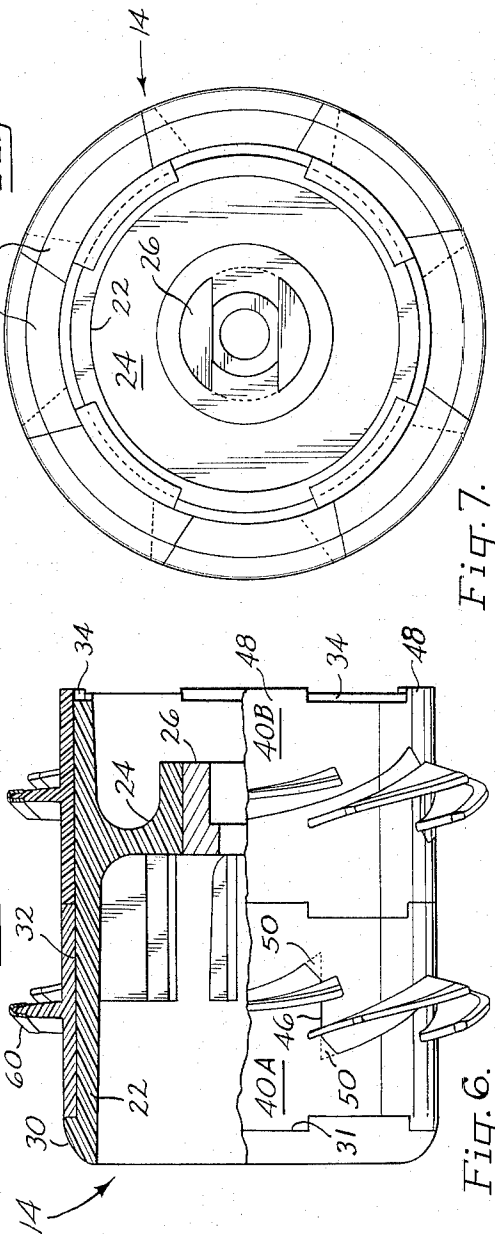
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1

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PUMP IMPELLER

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Filed May 4, 1964, Ser. No. 364,657
12 Claims. (Cl. 103-93)

This invention relates to pumps, and more particularly to axial flow, impeller-type pumps.

A general object of this invention is to provide a relatively economically produced pump of this description, which is efficient and entirely reliable in operation.

Another general object is to provide such a pump, which is capable of handling liquids carrying grit and other foreign matter, without undue wear occurring in the pump parts.

A further object is to provide a novel pump including an impeller, which is readily disassembled and repaired when such is necessary.

In a preferred embodiment of this invention, a multi-stage pump is contemplated, including an impeller which has multiple, circumferentially extending rows of impeller blades, where there is provided between adjacent rows of impeller blades a series of straightener vanes mounted in the housing for the pump effective to straighten the flow of liquid between rows of blades whereby greater efficiency is obtained in the pump. Each blade in each circumferentially extending row of blades helically curves partially around the circumference of the impeller, and has opposite ends overlapped with the ends of adjacent blades in the row. This overlapping enables maximum fluid pressures to be obtained by the pump.

As contemplated herein, the impeller blades in a row are presented by two sleeve sections, with successive blades in a row being integrally joined to first one and then the other sleeve section. The two sleeve sections are fitted snugly about a cylindrical body, with the sleeve sections forming a sheath on said body and locked thereon. During the assembly of the impeller, the sleeve sections may be advanced axially and rotated relative to each other, to produce the desired overlap of adjacent blades. The two sleeve sections may have an identical construction, and other rows of impeller blades in the impeller may be joined to sleeve sections also having identical construction. In a pump, therefore, which has multiple rows of such blades in an impeller, the impeller may be produced by manufacturing a suitable cylindrical body and fitting, as a sheath on this body, a sufficient number of such sleeve sections which follow one another on the body.

The straightener vanes or blades may be formed as integral parts of segments mounted in the pump housing with the segments forming a row extending circumferentially of the impeller in the pump. A lock ring placed about the outside of these segments operates to hold them in place, by preventing radial and axial movement of the segments.

