W. A. DOBLE.

IMPACT WATER MOTOR.

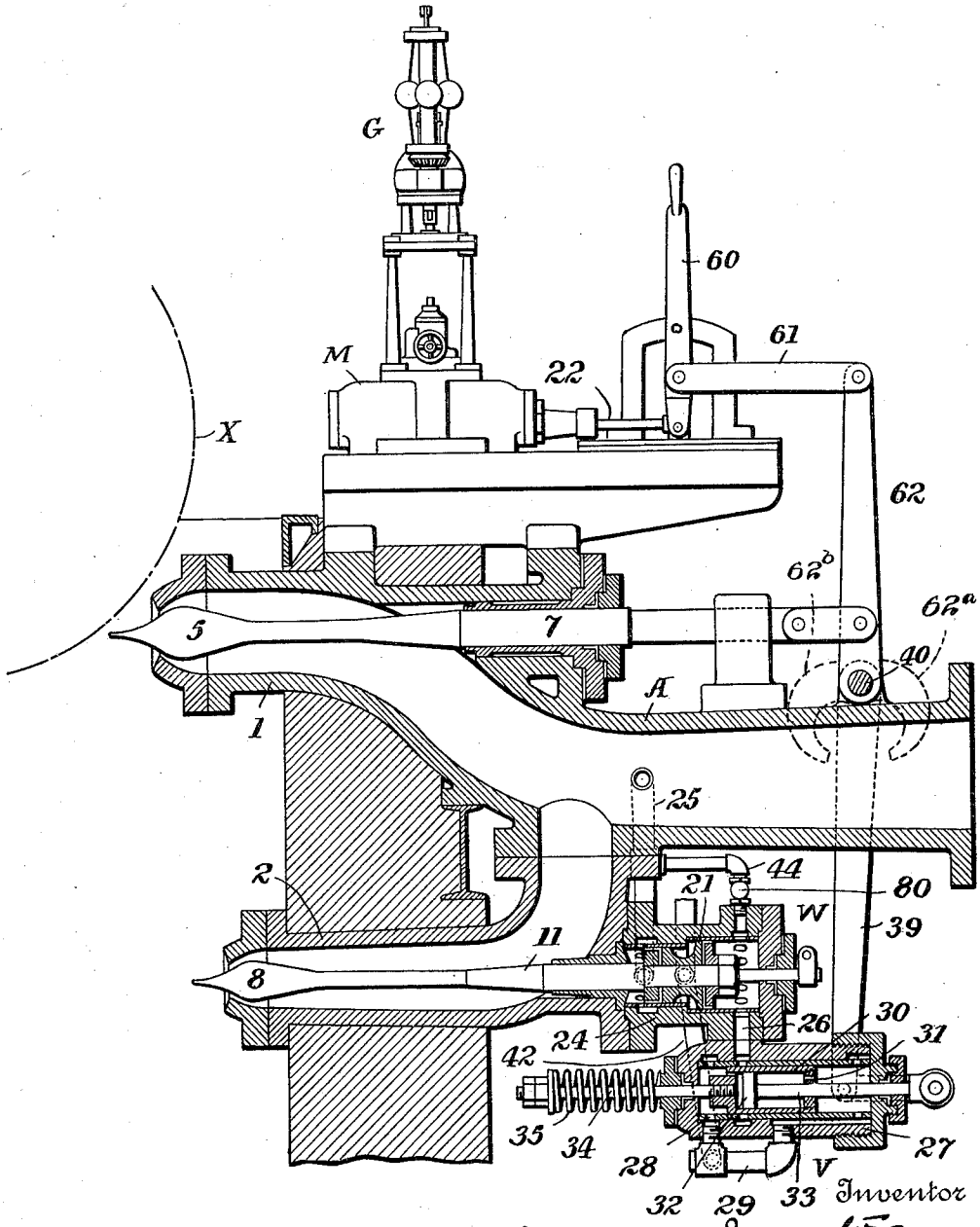
APPLICATION FILED FEB. 27, 1906.

1,030,393.

Patented June 25, 1912.

3 SHEETS—SHEET 1.

Fig. 1.



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3 SHEETS—SHEET 2.

Fig. 5.

