A. E. GUY.
CENTRIFUGAL PUMP.
APPLICATION FILED JULY 20, 1908.

962,023. Patented June 21, 1910.

5 SHEETS—SHEET 1.

Fig. 2,

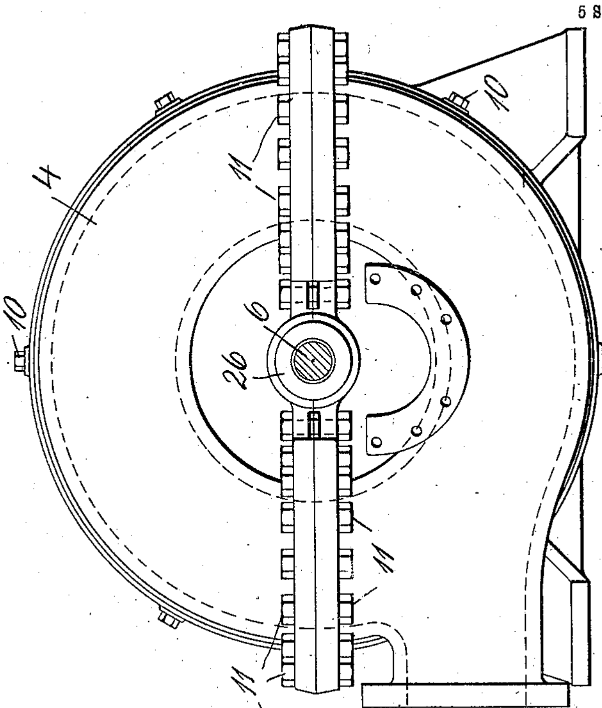
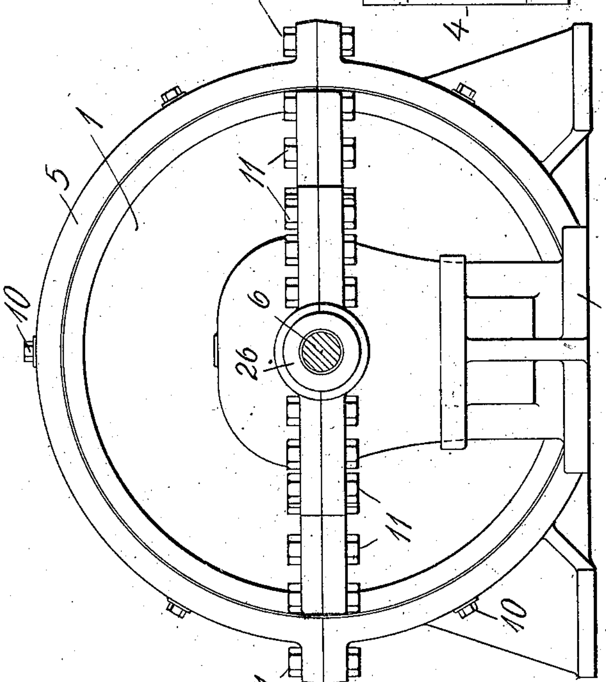


