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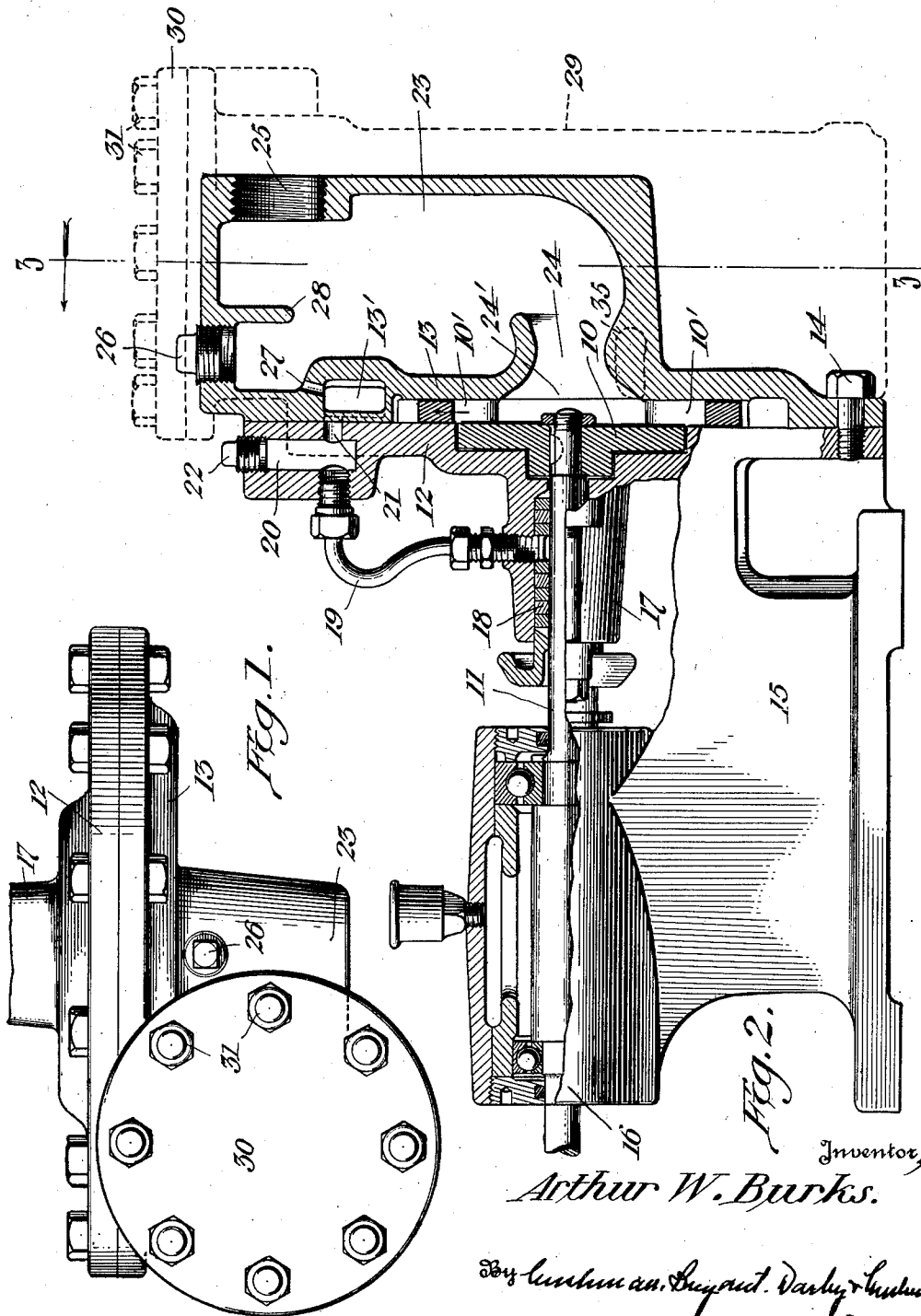
A. W. BURKS

