March 27, 1928. 1,664,249

A. C. DURDIN, JR

FLUID DISPLACING APPARATUS

Filed June 16, 1927

Fig. 1.

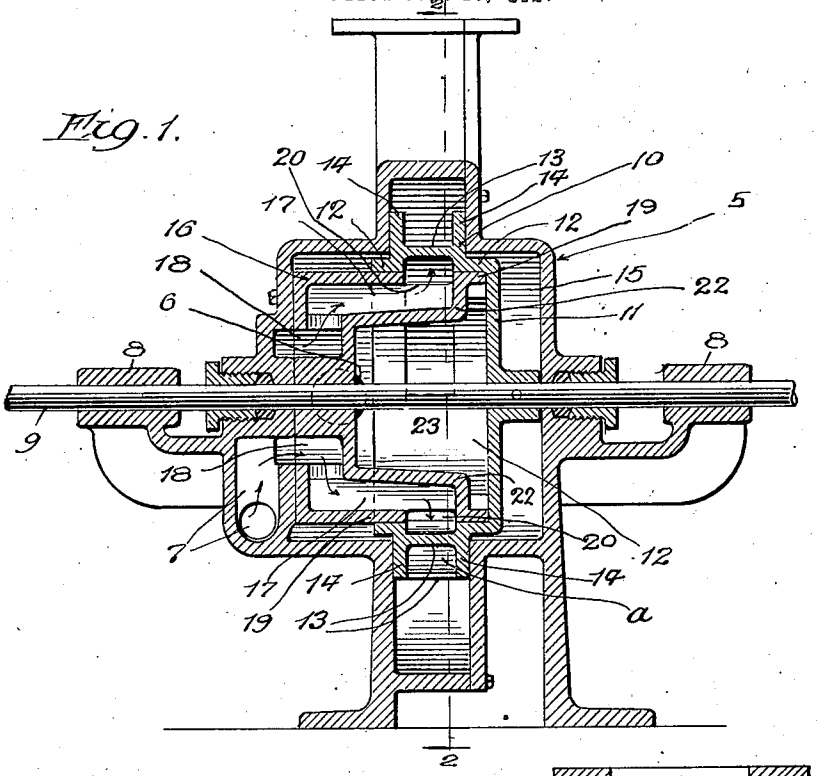
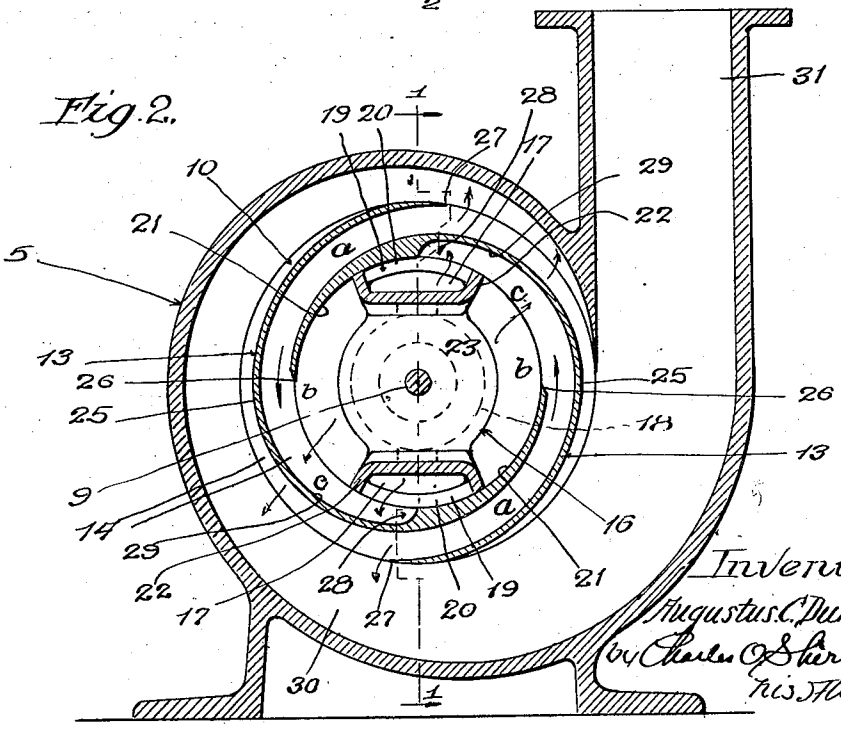


Fig. 2.