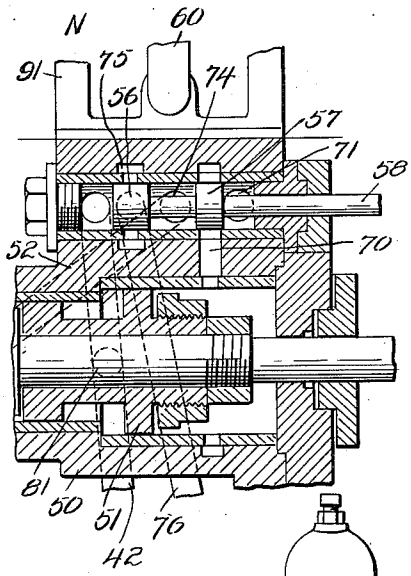


Fig. 2.

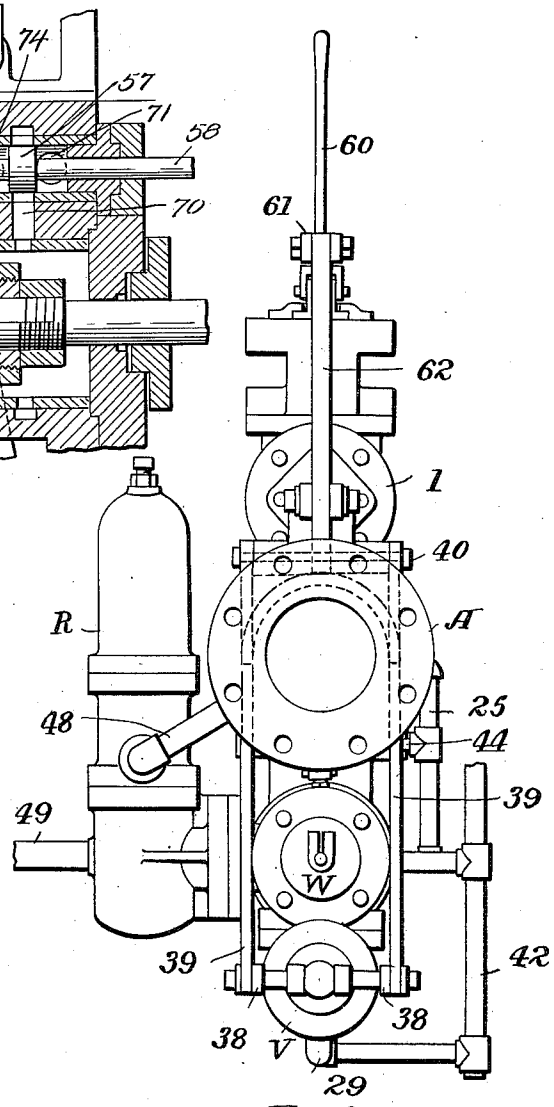
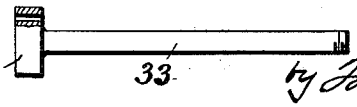


Fig. 3.



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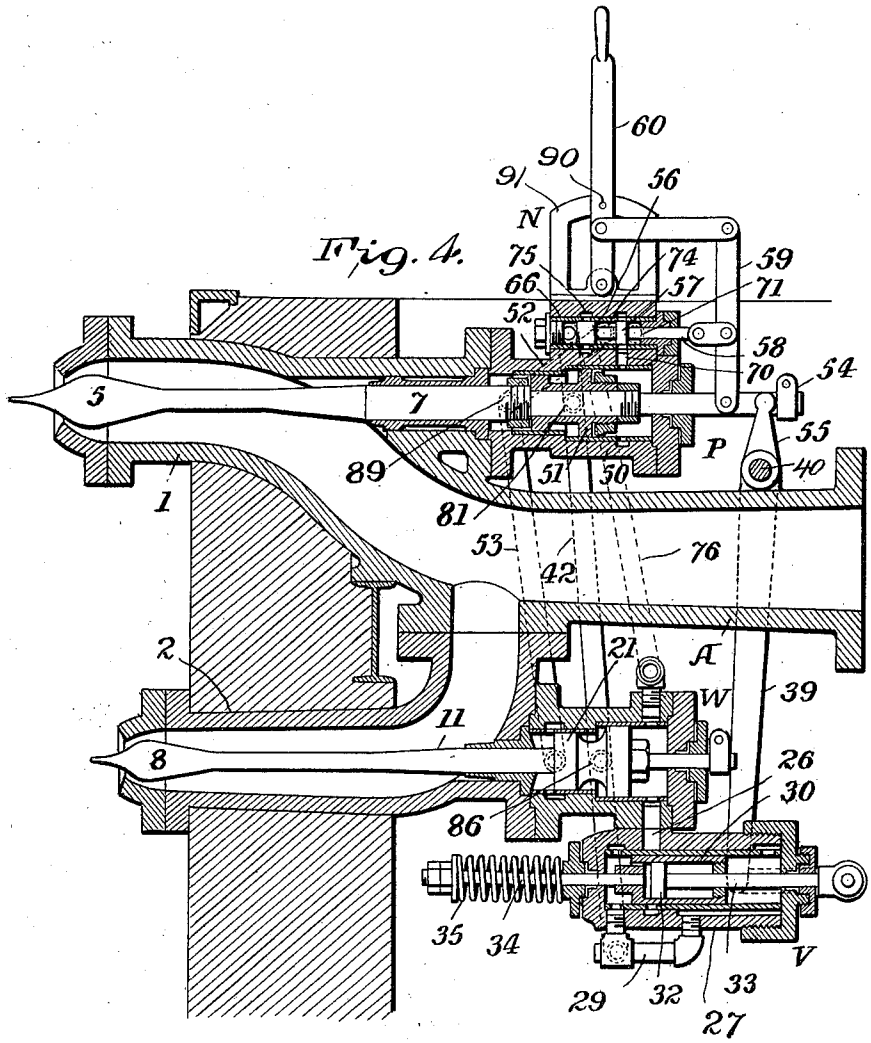
3 SHEETS—SHEET 3.

