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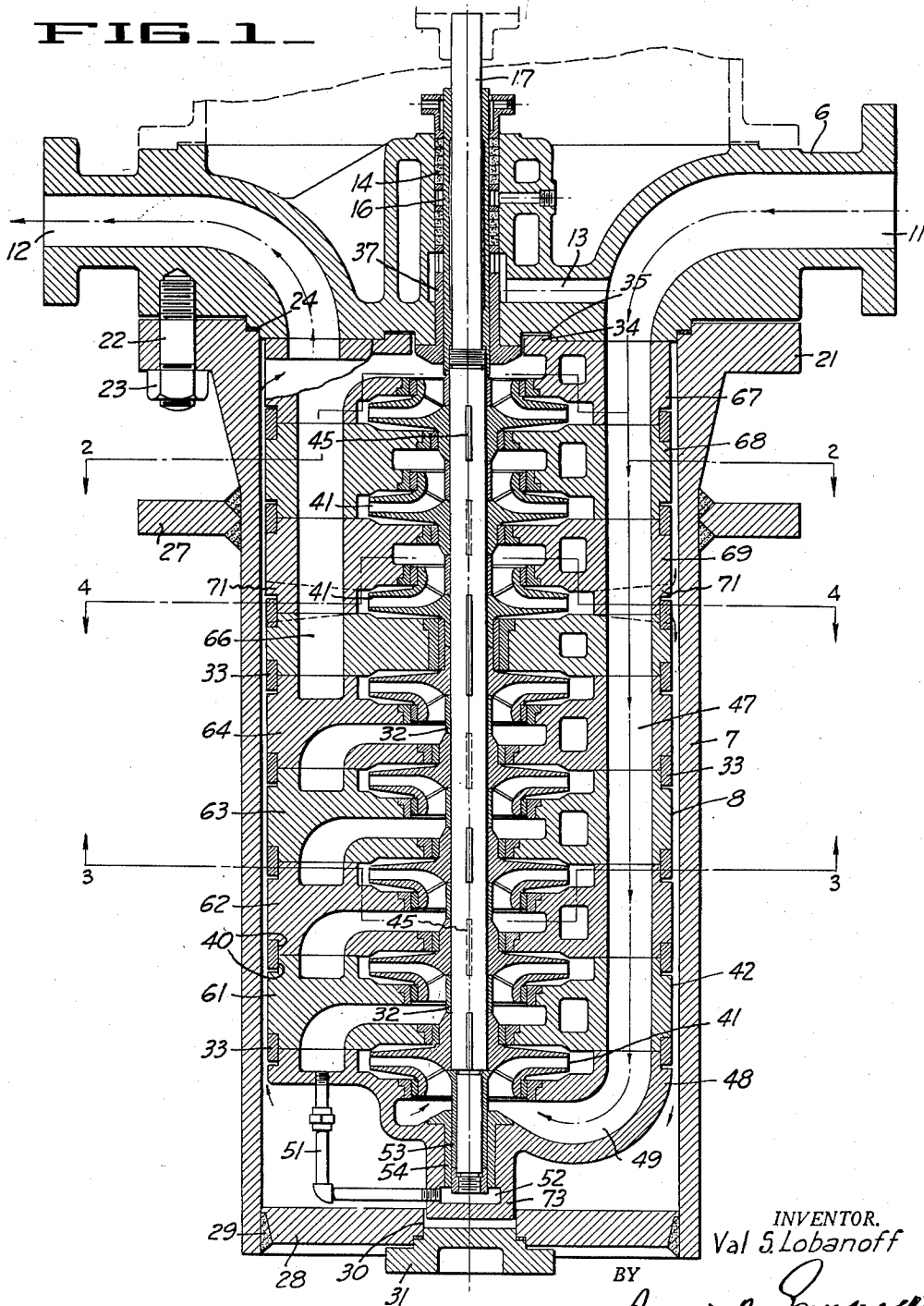
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CENTRIFUGAL PUMP