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FLUID-DISPLACING APPARATUS.

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This invention relates to fluid displacing apparatus adapted for creating vacuum or producing pressure, and more particularly to that type which employs a rotating impeller or rotor in conjunction with a body of water or other liquid for creating the vacuum or producing the pressure. One of the objects of the present invention is to minimize the centrifugal force exerted upon the liquid and at the same time to increase the efficiency of the apparatus. Another object is to reduce the amount of horse power required to drive fluid displacing apparatus of given size and at the same time obtain a greater vacuum or higher pressure than usual.

With these and other objects and advantages in view, this invention consists in a fluid displacing apparatus containing an impeller or rotor having one or more blades, each of which extends spirally or along an involute curve from a place spaced away from the axis of the impeller or rotor to the periphery thereof, and each blade having a curved inner face which is concentric, at its forward end, with the axis of the impeller or rotor, and terminates abruptly, is curved back sharply, to leave a deeply recessed portion and continues along a line parallel with the outer face of the blade to its discharge end at the periphery of the impeller. The invention further consists in a fluid displacing apparatus, having a casing containing separate and alternately arranged liquid and fluid outlets, disposed around the axis of rotation, and an impeller having one or more blades extending from said liquid and fluid outlets to the periphery of the impeller in a spiral or involute curve, the inner face or faces of said blades having forward portions that are concentric with the axis of rotation, from which concentric faces extend spiral or involute curve faces, which form relatively deep, recessed portions, beyond the concentric faces, the outer face or faces of the blades being spiral or involutely curved throughout their extent. The invention further consists in the several novel features of construction, arrangement and combination of parts hereinafter fully set forth and claimed.

The invention is clearly illustrated in the drawing accompanying this specification, in which:

Fig. 1 is a vertical longitudinal section of a fluid displacing apparatus containing the invention, taken on the line 1—1 of Fig. 2, and Fig. 2 is a vertical cross section thereof taken on the line 2—2 of Fig. 1.

Referring to said drawing, which illustrates a simple embodiment of the present invention, the reference character 5 designates a casing which may be of any suitable form having a liquid inlet passage 6 and fluid inlet passage 7. Journaled in suitable bearing brackets 8 is a drive shaft 9, which may be driven from any suitable source of power and at a relatively high speed. Said shaft passes through the casing 5 from side to side.

Arranged within the casing and mounted upon the drive shaft 9 is an impeller or rotor 10, which as shown contains a side wall 11 whereby the rotor is mounted upon the shaft, and at the edge of said side wall 11 the rotor has a cylindrical wall 12. The impeller or rotor is formed with one or more blades 13, two being shown in the drawing, and said blades are arranged spirally or along involute curves, around the axis of rotation of the impeller and extend substantially parallel with each other throughout the major portion of their extent. At the sides of said blades 13 are radially extending walls 14, which together with certain parts of the blades, form passage ways or channels (*a*) through the impeller that are of spiral or involute curve formation and lead from the interior of the impeller to its periphery.

The casing is formed with a large chamber 15 in which is contained a member 16 that is bolted or otherwise secured to one side wall of the casing. Said member 16 is formed with one or more fluid passage ways 17, which may be diametrically opposite each other, when two are employed (see Fig. 2), and said passage ways lead from an annular fluid passage way 18, that communicates with the fluid inlet passage 7 as is clearly shown in Fig. 1. The member 16 is formed with arcuate or cylindrical walls 19, which fit against the inner face of the annular or cylindrical wall 12 of the impeller, and in said arcuate or cylindrical walls 19, are formed fluid outlet openings 20 which are arranged to be covered and uncovered by the concentric portions of the impeller blades 13 as they travel across said fluid outlet openings. At the forward ends of said impeller blades

13, their inner faces 21 are made concentric with the axis of rotation of the impeller and said concentric portions are made long enough or of sufficient angular extent to completely cover the fluid outlet openings 20 during the passage of said concentric portions of the impeller blades over said openings.

