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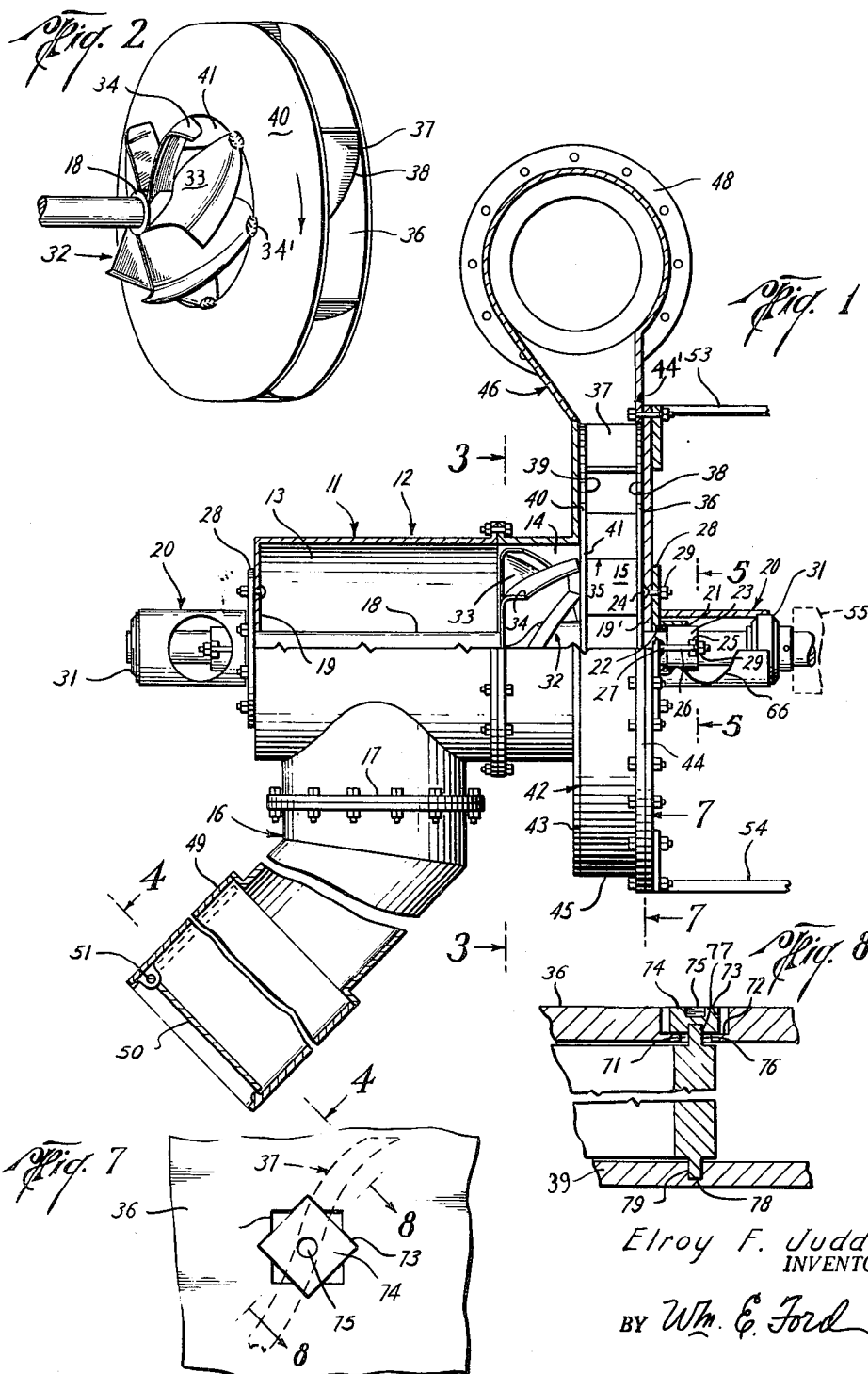
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2,766,697

