March 6, 1945. L. C. BADGLEY 2,371,019

JET TYPE PUMP

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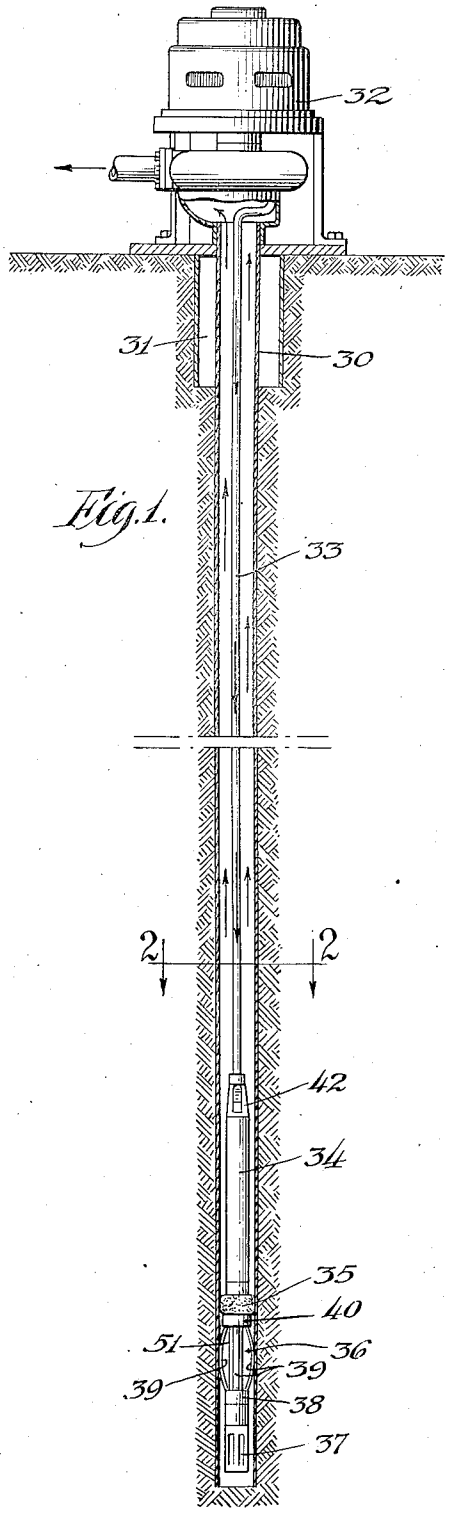



Fig. 1.

Fig. 2.

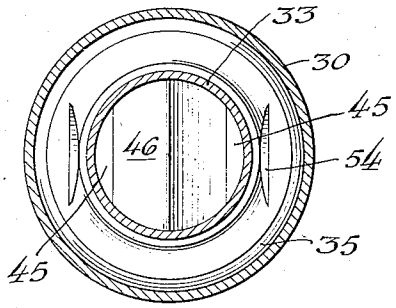
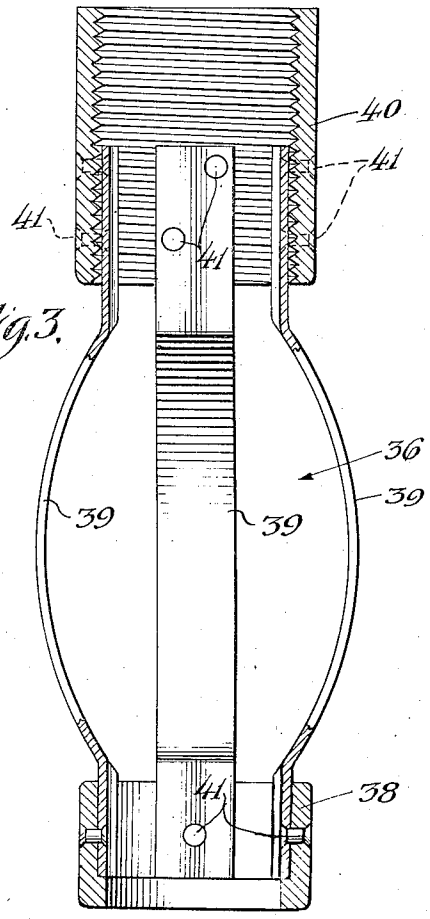



Fig. 3.




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March 6, 1945. L. C. BADGLEY 2,371,019

JET TYPE PUMP

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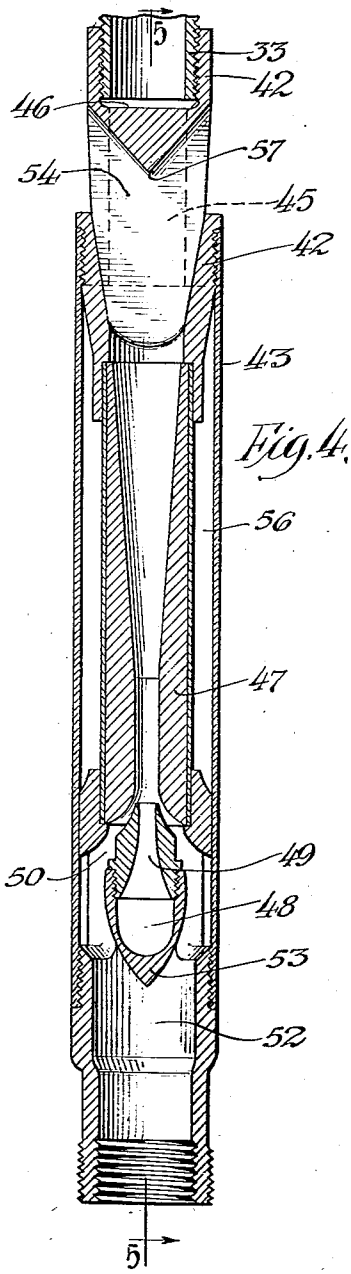



Fig. 4.

