

June 10, 1930.

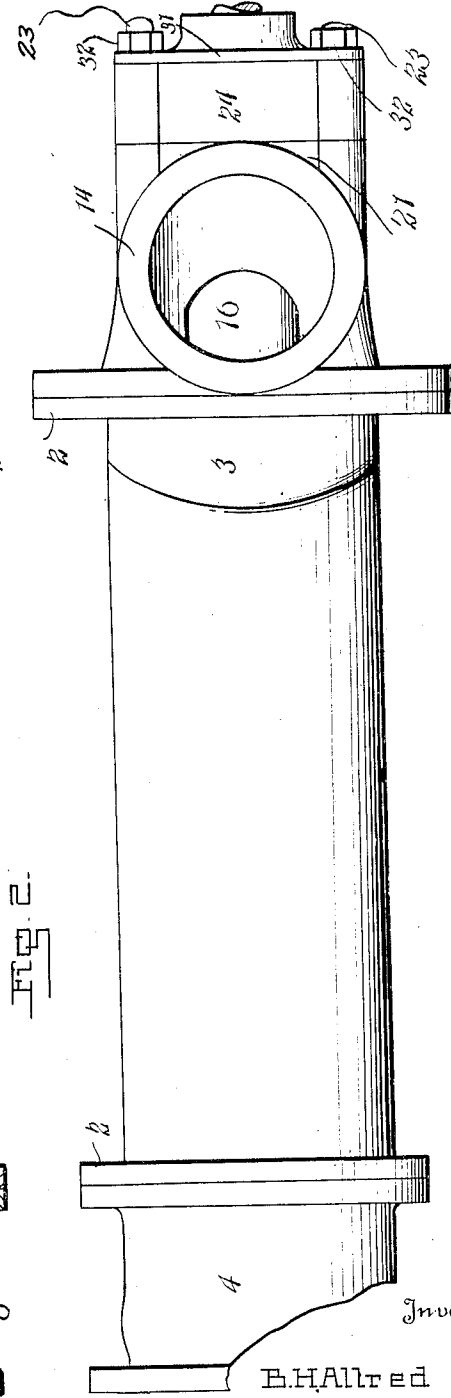
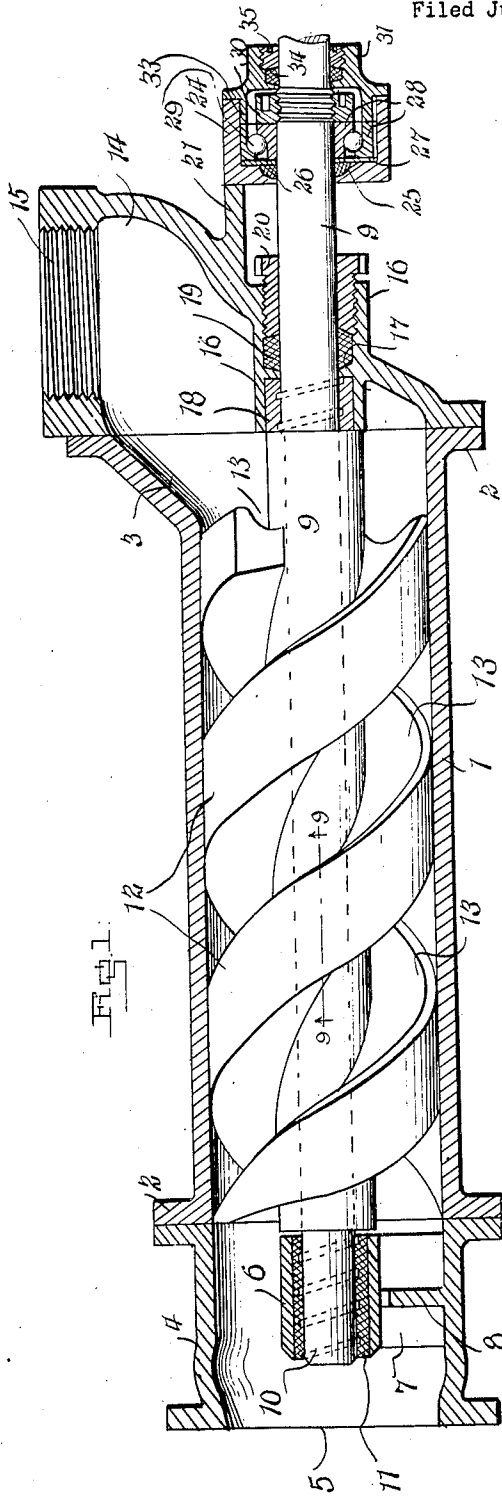
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1,762,708