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ROTARY HYDRAULIC AIR COMPRESSOR AND CENTRIFUGAL PUMP

Filed June 6, 1932

4 Sheets-Sheet 1



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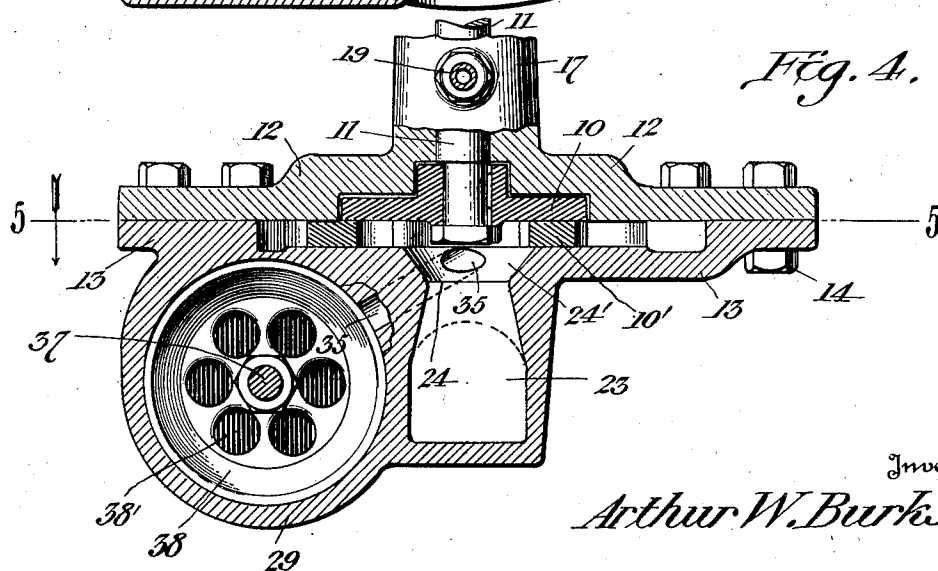
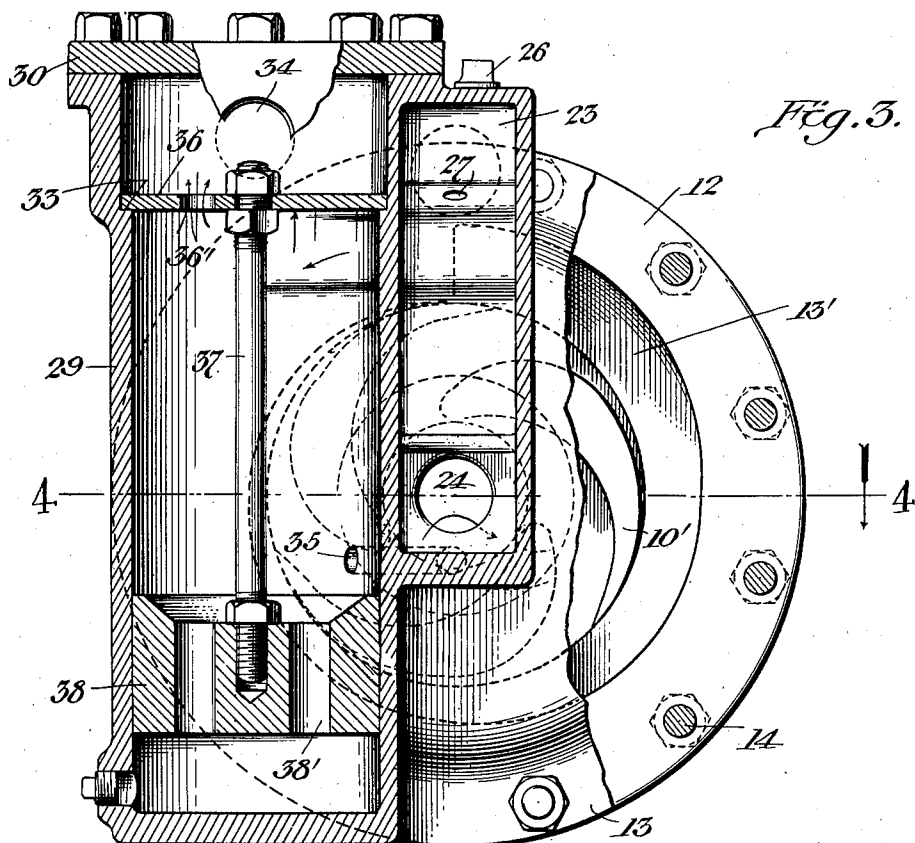
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ROTARY HYDRAULIC AIR COMPRESSOR AND CENTRIFUGAL PUMP

