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BALANCED MULTISTAGE CENTRIFUGAL PUMP

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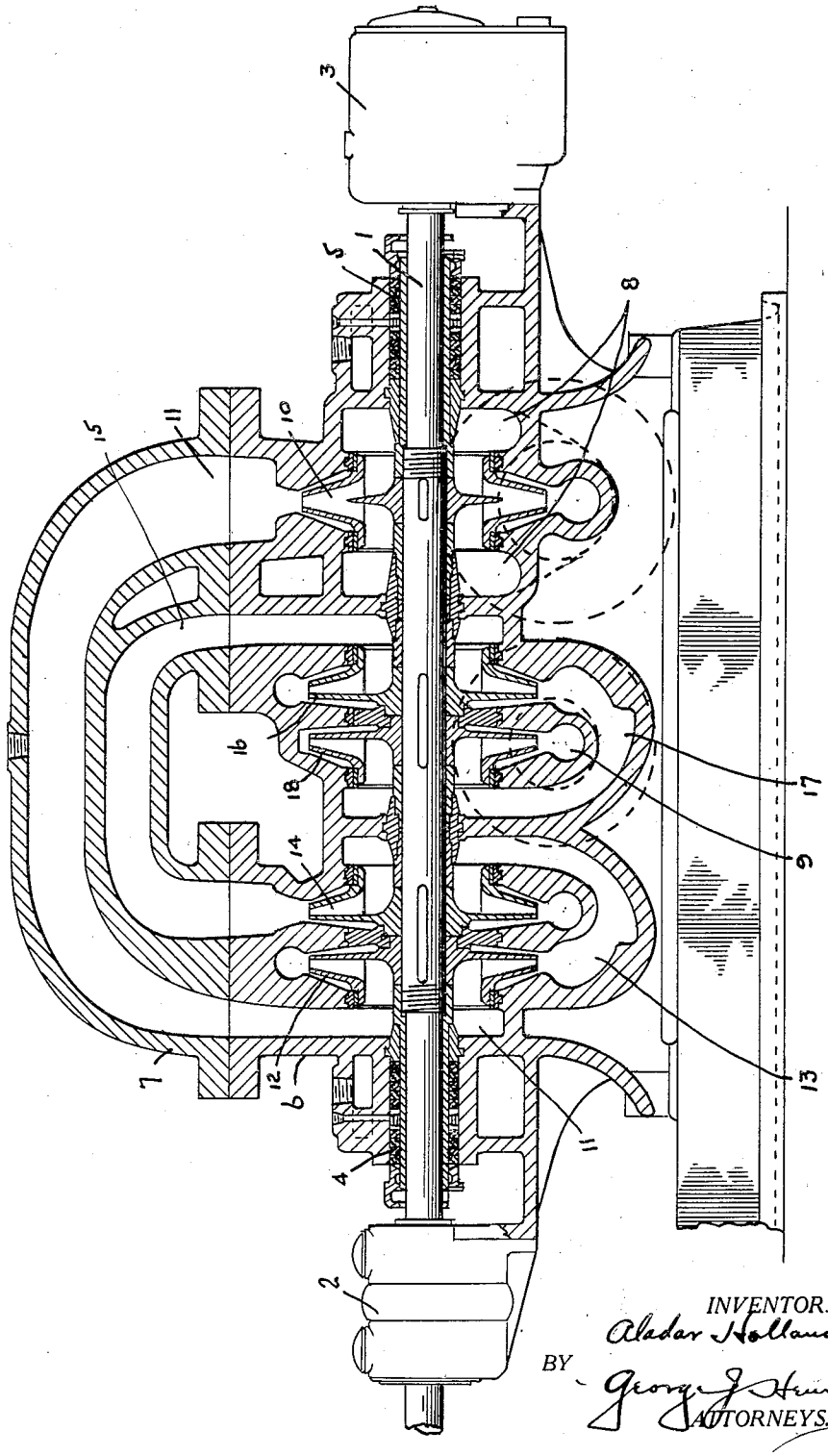

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BALANCED MULTISTAGE CENTRIFUGAL PUMP

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My invention has for its object the substantially perfect balancing of a multistage centrifugal pump as regards the axial thrust by water pressure on the unbalanced portions of the rotors.

A further object is in a multistage centrifugal pump the maintenance of a relatively low velocity during the flow through the first pressure stage impeller thereby preventing vapor formation at the impeller inlet or in the suction column.

Another object is a multistage pump which is maintained in perfect balance yet wherein the highest pressure to which any stuffing gland is exposed is the pressure of the first stage.

