No. 862,457. PATENTED AUG. 6, 1907.

E. J. FEENY.

PUMP.

APPLICATION FILED SEPT. 17, 1906.

3 SHEETS—SHEET 1.

Fig. 1.

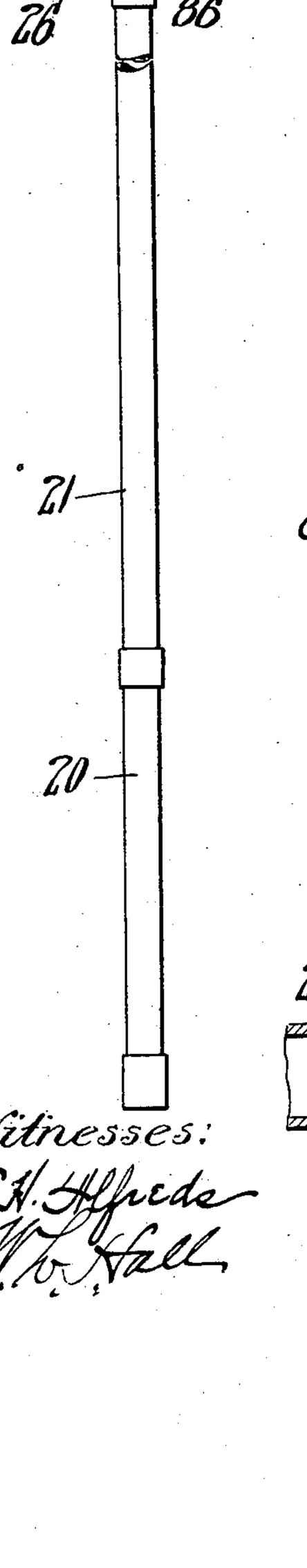


Fig. 2.

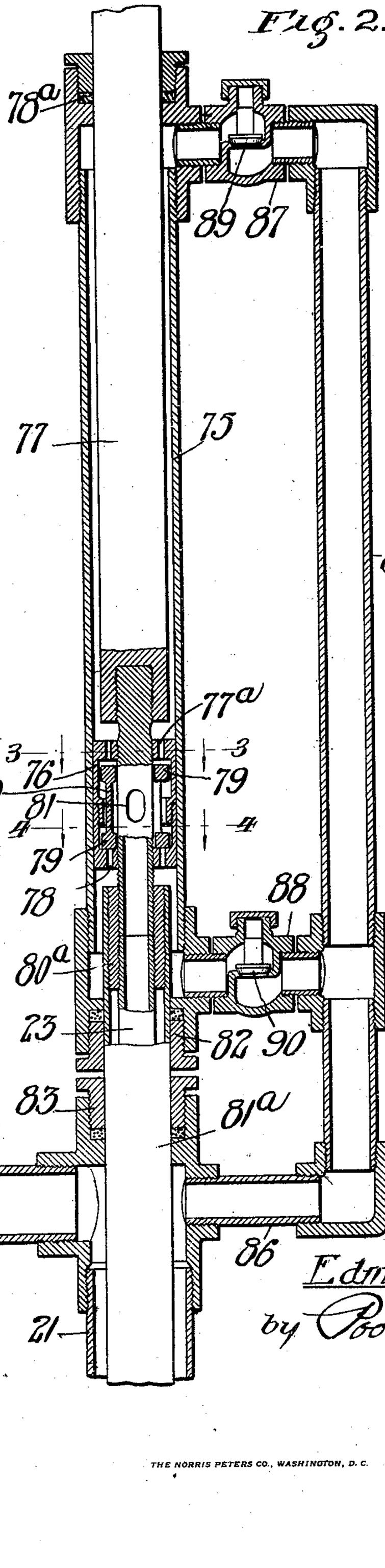


Fig. 3.

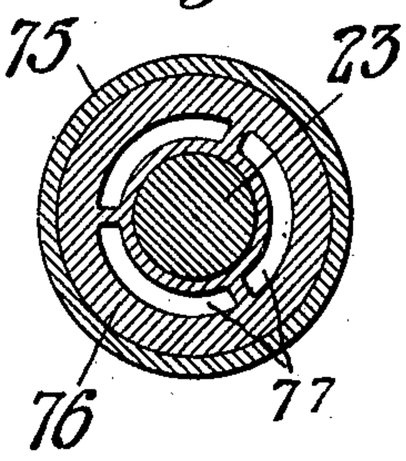
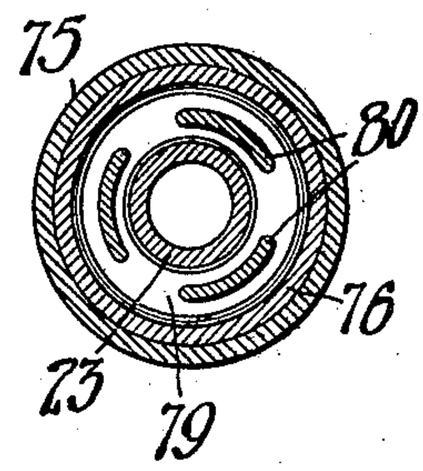


Fig. 4.



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3 SHEETS—SHEET 2.

Fig. 5.

