No. 890,662. PATENTED JUNE 16. 1908.

C. LAGER.

MULTISTAGE CENTRIFUGAL PUMP.

APPLICATION FILED MAR. 19, 1907.

3 SHEETS—SHEET 1.

Fig. 1.

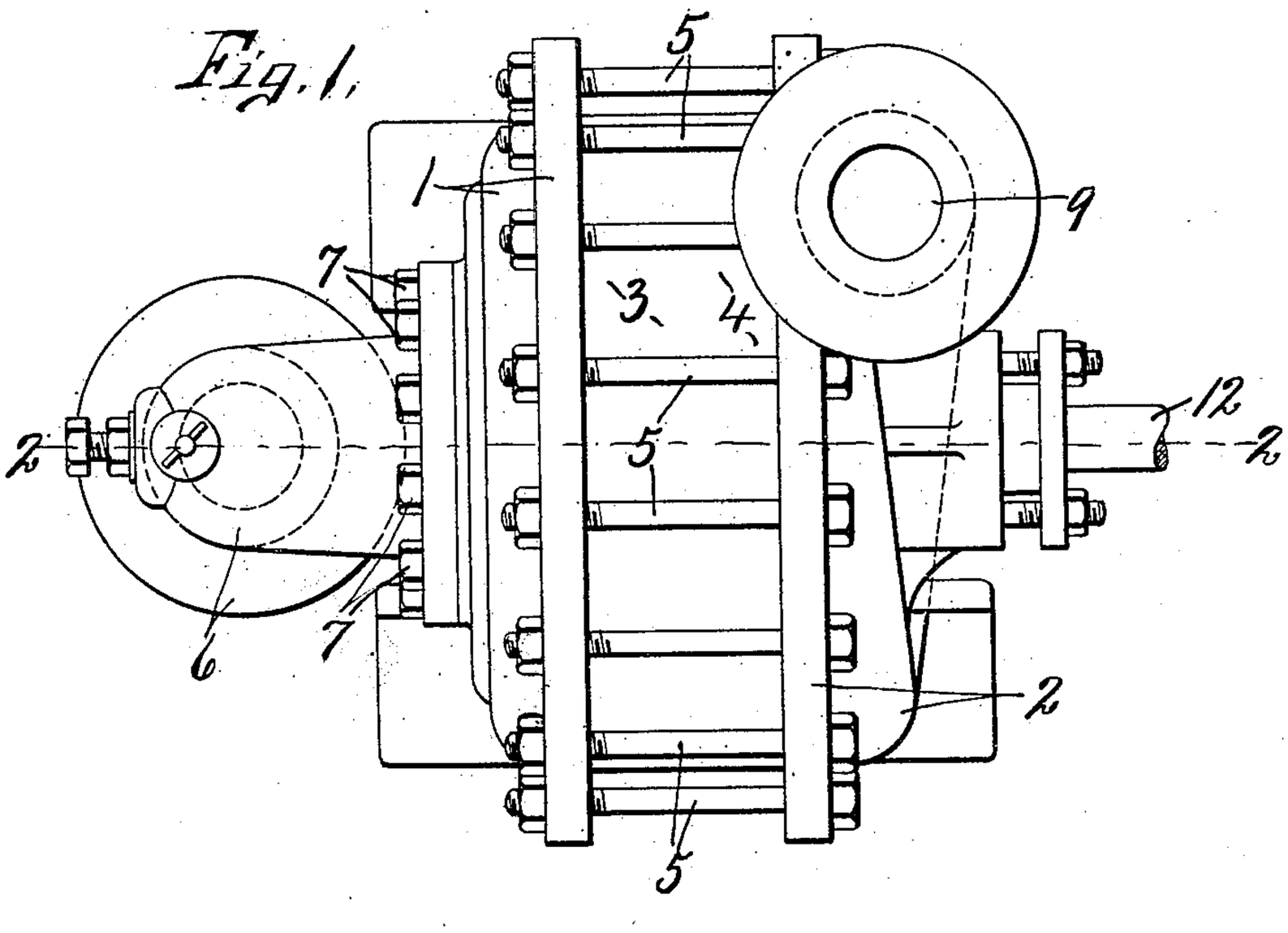
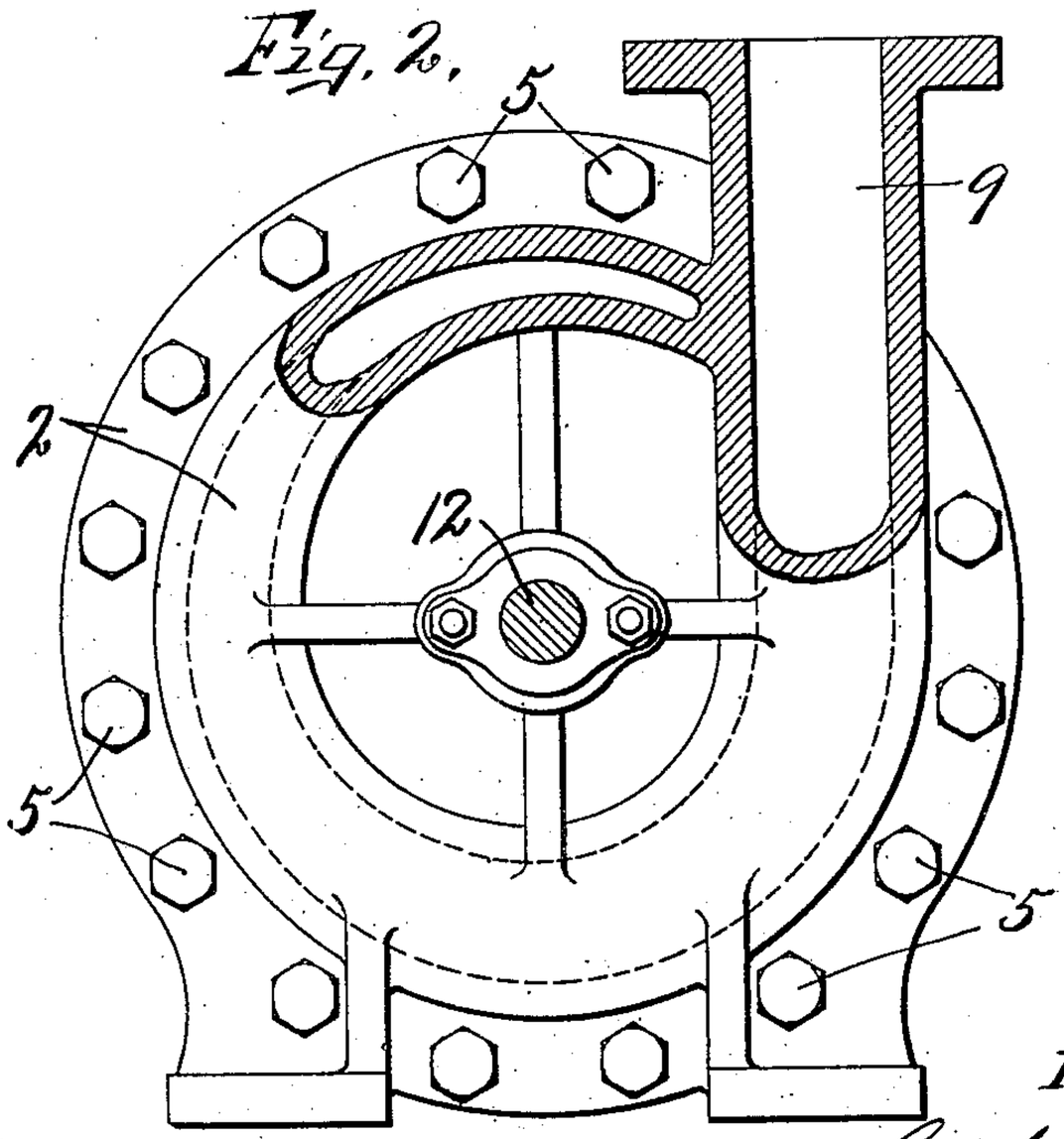


Fig. 2.