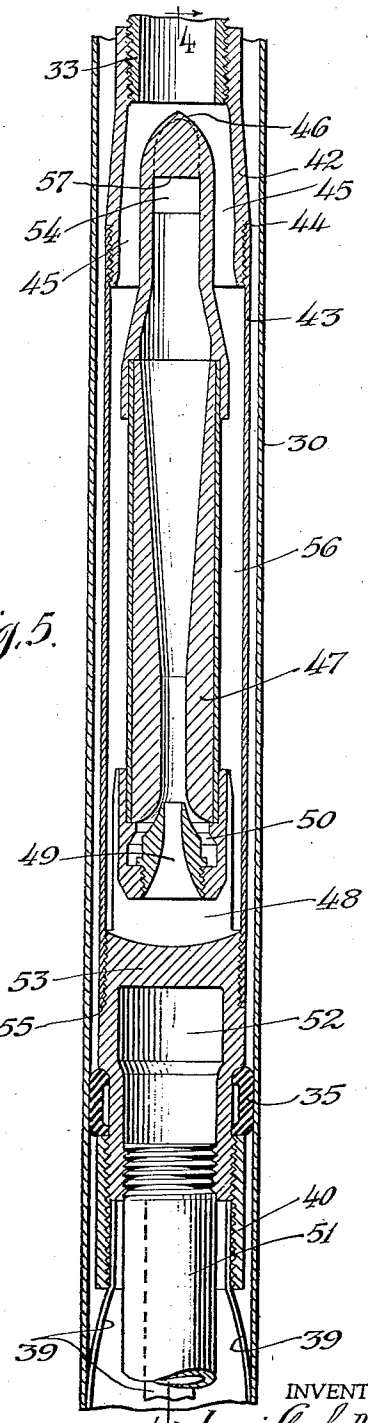



Fig. 5.

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March 6, 1945. L. C. BADGLEY 2,371,019

JET TYPE PUMP

Filed Aug. 28, 1940 4 Sheets-Sheet 3

Fig. 6.

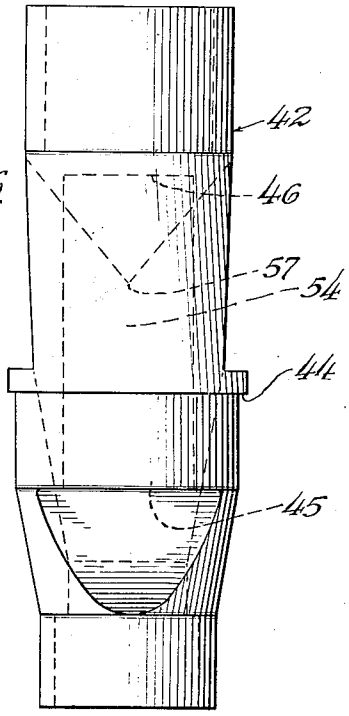



Fig. 7.

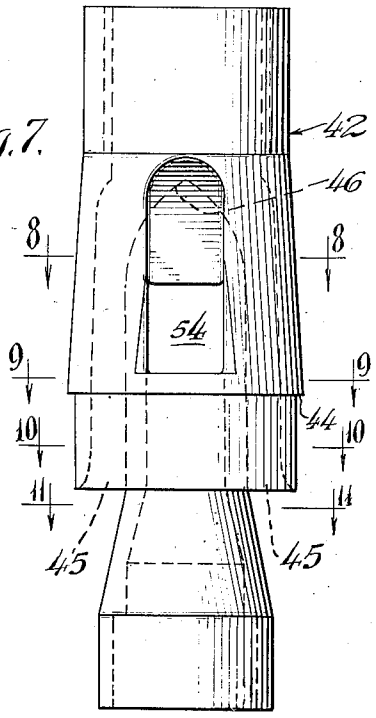



Fig. 8.

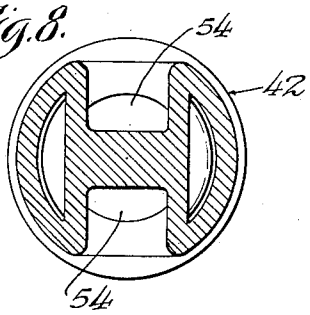



Fig. 10.

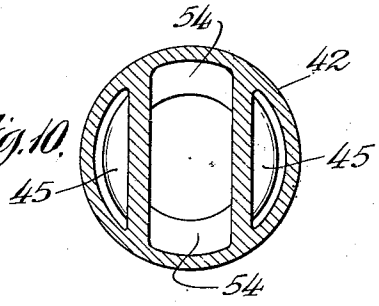



Fig. 9.

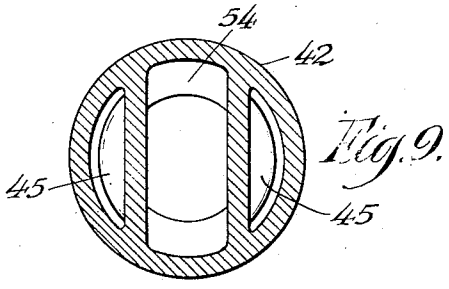
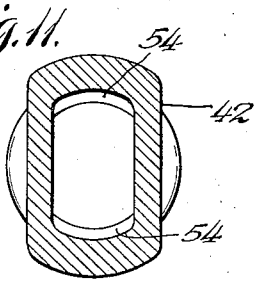



Fig. 11.




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JET TYPE PUMP

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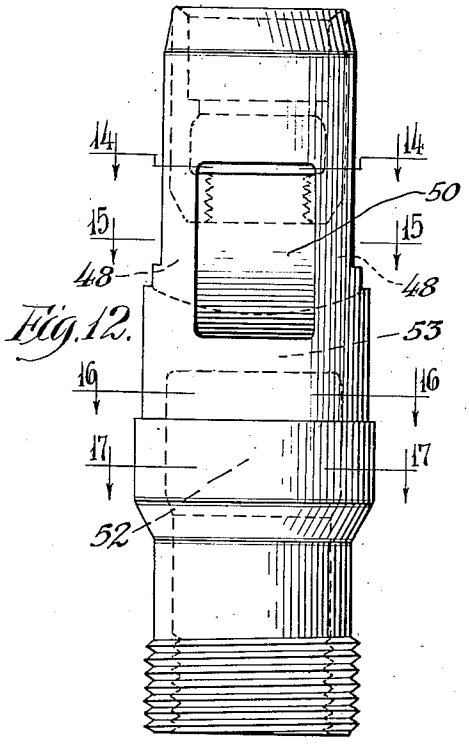



Fig. 12.