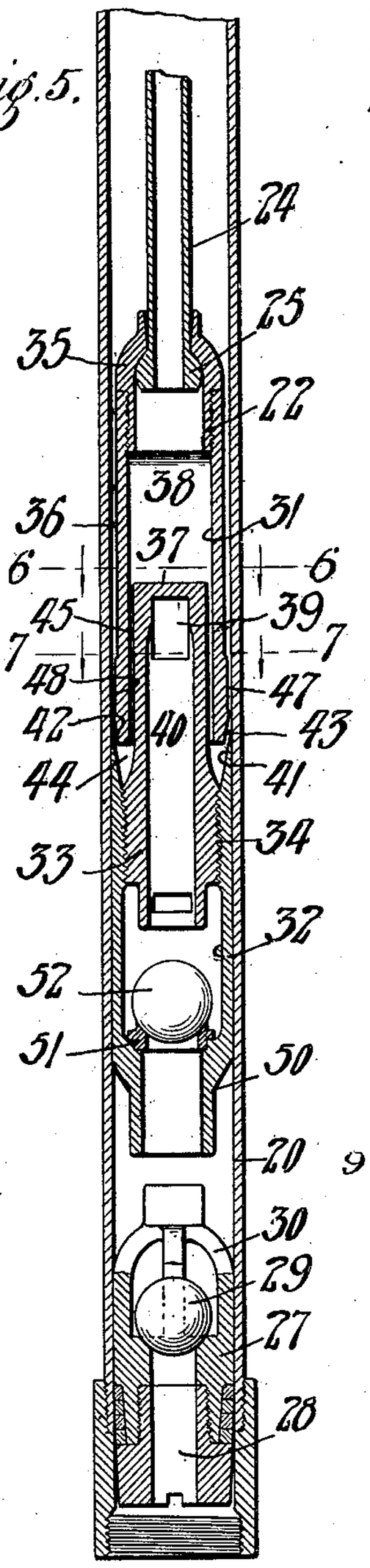


Fig. 8.

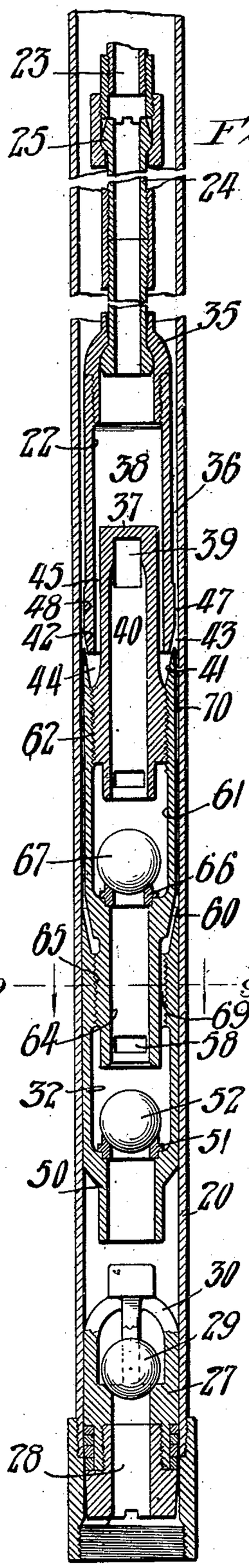


Fig. 6.

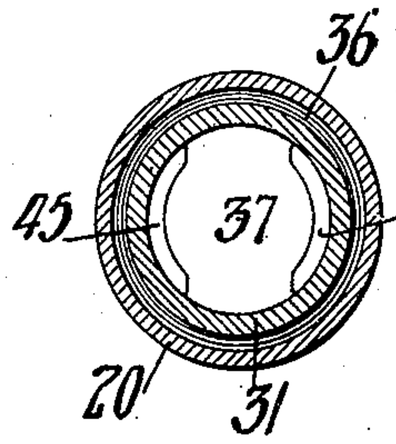


Fig. 7.

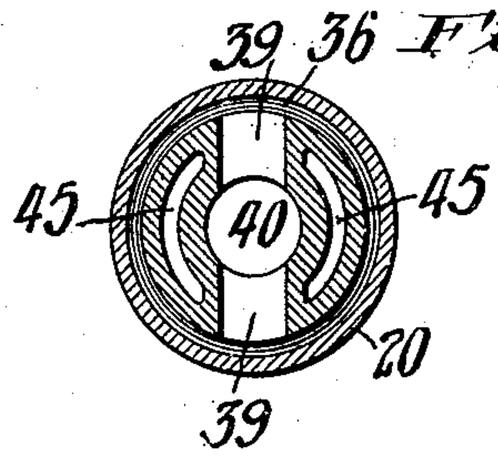
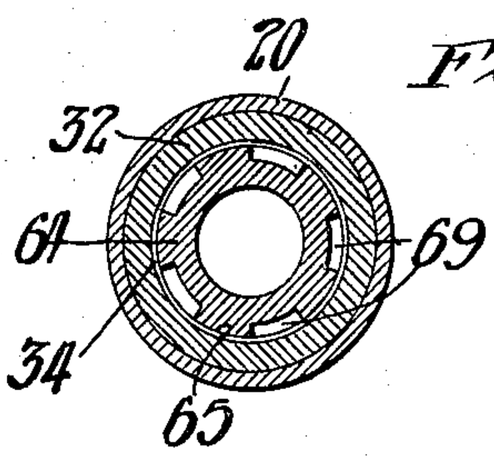


Fig. 9.



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No. 862,457. PATENTED AUG. 6, 1907.

E. J. FEENY.

PUMP.

APPLICATION FILED SEPT. 17, 1906.

3 SHEETS—SHEET 3.

Fig. 10.

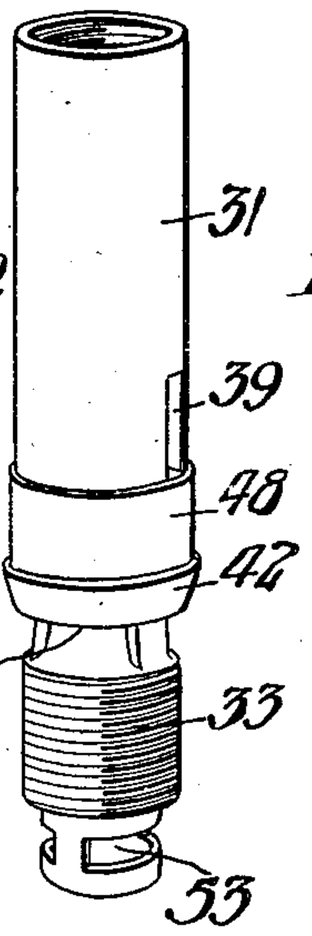

Fig. 11.