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3 SHEETS—SHEET 2.

Fig. 3.

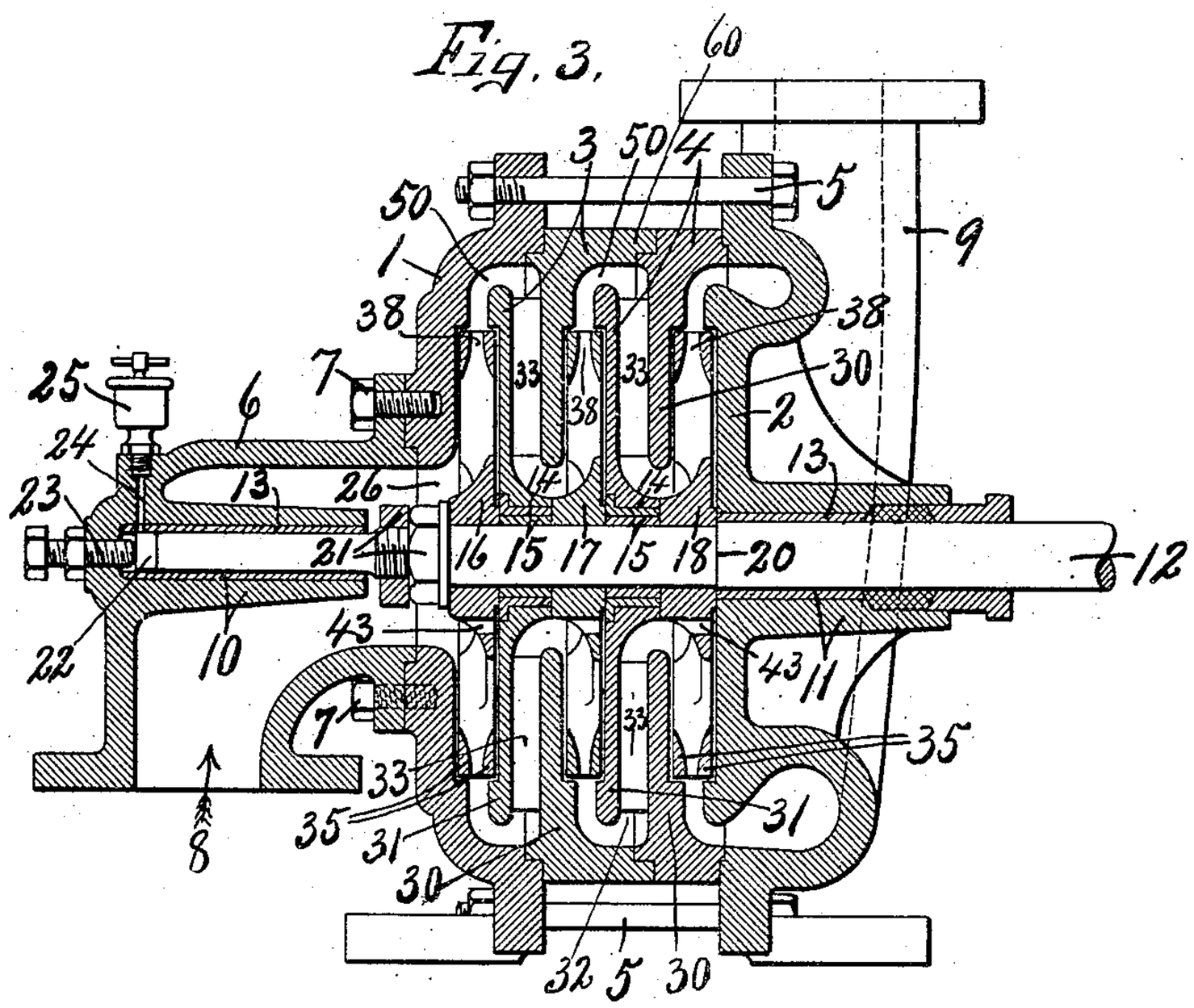


Fig. 4.

