D. W. JONES & E. W. KOPPE.

CENTRIFUGAL PUMPING APPARATUS.

APPLICATION FILED AUG. 28, 1907.

975,623.

Patented Nov. 15, 1910.

2 SHEETS—SHEET 1.

Fig. 1.

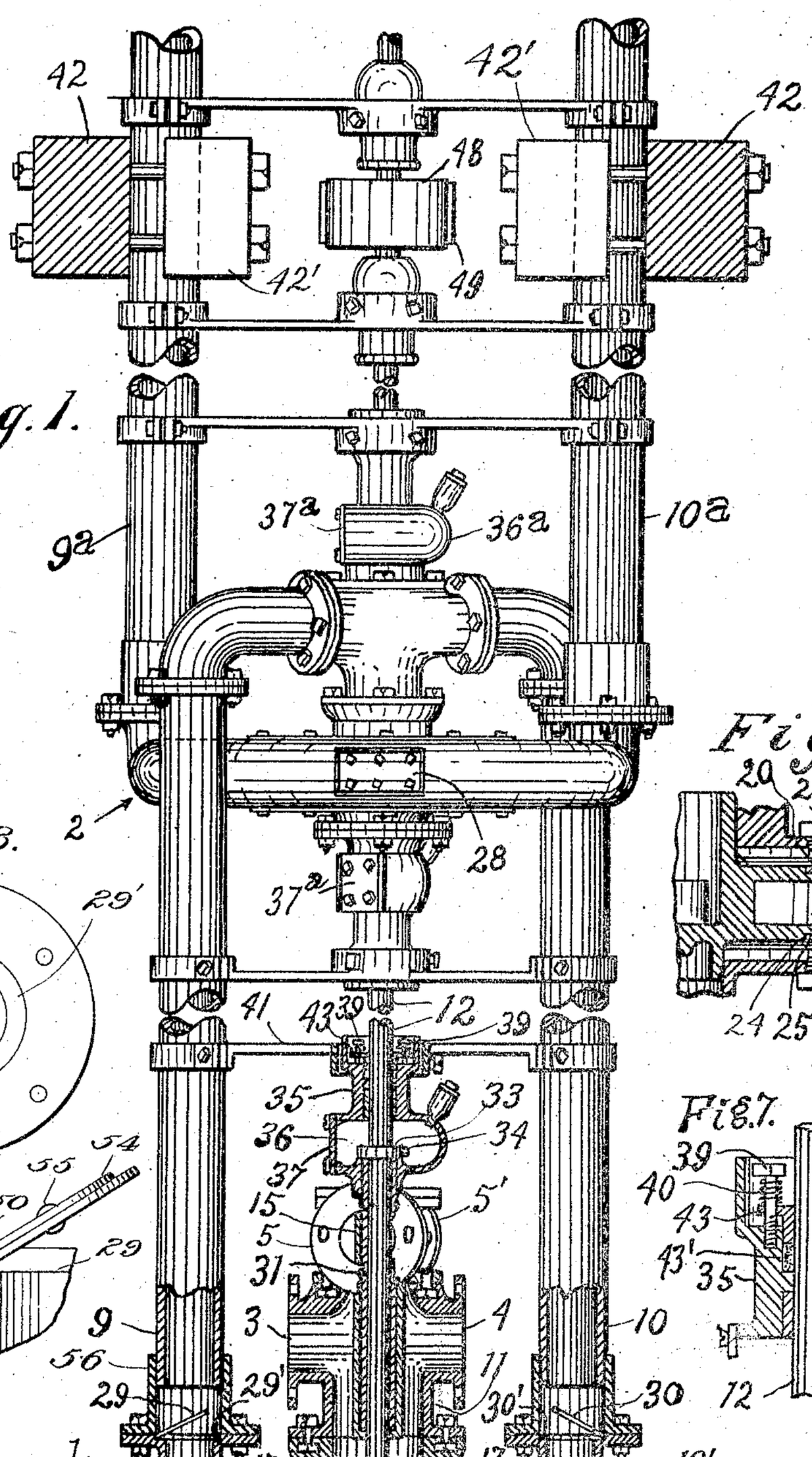


Fig. 6.