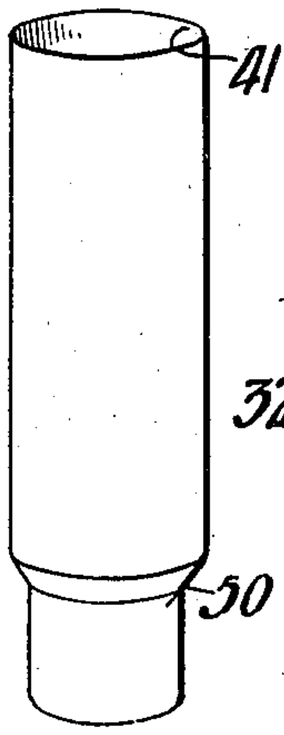

Fig. 12.

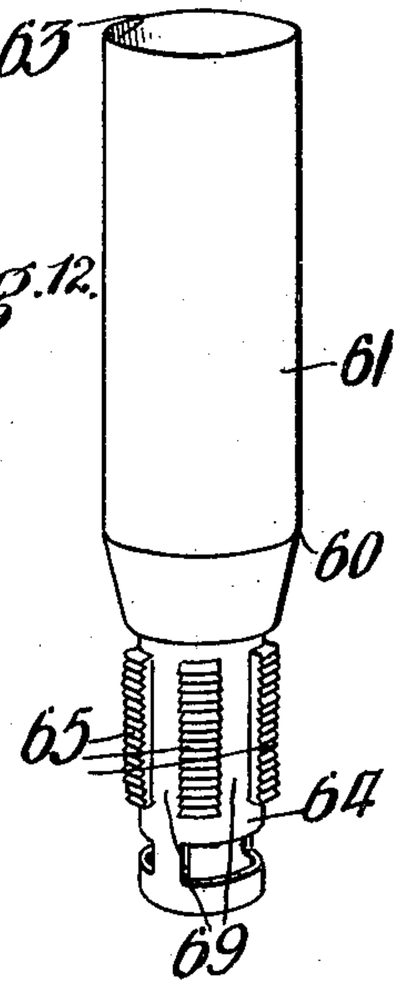

Fig. 13.

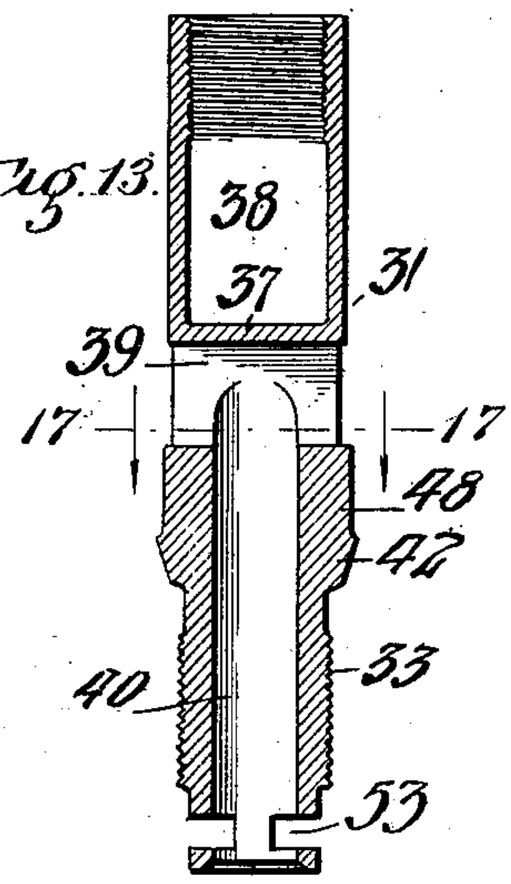

Fig. 14.

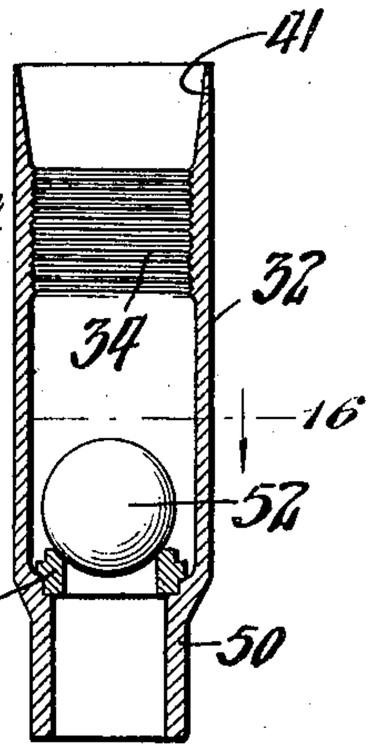

Fig. 15.

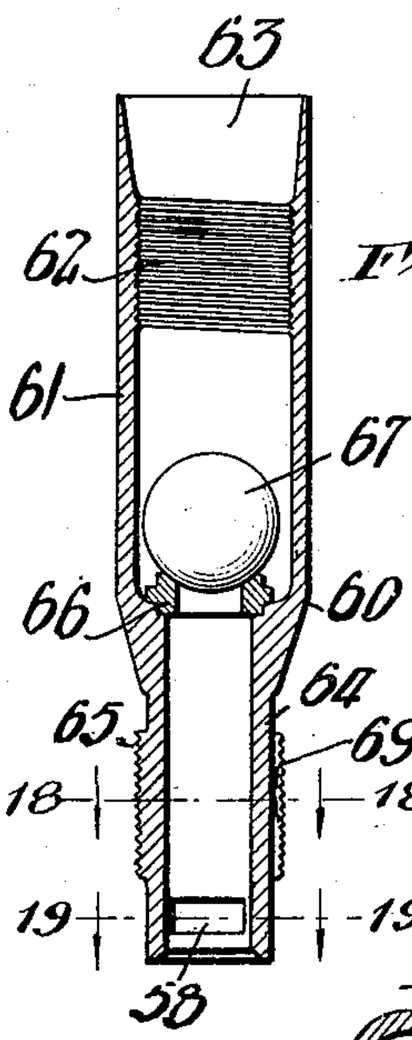

Fig. 16.

