April 1, 1941. C. JACUZZI 2,236,687

PUMPING APPARATUS

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FIG. 1

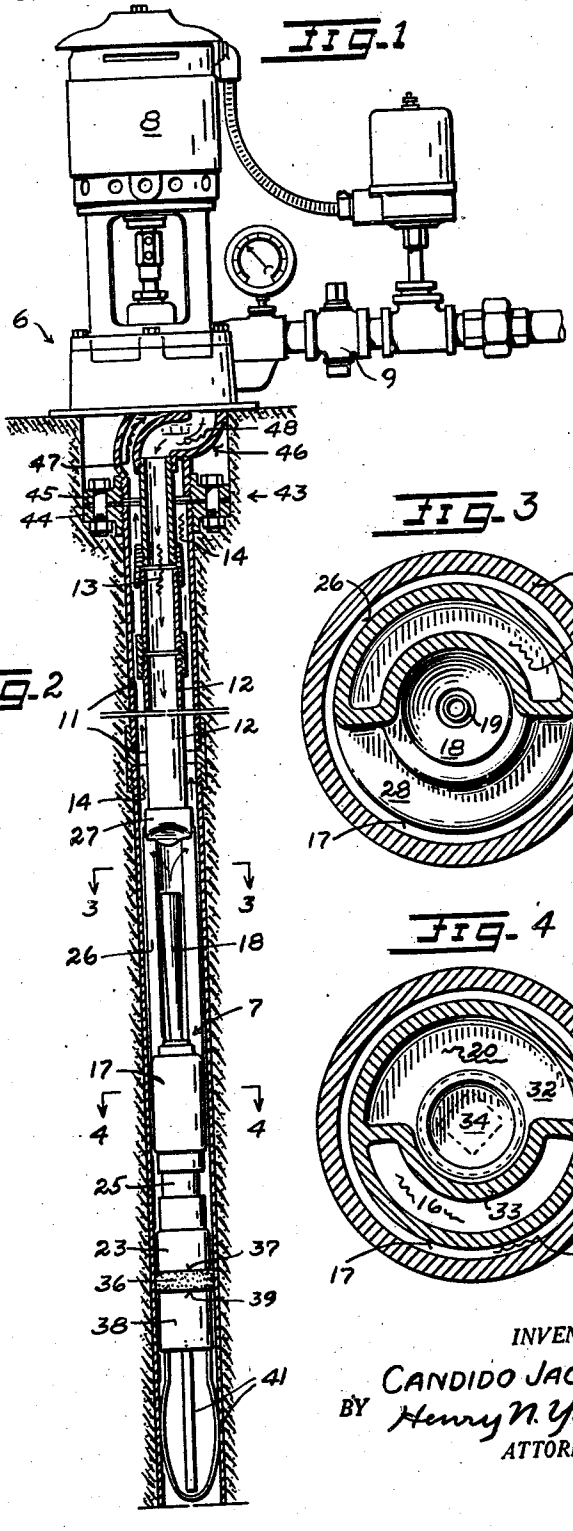


FIG. 2

FIG. 3

FIG. 4

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PUMPING APPARATUS

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5 Claims. (Cl. 103—5)

The invention concerns an hydraulic pumping system wherein the action of a mechanical lift pump disposed above the liquid level in a well is supplemented by a fluid-operated injector which pumps liquid from the well to the first pump, and more particularly relates to the installation and structure of the injector pump.

An object of the invention is to provide for an operative and adjustably positioned installation of the injector within a previously and/or fixedly installed casing or other pipe extending into a well, the pipe being utilized to conduct fluid in the system.

Another object is to provide for the mounting and dismounting of the injector pump within the pipe which receives it while said pipe is in fixedly installed position in a well.

A further object is to provide for the support of the injector pump in its place by means of a pipe secured thereto and disposed longitudinally in and along the pipe which receives it.

Yet another object is to provide a simple and effective means for releasably and laterally sealing the injector pump within the pipe which receives it, said sealing means being controlled by a manipulation of the pipe which carries the pump.

An added object is to provide an injector assembly which is particularly adapted for its installation in the described manner.