The fluid passage ways 17 are formed in hollow parts 22 of the member 16 which project from the main body portion of the member 16 and extend approximately parallel with the shaft 9, and between said hollow parts 22 is a space 23 which is contained within the annular wall 12 of the impeller. Said space is closed at one side by the side wall 11 of the impeller and forms a chamber through which the water or other liquid flows from the liquid inlet passage 6 of the impeller. The circumferential spaces (*b*) between the hollow parts 22 (that contain the fluid passages 17) may be regarded as the water or liquid outlets from the casing to the impeller, and said liquid outlets are diametrically opposed each other and are interposed between the fluid outlets 20. The fluid outlets and liquid outlets are thus arranged alternately as is clearly seen in Fig. 2.

As has already been explained, the inner faces of the forward ends of the impeller blades 13 are concentric with the axis of rotation of the impeller and are arranged to cover and uncover the fluid and liquid outlets during their travel around the same. The outer faces 25 of the impeller blades are in the form of spirals or involute curves, extending from the foremost ends 26 of the blades to the discharge ends 27, the discharge ends lying on the circumference or periphery of the impeller. While the exact angular extent of the concentric inner faces of the impeller blades is not material, I have shown said concentric portions as extending through an angle of about ninety-five degrees, the same being sufficient to cover a fluid outlet opening 20 while passing thereover. At the rear end of each concentric inner face 21, the inner face of the blade curves backward sharply forming a deeply recessed space 28, as seen in Fig. 2, and from said sharply curved portion the inner face portion 29 continues along a spiral line extending approximately parallel with the outer spiral face 25 of the blade to the discharge end 27. The foremost part of each impeller blade and the rearmost part of its companion blade form the passage ways or channels (*a*) and said passage ways or channels extend along spiral or involute curves from the internal side to the external or peripheral side of the impeller. The gap between the rear end of the concentric portion of each blade and the foremost end 26 of the companion blade, forms an inlet (*c*) to said passage (*a*) and permits the liquid and fluid to pass in alternate succession from the liquid space 23 and fluid outlets 20 to and through the impeller to its external or peripheral side.

The casing 5 is formed with a volute or other suitable conduit 30 as usual, around the impeller, and said conduit terminates in a discharge passage 31 through which the liquid and fluid are discharged.

In the operation of the apparatus, air or other fluid enters through the fluid inlet 7 and water or other liquid enters through the liquid inlet 6. The air or other fluid flows through the annular passage 18 and through the fluid passages 17 to the fluid outlets 20, and the water or other liquid flows through the liquid inlet 6 and into the liquid chamber 23. As the impeller is rotated the forward end 26 of each impeller blade passes alternately over the fluid outlets 20 and liquid outlets, *b*, and as the deeply recessed part 28 under an impeller blade begins to uncover a liquid outlet *b*, the liquid flows into said deeply recessed portion, and as the foremost end 26 of the companion blade reaches the same liquid outlet, the forward end of said companion blade commences to cover said liquid outlet, whereby a slug or body of liquid becomes entrained in the passage (*a*) between the inner spiral face of the first mentioned impeller blade and the outer spiral face of its companion blade, during which time the liquid continues to be moved radially toward the external side of the impeller and is finally discharged therefrom as the discharge end of the first mentioned impeller blade begins to uncover the same liquid outlet *b*. It is to be observed that from the time that the deeply recessed part 28 of the impeller uncovers the liquid outlet, the liquid commences to flow outward and continues to flow in a radial direction until it is discharged, whereby any centrifugal action of the impeller blades on the moving liquid is reduced to a minimum. As soon as said deeply recessed portion 28 of each impeller blade begins to uncover the next adjacent fluid outlet, a partial vacuum is created between the impeller blade and the slug of water which has entered the deeply recessed part 28, and as the impeller continues to rotate, the inner spiral face 29 of the impeller blade recedes from the fluid outlet, and the fluid rushes into the deeply recessed space 28 between the inner side of the impeller blade, and the slugs of water at each side of the fluid outlet 20, and is discharged when the discharge end of the blade passes the fluid outlet.

From the above it will be seen that the movement of the liquid from the liquid chamber 23 to the exterior of periphery of the impeller is continuous, and at no time is the water held in the passage ways of the impeller in any quiescent or substantially

quiescent condition. The movement of the liquid is substantially uniform, permitting of a more uniform and steady rotation of the impeller. Furthermore, because of the relatively long spiral or involute impeller blades, the centrifugal action of the same on the liquid is reduced to a minimum, although relatively large slugs or bodies of liquid are caught in the passage ways (*a*), and a greater vacuum is thereby obtained in an apparatus of given size and with less horse power than has been heretofore obtained by fluid displacing apparatus employing a rotor or impeller.