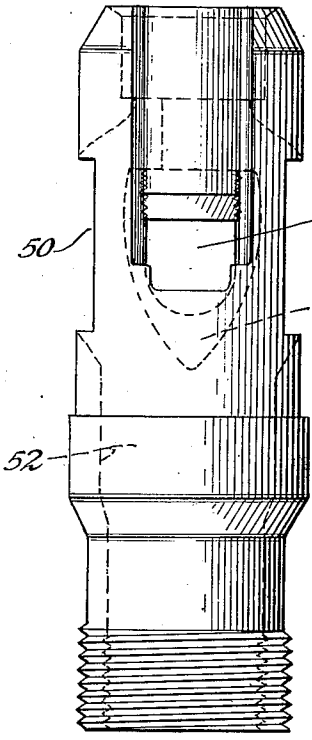



Fig. 13.

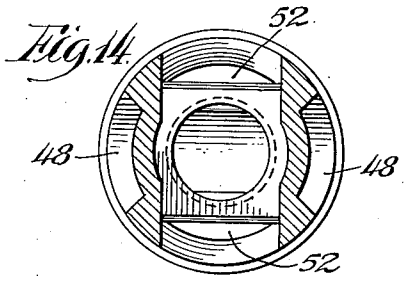



Fig. 14.

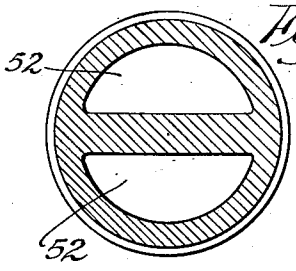



Fig. 16.

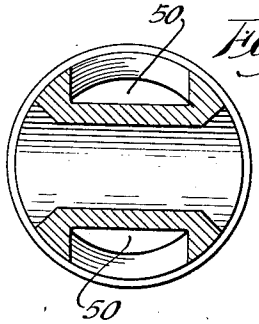



Fig. 15.

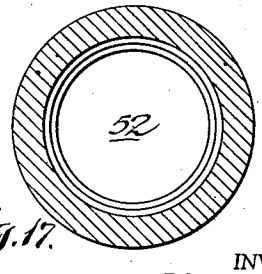



Fig. 17.

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Patented Mar. 6, 1945 2,371,019

# UNITED STATES PATENT OFFICE

2,371,019

## JET TYPE PUMP

Laurie Clarke Badgley, Springfield, Ill.

Application August 28, 1940, Serial No. 354,520

22 Claims. (Cl. 103—5)

This invention relates to improvements in pumps such as used for pumping water from relatively deep wells, and for other purposes. More specifically, the invention relates to "single" pipe hydraulic ejectors or pressure heads for use in combination with pumps or other pressure means.

It is an object of the present invention to provide an hydraulic ejector for use in water wells of relatively small diameter. Jet type deep-well pumps are well known on the market. In the past, the pumps of this type have usually made use of a multiple pipe arrangement within a well casing. This has resulted in limiting the capacity of the pump for any designated capacity of well casing, and has resulted in making pumps for a relatively small diameter casing, such as a 2-inch casing, unfeasible because of limited capacity.

As a result, jet pumps have found their greatest application in wells using larger casing, and in the past a person installing a jet pump for the initial equipment has usually had to put in a larger casing with its attendant additional expense in order to procure a satisfactory flow of water.

It is an object of the present invention to provide an arrangement in which one pipe is eliminated, and the well casing acts in place of the pipe. In this connection, it is an object to provide an arrangement adapted to installation in relatively small diameter casings, such as a 2-inch casing, or the like.

It is another object to provide an arrangement in which the pumped water capacity of the well is proportionately greater, with respect to the size of the well, than other arrangements now in use. In other words, it is an object to provide an arrangement wherein, by use of a pressure pipe of a certain designated size, for example, one inch, for a well of, for example, 60 feet, and a 3-inch casing, for example, the transverse area available for pump suction is equal to 81% of the total casing area as compared with 11.7% in the usual 3-inch installation using ¾-inch pressure pipe and a 1-inch suction pipe. These figures may not be entirely accurate, but they illustrate an advantage claimed for my construction: In this connection, it is an object to provide a device in which the water conducting area is substantially increased over other constructions now well known in the market, the size of the well casing being the same.

It is another object to provide an arrangement in which a "single" pipe is used for a central pressure pipe, and the well casing is used to conduct the water to the surface, the arrangement being such that for relatively small diameter wells wherein the annular well space for pumped water between the central pressure pipe and the inner periphery of the well casing become substantially maximum in value in transverse area and loss due to friction and restriction of the pumped water is materially reduced.

It is an object to provide a novel and efficient assembly comprising an inlet manifold, an outlet manifold, a jet and Venturi pipe, and an assembly tube.

It is an object of the device to provide a sealing means between the inlet manifold and the well casing comprising a compressible packer seal or packer, preferably on the inlet manifold, and a packer expander and spring dog assembly threaded to said inlet manifold, whereby rotation of the inlet manifold threads the packer expander against the packer and causes the packer to expand and complete the seal with the well casing.

It is an object to provide an inlet manifold having a chamber communicating with a connecting pipe leading to a foot valve or well, said chamber connecting with suction openings leading past a jet means, said inlet manifold having a V member dividing liquid from the well substantially equally between the suction openings, said inlet manifold also having ports terminating in a chamber arrangement leading to the inlet end of a jet, the arrangement being such that the suction openings and the ports use the inner periphery of a tube member, which seats over one end of said inlet manifold for one wall of each port and each suction opening.

It is another object to provide an outlet manifold of novel construction having means receiving the discharge end of a pressure pipe and an inverted V-shaped diverter directing liquid from the pressure pipe substantially equally into a plurality of conduits; a plurality of outlet ports, means receiving a Venturi pipe having a Venturi opening therethrough connecting with said outlet ports, a separator in the shape of a V directing liquid from said Venturi opening substantially equally through said outlet ports, the arrangement being such that the inlet manifold keeps the liquid from the pressure pipe separate from the liquid from the venturi when both are in the outlet manifold.

