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PARALLEL SERIES PUMP

Filed March 5, 1929

3 Sheets-Sheet 1

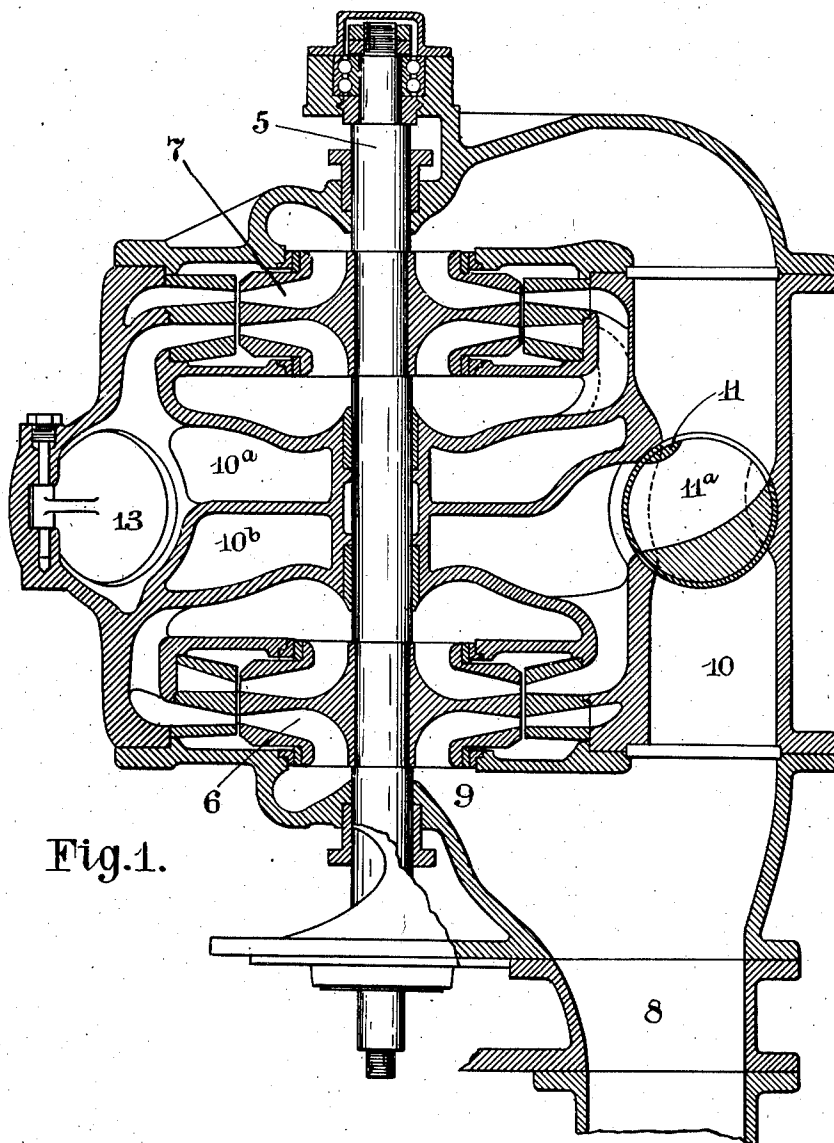


Fig. 1.

