

July 1, 1941.

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2,247,654

PUMPING APPARATUS

Filed Dec. 29, 1938

2 Sheets-Sheet 1

Fig. 1.

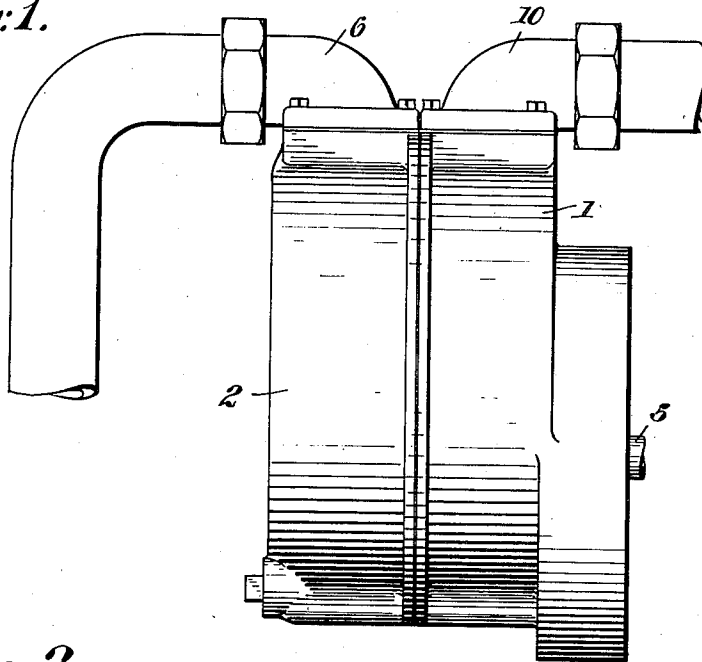
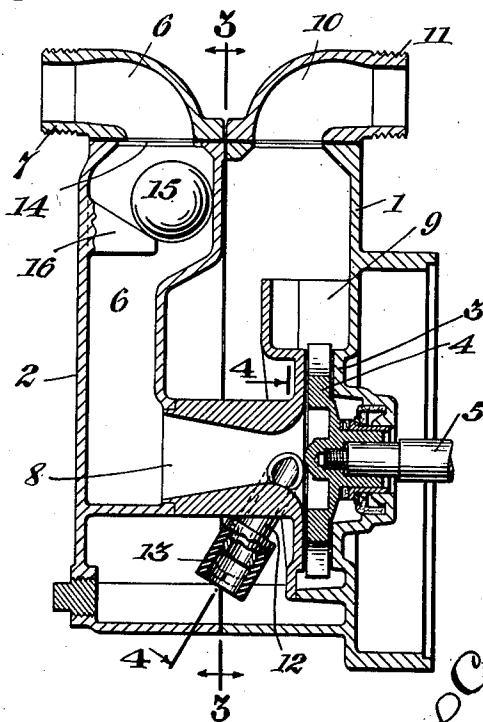


Fig. 2.



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2 Sheets-Sheet 2

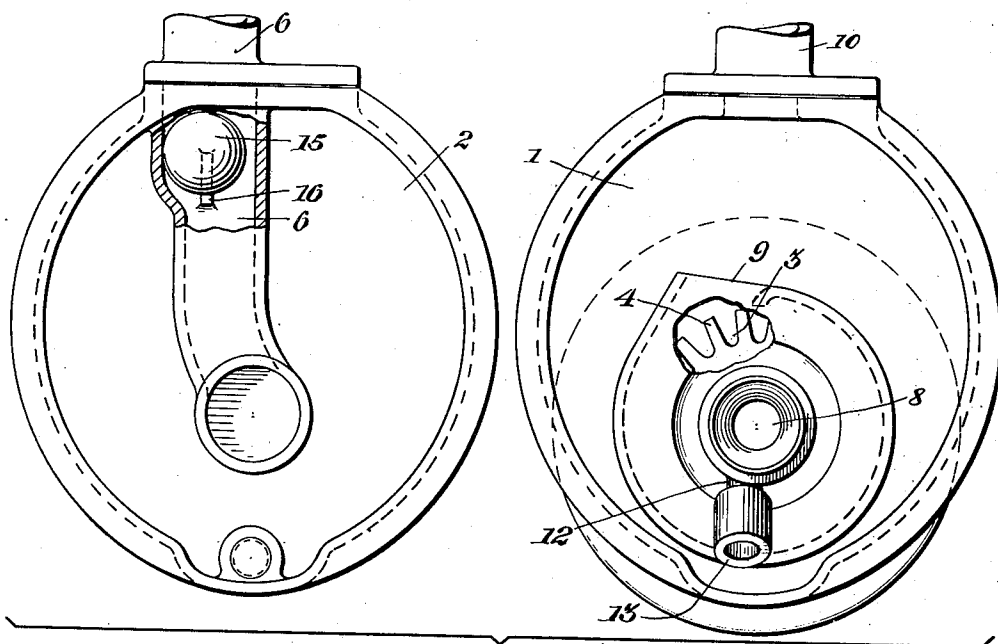
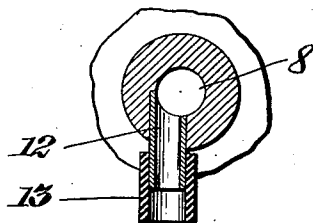