The sleeve sections described, and the segments including the straightener vanes, may be formed as molded plastic units using conventional-type molding techniques. Their design is such that the molding operation is relatively simple, and thus these components in the pump may be produced at relatively low cost. Nevertheless, when assembled in a pump, the various components cooperate to produce a highly efficient pump giving high pressures in the fluids pumped. When repair is necessary, replacement of the molded plastic components is relatively easily done.

Thus, a more specific object of the invention is to provide, in a pump, a novel form of impeller which includes a body, and mounted on said body a sheath which is locked on the body and which has joined thereto the necessary impeller blades.

2

Another object is to provide such a construction, where impeller blades are provided which extend in a circumferential row, these blades having overlapped ends, and the blades in the row being joined to two sleeve sections, with successive blades in the row joined to alternate ones of said sleeve sections.

Yet a further object is to provide a novel impeller, including as a component thereof, parts which may be used to produce, when properly organized in the impeller, any number of successive rows of impeller blades in a multi-stage pump.

A still further object is to provide a unique straightener vane construction for a multi-stage pump, featuring straightener vanes that project radially inwardly between successive rows of impeller blades on an impeller, that are part of separable segments held together in an annular zone extending about the impeller.

These and other objects and advantages of the invention will become more fully apparent as the following description is read in conjunction with the accompanying drawings, wherein:

FIG. 1 illustrates portions of a pump according to this invention, with the portions of the housing therefor broken away, and showing a rotatable impeller mounted therein;

FIG. 2 illustrates, in a view taken generally along the line 2-2 in FIG. 1, a straightener vane assembly in the pump including plural straightener vanes;

FIG. 3 is a side view of a sleeve section which forms part of the impeller, and which includes impeller blades as an integral part thereof;

FIG. 4 is an end view of the sleeve section in FIG. 3;

FIG. 5 illustrates how two of such sleeve sections may be utilized to produce a sheath having a circumferential row of helically curving blades extending thereabout;

FIG. 6 illustrates the impeller in the pump, with portions thereof broken away;

FIG. 7 is an end view of the impeller in FIG. 6,

FIGS 8 and 9 are cross sectional views taken along the lines 8-8 and 9-9, respectively, in FIG. 3, showing details of construction; and

FIG. 10 is an enlarged view illustrating an impeller blade in the completed unit.

Referring now to the drawings, where an embodiment of the invention is illustrated, and first of all more particularly to FIG. 1, here portions of a pump housing are indicated at 10a and 10b. Portion 10b of the housing includes a cylindrical wall 12 which defines a cylindrical cavity having an impeller mounted therein indicated generally at 14. The impeller is mounted on a shaft 16 connected to a suitable power source, such as a motor (not shown). A seal 18 seals the shaft to pump housing portion 10a.

Impeller 14 includes two circumferentially extending rows of impeller blades indicated in FIG. 1 at R₁ and R₂. Each blade, one of them being indicated at 20, helically curves about the circumference of the impeller. The impeller illustrated is rotatable in either of opposite directions, to produce fluid flow in an axial direction either to the left or to the right.

General details of a pump of this description, including the type of impeller described which is rotatable in either of opposite directions to produce fluid flow in opposite directions, are disclosed in a copending, prior filed application, entitled "Pump," filed January 14, 1964, and having Serial No. 337,645.

As best shown in FIG. 6, impeller 14 comprises a substantially cylindrical body 22, having in the center thereof a hub portion 24. The body, including the hub portion, may be made of molded plastic. The hub portion has a metal fitting 26 mounted therein, which is employed

in mounting the impeller on shaft 16. The impeller may be secured to the shaft by a nut which is fastened onto the shaft and bears against fitting 26.

Body 22 on the outside thereof, and adjacent one end, is provided with an annular flange 30. Flange 30 has notches 31 provided along the inner edge thereof. From flange 30 to the other end of the body, the body is bounded by a smooth, cylindrical outer surface 32. At the end of the body opposite flange 30, tabs 34 are provided, which are equally circumferentially spaced about the body. These tabs may have a thickness which is somewhat less than the thickness of the wall of body 22.