It is another object to provide a novel means of directing two streams of water in opposite directions past each other by means of conduits or outlet ports, and by use of dividers.

It is an object to provide a compact arrangement which is comparatively inexpensive to manufacture, which is extremely efficient and is adapted to installation in small well casings and the like, and which lends itself to manufacturing by modern methods and simple processes.

Other objects and advantages of the invention will appear as the nature of the improvements is better understood, the invention consisting substantially in the novel construction, combination and arrangement of parts hereinafter fully described, illustrated in the accompanying drawings, and finally pointed out in the appended claims.

In the drawings:

Figure 1 is a schematic vertical sectional view (with a portion broken away) of a pump installation in a well showing my invention;

Figure 2 is a cross sectional view taken on the line 2—2 of Figure 1, looking in the direction of the arrows;

Figure 3 is a longitudinal sectional view of a packer expander and spring dog assembly, forming a part of my invention;

Figure 4 is a fragmentary longitudinal sectional view showing construction details of the inlet manifold, the Venturi unit and jet, and the enclosing shell, being a view on line 4—4 of Figure 5;

Figure 5 is a view similar to Figure 4, but taken diametrically opposite in longitudinal section to that of Figure 4, and showing a portion of the packer expander in addition to the showing of Figure 4, being a view taken on the line 5—5 of Figure 4, looking in the direction of the arrows;

Figure 6 is a longitudinal view showing details of construction of the outlet manifold, internal construction being indicated by dotted lines;

Figure 7 is a view similar to Figure 6, but taken diametrically opposite thereto, showing principally outlets to the manifold showing in dotted lines internal construction;

Figure 8 is a cross-sectional view taken on the line 8—8 of Figure 7, looking in the direction of the arrows;

Figure 9 is a cross-sectional view taken on the line 9—9 of Figure 7, looking in the direction of the arrows;

Figure 10 is a cross-sectional view taken on the line 10—10 of Figure 7, looking in the direction of the arrows;

Figure 11 is a cross-sectional view taken on line 11—11 of Figure 7, looking in the direction of the arrows;

Figure 12 is a longitudinal view of the inlet manifold;

Figure 13 is a view similar to Figure 12 taken diametrically opposite thereto;

Figure 14 is a cross-sectional view taken on the line 14—14 of Figure 12 looking in the direction of the arrows;

Figure 15 is a cross-sectional view taken on the line 15—15 of Figure 12 looking in the direction of the arrows;

Figure 16 is a view similar to Figures 14 and 15 but taken on the line 16—16 of Figure 12, looking in the direction of the arrows; and

Figure 17 is a cross-sectional view taken on the line 17—17 of Figure 12, looking in the direction of the arrows.

Referring more in detail to the construction shown in the various drawings, and particularly as shown in Figure 1, a schematic arrangement illustrating an application of my invention to a water-well. The cross-hatch in Figure 1, illustrates the ground or other medium around a well casing or the like. The well casing is here designated as casing 30, and is the usual well casing extending into a well. While the description herein will refer primarily to a water well, it is to be understood that the invention will work equally well in pumping from such places as tanks, holds of boats, or any other place from which it may be desired to remove a liquid or the like.

The casing 30 passes into the pit, or the like, 31, over which is mounted the pump assembly 32 hereinafter referred to as pump 32. This pump 32 is not shown in detail since there is nothing particularly novel about the pump itself, but a desirable pump includes a motor (such as an electric motor) and impellers, all of well-known constructions.

Within the well casing 30 is mounted a pressure pipe 33 which is of relatively small diameter in cross-section as compared with the well casing, for example, a 2-inch diameter well casing, and a 1-inch pressure pipe.

As is apparent from Figure 1, the jet, venturi and manifold assembly 34, hereinafter referred to as assembly 34, is attached to the end of said pressure pipe and fits into the well casing with a slight clearance on each side. On the bottom of said assembly 34 is attached the packer 35, which consists of a rubber, or the like, gasket. Attached to said assembly 34 and operable to exert pressure on said packer 35, is a packer expander and spring dog assembly 36 hereinafter referred to as dog assembly 36 which will hereinafter be described in connection with Figure 3. Attached to the suction pipe below the dog assembly 36 is the ordinary foot valve and strainer arrangement 37, which are merely shown schematically here since these devices are well known in principle and form no particular part of this invention.

It will be observed from Figure 1 that the pressure pipe 33 extends to the pump and is connected thereto in an arrangement which is different from the connections of the well casing 30. It may be stated here that the flow of water under pressure through the pressure pipe is downward into the upper end of the assembly 34, and as indicated by the arrows, the flow of water from the well fills the remainder of the casing and moves upward into the pump, where a portion of the water is again returned through the pressure pipe for operation of the jet and venturi unit hereinafter described.

Referring to the construction shown in Figure 3, the dog assembly 36 (in the schematic drawings) comprises a ferrule 38, the spring dogs 39, and the packer expander 40. The spring dogs 36 are springs which are bowed radially outward, and are fastened by means of rivets 41 or the like to the ferrule at one end and the packer expander at the other. The springs extend outwardly radially more than the internal diameter of the well casing so that when they are forced down into the well casing on the pressure pipe and assembly 34, they exert pressure against the sides of the well casing 30 and normally tend to prevent the packer expander from turning.

The real purpose of this, as will be clearly apparent from examination of Figures 1 and 5, is to permit the entire arrangement to be placed inside the well casings and "pushed" downwardly without the packer 35 engaging the sides of the well casing. This packer 35 is preferably ex-

pansible outwardly in a radial direction, as will be clearly apparent from examination of Figure 5. If the entire arrangement has been inserted into the well casing, with the packer **35** not exerting any substantial pressure against the casing of the well, but the dog assembly **36** being held against substantial rotation by the spring dog **39**, rotation of the pressure pipe and the assembly above the dog assembly **36** will tighten the packer expander against the packer **35** causing it to expand outwardly in a radial direction and forming a seal with the casing **30**. The packer **35**, when expanded, seals the well casing from the well bottom and forces water trapped in the casing to move upwardly (if it moves in any direction). This results in the well casing forming one unit of the water conducting means.

Referring particularly to the structure of the assembly **34**, it is shown in detail in Figures 2, and 4 through 17, both inclusive.