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4 Sheets-Sheet 2



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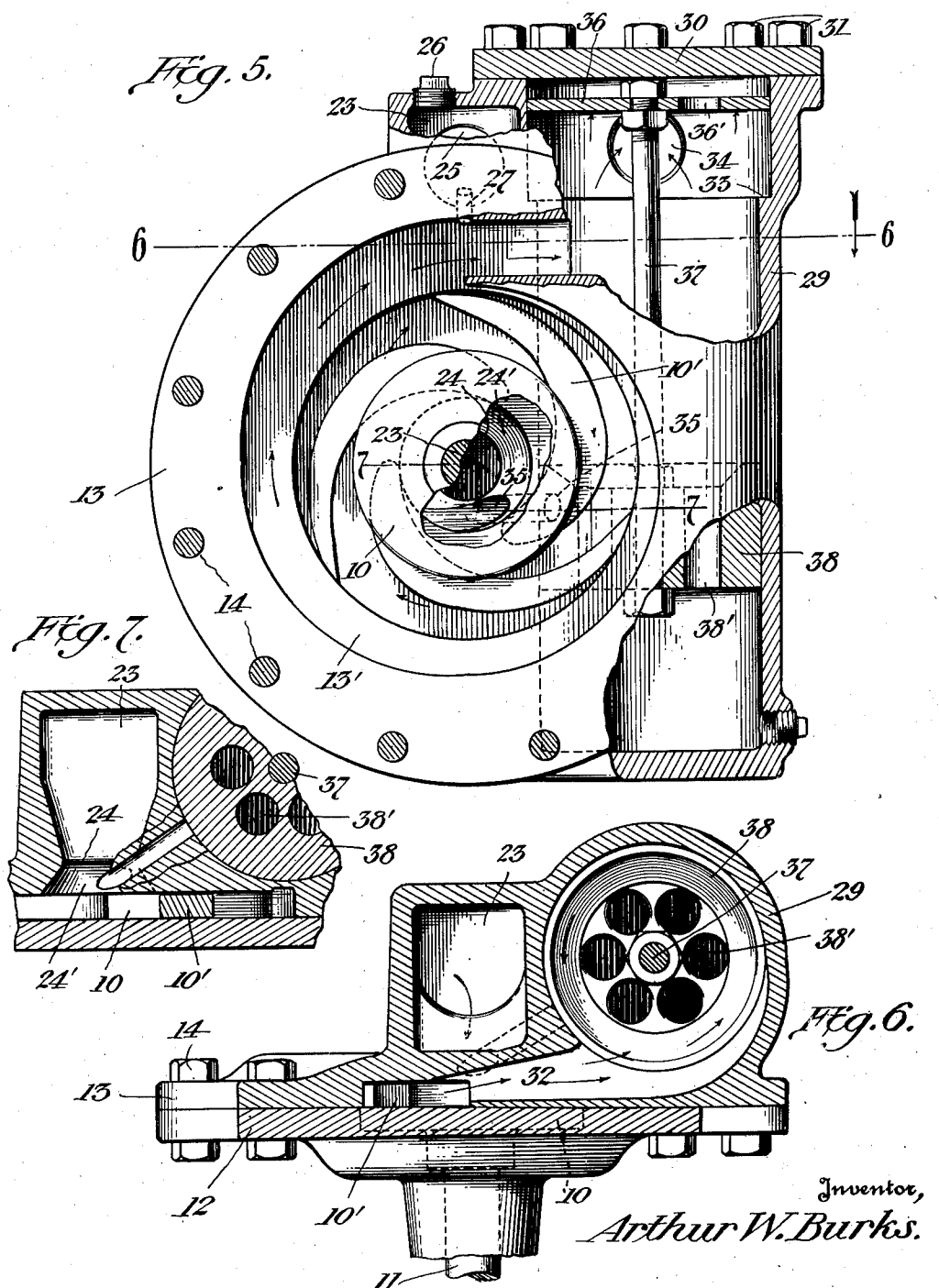
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ROTARY HYDRAULIC AIR COMPRESSOR AND CENTRIFUGAL PUMP

