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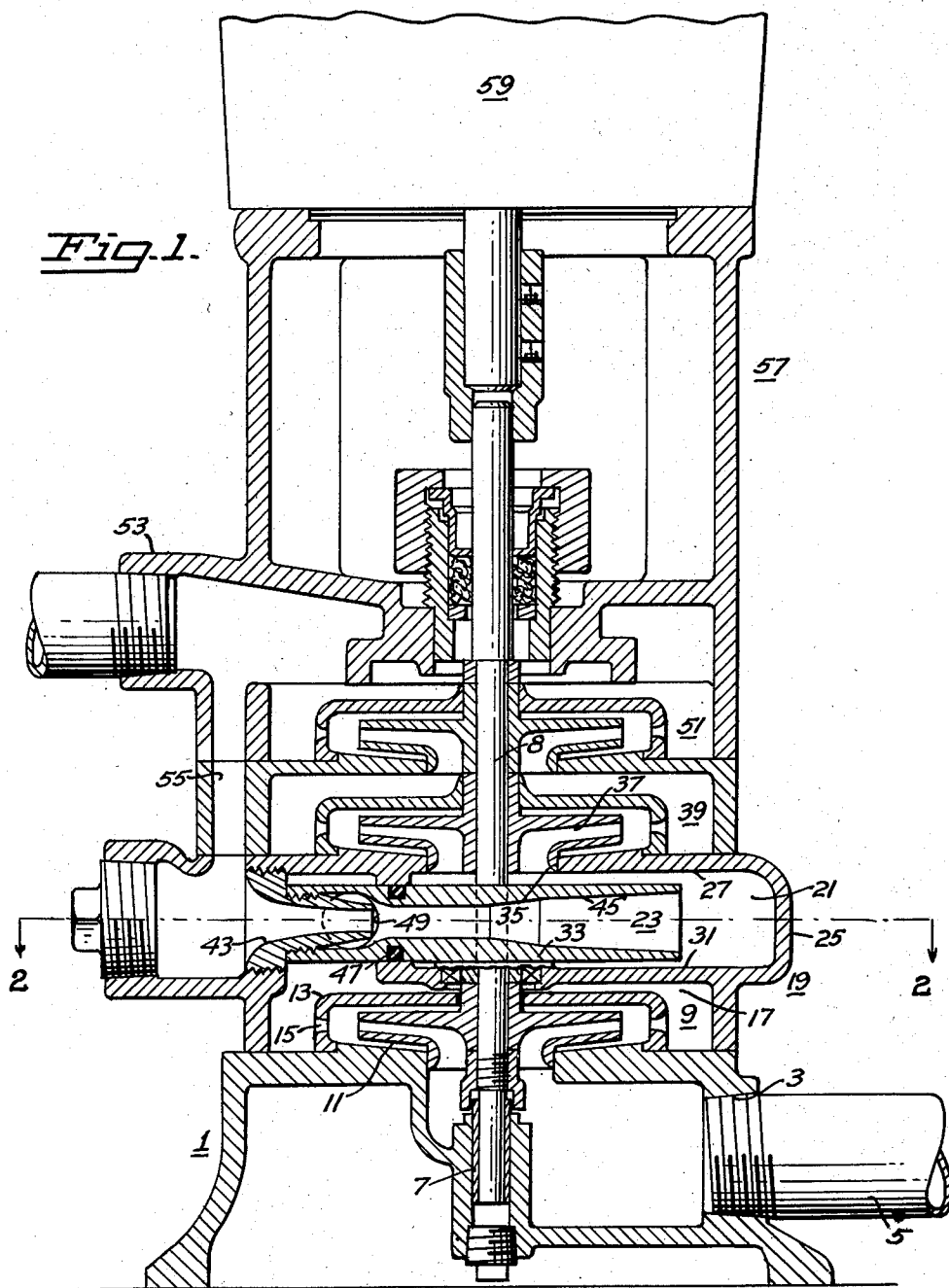
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SHALLOW WELL EXPANDED OUTPUT PUMP