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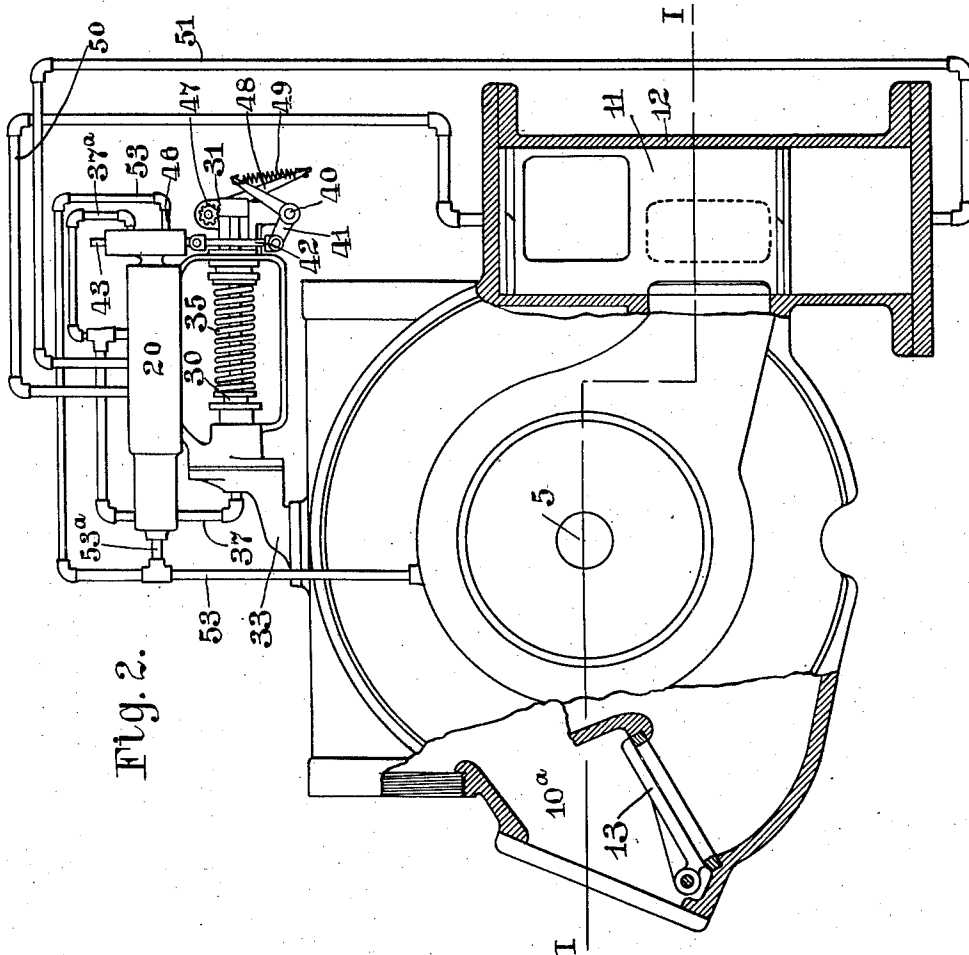
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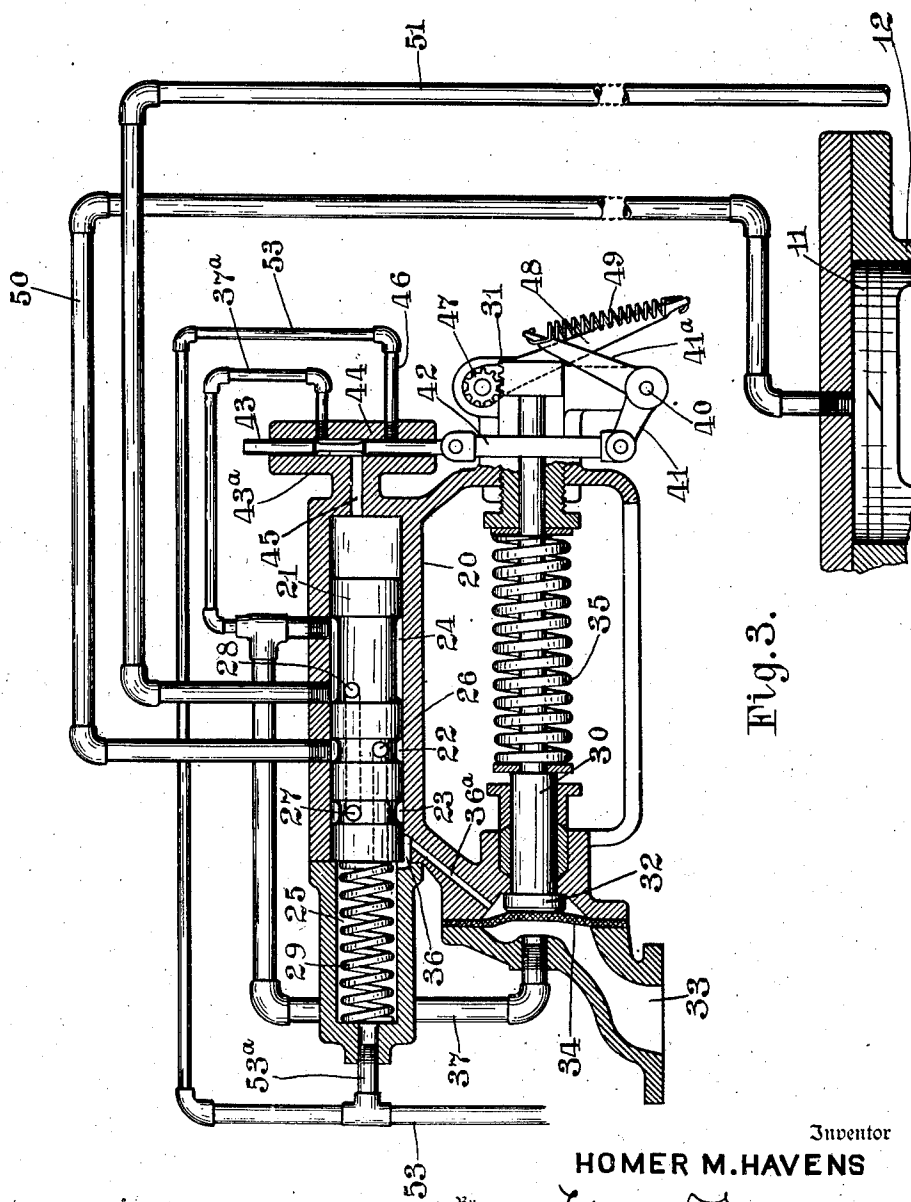
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PARALLEL-SERIES PUMP