The two rows R_1 and R_2 of impeller blades are produced by mounting on the circumference of the body, more specifically surface 32, plural sleeve sections, which may have an identical construction, and which may resemble sleeve section 40 illustrated in FIGS. 3 and 4. As will become more fully apparent below, these sleeve sections are so interfitted that they cooperate to form a cylindrical sheath snugly encompassing the circumference of the body, with one end of this sheath adjacent flange 30, and the opposite end of the sheath adjacent tabs 34.

Referring now to FIGS. 3 and 4, each sleeve section, which also may be made of molded plastic, has formed integral therewith and on the outside thereof multiple (four in the specific embodiment illustrated) helically curving impeller blades, of the type already identified as shown at 20. The blades are equally circumferentially distributed about the sleeve section, adjacent the right end of the sleeve section as viewed in FIG. 3.

The end of the sleeve section adjacent the impeller blades is defined by a saw-tooth margin or edge, comprising guide edges 44 extending obliquely on the circumference of the sleeve section, and edges 46 that extend more nearly in an axial direction than edges 44. It will be seen that each edge 46 joins at ends 46a, 46b with an adjacent set of ends 44a, 44b of adjacent guide edges 44. The end of the sleeve section opposite the end having the saw-tooth margin is notched at 47, and has tabs 48 between these notches.

As best shown in FIGS. 3 and 8, where the ends 44a, 46a of edges 44, 46 join, a reentering corner 49 is defined, and at this reentering corner a web of material 50 of substantially less thickness than the wall of the sleeve section spans the corner, with the outer surface of this web flush with the outer surface of the sleeve section. In this way, on the inner side of the web of material a pocket is defined. Where ends 46b, 44b join, and referring to FIGS. 3 and 9, the projecting corner defined is recessed, so that a web 52 of substantially less thickness than the wall of the sleeve section is left at the corner, this web 52 having an inner surface flush with the inner surface of the sleeve. In mounting two sleeve sections adjacent each other on body 22, the two webs described produce an interlocking fit, as will later be described.

Each blade 20 of a sleeve section includes a narrow ridge 56 extending along the length thereof on the outer edge of the blade, having a thickness which is somewhat less than the main body of the blade. This ridge is provided along the length thereof, and at regular intervals therealong, with perforations 58. This ridge with its perforations is utilized in mounting an overlay, shown at 60, which is mounted over the outer margin of the blade in the completed unit.

In making a sleeve section 40, a plastic may be selected which has the necessary strength, flexibility, etc. This plastic may not have the necessary abrasion-resistant properties desired, in a pump impeller which is to handle liquids containing grit such as sand and other impurities. Thus, overlays 60 have been included over the margins of the blades, which may be made of another plastic, or other material, having better wear-resistant properties than the material selected to make the sleeve section. When made of another plastic material, the overlays may be molded about the ridge portions of the various blades,

and when so processed projections are formed on the inside of the overlay that fit within perforations 58. The various projections and the perforations, together with the ridges, constitute means cooperating positively to lock the overlays from displacement on the outer margins of the blades.

Referring now to FIG. 6, in a completed impeller four sleeve sections of the type described are mounted end to end on body 22, with the sleeve sections then forming a continuous sheath. The sleeve sections at the ends of the sheath, i.e., adjacent the ends of body 22, have those ends that include tabs 48 disposed on the outside of the sheath. Thus, in FIG. 6, sleeve section 40A has its end with the tabs facing to the left, and these tabs snugly fit inside notches 31 provided along the inner edge of flange 48, to produce a mortice and tenon-type connection inhibiting relative rotation of the parts and movement of the sleeve section to the left relative to body 22. At the other end of the cylindrical body, the sleeve section shown at 40B has its end with the tabs facing toward the right, and the notches between these tabs overlie tabs 34 of body 22. Between these sleeve sections are two more sections, 40C and 40D. Sleeve section 40C has its saw-tooth margin fitting into the saw-tooth margin of section 40A, and sleeve section 40D has its saw tooth margin fitting into the saw-tooth margin of section 40B. The ends with the tabs of these two sections interfit in a region intermediate the ends of body 22.