Where relatively high velocities are employed on the suction side of centrifugal pumps or where the pump is placed at a considerable height above the surface of the water being pumped occasioning a relatively high degree of vacuum on the suction side of the pump, the pump frequently becomes what is called vapor bound; in such case the continuity of the fluid column is destroyed and the pump ceases to function.

In the pump of my invention I prevent such deleterious results by employing relatively large areas and therefore low velocity throughout the first stage of pumping, after which the water delivered from the first stage, being now under material pressure, may be increased in velocity through the subsequent pump stages.

A further object of this invention is to provide a multistage pump with a double suction first stage impeller, whereby even though the pump be operated at relatively high speeds it is possible to maintain a relatively low velocity of fluid therethrough, thus preventing vapor formation at the impeller inlet or in the suction column and consequently preventing the pump from becoming vapor-bound. This feature is especially important when the pump is utilized for handling hot boiler feed water or casing head gasoline, which volatilize very easily at normal room temperature, especially at reduced pressures.

By referring to the accompanying drawing the invention will be made clear.

The figure is a vertical cross section through the shaft axis of a multistage centrifugal pump employing my invention.

A main shaft is shown by the numeral 1 on which are mounted a plurality of impellers forming with the shaft the rotating element of the pump carried in the bearings 2, 3, and provided with conventional glands 4, 5, respectively.

A main body casing is shown at 6 to which is bolted the upper portion 7 which forms with a body casing the intricate volute for the several stages.

A suction inlet is shown at 8 and a pressure discharge outlet at 9.

The first stage impeller shown at 10 is of the double suction type withdrawing water from the section 8 both from the right and the left of the figure and discharging the same into the volute passage 11.

From the passage 11 water is delivered from the left and to the suction side of the impeller 12 which raises the water to the second pressure stage delivering the same through the volute passage 13 thence to the suction side on the right of the impeller 14.

This in turn delivers the water pumped to the third pressure stage into the volute passage 15 which in turn delivers the water to the suction side on the right of impeller 16 which in turn raises the water to the fourth pressure stage delivering it through the volute passage 17 from whence it enters from the left the suction side of impeller 18 which delivers the water pumped to the fifth pressure stage through the volute delivery passage 9.

The impellers are preferably of substantially the same diameter.

Conventional closures between the several stages are provided and it will be noted that the glands 4 and 5 are exposed only to the first stage of pressure and the suction of the impeller 10 only; that the leakages between the several impellers are confined to differences of one stage of pressure and are therefore a minimum; that the impeller 10 being of the double suction type therefore provide

a very much greater area—in this case at least twice the area of inlet as are the other impellers and that therefore the velocity of flow of fluid into the first impeller is substantially one-half of the velocity of flow into the suction side of the several other impellers or any of them and that only after the water is actually flowing through the impeller is its velocity increased.

The maintenance of a low suction velocity prevents the pump becoming vapor bound and losing its suction.

The impeller 10 is in perfect hydraulic balance receiving equal pressures and velocity on equal and opposite areas and delivering the same in a peripheral direction.

The impellers 12 and 14 are perfectly balanced, their areas being equal and opposite as regards direction of pressure.

The same is also true of impellers 16 and 18. The pump therefore presents a perfectly hydraulic balanced rotating element with minimum pressures at the glands 4 and 5 and with no greater than one stage of pumping pressure difference between any two compartments or adjacent impellers.

I claim:

1. A substantially balanced multistage centrifugal pump comprising an odd number of impellers, the first of said impellers being of the double suction type and the others of the single suction type, said double suction impeller having a greater capacity than any one of said single suction impellers, a means to direct a liquid stream into the opposite ends of the double suction type of impeller, a means to direct liquid discharged by the double suction type impeller in one direction into one end of one of the single suction type impellers, and a means to direct liquid discharged by the last mentioned impeller into one end of another of the single suction type of impeller in a direction opposite to the first mentioned direction.

2. A substantially balanced multistage centrifugal pump including a casing, a shaft rotatably mounted therein, a first stage double suction impeller mounted on the shaft near one end of the casing, an even number of single suction impellers mounted back to back on the shaft between the first impeller and the other end of the casing, said double suction impeller having a greater capacity than any one of said single suction impellers, and a passageway directing the fluid stream into the opposed suction inlet eyes of the first stage double suction impeller and directing the fluid stream discharged from the periphery thereof through the single stage impellers in series.

3. A balanced multistage centrifugal pump comprising an odd number of impellers, the first stage of said impellers being of the double suction type and the others of the single suction type, said double suction impeller having a greater capacity than any one of said single suction impellers, a means to direct a liquid stream into opposite ends of the double suction type impeller, and a means forming passages connecting the impellers in series, alternate ones of the single suction type impellers receiving the hydraulic thrust in one direction and the remaining single suction type impellers receiving the hydraulic thrust in the opposite direction.

