Aug. 4, 1953 J. H. DAVIS 2,647,467

SCREW PUMP

Filed May 28, 1946 3 Sheets-Sheet 1

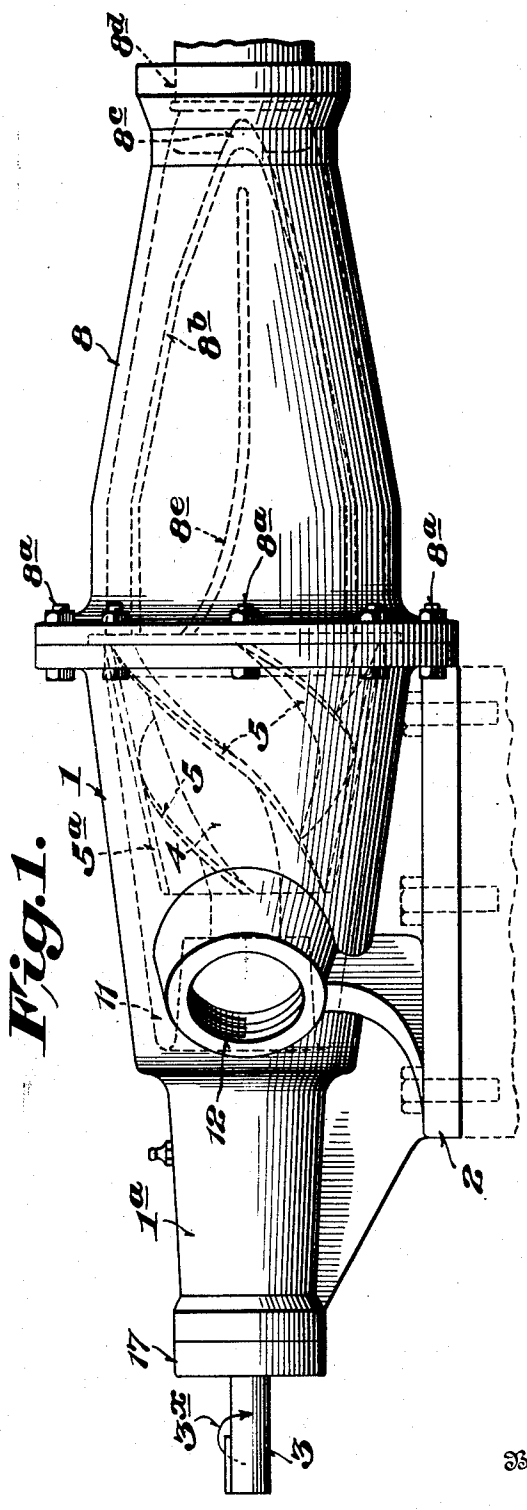


Fig. 1.

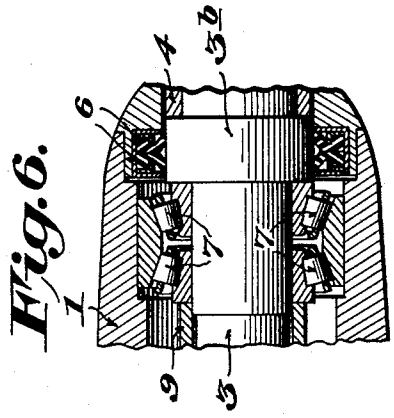


Fig. 6.

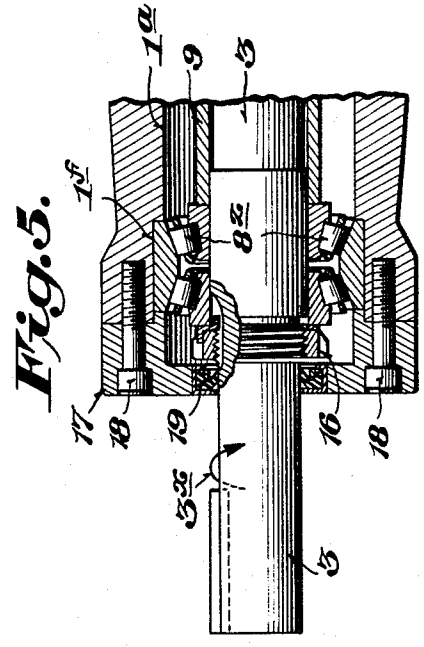


Fig. 5.