PUMP

Filed July 5, 1927

3 Sheets-Sheet 1



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3 Sheets-Sheet 2

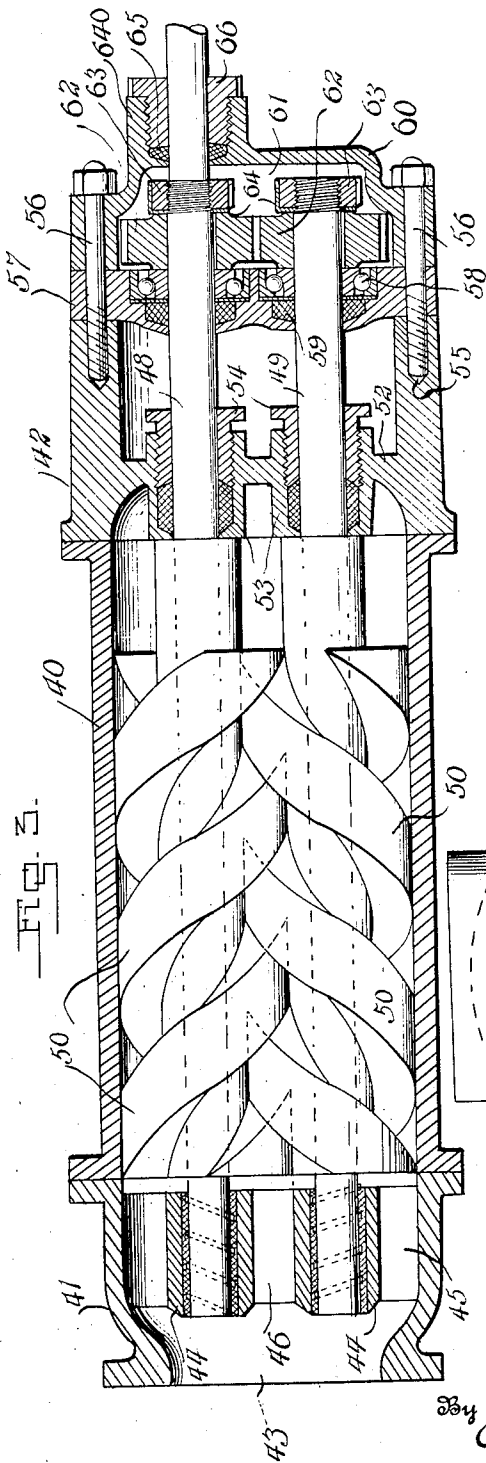


FIG. 3.

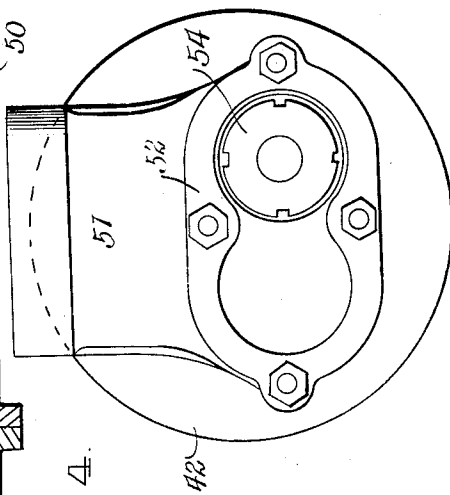


FIG. 4.