PUMP HAVING RADIAL INTAKE AND CENTRIFUGAL DISCHARGE

Filed Dec. 2, 1954

2 Sheets-Sheet 1



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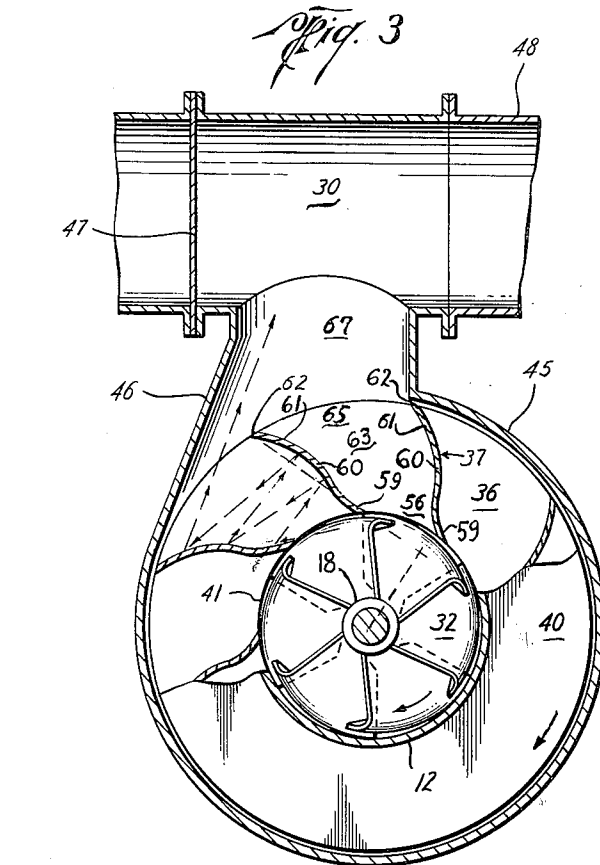
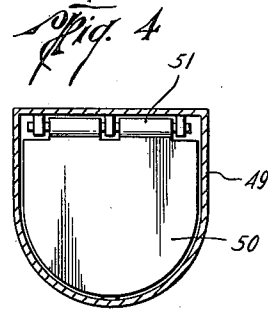
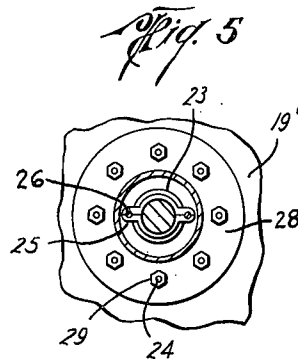
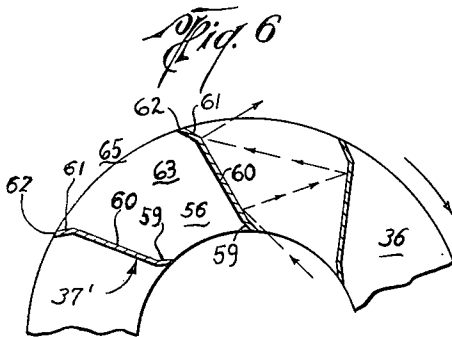
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PUMP HAVING RADIAL INTAKE AND CENTRIFUGAL DISCHARGE

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Application December 2, 1954, Serial No. 472,562

10 Claims. (Cl. 103—88)

This invention relates to a high fluid delivery capacity pump having a generally radial intake impeller and a centrifugal discharge impeller, and in particular the invention relates to such a pump adapted for connection to a tractor to be driven by the power take-off of such tractor and to be transported thereby; this application being a continuation-in-part application of application Serial No. 458,185 for Pump Having Radial Intake and Centrifugal Discharge Impellers, filed September 24, 1954, and now abandoned in favor of this application.

It is an object of this invention to provide a pump which draws fluid thereinto and generally radially directs such fluid to be received for further discharge centrifugally, thereby producing an effective balance between inlet suction and discharge pressure.

It is another object of this invention to provide a pump of this class which is adapted for connection to a prime mover, as a tractor, the pump being actuated by such prime mover as by means of the power takeoff from the prime mover transmission.

It is a further object of this invention to provide a pump of this class which has an inlet into a receiving chamber from which a first impeller of the pump directs fluid generally radially into a second impeller of the centrifugal, sirocco blade type, which centrifugally discharges the fluid outwardly.

It is another object of this invention to provide a pump of this class which has sirocco type blades with sides connected to radially spaced apart plates which rotate with minimum clearance in the pump housing to avoid the build up of back pressure, one of such plates having a central opening therein to receive fluid and the other of such plates being connected to the shaft of the pump whereby turbulence is minimized and the full force of fluid radially delivered through the opening is directed outwardly between the blades.