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Fig. 2.

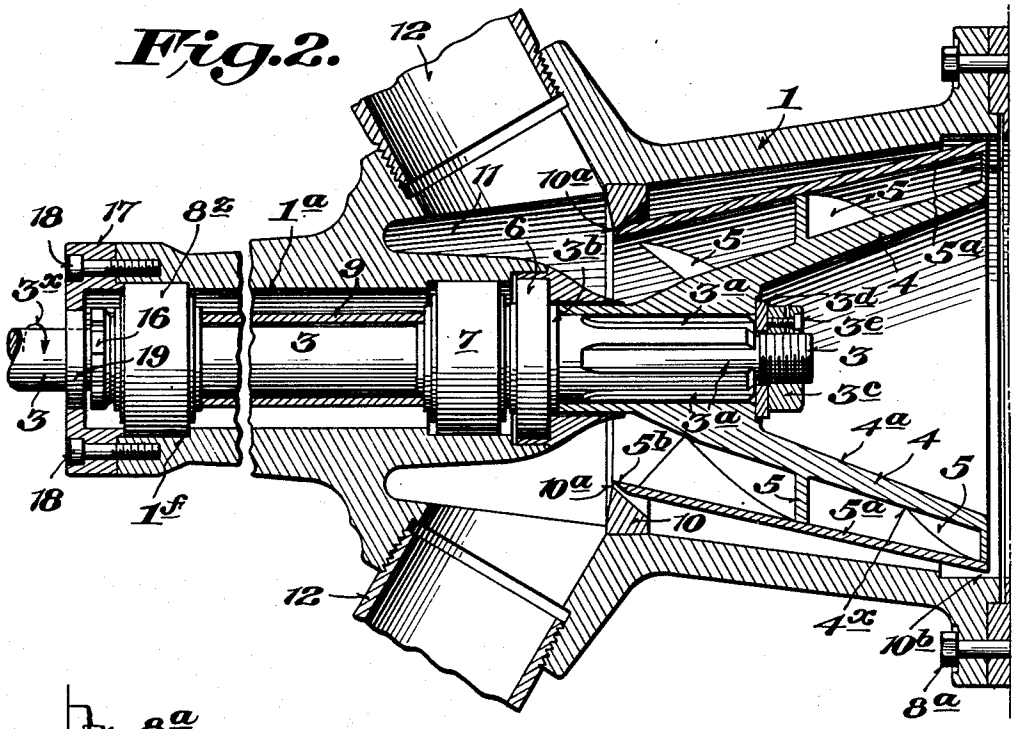
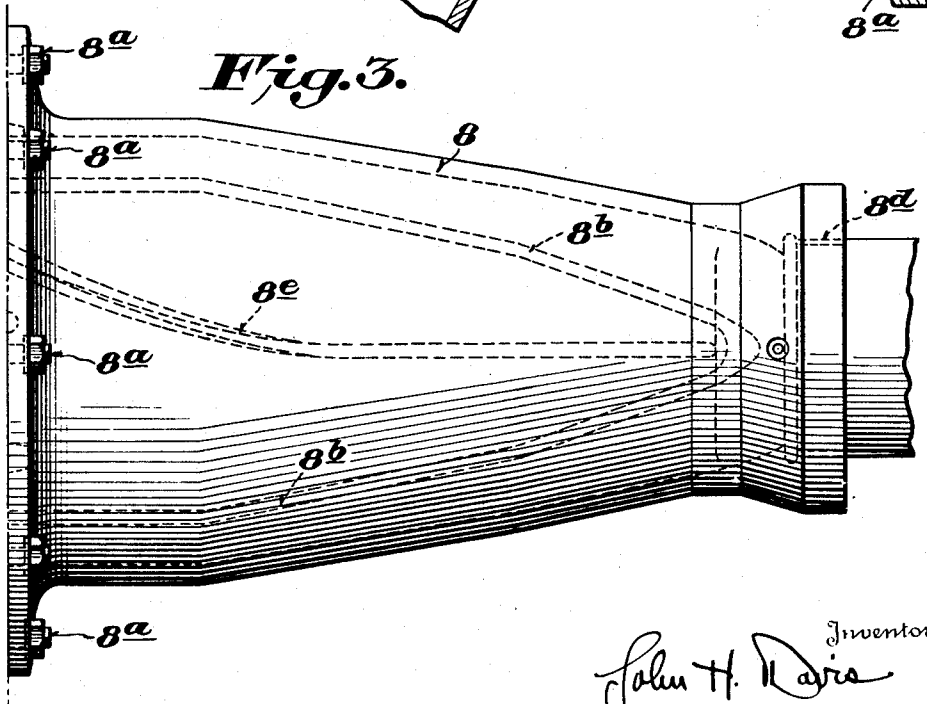


