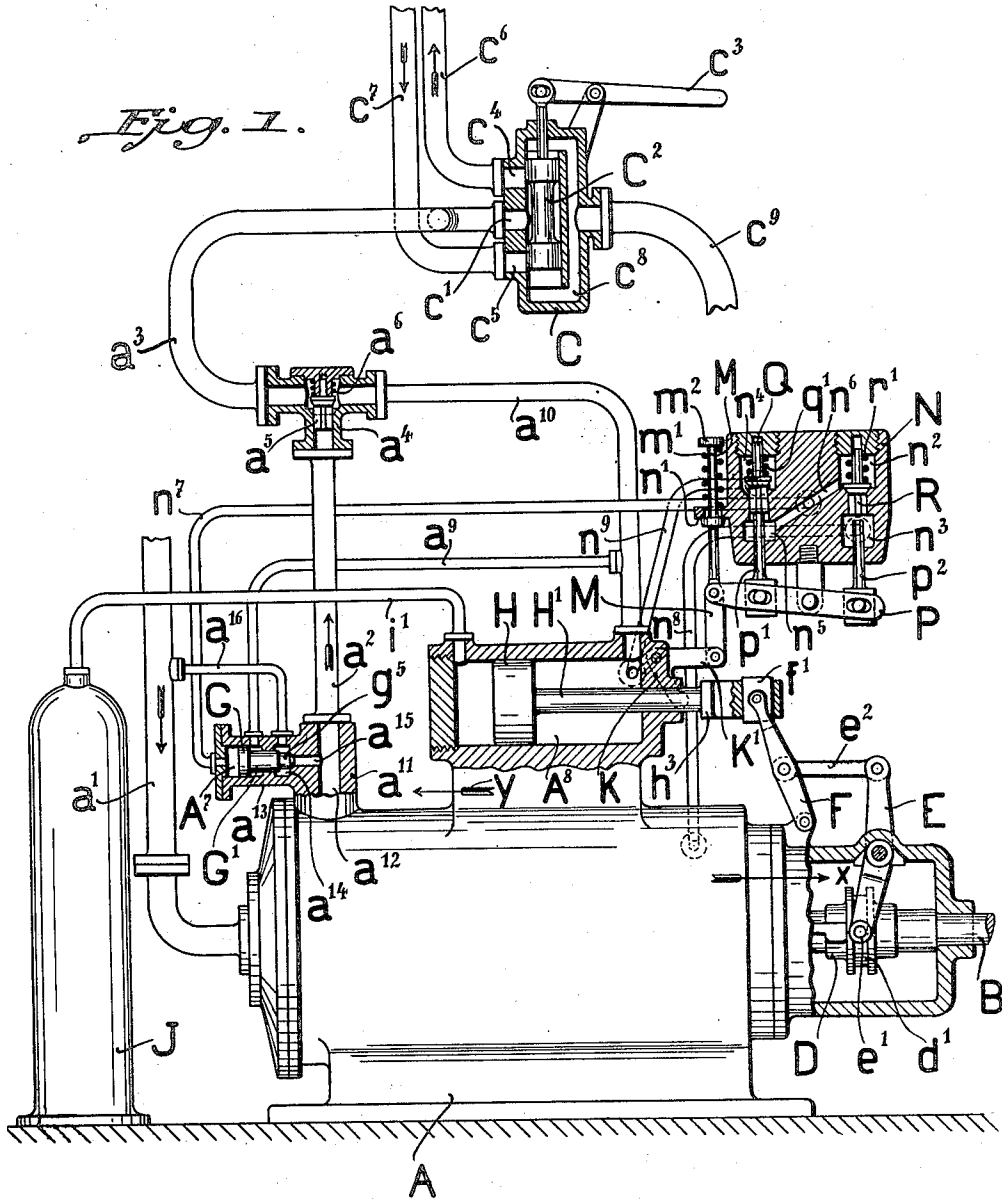


F. MARTIN.
CONTROLLING APPARATUS FOR PISTON PUMPS.
APPLICATION FILED OCT. 4, 1920.

1,418,952.