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4 Sheets-Sheet 3



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ROTARY HYDRAULIC AIR COMPRESSOR AND CENTRIFUGAL PUMP

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4 Sheets-Sheet 4

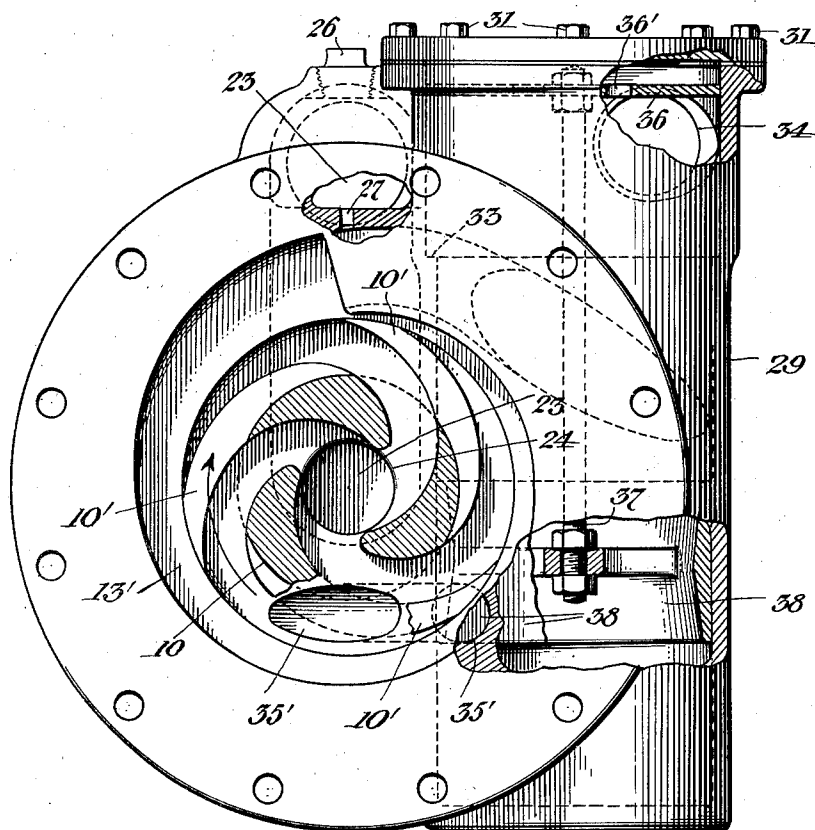


Fig. 8.

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UNITED STATES PATENT OFFICE

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ROTARY HYDRAULIC AIR COMPRESSOR
AND CENTRIFUGAL PUMP

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Application June 6, 1932, Serial No. 615,692

12 Claims. (Cl. 103—113)

The present invention relates to a rotary pump adapted to pump air either as a main operation or incidental and preliminary to a main water (or other liquid) pumping operation. To this end the pump is provided with a by-pass from its outlet side to its inlet side, the by-pass including an air separating chamber which separates by centrifugal action set up by the discharge. With the pump inlet connected to a water suction line, the water in the pump is bypassed until the air in the line is exhausted and water pumping begins. Hereupon valve mechanism is automatically actuated to cut off the by-pass and switch the pump delivery to a pressure or delivery line. In case the intake is in free communication with the atmosphere, however, air pumping will continue indefinitely.

The invention includes a novel arrangement of parts whereby the desired results are effectively secured, and relates particularly to the by-pass arrangement and valve mechanism.

In the accompanying drawings, I have shown a practical embodiment of the invention by way of illustration of its principles. In these drawings:

Figure 1 is a plan view of the new pump.

Figure 2 is a side elevation of the pump partly in vertical axial section.

Figure 3 is a section on line 3—3 of Figure 2.

Figure 4 is a section on line 4—4 of Figure 3.

Figure 5 is a section on line 5—5 of Figure 4, parts being broken away.

Figure 6 is a section on line 6—6 of Figure 5.

Figure 7 is a section on line 7—7 of Figure 5, and

Figure 8 is a view similar to Figure 5 showing a slightly modified construction.