Directing attention first to the construction shown in Figures 4 and 5, and in Figures 6 through 11, the pressure pipe **33** is threaded, shrunk-fitted or otherwise fastened into the portion which may be designated as outlet manifold **42**, in its entirety. This outlet manifold, in turn, is inserted in a tube **43**, preferably being threaded, shrunk-fitted or otherwise fastened therein, and preferably also having the flange or shoulder **44** to delineate the limits of the seat portion inwardly.

As is clearly apparent from examination of Figures 4 and 5, the pressure pipe **33** opens into a chamber which has a conduit (or a plurality of conduits) such as the conduits **45**, with a diverter **46** (in the shape of an inverted V), which diverter directs the fluid from the pressure pipe into the conduits **45** and down inside the tube **43**.

The liquid from the pressure pipe enters the area around the Venturi pipe **47**; that is, it fills the area between the Venturi pipe and the tube **43**, and is carried through the ports **48**. (See particularly Figures 4, 5, 12 and 13.) These ports **48** are portions of the wall of the inlet manifold, which portions are spaced from the tube **43**, as will be clearly apparent from Figure 14. The ports **48** terminate in a chamber section, the top of which has an inlet to the jet **49**. Water coming through the conduits **45** and ports **48** is forced back through the restricted nozzle of the jet **49** into the inlet end of the venturi **47**, and up through the Venturi pipe opening.

In accordance with the well-known action of Venturi units, liquid from the well comes up through the strainer and other means **37** (see Figure 1) and through the suction openings **50** where it is drawn into the end of the Venturi tube and carried therethrough.

The liquid is conducted from the foot valve by a connecting pipe **51** and enters the inlet chamber **52** of the inlet manifold **42** before reaching the suction openings **50**. Here the liquid passes on either side of the V member **53** (see Figure 15), the suction openings **50** being on either side of the V member **53**. This V member **53** keeps separate (1) the water coming through the conduits **45** and (2) water coming through the well connecting pipe **51**, until such water from both sources is mixed above the jet **49**, in the venturi.

After passing through the venturi **47**, the water goes through the outlet ports **54** on the outlet manifold **42**. These ports **54** (see Figures 4, 5, 6, 7 and 8) open from the chamber-like arrangement at the outlet end of the venturi, in the outlet manifold **42**. This construction will be clearly apparent from Figures 4, 5, 6, 7 and 8. A V-shaped separator causes the liquid passing through the venturi to pass out the ports on either side of the outlet manifold to the space between the pressure pipe and the well casing, and forces the water to rise in the space, which action is usually coupled with a suction action from the pump and carries the water out the top of the well.

Details of construction of the outlet manifold are clear in Figures 8, 9, 10 and 11, by reference back to Figure 7.

As above described, the outlet manifold **42** may be threaded to the tube **43** to where it sets against the shoulder **44** (see Figure 5). Figures 6 and 7 do not show such threads and they are not necessary in order to have a tight fit enabling the user to tighten "down" on the packer expander **40**.

While the assembly **34** has been sometimes described as attached by threads on the inlet and outlet manifolds and tube structure, it is understood that a very desirable arrangement is secured by "sweating" or "shrink-fitting" the tube and manifold assembly together. This, of course, eliminates the expense of threading these units and contributes to cheapness in manufacture. Of course, if the assembly is made by shrink-fitting, the parts may be taken apart in the same manner; that is, by heating the tube **43** and removing it, while heated, from the inlet and outlet manifolds. Proper shrink-fitting will make a very binding and tight arrangement, probably more satisfactory than threading.

The inlet manifold may be threaded with inner and outer threads at its bottom portion, the inner threads receiving the pipe **51** from the foot valve, and the outer threads being for the packer expander and spring dog assembly **36**.

Attention is directed to the fact that the use of the tube **43** as the outside wall for the suction opening **50** eliminates the bulk which would be necessary in event the inlet manifold structure were made with a wall over said suction opening **50**, and greatly increases the efficiency by providing a proportionately larger suction opening for a designated size assembly.

In actual operation, fluid, such as water, is forced by the pump into the pressure pipe **33**, and from said pressure pipe into the outlet manifold **42**, where it divides (in the arrangement shown here) and passes through the conduits **45**, filling the pressure chamber between the walls of the tube **43** and the venturi unit, then on through the ports **48**, through the jet **49** into the Venturi tube **47**. In passing through the jet and Venturi tube **47**, the action of the Venturi unit lifts water from the well through the connecting pipe **51** and inlet chamber **52**, through the suction openings **50**, from whence it enters the venturi, and the well water mixes with the water from the pressure pipe **33**, is carried out the outlet ports **54**.

It is not necessary that the conduits **45**, from the outlet manifold, which conduits carry water under pressure from the pressure pipe **33**, be aligned with the ports **48** on the inlet manifold. The reason for this is that the space between the Venturi pipe **47** and the tube **43** carries the water under pressure, and the pressure is general within the space between the Venturi pipe **47** and the tube **43**, making it equally desirable to have the ports **48** at any place within the angle of the periphery of the tube **43**. In other words, the actual construction of the pressure chamber between the venturi **47** and the tube **43** eliminates

the necessity of aligning the ports with the conduits 45 as they leave the outlet manifold.

Upon leaving the venturi, the water is split by a "splitter" 57, which is a V-shaped projection, and divides the pumped water so that it enters uniformly on each side into the space between the pressure pipe 33 and the well casing 30. With this arrangement, a retardation or bottleneck action is prevented, and considerably more water is secured than would be the case if the separator were not used. The water is prevented from returning to the well by the pressure from the Venturi unit, and, if the pump happens not to be working, the foot valve maintains the column of water without loss of pressure. On the outside of the assembly, the packer 35, by reason of its sealing action against the well casing 30, prevents the pumped water from mixing or diffusing with the well water. The packer 35 likewise prevents the loss of vacuum in the pipe 51 by sealing with the casing 30. No vacuum, of course, exists outside the assembly 34 above the packer 35. If the packer 35 permitted the water to pass downward, it would dissipate the vacuum, exerting a lifting force on the well water and cause failure of the pumping action.