Fig. 1,



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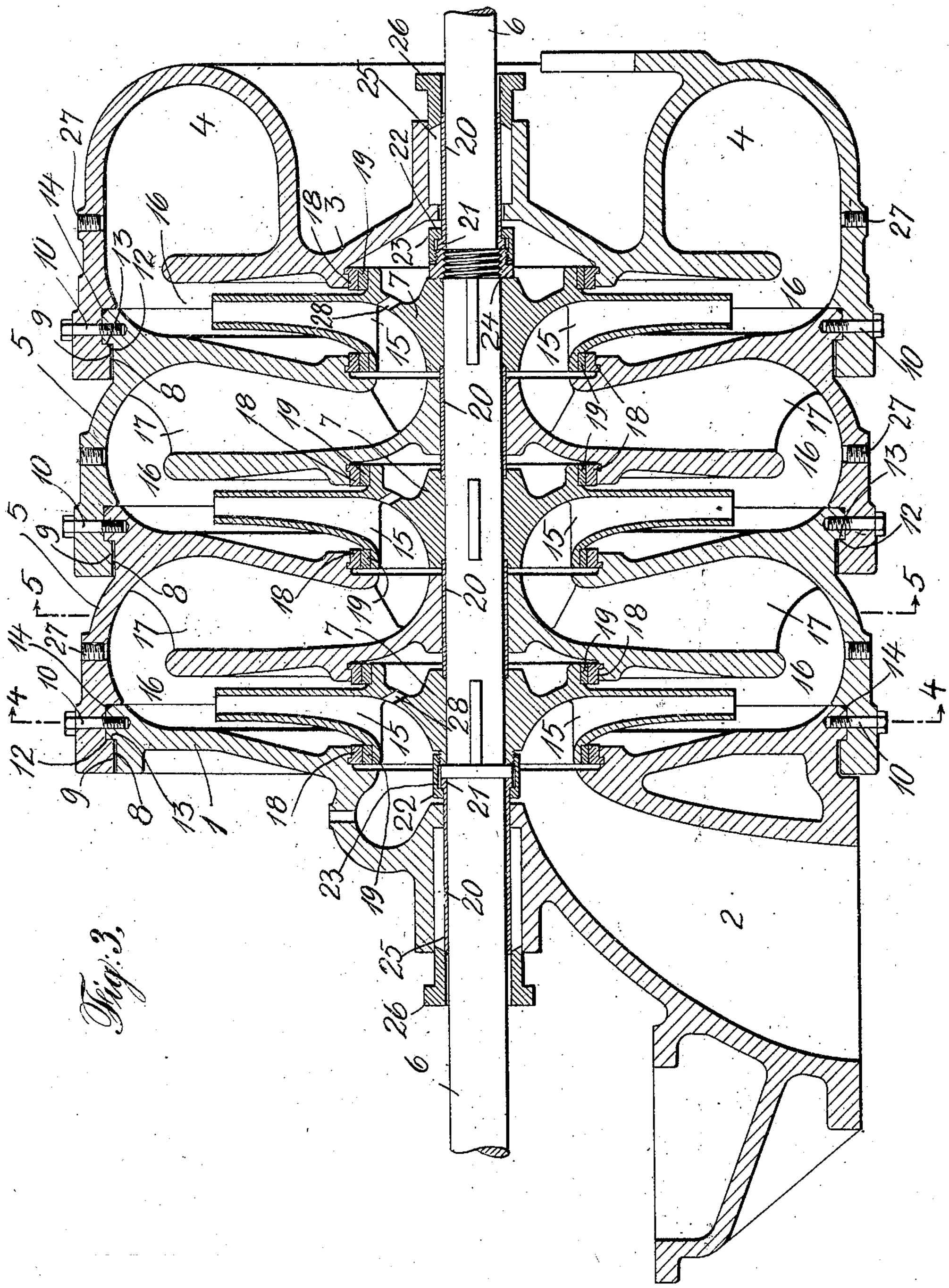

Fig. 3.

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5 SHEETS—SHEET 3.