In the completed impeller, after mounting of the sleeve sections, tabs 34 of body 22 are turned or bent over, whereby they extend radially outwardly and fit into the notches between the tabs of section 40B. After this has been performed, all the blade sleeve sections are locked in place on the body of the impeller, by an interfitting mechanical-type lock. At the left end of the body the sheath and body are locked from relative rotation, and from relative axial movement in one direction. At the right end of the body, the parts are locked from relative rotation, and from relative axial movement in the opposite direction. All the sleeve sections also are mutually interlocked. Thus, the parts are held fast, and this is without the necessity of using an adhesive or other bonding agency. This is advantageous, in that there is surety that the parts held properly. Further, if replacement of a sleeve section is necessary, such is easily done.

Earlier, webs 50, 52 were described. Referring to FIG. 6, with the sleeve sections fitted together, each web 50 at a reentering corner fits over the recessed projecting corner (of an adjacent sleeve section) that lodges within the reentering corner. Each web 50 is then backed up by a web 52 in the adjacent sleeve section. This interfit assures that the projecting corners remain flush.

It will also be noted that each helical blade in a sleeve section 40 has one end that extends beyond an edge 46. This projecting end overlies portions of an adjacent sleeve section in the assembled impeller. This overlying relationship, together with the other interfitting relationships described, serves to lock the parts snugly in the impeller.

When a completed impeller is to be assembled from a body and the necessary sleeve sections 40, first one of the sections is mounted in place, as described for section 40A. The section which is to abut thereagainst is then mounted in place as described in connection with section 40C. In mounting this section in place, the section is moved axially and also turned, in a manner of speaking "screwed," into position with guide edges 44 of the two sections sliding on each other. In this way, the blades of the last added section (section 40C), have one set of ends which are advanced beyond and then moved behind an adjacent set of ends of blades in the first mounted sleeve section. The third section (section 40D) may then be mounted in place, which enables the last section, (section 40B) to be mounted, by moving it axially and also turning it, whereby a set of blade ends are moved

5

behind a set of blade ends of section 40D. In this way, in a row of blades, when viewing the end of the impeller, successive blades in a circumferential direction have overlapped ends. Further, corresponding ends in the blades in a row of blades all lie on a common side of the blade adjacent. With such an overlapped disposition, maximum liquid pressures are produced upon rotation of the impeller.

If the impeller were to be molded as one piece, and to obtain such overlapping of the blade ends, a very difficult molding job would be presented. By utilizing sleeve sections, this is not the case. As best seen in FIG. 4, the sleeve section shown may be easily molded and withdrawn from the mold by withdrawing the same axially from the mold as there are no overhanging portions to prevent such removal. To summarize, by using the multiple sleeve sections disclosed, a considerably easier task is presented in making the molded parts, and these may be assembled readily to produce a completed impeller.

The impeller is a multi-stage impeller, and thus includes two circumferentially extending rows of blades. To obtain maximum efficiency in a pump using the impeller, it is desirable to have straightener vanes provided in the pump, disposed in the annular zone that extends about the impeller between the two rows of blades. Referring to FIG. 1, these straightener vanes, shown at 64, lie in planes extending substantially radially and longitudinally of shaft 16.

According to this invention, the vanes or blades are conveniently prepared from molded plastic, and mounted in place by structure best shown in FIGS. 1 and 2. Referring to these figures, it will be seen that the straightener vanes 64 are part of vane assemblies including curved segments 66. In cross section, the curved segments have a tapered outline, as best seen in FIG. 1. The straightener vanes, in groups of three, are joined to a curved segment 66 through a wall section 68. In the pump illustrated, four curved segments are provided, each of which has integrally joined thereto six straightener vanes, through two curved wall sections 68. Each vane assembly, comprising the curved segment and its straightener vanes joined thereto, may be molded as a unit.