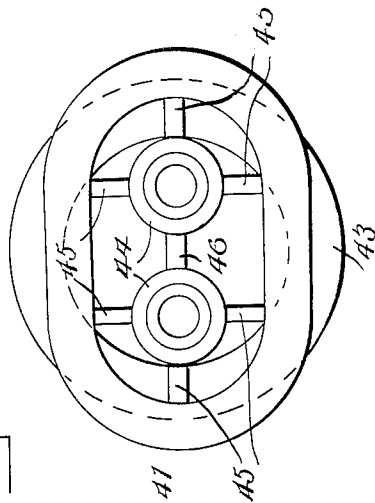


FIG. 5.

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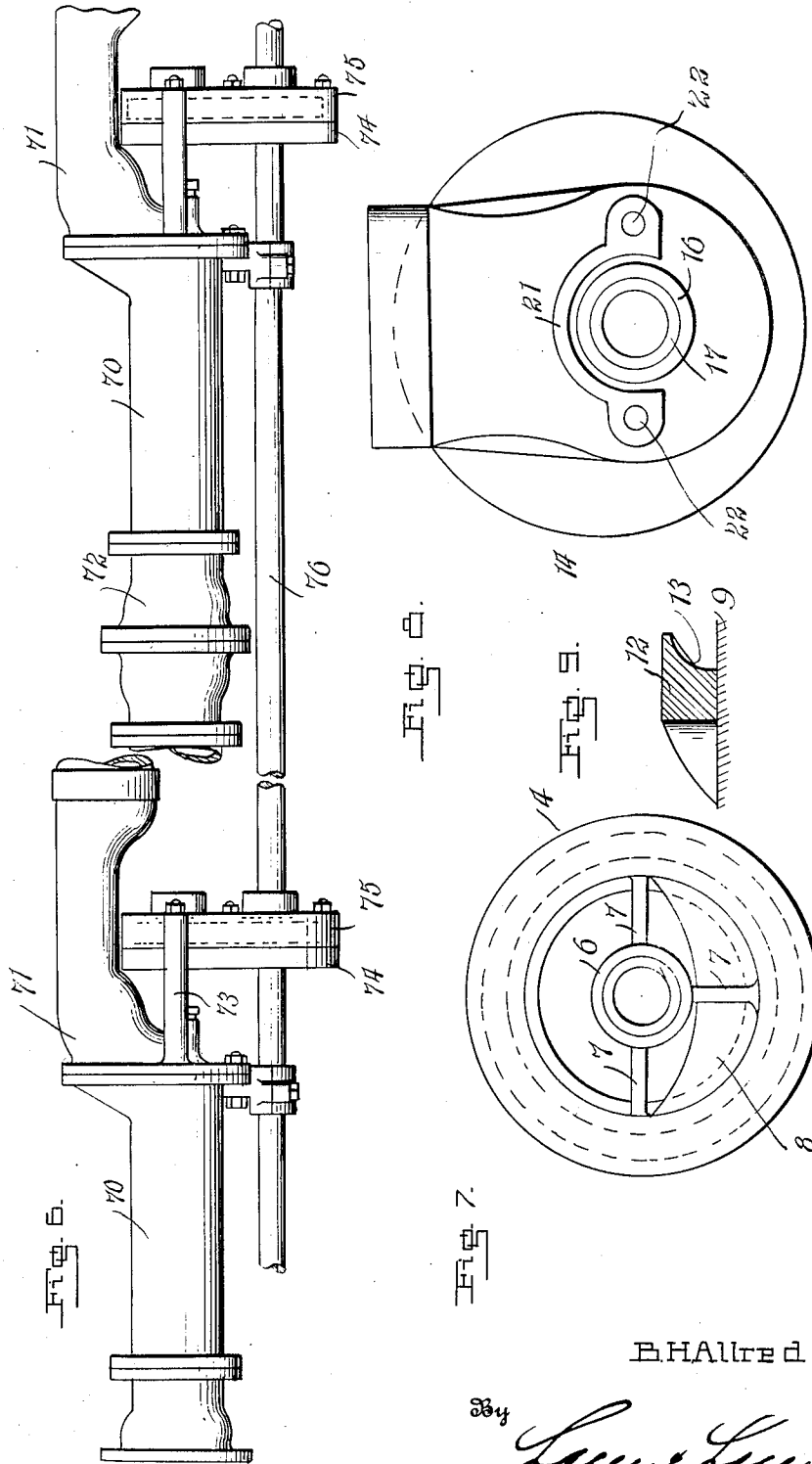
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3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE

BYRON HARVEY ALLRED, OF BOISE, IDAHO

PUMP

Application filed July 5, 1927. Serial No. 203,507.