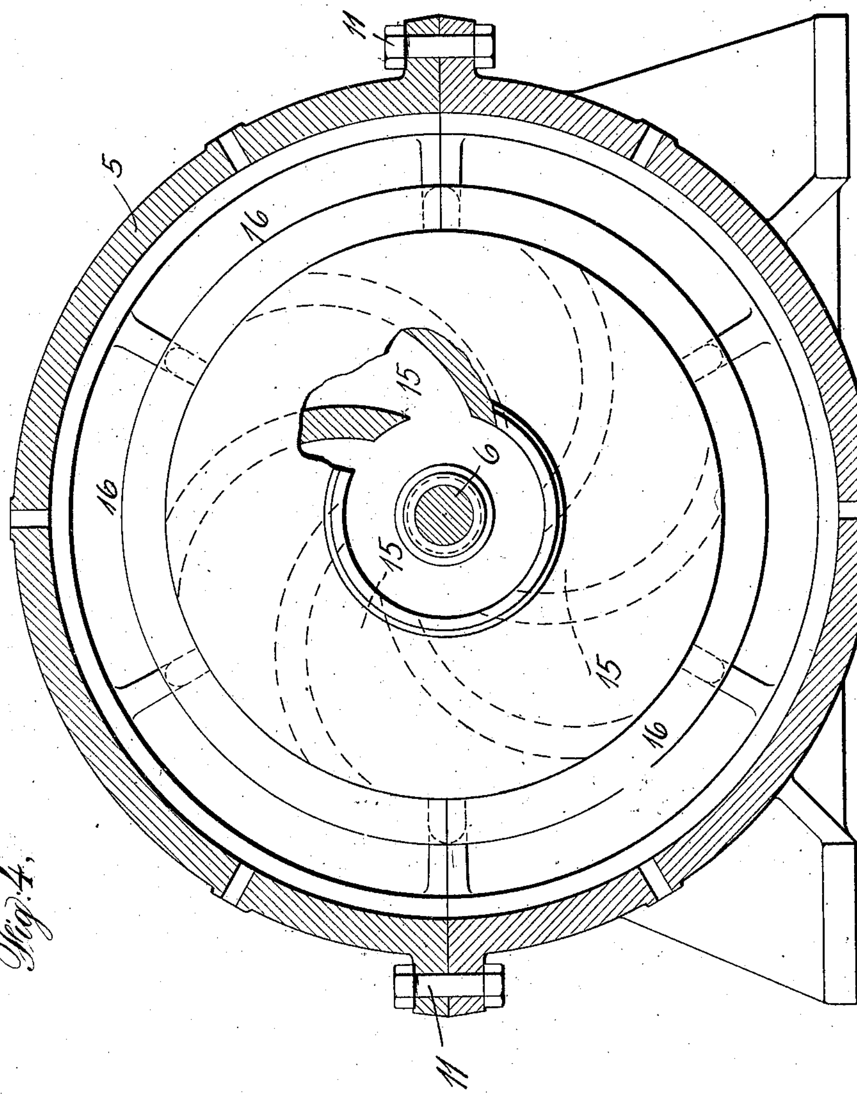

Fig. 4.

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5 SHEETS—SHEET 4.