Patented June 6, 1922.
2 SHEETS—SHEET 1.



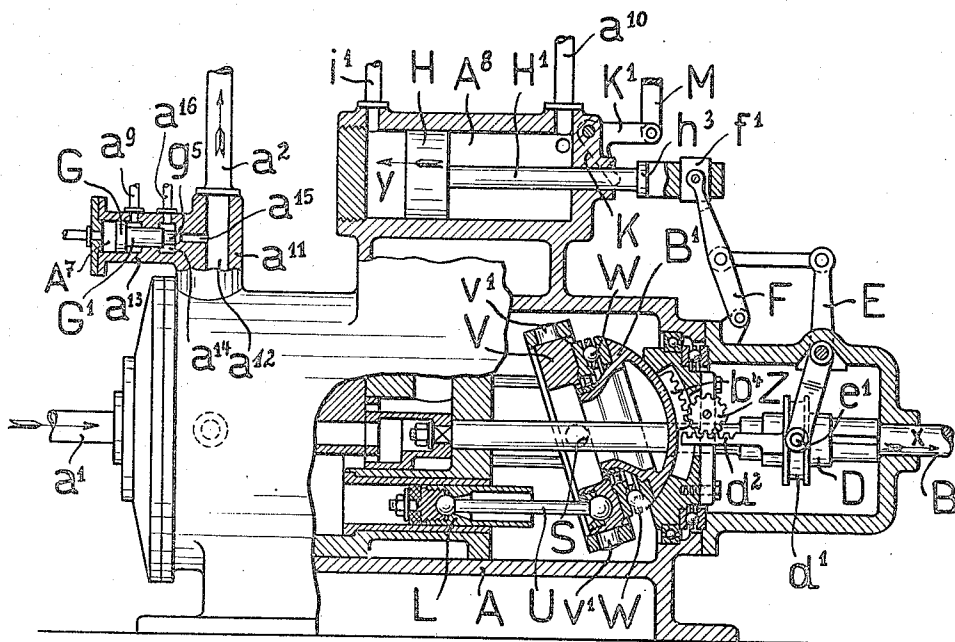
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Fig. 2.



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CONTROLLING APPARATUS FOR PISTON PUMPS.

1,418,952.

Specification of Letters Patent.

Patented June 6, 1922.

Application filed October 4, 1920. Serial No. 414,691.

To all whom it may concern:

Be it known that I, FRIEDRICH MARTIN, residing at Essen, Germany, a citizen of the German Republic, have invented a certain new and useful Improvement in Controlling Apparatus for Piston Pumps, of which the following is a specification.

The invention relates to controlling apparatuses for piston pumps with shaft drive and a variable stroke-length having means for adjusting the pump so that it will be without pressure and an auxiliary motor for actuating said adjusting means as described in my copending application Serial No. 419,043 filed October 23rd, 1920.

The present invention has for its object to simplify said controlling apparatuses and consists in providing a by-pass arrangement controlled by said auxiliary motor.

The invention is illustrated on the accompanying drawings in which:

Fig. 1 shows a side elevation, partly in section, of an embodiment of the invention, together with the adjacent parts of the pumping plant, and

Fig. 2, in a larger scale, a similar view of the means for varying the stroke-length of the pump.

Reference letter A denotes the housing of the piston pump, B the driving shaft of the pump coupled to, for instance, an electric motor, and a' the suction pipe. In the pressure piping is inserted a one-way valve a^4 between the two pipes a^2 and a^3 , being part thereof, the valve a^5 , actuated by a spring a^6 opposite pipe a^3 , tending to close a^2 , which is connected with the port a^{11} of the pump housing A. The pipe a^3 opens into a middle port c' of a slide box C, in which a piston slide C^2 may be displaced by a movable handle c^3 on the slide box C. In the slide box C are provided two other ports c^4 and c^5 on each side of port c' , which may both be simultaneously closed by the piston slide. A pressure pipe c^6 leads from the port c^4 to a working machine, while a water discharge pipe c^7 from the working machine is connected with c^5 . Lastly, still another discharge pipe c^8 is connected with the inner chamber c^8 of the slide box C.