My present invention seeks to improve the efficiency of pumps of the screw impeller type and consists in certain novel features of construction and arrangement of parts which will be hereinafter fully described and then particularly pointed out in the appended claims.

The invention is illustrated in the accompanying drawings, in which

Figure 1 is a longitudinal section of a single screw pump embodying my improvements;

Fig. 2 is a top plan view of the same;

Fig. 3 is a longitudinal section of a twin screw pump embodying the invention;

Fig. 4 is an end elevation of the pump shown in Fig. 3;

Fig. 5 is an elevation of the inlet head of the pump shown in Fig. 3, the view being taken at the inner end of the head;

Fig. 6 is a side elevation showing a multiple stage pump embodying the invention;

Fig. 7 is an end elevation of the inlet head of the pump shown in Figs. 1 and 2;

Fig. 8 is an elevation of the outlet head of said pump, and

Fig. 9 is a detail section on the line 9—9 of Fig. 1.

Referring more particularly to Figs. 1 and 2, the main body of the pump consists of a casing 1 which is of integral formation throughout and is provided with annular flanges 2 at its ends whereby the inlet and outlet heads may be bolted thereto. At the outlet end of the casing, the wall thereof is flared at that side toward which the outflow is directed, as shown at 3, and this flared formation enlarges the outlet end of the casing somewhat and also provides a guide whereby the liquid will be easily deflected into the outlet head and caused to flow around the operating mechanism without reaching any of the elements of said mechanism. The inlet head 4 is circular in end view and is provided at both ends with annular flanges whereby it may be secured to the casing and to an inlet or suction pipe, if the use of such pipe be deemed advantageous, although it is to be understood that the inlet head may be submerged in some instances and that the

pump may be disposed horizontally or vertically or in an inclined position as circumstances may demand. The inlet head 4 is somewhat contracted in diameter at its receiving end 5 so that the inflowing liquid may expand slightly within the head to readily pass into the casing 1 and on the axis of the inlet head is provided a hub or bearing sleeve 6 which is connected with the wall of the head by longitudinal radial fins 7 extending between the sleeve and the wall of the head and preferably cast integral therewith. There is also provided a transverse web 8 in the lower portion of the head which passes under the bearing sleeve and presents a baffle to the inflowing liquid so that it is caused to eddy within the head and will, therefore, be more readily taken up and driven forward by the impeller screw. It will be noted upon reference to Fig. 7 that the upper edge of the web is arcuate so that, while its ends meet the ends of the upper fins, there is an open space below said fins through which the incoming water may flow. The inflow consequently will be checked at one side sufficiently to cause it to eddy or whirl and under suction of the impeller assume a direction of rotation the same as the rotation of the impeller but there will not be such a backing up of the water as will tend to check the operation. To the contrary, the forming of the eddy facilitates take-up of the water by the impeller smoothly and without shock. The impeller shaft 9 extends axially through the cylindrical body 1 and has its rear end reduced to form a journal, as shown at 10, to be rotatably engaged in the bearing sleeve 6, as clearly shown in Fig. 1, a bushing or bearing 11 of rubber being fitted in the sleeve around the journal end of the shaft so that the shaft may rotate easily without the presence of oil or like lubricant, sufficient lubrication being provided by the water which will seep between the rubber bushing 11 and the end of the shaft. An easy-running bearing is thus obtained while contamination of the water is avoided. The impeller shaft is also provided with spiral ribs or threads 12 which are of such diameter that their outer surfaces bear closely against the inner wall of the body. Two spiral ribs