Fig. 3.



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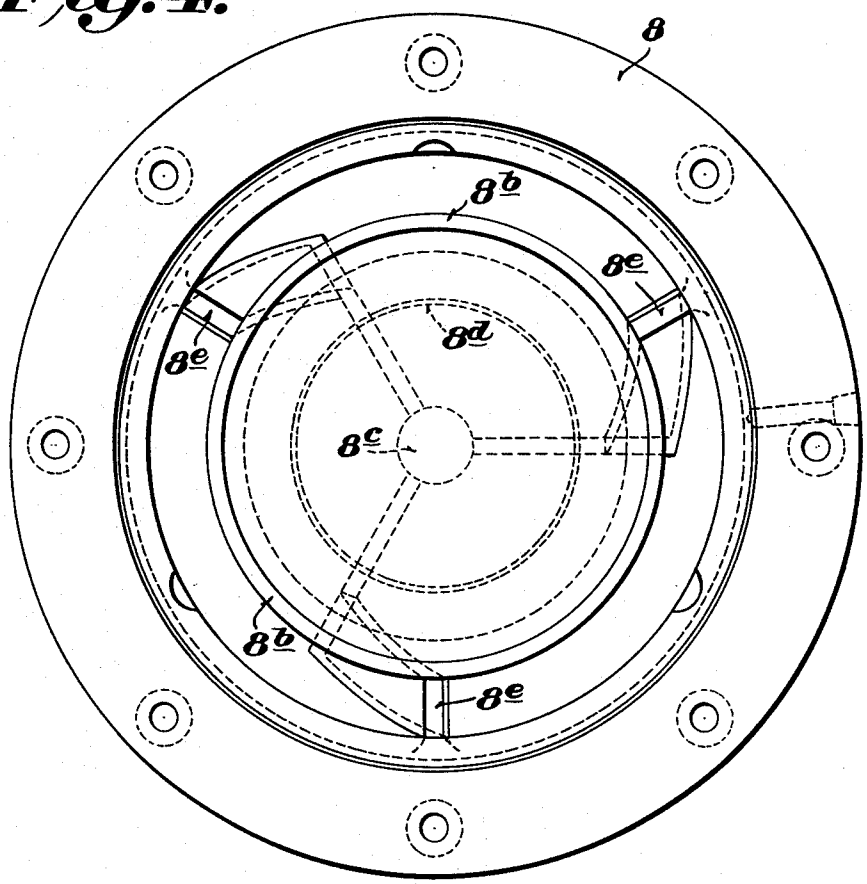
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SCREW PUMP

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Fig. 4.



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UNITED STATES PATENT OFFICE

2,647,467

SCREW PUMP

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Application May 28, 1946, Serial No. 672,801

8 Claims. (Cl. 103—89)

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This invention is a novel pump, and the principal object thereof is to provide a pump radically differing in principle from the conventional type of pump, my pump having a conical shaped impeller carrying fins surrounded by a sleeve secured thereto and closely fitting the machined outer edges of the fins which are preferably spirally arranged so that the cone and fins and sleeve rotate as a unit and impart to a liquid medium a velocity longitudinally of the impeller axis while building up a pressure radially from intake to discharge by centrifugal force, such pressure and velocity being governed by the rotational speed and diameter of the impeller.

A further object of the invention is to provide a pump of the above type which would be simple, novel and efficient in operation, and will be capable of delivering a wide range of fluid capacity by merely regulating the speed of the impeller or the area of the outlet.