Referring to the drawings, the pump comprises an impeller 10 which may be of any suitable form, the impeller being fixed on a drive shaft 11 for rotation thereby. As here shown, and preferably, the impeller casing is formed by a pair of castings 12 and 13 which have meeting faces in a plane normal to the axis of the shaft 11 and which are secured together circumferentially of the impeller by screws or bolts 14. As here shown, the impeller comprises a hub portion housed in a cavity in casting 12, the impeller blades 10', which are stepped forwardly of the hub portion, being disposed in a volute chamber 13' formed in the casting 13.

The casting 12 comprises a base portion 15 which serves to support the entire apparatus, and the casting also presents the bearings 16 and 17 for shaft 11. Bearing 17 contains pressure pack-

ing means 18, and a tube 19 leads to the interior of the bearing from a cavity 20 at the top of casting 12, this cavity being in communication, through a passage 21, with the casing interior at the end of the volute chamber so that no air suction can occur through the bearing. Cavity 20 is closed by a threaded plug 22.

Casting 13 defines a priming chamber 23 having at its lower end a pump inlet 24 coaxial with the impeller 10. As here shown, opening 24 is substantially venturi-form, its portion 24' adjacent the impeller having a considerable outward flare. Adjacent its top the priming chamber has an inlet opening 25 into which a suction line is adapted to be connected, and at its top the chamber is provided with an opening closed by means of a threaded plug 26. Priming fluid may be introduced through this top opening, and if the apparatus is intended to act as an air pump, the opening is left unplugged.

The outlet end of the volute chamber 13' is shown in Fig. 2, and it will be noted that a small duct 27 is provided between the volute chamber and priming chamber. In order to prevent the liquid emerging from duct 27 from escaping through the inlet opening 25, a baffle 28 is provided.

Casting 13 is also formed to provide an upright substantially cylindrical separating chamber 29 of relatively large capacity, this chamber having an integral closure wall at its bottom and being closed at its top by means of a plate 30 secured in position by bolts or screws 31. As may be most clearly seen in Figs. 5 and 6, an outlet passage 32 connects the volute chamber 13' with the separating chamber, the passage being directed substantially tangentially through the chamber wall, so that liquid and air discharged into the chamber are given a whirling, centrifugal, separating action.

The upper portion of chamber 29 is slightly enlarged so that a shoulder 33 is provided. Somewhat above this shoulder a discharge opening 34 is formed in a side wall of the chamber. A substantially horizontal return passage 35 connects the lower portion of the chamber with the inlet opening 24, passage 35 debouching into the flared mouth 24' of the opening. Passage 35 is inclined to the vertical plane of the impeller and faced in the direction of rotation of the latter.

A disk 36 is slidable in the upper enlarged portion of the separating chamber and has secured thereto a stem 37, which, at its lower end, is secured to a piston 38. The disk 36 and piston 38 are vertically movable between the positions shown in Fig. 3, wherein the disk 36 is seated on shoulder

33, and piston 38 is below the opening of return passage 35, and the other positions, shown in Fig. 5, wherein piston 38 closes passage 35 and disk 36 is above the discharge opening 34 in unobstructing relation to the latter. Fig. 3 illustrates the normal or rest position of the parts.

Disk 36, as here shown, is provided with one or more air escape openings 36', while piston 38 is provided with one or more axially extending through passages 38' to prevent vacuum and compression effects in the lower end of the separating chamber.

Assuming there to be no liquid in the pump and operation is to be initiated, plug 26 is removed and the casing filled with water, which will rise to the level of the inlet opening 25, into which, it will be assumed, a suction line is connected. The liquid will fill not only the priming chamber 23, but also the volute chamber 13' and separating chamber 29. Plug 26 is then replaced. Disk 36 and piston 38 occupy the positions shown in Fig. 3. Upon initiation of impeller rotation, water and air will be drawn through inlet 24 and discharged through passage 32 into the separating chamber, where the liquid settles and the air rises, escape of the air being permitted through opening 36'. Liquid in the separating chamber is drawn through return passage 35 and injected between the impeller blades. It has been found that with passage 35 arranged as described, a multiplicity of liquid pistons are formed between the blades, or, in other words, stratifications of air and water are present between the blades, and a very efficient air pumping action thus results. After the air has been exhausted from the system and water enters through inlet 25, disk 36, which has a much larger imperforate area than piston 38, will be lifted by the upward surge of liquid in the separating chamber, since, while opening 36' is large enough for the air exhaust, it will not pass the normal pump delivery. Passage 35 is also of restricted cross sectional area and unable to pass the normal pump delivery even in conjunction with opening 36'. Upward movement of disk 36 causes it to uncover discharge opening 34 to the pressure or delivery line and at the same time piston 38 cuts off passage 35. The pump continues to act as the ordinary centrifugal pump as long as the impeller is maintained in rotation. Upward movement of piston 38 is limited through abutment of the upper end of stem 37 with cap 30 so that the piston can never rise far enough to pass beyond passage 35 and uncover the same.