The differential of pressure between the pressure in the pressure pipe and the pressure of the pumped water between the pressure pipe and the casing of the well is comparatively great. For example, the pressure in the pressure pipe may be 45 pounds while the pressure of the pumped water is 25 pounds. In my construction, it is only necessary to use the packer 35 to seal against the relatively low 25-pound pressure, and prevent water under said 25-pound pressure from entering the well and destroying the vacuum. This arrangement has a very definite advantage due to the fact that the packer does not have to seal against a heavier pressure in that an inexpensive rubber packer is entirely satisfactory, and it is easy to secure a sealing action with a turn or two on the packer expander. The heavier pressure might make it necessary to have some other arrangement for sealing than the packer 35, or at least a very strong tightening action against the packer expander would be necessary. This advantage is inherent to my construction.

In the old style of unit, a separate pipe, known generally as a suction pipe, was required to carry water after it had passed through the Venturi unit. That separate pipe is eliminated in Applicant's construction and the objectionable bulk of the equipment and loss of efficiency is likewise eliminated, resulting in a unit of size sufficient for a satisfactory installation in small casings, for example, in a 2-inch pipe.

The unit is not difficult to place the arrangement in the well since, as previously explained, it is only necessary to attach the various elements at their respective places as indicated by Figure 1 (the packer expander being only partially threaded onto the inlet manifold), then place the structure in the well to the desired depth by simply inserting the bottom end of the combined structure in the casing, and moving it downward until it reaches a desired depth. The friction offered by the spring dogs 39 will not prevent the downward movement. When it has reached the desired depth, a twisting action is applied to the upper end of the pressure pipe 33 which action carries all the way down and causes the packer expander to thread further onto the inlet manifold, thus expanding the packer to a sealing position with the casing 30. The well is now ready for operation.

It may be desirable to mention that a portion of the water carried upward and pumped out of the well, is returned to the well through the pressure pipe in order to cause the venturi action.

Attention is directed to the fact that while I have referred to a "well casing" continually herein, a satisfactory substitute therefor would be any pipe or confining means. It is not intended that, by referring to a well casing, such a practise as inserting another pipe inside a well casing and placing the assembly and pressure pipe arrangement above described in said inserted pipe shall be clear of the claims of this patent which refers to a well casing. The obvious intendment in that sense is clear.

Wells of surprising depth are entirely feasible with this structure.

The form of the invention herein shown and described presents a preferred embodiment thereof, and delineates its adaption to practical use, but it is to be understood that the present disclosure is to be considered from the illustrative standpoint and not as imposing restriction or limitation on the invention.

While I have herein shown and described certain features of my invention, still I do not wish to limit myself thereto, except as I may do so in the claims.

I claim:

1. An injector pump for wells and the like comprising in combination a casing in a well, a pump exerting suction on one end of said casing, a pressure pipe from said pump into said well within the confines of said casing, a manifold assembly on the opposite end of said pressure pipe from that of the pump, said assembly having an outlet manifold attached to the discharge end of said pressure pipe, said outlet manifold having conduits and a diverter diverting the liquid from said pressure pipe into the conduits, a tube attached to said outlet manifold above the outlet ends of said conduits whereby said conduits discharge within the confines of said tube, an inlet manifold on the other end of said tube, and attached thereon, said inlet manifold having ports opening into the area within said tube, a Venturi pipe in connection with the inlet manifold and extending between said inlet and outlet manifolds and terminating within said outlet manifold, outlet ports in said outlet manifold communicating with said Venturi pipe, said outlet ports discharging into the space between the well casing and the pressure pipe, a splitter dividing the water from said venturi whereby it is divided between said outlet ports, a jet in said inlet manifold with communicating passages to said inlet manifold ports above mentioned, a plurality of suction openings in said inlet manifold, said suction openings leading from an inlet chamber, a portion of the walls of said suction opening being composed of the wall forming the inner circumference of said tube, and said suction openings leading into said venturi, a V-member separating the water from said inlet chamber and directing said water through such suction openings, a connecting pipe leading to said inlet chamber, packer expander and spring dog assembly threading on said inlet manifold, a packer on said inlet manifold expansible radially outwardly by said packer expander, and valve means such as a foot valve on said connecting pipe.

2. A jet type pump comprising a casing in a

well, a pressure pipe within said casing conducting fluid means such as water or the like under pressure downward into said well, an outlet manifold communicating with said pressure pipe within said well, a tube attached to said outlet manifold, an inlet manifold attached to said tube, and spaced from said outlet manifold, a jet means in connection with said inlet manifold, a Venturi pipe from said inlet manifold to said outlet manifold and spaced from said tube walls circumferentially thereof and forming, with said jet means, a Venturi unit, an annular pressure chamber formed by the space between the inner circumference of said tube and outer circumference of said Venturi pipe, and having ports leading to the inlet end of said jet from said pressure chamber, conduits from said pressure pipe leading to said pressure chamber, outlet ports from said Venturi unit, conducting means such as a connecting pipe and an inlet chamber leading from said well into said inlet manifold, suction openings leading from said inlet manifold into said venturi, the arrangement being such that the tube forms a portion of the walls of the pressure chamber, each of the ports leading to the inlet end of the jet and each of the suction openings, and sealing means such as a packer sealing between the casing and the assembly comprising the inlet and outlet manifolds and the tube, said sealing being below the outlet ports above mentioned.

3. In a device of the class described having a pressure pipe conducting fluid under pressure and a well casing removing the fluid which has been pumped, an assembly comprising an ejector unit, said assembly consisting of an outlet manifold connecting to the discharge end of said pressure pipe, an inlet manifold connecting to a source of liquid to be pumped, a Venturi unit consisting of a jet in said inlet manifold and a Venturi pipe leading from said inlet manifold to said outlet manifold, tube means between said inlet and outlet manifolds and circumferentially spaced from said Venturi tube, a pressure chamber formed within said tube means between said inlet and outlet manifolds, and outside of said Venturi pipe, conduits leading from said pressure pipe to said pressure chamber, means such as ports conducting liquid under pressure from said pressure chamber through said Venturi unit, suction openings cooperating with said Venturi unit and drawing said liquid from said well into said Venturi unit, outlet ports in said outlet manifold discharging said liquid from said Venturi unit outside of said assembly.