Other minor objects of the invention will be hereinafter set forth.

I will explain the invention with reference to the accompanying drawings, which illustrate one practical embodiment thereof to enable others familiar with the art to adopt and use the same; and will summarize in the claims the novel features of construction, and novel combinations of parts, for which protection is desired.

In said drawings:

Figure 1 is a side elevation of my pump.

Fig. 2 is a longitudinal section through the impeller chamber of the pump, also through the impeller mounted therein.

Fig. 3 is an enlarged side elevation of the nose of the pump showing the arrangement of fins therein.

Fig. 4 is an end view of the nose shown in Fig. 3 looking at the larger end.

Fig. 5 is an enlarged section through the outer roller bearing for the impeller shaft.

Fig. 6 is an enlarged section through the inner roller bearing of the impeller shaft.

As shown in the drawings, the pump comprises an impeller casing 1 having a base 2 adapted to be mounted on a fixed support. Casing 1 is provided with an axial extension 1*a* at one end in which are mounted the anti-friction bearings of an impeller shaft 3 carrying on its inner end within the casing 1 a cone head 4, said cone having formed on its periphery spiral fins 5, each of which as shown preferably extends through an arc of 180° within the length of the cone head 4. Four such fins 5 are shown, however, a greater or lesser number of fins may be provided, as desired. The head 4 is of conical shape, and such shape is preferable, but the angularity of the cone may be any desired degree.

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As shown, the height of the fins 5 is greater at the smaller end of the cone head 4 than at the large end so that the volume of fluid passing through the impeller will remain constant as the cross-sectional area at all points along the cone head axis is the same.

The conical head 4 is preferably hollow as indicated at 4*a*, Fig. 2, in order to save unnecessary weight. As shown, the shaft 3 is provided with splines 3*a* adapted to engage corresponding slots in the hub of the cone head. The inner end of the head 4 engages an external annular flange 3*b* on the shaft 3 and the cone head 4 is retained on the shaft 3 by means of a nut 3*c* engaging threads at the inner end of the shaft, a washer 3*d* being interposed between the nut 3*c* and the inner end of the hub of the cone head. Suitable locking means to prevent rotation of the nut may be provided, such as an Allen head screw 3*e* tapped into a threaded bore adjacent the periphery of the nut, the nut being split at right angles normal to the said screw 3*e* so that when the screw 3*e* is tightened the threaded bore of the nut 3*c* will be distorted. Other means, however, may be used.

Around the shaft 3 preferably opposite the enlarged shoulder 3*b* is an oil seal 6 of conventional type, and shaft 3 is journaled in the extension 1*a* of casing 1 by means of roller bearings 7 and 8*z* respectively, the inner bearings 7 engaging the annular shoulder 3*b* (Fig. 6) of shaft 3, and a sleeve 9 being disposed on the shaft 3 between the inner races of the bearings 7 and 8*z*. The outer race of bearing 8*z* is mounted in an enlargement 1*f* of bore 1*a* as shown in Fig. 5, and its outer face is engaged by a cap 17 secured by studs, bolts or the like 18 to the end of casing 1*a*, a seal or packing 19 (Fig. 5) being provided in the cap 17 around shaft 3 to seal the outer end of the bore 1*a* around shaft 3. The outer face of the inner race 8*z* is engaged by a lock nut 16 of conventional type mounted upon a threaded section of shaft 3. Thus the inner races of the bearings 7 and 8*z* are fixed with respect to the shaft 3 so as to prevent axial movement of the shaft within the casing.

Within the casing 1 around the cone head 4 is a sleeve 5*a* soldered, welded or brazed to the outer peripheries of the fins 5, said sleeve 5*a* following the peripheries of the fins throughout their lengths and terminating at the outer enlarged ends of the fins. Members 4, 5 and 5*a*

together form the pump impeller. Thus the liquid which enters the intake end of the impeller will have its velocity and centrifugal force increased in its movement towards the discharge end of the impeller, and the liquid emerging from the outer larger end of the impeller will have a strong swirling motion, while at the same time it is forced axially away from the end of the impeller towards the nose chamber 8 at the discharge end of the pump casing.