It is another object of this invention to provide a pump of this class in which the blades of a first impeller are directed angularly with relation to the shaft axis to transfer fluid in a general radial direction for impingement against the shaft connected plate of the second impeller.

It is still another object of this invention to provide a pump of this class having packing and bearings which are easily accessible.

It is yet another object of this invention to provide a pump of this class having an easily operable foot valve controlling the inlet thereto.

It is also another object of this invention to provide a pump of this class having a sequence of venturi simulating structures in the discharge impeller and outlet whereby once fluid flow is established through the pump, the delivery capacity is effectuated at a highest capacity rate.

It is still a further object of this invention to provide a pump of this class having an outlet restricting fluid discharge thereinto to travel substantially tangentially from the direction of rotation of the discharge impeller blades.

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It is yet another object of this invention to provide a pump of this class having its inlet impeller blades strengthened by connecting the ends thereof to the centrifugal outlet impeller.

It is also an object of this invention to provide a pump of this class in which the pitch of the sirocco type blades is variably adjustable whereby the pump capacity may be varied.

Other and further objects will be apparent when the specification is considered in connection with the drawings in which:

Fig. 1 is a view, part in section;

Fig. 2 is a perspective view of the arrangement of the blades of the two types of impellers;

Fig. 3 is a sectional view taken along line 3—3 of Fig. 1;

Fig. 4 is a view taken along line 4—4 of Fig. 1;

Fig. 5 is a sectional view taken along line 5—5 of Fig. 1;

Fig. 6 is a fragmentary sectional view of a modification of sirocco type blade construction;

Fig. 7 is a sectional view taken along line 7—7 of Fig. 1; and

Fig. 8 is a sectional view taken along line 8—8 of Fig. 7.

Referring to the drawings which disclose an operative embodiment of the invention, the pump 11 is shown as including the housing 12 which incloses a fluid receiving chamber 13, a first impeller chamber 14, and a second impeller chamber 15. An inlet connection 16 is connected to a flange 17 which extends from, and is connected to, the receiving chamber 13. A shaft 18 extends axially through the chambers 13, 14, and 15, and has ends journaled in the housing ends 19 and 19', the opposite end closures of the housing 12. End assemblies 20 having stuffing boxes 21 are provided for the shaft ends, each stuffing box providing a cylindrical recess to receive therein a packing 22 and a gland 23.

Such glands 23 are split and have ears which fit around a threaded stud 27, the head of which is welded to a base flange 28 of the assembly 20. Thus when a nut 29 is threaded on to a stud 27 and tightened against the ears 25, the glands 23 are forced against the packing 22. Studs 24 are rigidly connected to the housing end closures and extend outwardly therefrom through holes in the base flanges 28, and nuts 29 are threaded upon the studs 24 to connect the end assemblies 20 to the housing end closures. Thrust bearing assemblies 31 are press-fitted into the outer end of the assemblies 20 to receive the shaft 18 therethrough for anti-frictional rotation.

An impeller 32 is provided within the impeller chamber 14 and includes blades 33 which are rigidly connected to the shaft 18 and which extend angularly with relation to the shaft axis and provide surfaces which are parallel to each other. The blades 33 have outer portions 34 which are recurved in the direction of rotation as indicated in Fig. 3.

The impeller chamber 15 has an impeller 35 therein of the centrifugal type. Such impeller includes a circular plate 36 which is rigidly connected to the shaft 18. Blades 37 of the sirocco type have the side edges 38 thereof connected to the plate 36 and have opposite side edges 39 thereof connected to annular plate 40 which is spaced from the plate 36 in the direction of the impeller 32. The plate 40 provides the central opening 41 therein which extends around the shaft 18, such opening being of a diameter to receive fluid directed therethrough by the impeller 32.

For purposes of added strength, the outer portions 34 of the blades 33 are connected at 34' to the annular

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plate 46, exceptional rigidity being added thereby to the blades 33, see Fig. 2.