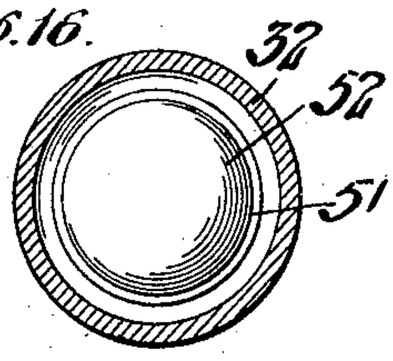

Fig. 17.

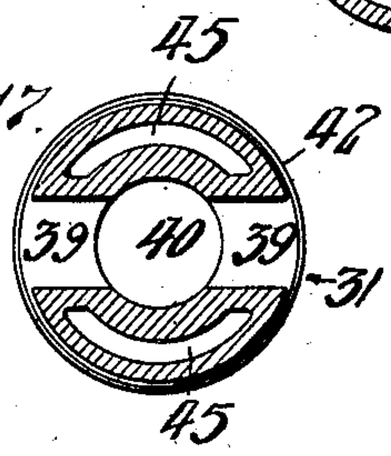

Fig. 18.

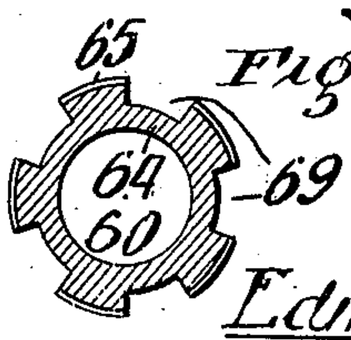

Fig. 19.

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UNITED STATES PATENT OFFICE.

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PUMP.

No. 862,457. Specification of Letters Patent. Patented Aug. 6, 1907.

Application filed September 17, 1906. Serial No. 334,946.

To all whom it may concern:

Be it known that I, EDMUND J. FEENY, a citizen of the United States, of Ottawa, in the county of Lasalle and State of Illinois, have invented certain new and useful Improvements in Pumps; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

This invention relates to improvements in pumps and embraces as one of its features, improvements in that class of pumps designed more particularly for pumping fluids containing in suspension more or less of gritty substance, such as oils mixed with fine sand as it comes from the well, and as another of its features, improvements designed to increase the capacity of the pump when pumping any fluid.

The invention also embraces a process of pumping liquids by the combined action of a lifting device as a piston and a fluid jet which serves to so reduce the pressure in front of the piston as compared to that in rear of the piston that the flow of liquid in each pumping stroke of the piston is increased beyond that due to the ordinary action of the piston.

My process also embraces the further step of utilizing the fluid jet which produces the injecting effect referred to to fluid pack the piston.

Among the objects of the invention is to provide an improved construction and arrangement of the parts of the pump, designed to prevent wear between the pump piston and cylinder and a further object of the invention is to increase the capacity of the pump by combining with the lifting action of the pump piston the injection action of a fluid forced through suitably arranged spaces or passages in the piston, said injection action operating to produce a differential pressure in rear of and in front of the piston which increases the capacity of the pump.

In the practice of my novel process fluid is forced through suitable passages in the piston to produce an injecting jet acting in the direction of the pumping stroke of the piston whereby the pressure in front of the piston is so decreased as to effect the forcing of the liquid from the rear to the front of the cylinder beyond that due to the usual lifting action of the piston. The said fluid jet may be employed also as a fluid packing in a pump wherein the piston is formed to provide an annular passage between the same and the cylinder, the said jet being forced through said passage in the direction of its pumping movement.

The invention consists in the matters hereinafter set forth and more particularly pointed out in the appended claims.

In the drawings:—Figure 1 is a side elevation of a pump embodying my invention, it being broken away between its ends to indicate an indefinite length of the casing. Fig. 2 is a vertical section of the double acting pump which operates to force a fluid packing jet between the piston and cylinder and which jet acts with an injection action to increase the capacity of the pump. Figs. 3 and 4 are transverse sections, taken on lines 3—3 and 4—4, respectively, of Fig. 2. Fig. 5 is a vertical section of the pump cylinder and one form of piston therein. Figs. 6 and 7 are cross-sections, taken on lines 6—6 and 7—7, respectively, of Fig. 5. Fig. 8 is a view similar to Fig. 5 illustrating a modification of the pump piston. Fig. 9 is a cross-section, taken on line 9—9 of Fig. 8. Figs. 10 and 11 are side elevations of the two sections constituting the form of piston shown in Fig. 5. Fig. 12 is an intermediate section joining said latter sections to constitute the elongated piston of the pump shown in Fig. 8. Fig. 13 is a longitudinal section of the section shown in Fig. 10. Fig. 14 is a longitudinal section of the section shown in Fig. 11. Fig. 15 is a longitudinal section of the section shown in Fig. 12. Fig. 16 is a cross-section, taken on line 16—16 of Fig. 14. Fig. 17 is a cross-section, taken on line 17—17 of Fig. 13. Figs. 18 and 19 are cross-sections, taken on lines 18—18 and 19—19, respectively, of Fig. 15.

As shown in the drawings, 20 designates the pump cylinder or barrel, 21 the tubing extending upwardly from said barrel to the surface at which the liquid is discharged, and 22 designates, as a whole, the piston within said cylinder 20, a simple form whereof is shown in Figs. 5, 6 and 7. Said piston is connected to a pump-rod 23 through which power is transmitted to reciprocate the piston. The said piston rod 23 is connected with the piston through the medium of a flexible joint so constructed that the movement of the piston is independent of the rigidity, or lack of alinement, of the piston-rod, thereby avoiding tendency of the piston rod to exert lateral stress on the piston in a manner to cause the piston to wear unequally on one side thereof. The joint herein shown embraces a short rigid rod 24 having at its ends bearing-heads 25 adapted to engage complemental sockets in the upper end of the piston and the lower end of the rod, as shown more clearly in Figs. 5 and 8. This construction is shown and claimed in my prior application for United States Letters Patent Serial No. 290,019, filed December 2nd, 1905.

