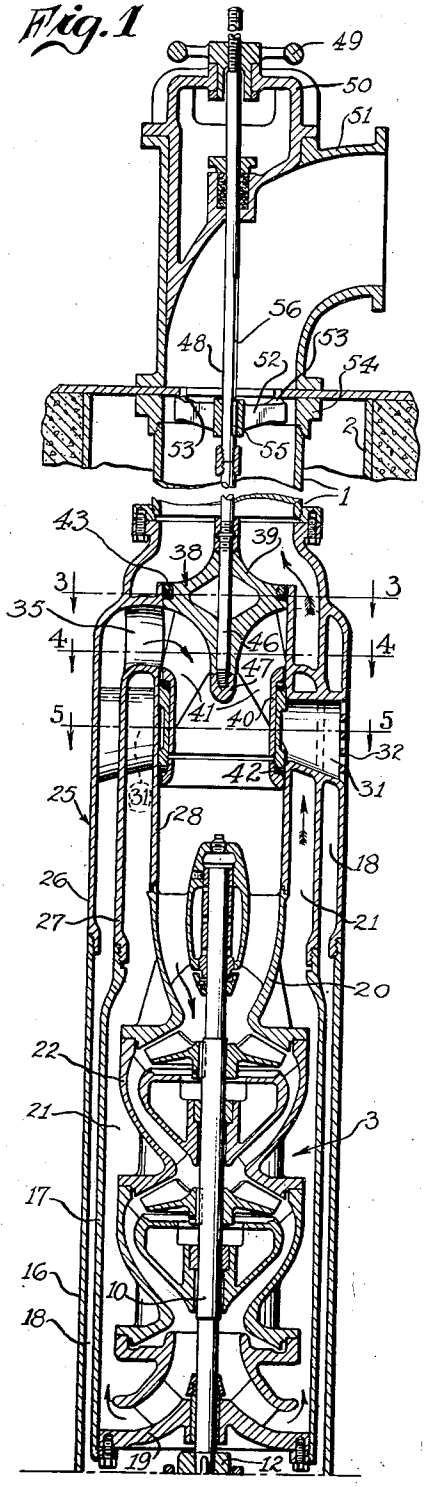
June 18, 1940. A. HOLLANDER 2,204,857

SERIES-PARALLEL SUBMERSIBLE PUMP

Filed June 13, 1938 2 Sheets-Sheet 1

Fig. 1



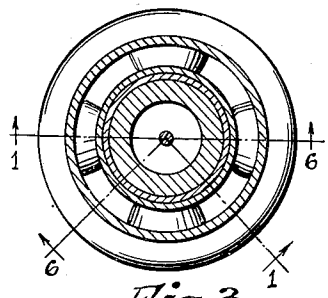


Fig. 3

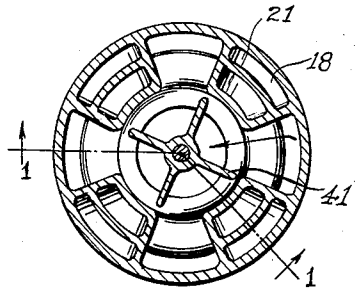


Fig. 4

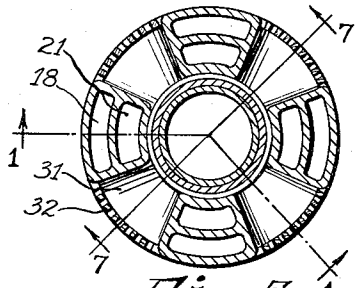


Fig. 5

Aladar Hollander

INVENTOR

BY John D. Chesnut

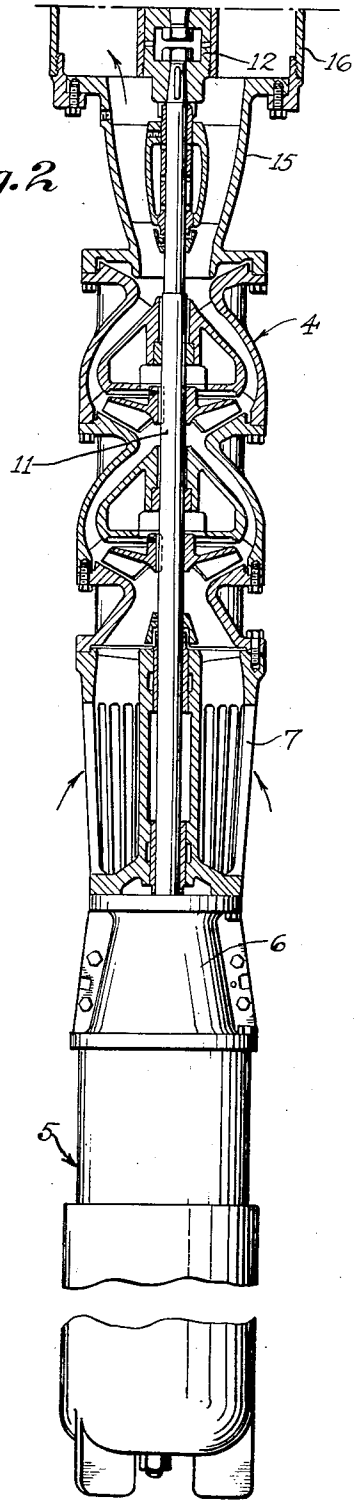
ATTORNEY

June 18, 1940. A. HOLLANDER 2,204,857

SERIES-PARALLEL SUBMERSIBLE PUMP

Filed June 13, 1938 2 Sheets-Sheet 2

Fig. 2



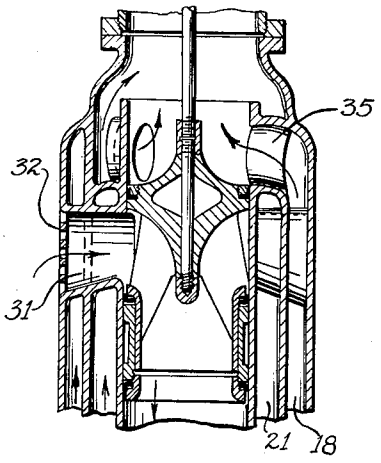


Fig. 6

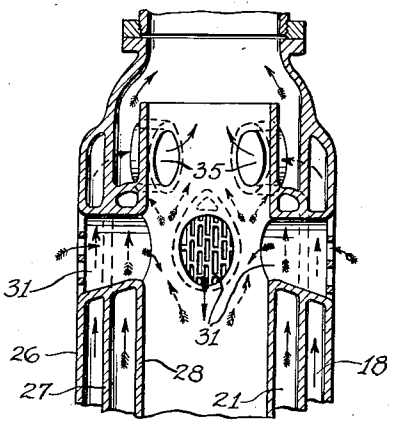


Fig. 7

Aladar Hollander
INVENTOR

BY John D. Chesnut
ATTORNEY

Patented June 18, 1940 2,204,857

UNITED STATES PATENT OFFICE

2,204,857

SERIES-PARALLEL SUBMERSIBLE PUMP

Aladar Hollander, Los Angeles, Calif., assignor to Byron Jackson Co., Huntington Park, Calif., a corporation of Delaware

Application June 13, 1938, Serial No. 213,430

8 Claims. (Cl. 103—106)

This invention relates generally to motor-pumps, and particularly to a series-parallel motor-pump unit.

In making deep water well pump installations it is customary to select the size of pump on a basis of a substantially constant head and capacity. In many instances, however, a wide variation in volume and head is desirable, and heretofore this has been obtained by connecting a booster pump at the surface in the discharge from the deepwell pump. This involves additional expense for extra equipment and power charges.

In other instances the pumping head varies progressively through a wide range as the liquid level is lowered during pumping, the unwatering of mines being a typical example of this condition. In this case it is usual practice to provide a pump having a head capacity far in excess of that required when the water level is high, in order to provide sufficient head when the water level has reached a low point, or to change to a pump having a higher head capacity after reaching the head limit of the first pump.

A principal object of this invention is to provide a deepwell pump capable of delivering either a large volume of liquid at relatively low head or a smaller volume at relatively high head. This object is attained by arranging the stages of a multistage deepwell pump in groups which are selectively connectible either in series or in parallel.