2,601,828

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2 SHEETS—SHEET 1

FIG. 1



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2 SHEETS—SHEET 2

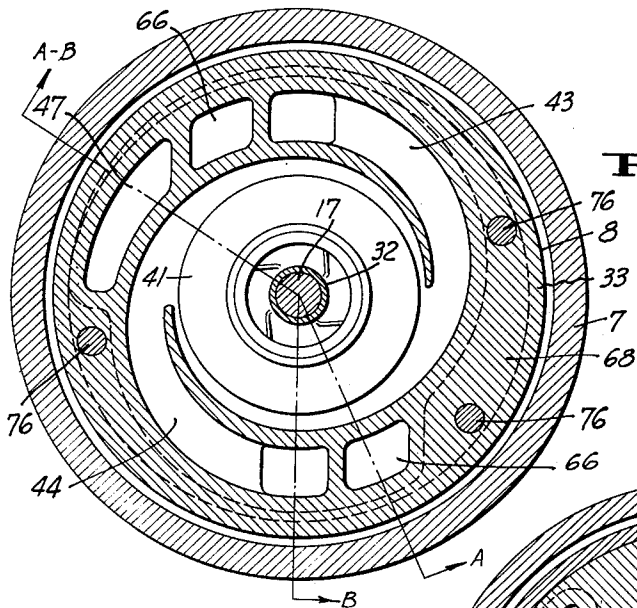


FIG. 2

FIG. 3

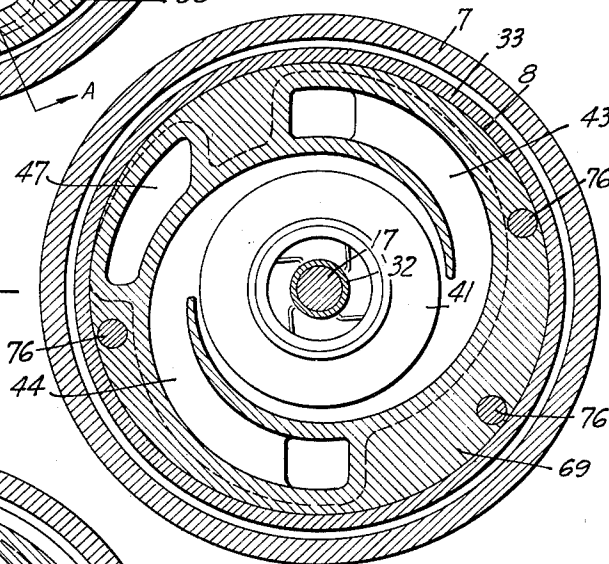
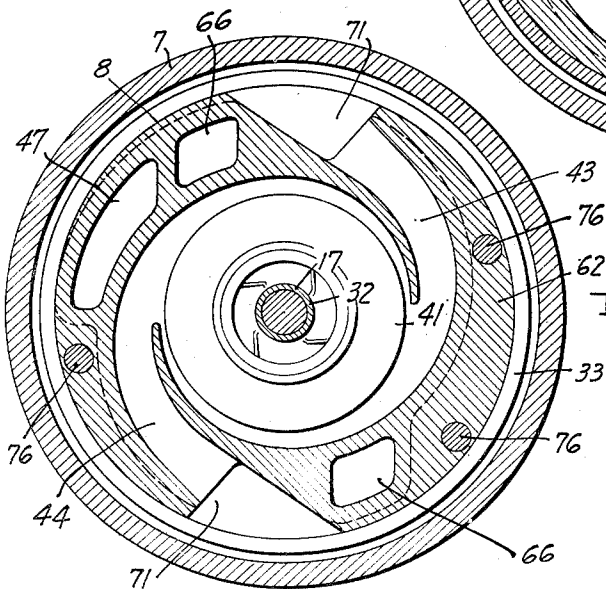


FIG. 4



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CENTRIFUGAL PUMP

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This invention relates to an improved multi-stage centrifugal pump. The invention relates more particularly to a pump having a plurality of stages, each including a double volute discharge so that the radial pressure is balanced in each stage; the pump is also preferably arranged vertically with the first stage at the bottom so that an adequate net positive static head is maintained at all times on the pump; the several stages are arranged on the shaft to provide little if any axial thrust on the shaft; finally, the entire pump unit is so mounted in its outer casing that the pump discharge pressure is utilized to maintain the unit fluid tight in a simple and convenient manner.