The invention possesses other objects and features of advantage, some of which, with the foregoing, will be set forth or be apparent in the following description of a typical embodiment of the invention, and in the accompanying drawing, in which,

Figure 1 is an elevation of a complete pumping apparatus embodying the features of present invention and operatively installed with respect to the casing pipe of a bored well.

Figure 2 is an enlarged axial section taken through the injector assembly of the apparatus in its installed position in the casing pipe.

Figures 3 and 4 are enlarged transverse sections taken respectively at 3—3 and 4—4 in Figure 1.

As is particularly brought out in Figure 1, the features of present invention are shown as applied in an operatively disposed pumping system which is arranged for the lifting removal of liquid from a well through the combined actions of a mechanically operated pump 6 disposed above the well, and an injector assembly 7 which receives its operating liquid from the pump 6 and is arranged to entrain and deliver liquid from the well to the latter pump. In the present instance, the pump 6 comprises a vertical-shaft centrifugal pump which is driven by an electric motor 8 and discharges through a back-pressure valve 9 and supplies the operating liquid for the injector under pressure from a point in its discharge passage ahead of the valve 9, the general arrangement and pumping system being well known in the art.

The injector 7 is designed for its removable disposal in an upright pipe 11 which in the present instance comprises the casing pipe of a bored well, said pipe having been fixedly installed as the well was bored, and the present injector may be installed any time after the pipe 11 has been placed. A pipe 12 carries the injector 7 at its lower end and extends through the pipe 11 from the top thereof and in spaced relation from its bore side whereby the pipe 12 and the bore portion of the pipe 11 about the pipe 12 define independent passages 13 and 14 respectively, said passages extending between the pump 6 and the injector 7, and one of said passages being utilized to supply operating fluid to the injector nozzle while the other passage conducts the pumped liquid to the top of the well and the pump 6. The pipe 11 is laterally sealed, at least above the injector, whereby to prevent a lateral flow of liquid to or from its bore; as shown, the pipe 11 is laterally imperforate above the injector therein. Each of the pipes 11 and 12 is of circular cross-section and would usually comprise a plurality of sections connected by suitable tubular coupling elements.

In its present embodiment, the injector 7 comprises a tubular body 15 having a liquid intake chamber 16 provided in a cylindrical intermediate portion 17 of the body and arranged for the discharge of liquid therefrom into an eductor tube 18 at its upper end, said tube discharging into the passage 14. An injector nozzle 19 is provided and disposed for the discharge of the jet of fluid therefrom axially into the intake end of the tube 18, and the passage of said nozzle is connected with the passage 13 of the pipe 12 through a body passage 20 whereby the latter pipe is arranged for its use to conduct the operating fluid to the injector.

The chamber 16 is arranged for connection at its bottom with an intake passage 21 which has a usual one-way valve 22 of the gravity type operative therein, said valve being shown in raised position in Figure 2, as when pumping is being effected. A lower injector body portion 23 encloses the valve 22 and provides the seat 24 for

the valve, and said body portion 23 is connected with the body portion 17 by means of a nipple member which is threadedly engaged in and between said body portions to secure them in unitary association; the sectional arrangement is primarily provided to permit and facilitate the assembly of the injector elements, the assembled injector comprising a unit.

It will now be noted that the eductor tube 18 is disposed to extend in the axial line of the injector body, and that this is provided for in the present case by flattening the body portion laterally of the tube to have a C-shaped cross-section with the circle of its outer face having no greater radius than that of the body portion 17 and having its center in the body axis, the portion of the body passage 20 therein also having a C-shaped cross-section. The tube 18 is thus understood to extend in a cylindrically curved trough provided in and along the body portion 26 to provide part of the passage 14, and to discharge into said passage from its upper end. The body portion 27 above the portion 26 is expanded opposite the discharge end of the tube 18 to have a circular cross-section for threadedly receiving the lower end of the pipe 12 in axial relation to the body. It is to be particularly noted that the injector body in its entirety lies within a cylindric space which is of less diameter than the bore of the pipe 11 whereby the injector assembly may be moved freely through said pipe, except when it is sealed in its operative position in the manner hereinafter brought out.