4. A jet type pump and the like having a central pressure pipe conduit carrying fluid, under pressure, downwardly, an injector unit comprising in combination, a tube, an outlet manifold connected to the discharge end of said pressure pipe, and an inlet manifold connected to a conduit leading from a source of liquid to be pumped, a Venturi unit comprising a jet in said inlet manifold and a Venturi pipe spaced from said tube leading from said inlet manifold to said outlet manifold, said inlet and outlet manifolds being located at opposite ends of said tube, a pressure chamber formed within said tube between said inlet and outlet manifold, conduit means leading from said pressure pipe into said pressure chamber, port means, a portion of the walls of each of which consists of a portion of the tube wall, conducting liquid from said pressure chamber through said Venturi unit, suction openings, a portion of each of the walls of which consists of a portion of the tube wall, said suction openings drawing liquid by means of the suction from the Venturi unit, from said source of liquid and discharging it into said Venturi unit, outlet ports in said outlet manifold discharging a liquid mentioned above from said Venturi unit outside of said assembly, the ports on said inlet manifold conducting liquid under pressure to the jet being formed with the tube as a portion thereof.

5. As an article of manufacture, an inlet manifold having an inlet chamber which communicates with a liquid to be pumped, a recessed portion in said inlet manifold receiving a Venturi pipe, a surrounding tube secured to said inlet manifold and providing in combination with said pipe an annular conduit and a central fluid pressure supply duct beyond the discharge end of said Venturi pipe connected to said annular conduit jet means in said inlet manifold discharging into said Venturi pipe, port means conducting liquid under pressure from said conduit and discharging it into said jet means, at least a portion of the inner wall of said port means formed of a recessed portion in the outer wall circumference of said inlet manifold, and a suction opening from the inlet chamber to the venturi.

6. As an article of manufacture, an inlet manifold having an inlet chamber which communicates with a liquid to be pumped, a recessed portion in said inlet manifold receiving a Venturi pipe, jet means in said inlet manifold discharging into said Venturi pipe, port means conducting liquid under pressure and discharging it into said jet means, at least a portion of the inner wall of said port means formed of a recessed portion in the outer wall circumference of said inlet manifold, and a suction opening from the inlet chamber to the venturi, at least a portion of the inner wall surface of the suction opening being formed of a recessed portion of the outer wall circumference of the inlet manifold.

7. As an article of manufacture, an inlet manifold having an inlet chamber which communicates with a liquid to be pumped, a recessed portion in said inlet manifold receiving a Venturi pipe, said means in said inlet manifold discharging into the said Venturi pipe when said Venturi pipe is in place in said inlet manifold, port means conducting liquid under pressure and discharging it into said jet means, and a suction opening from the inlet chamber to the Venturi pipe, at least a portion of the inner wall surface of the suction opening being formed of a recessed portion of the outer wall surface of the inlet manifold.

8. As an article of manufacture an hydraulic ejector comprising an assembly of at least four separate and distinct parts, one of said parts being an outlet manifold, another of said parts being an inlet manifold with jet means, a third part being a Venturi pipe having a venturi extending substantially along the length thereof leading from said jet means of the inlet manifold to the outlet manifold, and a fourth part being a tube positioned circumferentially around said Venturi means and spaced therefrom, and extending between said outlet manifold and inlet manifold said outlet manifold having conduits therein adapted to deliver fluid under pressure centrally thereof into the annular chamber formed by said third and fourth parts, and to discharge fluid received from said Venturi pipe outwardly of the center thereof, and said inlet manifold having a conduit therein adapted to deliver fluid from said chamber centrally to said

jet means and fluid from around said manifold to an annular space defined by the inlet manifold and of said Venturi pipe and around said jet means.

9. As an article of manufacture an hydraulic ejector comprising an outlet manifold having a pressure pipe receiving opening, at least one outlet port, a recessed portion communicating with said outlet port means, and leading from a Venturi pipe hereinafter defined, a separate pressure chamber tube seated on said outlet manifold, an inlet manifold comprising a separate member seating in the opposite end of said tube from the manifold, a separate Venturi pipe between said inlet and outlet manifolds and within the confines of said tube, a jet in connection with said inlet manifold discharging into said Venturi pipe, a port means in said inlet manifold having a portion only of its wall area defined by said tube and a portion defined by said inlet manifold, the construction being such that fluid received in the pressure pipe receiving opening of the outlet manifold moves through the outlet port into the space between the Venturi pipe and tube, through the port to the jet, whereby to create a suction at the opening of said Venturi pipe, and a passageway past said jet substantially entirely around the outer circumference of said jet connecting to a source of fluid to be pumped.

10. As an article of manufacture, an hydraulic ejector of the class described comprising in combination an outlet manifold having a pressure pipe receiving opening, a diverter, outlet ports, a recessed portion communicating with said outlet ports and receiving the outlet end of a Venturi pipe, and means for receiving a pressure chamber tube; a separate pressure chamber tube connecting to said outlet manifold, said tube forming the outer confining member of a pressure chamber; a separate member comprising an inlet manifold, said inlet manifold having an inlet chamber receiving a fluid being pumped, suction openings communicating with said inlet chamber and the Venturi pipe inlet hereinafter mentioned, a V-member dividing the flow of fluid being pumped as said material moves from said inlet chamber into said suction openings, means in said inlet manifold receiving said tube, said tube also forming at least a part of the outer wall portion of said suction openings, means in said inlet manifold receiving the inlet end of a Venturi pipe, a jet in connection with said inlet manifold port means leading from the pressure chamber to said jet; a separate Venturi pipe, being the Venturi pipe above mentioned positioned at its inlet end portion in position to receive fluid under pressure from said jet and fluid being pumped from said suction openings, and at its outlet end positioned in the place provided therefor in the outlet manifold, the opening of said Venturi pipe communicating with the outlet ports of said outlet manifold as above provided, the outer circumferences of said Venturi pipe forming the inner circumferences of said pressure chamber and forming with the outlet and inlet manifolds and tube above mentioned, the pressure chamber above mentioned.