The housing section 42 which provides the impeller chamber 15 includes the plate 43 and spaced therefrom the flange 44, such members 43, 44 being connected by means of the cylindrical rim 45. Such rim 45 has an upper portion thereof cut away and the outlet connection member 46 is connected to the rim 45 as indicated in Fig. 3 and to the flange 44 at 44' as indicated in Fig. 1. As best seen in Fig. 3 the outlet connection 46 extends tangentially from the rim 45 and when the direction of rotation is as indicated fluid will be directed to travel tangentially to an outlet chamber 30. A closure plate 47 may blank off one end of the outlet connection 46 while an outlet pipe 48 may be connected to the opposite end. Optionally, the member 46 may connect into an elbow directed at any angle or into an outlet 30 of a wide variety of shapes.

The inlet connection 16 has an enlarged outer end member 49 which has a flap or foot valve 50 hinged thereto at 51. The inlet connection 49 is of a length to permit the foot valve 50 to open inwardly therewithin as indicated by the dotted lines in Fig. 1.

In operation brackets 53, 54 may be connected to the end closure 19' and the other ends thereof are connected to a prime mover, as a tractor, not shown. A power take-off connection 55, as a universal connection, is made to the end of the shaft 13 as indicated in dotted lines in Fig. 1. Thus the rotation of the shaft 18 by the prime mover power take-off 55 will rotate the impellers 32 and 35 and create sufficient suction to lift the foot valve 50 so that fluid, as irrigation water, may be drawn upwardly into the inlet connection 16 and receiving chamber 13.

From the receiving chamber 13 the fluid is drawn by the impeller 32 and discharged from the impeller chamber 14 angularly through throats or venturis 33' into the opening 41 to impinge upon the back plate 36 to whirl in a pressurized vortex in chamber 15 and to be deflected outwardly between the blades 37. As the first impeller blades 33 extend angularly with relation to the axis of the shaft 18 and deflect the fluid in the direction of rotation of the impellers, the fluid discharged centrally into the chamber 15 impinges upon such back plate 36 and then is deflected therefrom outwardly and in the direction of rotation to bear upon the sirocco type blades 37 of the second impeller 35.

The blades 37 may be so arranged, as shown in Fig. 3, so that a straight line passing through the outer and inner ends of the blades and extended in the direction of rotation will be intersected by a radial line from the shaft axis perpendicular to such extended line at a point within the opening 41 and proximate the periphery thereof. As shown each blade has an inner part 59 which lies approximately parallel to such line, a part 60 adjacent thereto which is curved forwardly of such line in the direction of rotation, a part 61 which is recurved from the part 60 back toward such line, and an outer part 62 which terminates at such line at the periphery of the discharge impeller. Thus there is formed a throat or venturi restriction 56 between the outer portion of the part 59 of a leading blade and the inner portion of the part 59 of a trailing blade. A second throat or venturi restriction 63 is formed between the outer part 62 of a leading blade and the outer portion of a part 60 of a trailing blade. By virtue of these features of construction the fluid passing through the sirocco type blades 37 may be buffeted in a pressurized course as that indicated by the arrows in Fig. 3. A third throat or pressure release area 65 is created between the outer ends 62 of adjacent blades where the passage there-through merges into the connection 46.

Since the connection member 46 extends tangentially from the rim 45 to the outlet chamber 30 a third throat or venturi restriction 67 occurs at the point of connection

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between the member 46 and the outlet chamber 30.

It can thus be seen that throughout its passage through the pump 11 the fluid at no point amounts to a force which has any substantial component which resists the rotation of the impeller blades of either impeller, but rather the pump is so constructed that in every feature the rotation of the shaft is abetted and the construction is such as to draw fluid through a succession of substantial venturis. The volume of fluid transferred is thus of a very high ratio to the total volume of the pump, and the rate of transfer is so great that adequate delivery is obtainable at low speeds of shaft rotation, such as the shaft rotation obtainable when the driving medium may be the power take-off of a tractor.

Also, by spacing the inlet from the first impeller 32 to discharge into the receiving chamber substantially transversely of the axis of shaft 18 an end assembly 20 may be provided at either end of the housing 12 so that the outer end of the shaft 18 may be journaled for accessible bearing and packing changes. By providing openings 66 in the housings of the assemblies 20 the half glands 23 may be removed therethrough after the nuts 29 have been removed from the studs 27.