Wall 12 of pump housing portion 10b has apertures 71 formed therein which are circumferentially distributed about the impeller. These apertures have a substantially rectangular outline. Within the pump, curved segments 66 are mounted about the outside of cylindrical wall 12, with a wall section 68 fitting within each aperture. With the vane assemblies so mounted, the straightener vanes project radially inwardly, and are located in a zone disposed between the two circumferentially extending rows of impeller blades. Holding the segments securely in place is a lock ring 73, which extends about the outside of the various segments. Ring 73 has a frusto-conical inner surface 74, and with the ring thrust axially to the right in FIG. 1, the ring produces a radially inwardly directed pressure on segment 66. A coil spring 76 seated on the outside of the lock ring biases the lock ring to the right in FIG. 1, thus to keep the segments tightly wedged into place.

The straightener vanes are readily removed, should it be necessary to remove the impeller from the pump, or to remove or replace some or all of the vanes. This may be done by removing the lock ring, which enables the segments to be withdrawn by pulling them radially outwardly from their seated position.

A pump constructed as contemplated, with the impeller and the straightener vanes described, may be operated satisfactorily for long periods of time without servicing. The pump is especially useful in handling fluids containing grit and other foreign particles. The various parts are economically produced and readily assembled into operative position.

While an embodiment of the invention has been described, it is appreciated that various changes and modifications may be made without departing from the inven-

6

tion. It is desired to cover all such changes and variations as would be apparent to one skilled in the art, and that come within the scope of the appended claims.

It is claimed and desired to secure by Letters Patent:

1. A pump impeller comprising

a cylindrical body,
a cylindrical sheath fitting snugly about the circumference of said body,

means adjacent one end of the sheath, presented by the sheath and by said body, producing an interfitting mechanical lock holding the sheath in place,

means adjacent the opposite end of the sheath, presented by the sheath and body, producing another interfitting mechanical lock holding the sheath in place, and

impeller blades distributed circumferentially on said sheath projecting out from and joined to the sheath.

2. An impeller for a pump comprising

a cylindrical body,
a cylindrical sheath fitting snugly about the circumference of said body,

means adjacent one end of the sheath, presented by the sheath and body, producing an interfitting mechanical lock holding the sheath from relative rotation on the body, and preventing axial movement in one axial direction thereon,

means adjacent the opposite end of the sheath, presented by the sheath and body, preventing axial movement of the sheath in the opposite axial direction, and

impeller blades distributed circumferentially on said sheath projecting out from and joined to the sheath.

3. A pump impeller comprising

a cylindrical body,
a cylindrical sheath fitting snugly about the circumference of said body,

mortise and tenon means presented by the sheath and body adjacent one end of the body producing an interfitting mechanical lock holding the sheath in place,

radial tabs presented by the body adjacent the opposite end of the sheath producing an interfitting mechanical lock holding the sheath in place, and

impeller blades distributed circumferentially on said sheath projecting out from and joined to the sheath.

4. In an impeller,

a pair of sleeve sections aligned axially with each other and with one end of one next to one end of the other at a joint between the sections,

each of said sleeve sections including at least one helically curving impeller blade on the outside thereof, said impeller blades of the two sleeve sections having one set of ends which overlap each other,

said joint between the sleeve sections being defined by marginal edges for the sections shaped to enable one section to be shifted axially toward the other with said one end of the blade for the one section moving in the same direction from one to the other side of said one end of the blade for the other section, and then to enable relative rotation of the sleeve sections, whereby an overlapping of said one ends of the blades is established.

5. In an impeller,

a pair of axially aligned sleeve sections mounted with one end of one next to one end of the other at a joint between the sections,

a circumferential row of helically curving blades presented by the two sleeve sections, with alternate blades joined to one and the remainder of the blades joined to the other of the sleeve sections,

corresponding ends of each blade in said row, in one circumferential direction, being overlapped and located on one side of the nearer end of the blade directly in front, and the side on which the end is located being common for all the blades,

said joint between the sections being defined by edges accommodating axial advancement and then relative rotation of the two sections, whereby ends of the blades may be shifted into their overlapped positions.