A further object of this invention is to reduce the axial thrust of the pump shaft of a submersible motor-pump unit, by so arranging the impellers that the hydraulic thrust is balanced.

Other objects and advantages will be apparent from the following description, taken in conjunction with the accompanying drawings, wherein:

Fig. 1 is a central longitudinal section through the upper group of stages of a series-parallel pump constructed in accordance with this invention, this view being taken on line 1—1 of Figs. 3, 4, and 5, and showing the groups of stages connected in series.

Fig. 2 is a downward continuation of Fig. 1, showing the lower group of stages and the submersible motor;

Fig. 3 is a transverse sectional view taken on line 3—3 of Fig. 1;

Fig. 4 is a transverse sectional view taken on line 4—4 of Fig. 1;

Fig. 5 is a transverse sectional view taken on line 5—5 of Fig. 1;

Fig. 6 is a fragmentary longitudinal section through the upper portion of the upper casing, showing the cross-over valve connecting the groups of stages in parallel; and

Fig. 7 is a view similar to Fig. 6, with the valve removed.

Referring to Fig. 1, the motor-pump unit is shown suspended from a discharge column 1 within a well casing 2. The unit comprises generally an upper group of stages 3, a lower group 4, and a submersible electric motor 5. An adapter 6 and a strainer 7 are interposed between the motor and the lower group 4. The motor, adapter, strainer, and lower group of stages are described in detail in the copending application of Aladar Hollander for Submersible motor pump, Serial No. 178,738, filed December 8, 1937, and therefore a brief description thereof will suffice.

Each group of stages is provided with an impeller shaft, designated 10 and 11 respectively, the shafts being connected by a coupling 12 and the lower shaft 11 extending downwardly through the strainer 7 and into the adapter 6 where it is coupled to the motor shaft, as described in detail in the above-mentioned copending application.

A discharge piece 15 is connected at its lower end to the uppermost bowl of the lower group 4, and is secured at its upper end to the lower end of an outer shell 16. Housed within the outer shell is an inner casing 17 of smaller diameter forming an annular discharge passage 18 for the discharge from the lower group of stages 4. The inner casing is closed at its lower end by the end wall of a discharge piece 19 for the upper group of stages 3. A suction piece 20 is connected to the uppermost bowl of the upper group. It will be observed that the upper group of stages is inverted, the upper end being the suction end, and the lowermost stage discharging into the space 21 between the inner casing 17 and the pump bowls 22.

A special cross-over fitting 25 is secured to the lower end of the discharge column 1, and comprises generally three concentric tubes 26, 27, and 28 threadedly connected at their lower ends to the upper ends of the outer shell 16, the inner casing 17, and the suction piece 20, respectively. The annular space between the tubes 26 and 27 thus forms a continuation of the annular discharge channel 18 from the lower group, and the annular space between the tubes 27 and 28 forms a continuation of the annular discharge passage 21 from the upper group. The inner tube 28 forms a continuation of the suction inlet of the first stage of the upper group.

A plurality of inlet ports 31, herein four in

number, are equally spaced about the fitting 25 and extend from the outer wall thereof through the two annular passages and the tubes 27 and 28, thus connecting the suction inlet of the upper group of stages directly with the well fluid when these ports are open. A screen 32 covers each port to limit the size of solids entering the pump through these inlets. In the plane of Fig. 5, which is taken in the medial plane of the ports 31, the latter occupy segments which alternate with segmental branches of the annular passages 18 and 21.

Disposed in planes above the ports 31 are a plurality of ports 35 extending from the upper end of the passage 18 radially inwardly through the passage 21 and the inner tube 28. As shown most clearly in Fig. 7, and in transverse section in Fig. 4, there are four ports 35, arranged in alternate angular relation to the ports 31, whereby the former are disposed above the spaces between the latter. This spacing of the two series of ports 31 and 35 divides the inner passage 21 into a plurality of tortuous paths, deflecting the discharge from the upper group of stages first around the ports 31 and then around the ports 35.