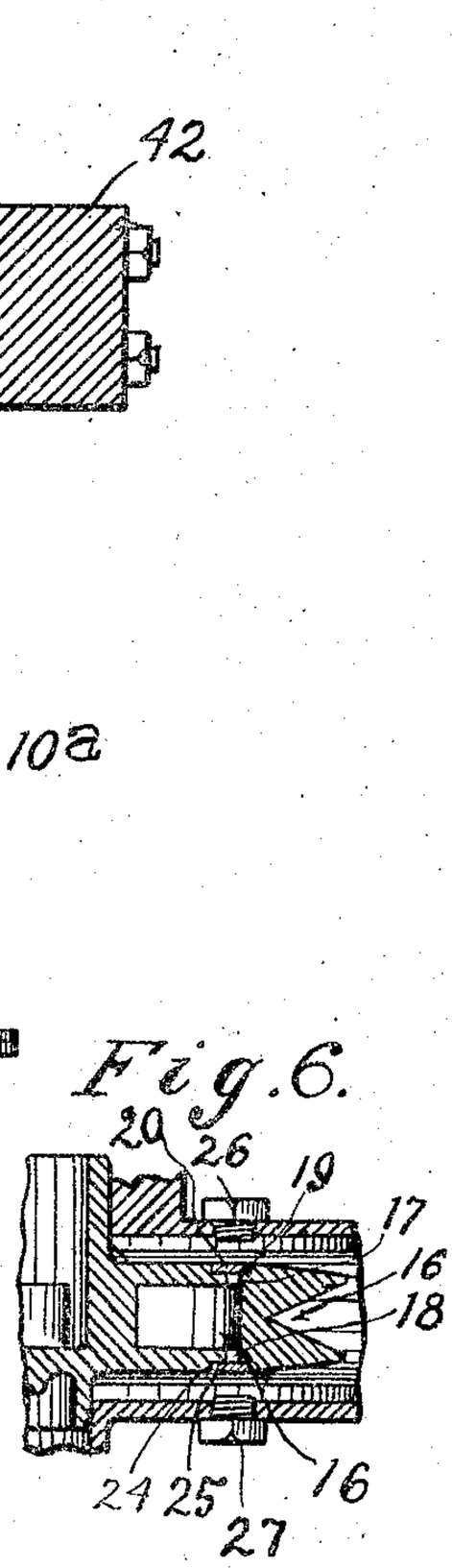


Fig. 8.

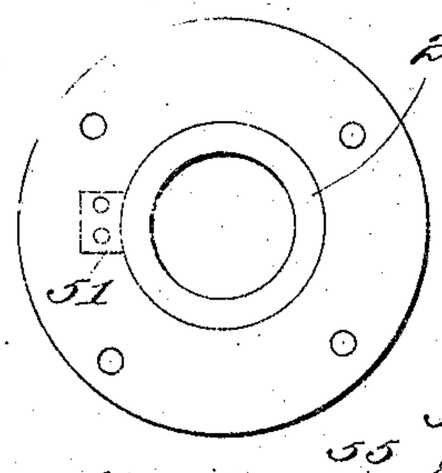


Fig. 9.

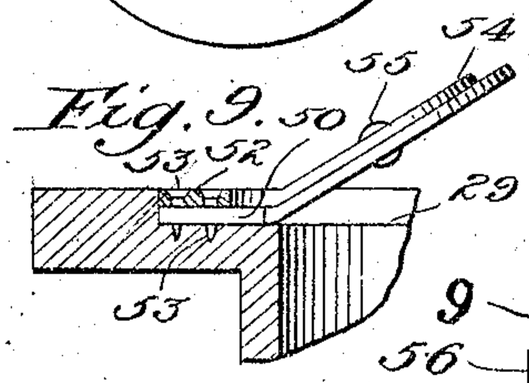


Fig. 7.




Witnesses:

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2 SHEETS—SHEET 2.