The tubing of the pump is provided at the discharge point with a spout 26. The cylinder of the pump is provided at its lower end with an upwardly opening check-valve consisting, in this instance, of a hollow plug 27, the bore 28 of which is closed at its upper end by a downwardly seating ball-valve plug 29, which latter is suitably confined in place by a cage 30.

Referring now to the construction of the simpler form of piston shown in Figs. 5, 6, 7, 10, 11, 13, 14, 16 and 17, said piston is made as follows: This form of piston comprises two cylindric, tubular members 31 and 32, respectively, the upper member having a reduced screw-threaded portion 33 which has screw-threaded engagement with interior screw-threads 34 on the lower member or section, as shown in Figs. 5 and 14. The upper section 31 of the piston is joined by a suitable coupling 35 with the lower end of the jointed rod 24 which constitutes the flexible joint between the piston and the piston rod. Said coupling has screw-threaded engagement with the upper end of the upper member 31 and is formed at its inner upper end to constitute a socket to receive the ball or jointed end 25 of the rod member 24. It will be observed by an inspection of Fig. 8 that said rod 24 is made of two parts to facilitate the assemblage thereof with the associated parts. The upper section 31 of the piston is made of less diameter than the pump cylinder or barrel 20 thereby providing between said parts an annular passage 36. The upper and lower ends of the hollow piston section 31 are divided by a transverse diaphragm 37 forming between said diaphragm and the upper end of said section a chamber 38. Said upper section of the piston is provided below said diaphragm 37 with lateral openings 39 extending to the cylindric surface of the piston and through which the passage 40 below the diaphragm 37 communicates with the annular passage 36 between the upper end of said section and the cylinder wall. Above the screw-threaded part 34 of the lower section is formed an upwardly flaring portion 41 which fits outside of in partial overlapping relation with an exterior annular oblique surface 42 (Figs. 5, 10 and 13) on the upper section 31 of the piston, thereby forming between the same an upwardly directed oblique annular passage 43 (Fig. 5). When the sections of the piston are brought together the lower end of the larger portion of the upper section terminates just within the expanded or enlarged upper end 41 of the lower section, thereby forming between said upper and lower sections an annular space 44 which communicates with the space 38 in the upper part of the piston through laterally separated passages 45 (Figs. 5, 6 and 17), and said annular space 44 also communicates with the annular passage 36 between the piston and cylinder through the passage 43, the said passage 36 extending considerably above the lateral ports 39, 39. The said annular space or passage 36 is restricted at its lower end, as shown at 47, (Fig. 5) by reason of the enlargement of the upper piston section at 48 (Figs. 10 and 13) as compared to the diameter of the section above the same. The liquid which passes through the piston to the upper side thereof and is raised by said piston passes through the annular space 36 between the upper section of the piston and pump barrel.

The lower section 32 of the piston is made to fit snugly within the cylinder, though not with a working fit. It comprises a short tubular member having a reduced lower end 50. Located near the lower end of said lower section is an annular valve seat formed, as shown, on a removable ring 51 which is engaged by a spherical valve closure 52 constituting the check-valve of the piston, said check-valve rising as the piston is lowered to permit liquid contained in the lower end of the cylinder to pass upwardly through the piston and from thence through the annular passage 36 surrounding the same to the upper side of the piston; and when the piston is raised to raise the liquid above the same, the valve seats upon the valve ring 51 to prevent the liquid from leaking past the valve in a familiar manner. The lower end of the reduced part of the upper section 31 of the piston is provided with lateral ports 53 through which liquid may pass at a time when the valve closure 52 is raised against the lower end of said upper section, as when the piston is being lowered.

The piston operates in the usual manner of a valved piston of this character to raise the liquid above the piston when the piston rises, the spherical valve closure 52 of the piston being at this time seated, and the cylinder valve at the same time opened to permit the lower end of the cylinder to be filled with the liquid being pumped. When the piston descends, the lower cylinder valve closes and the piston valve opens to permit the liquid to pass through the hollow piston, through the ports 39 and thence through the annular passage 36 to the upper side of the piston, to be raised during the next up-stroke of the piston.

The piston is fluid packed, and may be packed by fluid supplied from a source near the discharge point of the pump through the hollow piston rod 23. The construction and arrangement of the piston described permits the packing fluid to pass from the hollow piston rod, through the chamber 38, thence through the passages 45, 45, to the annular space 44, and thence upwardly through the annular, oblique passage 43 and the restricted passage 47 to the passage 36, wherein such packing fluid commingles with the liquid being pumped. The fluid thus operating to pack the piston is forced under such pressure or speed through the passages 36, 43 and 47 as to prevent the weight of the liquid column above the same causing the liquid to leak downwardly between the piston and cylinder.

I have provided, in connection with the construction described, pumping means located at or near the discharge spout of the pump in the nature of a double-acting fluid pump which forces the packing jet through said annular packing spaces during both strokes of the piston whereby the piston is fluid packed in both directions of its pumping movement. Any suitable double pump mechanism may be employed for this purpose, and an approved pumping mechanism will hereinafter be described. It is understood that the lower section or part of the piston, although fitting snugly in the cylinder is not intended to constitute a metal packing fit, and said lower section constitutes an elongated guide for the piston.