The driving shaft B of the pump which is provided with a plurality of pistons L (Fig. 2) longitudinally arranged around the shaft B carries a muff D which is displaceable on

the shaft B in axial direction and is designed to vary the stroke-length of the pump. For this purpose the muff D is connected, as fully described in said copending application, by means of a gearing d^2 , Z , d^4 , to an eccentric member B' adjustably mounted at an inclination on the shaft B on which eccentric member there is supported by means of a ball bearing W a tilting die V connected to the casing A by means of a universal joint having two pairs of pins v^1 and S and jointed to the pistons L by means of connecting rods U. Through the displacement of the muff D a change in the stroke length may be accomplished from a certain maximum value to a comparatively small amount, through which the by-pass arrangement gets into operation. A diminishing in stroke length occurs when the muff D is displaced in the direction of the arrow x .

In a groove d' of the muff D engages a pin e' on one of the arms of the double-armed lever E, which is revolvably mounted on the pump housing A. The other arm of the lever E has a link connection e^2 with a single-arm lever F. This lever F is positively connected with a piston rod H' of the piston H, provided with an abutment shoulder h^3 and running in a cylinder A^8 by means of a sleeve f' , which is jointed to the lever F and guided in a groove on the piston rod H'. Every position of the piston H corresponds, therefore, with a certain position of the muff D, and consequently with a certain stroke length of the pump piston. The direction in which the piston H moves during a reduction of the stroke length is denoted by an arrow y . The right-hand end of the cylinder A^8 is connected with pipe a^3 through a pipe a^{10} . The left end of cylinder A^8 is connected with a bottle J by means of a pipe i' , the air pressure of which is approximately the same as the mean operating pressure of the pump.

The port a^{11} having a main passage a^{12} leading to the pipe a^2 is provided with a side projection a^{13} , in which a chamber a^{14} is to be found that connects with the passage a^{12} through a port a^{15} . Furthermore, a by-pass pipe a^{16} leads from the chamber a^{14} to the suction pipe a' . The port a^{15} can be closed by a valve plunger g^5 which constitutes the free end of the rod G' for the pis-

ton G. The diameter of the valve plunger g^5 is of a suitably smaller dimension than the diameter of the piston rod G'.

The piston G, which runs in a cylindrical chamber A⁷, belongs to the auxiliary motor which is intended to regulate the by-pass system comprising the port a^{15} , the valve plunger g^5 , the chamber a^{14} , and the pipe a^{16} , in such a manner that the pump is discharged. The portion of the cylinder chamber A⁷, shown to the right of the piston G and extending to the chamber a^{14} , is tightly closed at the place where the piston rod G' runs through and is in constant connection with pipe a^{10} by means of another pipe a^9 . The portion of the cylinder chamber A⁷ situated to the left of the piston G is connected by means of a pipe n^7 with a valve housing N, which belongs to the starting system of the auxiliary motor.