In the present structure, the top of the body portion 17 is defined by a wall 28 which in part defines the bottom of the trough which receives the eductor tube 18, defines the top of the chamber 16, extends transversely of the body axis, and is provided with an opening which threadedly receives the inner end of the tube 18. The chamber 20 terminates in an interior body portion 29 which extends into the chamber 16 from the side thereof at which the C-shaped portion of the chamber 20 is provided, and has an upper wall 31 and a lower wall 32 connected by a cylindrically curved side wall 33. The wall 31 is provided with a threaded perforation to threadedly receive the base of the nozzle 19, and the wall 32 is perforated to threadedly receive a plug 34 which is removable to permit an adjustment or replacement of the tube 18 or the nozzle 19 through the lower end of the body portion 17 when the nipple 25 is disconnected therefrom. The design and cooperative relation of the jet nozzle and the eductor tube are preferably those taught in the United States Patent No. 1,758,400 which issued to R. Jacuzzi on May 13, 1930.

A tubular extension 35 at the lower end of the body portion 23 is contracted and mounts a sealing or packing ring 36 of resiliently yielding material, said ring transversely engaging a beveled shoulder 37 at the upper end of the extension. The lower end portion of the part 35 threadedly mounts a tubular element 38 which has its upper end 39 arranged to engage and axially compress the ring 36 against the shoulder 37 for effecting a radial expansion of the ring when the element 38 is turned up on the extension 35. When the ring 36 is sufficiently expanded in a radial direction, it is arranged to tightly engage the inside of the pipe 11 to laterally seal the injector body in the pipe as is necessary if the pipe bore above the body is to be utilized as a pressure discharge duct for the injector in the described manner.

Means are provided for rendering the sealing ring operative after the injector has been disposed where desired in the pipe 11, said means essentially comprising a turning up of the element 38 against the under side of the sealing ring 36. Preferably, and as shown, the element 38 mounts a dogging means 41 at its lower end, said means comprising a pair of spring loops having their extremities fixed to the element 38 and constantly bearing against the inner face of the pipe 11 to permit a longitudinal movement of the element 38 through the pipe while preventing a rotation of the element in either direction. It will be noted that the present spring dog 41 is operative to center the injector in the pipe 11, and that the pipe 12 extends axially of the injector, whereby to facilitate the installation and removal of the injector.

By reason of the provision of the dogging means 41 on the lower end of the injector, an appropriate rotation of the injector may turn it in the element 38 to effect a radial expansion of the ring 36 to seal the injector in the pipe 11. A reverse rotation of the pipe 12 and the injector will, of course, release the ring from its sealing engagement with the pipe 11 to permit an adjustment or withdrawal of the entire injector assembly. It will be understood that rings 36 and spring dogs 41 of different normal external diameters would be provided for use in installing a given injector assembly in pipes having different bores.

A suitable coupling means 43 is provided at the top of the pipe 11; as shown, flanges 44 and 45 are respectively mounted on the upper pipe end and on the lower end of a fitting 46 for securing the fitting to the pipe top. The fitting 46 provides passages 47 and 48 for connecting the pipe passages 14 and 13 respectively with the intake and discharge of the pump 6, and is arranged for its direct fixing to and beneath the latter pump in the present instance.

With a pipe 11 already installed in a well, an injector assembly 7 of appropriate size, and carrying a dogging means and sealing ring for their intended coaction with the inside of the pipe, would be lowered through the pipe 11, sections of the pipe 12 being added as required until the injector is at the desired depth in the pipe 11. The upper end of the pipe 12 is then secured to the fitting 46 on the pump 6 with its passage 48 in registration with the pipe passage 13, after which the pump and pipe and injector are rotated together to effect a compression of the ring 36 to seal the injector in the pipe 11 in the described manner. The fitting 46 may now be secured to the pipe 11 by bolting the flanges 44 and 45 together to complete the installation.