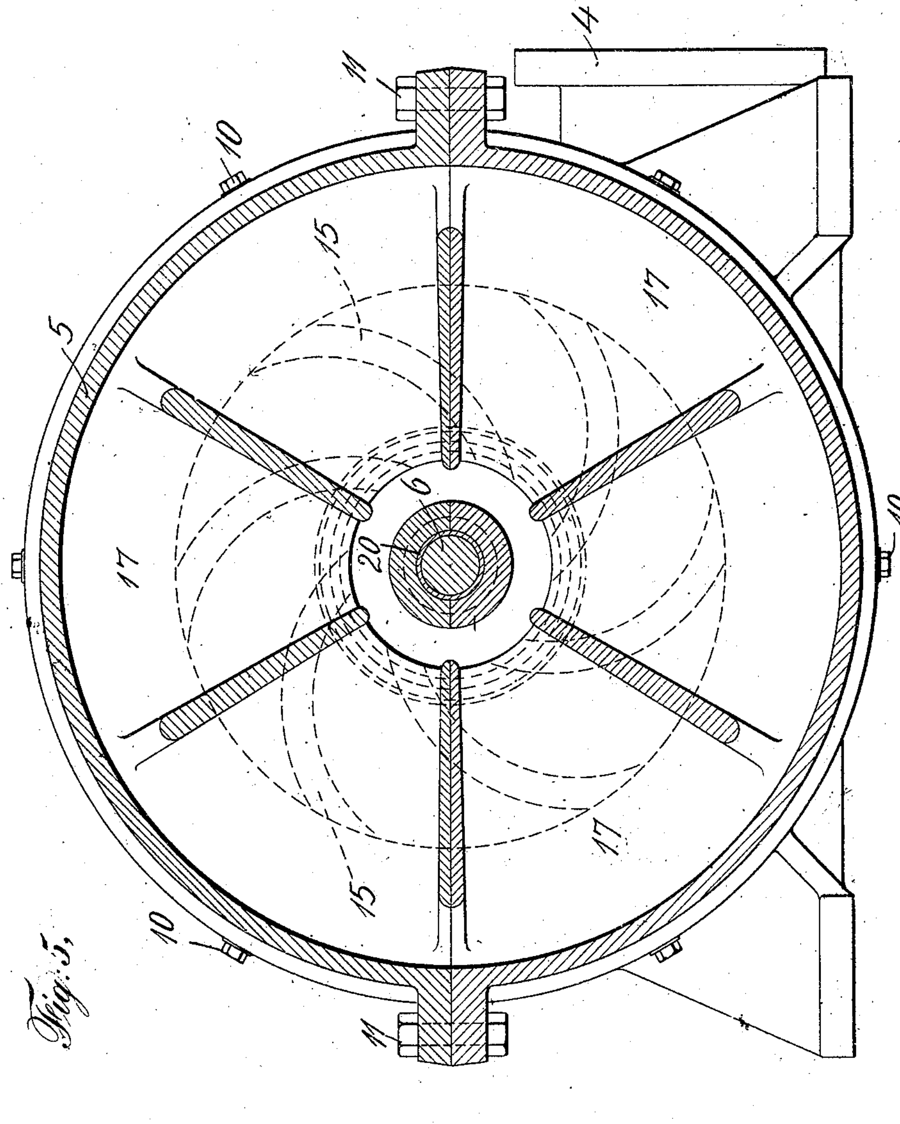

Fig. 5.

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5 SHEETS—SHEET 5.