Valve mechanism is provided for selectively connecting the interior of the inner tube 28 either with the inlet ports 31 or the ports 35. As shown herein, the valve mechanism comprises a reciprocating valve body 38 slidable in the bore of the inner tube 28. The valve body comprises a hub portion 39 and an annular ring portion 40 connected by radial webs 41. A pair of lip-type packing rings 42 are secured to the periphery of the ring portion 40, and are spaced apart axially a sufficient distance to embrace the inlet ports 31, as shown in Fig. 1. A third packing ring 43 is secured to the periphery of the hub portion 39, being spaced above the upper ring 42 a sufficient distance to form a seal between the ports 35 and the space above the valve when the rings 42 seal off the inlet ports 31.

The valve body is secured to a stem 46 by a nut 47, the stem being connected to an operating rod 48 extending to the surface. The upper end of the rod threadedly engages a hand wheel 49 journaled in a bracket 50 mounted on the discharge elbow 51. A spider 52 is removably supported in non-rotatable relation, as by a splined connection 53, to the base flange 54 from which the discharge column is suspended, and a key 55 in the hub of the spider engages a spline 56 in the rod 48 to prevent rotation of the rod. Hence when the handwheel is rotated the rod 48 and the valve body 38 are raised or lowered to selectively move the valve to the upper position shown in Fig. 1 or to the lower position shown in Fig. 6. The splined connection 53 permits removal of the spider 52 with the rod 48 when the discharge elbow 51 is removed. If desired, one or more centering spiders may be provided on the operating rod, to slidably engage the discharge column.

The operation of the pump is as follows: For series operation the valve is located in the position shown in Fig. 1, with the inlet ports 31 closed and the ports 35 in communication with the interior of tube 28. When the motor 5 is energized the lower group of stages 4 discharge into passage 18, thence through ports 35 and through the passages formed in the valve body and into the suction piece 20 of the upper group of stages 3. This group discharges into the space 21, which communicates at its upper end with the discharge column 1. In order to pass the ports 31 and 35, the fluid in passage 21 is deflected first around ports 31 and then around ports 35. It will be understood that with this arrangement of all of the pump stages in series a relatively small volume of fluid at relatively high head is delivered.

When the hand wheel 49 is rotated to lower the valve to the position shown in Fig. 6, the inlet ports 31 are opened to communication with the inlet 20 of the upper group of stages, and the ports 35 are open to the discharge column. The suction of each group of stages is thus connected directly to the well, and each group discharges directly into the discharge column 1. With this arrangement the volume delivered is substantially twice that delivered with the series connection, and the head is substantially half.

In Fig. 7 the flow of fluid during parallel operation is indicated by arrows, the plain arrows designating the discharge from the lower group of stages and the feathered arrows designating the flow to and from the upper group. The valve is in its lower position as in Fig. 6, but has been omitted from this figure to illustrate more clearly the flow channels around the ports 31 and 35.

The arrangement described is exceedingly compact, the overall diameter being only slightly greater than that of the standard deepwell pump of the same capacity, being increased only by the width of the extra discharge passage and the thickness of the shell.

By mounting one group of impellers in opposed relation to the other group, the hydraulic thrust is balanced and the only load imposed on the thrust bearing is the weight of the pump shafts.

For high head installations the double-case construction of the upper group of stages is particularly advantageous. The bowls of this group are subjected externally to the discharge pressure, and consequently need not be of extra strength to withstand an unbalanced high pressure.

Of particular importance from a practical standpoint is the arrangement whereby the crossover valve may be removed without pulling the pump. With the development of submersible motors to the point where they are fully capable of operating for years without being removed from the well, it is highly desirable that any valves in the pump be removable for inspection and repair without disturbing the pump, motor, and discharge column assembly. To pull the valve, it is only necessary to remove the discharge elbow 51, the hand-wheel nut 49 being unthreaded from the operating rod 48 to permit this. The spider 52 is removed with the upper splined section of rod, and the discharge column forms an unobstructed passage for the removal of the valve. The valve may therefore be of maximum diameter, avoiding undue throttling of the flow through the valve.

As mentioned at the outset, an important field of utility of this device is in the unwatering of mines. When the water level is high and the head is correspondingly low, the groups of stages may be connected in parallel to deliver a large volume of water. When the water level has been lowered to a point where the head reaches the maximum capacity of the pump when connected in parallel, the valve may be shifted to series position. The single pump thus has the volume and head capacity range of two pumps.