Fig. 3.

Fig. 4.



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PUMPING APPARATUS

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Application December 29, 1938, Serial No. 248,220

6 Claims. (Cl. 103—113)

My invention consists in the novel features hereinafter described, reference being had to the accompanying drawings, which illustrate one embodiment of the same selected by me for purposes of illustration, and the said invention is fully disclosed in the following description and claims.

My present invention is an improvement in the general type of self-priming pumps of the general type represented by my former Letters Patent of the United States, No. 1,993,267, granted March 5, 1935, although it is not limited to pumps of the identical construction therein shown, but is applicable to many other forms of pumping apparatus in which there is provided a priming reservoir and a priming passage connecting the priming reservoir to the casing of the pump.

In the operation of pumps of this general type with the starting up of the rotor within the pump casing, water from the reservoir is continually admitted to the pump casing, together with air from the inlet passage, the water being discharged from the pump casing and returning to the reservoir for recirculation until the air in the inlet passage is exhausted to such a degree that the pressure on the surface of the liquid in the sump or source from which water is being pumped is sufficient to force the water up into the inlet passage to supply the pump. The water will thereafter be discharged from the pump, but a certain amount of the water will continue to be recirculated through the priming passage, thereby diverting a certain amount of the driving power of the rotor to such recirculation and detracting somewhat from the maximum capacity of the pump. The only way that this can be prevented is by closing the priming passage after the pump is fully primed and discharging only water unmixed with air therefrom. Obviously this could be done by means of a manually operable valve, but this requires the attention of an attendant, and the interposition of another valve mechanism of an automatic character has a tendency to become clogged by sediment or solid matter in the liquid to be pumped.

These devices are largely used for the purpose of pumping ditches and excavations where water accumulates continually with greater or less rapidity, and it is customary to operate the pump continuously to reduce the collected water to a predetermined level and to prime itself and resume pumping as soon as the collected water rises above that level. Such water also frequently contains earth, stones and other solid matter

which would clog the ordinary types of valve mechanisms, if such were employed.

The object of my invention is to provide a pumping apparatus of this general type having a priming passage comprising a tubular wall of flexible material, preferably rubber, of sufficient elasticity to maintain itself normally in the tubular form under the suction of the pump, while passing air and water therethrough, and thereby provide for the free passage of any solid matter therethrough, but being capable of collapsing upon itself or flattening so as to completely close the priming passage under the greater suction of the pump when fully primed, and delivering water from its main outlet.

Another feature of my invention is the employment of a priming passage connecting the priming reservoir with the main inlet passage of the pump located coaxially with respect to the axis of the rotor, the priming passage being connected to the inlet passage, which is in the form of a Venturi passage, preferably at one side of the axis of said passage, and preferably between the reduced diameter of the Venturi passage and the casing of the pump, to secure the maximum suction through the priming passage. Other details of construction and combination of parts will be hereinafter fully described in the following description and claims.

Referring to the accompanying drawings, which illustrate one form of my invention, selected by me for purposes of illustration,

Fig. 1 represents a side elevation of a pumping apparatus embodying my invention.

Fig. 2 is a vertical transverse sectional view of said pumping apparatus.

Fig. 3 is a vertical longitudinal section of the pumping apparatus on the line 3—3 of Fig. 2.

Fig. 4 is a detail section on the line 4—4 of Fig. 2.