*Fig. 2.*

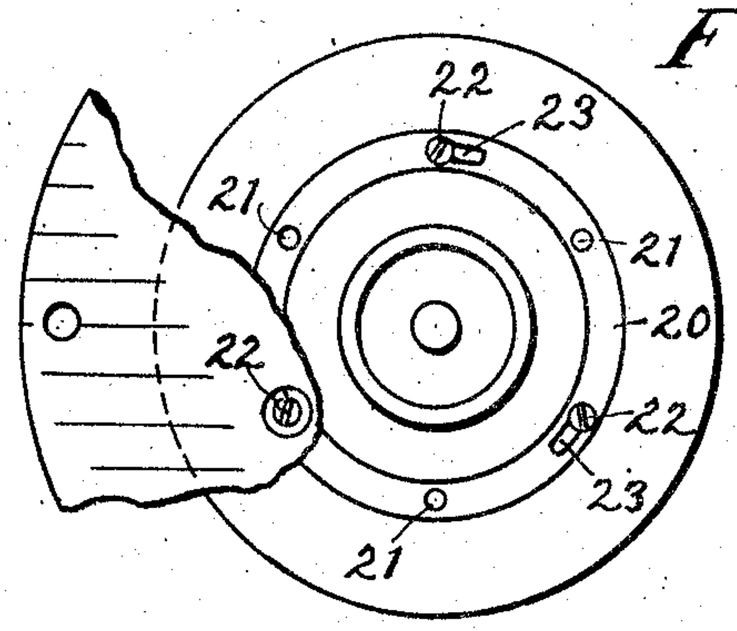



*Fig. 3.*

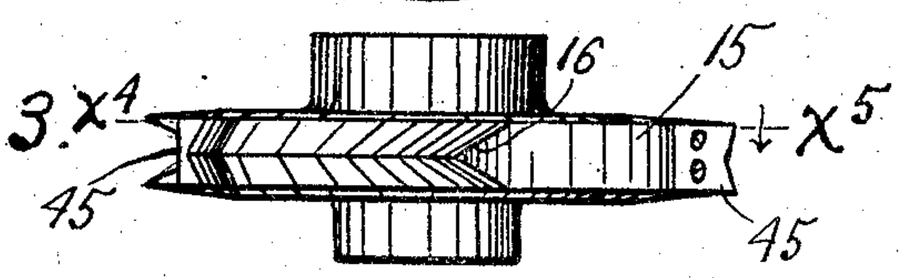



*Fig. 4.*

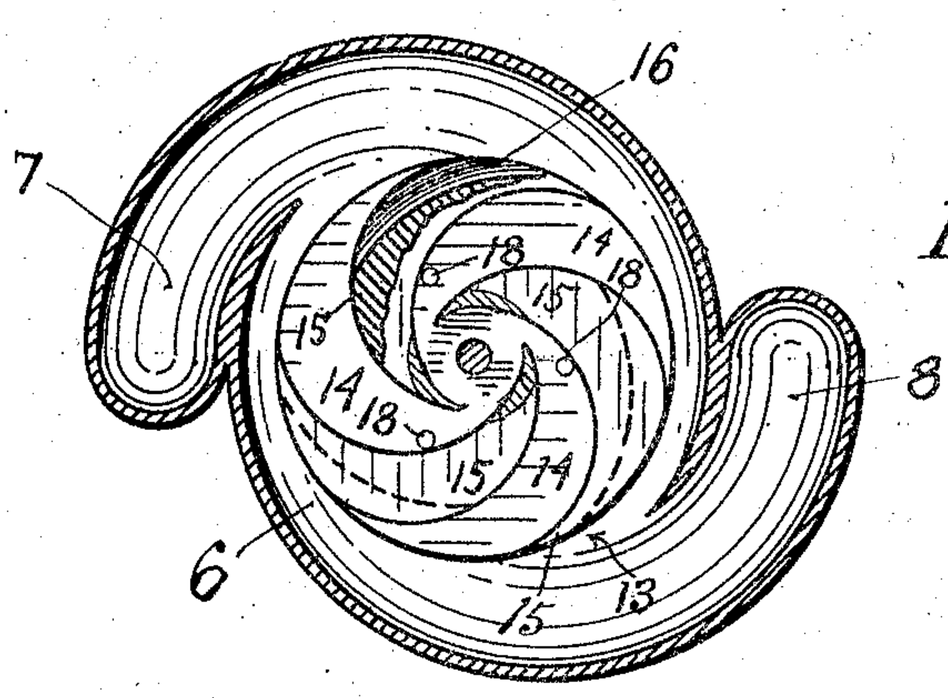
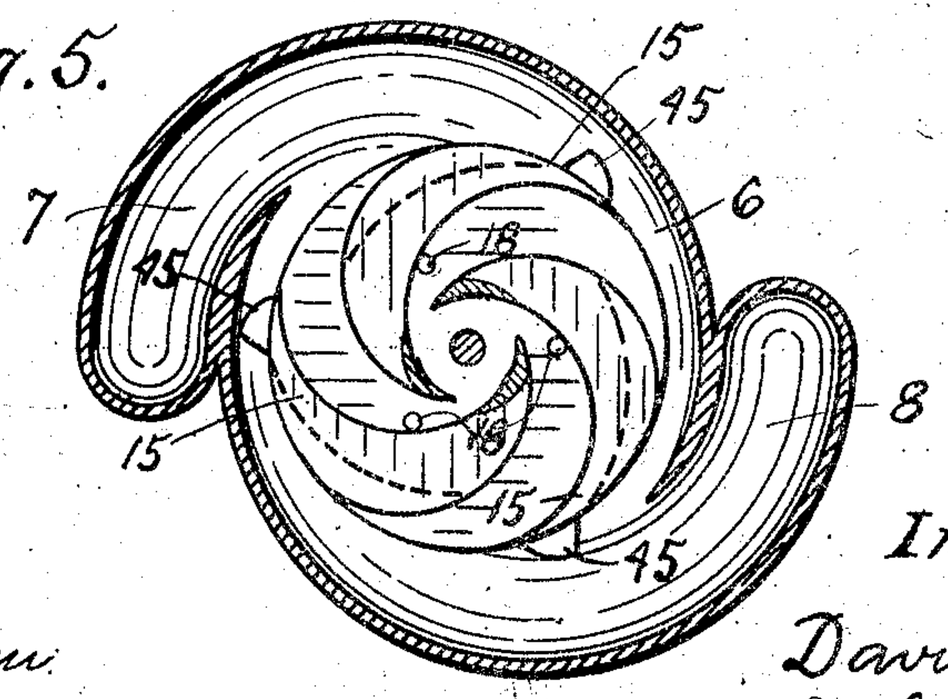



*Fig. 5.*

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# UNITED STATES PATENT OFFICE.

DAVID W. JONES AND EARL W. KOPPE, OF LOS ANGELES, CALIFORNIA.

## CENTRIFUGAL PUMPING APPARATUS.

975,623. Specification of Letters Patent. Patented Nov. 15, 1910.

Application filed August 28, 1907. Serial No. 390,435.

*To all whom it may concern:*

Be it known that we, DAVID W. JONES and EARL W. KOPPE, both citizens of the United States, residing at Los Angeles, California, have invented a new and useful Centrifugal Pumping Apparatus, of which the following is a specification.

An object of this invention is to provide improved means whereby the rotating portion of a centrifugal pump will automatically balance itself so that friction caused by upward or downward thrust of the pump runner will be practically eliminated within certain limits.

A further object is to provide means whereby if further balancing of the pump is necessary to prevent upward or downward thrust, such balancing may be readily accomplished by adjusting the size of balancing ports provided in the runner itself.

Another object is to provide a pump in which the discharge pipes are so disposed that the discharging streams balance each other in a manner to prevent one side of the pump frame from being weighted more than the other.

Another object is to so form the pump chamber and arrange the outlets with relation thereto, that the friction of the water against the sides of the casing will be reduced.

Other objects and advantages may hereinafter appear.

The accompanying drawings illustrate the invention in the embodiment thereof which we at present deem preferable.