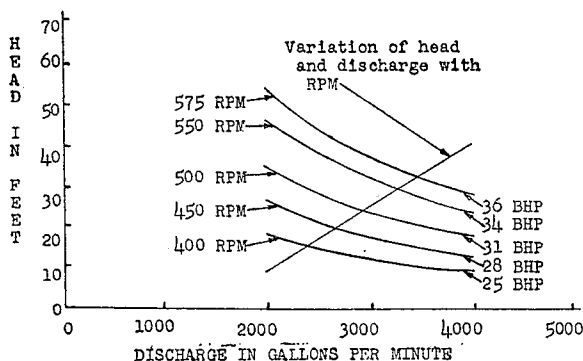
The first or suction impeller blades 33 have the outer portions 34 recurved in the direction of rotation to at least partially entrap the fluid between blades and to rotate with slight clearance within the housing to thereby avoid the build up of back pressure. Such blades are angularly extended with relation to the shaft axis, to better direct the flow of fluid for most effective delivery between impellers. Thus, the fluid is delivered into the central part of the chamber 15 to form a pressurized, whirling vortex from which the fluid may be most efficiently drawn for discharge by the centrifugal outlet impeller.

As shown in Fig. 6, blades 37' of a simplified construction are shown and because of the configuration of such blades, and the pitch thereof, a pump is provided of lesser capacity than that which can be delivered by the use of blades of the construction shown in Fig. 3. In such arrangement, the fluid takes a less buffeted, pressurized course between the blades 37'.

As is well known in sirocco type blades, variation of the pitch thereof can vary the pump capacity. In order to provide a pump wherein this variation may be selectively accomplished as shown in Figs. 7 and 8, each blade 37 has a cylindrical pin 78 on one side thereof approximately centrally of the length of the blade and this pin extends into a bore 79 in the plate 39. On the opposite side of the blade from the pin 78, a pin 76 of non-cylindrical or square cross-section is provided to extend through a bore 71 in the plate 36 and into a matching opening 77 in an adapter 74 which is externally of square cross-section. The adapter 74 fits into sockets provided by teeth 73 cut in the plate 36 to the depth of the shoulder 72, eight such teeth spaced apart at 45° being shown. Thus by changing sockets in which the adapter 74 is positioned, blade pitch may be varied. Adjustment may be made on location by removing the housing plate 19' and threading a handle into the threaded bore 75 in the adapter 74 by which the adapter may be withdrawn and shifted in socket position.

The performance of a pump constructed after the disclosure of this invention was tested at an engineering experiment station of a technical institution where it was possible to vary the head or lift by spacing the pump axis with relation to a body of water from which the pump drew water. A model 70 John Deere tractor was employed as prime mover for the pump and was operated to drive the pump at various speeds and brake horse powers. With the head in feet as ordinate and discharge in gallons per minute as abscissa curves were plotted of gallons per minute against head in feet with the tractor operated at various speeds and brake horse powers. The variation of head and discharge in gallons per minute bore a uni-

form relation to the pump speed and the delivery in gallons per minute per brake horse power was phenomenal:



Broadly this invention is directed to a pump having impeller blades of a first impeller shaped to direct fluid generally radially into the central opening of a second impeller, such opening being axially spaced from said first impeller, the pump then ejecting the fluid from such space outwardly through sirocco type blades having substantial venturis formed therebetween, the pitch of the sirocco type blades being selectively adjustable. The invention is not limited to the disclosure of the drawings but considers various modifications of structure which may fall within the broad spirit thereof and within the broad scope of interpretation claimed and merited for the appended claims.

What is claimed is:

1. A pump including a housing having a first smaller diameter portion and a second larger diameter portion axially aligned and in communication therewith, a shaft extending coaxially through said housing with ends journaled in said portions, a transverse inlet into said first portion and spaced from said second portion, an impeller chamber in said first portion adjacent said second portion, a plurality of blades connected to said shaft within said chamber and providing parallel surfaces angularly extending with relation to the axis of said shaft and recurved at the top to deflect fluid radially inwardly and into said second portion, a plate connected to said shaft in said second portion and spaced from said first portion, a second impeller including curved, generally radially extending sirocco type blades providing successive venturis mounted upon said plate generally outwardly of the diameter of said first impeller blades, and an outlet connection connected to said second portion periphery to receive fluid delivered centrifugally therinto by said sirocco type blades.