On the cylinder A⁸ is hinged a bell crank K K', one arm of which, K, reaches into the path of the collar h^3 of the piston rod H'. The other arm K' of the bell crank is connected by means of a link-rod M with a double-armed lever P provided on the valve housing N. The link-rod M extends so far beyond the lever P and passes with sufficient play through an eyelet N' provided on the valve housing N, that the bell crank K K' and the lever P can move freely within certain limits. A rod p' slidable in the valve housing N engages with one of the arms of lever P, and a rod p^2 , also slidable in the valve housing N engages with the other arm of the crank. In the valve housing N are provided two double chambers, each consisting of two connected chambers n^2 , n^3 and n^4 , n^5 , respectively. By means of a valve plunger R, actuated by a spring r' , the chamber n^2 may be closed from the chamber n^3 into which the rod p^2 extends; and by means of the valve plunger Q, actuated by a spring q' , the chamber n^4 may be closed from the chamber n^5 into which the rod p' extends. It is now so arranged that the rods p' and p^2 , intended to open the valves when both valve plungers Q and R are situated in their final position, will arrive simultaneously in this position. Furthermore, the position of the collar h^3 is selected so that it abuts against the arm K of the bell crank K K', when the piston H is in that very position in which the piston stroke length of the pump is only slightly larger than that stroke length which is required to set the by-pass system in action; the bell crank K K' then being held by the collar h^3 in such a position that the rods p' and p^2 simultaneously abut against the corresponding valve plungers.

As long as the arm K of the bell crank K K' is out of contact with the collar h^3 of the piston rod H, the lever P, through the in-

termediary of a spring m' which acts against a collar m^2 provided on the free end of the link-rod M, will be retained in a position wherein the rod p' holds the valve plunger Q in its open position against the action of spring q' , as shown on the drawing. The rod p^2 is now at a certain distance from the valve plunger R, which is kept closed by the spring r' .

The chambers n^2 and n^5 are connected by a passage n^8 , which in turn connects with the pipe n^7 . The chamber n^3 is connected with the suction chamber of the pump through the pipe n^8 , and the chamber n^4 is by means of a pipe n^9 , connected with the righthand end of the cylinder A⁸.

During correct running of the pump, the different parts of the described device take the position shown on the drawing. The piston slide C² is then adjusted in such a manner that the pressure pipe c^6 leading to the working machine stands in connection with the pipes a^2 and a^3 coming from the pump; and the pipe c^7 , which serves to lead off the discharge water from the working machine, stands in connection with the discharge pipe c^9 . Furthermore, the collar h^3 of the piston rod H' is out of contact with the arm K of the bell crank K K', so that the valve plunger Q is held in open position by the spring m' . The portion of the cylinder chamber A⁷, situated to the left of piston G is then connected with the right end of the cylinder A⁸, through the pipes and passages n^7 , n^6 , n^5 , n^4 , n^9 , that end being under action of the air pressure from the left side of the piston G. The portion of the cylinder chamber A⁷ which lies to the right of the piston G stands also in connection with the right end of the cylinder A⁸ through pipes a^9 , a^{10} . On both sides of the piston G the same pressure is consequently to be found. As the acting cross-section is smaller on the righthand side of the piston G than on the lefthand side, on account of the pressure of the piston rod G', the force acting on the lefthand side of the piston is the greater one. The two forces acting on the piston in the cylinder chamber A⁷ consequently result in a third, which tends to press the valve plunger g^5 into its seat, this third force being proportionate to the difference between the two acting cross-sections, that is, the cross-section of piston rod G'. As now the diameter of the valve plunger g^5 is smaller than the diameter of the piston rod G', its pressure surface on the right is also smaller than the cross-section of the piston rod. Therefore, this fluid pressure acting from the right on the valve plunger g^5 can be no greater than the pressure existing in cylinder chamber A⁷; consequently the force which tends to lift the valve plunger g^5 from its seat is in

every case smaller than the above-mentioned resulting third force which tends to press the valve plunger into its seat.

The port a^{15} will consequently remain closed by the valve plunger g^5 as long as the collar h^3 is out of contact with the arm K of the bell crank K K', and as a consequence the by-pass system is out of action.

The pump, as a consequence, operates in such a manner that the starting piston H, as long as the consumption of pressure fluid is only slight, automatically regulates to a correspondingly short stroke length; and oppositely, during a greater consumption of pressure fluid, to a correspondingly longer stroke length.