Filed Oct. 25, 1954

3 Sheets-Sheet 1



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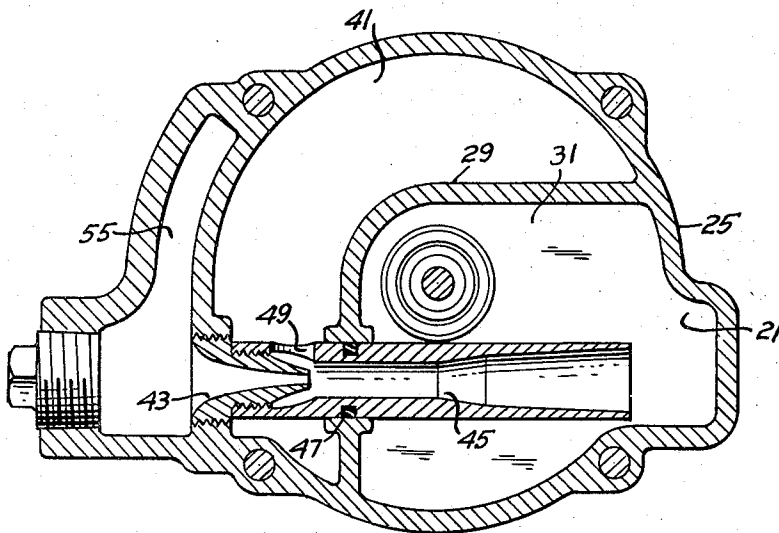


Fig. 2.

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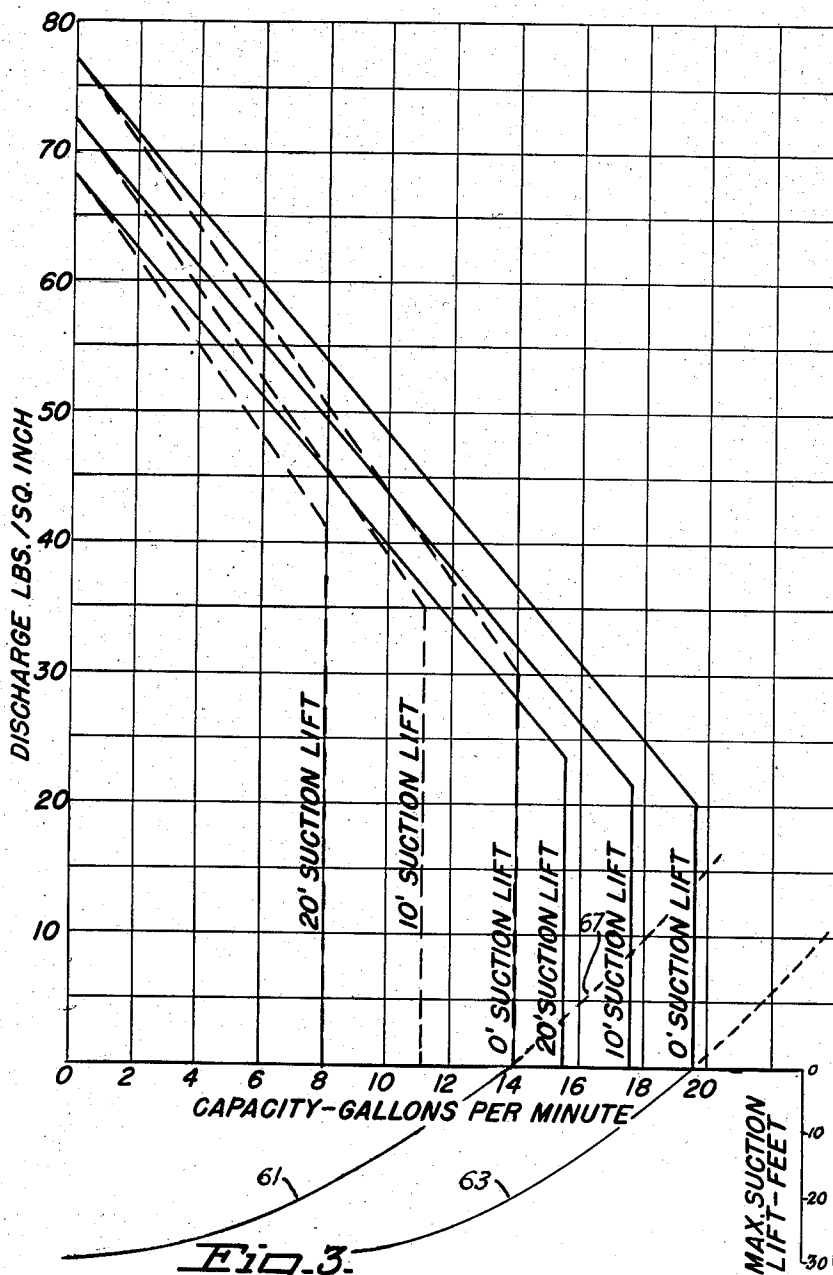


Fig. 3.