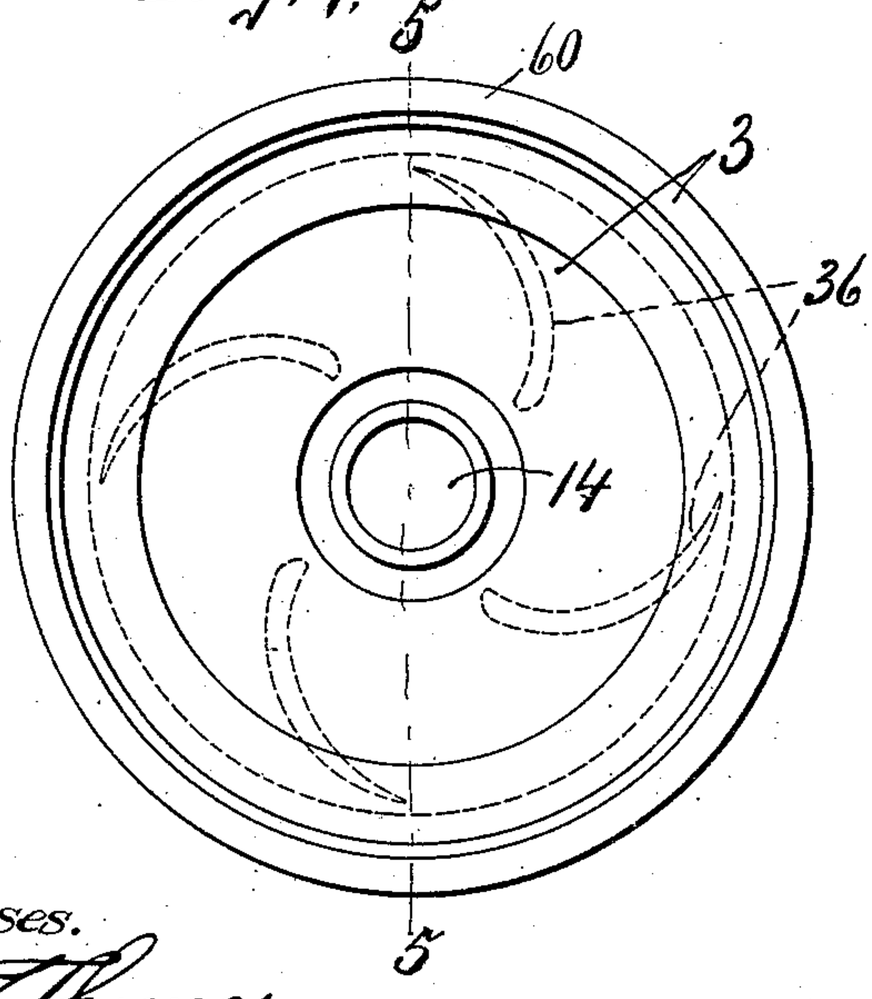
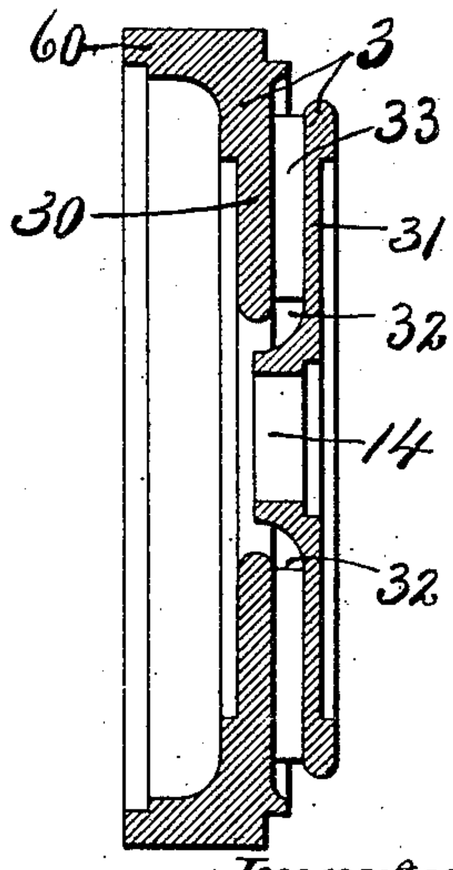


Fig. 5.