The outer wall 4x (Fig. 2) of the cone head 4 should be slightly arcuate in form rather than a true conical surface, the flare being outward and greatest at the center of the length of fins 5. This permits the cross-sectional area between the head 4 and the sleeve 5a to remain constant.

The casing 1 surrounds the sleeve 5a and is spaced therefrom, and within the portion opposite the inner end of the sleeve 5a is an annular ring 10 which is substantially V-shaped in cross-section with its apex disposed adjacent the beveled inner end 5b of the sleeve 5a, thus providing a very slight clearance 10a between the ring 10 and the inner end of the sleeve. The clearance between the apex and the inner end 5b of sleeve 5a is for the purpose of preventing any extraneous matter except the finest sand passing through the clearance space 10a between the ring 10 and sleeve 5a. It will be noted however that the clearance between the casing 1 and the inner end of the sleeve 5a progressively decreases towards the outer end of the sleeve, said difference in clearance permitting sand, grit or other sediment which may be passed through the clearance 10a to be carried out along with the liquid passing through said clearance space 10b at the outer end of the sleeve 5a, the movement of liquid axially through the impeller creating a suction in the clearance space 10b sufficient to maintain the same clear of sediment, said suction pulling the sediment to and beyond the outer end of sleeve 5a and into the nose chamber 8 hereinafter described.

In the casing 1 around the shaft 3 and opposite the inlet end of the impeller is an inlet chamber 11, the end of which communicates directly with the space between the cone head 4 and the sleeve 5a. Inlet chamber 11 is fed by one, two or more inlet pipes 12, two being indicated in Fig. 2, whereby a substantial flow of water is constantly maintained at the inlet end of the impeller to be passed therethrough into the nose chamber 8.

As shown in Fig. 1, the nose member 8 is secured to the outlet end of casing 1 by means of bolts 8a, said nose chamber 8 being substantially cylindrical adjacent the impeller and reducing in diameter towards the outlet end 8d. Within the nose chamber 8 is a core 8b substantially parallel with the inner wall of the nose chamber 8 throughout the major portion of its length but contracting towards the outlet end to substantially a point 8c, in order to keep the amount of fluid passing through the nose chamber 8 substantially constant throughout the length thereof due to the decrease in diameter towards the outlet end 8d of the nose chamber 8. Said core 8b is designed to fill the otherwise vacuum cone which would be created by the flow of whirling water discharged from the impeller into the nose chamber 8. Between the core 8b and the inner wall of the nose chamber 8 is an annular series of fins 8e, three being indicated in Fig. 4 which as shown in Fig. 3 are substantially coaxial with the nose chamber 8 from the outer

end 8c to approximately one-half the length back through the nose chamber, at which point the fins are formed arcuately to substantially the shape of the reverse curve of the outer ends of the fins 5, the purpose of the fins 8e being to stop whirling of the volume of water discharged into the nose chamber from the impeller and to cause the flow of water in the nose chamber to be in a straight line direction. The fins 8e are an important part of my invention, for it has been found in practice that without the fins the volume of water delivered by the pump is substantially infinitesimal as the tendency of the water discharged from the impeller is to pass in a radial direction tangent to the outer end of the impeller. The volume of water, however, upon striking the fins 8e is caused to move in a straight line towards the outlet 8d of the nose chamber.

In operation, the pump shaft 3 is driven in the direction of the arrows 3x, Fig. 2, by any suitable prime mover. The liquid to be pumped is supplied through the inlet pipes 12 to the inlet chamber 11, the pump being previously primed. As the shaft 3 rotates, the impeller 4, 5 and 5a rotates therewith. The rapid increase in diameter of the impeller cone 4, combined with the high pitch of the spiral fins 5 will cause the pressure of the liquid within the impeller to gradually build up parallel to the impeller axis, forcing the liquid along the impeller 4, 5, 5a through the fins 5 while building up a high pressure radially due to centrifugal force, which pressure reacts upon the conical sleeve 5a to exert an axial component whereby as the liquid emerges from the outer tips of the fins 5 the liquid in the sleeve 5a is given a strong swirling motion and a rapid movement toward the pump outlet, which swirling motion however is counteracted in the nose chamber 8 by the fins 8e as result of which the volume of liquid is caused to proceed in a straight line direction when passing through the outlet 8d. The quantity of liquid delivered through the outlet 8d may be varied by varying the speed of rotation of the impeller, or by valve means (not shown) applied to the discharge end 8d. My pump will have a wide range of capacity depending upon the adjustment of the valve means, whereby the pump may be continued to be run at full speed while delivering only a small capacity without injury thereto as no back pressure is built up therein to injure the pump. This feature is an important improvement over conventional pumps designed for only one capacity and which must be driven at the designed speed to deliver such capacity, for in my pump as the valve means is closed the power to rotate the impeller at the same speed becomes less rather than greater, as in conventional pumps.