Referring to said drawings, Figure 1 is a side elevation partly in section and partly broken away, of a pumping apparatus constructed according to the principles of this invention. Fig. 2 is a plan of one of the pump runners including a fragment of the casing therefor. Fig. 3 is a side elevation of a modified form of one of the pump runners. Fig. 4 is a plan section on line $X^4$—$X^5$ of Fig. 1. Fig. 5 is a similar plan section, showing the modification of the pump runner on line $X^4$—$X^5$ of Fig. 3. Fig. 6 is an enlarged fragment of a portion of the sectioned runner shown in Fig. 1. Fig. 7 is an enlarged section of a portion of bearing means shown in Fig. 1. Fig. 8 is a plan view on an enlarged scale of the short upright section of pipe forming one of the outlets of the pump. Fig. 9 is an enlarged fragmental cross sectional view of the same, illustrating the method of seating the valve thereon.

In the drawings we have shown a plurality of widely separated pumps arranged one above the other according to the principles of the invention.

1 designates the lowermost pump and 2 a second pump at a considerable distance thereabove. One or more intake pipes may be provided for the lower pump. In Fig. 1, 3 and 4 designate oppositely disposed intake pipes in fixed relation to the lower pump, 5 and 5′ designate members of a pair of swiveled intake pipes communicating with the same pump. Said supplemental intake pipes 5 and 5′ form part of a swiveled T-fitting which permits of the pump being used to draw water from a different pair of wells when it is desired to make a change on account of a well being exhausted or for any other reason. This arrangement is of great utility in many instances where several wells are dug in the bottom of one pit or where there are tunnels running into the pit from wells located at a distance therefrom. It is vastly easier to swing the T-fitting about than it would be to readjust the entire pumping apparatus. It is to be understood that when the suction pipes 5 and 5′ are not in use they are closed by suitable caps.

The pump chamber 6 is provided with oppositely disposed discharge channels 7 and 8 eccentrically curved with relation to the pump chambers thus giving the chamber a double conchoidal appearance. The discharge pipes 9 and 10 communicate with the outer ends of said discharge channels.

The intake pipes 3, 4, 5 and 5′ communicate with the upper side of the pump chamber through intake pipe or neck 11 through which extends the operating shaft 12 to the lower end of which is secured a pump runner 13. Said runner is provided with the outwardly radiating conchoidal discharge channels 14, of which there may be any desired number. Three of these channels are shown as we have found in practice that such a number give excellent results but the number may be more or less as desired. The outer faces of webs 15 which separate these

channels are provided with V-shaped grooves 16, one function of said grooves being to cause the resistance of the water, as the runner is rotated, to bear against the center of the web, thus keeping the runner in a more perfect balance than if the face of the web were smooth and vertical.

A tendency of the stream to divide as it is thrown off by the runner is created by reason of the form and location of grooves 16. As shown in the sectioned portion of Figs. 1 and 4, said grooves are deep and wide at the mouths of the discharge channels, but taper in width and depth as they extend from the mouths of said channels along the periphery of the closed runner shown, to their terminal points. Consequently, as the runner is rotated, the water in the center of the stream issuing from the discharge channels of the runner, first lies at the bottom of the groove and therefore nearest to the center of the runner, but as the runner rotates, such portion of the water is rapidly moved along to the shallow portion of the groove and in being thus moved, must pass outward from the center of the runner more rapidly than does the water above and below the central portion of the grooves. This results in spreading the stream, because the central portion thereof being delivered the most rapidly, the upper and lower portions of the stream are crowded apart, and kept separate by the central or mid-width portion of the stream.

Each of the balancing grooves 16 extends outwardly from the discharge channels of the runner to and along a portion of the periphery of the runner,—that is to say, outward to a point where the face of the groove is in line with the edges of the upper and lower side-plates of the runner. The object of thus extending the groove is to bring it so near the periphery of the runner that the side-plates thereof will not interfere with the upward and downward movements of the water thrown off from said groove, and therefore will not hinder the balancing effect produced by the groove. Said grooves are made V-shaped, that is to say, with a double bevel, the tendency of the upper bevel to raise the runner being offset by the tendency of the lower bevel to depress the runner. The result of these two effects will ordinarily be to cause the runner to occupy a proper middle position. This effect is made much more pronounced by reason of the grooved webs 15 being confined within a runner inclosed by side walls forming a part thereof, so that no portion of the issuing streams of water within the runner can escape past or to the rear of the edges of the advancing webs of the runner. Some of the water would necessarily thus avoid the balancing grooves if the webs of the runner were inclosed only by walls separate from the runner and spaced from the webs to leave the clearance necessary for smooth running. If, however, the pump is used in a deep well so that the heavy weight of shafting above it tends to unduly depress the runner, or if the pump is being used in a shallow well at slow speed, greater regulation may be necessary than that ordinarily provided by the balancing groove. In such cases auxiliary regulating means are employed as will next be described.