When rotation of the impeller is interrupted, piston 38, which is of substantial weight, returns the valve parts to the positions shown in Fig. 3. Due to the tendency of the liquid in the pump to siphon back through the intake, duct 27 has been provided. When the water drops to a level allowing air to reach this duct, air will pass from the pump chamber or volute into the suction side of the pump, thus stopping the siphoning action and allowing the water to remain in the pump during its idle period for the purpose of priming when the pump is again put into operation. Baffle 28, in blocking access to opening 25, prevents loss of priming liquid through duct 27 during the priming operation.

It will be evident that if plug 26 is removed, placing the priming chamber in communication with the atmosphere, no water will be drawn in through the suction line and the pump will continue to function as an air pump, the operation being the same as the priming operation above described.

The action of the described pump has been found to be very satisfactory in use, priming being quickly accomplished and no loss of delivery, during water pumping, being occasioned by reason of the return passage 35, since the latter is closed off by the piston 38.

The described embodiment of the invention has the preferred arrangement of the return passage so far as the specific form of pump shown is concerned. Even with this pump, however, the point of entrance of the return passage into the impeller chamber may be considerably varied so long as this point enters the chamber in a zone in which a permanent suction effect exists when the pump is in operation, that is, radially inwardly of the discharge zone constituted by the volute. Figure 8 shows a return passage 35' entering the impeller chamber radially inwardly of the peripheral circle of the impeller and radially outwardly spaced from the inlet. It has been found that with this arrangement there is relatively little circulation through the passage once water pumping has been initiated, but the valve is preferably used in order to cut off the circulation entirely.

It will be noted that the return passage can be variously located without affecting the other parts of the pump, stem 37 merely being adjusted to the proper length. The return passage can be conveniently formed by a drilling operation once its location has been decided upon. The direction of the return opening 35' is the same as that of return opening 35. In other words, passage 35' may be considered as being below the plane of opening 35 and parallel thereto.

Due to the tangential direction of the discharge into the separating chamber, the water keeps to the outside of the chamber to be centrifugally separated from the entrained air and even if a hollow air core were to occur in the separating chamber, the return passage 35 or 35' would be completely cut off therefrom by the peripheral wall of swirling water.

It will be understood that various changes may be made in the specific structure disclosed without departure from the scope of the invention as defined in the following claims.

I claim:

1. The combination with a centrifugal pump comprising an impeller and a casing therefor, said casing having an axial inlet opening and a peripheral outlet opening, of an upright substantially cylindrical centrifugal air and water separating chamber into which the outlet opening debouches through a side wall thereof on a line substantially tangential thereto, to set up a whirling body of water therein along the peripheral wall thereof to separate air from water by centrifugal force, a return passage extending outwardly from the inner periphery of said separating chamber adjacent said whirling body of water and debouching into said inlet opening, a movable valve member for controlling said return passage, the return passage being normally open and of insufficient size to pass the normal delivery of the pump, and a movable member in said separating chamber operatively connected to said valve member and actuated by the upward surge of liquid in said separating chamber consequent upon initiation of pumping to move said valve member to close said return passage and maintain it closed under all pressure conditions existing during pumping.

2. The combination with a centrifugal pump

comprising an impeller and a casing therefor, said casing having an outlet and an axial inlet opening flared toward the impeller, of a centrifugal air and water separating chamber into which the pump outlet debouches on a tangential line to set up a whirling body of water therein along the peripheral wall thereof to separate air from water, a return passage from the inner periphery of said separating chamber to said inlet opening and debouching into the flare of the latter, a movable valve member for controlling said return passage, the return passage being normally open and of insufficient size to pass the normal delivery of the pump, and means in said separating chamber actuated by the upward surge of liquid therein consequent upon initiation of pumping to move said valve member to close said return passage.