In the construction illustrated in these drawings, 1 represents the main casing of the pump structure which is substantially cylindrical in form, the interior of which provides the priming reservoir indicated at 2. The pump casing, indicated at 3, is preferably enclosed within the reservoir 2 and contains a rotor 4 provided with an operating shaft 5 by which it may be driven in any suitable or desired manner, as by a small gasoline engine, or by an electric motor, or by belt and pulley, for example. 6 represents the inlet passage, which in this instance extends from a threaded tubular part 7 at the upper end and at one side of the casing downwardly to a horizontal portion 8, in the form of a Venturi

passage, which discharges into the pump casing 3, coaxial with the axis of the rotor 4 and is entirely separated from, although enclosed within, the priming reservoir 2. The pump casing 3 is provided in this instance at its upper end with a discharge 9 which communicates with the priming reservoir within the casing 1, and also with a main outlet 10, terminating in a threaded tubular part 11, to which a pipe may be secured to direct the pump water to any desired point. It will be understood that a pipe will be connected with the threaded part 7 of the inlet passage, and will extend in the usual manner to the sump, excavation, ditch, or other source from which the water is to be pumped.

12 represents the priming passage which extends from the lower part of the priming reservoir, preferably in a substantially straight line upwardly, and discharges into the Venturi passage 8 at a point between its smallest diameter, and the pump casing, and preferably at one side of the axis of the Venturi passage, with the axis of the priming passage offset from the axis of the inlet passage in the direction of rotation of the pump rotor as shown best in Fig. 4, in order that the greatest amount of suction when the rotor is revolving may be applied to the priming passage. As viewed in Fig. 4, the direction of rotation of the rotor is clockwise so that the lower portion of the rotor moves toward the left, and the axis of the priming passage entering the lower side of the inlet passage is offset to the left from the axis of the inlet passage. It will be understood that the annular restriction of the inlet passage constituting the Venturi section effects a pressure velocity conversion in fluid flowing therethrough, a portion of the energy in the form of fluid pressure being converted into velocity with consequent decrease in the fluid pressure in said portion of the inlet passage or expressed in another way, an increase in the suction applied to the priming passage. A portion of the wall of the priming passage is formed of collapsible tubing, indicated at 13, which may be a section of rubber tubing of the desired diameter, slipped over the adjacent metallic portion of the passage, with or without the ordinary hose clamp as may be found desirable, and projecting downwardly therefrom, which is my preferred construction.

In starting up the pump, assuming that the inlet pipe at its lower end is below the surface of the water to be pumped and that the priming reservoir is filled with water up to a point considerably above the axis of the rotor, the rotor is started and will discharge water from its outlet 9 together with air which is drawn in through the inlet passage, the water returning to the priming reservoir 2, and being recirculated through the priming passage 12, 13, while the air is delivered from the casing through the outlet 10. This operation continues until a sufficient vacuum exists in the inlet passage 6 so that the pressure of air on the surface of the water in the sump or excavation will force the water up through the inlet passage until it completely fills the pump when no more air will be discharged and the water drawn up by the pump through the inlet passage will be delivered through the outlet passage 11. The vacuum required merely to prime the suction line, is approximately equal to the static suction lift, but the vacuum required to pump a stream of water is considerably greater, due to the suction head required to over-

come the velocity and friction head of the stream of water being pumped.

During the priming period while air alone or a mixture of air and water is being drawn through the Venturi section of the inlet passage, the venturi does not greatly affect the suction on the priming passage, owing to the fact that air, being an elastic and infinitely expansible fluid, will expand or contract to accommodate itself to changes in cross-sectional area of the inlet passage. However, the instant priming is completed and a solid stream of water begins to flow through the venturi, the suction on the priming passage is greatly increased. Since water is substantially non-elastic, it does not appreciably expand or contract with changes in the cross-sectional area of the passage and the restricted area of the Venturi section results in static energy in the form of fluid pressure being converted to kinetic energy in the form of greater velocity with a consequent reduction in pressure. Moreover, as the pump is designed for pumping liquid rather than gas, the velocity through the venturi of the inlet passage is increased as soon as a solid stream of liquid reaches the pump and this increased velocity further increases the Venturi action.