It is in general an object of the invention to provide a novel pump having the foregoing characteristics and advantages.

The invention includes other objects and other features of advantage, some of which, together with the foregoing, will appear hereinafter wherein the present preferred pump construction is set forth. In the drawings accompanying and forming a part hereof, Figure 1 shows in vertical section a pump embodying the present invention, the upper half of the view being taken along the line A—A of Figure 2 and the lower half of the view being taken along the line B—B of Figure 2.

Figures 2, 3 and 4 respectively are sections taken along the lines 2—2, 3—3 and 4—4 of Figure 1.

Referring to the drawing, the pump shown comprises a head structure generally indicated by numeral 6, an outer casing structure 7 and a pump unit 8 provided in a spaced relation within the outer casing 7. These units will be discussed in the order mentioned.

Head structure 6 includes an inlet conduit 11 and an outlet conduit 12. Outer casing 7 is generally cylindrical in section and is flanged at its upper end as at 21 for attachment by studs 22 and nuts 23 to the head structure 6, a gasket 24 being interposed between the two. A support ring 27 is welded to the casing 7 at a convenient elevation. The lower end of the casing is closed by plate 28, secured in place as by welding 29; plate 28 includes an aperture 30 therein closed by a suitable end closure 31.

The pump unit 8 comprises a plurality of different stages and that shown includes eight stages although more or less can be employed as desired; each stage is made up in a conventional manner, that is, it includes a centrifugal impeller 41 fitting within a cooperating casing 42 and adapted to receive fluid on one side and discharge it force-

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fully toward the outer periphery of the impeller and into double volute discharge passages 43 and 44 in the casing 42 so that the radial pressure in each stage is equalized. Each impeller 41 is secured to shaft 17 by a key 45, a spacer 32 being provided between each impeller; shaft sleeves 16 and 53 are secured at each shaft end to protect the shaft against abrasion by any solid in the fluid handled by the pump.

In accordance with this invention, the several volute casings 42 are so arranged that inlet passage 11 from the head structure 6 is continued by passage 47; further, the lowermost volute casing 42 is fitted with an end closure 48, including a passage 49 therein to direct feed into the first stage of the pump which is the lowermost stage within casing 7; the discharge passages in the first stage are connected by a conduit 51 to a cavity 52 provided beneath guard sleeve 53 in closure 48 and bushing 54 at the lowermost end of shaft 17 to force fluid from the first stage between the guard sleeve and the bushing and so keep these cool and free running. A similar arrangement is provided at the other shaft end wherein guard sleeve 16 runs in a bushing 37 mounted in the head structure 6 adjacent to the uppermost pump stage. The bushing terminates in passage 13 which is connected to inlet passage 11; the gland or stuffing box 14 provided about the guard sleeve also terminates in passage 13 so that it is only subject to the inlet fluid pressure.

The several stages are provided in such relation to one another along shaft 17 that the shaft 17 is substantially free of axial thrust. This is accomplished by dividing the pump unit into two opposed stage groups; in the first group, the first stage indicated at 61 discharges into the next uppermost stage 62, which in turn discharges into the next uppermost stage 63 and thence into the next uppermost stage 64, which is about midway along shaft 17; this stage then discharges through passage 66 to the second group which includes the uppermost stage 67, this stage then discharging to the next lower stage 68, which in turn discharges to the next lower stage 69, which stage discharges through outlet 71 about midway of the unit into the space provided between the pump unit 8 and the casing 7; the discharge pressure passes upwardly between the pump unit and the casing and thence out through passage 12. Thus, the thrust of the two groups is balanced, one against the other.