I do not limit my invention to the exact forms shown in the drawings, for obviously changes may be made therein within the scope of the claims.

I claim:

1. A liquid pump, comprising an impeller chamber contracting towards one end into an inlet; a nose chamber of greater length than the impeller chamber connected to the larger end of the impeller chamber and contracting towards its outer end into an outlet; a driven shaft entering the inlet end of the impeller chamber coaxially thereof; an impeller on said shaft within the impeller chamber and comprising a substantially cone-shaped head enlarging towards the nose chamber, a series of spirally arranged fins on

said cone head having a steep pitch, said fins being spaced from the walls of the impeller chamber, and a sleeve surmounting the fins and rotatable with the head, said sleeve having a slight clearance from the walls of the impeller chamber; the space between the head and sleeve progressively decreasing toward the larger end of the impeller; an inlet port at the inlet communicating with the smaller end of the impeller and having a feed opening communicating therewith; and said nose chamber having an axially disposed core therein whose outer surface is substantially parallel with the inner wall of the nose chamber throughout the major portion of its length thereby maintaining the area between the core and nose chamber substantially constant throughout its length, and said nose chamber having fixed axially disposed fins between its inner wall and the surface of the core adapted to convert the rotary motion of the liquid emerging from the impeller into rectilinear motion within the nose chamber before emerging from the outlet, the area between adjacent fins and the head and sleeve of the impeller remaining substantially constant throughout the length of the head, to maintain a constant volume of liquid passing through the impeller.

2. A liquid pump, comprising an impeller chamber contracting towards one end into an inlet; a nose chamber of greater length than the impeller chamber connected to the larger end of the impeller chamber and contracting towards its outer end into an outlet; a driven shaft entering the inlet end of the impeller chamber coaxially thereof; an impeller on said shaft within the impeller chamber and comprising a substantially cone-shaped head enlarging towards the nose chamber, a series of spirally arranged fins on said cone head having a steep pitch, said fins being spaced from the walls of the impeller chamber, and a sleeve surmounting the fins and rotatable with the head, said sleeve having a slight clearance from the walls of the impeller chamber; the space between the head and sleeve progressively decreasing toward the larger end of the impeller; an inlet port at the inlet communicating with the smaller end of the impeller and having a feed opening communicating therewith; and said nose chamber having an axially disposed core therein whose outer surface is substantially parallel with the inner wall of the nose chamber throughout the major portion of its length thereby maintaining the area between the core and nose chamber substantially constant throughout its length, and said nose chamber having fixed axially disposed fins between its inner wall and the surface of the core adapted to convert the rotary motion of the liquid emerging from the impeller into rectilinear motion within the nose chamber before emerging from the outlet, said impeller fins each making a half turn throughout the length of the head; and the area between adjacent fins and the head and sleeve of the impeller remaining substantially constant throughout the length of the head, to maintain a constant volume of liquid passing through the impeller.