3. The combination with a centrifugal pump comprising an impeller and a casing therefor, said casing having an axial inlet opening and a peripheral outlet opening, of a priming chamber on the inlet side of the pump and communicating with said inlet opening, an upright cylindrical centrifugal air and liquid separating chamber into which the pump outlet debouches on a tangential line to set up a whirling body of liquid therein along the peripheral wall thereof to separate air from liquid, said chamber being closed at its lower end, an upwardly movable valve member normally closing the upper end of said separating chamber with the exception of a relatively small air escape opening, a valve member in the lower end of said separating chamber, means connecting said valve members, a normally open return passage extending from the inner periphery of said separating chamber at a point above the normal position of the lower valve member, said passage being adapted to take liquid from said whirling body and pass the same to said inlet opening but being of insufficient size to pass the normal delivery of the pump, said upper valve member being displaced upwardly by the surge of liquid in said separating chamber consequent upon the initiation of pumping to permit the escape of the liquid, the lower valve member being moved by the upper valve member to close the return passage.

4. The combination with a centrifugal pump comprising an impeller and a casing therefor, said casing having an axial inlet opening and a peripheral outlet opening, of an upright cylindrical centrifugal air and liquid separating chamber in communication below its top with said outlet, and into which said outlet debouches on a tangential line to set up a whirling body of liquid therein along the peripheral wall thereof to separate air from liquid, said separating chamber being closed at the bottom, a return passage leading from the inner periphery of said separating chamber below the pump outlet and adapted to take liquid from said whirling body and pass the same to said pump inlet, said return passage being of insufficient size to pass the normal delivery of the pump, a disc closing said separating chamber above the outlet communication with the exception of a relatively small air escape opening, a valve member in the cylinder below said return passage, and means connecting said disc and valve member for movement together, said disc being displaced upwardly by the surge of liquid in the separating chamber consequent upon initiation of pumping and moving the valve member to cover said return passage, the separating chamber having a discharge opening at its upper end above which the disc

moves to communicate said discharge opening with said outlet opening.

5. The combination with a centrifugal pump comprising an impeller and a casing therefor, said casing comprising an axial inlet opening and a peripheral outlet opening, a priming chamber on the inlet side of the pump having a communication with a source of supply and another communication with said axial inlet opening, a conduit establishing a return circuit between said outlet opening and said axial inlet opening and being separate from said priming chamber, said conduit including a centrifugal air and liquid separating chamber into which the pump discharge debouches tangentially and sets up a whirling body of water, and a restricted passage between said separating chamber and inlet opening, the separating chamber having a discharge opening in its upper portion, and valve mechanism including a portion normally freeing said passage and a portion normally substantially cutting off said discharge opening from said outlet opening, said valve mechanism being automatically moved upon initiation of pumping to close said passage and maintain it closed under all pressure conditions existing during pumping and to place said outlet opening in communication with said discharge opening.

6. The combination with a centrifugal pump comprising an impeller and a casing therefor, said casing having an axial inlet opening flared toward the impeller and a peripheral outlet opening, of a centrifugal air and water separating chamber in connection with said outlet opening and into which the pump debouches on a tangential line to set up a whirling body of water along the inner peripheral wall thereof, a return passage leading from the inner periphery of said separating chamber to said inlet opening, said passage debouching into the flare of said inlet opening at an angle to the plane of the impeller eccentrically of the latter and in the direction of its rotation, a movable valve member for controlling said return passage, the return passage being normally open and of insufficient size to pass the normal delivery of the pump, and means in said separating chamber actuated by the upward surge of liquid in said separating chamber consequent upon initiation of pumping to move said valve member to close said return passage and maintain it closed under all pressure conditions existing during pumping.