Each of the volute casings 42, except that in the uppermost stage, includes two circumferential

recesses 40; a like recess is provided in end closure 48. A ring 33 is fixed into each adjacent recess pair to hold the several units in alignment; each of the casings is formed with parallel flat ends so that they fit together snugly in a stack in which they are retained by rings 33. The uppermost casing is provided with a circular shoulder 34 fitting into a like recess 35 in the head structure 6 to align the unit and the head. The several stages and the end closure are also aligned by three rods 76 which are extended through the head structure 6, the several volute casings and the end closure 48 to retain these together. The rods merely serve to prevent rotation of the several casings making up the unit and their displacement, the actual pressure holding the unit components fluid tight being application of the discharge pressure into the space between the unit and the casing. With this construction, only the outer casing is subject to bursting pressure, the pressure applied to the several casings 42 only serving to compress them into a fluid tight assembly. Since the outer casing is of a simple cylindrical construction, it can be readily fashioned to withstand any desired pressure. Further, with only a simple foundation plate 27 required for support, it is obvious that the outer casing is free to expand and contract as it is subject to varying temperatures and pressures.

The inlet casing 49 has a projection 73 fitting into aperture 30 in end closure 23 on casing 7. This serves to retain the pump unit in axial alignment during handling and shipping and so prevent any damage to it from this handling.

From the foregoing, I believe it will be apparent that I have provided a novel and simple pump construction in which the pressure available from operation of the pump is utilized to hold the inner volute casings in a fluid pocket without any gaskets. It is very simple in construction, can be assembled and dismounted readily, being rugged in construction and combining a high efficiency in operation. Further, the pump embodies both radial and axial balance without the use of any high pressure balancing drums, discs, floating seals or other complicated balancing devices.

I claim:

1. A centrifugal pump comprising a cylindrical outer casing open at the upper end thereof and sealed at the lower end thereof; a closure for the upper casing end secured thereto and including an inlet conduit, an outlet conduit from said casing; and a pump unit, mounted in said casing and depending from said closure in a spaced relation to said casing, said unit including a pump shaft mounted in said outer casing and having a plurality of impellers mounted thereon in two opposed groups to provide a substantial absence of any axial thrust on said shaft, a double volute casing mounted cooperatively with respect to each impeller, the unit including a conduit from said inlet conduit to the lowermost stage in said pump to supply fluid thereto, said unit including a final pump stage intermediate of the unit and discharging into the space between said unit and said outer casing to apply

the pressure of fluid discharged from said unit to the exterior of said unit to maintain said unit fluid tight; each double volute casing having a flat face on each side thereof, said faces being normal to the axis of rotation of said pump shaft, and a peripheral recess, a ring fitting in the recess in each two adjacent double volute casings, a rod extended through the several double volute casings to retain them against displacement; a bushing in the end closure about the pump shaft and having an end terminating short of the end of the shaft, a stuffing box about the pump shaft and having an end terminating in a spaced relation to said bushing, and a conduit about the bushing end and the stuffing box end and leading to the inlet conduit.

2. A centrifugal pump comprising a cylindrical outer casing open at the upper end thereof and sealed at the lower end thereof; a closure for the upper casing end secured thereto and including an inlet conduit, an outlet conduit from said casing; and a pump unit, mounted in said casing and depending from said closure in a spaced relation to said casing, said unit including a pump shaft mounted in said outer casing and having a plurality of impellers mounted thereon in two opposed groups to provide a substantial absence of any axial thrust on said shaft, a double volute casing mounted cooperatively with respect to each impeller, the unit including a conduit leading from said inlet conduit to the lowermost stage in said pump to supply fluid thereto, said unit including a final pump stage intermediate of the unit and discharging into the space between said unit and said outer casing to apply the pressure of fluid discharged from said unit to the exterior of said unit to maintain said unit fluid tight; a first bushing in the end closure about the pump shaft and having an end terminating short of the end of the shaft, a stuffing box about the pump shaft and having an end terminating in a spaced relation to said first bushing, and a conduit about the bushing end and the stuffing box end and leading to the inlet conduit, a second bushing about the end of said shaft adjacent said lowermost stage, said second bushing having an end terminating into a cavity which communicates with an outlet of a pump stage located above the inlet to said lowermost stage, said first and said second bushings being lubricated by fluid passing therethrough.

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