3. A liquid pump, comprising an impeller chamber contracting towards one end into an inlet; a nose chamber of greater length than the impeller chamber connected to the larger end of the impeller chamber and contracting towards its outer end into an outlet; a driven shaft entering the inlet end of the impeller chamber coaxially thereof; an impeller on said shaft within the impeller chamber and comprising a substantially cone-shaped head enlarging towards the nose chamber, a series of spirally arranged fins on said cone head having a steep pitch, said fins being spaced from the walls of the impeller chamber, and a sleeve surmounting the fins and rotatable with the head, said sleeve having a slight clearance from the walls of the impeller chamber; the space between the head and sleeve progressively decreasing toward the larger end of the impeller; an inlet port at the inlet communicating with the smaller end of the impeller and having a feed opening communicating therewith; and said nose chamber having an axially disposed core therein whose outer surface is substantially parallel with the inner wall of the nose chamber throughout the major portion of its length thereby maintaining the area between the core and nose chamber substantially constant throughout its length, and said nose chamber having fixed axially disposed fins between its inner wall and the surface of the core adapted to convert the rotary motion of the liquid emerging from the impeller into rectilinear motion within the nose chamber before emerging from the outlet, the inner end of the sleeve being beveled; and a ring of substantially correspondingly shaped cross-section disposed in the impeller chamber with its apex adjacent the beveled end of the sleeve while providing a slight clearance between the sleeve and ring; and the clearance between the sleeve and walls of the impeller chamber progressively decreasing towards the outer end of the sleeve, whereby during operation of the pump suction created between the outer end of the sleeve and wall of the impeller chamber will maintain the space between the sleeve and wall of the impeller chamber free from sediment.

4. A liquid pump, comprising an impeller chamber contracting towards one end into an inlet; a nose chamber of greater length than the impeller chamber connected to the larger end of the impeller chamber and contracting towards its outer end into an outlet; a driven shaft entering the inlet end of the impeller chamber coaxially thereof; an impeller on said shaft within the impeller chamber and comprising a substantially cone-shaped head enlarging towards the nose chamber, a series of spirally arranged fins on said cone head having a steep pitch, said fins being spaced from the walls of the impeller chamber, and a sleeve surmounting the fins and rotatable with the head, said sleeve having a slight clearance from the walls of the impeller chamber; the space between the head and sleeve progressively decreasing toward the larger end of the impeller; an inlet port at the inlet communicating with the smaller end of the impeller and having a feed opening communicating therewith; and said nose chamber having an axially disposed core therein whose outer surface is substantially parallel with the inner wall of the nose chamber throughout the major portion of its length thereby maintaining the area between the core and nose chamber substantially constant throughout its length, and said nose chamber having fixed axially disposed fins between its inner wall and the surface of the core adapted to convert the rotary motion of the liquid emerging from the impeller into rectilinear motion within the nose chamber before emerging from the outlet, the walls of said head being flared outwardly, and said flare being greatest at the center of its length.

5. A liquid pump, comprising an impeller chamber contracting towards one end into an inlet; a nose chamber of greater length than the impeller

chamber connected to the larger end of the impeller chamber and contracting towards its outer end into an outlet; a driven shaft entering the inlet end of the impeller chamber coaxially thereof; an impeller on said shaft within the impeller chamber and comprising a substantially cone-shaped head enlarging towards the nose chamber and terminating adjacent the outer end of said impeller chamber, a series of spirally arranged fins on said cone head having a steep pitch, said fins being spaced from the walls of the impeller chamber, and a sleeve surmounting the fins and rotatable with the head, said sleeve embracing the length of the head, said sleeve having a slight clearance from the walls of the impeller chamber; the space between the head and sleeve progressively decreasing toward the larger end of the impeller; an inlet port disposed around the shaft and communicating with the smaller end of the impeller and having an inlet opening communicating therewith; and said nose chamber having an axially disposed core therein whose outer surface is substantially parallel with the inner wall of the nose chamber throughout the major portion of its length thereby maintaining the area between the core and nose chamber substantially constant throughout its length, and said nose chamber having fixed axially disposed fins between its inner wall and the surface of the core adapted to convert the rotary motion of the liquid emerging from the impeller into rectilinear motion within the nose chamber before emerging from the outlet, the area between adjacent fins and the head and sleeve of the impeller remaining substantially constant throughout the length of the head, to maintain a constant volume of liquid passing through the impeller.