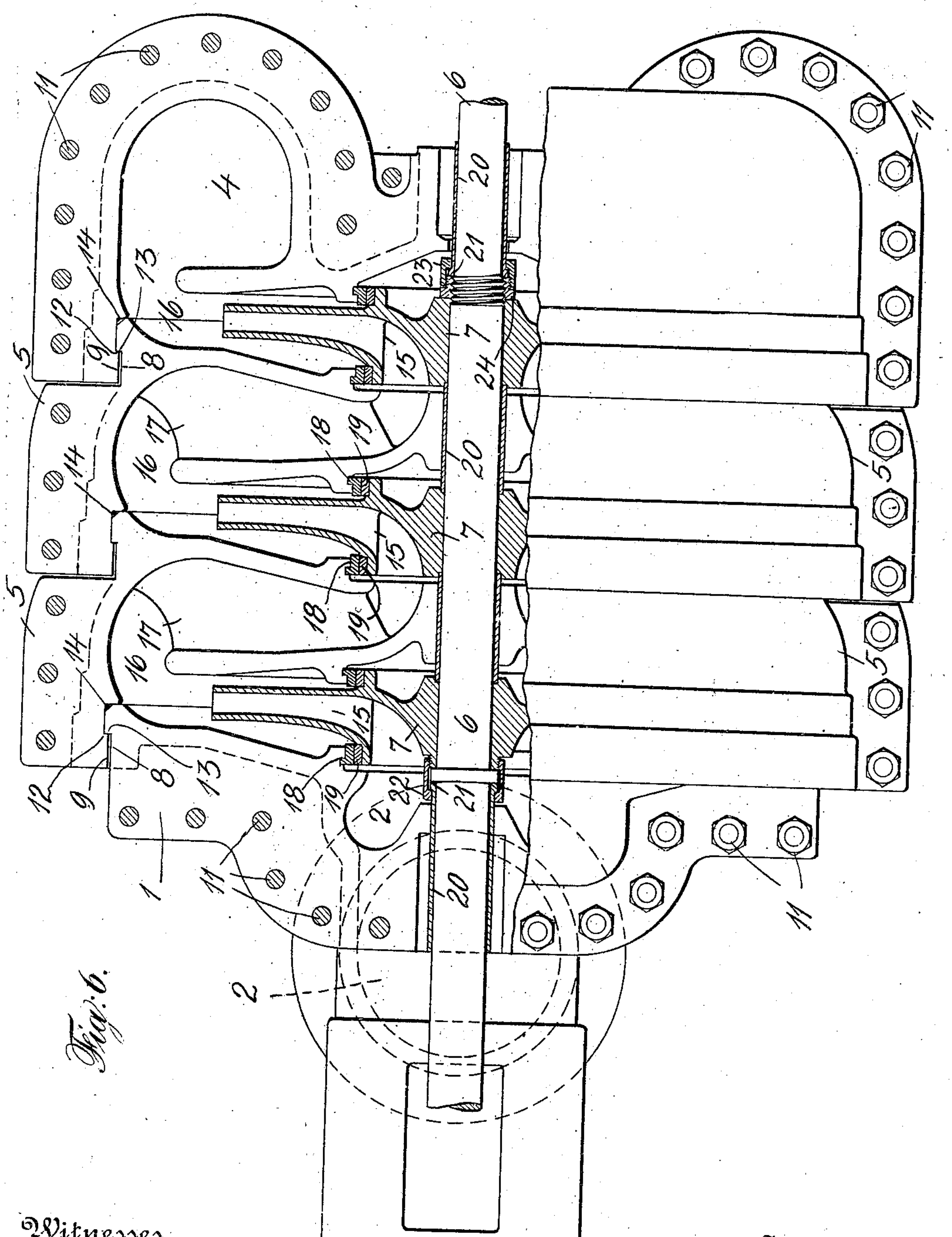

Fig. 6.

Witnesses.

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UNITED STATES PATENT OFFICE.

ALBERT E. GUY, OF TRENTON, NEW JERSEY, ASSIGNOR TO DE LAVAL STEAM TURBINE COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW JERSEY.

CENTRIFUGAL PUMP.

962,023. Specification of Letters Patent. Patented June 21, 1910.

Application filed July 20, 1908. Serial No. 444,345.

To all whom it may concern:

Be it known that I, ALBERT E. GUY, a citizen of the United States of America, and a resident of Trenton, county of Mercer, and State of New Jersey, have invented certain new and useful Improvements in Centrifugal Pumps, of which the following is a specification.

My invention relates to improvements in centrifugal pumps, and particularly to multiple impeller pumps, and comprises an improved sectional construction, whereby all the intermediate sections of the pump may be of the same design, the interior of the pump being nevertheless accessible by the removal of the upper half of the pump casing; and my invention also comprises an improved construction of passages whereby the efficiency of the pump is increased.

The objects of my invention are, to improve the efficiency of centrifugal pumps, particularly pumps of the series type, to facilitate the construction of such pumps in sections, and to make the interior of the pump readily accessible.

I will now proceed to describe my invention with reference to the accompanying drawings, showing one embodiment thereof, and will then point out the novel features in claims.

In said drawings: Figure 1 shows a front elevation of the admission end of the pump and Fig. 2 a similar elevation of the discharge end; Fig. 3 shows a longitudinal vertical axial section of the pump; Fig. 4 a transverse section on the line 4—4 of Fig. 3; Fig. 5 shows a transverse section of the pump on the line 5—5 of Fig. 3; Fig. 6 shows a plan view of the pump with a portion of the upper part of the pump casing broken away and the impellers of the pump sectioned.

In the drawings, 1 designates a front head of the pump casing, containing the admission duct 2, and 3 designates the rear head of the pump casing, containing the discharge duct 4.

5, 5 designate intermediate sections, connected to each other and to the front and rear heads as hereinafter described.

6 designates the rotary impeller shaft, arranged to be driven in any suitable manner, and 7, 7 designate impellers mounted thereon.

As shown particularly in Fig. 3, each intermediate section 5 has a bell-mouth 8, adapted to receive the spigot end 9 of a similar section 5, or of the front head 1; and the rear head 3 has a similar bell mouth adapted to receive the spigot end 9 of the last intermediate section 5. The intermediate sections are all of precisely similar construction, and there may be more or less of them, according to the conditions under which the pump is to operate.

Both the heads and the intermediate sections of the pump casing are formed in two parts, bolted together; the parting line being in the horizontal plane passing through the axis of the pump. The upper members or parts of the several pump sections are all secured together by bolts 10; and the lower sections are also secured together in the same manner. The construction is such, it will be seen, that by removing the bolts 11 which secure the upper and lower members of the several sections together, the entire upper portion of the pump casing may be lifted off as one piece. This makes it very easy to obtain access to the interior of the pump.

The several sections of the pump casing are held together not so much by the bolts 10 as by interlocking shoulders 12 and 13 formed on the coacting bell and spigot ends of the several sections. In the joints thus formed suitable packing material 14 may be inserted.