At the same distance from the operating shaft, both above and below the discharge channels, and leading laterally into each discharge channel are ports, two of which 17 and 18 are shown in Fig. 6. These ports being all of the same character the top ones will be marked 17 and the bottom ones 18. In the top of the runner is an annular way desirably formed as a channel 19 in which is mounted a regulating ring 20 which is provided with ports 21 which may be brought into register with ports 17, or out of register, and said ring can be turned so that ports 17 may be partly or wholly opened or closed. Ring 20 is held on to the runner by means of screws 22 which pass through slots 23 in the ring and screw into the body of the runner. In the bottom of the runner is a like channel 24 in which is a like ring 25 having the same slots and ports therein as ring 20 and for the purpose of controlling ports 18 in the same manner that ring 20 controls ports 17. When it is desired to have the runner provided with an upward thrust, ports 17 will be partially or wholly opened, depending upon the amount of the upward thrust desired. When it is desired to have the runner provided with a downward thrust ports 18 will be partially or wholly opened depending upon the amount of downward thrust desired. It will be understood that when ports 17 are opened, ports 18 are closed, and vice versa. In the casing of the pump chamber are openings which are closed by plugs 26 and 27 which may be removed when it is desired to adjust the balancing rings 20 and 25.

To provide means for removing any obstructions in the discharge channels of the pump chambers, or in the pump runners, we provide removable plates 28 which cover openings in the priphery of the pump chamber casings. Said removable plates are placed in the periphery of the pump case so that the peripheral openings in the runner pass opposite them. This construction affords ready access to the runner for the purpose of removing therefrom sticks or other obstructions sucked in by the operation of the pump. Owing to said removable plates being located on the periphery of the case and therefore in line with the direction in which the discharge passages 14 of the runner extend, it is possible to reach the hand or a suitable tool into the interior of the

runner for the purpose of removing obstructions in a manner that would not be possible if the openings closed by said plates 28 were elsewhere located.

In the discharge pipes 9 and 10 are upwardly opening valves 29 and 30 which prevent the return of the water to the pump chambers when the runners stop rotation. As shown in the sectional portion of Fig. 1, the central portion of the upper part of the T-fitting is bored so that the bore is somewhat larger than the operating shaft, for the reception of the babbitt packing 31 which extends downwardly nearly to the lower end of the depending hollow-stem 15. A collar 33 is secured to the shaft by screw 34 to prevent the shaft from passing lower in the fitting. To the top of the fitting is secured a bearing member 35 through which the operating shaft passes. The lower portion of this bearing member is preferably enlarged to form a lubricating chamber 36. This chamber is provided with a removable door 37 so that it may be cleaned out when desired. In the bearing member just above the lubricating chamber is a babbitt packing 38. In the upper part of the bearing is a spring pressed packing gland 43. 39 designates a headed bolt at each side of said gland and 40 spiral springs between said gland and the heads of said bolts to press said gland against packing 43′. Said springs are adapted to move said glands sufficiently to compensate for the wearing away of the greater portion of said packing.

Secured to the top of the bearing and surrounding the same is a brace bar 41, having each end thereof secured upon the discharge pipe and together with said pipes forming a part of the frame. When more than one step is used the discharge pipes of the lower pump chamber discharge into the suction port by the pump chamber above, and as many steps may be used as desired. The discharge pipes at the surface of the ground are clamped between supporting beams 42, 42′ which may support the entire apparatus. The water may discharge into any convenient receptacle, such as a box or a flume (not shown). Secured to the operating shaft between the two upper brace bars is the power pulley 48 to which power is applied by belt 49 from any suitable source of energy.