The invention also finds particular utility in

municipal water systems served from wells. In such systems a relatively low pressure is sufficient for public use, while for fire extinguishing a much higher pressure is required. The usual practice is to boost the low pressure by means of fire pumps. However, by installing a series-parallel deepwell unit as described, high pressure water may be delivered directly to the fire mains from the well by the same pump which normally delivers low pressure water.

Other instances where the invention is particularly useful will be apparent to those familiar with this art.

While I have shown and described a preferred form of the invention, it will be apparent that various changes may be made within the spirit of the invention and the scope of the appended claims.

I claim:

1. A series-parallel submersible motor-pump unit comprising, in combination: a multistage pump adapted to be supported at the lower end of a discharge column extending to adjacent the bottom of a deep well or the like, a submersible motor supported below said pump and connected in driving relation therewith, said pump being divided into groups of stages, and a cross-over valve for selectively connecting said groups of stages in series or in parallel, said valve being manipulable from the upper end of said column and removable through said column while the pump and motor remain in operative position.

2. A series-parallel submersible motor-pump unit as defined in claim 1, in which said valve is located at the upper end of said pump, and valve actuating means extending from said valve upwardly within said discharge column to the upper end thereof.

3. A series-parallel submersible motor-pump unit comprising a multistage pump adapted to be supported at the lower end of a discharge column, a submersible motor supported below said pump and connected in driving relation therewith, said pump comprising superposed groups of stages, an inner casing enclosing the upper group and defining therewith a discharge passage for said group, an outer casing disposed in spaced relation to said inner casing and defining therewith a discharge passage for the lower group of stages, an inlet port extending through said casings to connect the inlet of said upper group with the exterior of said outer casing, and valve mechanism for selectively connecting the discharge passage for the lower group in communication with the discharge column and simultaneously opening said inlet port, or connecting said last-named passage with the inlet of the upper group and simultaneously closing said inlet port.

4. A series-parallel submersible motor-pump comprising a discharge column, an outer casing supported at the lower end of said column, a pump suspended from the lower end of said casing and discharging thereinto, a submersible motor suspended below said pump, an inner casing mounted within said first casing in spaced relation thereto, a second pump mounted within said second casing in spaced relation thereto, said second pump discharging into said discharge column and having its inlet connectible with said outer casing, said motor being connected in driving relation with both of said pumps.

5. A series-parallel deepwell pump comprising: a plurality of pump units arranged in coaxial relation and having a common discharge outlet, a double-walled casing disposed about one of said units and forming inner and outer concentric passages, the inner passage being connected to the discharge of said one unit and the outer passage being connected with the discharge of the other of said units, and a triple-walled casing having its outer wall and intermediate wall connected respectively in end-to-end relationship with the walls of said first casing, and having its inner wall connected to the inlet of said one unit.

6. A pump as defined in claim 5, and including a first radial series of ports extending laterally through all three walls of said triple-walled casing and connecting the inlet of said one unit with the exterior of said casing, and a second radial series of ports extending through the inner wall and the intermediate wall and connecting said outer passage selectively with said discharge outlet or with the inlet of said one unit.

7. A pump as defined in claim 5, and including a first radial series of ports extending laterally through all three walls of said triple-walled casing and connecting the inlet of said one unit with the exterior of said casing, and a second radial series of ports extending through the inner wall and the intermediate wall and connecting said outer passage selectively with said discharge outlet or with the inlet of said one unit, said second series being spaced longitudinally of said casing relative to said first series, and the ports of said second series being disposed in alternate angular relationship to the ports of said first series.

8. A pump as defined in claim 5, and including a first radial series of ports extending through all three walls of said triple-walled casing and connecting the inlet of said one unit with the exterior of said casing, a second radial series of ports extending through the inner wall and the intermediate wall and connecting said outer passage selectively with said discharge outlet or with the inlet of said one unit, and valve mechanism movable to a position wherein said first series of ports are open and said second series of ports communicate with said discharge outlet whereby said pump units operate in parallel, said valve mechanism being also movable to a position wherein said first series of ports are closed and said second series communicate with the inlet of said first-mentioned pump unit, whereby said units operate in series.

ALADAR HOLLANDER.