If the feeding of the pump has to be continuous, then the piston slide C² is so adjusted that the ports c^4 and c^5 will be closed. A pressure increase will then follow in the pipes a^2 , a^3 and a^{10} , as well as on the righthand side of the piston H, and the piston H travels to the left and the stroke length of the pump is diminished. Through the displacement of the piston H, the collar h^3 will finally abut against arm K of the bell crank K K'. Upon further displacement of the piston H in the same direction and with continued diminishing of the stroke length of the pump, through the intermediary of the bell crank K K', the link-rod M and the double-armed lever P, the rod p^1 will be lowered and the rod p^2 will be raised. The valve plunger Q will then finally, actuated by the spring q^1 , be placed on its seat, while the valve plunger R, actuated by the rod p^2 , is lifted from its seat. The portion of the cylinder chamber A⁷ situated to the left of the piston G will now, on the one hand, be shut off from the righthand side of the cylinder chamber A⁸, which is under pressure; but will, on the other hand, be set in communication with the suction chamber of the pump over the path n^1 , n^6 , n^2 , n^3 , n^8 . As a consequence the forces acting on the righthand side of the piston G, will obtain higher power, so that the piston moves to the left and the valve plunger g^5 arrives in the open position. With the short stroke length of the piston which exists at the moment of reversing of the piston G, the pump now begins to feed directly into the suction piping a' through port a^{15} , chamber a^{14} and the by-pass pipe a^{16} . The pressure in the pipe a^2 sinks simultaneously, so that the one-way valve a^3 closes automatically, actuated by pressure now existing in the pipes a^{10} and a^3 , produced by the air pressure load on the piston H. The pump is consequently, while working with further continued circulation, completely unloaded.

If the working machine is again to be started, the ports c^4 and c^5 are to be opened by displacement of the piston slide C². As a consequence, the pressure sinks in the pipes

a^3 and a^{10} , as well as on the right side of the piston H, and the latter slides to the right, actuated by the air pressure which exists on its left side.

The arm K of the bell crank K K' abutting against the collar h^3 , follows the movement of the piston H, actuated by the spring m^1 . The valve plunger R now moves downward and the rod p^1 again approaches the valve plunger Q; at that moment when the valve plunger R has arrived at its ultimate position, the rod p^1 gets in contact with the valve plunger Q. During the further movement of the piston H, the valve plunger will now be lifted so that the portion of the cylinder chamber A⁷, situated to the left of the piston G, again gets into communication with the righthand end of the cylinder A⁸, which is under pressure, this communication taking place through ports n^1 , n^6 , n^5 , n^4 , n^9 . As a consequence the piston G travels to the right, so that the valve plunger g^5 again closes the port a^{15} and thus places the by-pass device a^{15} , g^5 , a^{14} , a^{16} out of commission. Then the condition from which the description of the operation of the pumping plant was started has again been reached.

Having thus described my invention, what I claim is:—

1. A controlling apparatus for piston pumps with shaft drive and a variable stroke-length comprising an adjusting member for varying the stroke-length of the pump, a controlling piston, means connecting said controlling piston to said adjusting member, means enabling said controlling piston to be actuated by the fluid pressure generated by the pump in the sense of shortening the stroke-length of the pump, a source of power acting on the controlling piston in opposition to the fluid pressure of the pump, a by-pass system comprising a controlling valve, an auxiliary motor for opening said by-pass controlling valve and means operable by the controlling piston when having reached a position corresponding to a comparatively small stroke-length for causing said auxiliary motor to function.

2. A controlling apparatus for piston pumps with shaft drive and a variable stroke-length comprising an adjusting member for varying the stroke-length of the pump, a controlling piston, means connecting said controlling piston to said adjusting member, means enabling said controlling piston to be actuated by the fluid pressure generated by the pump in the sense of shortening the stroke-length of the pump, a source of power acting on the controlling piston in opposition to the fluid pressure of the pump, by-pass system comprising a controlling valve and an auxiliary motor for opening said by-pass controlling valve, said auxiliary motor having a cylinder, a piston working therein under the action of the fluid

pressure generated by the pump and being rigidly connected to said by-pass controlling valve and a starting gear operable by the controlling piston when having reached a position corresponding to a comparatively small stroke-length for causing said auxiliary motor to function.