As shown in Fig. 1, brace bar 41 carries a collar which embraces bearing member 35 of shaft 12. A set screw or other adjusting means, operating between said collar and bearing member, serves to adjust the parts and then hold them in fixed position with relation to each other.

The upper pump 2, being constructed in a manner similar to the lower pump 1, specific reference is not made to all its parts, but $9^a$ and $10^a$ indicate the discharge pipes of said upper pump, and $36^a$, $37^a$ indicate respectively the lubricating chamber and the removable door.

Hitherto, in the construction of centrifugal pumps, adapted for being used in deep wells, it has been necessary to provide, not only discharge pipes, but also a separate suspension frame in addition to said discharge pipes; whereas by our invention the discharge pipes are arranged to themselves form the suspension frame, so that in constructing, for example a #5 centrifugal pump, and mounting said pump in a well pit, the following saving is effected by constructing the pump according to the principles of our invention: As formerly constructed, a suspension frame, generally of wood, is used at a cost of approximately $1.30 a foot, in addition to 65c. per foot for the single discharge pipe employed, making the total cost $1.95 per foot. With the present invention, the two discharge pipes form the upright members of the frame, and together cost $1.30 per foot. It follows that we produce a superior steel frame for $1.30 per foot, including the pipe for discharging the water from the well, thus saving 65c. per foot.

We are aware that pumping apparatus has heretofore been devised in which a plurality of centrifugal pump runners have been used one above another. So far as we know, however, the successive pump runners have been placed close to each other, whereas in a pumping apparatus constructed according to the principles of our invention, the pumps are widely separated from each other so as to take advantage of the vacuum created by an upper pump so as to advance the water a substantial distance toward the top of the well in passing from a lower pump to a pump next above in the series. We have found that by separating the pumps a considerable distance from each other as above described we are enabled to pump a given amount of water with less revolutions per minute than would be required to pump the same amount of water if the pumps were placed close to each other. One reason for the advantage gained by separating the pumps as above described, appears to be that the water passes to a next higher pump in a smooth even stream, whereas when the pumps are close together the stream is agitated and more friction is produced, at the intake of an upper pump. The principal reason, however, why so much power is gained by widely separating the vertically disposed pumps, evidently lies in the well known fact that water requires to travel a considerable distance before the inertia thereof can be sufficiently overcome to greatly increase the quantity passing through a conduit. So far as we are aware, centrifugal pumps have not heretofore been

constructed in a vertical series arranged to take advantage of the principle.

In Fig. 5 is shown a modification of the pump in which the runner is supplied with lugs or extensions 45, one of said extensions being located at the outer end of each web of the runner thereby forming extensions of the webs. Said extensions assist materially in driving the water into the discharge channels 7 and 8 but are not absolutely necessary to the successful operation of the pump. They may be fastened to the pump runner by screws or other suitable means. It will be seen from Fig. 1, that the opening in the top of the pump casing is not sufficiently large to allow the runner to be inserted with the extensions attached thereto. Said extensions can, however, be put in place by removing plates 28 and inserting said extensions through the openings in the periphery of the case. By this arrangement a pump runner is provided having webs or vanes which extend close to the periphery of the pump casing and therefore circulate the water in a most efficient manner. When thus constructed with extended webs the same amount of water can be raised with much less speed of rotation, or a much higher lift can be attained when running at the same speed. Therefore, by the use of the extended webs, it is often possible to greatly cheapen the cost of installing a pumping plant, because a single step pump can thus be made to raise water to a height to which it could otherwise be lifted only by a two-step pump.

The check valves 29 and 30 are seated in annular grooves 29′ and 30′, formed in the top of discharge means 9′ and 10′ respectively, which form part of the pump. This arrangement removes all obstruction from the top of the flanges with which means 9′ and 10′ are provided, and therefore makes it possible to make the joints in the usual manner without the use of a specially constructed fitting for the attachment of the pipes 9 and 10 to the pump.

The check valves 29 and 30 are each provided, as best shown in Figs. 9 and 10, with offset portions or extensions 50, each of which seat in a recess 51 provided at one side of the stepped portion or groove 29′ or 30′. 52 is a washer which fits into recess 51 and is held down upon extension 50 of the valve by means of screws 53. 54 designates the usual weight which is attached to the flap of the valve by means of the rivet 55. 56 is a short sleeve flanged at its lower end as shown, to complete the casing of the valve. It will be noted that this construction provides a check valve with scarcely any additional expense to that required for forming the ordinary joint at the discharge outlets of the pump casing.