The suction on the priming passage is likewise increased, upon completion of the priming operation, by the off-set relation of the priming passage to the inlet passage as shown in Fig. 4. During the priming period while air or a mixture of air and liquid is flowing through the inlet passage, the offset relation of the priming passage has substantially no effect. However, as soon as priming is completed and a solid stream of liquid reaches the pump, the rotary movement of the rotor is transmitted back through the solid liquid stream and produces a swirling movement of the liquid in the inlet passage close to the pump. Owing to the offset relation of the priming passage whereby liquid flowing from the priming passage to the inlet passage enters the latter approximately tangentially, this swirling movement of liquid in the inlet passage produces an injector-like action on the priming passage as soon as priming is completed. Thus, by locating the connections of the priming passage to the inlet passage close to the pump casing where this swirling effect takes place, and by offsetting the axis of the priming passage with respect to that of the inlet passage in the proper direction as shown in Fig. 4, there is obtained an injector action which markedly increases the suction on the priming passage as soon as a solid stream of water reaches the inlet passage, and thus effectively closes the collapsible tubing 13 upon completion of priming. By reason of this decided increase in the suction effect as soon as priming is completed, it is possible to use collapsible tubing strong enough to withstand the suction lifts encountered for example when the pump is used for draining deep excavations, and yet be assured that the collapsible tubing will close properly when all the air has been exhausted from the intake pipe and the pump is fully primed.

The collapsible section 13 of the priming passage is of sufficient strength and rigidity to withstand the vacuum developed in the tube during the priming operation, that is to say, so long as water and air are being drawn through the pump. The walls of this collapsible portion 13 are, however, so formed as to be unable to resist the greater vacuum of the pump in drawing up and delivering water without included air, and this

greater vacuum quickly closes the collapsible tube, as indicated in dotted lines in Fig. 2, thereby completely closing the priming passage, cutting off all further recirculation of water through said priming passage, and therefore enabling the full capacity of the pump to be devoted to the discharge of water through the outlet 11. It will also be seen that the collapsible tubular portion 13 of the passage is not only subjected to the collapsing action of the higher vacuum produced by the pump in moving a solid body of water therethrough, but the pressure of the water itself, which is built up within the priming reservoir 2 by the pump, is also applied to the exterior of the tube, and tends to effect the collapsing and closing of the said flexible portion.

It will be obvious that the vacuum required to prime the suction lift will be higher at high lifts than at low lifts. The collapsible tubular portion 13 is so constructed that it will remain open during the priming of the suction line even at high lifts, but will close as soon as the pump begins to discharge water, due to the greater vacuum required and higher pressure on the exterior of the walls of the tube, regardless of the height of the lift from the water source. By constructing the flexible tubular portion so that it will function properly at high lifts, it will obviously function in the same manner at low lifts, down to water level, because although a low vacuum is required to prime the suction line, the combination of the increased vacuum and increased pressure within the reservoir will be sufficient to collapse the tube under all circumstances. The lower the lift the greater the amount of water pumped; and the greater the amount of water pumped the greater the vacuum and pressure required to create the greater velocity of water. It is evident, therefore, that although the flexible tube must withstand a sufficiently high vacuum to prime the suction line at high lifts, the same tube will close at the low lifts, because the combination of the low vacuum required to overcome the low static, together with the increase in vacuum and pressure required to remove the greater quantity of water at the low lift, provides combined forces which are sufficient to collapse a tube which will withstand the vacuum required for the highest practical suction lifts. As soon as the water level in the sump or ditch or excavation has fallen so as to admit air to the inlet pipe or passage, air will be drawn in to the pump casing, and the pumping operation will cease temporarily until the water again collects so as to close the lower end of the inlet pipe.

In order to prevent the syphoning out of the water in the priming reservoir, I prefer to provide the inlet pipe 6 with the valves seat 14, to receive a ball valve 15, of such specific gravity that it will float in the liquid being pumped, a suitable projection 16 being provided to engage the ball and prevent it from passing to the lower end of the inlet passage within the casing. As soon as air is admitted to the inlet passage, the water in the downwardly extending portion of the inlet passage or pipe, will tend to run back into the sump and the ball will immediately seat and prevent the syphoning of the water within the reservoir.

When the pump is handling air and water, as during a seepage condition, or when a leak occurs in the suction line, the air reduces the vacuum on the flexible tubular portion 13 of the priming passage, due to the pump becoming somewhat air-

bound, thereby allowing the water to be expelled and permit the normal recirculation and priming action to continue until the air is expelled, at which time the collapsible tube again closes the priming passage, shutting off recirculation, and again providing the maximum capacity of the pump.