An important function is produced by the jet thus forced between the piston and cylinder, in addition to its packing function, and that is the action of said jet is such as to operate with an injecting effect to draw the liquid through the piston in a quantity beyond that produced by the ordinary lifting action of the piston. Thus, when the packing fluid is forced into the piston and thence outwardly through the annular passages 43 and 47 to the annular passage 36, the speed at which the packing fluid is directed through said passages has the effect of reducing the pressure in the upper part of said passage below that in the piston at a point below the radial ports 39, whereby the superior pressure in the lower

part of the piston and in the lower part of the cylinder and the source from which the fluid is drawn forces an additional quantity of the fluid through the piston. Such injecting action is effected in both strokes of the piston when the pump by which the packing fluid is forced through the piston is a double acting pump. The injecting effect of the fluid thus produced operates during the down-stroke of the piston to assist in raising not only the piston check-valve 52 as is its usual action, but also causes the check-valve 29 at the lower end of the cylinder to be raised off its seat, so as to increase the flow of liquid through said valve through the piston. Such injecting effect acts also during the upstroke of the piston to not only assist in lifting the cylinder check-valve 29 off its seat, as is usual in the action of the pump, but also to lift the piston check-valve 52 off its seat, and thereby increase the passage of liquid through the piston. In both strokes of the piston, therefore, it is found that the capacity of the pump is materially increased. This increased capacity of the pump is due to the forcing of fluid at a high speed through the relatively long annular passage 36 which extends above the ports 39 of the piston whereby is produced a lower pressure in said passage so that the higher pressure below forces the fluid in increased quantities through the passage 40 of the piston, such differential pressure acting to raise the valves 52 and 29 off of their seats at times, when under normal conditions in this type of pump, they would be pressed tightly upon their seats. By the construction described, therefore, I am able to produce, not only a packing action of the fluid in both strokes of the piston, but am also able to greatly increase the capacity of the pump. It is obvious that the same conditions would obtain in one stroke of the piston when a single acting pump is employed to force the packing fluid through and out of the piston in the manner described.

The construction shown in Figs. 8 and 9, while performing the office of fluid packing the cylinder in the same general manner as above described, is designed to perform also the function of further increasing the capacity of the pump by the injecting action of the packing jet. In this form of pump, the two sections 31 and 32, hereinbefore referred to, are supplemented by a third or intermediate section 60, shown in detail in Figs. 9 and 15, and shown as assembled in the pump cylinder in Fig. 8. The upper and lower sections 31 and 32 bear similar reference letters as disclosed in the description of the other figures. The section 60 interposed between the two sections 31 and 32 hereinbefore described, comprises a main tubular part 61 provided at its upper end with a screw-threaded portion 62 which has screw-threaded connection with the screw-threaded lower end 33 of the upper section (Fig. 8). It is provided at its extreme upper end with an outwardly flaring portion 63 that fits around the part 42 of the upper section, and is provided with a reduced lower portion 64 having exterior screw-threads 65 that engage the screw-threads 34 in the upper end of the lower section 32 of the fluid. The said intermediate section is provided between the larger and reduced portions thereof with an internal ring 66 on which is formed a valve seat that is engaged by a spherical valve closure 67 that is adapted to rise when the cylinder is being forced downwardly and to be seated by gravity when the cylinder is raised. The lower reduced end of the intermediate section 60 of the cylinder is provided with lateral openings 58 upwardly through which the liquid passes in case the lower end thereof is closed by the rising of the closure 52 of the lower cylindric section. The screw-threads of the lower reduced end of the intermediate section 60 are cut away or interrupted to provide channels or grooves 69 between the same and the upper cylindric portion of the lower section, as clearly indicated in Figs. 9 and 12, upwardly through which liquid may pass to the annular passage 70 between the intermediate section of the piston and the cylinder, as will be hereinafter more fully described. The said intermediate section 61 of the piston is made of somewhat greater diameter than the upper section 31, but still of sufficiently less diameter than the internal diameter of the pump cylinder or barrel as to provide the annular passage 70, before referred to around said intermediate section. Said annular passage 70 directs liquid delivered thereto through the passages 69, 69 to the annular passage 36 between the upper section of the piston and the cylinder walls. In this construction, the spherical valve closures 52 and 67 rise, as in the usual operation of pumps of this character, during the down-stroke of the piston, to permit the liquid, which is contained in the lower part of the cylinder, to pass upwardly through the hollow cylinder and above the same and to be raised during the next succeeding up-stroke of the piston. During the up-stroke of the piston, the natural or normal operation of the valves tend to occur, that is to say, the valves 52 and 67 tend to close on their seats so as to lift all of the liquid that has been forced above the piston. This tendency, however, is overcome by reason of the injecting effect of the jet of packing fluid which is forced through the hollow piston rod 23 into the chamber 44 of the piston, thence through the passages 43 and 47 into the annular passage 36. Such injecting effect tends at this time to raise the valves 52 and 67 to increase the flow of liquid therethrough. The forcing of this fluid packing jet through said passages acts, in the manner above described, to fluid pack the piston. The said fluid packing jet acts, however, with greater force than in the construction hereinbefore described, to produce an injecting effect to increase the pumping capacity of the pump, inasmuch as such injecting effect acts, not only through the interior passages of the piston, as heretofore described, but in addition thereto, such effect is exerted to force the liquid in the lower end of the piston upwardly through the passages 69 of the interrupted screw-thread 65 at the lower end of the intermediate section and through the annular passage 70 formed between the intermediate portion of the piston and the inner wall of the barrel or cylinder of the pump. That is to say, the increased capacity of the pump of the latter described construction is that added to the former construction by reason of said passages 69 and 70. In this manner, I am enabled, not only to fluid pack the piston as effectively as described in the prior construction, but am enabled to very materially increase the capacity of the pump beyond the construction previously described.

The double acting pump hereinbefore referred to for forcing fluid through and out of the piston for packing purposes and for also effecting an injecting action to

increase the capacity of the pump, is generally similar to that shown in my prior application for United States Letters Patent, Serial No. 290,019, filed December 2nd, 1905. Said double acting pump is so arranged that a portion of the liquid raised by the main pump is diverted to constitute a supply for the double acting pump for the purpose of fluid packing the piston and increasing the capacity of the pump as before stated.