or threads are provided and the shaft is rotated in such direction that the water or other liquid will be taken up by the ribs or threads and positively driven toward the outlet end of the pump body. By providing a double thread or two ribs or threads, I obtain two points of intake and discharge so that twice the volume of liquid is delivered as could be delivered by a single thread screw of the same diameter, which is the arrangement most generally employed. Moreover, the double thread impeller screw requires an incline only half the pitch of that required in a single thread screw of any type and of the same length so that the pump will deliver practically double the quantity of liquid delivered by a single thread screw with only a very slight increase of power and, moreover, the double thread screw, because of its longer inclined plane, can be machined at less cost and made to fit closer than a single thread screw can be made to fit. The forward side of each thread or rib 12 is hollowed out or made concave, as indicated at 13, and this formation increases the capacity of the pump over that employing a straight wall rib and also has a very marked tendency to draw the heavier particles contained in the liquid toward the center of the screw, which particles ordinarily are driven by the centrifugal motion of the screw to the outer edge or rim of the threads and into contact with the case and, consequently, cause wear which is overcome by my construction. The construction produces an outer circumferential surface of rib or thread equal in width to the space between the outer surfaces of adjacent ribs or threads, thereby minimizing the "slip". The outlet head 14 is bolted to the flange 2 of the pump body or casing 1 at the outlet end of the same and the bore of this outlet head is so shaped as to provide a chamber of somewhat irregular form but having its far or outer wall approximately parallel with the flared portion 3 of the cylinder and having an outlet opening 15 disposed laterally with respect to the axis of the pump body so that the outflowing liquid will be deflected to one side and may be delivered into a discharge pipe extending at a right angle to the pump body, it being noted that the outlet opening of the head is threaded to facilitate the attachment of a conductor pipe. The said head 14 is provided with a sleeve 16 formed integral with and projecting inwardly from the outer wall of the same and alined with the axis of the pump body to form a bearing for the impeller shaft 9, as shown clearly in Fig. 1, an internal annular rib or flange 17 being formed in the sleeve between the ends thereof, and a rubber bushing 18 being disposed within the inner end of the sleeve around the shaft and at the inner side of said rib or flange to properly support and permit free rotation of the shaft, while at the outer side of the said rib 17 are provided packing 19 and a gland 20 to compress the packing against the said rib 17 and thereby prevent leakage of water or other liquid outwardly along the impeller shaft and also prevent oil or lubricant working inwardly along the shaft to reach the water. Of course, a rubber sealing sleeve or the like may be provided if preferred. Upon its outer side, the outlet head 14 is provided with an arcuate flange or web 21 which is disposed concentric with the bearing sleeve 16 so as to span the projecting portion of the impeller shaft, and at the ends of this web or flange are sockets 22 (see Fig. 8) to receive securing bolts 23 whereby a bearing casing 24 is secured to the said web or flange. It may be noted at this point that the bearing case 24 is secured to the web or flange 21 in abutting relation and it is thereby held in spaced relation to the lower portion of the outlet head so that there is an open space below the web 21 through which the impeller shaft extends and, therefore, any liquid which might leak along the shaft will drop therefrom whether the same be oil or water and will be prevented from entering either the gland 20 or the bearing case 24. The bearing case is, of course, provided with a central opening in its back wall, through which the impeller shaft passes, and around the said central opening the back wall is recessed, as shown at 25, to receive packing 26. A metallic washer 27 is fitted against the rear wall of the bearing case and extends over the said packing so as to provide a pressure plate for the race rings 28 between which are mounted anti-friction balls 29, an effective end thrust bearing being thus provided to take up the thrust exerted by the flowing liquid. The race rings are held to the washer 27 by a nut 30 which is threaded onto the impeller shaft and bears against the inner race ring so as to clamp the same firmly against the washer 27, the packing 26 being thereby compressed so that it will prevent leakage of oil along the impeller shaft through the back plate of the case. The nut 30 also facilitates the proper adjustment of the impeller shaft so that the desired fit of the impeller screw or ribs within the pump body may be attained. A cap plate 31 is fitted about the impeller shaft and over the nut 30 and abuts the outer edges of the bearing case, as shown clearly in Figs. 1 and 2, this cap plate being secured in place by the same nuts 32 which secure the bearing case to the outlet head, said nuts being fitted upon the outer ends of the bolts 23 and being turned home against the projecting ends of the cap plate 31, as will be readily understood upon reference to Fig. 2. It will be noted that the cap plate 31 is formed with an internal annular flange 33 fitting closely within the bearing case and abutting the outer race ring 28 and spaced annularly from the nut 30. A chamber is thus

formed around the nut 30 in which oil or grease may be placed so that the bearing will run in lubricant, and packing 34 and a gland 35 are fitted in the central portion of the cap plate so as to prevent leakage of the lubricant outwardly along the shaft. The shaft may be rotated by any approved driving agency.