Obviously variations in the construction of the pump from that illustrated in the accompanying drawings may be made without departing from the spirit of my invention.

What I claim and desire to secure by Letters Patent is:

1. In a pumping apparatus, the combination with a priming reservoir, of a centrifugal pump comprising a casing and rotor, a main inlet communicating with the pump casing adjacent to the axis of the rotor and comprising a Venturi passage, said pump casing having a discharge passage, and a communication therefrom to said priming reservoir, a priming passage connecting the priming reservoir with the zone of low pressure of said Venturi passage, and having a tubular portion with a flexible wall, capable of collapsing upon itself to close the priming passage by the suction of the pump when fully primed, to prevent further recirculation through the priming passage and secure the maximum delivery from the pump.

2. In a pumping apparatus, the combination with a priming reservoir, of a centrifugal pump comprising a casing and rotor, a main inlet communicating with the pump casing by a Venturi passage substantially coaxial with the rotor, said pump casing having a discharge passage, and a communication therefrom to the priming reservoir, a priming passage connecting the priming reservoir with the zone of low pressure of said Venturi passage, and comprising a tubular portion of elastic material, capable of collapsing upon itself to close the passage therethrough by the suction of the pump, when fully primed to prevent further recirculation through the priming passage and secure maximum discharge from the pump.

3. In a pumping apparatus, the combination with a priming reservoir, of a centrifugal pump comprising a casing and rotor, a main inlet communicating with the pump casing by an inlet passage substantially coaxial with the rotor, said pump casing having a discharge passage, and a communication therefrom to the priming reservoir, a priming passage from the priming reservoir discharging into said coaxial inlet passage, closely adjacent the pump casing and at one side of said inlet passage, the axis of the priming passage being offset from the axis of the inlet passage in the direction of rotation of the rotor, said priming passage comprising a tube of flexible rubber capable of collapsing upon itself to close the priming passage under the suction of the pump when fully primed to prevent further recirculation through the priming passage and secure maximum delivery from the pump.

4. In a pumping apparatus, the combination with a priming reservoir, of a centrifugal pump comprising a casing and rotor, a main inlet communicating with the pump casing by a Venturi passage substantially coaxial with the axis of the rotor, said pump casing having a discharge passage and a communication therefrom to the priming reservoir, a priming passage connecting the priming reservoir with the zone of low pressure of said Venturi passage, at one side of the same, and closely adjacent the pump casing, the axis

of the Venturi passage in the direction of rotation of the rotor, said priming passage comprising a collapsible tube, the walls of which are formed of elastic material capable of collapsing together to close the priming passage by the suction of the pump when fully primed, to prevent further recirculation through the priming passage and secure maximum delivery from the pump.

5 5. In a pumping apparatus, the combination 10 with a priming reservoir, of a centrifugal pump comprising a pump casing and rotor located within the priming reservoir, the pump casing having a main inlet passage separated from said reservoir and connected to the pump casing by a Venturi passage discharging into the pump casing 15 substantially coaxial with the axis of the rotor, said pump casing having an outlet discharging into said reservoir, and said pumping apparatus having a main discharge from said reservoir, a 20 priming passage connecting said reservoir with said Venturi passage at a point between the point of smallest diameter of said Venturi passage and the pump casing and at one side of said Venturi passage, the axis of the priming passage being 25 offset from the axis of the Venturi passage in the direction of rotation of the rotor, said priming passage comprising a tubular portion having an elastic wall capable of collapsing upon itself to

close said priming passage under the suction of the pump when fully primed to prevent further recirculation through said priming passage and secure the maximum delivery from the pump through said main outlet passage.

6. In a pumping apparatus, the combination with a priming reservoir, of a centrifugal pump comprising a pump casing and a rotor, an inlet passage separated from said reservoir and discharging into the pump casing substantially coaxially with the axis of the rotor, the inlet passage having an annular restriction for effecting a pressure velocity conversion in fluid flowing therethrough, said pump casing having a discharge passage and a communication therefrom to said priming reservoir, a priming passage connecting said reservoir with said restricted portion of the inlet passage at a point closely adjacent the point of smallest diameter of said inlet passage and between said point of smallest diameter and the pump casing, said priming passage comprising a tubular portion having an elastic wall capable of collapsing upon itself to close said priming passage under the suction of the pump when fully primed to prevent further recirculation through said priming passage and secure the maximum delivery from the pump through said main outlet passage.

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