2. A pump including a housing, a shaft journaled therein, an inlet connection into one end of said housing and extending transverse to the axis of said shaft, an impeller spaced from said inlet and including a plurality of blades connected to said shaft and providing parallel surfaces angularly extending with relation to the axis of said shaft and recurved at the top to deflect fluid generally axially, a plate connected to said shaft and spaced from said first impeller on the opposite side therefrom from said inlet, a second impeller including curved, generally radially extending sirocco type blades providing successive venturis mounted upon said plate to extend toward said first impeller and to receive fluid delivered generally axially from said first impeller for further transfer centrifugally, and an outlet connection connected to the periphery of said housing outwardly of said second impeller to receive fluid delivered centrifugally theretinto from said second impeller.

3. A pump including a shaft, a suction impeller and a discharge impeller axially spaced apart upon said shaft, said discharge impeller providing an annular opening around said shaft to receive fluid delivered therinto from said suction impeller, said suction impeller including a

plurality of blades connected to said shaft and providing parallel surfaces angularly extending with relation to the axis of said shaft for directing fluid into said discharge impeller, radially spaced blades on said discharge impeller outwardly of said opening and providing successive venturis through which fluid from said opening is drawn upon rotation of said shaft, and an outlet outward of the periphery of said blades to receive fluid discharged therinto.

4. A pump including a shaft, a suction impeller and a discharge impeller axially spaced apart upon said shaft, said discharge impeller providing an opening around said shaft to receive fluid delivered therinto from said suction impeller, said suction impeller including a plurality of blades connected to said shaft and providing parallel surfaces angularly extending with relation to the axis of said shaft for directing fluid into said discharge impeller, radially spaced blades on said discharge impeller outwardly of said opening and providing successive venturis through which fluid from said opening is drawn upon rotation of said shaft, and an outlet constructed to receive fluid in tangential discharge from said blades and providing venturi means to receive the discharge fluid therethrough.

5. A pump including a housing, an assembly at either end of said housing including a closure having a split gland stuffing box unit adjacent said housing and a thrust bearing assembly spaced outwardly therefrom and providing an opening therein through which said split gland may be removed, a shaft extending through said housing with either end extending through a stuffing box and journaled in a thrust bearing, an inlet connection into said housing transverse to said shaft, a first impeller on said shaft spaced from said inlet connection and having a plurality of blades connected to said shaft and providing parallel surfaces angularly extending with relation to the axis of said shaft to direct fluid generally axially along said shaft, and a second impeller on said shaft providing an opening to receive fluid delivered therinto from said first impeller and providing successive venturis through which said fluid is discharged centrifugally outwardly.

6. A pump including a housing, a shaft journaled therein, an inlet connection into said housing transverse to said shaft, a suction impeller on said shaft spaced from said inlet, a discharge impeller on said shaft providing an annular opening around said shaft to receive fluid delivered therinto from said suction impeller, said suction impeller including a plurality of blades connected to said shaft and providing parallel surfaces angularly extending with relation to the axis of said shaft for directing fluid into said discharge impeller, blades on said discharge impeller providing successive venturis outwardly of said opening through which said fluid is discharged peripherally, and a valve hingeably closing said inlet connection and inwardly opening responsive to fluid pressure.

7. A pump including a housing and a shaft supported therein, said housing including an inlet portion of relatively small diameter in which one end of said shaft is journaled and a larger diameter outlet portion in connected abutment with said inlet portion and in which the other end of said shaft is journaled, an outlet impeller of the centrifugal type mounted on said shaft for rotation within said outlet portion and in a manner to leave a central opening around said shaft and in communication with said inlet portion, and an inlet impeller comprising a plurality of blades connected to said shaft and providing parallel surfaces angularly extending with relation to the axis of said shaft and spaced apart to provide venturi effect spaces of reduced cross-sectional area adjacent said shaft and said central opening through which fluid may be drawn to fill said opening, said blades having their outer parts recurved in direction of rotation to rotate with close clearance within

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said inlet portion and to provide a more effective, at least partially enclosed fluid entrapment space between blades and to minimize back pressure build up within said inlet portion, one end of said shaft extending beyond said housing for connection to a prime-mover to rotate said pump.