6. A liquid pump, comprising an impeller chamber contracting towards one end into an inlet; a nose chamber of greater length than the impeller chamber connected to the larger end of the impeller chamber and contracting towards its outer end into an outlet; a driven shaft entering the inlet end of the impeller chamber coaxially thereof; an impeller on said shaft within the impeller chamber and comprising a substantially cone-shaped head enlarging towards the nose chamber and terminating adjacent the outer end of said impeller chamber, a series of spirally arranged fins on said cone head having a steep pitch, said fins being spaced from the walls of the impeller chamber, and a sleeve surmounting the fins and rotatable with the head, said sleeve embracing the length of the head, said sleeve having a slight clearance from the walls of the impeller chamber; the space between the head and sleeve progressively decreasing toward the larger end of the impeller; an inlet port disposed around the shaft and communicating with the smaller end of the impeller and having an inlet opening communicating therewith; and said nose chamber having an axially disposed core therein whose outer surface is substantially parallel with the inner wall of the nose chamber throughout the major portion of its length thereby maintaining the area between the core and nose chamber substantially constant throughout its length, and said nose chamber having fixed axially disposed fins between its inner wall and the surface of the core adapted to convert the rotary motion of the liquid emerging from the impeller into rectilinear motion within the nose chamber before emerging from the outlet, said impeller fins each making a half turn throughout the length of the head; and the area between adjacent fins and the head and sleeve of the impeller remaining substantially constant throughout the length of the head, to maintain a constant volume of liquid passing through the impeller.

7. A liquid pump, comprising an impeller chamber contracting towards one end into an inlet; a nose chamber of greater length than the impeller chamber connected to the larger end of the impeller chamber and contracting towards its outer end into an outlet; a driven shaft entering the inlet end of the impeller chamber coaxially thereof; an impeller on said shaft within the impeller chamber and comprising a substantially cone-shaped head enlarging towards the nose chamber and terminating adjacent the outer end of said impeller chamber, a series of spirally arranged fins on said cone head having a steep pitch, said fins being spaced from the walls of the impeller chamber, and a sleeve surmounting the fins and rotatable with the head, said sleeve embracing the length of the head, said sleeve having a slight clearance from the walls of the impeller chamber; the space between the head and sleeve progressively decreasing toward the larger end of the impeller; an inlet port disposed around the shaft and communicating with the smaller end of the impeller and having an inlet opening communicating therewith; and said nose chamber having an axially disposed core therein whose outer surface is substantially parallel with the inner wall of the nose chamber throughout the major portion of its length thereby maintaining the area between the core and nose chamber substantially constant throughout its length, and said nose chamber having fixed axially disposed fins between its inner wall and the surface of the core adapted to convert the rotary motion of the liquid emerging from the impeller into rectilinear motion within the nose chamber before emerging from the outlet, the inner end of the sleeve being beveled; and a ring of substantially correspondingly shaped cross-section disposed in the impeller chamber with its apex adjacent the beveled end of the sleeve while providing a slight clearance between the sleeve and ring; and the clearance between the sleeve and walls of the impeller chamber progressively decreasing towards the outer end of the sleeve, whereby during operation of the pump suction created between the outer end of the sleeve and wall of the impeller chamber will maintain the space between the sleeve and wall of the impeller chamber free from sediment.

8. A liquid pump, comprising an impeller chamber contracting towards one end into an inlet; a nose chamber of greater length than the impeller chamber connected to the larger end of the impeller chamber and contracting towards its outer end into an outlet; a driven shaft entering the inlet end of the impeller chamber coaxially thereof; an impeller on said shaft within the impeller chamber and comprising a substantially cone-shaped head enlarging towards the nose chamber and terminating adjacent the outer end of said impeller chamber, a series of spirally arranged fins on said cone head having a steep pitch, said fins being spaced from the walls of the impeller chamber, and a sleeve surmounting the fins and rotatable with the head, said sleeve embracing the length of the head, said sleeve having a slight clearance from the walls of the impeller chamber; the space between the head and sleeve progressively decreasing toward the larger end of the impeller; an inlet port disposed around the shaft and communicating with the smaller end of the

impeller and having an inlet opening communicating therewith; and said nose chamber having an axially disposed core therein whose outer surface is substantially parallel with the inner wall of the nose chamber throughout the major portion of its length thereby maintaining the area between the core and nose chamber substantially constant throughout its length, and said nose chamber having fixed axially disposed fins between its inner wall and the surface of the core adapted to convert the rotary motion of the liquid emerging from the impeller into rectilinear motion within the nose chamber before emerging from the outlet, the walls of said head being flared outwardly, and said flare being greatest at the center of its length.

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