The several impellers 7 are or may be of the same construction, and are provided with the usual vanes 15. Each impeller discharges into an outwardly extending passage 16, the cross-sectional area of which (in transverse planes) increases rapidly, beyond the periphery of the impeller, owing to radial divergence. This passage 16 in all the intermediate sections, is recurved and leads to the intake of the next impeller. The passage 16 in the rear head leads to the discharge duct 4. These passages 16 may be termed pressure passages, since in them the kinetic energy of the water as it leaves the impeller is transformed in part into potential energy; by which term "potential energy" I mean that energy which has been converted from energy of motion into capacity for reconversion into energy of motion by reason of the generation of pressure. The water as it leaves the impellers is of course moving with great velocity; but owing to the much greater, and rapidly increasing, cross-sectional area of the passage 16, this velocity rapidly diminishes, with transformation of kinetic energy into pressure, until where the streams change direction the velocity is low and the pressure high.

Heretofore it has been customary in multiple centrifugal pumps, to receive the discharge from each impeller in a so-called "diffuser passage" provided with vanes. I have found that these vanes are detrimental. Each particle of water after leaving the impeller is caused to move in a curved path. If the curvature of blades in the discharge passage exactly corresponds to this curved path of the water, the blades are functionless; if such blades have any other shape or curvature they necessarily cause shock, impeding the flow of water and decreasing the efficiency of the pump. Therefore, in this pump the portion of each passage 16 adjacent each impeller, is unobstructed either by blades or vanes or by anything else which may impede the natural flow of the water, and is of such progressively increasing cross sectional area that the velocity of the water will decrease according to natural law and without shock. At the bends in these passages, near the outside of the casing, the velocity of water is very low, relatively, as above stated, and therefore the friction of the water against the walls of the passages is relatively small. Just beyond the middle of the return bend, the passage increases in width, measured axially of the pump, the enlargement thus formed constituting a space in which the liquid becomes relatively quiescent. Beyond this joint the passage decreases in cross-sectional area rapidly, the potential energy (pressure) of the water being thereby reconverted into velocity or kinetic energy. As rotation of the water in these portions of said passages is undesirable, vanes 17 are provided which prevent such rotation. These vanes, however, cause practically no shock to, or retardation of, the water, since when the water reaches them its velocity is low and its inertia consequently small; and for the same reason these vanes cause no appreciable churning or disturbance of the streams. It will be noted that the inwardly extended portions of these passages 16, in which the vanes 17 are, decrease in width both in axial planes and in transverse planes, so that the progressive decrease in cross-sectional area toward the center is very rapid and therefore the increase of velocity of the stream correspondingly rapid. As a result of this construction, each impeller adds to the moving stream of water an increment of energy substantially equal to that added by each of the other impellers and substantially the same as that which would be added if the pump contained but one impeller; and the construction of the impellers and of the passages in the casing through which the stream flows is such that there is minimum loss from shock, fluid friction, etc. Obviously the pump may be adapted for operation against practically any desired head by providing it with a suitable number of impellers and corresponding intermediate casing-sections.

Between the hub of each impeller and the adjacent walls of the casing, bearing rings 18 and 19 are provided. Between each section of the casing and the impeller shaft a bushing 20 is provided, each of the intermediate bushings fitting into a shallow recess in the hubs of two adjacent impellers, thereby preventing leakage backward around the shaft. The end bushings 20 have shoulders 21; the said shoulder of the bushing 20 at the admission end of the pump being engaged by a shoulder 22 of a collar 23 screw-connected to a reduced portion of the first impeller. The shoulder 21 of the bushing 20 at the discharge end of the pump is engaged by the shoulder 22 of another collar 23 screw-connected to a collar 24 itself screw connected to the impeller shaft. By this means the impellers are held in place upon the shaft against longitudinal motion. The impellers are keyed to the shaft against rotative motion with respect thereto, in the ordinary manner. The usual packing boxes 25 and glands 26 are provided at the ends of the pump. The pump casing is provided with suitable priming openings 27 which when the pump is in operation are closed by suitable screw plugs.

From the foregoing description the operation of the pump will be obvious and therefore I will not particularly describe such operation.

In the impellers, near their hubs, are openings 28, serving to admit fluid to the rear side of said impellers so as to balance them.