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3 SHEETS—SHEET 3.

Fig. 6.

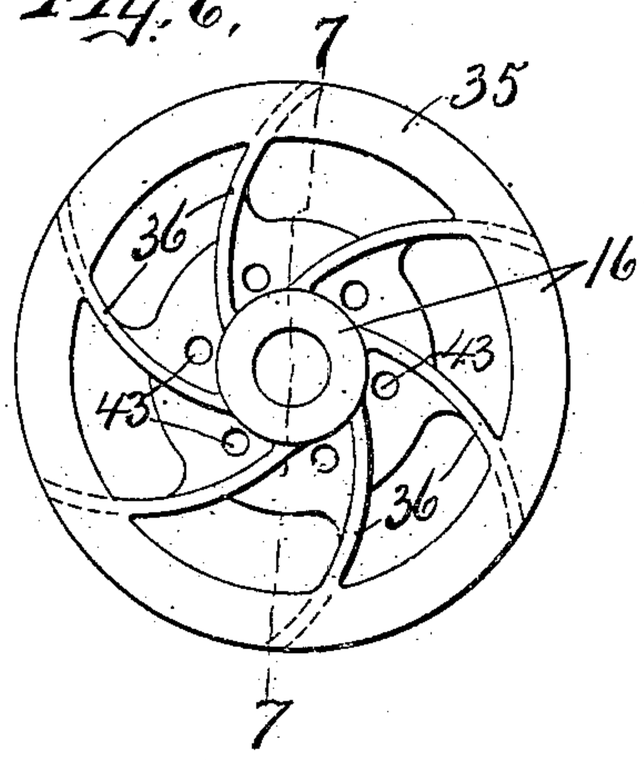


Fig. 7.

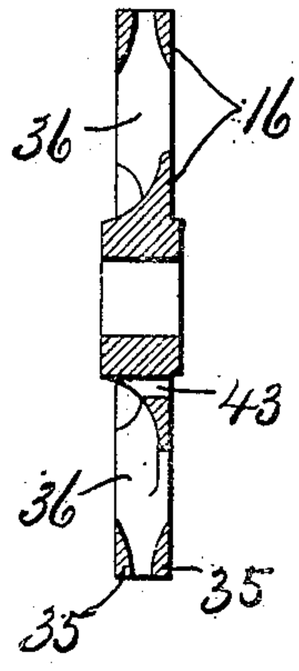


Fig. 8.