More or less variation of the exact details of construction is possible without departing from the spirit of this invention; I desire, therefore, not to limit myself to the exact form of the construction shown and described, but intend, in the following claims, to point out all of the invention disclosed herein.

I claim as new, and desire to secure by Letters Patent:

1. A fluid displacing apparatus comprising a casing having a liquid inlet passage and a fluid inlet passage therein, both terminating in circumferentially arranged outlets, said casing having also a liquid and fluid discharge passage, and an impeller rotatively mounted in said casing, said impeller embodying a plurality of blades extending from said liquid and fluid outlets to the periphery of the impeller along spiral like curves, said blades having parallel portions spaced apart to form spiral like passages therebetween leading from the liquid and fluid outlets to the periphery of the impeller, the forward inner faces of the blades being concentric with the axis of rotation of the impeller and the remainder of the inner faces of the blades, being curved back sharply at the rear ends of said concentric portions to form deep recesses following the concentric portions.

2. A fluid displacing apparatus comprising a casing having a liquid inlet passage and a fluid inlet passage therein, both terminating in circumferentially arranged outlets, said casing having also a liquid and fluid discharge passage, and an impeller rotatively mounted in said casing and surrounding said liquid and fluid outlets, said impeller embodying a plurality of blades extending from said liquid and fluid outlets to the periphery of the impeller along spiral like curves, the forward portion of each blade and rear portion of a companion blade extending in parallel lines and being spaced apart to form spiral like passage ways leading from the liquid and fluid outlets to the periphery of the impeller, the forward inner faces of each impeller being concentric with the axis of rotation of the impeller and the remainder of the inner face of each blade being set back from said concentric portion to form a deep recess following the concentric portion and extending in a spiral direction to the discharge end of the blade.

3. A fluid displacing apparatus comprising a casing having a liquid inlet passage and fluid inlet passage therein, both terminating in circumferentially arranged outlets, said casing having also a liquid and fluid discharge passage, and an impeller rotatively mounted in said casing and surrounding said liquid and fluid outlets, said impeller embodying a plurality of blades extending from said liquid and fluid outlets to the periphery of the impeller along spiral like curves, the forward portion of each blade and rear portion of a companion blade extending in parallel lines and being spaced apart to form spiral like passage ways leading from the liquid and fluid outlets to the periphery of the impeller, the forward inner faces of each blade being concentric with the axis of rotation of the impeller and the remainder of the inner face of each blade being set back from said concentric portion to form a deep recess following the concentric portion, said remainder of the inner face extending parallel with the outer face of the blade to its discharge end.

4. In a fluid displacing apparatus, an impeller embodying an annular body having a plurality of blades extending from the inner side of the body to the periphery thereof along spiral like curves, the foremost part of each blade and rearmost part of its companion blade being spaced apart to form spiral like passages therebetween, the inner faces of said foremost parts of the blades being concentric with the axis of rotation of the impeller and the remainder of the inner faces of both blades being set back to form recesses following said concentric parts.

5. In a fluid displacing apparatus, an impeller embodying an annular body having a plurality of blades extending from the inner side of the body to the periphery thereof along spiral like curves, the forward part of one blade and rear part of its companion blades being parallel and spaced apart to form a spiral like passage therebetween, the inner faces of the blades having concentric portions at their forward ends and the remaining parts of the inner face of each blade being set back to form a recess following the concentric portion, and extending parallel with the outer face of the blade to its discharge end.

6. In a fluid displacing apparatus, an impeller embodying an annular body having a blade extending from the inner side of the body to the periphery thereof along a spiral like curve, the inner face of the foremost part of the blade being concentric with the axis of rotation of the impeller, and the remainder of the inner face of the blade, be-

ing set back from said concentric part to form a deep recess following said concentric part.

7. In a fluid displacing apparatus, an impeller embodying an annular body having a plurality of blades extending from the inner side of the body to the periphery thereof along spiral like curves, the opposing faces of the foremost part of each blade and rearmost part of its companion blade being parallel and spaced apart and forming a spiral passage therebetween from the foremost end of one blade to the rearmost end of the other blade, the inner faces of said foremost parts of the blades being concentric with the axis of rotation of the impeller and the remainder of the inner faces of both blades being of spiral shape to form recesses following said concentric parts.

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