The double acting pump comprises a barrel or cylinder 75 shown as located in alinement with the pump casing and a reciprocating piston 76 which is attached to the upper end of the hollow piston rod 23. The said piston 76 is hollow and is provided in its upper and lower end walls with ports 77ª, 78, respectively, through which fluid passes from the cylinder to the interior of the piston. The said ports 77ª, 78 are closed by a valve within the hollow piston and surrounding the piston rod, said valve having the form of two rings 79, 79 connected by integral bars 80. The hollow piston rod extends into the piston and is provided therein with a port or opening 81 through which fluid passes from the double acting pump cylinder to the hollow piston rod. The piston rod 23 extends above the piston 76 and is connected with an enlarged section 77 which extends through a suitable stuffing box 78ª in the upper part of the end wall of the cylinder 75 for connection with the operative mechanism of the pump, (not shown). The piston rod 23 below the double-acting piston is contained within and connected by a coupling 80ª with the upper end of a large tube 81ª of the same diameter as the section 77 of the piston rod, and said tube 81ª extends through a stuffing box 82 in the lower end of the double acting pump cylinder or barrel and a like stuffing box 83 in the upper end of the pump casing 21. Said pipe 81ª extends below the stuffing box 83 when the piston 76 is in its lowermost position a distance somewhat greater than the length of the stroke of the piston. The enlarged upper section 77 of the pump piston rod and the tube 81ª described are provided in constructions where the fluid directed to the hollow piston is diverted from the outflow of the main pump, in order to limit the capacity of the double-acting pump cylinder to that required to supply a fluid to the annular spaces of the lower pump piston to fluid pack the same and to provide the fluid to increase the pump capacity of the piston in the manner described.

The arrangement for diverting a portion of the outflow of the liquid from the upper end of the pump casing to the upper and lower ends of the cylinder or barrel 75 of the double acting pump, consists of a pipe 85 which receives liquid from the upper end of the pump casing through a pipe 86, and is provided with upper and lower branches 87 and 88 through which liquid is delivered alternately to the upper and lower ends of the double acting pump cylinder 78. Said branches 87 and 88 are provided with downwardly closing check-valves 89 and 90, respectively, which control the flow of the liquid to the double acting pump cylinder. When the piston 76 moves upwardly the lower ports 78 and the check-valve 89 are closed and the upper ports 77ª and the check-valve 90 open. The liquid in the cylinder above the piston is, therefore, forced through the ports 77ª of the hollow piston, thence through the port 81 of the hollow piston rod 23, and thence downwardly through the hollow piston rod to the piston below, and operates in the manner described to fluid pack the lower piston and to produce the injecting effect described to increase the capacity of the lower pump. During the down-stroke of the double acting pump piston the liquid previously forced into the lower end of the cylinder through the branch 88 is forced through the port 78 into the hollow piston rod, the check-valve 89 and the upper piston ports 77ª being at this time closed. The capacity of the upper double acting pump, with respect to that of the passages afforded by the arrangement of the described parts of the main piston is such as to carry the liquid through said passages under considerable pressure and speed. The double-acting pump which operates to divert a portion of the liquid being pumped to the cylinder for the purpose of fluid packing the same, and also for the purpose of increasing the capacity of the pump in the manner stated is a convenient construction for this purpose, but it will be understood that any other form in the nature of a double acting pump may be used for this purpose, and that the source of fluid need not necessarily be the source of supply from which the liquid is being taken by the main pump nor need not be a liquid, as distinguished from a fluid. For instance, the packing and injecting fluid may be compressed air, steam or the like.

It will be understood that the lower section 32 of the piston, while fitting snugly in the cylinder when the parts are first assembled, is not intended to operate with a packing effect in the cylinder, the packing being produced by the fluid jet referred to; but said lower extension of the piston is intended merely to serve as a guide. It will be seen, therefore, that the piston proper operates without a packing fit in itself in the cylinder. The piston, while shown as made of a number of sections suitably joined together, may be otherwise constructed so long as the principle of operation remains the same as hereinbefore described.

The construction and arrangement shown whereby fluid is delivered to a piston which operates without a working fit in the cylinder and is projected therefrom to fluid pack the piston is not herein broadly claimed, but is made the subject of a prior application for United States Letters Patent, filed by me March 21st, 1905, Serial Number 251,244.

I claim as my invention:—

1. In a pump, the combination with the reciprocating piston thereof, of means for producing at the piston a fluid injecting action to supplement the action of the piston for the purpose set forth.

2. In a pump, the combination with the reciprocating piston thereof and means for producing at the piston a fluid injecting action to supplement the action of the piston, combined with means for fluid packing the piston, for the purpose set forth.

3. The combination with the cylinder of a pump and its piston operating without packing fit therein, of means for directing a jet of fluid to the piston in a manner to fluid pack the same, and means whereby said fluid jet operates, by an injecting effect, to supplement the forcing action of the piston and thereby increasing the capacity of the pump.

4. The combination of the cylinder of a pump and its hollow valved piston provided with passages for receiving and discharging a jet of fluid forced thereinto, said passages of the piston being constructed to discharge said jet of fluid with an injecting effect which acts through the hollow piston to decrease the pressure on the advance side of the piston whereby the pumping action of the piston is

supplemented by the superior pressure in rear of the piston for forcing liquid through the piston.

5. The combination of the cylinder of a pump and its hollow valved piston operating without a packing fit therein, provided with passages for receiving and discharging a jet of fluid forced thereinto, said passages of the piston being constructed to discharge said jet of fluid with an injecting effect which acts through the hollow piston to decrease the pressure on the advance side of the piston, whereby the pumping action of the piston is supplemented by the superior pressure in rear of the piston for forcing liquid through the piston, and means whereby said jet operates to fluid pack the piston.

6. The combination with a pump cylinder and its piston, the latter being made smaller at its advance end than the interior diameter of the cylinder, thereby affording an annular passage around the piston, of means for delivering a jet of fluid to said passage, said parts being so constructed and arranged that said jet effects an injecting action which increases the capacity of the pump.