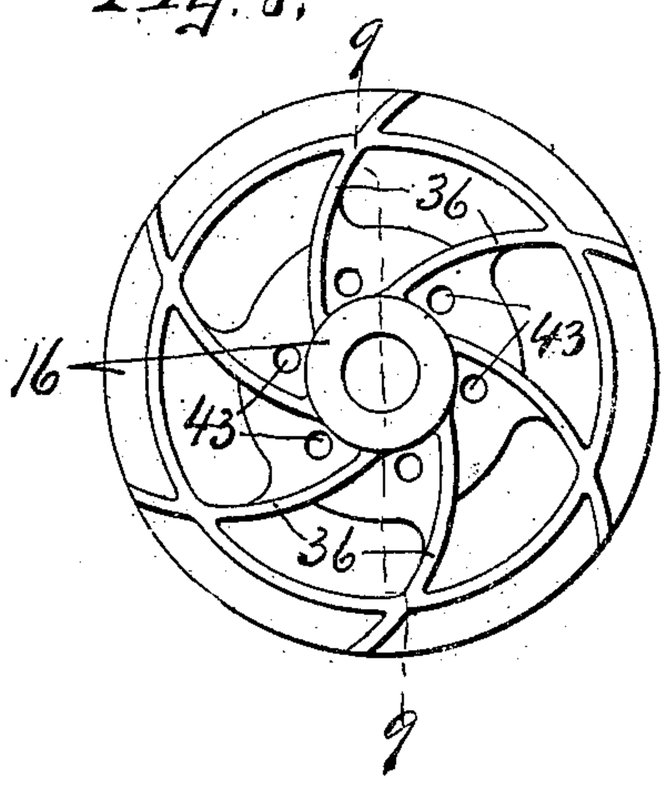
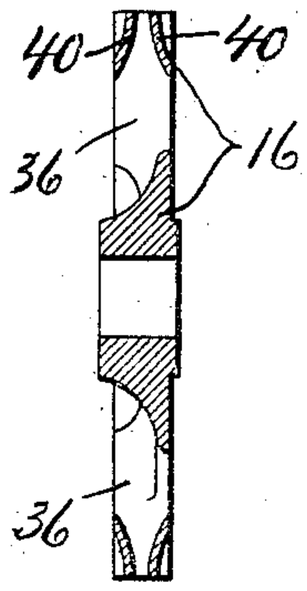


Fig. 9.



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UNITED STATES PATENT OFFICE.

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MULTISTAGE CENTRIFUGAL PUMP.

No. 890,662. Specification of Letters Patent. Patented June 16, 1908.

Application filed March 19, 1907. Serial No. 363,206.

To all whom it may concern:

Be it known that I, CARL LAGER, of Baldwinsville, in the county of Onondaga, in the State of New York, have invented new and useful Improvements in Multistage Centrifugal Pumps, of which the following, taken in connection with the accompanying drawings, is a full, clear, and exact description.

This invention relates to certain improvements in multi-stage centrifugal pumps referring more particularly to the construction of the impellers and to the inclosing case in which the impeller chambers are formed.

The essential object of my present invention is to simplify the general structure of the pump and at the same time to increase its working efficiency by reducing the number of parts and locating the diaphragm and water passages therethrough in a plane at one side of the main body of the partition so that the water ways may be readily milled and cleaned from obstructions which might interfere with the free passage of the water and thereby cause excessive friction.

A further object is to construct the impellers in such manner as to automatically counter-balance them and their driving shaft against end thrust and at the same time to materially reduce the weight of said runners.

Other more specific objects and uses will be brought out in the following description.

In the drawings—Figure 1 is a top plan of a multi-stage centrifugal pump embodying the various features of my invention. Fig. 2 is an end view of the same showing portions of the delivery conduit in section. Fig. 3 is a longitudinal vertical sectional view taken on line 2—2, Fig. 1, except that the driving shaft is shown in elevation. Fig. 4 is an end view of one of the detached intermediate case sections constituting one of the partitions which divide the interior of the casing into compartments. Fig. 5 is a sectional view taken on line 5—5, Fig. 4. Fig. 6 is an end view of one of the impellers, and Fig. 7 is a sectional view taken on line 7—7, Fig. 6. Fig. 8 is an end view of a slightly modified form of impeller and Fig. 9 is a sectional view taken on line 9—9, Fig. 8.

The casing comprises a suction inlet section —1—, a delivery section —2— and any suitable number of, in this instance two, intermediate sections —3— and —4—, all of which are clamped together end to end by suitable clamping bolts —5— which connect the end sections —1— and —2— beyond the periphery of the intermediate sections —3— and —4— thereby clamping said intermediate sections end to end to each other and between the end sections —1— and —2— without passing the bolts through the intermediate sections.