We claim:—

1. In a centrifugal pump, a runner having a plurality of discharge channels, said channels having ports extending outwardly through the top of the runner; and means to control the discharge through said ports.

2. In a centrifugal pump, a runner having a plurality of discharge channels, said channels having ports extending outwardly through the bottom of the runner; and means to control the discharge through said ports.

3. In a centrifugal pump, a runner having a plurality of discharge channels, said channels having ports extending outwardly through the top of the runner; and a regulating ring mounted on said runner revolubly with relation thereto, said ring having ports which may be brought into or out of register with said ports in the runner to partly or wholly open or close the same.

4. In a centrifugal pump, a runner having a plurality of discharge channels, said channels having ports extending outwardly through the bottom of the runner; and a regulating ring mounted on said runner revolubly with relation thereto, said ring having ports which may be brought into or out of register with said ports in the runner to open or close the same.

5. In combination, a case, a centrifugal pump runner adapted to rotate in said case, and extensions adapted to be fastened to the periphery of said runner when the runner is in place in said case.

6. In combination, a centrifugal pump runner, extensions adapted to be attached to the periphery of said runner, a case for said runner, a removable side plate to provide for the insertion of said runner, and another removable plate in said case to provide for the attachment of said extensions after the runner is in place.

7. In combination, a centrifugal pump runner, extensions adapted to be attached to the periphery of said runner, a case for said runner, a removable side plate to provide for the insertion of said runner, the opening covered by said plate being of less diameter than the runner with the extensions attached thereto, and another removable plate on said case to provide for the attachment of said extensions after the runner is in place.

8. In a centrifugal pump, a runner having radiating conchoidal discharge channels, one face of each of said channels being provided with a V-shaped groove, said V-shaped groove extending to and along the periphery of the runner and there forming a separate channel, said runner being inclosed by side walls forming a part thereof.

9. In a centrifugal pump, a runner inclosed by side walls forming a part thereof and having a discharge channel opening

through the periphery thereof, said runner having also a separate groove extending from the mouth of said discharge channel along a portion of the periphery of the runner.

10. In a centrifugal pump, a runner inclosed by side walls forming a part thereof and having a discharge channel opening through the periphery thereof and a V-shaped peripheral groove extending from said channel, said groove diminishing in depth from said channel.

11. In a centrifugal pumping apparatus adapted for pumping from well pits, the combination, with a pump casing adapted for location at a distance below the top of a well pit, of upright discharge pipes leading from and connected with opposite sides of said casing, cross-beams to extend across the top of the well pit on opposite sides of each of said pipes, and means for clamping each of said pipes between pairs of said cross-beams to suspend said pipes and casing.

12. In a centrifugal pumping apparatus adapted for pumping from well pits, the combination, with a pump casing adapted for location at a distance below the top of a well pit, of means for supporting said casing, an intake pipe leading upwardly from the central portion of said casing, said intake pipe having branches leading downwardly to a point below said casing at opposite sides thereof, and a second pump casing supported by and discharging into said branches.

13. A centrifugal pumping apparatus provided with main intake pipes 3 and 4 and swiveled supplemental intake pipes 5 and 5′.

14. In a centrifugal pump, the combination, with the casing of the pump, of a section of pipe having an upwardly directed flanged end, there being a stepped portion of uniform depth extending around the inner edge of said flange and countersunk below the face thereof to form a valve seat, a check valve having a flap adapted to seat on said stepped portion, a sleeve adapted to surround said valve to form a casing therefor, a flange carried by the lower end of said sleeve, means for securing said flanges together, and an upright suspension pipe extending upwardly from said sleeve.

In testimony whereof we have hereunto signed our names in the presence of two subscribing witnesses at Los Angeles, California, this 21st day of August, 1907.

DAVID W. JONES.
E. W. KOPPE.

Witnesses:
ALBERT H. MERRILL,
MONTROSE WARN.