8. A pump including a housing and a shaft supported therein, said housing including an inlet portion of relatively small diameter in which one end of said shaft is journaled and a larger diameter outlet portion in connected abutment with said inlet portion and in which the other end of said shaft is journaled, an outlet impeller of the centrifugal type mounted on said shaft for rotation within said outlet portion and in a manner to leave a central opening around said shaft and in communication with said inlet portion, an inlet impeller mounted on said shaft to rotate within said inlet portion adjacent said opening and having a plurality of blades connected to said shaft and providing parallel surfaces angularly extending with relation to the axis of said shaft and spaced apart to provide venturi effect spaces of reduced cross-sectional area adjacent said shaft and said central opening through which fluid may be drawn to fill said opening, said outlet impeller comprising a circular plate connected to said shaft in spaced relation from said inlet impeller, curved generally angularly extending, sirocco type blades mounted thereon, and an annular plate surrounding said opening and connected to the sides of said blades opposite said circular plate and with surface parallel to said circular plate, said plates rotating with close clearance within said housing to minimize back pressure build up within said outlet portion, one end of said shaft extending beyond said housing for connection to a prime mover to rotate said pump.

9. A pump including a housing and a shaft supported therein, said housing including an inlet portion of relatively small diameter in which one end of said shaft is journaled and a larger diameter outlet portion in connected abutment with said inlet portion and in which the other end of said shaft is journaled, an outlet impeller of the centrifugal type mounted on said shaft for rotation within said outlet portion and in a manner to leave a central opening around said shaft and in communication with said inlet portion, and an inlet impeller comprising a plurality of blades connected to said shaft and providing parallel surfaces angularly extending with relation to the axis of said shaft and spaced apart to provide venturi effect spaces of reduced cross-sectional area adjacent said shaft and said central opening through which fluid may be drawn to fill said opening, said blades having their outer parts recurved in direction of rotation to rotate with close clearance within said inlet portion and to provide a more effective, at least partially enclosed

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fluid entrapment space between blades and to minimize back pressure build up within said inlet portion, said outlet impeller comprising a circular plate connected to said shaft in spaced relation from said inlet impeller, curved generally angularly extending, sirocco type blades mounted thereon, and an annular plate surrounding said opening and connected to the sides of said blades opposite said circular plate and with surface parallel to said circular plate, said plates rotating with close clearance within said housing to minimize back pressure build up within said outlet portion, the outer edges of said inlet impeller blades adjacent said annular plate being connected thereto to brace said impeller blades for rigidity, one end of said shaft extending beyond said housing for connection to a prime mover to rotate said pump.

10. A pump including a housing, a shaft journaled therein, a suction impeller thereon, an inlet connected to said housing transverse to said shaft at a point in spaced relation thereon from said suction impeller, said suction impeller having a plurality of blades connected to said shaft and providing parallel surfaces angularly extending with relation to the axis of said shaft and spaced apart to provide venturi effect spaces of reduced cross-sectional area adjacent said shaft and adapted to have fluid drawn therethrough from said inlet and deliver it to surround said shaft on the opposite side of said suction impeller from said inlet, a centrifugal discharge impeller of larger diameter than said suction impeller mounted on said shaft to receive the fluid delivered by said suction impeller and discharge it outwardly, said discharge impeller having radially spaced apart blades extending on bent lines with general axes intersecting radial lines at points inwardly of said blades when said axes are extended in direction of rotation, said blades being arranged to provide successive venturis between blades, and means to adjust the angularity pitch of said discharge impeller blades to vary the capacity of fluid delivered therethrough, one end of said shaft extending outwardly of said housing for connection to a prime mover.

References Cited in the file of this patent

UNITED STATES PATENTS

509,143	Smith	Nov. 21, 1893
860,465	Hancock et al.	July 16, 1907
939,136	Jacobsen	Nov. 2, 1909
1,143,082	Shepherd et al.	June 15, 1915
2,253,406	Wagner	Aug. 19, 1941
2,361,007	Buchanan	Oct. 24, 1944

FOREIGN PATENTS

383,594	Great Britain	Nov. 17, 1932
576,267	France	Oct. 13, 1924