A suction inlet conduit —6— constituting a part of the casing is secured by clamping bolts —7— to the inlet side of the adjacent end section —1— and is provided with a suction inlet —8— adapted to be connected to the source of water supply while the opposite end section —2— is provided with a delivery pipe —9— which is usually formed integral with the delivery section —1— and tangential to its delivery conduit as best seen in Fig. 2. The inlet section —6— and delivery section —2— are formed with central alined bearings —10— and —11— respectively in which is journaled a suitable driving shaft —12— adapted to be driven from any available source of power, not necessary to herein illustrate or describe, said bearings being provided with wearing sleeves —13— inclosing the adjacent portions of the shaft and adapted to be readily removed when worn and replaced by new ones and thereby avoiding the replacement of the case sections in which they are supported. The intermediate sections —3— and —4— divide the intervening space between the end sections —1— and —2— into a series of, in this instance three, impeller chambers and are provided with central alined openings —14— in which are fitted tubular wearing sleeves or bearings —15— for the central portion of the shaft —12— which carries a series of, in this instance three, impellers, —16—, —17— and —18—, each revolving in one of the impeller chambers.

The portion of the shaft upon which the impellers are mounted is reduced in diameter forming a shoulder —20— against which the last impeller of the series abuts, said impellers being spaced apart by the sleeves —15— and are held against endwise movement between the shoulder —20— and suitable lock nuts —21— which are secured upon the shaft —12— at the inlet side of the first impeller, the spacing sleeves being of sufficient length

to prevent undue friction between the impellers and adjacent sides of the partitions —3— and —4—.

The end thrust, due to the action of the impellers upon the water, is always toward the inlet and I, therefore, provide an end thrust bearing —22— between the inlet end of the shaft —12— and a suitable adjusting screw —23—, said bearing being lubricated through an oil passage —24— leading from an oil cup —25— in the top of the casing section —6.

Water is drawn into the pump through the suction inlet —8— and through a central opening —26— in the casing section —1— to the first runner —16— which delivers it through suitable passages in the partition or case section —3— to the second runner of the series, which in turn, delivers it to the next runner and so on through any number of runners, when it is finally discharged from the last one of the series into the discharge conduit —9—, the pressure produced by each successive runner or impeller being increased so that the pressure produced by the last runner of the series equals that produced by the first runner multiplied by the number of runners.

The collective pressure produced by the runners tends to excessive end thrust in the direction of the suction inlet but which I have overcome by the use of a specific form of impeller by which the pressure at the front and back of each impeller is substantially the same, as will be presently described.

Each of the intermediate case sections —3— and —4— are substantially identical and preferably consists of a pair of circular disks or diaphragms —30— and —31— disposed side by side a sufficient distance apart to form intervening water passages —32— and are united by integral vanes —33— dividing the intervening water way into equal compartments extending radially from the shaft. The diaphragm —30— is of greater diameter than its companion disk —31— and its outer marginal portion or periphery is widened and surrounds the disk —31— of the next adjacent intermediate section forming therewith an intervening annular water passage connecting the inclosed impeller chamber with the radial passages in the next succeeding intermediate case section. The meeting faces of the sections —1—, —2—, —3— and —4— are provided with interfitting annular tongues and grooves which serve not only to lock the sections against relative radial displacement but also affords more effective water tight joints.

The impellers 16, —17—, and —18— are substantially identical in construction, each comprising a central hub and a pair of rings —35— of somewhat greater diameter than the hub and connected thereto by vanes —36— as best seen in Figs. 3, 6 and 7, said rings being spaced apart forming intervening delivery slots or openings —38— of suitable size to obtain the desired capacity of delivery with a minimum friction.

The rings —35— are of greater interior diameter than the exterior diameter of the hub of the impeller leaving the intervening space open from end to end or side to side, the vanes —36— being formed integral with the hub and the rings —35— serving to unite the outer ends of the vanes to give them the desired strength and are preferably formed integral therewith.