The operation will be readily understood from the foregoing description. The impeller shaft is rotated at a comparatively high speed and thereby tends to create a vacuum within the pump body inasmuch as the threads or ribs are fast to the impeller shaft and, consequently, will rotate with the shaft. The partial vacuum created by the rotation of the impeller screw will suck liquid from the well or other source of supply, and this suction will be supplemented by positive engagement of the screws with the inflowing stream of liquid so that it will be positively propelled toward the outlet head and driven through the head.

In Figs. 3, 4 and 5, I have illustrated a twin screw pump embodying the invention, and this twin screw pump will operate in the same manner as the single screw pump previously described. In Figs. 3, 4 and 5, the pump body or casing 40 is elliptical in cross section and the inlet head 41 and outlet head 42 are of like contour, the inlet head, however, being circular at its outer end, as shown at 43. At the inner end of the inlet head 41, I provide two bearing sleeves 44 which are connected with the wall of the head by radial fins or webs 45 and with each other by a central web 46, the baffle, such as shown at 8 in Figs. 1 and 7, being omitted. Two impeller shafts 48 and 49 are provided and have their rear ends rotatably mounted in the respective bearing sleeves 44, as shown in Fig. 3 and as will be understood, these shafts being each equipped with a double rib impeller 50 and the ribs being so arranged that each extends from the adjacent wall of the pump body 40 to the other impeller shaft and intermeshes with the opposed ribs, the shafts being, of course, arranged in parallelism. The outlet head 42 has an upstanding portion 51 which corresponds in all respects to the outlet side or end of the head 14 shown in Figs. 1 and 2, and the head 51 is also provided with a web 52 which is elliptical in outline to carry packing boxes 53 in which the outer portions of the shafts 48 and 49 are mounted, glands 54 being mounted in the said boxes and operating in the usual manner to compress the packing about the shafts. Other forms of bearings and sealing devices may, of course, be used. At its opposite sides, the web 52 is elongated to provide the sockets 55 which receive securing bolts 56, and carried by the said bolts and abutting the said sockets is a bearing plate or casing 57 through which the shafts 48 and

49 pass and in which are mounted thrust bearings 58 and packing 59 corresponding in all respects to the thrust bearings and packing shown in Fig. 1 and previously described. Abutting the outer side of the bearing plate or casing 57 is a gear case 60 having an outer web which entirely covers the bearing case or plate 57 and having an internal chamber 61 which receives the end of the shaft 49 and the projecting end portion of the shaft 48, intermeshing gears 62 being secured upon the shafts within the said chamber, as shown clearly in Fig. 3, whereby the shafts will be simultaneously rotated at the same speed but in opposite directions so that the proper movement will be imparted to the impeller screws. To retain the gears upon the respective shafts, nuts 63 and locking washers 64 are fitted upon the shafts against the outer sides of the gears, as clearly shown. The gear case 60 is provided upon its outer side with a packing box 640 receiving packing 65 and a gland 66 so that the internal chamber of the case may be filled with lubricant and the escape of the lubricant along the shaft will be prevented while the gears and the bearings will run in lubricant. In this form of the invention, there is an open bottom space between the outlet head and the bearing and gear case 57 so that any liquid or oil which might possibly leak along the impeller shafts will be thrown off and prevented from entering either the bearing case or the packing glands.