3. An arrangement of the class described for use in combination with a piston pump having an adjustable stroke-length comprising a pressure controlled regulating device, a source of pressure permanently connected to said regulating device, means connecting said regulating device to the pressure chamber of the pump, means operatively connecting said regulating device to the piston of the pump for regulating the same, a by-pass system, an auxiliary motor controlling said by-pass system, a control device for said auxiliary motor and means operatively connecting said regulating device to said control device whereby when said regulating device has adjusted the pump piston to a diminished stroke-length, said control device will be operated to cause said auxiliary motor to function.

4. An arrangement of the class described in combination with a piston pump having an adjustable stroke-length comprising a pressure-operated regulating device for adjusting the stroke-length of said pump, a source of power connected to said regulating device, means providing communication between said regulating device and the pressure chamber of the pump, means operatively connecting said regulating device to the piston of the pump whereby its stroke-length may be adjusted, a by-pass system, an auxiliary motor included in said system for controlling the same, said auxiliary motor comprising a cylinder and a slidably mounted piston working therein provided with differential pressure surfaces, a control device for said auxiliary motor, means operated by said regulating device for actuating said control device whereby upon a diminishing of the stroke-length by the regulating device, said control device will be caused to function thereby operating said auxiliary motor to bring said by-pass system into circulative communication with the pump.

5. An arrangement of the class described in combination with a piston pump having an adjustable stroke-length comprising a pressure operated regulating device for adjusting the stroke-length of said pump, a source of power connected to said regulating device, means providing communication between said regulating device and the pressure chamber of the pump, means operatively connecting said regulating device to the piston of the pump whereby its stroke-length may be adjusted, a by-pass system, an auxiliary motor included in said system for con-

trolling the same, said auxiliary motor comprising a cylinder and a slidably mounted piston working therein provided with differential pressure surfaces, a control device for said auxiliary motor, means including said control device providing for communication of one end of the auxiliary motor cylinder with the regulating device and with the suction chamber of the pump, means operatively connecting the regulating device to said control device whereby upon the diminished stroke-length said control device will be actuated to connect the cylinder of the auxiliary motor to the suction chamber of the pump thereby bringing said by-pass system into circulative communication with the pump.

6. An arrangement of the class described for use in combination with a piston pump having an adjustable stroke-length comprising a regulating device, a source of pressure in constant communication with said regulating device, means providing communication between said regulating device and the pressure chamber of said pump, means operatively connecting said regulating device to the pump piston whereby its stroke-length may be adjusted, a by-pass system, an auxiliary motor included in said system for controlling the same, said auxiliary motor comprising a cylinder, a piston slidably mounted in said cylinder provided with differential pressure surfaces, a valve of smaller cross-sectional area rigidly secured to said piston and operated thereby, said valve controlling the inlet connection of said system with said pump, a control device for said by-pass system, means providing constant communication between the side of said piston of smaller acting cross-section and the regulating device, means providing communication between the other side of said piston and the regulating device and with the suction chamber of the pump, said last two means being controlled by said control device, means providing an operative connection between said regulating device and said control device whereby upon a diminished stroke-length said control device will have actuated to close communication between one end of said auxiliary motor cylinder and the regulating device and to open communication between this end of the auxiliary motor cylinder and the suction chamber of said pump whereby said auxiliary motor will function thereby establishing circulative communication between said by-pass system and the pump.

The foregoing specification signed at Essen, Germany, this 17th day of June, 1920.

FRIEDRICH MARTIN.

In presence of—

HANS GOTTSMANN,
JOHANN DECKERS.