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This invention relates to centrifugal pumps of the parallel-series type, especially such as used in fire engines. When such pumps operate in parallel the volume is comparatively large and when operated in series the volume is smaller but the discharge is at approximately twice the pressure. Such a pump when operating with added pressure in the suction side, as when connected with a street hydrant, will operate in parallel at a higher pressure practicably equal to the normal pressure plus the pressure applied to the suction side. For example if the pump operates with a given efficiency at 150 pounds discharge pressure and zero suction pressure it will operate with approximately the same efficiency at 200 pounds discharge pressure and 50 pounds suction pressure thus the discharge is increased by approximately the amount applied to the suction pressure.

In practice when the hose attached to the discharge of the pump is lengthened or when the pump is connected with a stand pipe in a tall building or when it is desired to deliver water at an unusual elevation or distance by reducing the nozzle cross section it is important that the change from low pressure to high be effected automatically.

The object, generally, of the present invention is to provide an improved automatically operating means for effecting the change from parallel to series, or conversely, by the discharge pressure or by the difference between the pressures of the intake and discharge of the pump. Another object is to make the change over from parallel to series operation and conversely positive and prevent small fluctuations in the pressure from effecting such changes. Other objects will appear from the disclosure herein.

The invention is embodied in the example herein shown and described, the features of novelty being finally claimed.

In the accompanying drawings—

Figure 1 is a horizontal sectional view of the pump with the parallel-series valve thereon taken through the axis of the shaft thereof or on the line I—I Fig. 2, parts being in full.

Fig. 2 is a diagrammatic view of the mech-

anism of my invention as applied to or combined with the pump with parts of the latter in section.

Fig. 3 is a detail on a larger scale of the mechanism for accomplishing the change from parallel to series operation or conversely.

In the views 5 designates the pump shaft which is driven by the engine and upon which shaft is shown two double impellers 6 and 7 making, a so called, four stage pump.

8 designates the intake which leads to the first stage of the impeller 6 through the passage 9 and to a passage 10 across one side of the main casing to the impeller 7. In the passage 10 is a reciprocating parallel-series valve 11 sliding in cylinder 12 adapted to open or close each passage according to its position in said cylinder. If the passage 10 be closed, as shown in Fig. 1, the pump operates as a four stage high pressure series pump because of the passage 11^a opposite the passage closing wall of the valve and if said passage 10 is open and passage 11^a closed it operates as a low pressure parallel pump. When series operation takes place a gravity valve at 13 is held closed because the pressure on the upper side of that valve in the passage 10^a is greater than the pressure on the lower side thereof; in parallel operation the pressure in 10^a and 10^b are equal and the valve is open.

Fitted to slide in a cylinder 20 is a valve 21 having two small annular grooves 22 and 23 and an annular groove 24 that is wider than the distance from the end of the valve to the right hand head of the cylinder. The annular groove 22 communicates with the chamber 25 at the left hand end of the cylinder 20 through a port 26 and a longitudinal perforation, shown in broken lines, in the valve 21.

The annular groove 23 communicates with the wider groove 24 through ports 27 and 28 and a longitudinal passage in the valve, shown in broken lines, connecting them. The valve 21 is pushed at the left hand end by a coil spring 29 in the chamber 25 beyond the left hand end of the cylinder when the pres-

sure against the valve 21 is sufficiently reduced.

Arranged in suitable bearings adjacent the valve cylinder 20 is a slidable rod 30 having at one end a rack 31 and at its other end a head 32 in cavity 33 connected with the outlet or discharge of the pump. In said cavity in front of said head is a diaphragm 34; and on said rod 30 is a coil spring 35 of a predetermined power tending to push the rod toward the diaphragm when the pressure drops in the discharge of the pump. Said cavity at the right hand side of the diaphragm is in constant communication with the suction of the pump through chamber 25, a short groove 36 and passage 36^a; and said cavity at the left hand side of the diaphragm communicates constantly with the discharge of the pump and by means of the pipe 37 with the chamber formed by the wide groove 24. The diaphragm is actuated by the difference between the pressures in the right and left hand side of the diaphragm.