In the smaller sizes of pumps the face width of the periphery of the impellers or combined face width of the rings —35— and intervening space —38— is substantially equal to the width of the vanes —36— but in the larger sizes of pumps the outer faces of the sides of the rings as —40—, Figs. 8 and 9, are preferably cut away to reduce the weight although the width of the vanes remains the same to the periphery of the impeller. The hub of each runner is also provided with a series of apertures —43— extending therethrough from front to rear which not only reduces the weight of the impeller but also affords additional means for balancing the water pressure at opposite sides of each runner which together with the openings between the hub and rings practically equalize the pressure at both sides of the runner thereby counterbalancing the end thrust of the several runners and their supporting shaft.

It will be observed upon reference to Fig. 3 that the contiguous faces of adjacent case sections are formed with annular recesses constituting a runner chamber and that the marginal edge of the first and next succeeding case section over-hangs and surrounds the next adjacent disk —31— and forms therewith a water passage —50— connecting the inclosed impeller chamber with the water passage between the disks —30— and —31— which latter in turn discharge through the central opening of the diaphragm —30— and into the opening of the adjacent impeller. It will be observed that the disk —31— is disposed some distance wholly at one side of the adjacent face of the disk —30— leaving a clear opening between the disks so that a suitable milling or cleaning tool may be inserted radially from the periphery through the passages and between the disks to smooth the sides of the water ways and to remove any obstructions which may interfere with the free passage of the water therethrough as it is well known that the efficiency of operation of this class of pumps depends largely upon the smoothness of the sides of the water ways. Another important feature is that the sides and periphery of the plate or disk —31— may be milled by ordi-

nary tools and in fact all parts of both disks —30— and —31— are easily accessible for truing up in a lathe or by other suitable instruments. Further more it will be observed that the only core required is that to form the intervening spaces between the disks and between the vanes, which enables the device to be readily molded in any ordinary sand mold.

As best seen in Fig. 5, the diaphragm or disk —30— is provided with an annular flange —60— projecting axially from the side opposite to that about which the disk —31— is secured, a distance greater than the axial width of said disk —31— forming a part of the case inclosing one of the impeller chambers and also surrounding the diaphragm or disk —31— of the next adjacent partition.

The operation may be briefly described as follows: Water is drawn in through the inlet —8— centrally through the inlet —26— of the first case section —1— into the central opening of the first impeller from which it is discharged radially into the annular passage —50— and is then returned toward the center through passages —33— between the diaphragm —30— and —31— of the next case section —3— being then delivered through the central opening in said intermediate case section —3— centrally in the second runner and so on through the next annular passage —50— around the periphery of the diaphragm —31— of the intermediate section —4— and into the third runner from which it is discharged into the delivery conduit —9—. During this action of the water, the water pressure at opposite sides of each runner is substantially equalized by the free passage of the water through the open space between the rings —35— and hub of each impeller thereby counter-balancing the end thrust of the said impellers in the direction of the inlet.

What I claim is:

1. In a centrifugal pump, a case section forming one side of an impeller chamber and having an integral but smaller disk spaced apart from and united to the main body by integral vanes forming water passages, portions of said vanes and intervening space being disposed in a plane wholly at one side of said main body to permit cleaning and smoothing of the sides of the water passages.

2. In a centrifugal pump, a case section comprising two disks of unequal diameters and spaced apart forming a waterway, the smaller disk and a considerable portion of the waterway extending some distance beyond the adjacent side of the larger disk, and vanes uniting said disks.

3. In a multi-stage centrifugal pump, opposite end and intermediate case sections and external bolts clamping said sections together, the intermediate sections dividing the interior of the case into impeller compartments and each comprising two disks of unequal diameters, the smaller disk of each intermediate section being spaced apart some distance from the adjacent end of its larger disk forming an intervening waterway, vanes uniting said disks across the waterway, impellers in the impeller chambers and connected for serial operation, each impeller comprising a hub and vanes projecting therefrom, and rings connecting the extreme outer ends of the impeller vanes and spaced apart forming intervening water passages.

In witness whereof I have hereunto set my hand this 9th day of March 1907.

CARL LAGER.

Witnesses:
H. E. CHASE,
MILDRED M. NOTT.