7. In a centrifugal pump, an impeller and a casing therefor, said casing comprising a unitary casting having formed therein an axial inlet passage to the impeller and a peripheral outlet passage, said casting having a cylindrical centrifugal air and liquid separating chamber formed therein provided with a discharge opening in its upper portion, said outlet passage debouching into said chamber substantially tangentially below said discharge opening to set up a whirling body of liquid along the peripheral wall of the chamber to separate air from liquid by centrifugal force, the casting also having a return passage formed therein connecting the lower portion of said chamber with said inlet, and automatically actuated valve mechanism in said separating chamber adapted in one position to substantially close said discharge opening and free said return passage and in another position to free the discharge opening and close the return passage.

8. In a centrifugal pump, an impeller and a casing therefor, said casing comprising a unitary casting having formed therein an axial inlet passage to the impeller and a peripheral outlet pas-

sage, said casting having a priming cavity formed therein in connection with said inlet passage and a cylindrical centrifugal air and liquid separating chamber provided with a discharge opening in its upper portion, said outlet passage debouching into said chamber substantially tangentially below said discharge opening and being adapted to set up a whirling body of liquid along the inner peripheral wall of said chamber to separate air from liquid by centrifugal force, the casting also having a return passage formed therein connecting the lower portion of said chamber with said inlet, and automatically actuated valve mechanism in said separating chamber adapted in one position to substantially close said discharge opening and free said return passage and in another position to free the discharge opening and close the return passage.

9. The combination with a centrifugal pump, of a centrifugal air and liquid separating chamber in connection with the pump intake and outlet and normally providing a by-pass between the two, and in which a whirling body of liquid is set up to separate any air therefrom by centrifugal force, the chamber having a discharge opening, and valve mechanism comprising spaced interconnected elements of which one controls said discharge opening and provides an air escape and another controls the return to the pump intake, the pump outlet debouching into said chamber between said elements, normal delivery of the pump moving said one of said elements to free said discharge opening and thereby moving said other to cut off said return and maintain it closed under all pressure conditions existing during pumping.

10. The combination with a centrifugal pump comprising an impeller and a casing forming an impeller chamber, said impeller chamber having an inlet substantially centrally of the impeller and having an outlet, of a substantially cylindrical centrifugal air and liquid separating chamber into which the pump outlet is directed on a substantially tangential line to set up a whirling body of liquid from which any air is separated by centrifugal force, a liquid return passage leading from said separating chamber to the inlet side of said pump and entering the impeller chamber at one side of the impeller and between said inlet and the peripheral circle of the impeller, and valve mechanism in said separating chamber adapted in one position to cut off said liquid return passage and in another position to free said return passage, said mechanism being actuated

by the upward surge of liquid in said separating chamber.

11. The combination with a centrifugal pump, of an upright cylindrically walled centrifugal air and liquid separating chamber closed at its top and bottom; said chamber having a tangentially directed inlet opening in a wall thereof disposed to set up a whirling body of liquid therein from which any air is separated by centrifugal force, a discharge opening above said inlet opening, and a relatively small return opening below said inlet opening; means conducting the pump output to said inlet opening, means connecting said return opening with the pump inlet, and movable valve means in said chamber, said valve means comprising upper and lower portions of which the lower normally frees said return opening, the upward surge to the discharge opening of liquid in said chamber upon initiation of pumping acting to move said upper portion and thereby said lower portion to close said return opening and maintain it closed during pumping, said valve means being at all times unobstructing as to said inlet opening.

12. The combination with a centrifugal pump, of an upright cylindrically walled centrifugal air and liquid separating chamber closed at its top and bottom; said chamber having a tangentially directed inlet opening in a wall thereof disposed to set up a whirling body of liquid therein from which any air is separated by centrifugal force, a discharge opening above said inlet opening, and a relatively small return opening below said inlet opening; said discharge opening being in a side wall of the chamber but below the top of the latter, means conducting the pump output to said inlet opening, means connecting said return opening with the pump inlet, and valve means in said chamber reciprocable in the axial direction of the chamber, said valve means comprising interconnected upper and lower portions which normally lie below said discharge opening and said return opening, respectively, the upward surge of liquid in said chamber upon initiation of pumping acting to move said upper portion to a position above said discharge opening whereby said lower portion is moved to a position in which it closes said return opening, and means preventing movement of said lower portion beyond closing relation to said return opening, said valve means being at all times unobstructing as to said inlet opening.

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