The connections of the injector body portions and of the pipe 12 with the injector and of the pipe sections with each other and of the pipe 12 with the fitting 46 are all preferably made so tight, or otherwise secured, as the assembly is effected that a reverse rotation of said assembly will not loosen any of the jointures but will, rather, back off the element 38 to permit a contraction of the ring 36 to break its seal and so free the injector assembly for its removal with the pipe 12. In this manner, the injector may be adjusted along the pipe 11 or removed therefrom without disturbing the pipe in its mounted position.

From the foregoing description taken in connection with the accompanying drawing, the advantages of the construction and method of

operation will be readily understood by those skilled in the art to which the invention appertains. While I have now described the features and principles of operation of a structure which I now consider to be a preferred embodiment of my invention, I desire to have it understood that the showing is primarily illustrative, and that such changes may be made, as desired, as fall within the scope of the following claims.

I claim:

1. In combination with an installed well casing which is laterally sealed above its liquid-intake portion, an injector pump for operation with pumped liquid disposed in said casing and having its nozzle discharging a solid jet of liquid thereinto in its axial line above said liquid intake portion thereof, means providing an intake passage to said pump from the casing portion below it, a pipe for pump-operating liquid extending longitudinally through the casing to said pump and arranged to provide a continuous passage for pumped liquid laterally of the pipe and within and along the casing bore, means sealing the pump in the casing whereby said last passage is arranged to provide the sole discharge duct for the pump and from the well, and means for effecting a pressure discharge into the pipe of liquid which has previously been discharged from the well.

2. In an injector pump for laterally sealed installation in a laterally closed well bore, a pump body, providing a passage for pump-operating liquid longitudinally therethrough and having cylindrical upper and lower portions mutually coaxial and connected by an intermediate body portion which is laterally flattened to have a C-shaped cross-section and to provide an external recess about the body axis thereof, a jet nozzle mounted in the upper wall of the lower body portion to discharge liquid from said body passage into said recess in the axial line of the body, for inducing a flow of liquid into the recess from the well, means for supplying a pump-operating liquid under pressure to the body passage, and means providing a discharge conduit from the recess and within the well bore.

3. In an injector pump for installation in the sealed portion of a well bore which is laterally sealed above its liquid-intake portion, a pump body providing a passage for pump-operating liquid longitudinally therein and having cylindrical upper and lower portions which are mutually coaxial and are connected by an intermediate body portion which is laterally flattened to provide an external recess about the body axis and between the first portions, means at the lower pump portion providing an eductor passage from the pump intake for discharging liquid upwardly into the recess in the axial line of the pump body and from below the pump, a jet nozzle mounted in the lower body portion and connected with the first body passage to discharge liquid therefrom axially into the eductor passage for inducing a flow of liquid into the recess from the well, means for laterally sealing the pump in the well bore at a point of the pump between the recess and the intake for the pump, means for supplying pump-operating liquid under pressure to the body passage, and means providing a discharge conduit from the recess and within the well bore.

4. In an injector pump for installation in the sealed portion of a well bore which is laterally sealed above its liquid-intake portion, a pump body of cylindrical outline providing a passage for pump-operating fluid therein and having cylindrical upper and lower portions which are mutually coaxial and are connected by an intermediate body portion which is shaped to provide an external recess between the first body portions and within the confines of the body cylinder, a jet nozzle mounted in the upper wall of the lower body portion to discharge fluid from said body passage into said recess axially of the body for inducing a flow of liquid into the recess from the well, means for supplying a pump-operating fluid under pressure to the body passage, and means providing a discharge conduit from the recess.

5. In combination with a well bore having a laterally sealed portion above its liquid intake portion, an injector pump in said sealed portion of the well bore and comprising a pump body providing a passage for pump-operating fluid therein and having upper and lower portions which are mutually aligned and are connected by an intermediate body portion shaped to provide a recess external of the body and defined between the first body portions and the intermediate body portion and the sealed well bore portion, means sealing the lower body portion in the well bore thereat, a jet nozzle mounted in the upper wall of the lower body portion to discharge fluid upwardly into said recess for inducing a flow of liquid into the recess from the well, means supplying a pump-operating fluid under pressure to the body passage, and means providing a discharge conduit from the recess.

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