4. A multistage centrifugal pump including the combination of a casing, a shaft rotatably mounted in the casing, a first stage double suction type impeller mounted on the shaft, an even number of single suction type impellers mounted on the shaft so that the entrance end of one half the number of single type impellers face toward one end of said casing and so that the entrance end of the remaining single suction type impellers face in the opposite direction, and said double suction impeller having a greater capacity than any one of said single suction impellers, and means forming a liquid passage arranged to direct a liquid stream into the opposed inlet eyes of the first stage impeller and for directing the liquid discharged therefrom through the other impellers in series.

5. A multistage centrifugal pump including the combination of a casing, a shaft rotatably mounted in the casing, a first stage double suction type impeller mounted on the shaft adjacent one end of said casing, a second stage single type impeller mounted on the shaft adjacent the opposite end of the casing and having its inlet end directed toward said opposite end, a third stage single type impeller mounted on the shaft adjacent said second stage impeller and having its inlet end directed toward said one end of the casing, a fourth stage single type impeller mounted on the shaft adjacent said first stage double impeller and having its inlet end directed toward said one end of the casing, a fifth stage single type impeller mounted on the shaft intermediate said third and fourth stage impellers and having its inlet end directed toward said opposite end of the casing, said double suction impeller having a greater capacity than any one of said single suction impellers, a means to direct a liquid stream into opposite inlet ends of the first stage double suction type impellers, and a means forming a passage connecting the impellers in series.

6. A multistage centrifugal pump including the combination of a casing, a shaft rotatably mounted in the casing, a first stage double suction type impeller mounted on the shaft adjacent one end of said casing, a second stage single type impeller mounted on

the shaft adjacent the opposite end of the casing and having its inlet end directed toward said opposite end, a third stage single type impeller mounted on the shaft adjacent said second stage impeller and having its inlet end directed toward said one end of the casing, said double suction impeller having a greater capacity than any one of said single suction impellers, a means to direct a liquid stream into opposite inlet ends of the first stage double suction type impeller, and a means forming a passage connecting the impellers in series.

7. A substantially balanced multistage centrifugal pump including a casing, a shaft rotatably mounted in the casing, a first stage double suction impeller mounted on the shaft, a pair of single suction impellers mounted back to back on said shaft, the inlet area of the double suction impeller being greater than the inlet area of the second stage impeller, a liquid passage connecting the discharge of the first stage to the inlet of the second stage, and a liquid passage connecting the discharge of the second stage with the inlet of the third stage.

8. A substantially balanced multistage centrifugal pump including a casing, a shaft rotatably mounted in the casing, a first stage double suction impeller mounted on said shaft, a plurality of pairs of single suction impellers mounted back to back on said shaft, the inlet area of the double suction impeller being greater than the inlet area of said second stage impeller, a first fluid passage connecting the discharge of the first stage to the inlet of the second stage, a second fluid passage connecting the discharge of the second stage to the inlet of the third stage, a third fluid passage connecting the discharge of the third stage to the inlet of the fourth stage, a fourth fluid passage connecting the discharge of the fourth stage to the inlet of the last stage, and a discharge passage for said last stage.

9. A substantially balanced multistage centrifugal pump including a casing, a shaft rotatably mounted in the casing and extending therethrough, bearings at each end of the shaft external to the casing, stuffing boxes between the casing and shaft adjacent each end thereof, a first stage double suction impeller mounted on said shaft at the inlet end of the pump casing and adjacent one of said stuffing boxes, a pair of single suction impellers mounted back to back on the shaft, said double suction impeller having a greater capacity than any one of said single suction impellers, and means for directing a fluid stream into the opposed suction inlet eyes of the first stage double suction impeller and for directing the fluid discharged therefrom through the single suction impeller farthest from the first stage double suction impeller and then through the other of said single suction impellers.

10. A multistage centrifugal pump including the combination of a casing, a shaft rotatably mounted in the casing and extending therethrough, bearings at each end of the shaft external to the casing, stuffing boxes between the casing and shaft adjacent each end thereof, a double suction impeller mounted on said shaft at the inlet to the pump and adjacent one of said stuffing boxes, a plurality of pairs of single suction impellers mounted back to back on said shaft, said double suction impeller having an inlet area greater than the inlet area of any one of said single suction impellers, a liquid passage leading from the periphery of said double suction impeller to the eye of the single suction impeller furthest from said double suction impeller and adjacent to the other stuffing box, a fluid passage connecting the periphery of said first single suction impeller with the eye of the adjacent single suction impeller, and fluid passages connecting the last named impeller with the subsequent pairs of impellers in like manner.

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