7. The combination with a pump cylinder and its piston, the latter being made smaller at its advance end than the interior diameter of the cylinder, thereby affording an annular passage around the piston, of means for delivering a jet of fluid to said passage in a manner to fluid pack the piston, said parts being so constructed and arranged that said jet effects an injecting action which increases the capacity of the pump.

8. The combination with a pump cylinder and its piston, the latter being made smaller at its advance end than the interior diameter of the cylinder, thereby affording an annular passage around the piston, which communicates by a suitable passage with the cylinder in rear of the piston, of means for delivering a jet of fluid to said passage, said passage being so constructed and arranged that said jet produces an injecting effect which acts through the passage leading to the rear of the piston to supplement the pumping action of the piston to increase the action of the pump.

9. The combination with a pump cylinder and its piston, the latter being made smaller at its advance end than the interior diameter of the cylinder, thereby affording an annular passage around the piston which communicates with the cylinder in rear of the piston through a suitable passage, of means for directing a jet of fluid to said annular passage in a manner to fluid pack the piston, and means whereby said fluid jet operates to produce an injecting effect which acts through the passage leading to the rear end of the piston to decrease the pressure at the front end of the piston and thereby increase the capacity of the pump.

10. The combination with a pump cylinder and its hollow, valved piston, the latter being made smaller at its advance end than the interior diameter of the cylinder, thereby affording an annular passage around the piston, which passage communicates through the hollow piston with the space in the cylinder in rear of the piston, of means for delivering a jet of fluid to said passage and means whereby said jet operates to produce an injecting effect, which acts through said hollow piston to decrease the normal pressure in front of the piston as compared with the pressure in rear thereof, and thereby supplement the action of the piston to increase the capacity of the pump.

11. The combination with the cylinder of a pump and its hollow, valved piston, the latter being made smaller at its advance end than the interior diameter of the cylinder, thereby affording an annular passage around the piston, said piston being provided with a radial port connecting the interior of the piston with said annular passage, and the piston being provided with a passage which extends below said radial port designed to receive a jet of fluid, opening at its lower end obliquely into said annular passage, whereby a fluid jet forced through said piston passage is discharging therefrom into said annular passage, thereby producing an injecting effect which acts through said port and hollow piston to supplement the action of the piston to increase the capacity of the pump.

12. The combination with a pump and its hollow, valved piston, the latter being made smaller at its advance end than the interior diameter of the cylinder, thereby affording an annular passage around the piston, said piston being provided with a radial port connecting the hollow interior of the piston with said annular passage, and the piston being further provided with a passage which communicates with said annular passage below said radial port, whereby a jet of fluid forced through said piston passage is discharged into the annular passage in a manner to fluid pack the pump, and also to produce an injecting action which operates, through the hollow piston, to increase the capacity of the pump.

13. The combination with a pump cylinder and its hollow, valved piston, the latter being made smaller at its advance end than the interior diameter of the cylinder, thereby affording an annular passage around the piston, said piston being provided intermediate the ends of said hollow annular passage with a radial port through which the hollow piston communicates with said annular passage, and the piston being provided with another passage which communicates with said annular passage below said radial port, the connection between said piston passage and the annular passage being constructed to direct fluid from said passage of the piston to said annular passage and against the piston wall in the form of a hollow flaring jet.

14. The combination with the pump cylinder and its elongated hollow, valved piston, the latter being made smaller at its advance end than the interior diameter of the cylinder, thereby providing an annular passage around the piston, said piston being provided with a radial port through which communication is had from the interior of the piston to said annular passage and provided also with another passage which commuincates with said annular passage below said port, whereby a jet of fluid forced through said piston passage is projected into the said annular passage outwardly against the wall thereof, said annular passage having communication with the interior of the piston through said radial port, and the piston being constructed and arranged to provide outside of the same a second passage which affords communication between said annular passage and the cylinder in rear of the piston.

15. The combination with the cylinder of a pump, its piston and its hollow piston-rod, of means for delivering a fluid under pressure through said rod to the piston, said piston being provided with passages through which the fluid is discharged therefrom, and said passages being formed and arranged to produce an injecting action which supplements the force of the piston to increase the capacity of the pump.

16. The method of pumping liquids which consists in supplementing the action of the reciprocating piston of the pump by producing at the piston an injection action of a fluid acting in the direction of the flow of the pumped liquid.

17. The method of pumping liquids which comprises the steps of forcing the liquid through and out of the pump cylinder by the action of a piston and forcing a jet of fluid under higher pressure than that at the outlet of the pump to the piston in a manner to produce an injecting action to supplement the force of the piston on said liquid.

18. The method of pumping a liquid and fluid packing the piston of the pump which consists in moving the liquid through and out of the cylinder by the action of a piston and forcing a jet of fluid to the piston under higher pressure than that at the outlet of the pump in a manner to fluid pack the piston, and utilizing the action of said fluid jet to produce an injecting effect to supplement the force of the piston on said liquid of the pump.

19. In a pump, the combination with its reciprocating piston operating without a working fit therein, of means operating to deliver fluid to the piston and discharge it therefrom in a manner to fluid pack the piston during both strokes of the piston.

20. In a pump, the combination with its reciprocating piston, said piston being made smaller at its advance end than the interior diameter of the cylinder and provided with a passage which communicates with the annular space between the piston and cylinder, of means operating to deliver fluid to the passage of the piston during both strokes of the piston from whence it is discharged into the

inner or lower end of the annular passage to fluid pack the piston.

21. In a pump, the combination with its reciprocating piston operating without a working fit therein and a hollow piston-rod, of means operating during both strokes of the piston to deliver fluid through the hollow piston rod to the piston and discharge it therefrom in a manner to fluid pack the piston.

22. In a pump, the combination with the reciprocating piston thereof, of means acting in both strokes of the piston for producing at the piston a fluid injecting action to supplement the action of the piston for the purpose set forth.

In testimony, that I claim the foregoing as my invention I affix my signature in the presence of two witnesses, this 27th day of August, A. D. 1906.

EDMUND J. FEENY.

Witnesses:

THOMAS R. BLACK,

JOHN B. BENBOW.