11. A jet pump comprising an outlet manifold, an inlet manifold, a Venturi tube extending from one manifold to the other and an outer tubular shell interconnecting said manifolds, and means on one of said shell and tube and said manifolds for securing the manifolds, tube, and shell in assembled relation.

12. A jet pump comprising a venturi, a central jet discharging into the throat of said venturi, concentric means forming an inner and outer concentric channel for delivering fluid under pressure to said jet, and for leading fluid from the discharge end of said venturi respectively, said concentric means being substantially coaxial with said venturi and being located on the discharge side of said venturi, and crossed duct means symmetrical about axial planes at right angles to one another for leading fluid from the inner channel exteriorly of and around said venturi to said jet and for leading fluid discharged from said venturi into said outer channel.

13. A jet pump comprising a central fluid inlet passage, a concentric surrounding discharge passage, a venturi coaxially arranged with respect to said passages having its discharge end in juxtaposition with respect to said passages, a central nozzle discharging into the inlet end of said venturi short of the throat thereof, an annular suction passage defined at least in part by the inlet end of said venturi and the exterior of said nozzle, means for leading fluid from said inlet passage exteriorly and substantially concentrically around the length of said venturi and into said nozzle, and means for leading fluid from the outlet end of said venturi into said discharge passage.

14. A jet pump comprising a central fluid pressure inlet passage, a concentric surrounding discharge passage, a venturi coaxially arranged with respect to said passages, a central nozzle discharging into said venturi short of the throat thereof, an annular suction passage defined by the inlet end of said venturi and the exterior of said nozzle duct means for leading fluid from a central point well beyond the inlet end of said nozzle and around said nozzle to the annular suction passage, means for leading fluid from said fluid pressure inlet passage into said nozzle, and for leading fluid from the outlet end of said venturi into said discharge passage.

15. A jet pump comprising an outlet manifold, an inlet manifold, a Venturi tube extending from one manifold to the other, an outer tubular shell connecting said manifolds, means on one of said shell and tube and said manifolds for securing the manifolds, tube, and shell in assembled relation, and means carried by the inlet manifold for engaging a surrounding well casing in sealing relationship therewith.

16. A manifold fitting for a jet pump assembly adapted to be coupled to a depending pressure pipe, comprising a substantially cylindrical block symmetrical with respect to planes at right angles passing through the axis of the block, said block having an enlarged cylindrical central body portion tapering to a lesser diameter at its lower end, a co-axial bore extending into the lower end of the block, said bore flattening and fanning out as it progresses upwardly through the block and emerging in symmetrical opposed discharge passages in the side wall of said block between the central body portion and the upper end thereof, and a second coaxial bore extending into the upper end of the block said bore merging into a dividing passage, extending around said discharge passages and emerging through opposed openings in said tapered position.

17. As an article of manufacture, an hydraulic ejector comprising an assembly of four parts, one of said parts being an outlet manifold having two separate axially directed passages crossing one another, another of said parts being an inlet manifold with jet means, a third part being a

venturi leading from said jet means of the inlet manifold to the outlet manifold, and holding said outlet and inlet manifold parts in spaced axial relation, and a fourth part comprising a tube positioned circumferentially around said venturi and spaced therefrom, said tube being adapted to couple to said manifolds to hold the parts in assembled relation.

18. As an article of manufacture, an hydraulic ejector comprising an assembly of four parts, one of said parts being an outlet manifold, another of said parts being an inlet manifold with pet means, a third part being a Venturi pipe leading from said jet means of the inlet manifold to the outlet manifold, and adapted to hold said outlet and inlet manifold parts in spaced axial relation, said parts having interengaging annular shoulders and recesses to maintain axial alignment, and a fourth part comprising a tube positioned circumferentially around said Venturi pipe and spaced therefrom, said tube adapted to couple ot said manifold to hold the parts in assembled relation.

19. A manifold fitting for a jet pump adapted to be coupled to a depending pressure pipe, comprising a substantially cylindrical block having a central enlarged body portion adapted to receive a tubular housing extending over one end of said block, and two sets of intertwining Y passages each comprising a stem and forked passages, said stem passage emerging at either end of the block, and the corresponding forked passages emerging through the wall of the block on the opposite sides of said enlarged portion from the respective end of the block through which the stem passage emerges said enlarged portion acting in part as a radial wall between the wall emerging forked passages of one set, and the wall passages of the other set.

20. A manifold fitting for a jet pump comprising a substantially cylindrical block adapted to be received in a tubular shell, said block being fluted on opposite sides from one end to a central position to provide in combination with a tubular shell a pair of passages, a diametrical passage connecting the fluted passages, a bore extending into said end of the block to receive a Venturi tube, said bore extending to said diametrical passage, and means within said bore adapted to support a concentric jet connecting with said diametrical passage, said block being fluted along the central length thereof at points circumferentially arranged between said first named fluted passageways to provide in combination with a surrounding shell a pair of longitudinal passageways duct means connecting said last named passageways to said bore adjacent said jet supporting means on the side toward the said end of the block, and a port extending axially inward from the other end of the block and dividing radially to merge into said last named fluted passageways.

21. In a jet pump assembly, a pair of circular coaxial spaced cylindrical tubes, the inner tube having a venturi therein, means at one end of said tubes for delivering a central pressure stream into the annular space between said tubes, and for delivering a discharge stream from said venturi into the annular space around said central pressure stream, means at the other end of said tubes for directing the pressure stream passing through the annular space between the tubes into a central axial jet stream directed into the other end of said venturi, said last named means including means for connecting a central area around the said other end of said venturi with a central source of fluid supply, said area and source being on opposite sides of the said jet stream, means for securing the opposite ends of one of said tubes to secure all of the aforesaid means and tubes in assembled relation.

22. In combination a tubular shell and a manifold fitting for a jet pump, said fitting comprising a substantially cylindrical block adapted to be received and partially enclosed in said tubular shell, an inlet chamber in one end, a chamber in the other end, a jet adapted to discharge into said chamber and a transverse passage for feeding said jet connecting with longitudinal channels formed in the outer wall of said block, ducts leading from the inlet chamber to the second named chamber around said transverse passage, and formed by openings in the manifold wall on opposite sides, said openings and ducts being closed and completed by the aforementioned tubular shell.

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