In Fig. 6, I have illustrated a multiple stage pump embodying the invention. In this arrangement, a series of casings or pump bodies 70 is provided and arranged in axial alinement, each pump body having secured to its upper or inner end a discharge head 71 which instead of extending laterally with respect to the pump body has its longitudinal axis disposed parallel with the longitudinal axis of the pump body so that the general flow of the liquid will be in one direction either along or parallel with the axes of the several pump bodies. It will be understood that the outlet heads 71 are each connected to an inlet head 72 of a succeeding pump body and an intermediate pipe or body is provided to deflect the liquid from the axis of the outlet head to the axis of the coupled inlet head. Each outlet head 71 is constructed with the socketed projections 73 to which bearing case 74 and gear case 75 are secured, just as the cases 57 and 60 are secured to the head 42 or the case 24 is secured to the head 14. The gear cases 75, however, are elongated with respect to the previously described gear cases so as to extend to one side of the axis of the pump body and receive a driving shaft 76 which extends parallel with all the pump bodies, as shown in Fig. 6. Within each gear case, a driving gear is secured upon the shaft 76 to mesh with the gear upon the impeller

shaft, and it is to be understood that this multiple stage arrangement may be employed in connection with either a single screw pump or a twin screw pump as may be desired.

5 The form of head shown at 71 may be used upon either a single screw or twin screw pump and in a single stage wherever it is necessary or desirable to drive the liquid along a line parallel to the driving shaft, as, for instance, when a single pumping body must be used in a small shaft or well.

10 It is to be noted that the pump body within which the screws operate is a solid case which requires no bolting and packing to prevent leakage and it may be cast and machined more accurately than would be possible if it were made in two or more pieces. The form of my pump is such that the inflowing liquid enters directly through the intake head and is drawn into the rotating screws on a line parallel with the axes thereof so that the pump and pipe intake friction is minimized and a greater quantity of liquid may be delivered for a given size pump with less power than was possible with the pumps heretofore constructed. The formation of the baffle in the inlet head of the single screw pump prevents the inflowing liquid being driven backward into the suction pipe by the action of the screw threads and permits the threads to be so placed as to dip into and suck up the impounded liquid supplied from the suction pipe. The liquid passing into the discharge head is driven forward by the rotating screws and is guided upwardly and outwardly at an easy angle which minimizes the retarding action of the skin friction. Inasmuch as the outflowing liquid is not driven against a perpendicular wall and caused to pass through a right angle, the power required to drive the pump is minimized. The thrust bearings arranged in connection with the discharge head are so located as to provide an efficient balance for the impelling screw or screws so that vibration and side thrust are reduced to a minimum and the bearings will last a long time without requiring any renewal.

Having thus described the invention, I claim:

50 1. In a pump of the type described, an outlet head having a bearing sleeve formed in its lower portion, an arcuate web formed on the outer side of the outlet head and projecting outwardly therefrom, an impeller shaft rotatably fitted through the bearing sleeve in the outlet head and extending through the pump body, the arcuate web being located above the shaft, a packing box within the said bearing sleeve and around the shaft, a case secured to and abutting the web on the outlet head, there being a clear space below the web between the head and the case to permit escape of fluid creeping along the shaft, a chambered cap secured over

the outer side of said case, the impeller shaft extending through said case and said cap, packing within the case around the shaft, a box on the outer side of the cap, packing in said box around the shaft, and bearings within the case around the shaft to receive end thrust.

2. In a pump of the type described, the combination of a tubular pump body, an impeller shaft extending through said body, and a spiral rib on said shaft extending from end to end of the pump body and having a concave recess extending along its forward face, said recess being of uniform cross section and depth and unobstructed from end to end of the rib whereby the advancing edge of the rib overhangs the shaft.

3. In a pump of the type described, the combination of a pump body, an inlet head secured to the receiving end of said body, a bearing sleeve disposed longitudinally of the inlet head, longitudinal webs integrally connecting the sides and bottom of the sleeve with the wall of the head, a baffle extending across the head below said sleeve and having an arcuate upper edge providing a clear opening below the upper fins, and an impeller screw working within the pump body and having one end journaled in the said bearing sleeve, the end of the screw being close to the baffle.

In testimony whereof I affix my signature.
BYRON HARVEY ALLRED. [L. S.]

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