6. In an impeller,
a pair of axially aligned sleeve sections mounted with one end of one next to one end of the other at a joint between the sections,
said joint being defined by a saw-tooth margin for one section and a matching saw-tooth margin for the other section and said two saw-tooth margins including guide edges extending obliquely on the circumference of the sleeve sections, and so disposed that with the margins abutting, the sections may be rotated relative to each other simultaneously with advancement of the sections axially toward each other, with said guide edges sliding on each other, and
a circumferential row of helically curving blades presented by the pair of sections, with successive blades joined to alternate sections,
each of said blades having opposite ends lying axially on opposite sides of blades adjacent, and said blades, in a circumferential direction, having ends overlapped with the ends of adjacent blades.
7. In an impeller,
a pair of axially aligned sleeve sections forming a cylindrical sheath,
a circumferential row of helically blades extending about said sheath,
each of said blades in said row having opposite ends lying, in an axial direction, on opposite sides of the blades adjacent, and said blades, in a circumferential direction, having ends overlapped with the ends of adjacent blades,
successive blades in said row being joined to alternate sleeve sections, and
a joint between said sleeve sections defined by a first set of matching edges for the two sections extending obliquely about the circumference of the sheath substantially paralleling the longitudinal axes of the blades, and a second set of matching edges for the two sections extending between adjacent ends of said first set of edges whereby said first-second edges form a saw-tooth pattern.
8. The impeller blade of claim 7, wherein said second set of edges extend more nearly in an axial direction than said first set of edges, and adjacent blades in said row have ends extending across the said second set of matching edges.
9. The impeller blades of claim 8, wherein said first and second edges of one section define reentering corners receiving portions of the other section, and means is provided in said one section adjacent these reentering corners overlying the portions of the other section which are received within the reentering corners.
10. An impeller comprising
a cylindrical body,
a first sleeve section snugly encompassing the circumference of said body and mounted thereon,
means adjacent one end of the sleeve section, presented by the sleeve section and body, producing an interfitting mechanical lock holding the sleeve section in place,
a second sleeve section snugly encompassing the circumference of the body, with one end thereof next to the end of said first sleeve section opposite its said one end,
said opposite end of said first and said one end of the

- second sleeve sections meeting each other at a joint between the sections,
said joint being defined by a saw-tooth margin for said first section and a matching saw-tooth margin for said second section and said two saw-tooth margins including guide edges extending obliquely on the circumference of the two sleeve sections accommodating, with the margins abutting, relative rotation of the sleeve sections simultaneously with advancement of the sleeve sections axially toward each other while said guide edges slide on each other,
helically curving blades disposed in a circumferential row with successive blades joined to alternate sleeve sections,
each of said blades having opposite ends lying, in an axial direction, on opposite sides of the blade adjacent, and said blades, in a circumferential direction, having opposite ends overlapped with ends of adjacent blades, and
means adjacent the opposite end of said second sleeve section and presented by the second sleeve section and body, producing an interfitting mechanical lock holding this second-mentioned sleeve section in place.
11. In a pump
a pump housing including an annular wall defining an impeller chamber,
a power-driven rotatable impeller mounted within said chamber having multiple, circumferentially extending rows of impeller blades thereon,
a vane assembly mounted in said pump housing,
said vane assembly including a segment extending about the outside of said wall and vanes disposed radially of the impeller projecting inwardly from the segment, said wall including aperture means therein communicating with the pump chamber at a region disposed between said rows of impeller blades, through which the vanes extend, whereby the vanes have radially inner ends in said chamber disposed in said region, and
a lock ring extending about the segment and annular wall holding the segment from displacement radially outwardly of the impeller.
12. In a pump
a pump housing including an annular wall defining an impeller chamber,
a power-driven rotatable impeller mounted within said chamber having blades mounted thereon producing fluid flow on rotation of the impeller, and
a vane assembly mounted in said pump housing,
said vane assembly including a segment extending above the outside of said wall and vanes disposed radially of the impeller projecting inwardly from the segment, said wall including aperture means therein through which said vanes extend whereby the vanes have radially inner ends in said chamber.

References Cited by the Examiner

UNITED STATES PATENTS

809,277	1/1906	Barker	103—115
1,142,690	6/1915	Franke	253—77
2,077,959	4/1937	Smith	170—159
2,423,700	7/1947	Hardy	170—159

FOREIGN PATENTS

572,859 10/1945 Great Britain.

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