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SHALLOW WELL EXPANDED OUTPUT PUMP

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5 Claims. (Cl. 103—5)

Our invention relates to shallow well pump systems and more particularly to a pump assembly therefor of the type involving an injector unit.

Among the objects of our invention are:

(1) To provide a novel and improved pump assembly for a pump system;

(2) To provide a novel and improved pump assembly having the ability to pump larger volumes than comparable prior art pumps under similar conditions;

(3) To provide a novel and improved pump assembly employing to maximum advantage, a combination of centrifugal and injector pump components.

Additional objects of our invention will be brought out in the following description of a preferred embodiment of the same, taken in conjunction with the accompanying drawings, wherein:

Figure 1 is a view in section through a pump assembly embodying the present invention;

Figure 2 is a view in section taken in the plane 2—2 of Figure 1;

Figure 3 is a view, depicting by means of performance curves, the improved results attributable to the present invention.

Referring to the drawings for details of our invention in its preferred form, the same involves a base 1 having a suction line opening therein in the form of a threaded hole 3 for securing thereto the suction line 5 of a pump system, when the pump assembly is installed in such a system. Centrally supported in the base unit, which may be a casting, is a bearing 7 for rotatably supporting the lower end of the shaft 8 which carries the rotatable elements of the pump assembly.

Disposed adjacent the base unit is an impeller stage 9 which constitutes the first stage of the assembly, such stage involving an impeller 11 mounted on the shaft and supported within a housing or spider 13 having peripheral ports 15 about the periphery thereof to pass the discharge from the impeller.

Assembled over the impeller housing and defining therewith a flow passage 17 for the output of the impeller stage, is a section 19 of the pump casing, which extends above the impeller stage and forms a housing 21 for an injector unit 23, which in the instant embodiment of the invention, constitutes in effect the second stage of the pump assembly.

Such housing includes a generally circular outer wall 25, and ceiling 27, and a substantially right angle partition 29 bounding a floor section 31 which is provided with an opening for the pump shaft and its bearing assembly, in line with a corresponding opening 35 in the ceiling of the housing adapted to rotatably receive the intake end of the impeller 37 of an impeller stage 39 following the injector unit.

That portion 41 of the injector housing lying outside the partition, is open to the preceding stage for admission of water discharged from such stage.

Through the wall and partition of the injector housing, are aligned openings for the installation of an injector

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unit involving a nozzle 43 and a Venturi 45. The nozzle is mounted in the outer wall opening, which is threaded for the purpose. The Venturi is removably sealed in the partition opening, by an O-ring seal 47, with the input end of the Venturi preferably threadedly secured about the nozzle.

In the region of the nozzle discharge, the Venturi is provided with an intake opening or openings 49 for admission of the flow from the preceding stage.

The output of the injector unit is passed through the impeller stage 39, which in turn may be followed by one or more additional impeller stages 51 mounted on the same shaft, the discharge end of the final or last stage of the pump assembly, communicating with a spout or discharge coupling 53 integrally formed therewith.

Beginning with the injector unit, each stage includes a casing section formed with a wall passage communicating with each other, to form a flow passage 55 from the discharge of the final stage back to the nozzle of the injector unit, whereby a portion of the output of the pump will be supplied to the nozzle to run the injector stage.

Beyond the injector stage, the pump unit may be of conventional design, including the motor bracket 57 and the drive motor 59.

The significant factor in the pump unit assembly of the present invention is the disposal of an injector unit in the assembly with its suction end in communication with the discharge of a preceding stage in the assembly, to relieve the injector unit of the burden of working against a negative suction head, as when forced to lift the water from the well to the impeller stages of the pump assembly, this burden being placed upon the preceding impeller stage in the preferred embodiment of the invention. The injector unit can then be designed to a different characteristic curve and operated at a favorable point on such curve where increased output would be available.