What I claim is:—

1. A centrifugal pump casing comprising front and rear head sections and one or more intermediate sections having bell-and-spigot connections with each other, the several spigots projecting a substantial distance into the corresponding bell-mouths of the adjacent sections, and interlocking therewith

against longitudinal separation, the several sections being thereby connected into one unitary structure without the necessity of other longitudinal fastenings, each such section formed of a plurality of members separable transversely, means for securing the several members of each section together, and fastening means arranged approximately radially with respect to the casing for securing together corresponding members of different sections, whereby corresponding members of the entire pump casing may be removed as an integral structure.

2. A centrifugal pump casing comprising front and rear head sections and one or more intermediate sections having bell-and-spigot connections with each other, the several spigots projecting a substantial distance into the corresponding bell-mouths of the adjacent sections, such spigots and bell-mouths comprising shoulders interlocking therewith against longitudinal separation, the several sections being thereby connected into one unitary structure without the necessity of other longitudinal fastenings, each such section formed of a plurality of members separable transversely, means for securing the several members of each section together, and fastening means arranged approximately radially with respect to the casing for securing together corresponding members of different sections, whereby corresponding members of the entire pump casing may be removed as an integral structure.

3. A centrifugal pump casing comprising front and rear head sections and one or more intermediate sections having bell-and-spigot connections with each other, the several spigots projecting a substantial distance into the corresponding bell-mouths of the adjacent sections, and interlocking therewith against longitudinal separation, the several sections being thereby connected into one unitary structure without the necessity of other longitudinal fastenings, each such section formed of a plurality of members separable transversely, means for securing the several members of each section together, fastening means arranged approximately radially with respect to the casing for securing together corresponding members of different sections, whereby corresponding members of the entire pump casing may be removed as an integral structure, and packing material in the joints formed by said engaging spigots and bell-mouths.

4. A centrifugal pump casing comprising a plurality of adjacent sections having joints with one another, each such section formed of a plurality of members separable transversely, means for securing the several members of each section together, and fastening means arranged approximately radially with respect to the casing for securing together corresponding members of different sections, whereby corresponding members of such pump-casing-sections may be removed as an integral structure.

5. A centrifugal pump comprising in combination a pump casing and a rotary impeller therein, said pump casing having a chamber in which the impeller may rotate and having a return-bend pressure passage leading therefrom to an outlet, the portion of said chamber between the periphery of the impeller and the return-bend being a substantially straight space of length, radially, greater than the width of the discharge opening of the impeller, and of materially greater width than the width of said discharge opening of the impeller, such straight space increasing progressively in area from the impeller outward and being unobstructed, such passage increasing in width, measured axially of the pump, from about the middle of the return bend to near the end of the return-bend, and thence decreasing in cross-sectional area progressively toward the outlet to which it leads, whereby the velocity of the liquid is permitted to decrease greatly after leaving the impeller and before the return bend is reached, and remains low while passing through the return bend and then gradually increases, the enlargement in said passage, beyond the middle of the return-bend, constituting a space in which the liquid becomes relatively quiescent before its velocity begins to increase, whereby swirling and eddy currents are avoided.

6. A multiple centrifugal pump comprising in combination a pump casing and a plurality of rotary impellers, said pump casing comprising a plurality of impeller chambers, one for each such impellers, and comprising also one or more return-bend pressure passages leading from one of said chambers to the intake of the next impeller, the portion of said chamber between the periphery of the impeller and the return-bend being a substantially straight space of length, radially, greater than the width of the discharge opening of the corresponding impeller, and of materially greater width than the width of that discharge opening of the impeller, such straight space increasing progressively in area from the impeller outward and being unobstructed, such passage increasing in width, measured axially of the pump, from about the middle of the return bend to near the end of the return-bend, and thence decreasing in cross-sectional area progressively toward the outlet to which it leads, whereby the velocity of the liquid is permitted to decrease greatly after leaving the impeller and before the return bend is

reached, and remains low while passing through the return-bend and then gradually increases, the enlargement in said passage, beyond the middle of the return-bend, constituting a space in which the liquid becomes relatively quiescent before its velocity begins to increase, whereby swirling and eddy currents are avoided.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

ALBERT E. GUY.

Witnesses:
ELWOOD RODENBAUGH,
ANNA MAYER.