Pivoted at 40 is a bell crank lever, the shorter arm 41 of which is connected by link 42 with a valve rod 43 slidable in a boring in a cross head 44. The valve rod 43 is cut with a wide annular groove at 43^a to permit communication of pressure and discharge past it, as hereinafter stated, through passage 45 to the right hand end of cylinder 20. Pressure to move valve 21 to the left is established by a branch 37^a of pipe 37 when the valve 43 is raised; and discharge takes place by a pipe 53 connected with the intake of the pump when the valve rod 43 is lowered, the pressure of branch 37^a being cut off when the said rod is lowered.

The rack 31 engages a pinion 47 having a fixed bearing in an extension of the frame carrying the rod 30, the shaft of said pinion having affixed to it an arm 48 connected at its free end by means of a coil spring 49 with the longer arm 41^a of the bell crank lever. The spring 49 yieldingly holds the arm 48 and valve 43 in either of the positions to which thrown.

It will therefore be clear that when the pressure in the discharge 33 of the pump is increased the spring 35 is compressed and functions, through mechanism described, to raise the valve rod 43 to the position shown in Fig. 3 thereby establishing communication of the pump pressure through pipes 37 and 37^a and passage 45 with the right hand end of the valve 21 moving the latter to the left and thereby also establishing communication of the discharge pressure through pipe 37 and large groove 24 through pipe 51 with the bottom of cylinder containing the parallel-series valve 11. This pressure on valve 11 moves it to close passage 10 and connect by opening 11^a in the valve 11 the second stage of impeller 6 with the first stage of impeller 7.

In this last described position of the valve

21 communication is established from the intake of the pump through pipe 53 chamber 25 and groove 22 through pipe 50 to the top of the cylinder 12 containing valve 11 thereby bleeding the upper end of said cylinder.

Conversely, when the pressure in the cavity 33 of the outlet of the pump is reduced the spring 35 of the rod 30 functions, through the means described, to lower the valve rod 43 thereby closing the connection of the right hand end of valve 21 with the discharge of the pump and bleeding cylinder 20 through pipe 53. The bleeding of the cylinder at the right hand end of valve 21 permits the spring 29 to move said valve to the right and the establishing of communication of discharge pressure of the pump through pipe 37 into groove 24 and passages 28 and 27 and pipe 50 to the upper end of the parallel-series valve 11. By this movement of the valve 21 communication is also established with the suction of the pump through a short lateral 53^a, the chamber 25, port 26 and the pipe 51 to the bottom of the cylinder 12 of the parallel-series valve 11 thereby bleeding said cylinder below said valve 11.

The operation may be summarized as follows:

The parts as shown in the views are the positions where series operation of the pump takes place. In this position the discharge pressure in cavity 33 exerts pressure on valve 21 through pipe 37 and branch pipe 37^a forcing said valve to the left. The pressure in the discharge is also exerted through diaphragm 34 on head 32 holding rod 30 to the right against the pressure of spring 35 and yieldingly holding the valve 43 in the position shown to maintain the access of pressure to the cylinder of valve 21. No pressure is exerted in pipe 50 leading from the upper end of cylinder of valve 11 said valve being held at the upper end of said cylinder by the discharge pressure in pipe 51 through wide groove 24 of valve 21 through said pipe 51 connected with the lower end of the cylinder of valve 11.

If now the pressure in the pump discharge 33 is reduced to a point where the spring 35 throws the valve rod 43 down to fetch the reduced portion 43^a thereof opposite the end of passage 45 and intake or suction pipe 46 the pressure of spring 29 will throw the valve 21 to the right thereby bringing the groove containing port 27 into coincidence with pipe 50 and the port 22 into coincidence with pipe 51 with the result that the reduced discharge pressure in cavity 33 will be communicated through pipe 37, wide groove 24, ports 28 and 27 and their connecting passage through pipe 50 to the upper end of the valve 11 thereby depressing said valve and permitting parallel operation of the pump. In this operation it will be observed that the dia-

phragm is actuated by the difference in pressure at the two sides thereof.