We have discovered that by relating such stages in the manner described, not only is the efficiency of the pump unit assembly enhanced, but the output capacity of a pump assembly could be expanded far beyond expectations, the magnitude of such increase in capacity running on the order of 40% to 95% or more, with the same pump, the variations depending on the suction lift involved. This remarkable accomplishment may better be illustrated by reference to and analysis of the performance curves of Figure 3 of the drawings, the values depicted therein being the results of comparative tests, involving a pump assembly of the present invention, and as a reference for comparison, a pump assembly having similar stages but arranged with the injector unit as the initial stage. The straight line curves represent the summation of the performance characteristics of both the impeller stages and injector unit, the slope and cut-off being determined primarily by the injector unit.

Such curves represent the output capacities of the pump assemblies involved, measured in gallons per minute, plotted against the discharge head in terms of pounds per square inch discharge pressure for maximum suction lift conditions of 0, 10 and 20 feet respectively. The dash line curves are those of the reference pump unit wherein the injector unit constitutes the first element of the pump assembly. This might be deemed to represent the prior art. The solid line curves, on the other hand, represent performance characteristics of a pump assembly embodying the present invention wherein the injector unit follows a previous stage such as an impeller stage and consequently functions on a more favorable portion of its characteristic curve.

For a condition of zero lift, the prior art pump as-

sembly developed a maximum output of 14 gallons per minute at which output the pressure was 30 pounds per square inch, whereas the pump assembly embodying the teachings of the present invention at the same pressure, had an output capacity of 16.3 gallons per minute. This means an efficiency of 116.4% or an increase in efficiency of 16.4%.

Of probably greater importance than this, from a practical standpoint, is the fact that the output capacity of the pump has been expanded far beyond that of the prior pump, it being noted that under the zero lift condition, the new pump assembly is capable of delivering a maximum output of 19.6 gallons, which represents an increase in capacity over the old pump of the order of 40%.

Conversely, these curves will show that for the same output from both pump units, that from the pump unit of the present invention will be delivered at higher pressure.

With increase in suction lift, the increased efficiency is retained at about the same value, while at the same time, the output capacity of the pump increased at a substantial rate over that of the prior art pump assembly.

Taking a condition of a 10 foot maximum suction lift, it is noted that the output of the first pump is 11 gallons per minute. By comparison, the pump of the present invention is capable of producing a maximum output of 17.6 gallons per minute. Under the condition of 10 foot maximum suction lift, therefore, the improved pump shows a gain in output over the first pump of close to 63%, as distinguished from the gain in output of 40% at zero suction lift, it being further noted that such increased output being within a pressure range suitable for household and farm installations.

Making a similar comparison of the two pumps for a condition of 20 foot maximum suction lift, the results become even more remarkable. It is noted that the prior art pump develops under such condition, a maximum capacity of 8 gallons per minute, whereas the improved pump of the present invention under the same suction lift conditions is capable of developing a maximum output capacity of 15.5 gallons per minute. This represents a percentage gain of the order of 93% over that of the earlier pump.

The remarkable increase, both in efficiency and maximum output capacity, characteristic of the pump of the present invention is believed attributable to the fact that by installing the injector unit beyond an initial stage, conditions for operation which are more conducive to greater output at increased pressure can thereby be created, and the injector unit operated accordingly.

This might be explained to a degree by an analysis of the two curves 61 and 63, which represent jet system performance in terms of output in gallons per minute for various values of maximum suction lift. The curve 61 is that for a system in which the injector unit is installed in accordance with prior practice, e. g., in the base of the pump, while the curve 63 relates to system performance with the injector unit installed beyond the first impeller stage.

Analyzing the first curve, it is noted that inasmuch as the injector unit is in the base of the pump assembly and is directly exposed to the negative pressures involved, for example, in lifting water from a well, this curve also represents injector unit performance as well as injector-system performance. From a practical viewpoint, therefore, the injector unit in a system of this type, will practically always be operating at negative pressures, and accordingly, operation of the injector unit will never occur above the zero axis. Therefore, the capacity of the system is limited to a maximum of 14 gallons per minute, but inasmuch as the water level in a well isn't apt to be at or even close to ground level, the likelihood of such system ever approaching such maximum output capacity becomes but a remote possibility in practice.