The mechanism including the arm 48 and spring 49 is such that it will operate to throw the pump from series into parallel operation at a lower pressure than to throw the pump from parallel into series operation because the pressure on the spring 35 must be increased by the amount required to cause rod 30 to travel the distance necessary to trip the bell crank 41 through arm 48 and spring 49. Conversely said mechanism will not trip back until the discharge pressure of the pump has been reduced by an amount sufficient to permit spring 35 to force rod 30 to the left a sufficient distance to trip the mechanism referred to in the opposite direction. It will be observed, therefore, that it is the delay in the operation of said mechanism from one direction to the other that prevents the operation of the parallel-series valve by small fluctuations in the discharge pressure.

In the change from parallel operation of the pump to series operation thereof increase of pressure in the discharge chamber 33 causes pressure on the diaphragm 34 to move rod 30 to shift the valve rod 43 upward into position to admit pressure to valve 21 and the shifting of that member to the position as best shown in Fig. 3. In this operation the upper end of the cylinder of piston 11 is bled through port 26 and the suction pipe 53 as before indicated.

The forms and arrangement of the parts can be changed without departing from the gist of the invention as claimed.

What I claim is:

1. In combination with a parallel-series centrifugal pump, a valve for changing the pump from parallel to series operation and conversely, a reciprocable valve and cylinder therefor, a fluid conductor from the discharge of the pump connected with one end of said cylinder to actuate the valve therein in one direction and a spring for actuating said valve in the opposite direction, the said reciprocable valve having ports and passages and conductors cooperating therewith for actuating the first named valve for changing the pump from parallel to series operation and conversely according to the pressure in said discharge, a valve for controlling the admission to and exit of fluid pressure from said last named valve, and means actuated by the pressure in the pump discharge for controlling the position of the said last named valve.

2. In combination with a parallel-series centrifugal pump, a valve for changing the pump from parallel to series operation and conversely, a reciprocable valve and cylinder therefor, a fluid conductor from the discharge of the pump connected with one end of said cylinder to actuate the valve therein in one direction, a spring for actuating said valve

in the opposite direction, the said reciprocable valve having ports and passages cooperating therewith for actuating the first named valve for changing the pump from parallel to series operation and conversely according to the pressure in said discharge, a valve for controlling the admission to and exit of fluid pressure from said last named valve and means actuated by the pressure in the pump discharge for controlling the position of said last named valve, said means including a rod and a spring for actuating the rod in one direction and means for operably connecting said rod with said last named valve and a diaphragm in the pump discharge for operating said rod in the opposite direction.

3. In a parallel-series centrifugal pump, a reciprocable valve connected with the intake and discharge of the pump adapted to be shifted to convert the pump from parallel to series operation and conversely, and means adapted to be actuated by the difference between the intake and discharge pressures of the pump to automatically shift said valve, said means including a reciprocating sliding valve, a spring to actuate said valve in one direction, said valve being actuated in the opposite direction by the pressure in the pump discharge and a spring actuated valve controlled by the pump discharge pressure for controlling the admission of pressure to said last named valve.

4. In a parallel-series centrifugal pump, a reciprocable valve connected with the intake and discharge of the pump adapted to be shifted to convert the pump from parallel to series operation and conversely, and means adapted to be actuated by the difference between the intake and discharge pressures of the pump to automatically shift said valve, said means including a shiftable spring actuated valve controlled by the pump discharge pressure for controlling the admission of pressure to said first named valve and means for yieldingly holding said shiftable spring actuated valve in the position to which shifted.

5. In a parallel-series centrifugal pump, a reciprocable valve adapted to be moved to convert the pump from parallel to series operation or conversely, means to be actuated by the difference between the intake and discharge pressure of the pump to automatically shift said valve, said means including a reciprocating sliding valve, spring-actuated in one direction and actuated by the pressure in the discharge in the other direction, a shiftable spring actuated valve for controlling the admission of the actuating pressure to said last named valve including a rod extending into the discharge of the pump, a diaphragm in said discharge acting on said rod, and a passage connecting the rod side

of said diaphragm with the suction side of the pump.

6. In a centrifugal pump having coupled impellers and provided with fluid passages for parallel and series operation of the pump, a cylindrical chamber and a cylindrical ported piston valve fitted in and reciprocable in said chamber and interposed in said fluid passages to cause parallel or series operation according to the position of said valve in said chamber, and means for conveying pump pressure to an end of said valve to cause reciprocation thereof to effect the change of position to produce parallel or series operation.

7. In a centrifugal pump having coupled impellers and provided with fluid passages for parallel and series operation of the pump, a cylindrical chamber and a cylindrical ported piston valve fitted and reciprocable in said chamber and interposed in said fluid passages to cause parallel or series operation according to the position of said valve, means for conveying pump pressure to one end of said valve to cause reciprocation thereof to effect such change of position to produce parallel or series operation, and means for controlling the flow of fluid pressure to an end of said piston.

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