Now, considering the improved pump assembly of the

present invention, the system curve 63 covering this system, establishes the realization of surprisingly increased output over the old system for corresponding values of suction lift, with its maximum capacity reaching 19.6 gallons per minute at the zero suction lift value.

While the new system, like the old, is operating at negative pressures in raising the water from a well, the injector unit, unlike the corresponding unit in the old system, is not functioning under the same conditions, but is now operating under positive pressures, or in other words, in a region above the zero axis on the graph of Figure 3, and may well be represented as the phantom extension 67 of the curve 61. The significance of all this lies in the fact that while the basic structural difference of the new and improved pump assembly over the old, might appear to reside in a mere raising of the injector unit from a position comparable to a first stage, to a position comparable to a second stage, from an operational viewpoint this does not hold, for the net effect of such change is to functionally submerge the injector unit a substantial distance below the level of the water in the well.

By reason of characteristics above described, the pump of the present invention is adapted to a field of use not limited to shallow well systems, for such pump is capable of pumping hot or volatile liquids which normally present conditions simulating high suction lifts. Prior injector type pumps were incapable of coping satisfactorily with situations of this character.

While the pump assembly illustrated and described above, utilized but one impeller stage before the jet unit, any number of such impeller stages may be employed before the jet unit, the only essential requirement of the present invention being that at least one such impeller stage shall precede the injector unit to avoid exposure of the injector unit to the negative pressures of suction lift conditions, while at the same time creating a more favorable condition under which the injector unit may function.

The number of impeller stages following the jet unit is also optional, this being determined mainly by the pressure desired at the output of the final stage.

Thus, while we have disclosed and illustrated our invention in its preferred form, it is apparent that the same is subject to alteration and modification without departing from the underlying principles involved, and we accordingly do not desire to be limited in our protection to the specific details illustrated and described in the preferred embodiment, except as may be necessitated by the appended claims.

We claim:

1. A shallow well type pump assembly having means for coupling a suction line thereto, an injector involving a nozzle and a Venturi, an impeller stage having its suction end in flow connection with the entire output from said injector, means for directing a portion only of the output of said pump assembly to said nozzle, and pump means for continuously feeding liquid from such suction line to said Venturi at positive pressure.

2. A shallow well type pump assembly involving a base having means for coupling a suction line thereto, an injector involving a nozzle and Venturi, an impeller stage having its suction end in flow connection with the entire output from said injector, means for directing a portion only of the output of said pump assembly to said nozzle, and pump means in said base for continuously feeding liquid from such suction line to said Venturi at positive pressure.

3. A shallow well type pump assembly involving a base having means for coupling a suction line thereto, at least one impeller stage at the intake end of said pump assembly with its suction end exposed to the suction line coupling means of said base, an injector involving a nozzle and Venturi, means coupling said Venturi in flow connection with the output of said impeller stage, another

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impeller stage, means for feeding the entire output of said injector stage to said last mentioned impeller stage, and means for directing a portion only of the output of said last mentioned stage to said nozzle.

4. A shallow well type pump assembly involving a base 5 having means for coupling a suction line thereto, at least one impeller stage at the intake end of said pump assembly with its suction end exposed to the suction line coupling means of said base, an injector involving a nozzle and Venturi, means coupling said Venturi in flow connection with the output of said impeller stage, another im- 10 peller stage, means coupling only the intake end of said other impeller stage in flow connection with the output from said injector, and means for continuously directing a portion only of the output of said other stage to said nozzle.

5. A shallow well type pump assembly involving a base having means for coupling a suction line thereto, at least one impeller stage at the intake end of said pump assembly with its suction end exposed to the 20

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suction line coupling means of said base, an injector having a nozzle and Venturi, with said Venturi in flow connection with the output of said impeller stage, another impeller stage having its suction end in flow connection with the output from said injector, said other impeller stage having a continuous output, and means for directing a portion only of the continuous output of said other stage to said nozzle, and means directing the remainder of the output of said other stage to the discharge of said pump assembly.

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