Fig. 4.



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IMPACT WATER-MOTOR.

1,030,393. Specification of Letters Patent. Patented June 25, 1912.

Application filed February 27, 1906. Serial No. 303,219.

To all whom it may concern:

Be it known that I, WILLIAM A. DOBLE, a citizen of the United States, residing at San Francisco, in the county of San Francisco and State of California, have invented certain new and useful Improvements in Impact Water-Motors, of which the following is a specification.

My invention relates to impact water motors and especially to that class of water motors in which there is a compensating device which acts to prevent an undue increase of pressure in the casing communicating with the jet nozzle, and my invention consists in means for controlling the main valve and the compensating valve as fully set forth hereinafter and illustrated in the accompanying drawings, in which—

Figure 1 is a sectional elevation of the nozzle, casings and valves and adjuncts of an impact water motor; Fig. 2 is an end elevation of Fig. 1; Fig. 3, a detached sectional view illustrating a modification; Fig. 4, a sectional elevation showing a modified arrangement for actuating the main valve. Fig. 5 is a sectional elevation of a portion of the apparatus shown in Fig. 4 on an enlarged scale.

The casing A has two nozzles, the nozzle 1, from which the jet flows to the impact wheel X, and controlled by a needle valve 5, and the nozzle 2 of the compensating device provided with a needle valve 8, the stem 11 of which is connected to the differential piston 21 of a motor W of suitable character.

A speed governor G of any desirable construction, as a Lombard governor, is driven from the impact wheel and controls the movements of a motor M, which is one means of operating the valve 5. The motor may shift the valve 5 through any suitable connections; as shown in Figs. 1 and 2, the connections are direct mechanical connections consisting of levers 60, 62, connected by a link 61, the former connected with the piston rod 22 of the motor M and the latter connected to the stem 7 of the valve 5 by a link.

The motor W of the valve 8 of the compensating device is operated by water pressure, and the latter is controlled by a suitable control device V so that after the valve 5 has effected about three fourths of its movement in closing, the motor W may under certain conditions begin to open the valve 8 as set forth in my Patent No. 941,440 November 30, 1909. As shown, the reduced end of the cylinder 24 of the motor W is in constant connection with the pressure, as with the interior of the casing A, through a pressure pipe 25, while the enlarged end of said cylinder communicates with a port 26 leading to the cylinder 27 of the control device V. The said cylinder 27 also communicates through a port 28 with a discharge or drain pipe 29, and a cylinder valve 30 slides in the cylinder of the control device so as to close or open the port 26.

Within the cylinder valve 30, which has at each end a head with a perforation 31, slides a piston 32, forming with the valve 30 a cataract device. The rod 33 of the piston 32 extends through one head of the cylinder valve and of the cylinder 27, and is connected by links 38 to arms 39, 39, loosely mounted on a rock shaft 40, to which the lever 62 is rigidly secured. This shaft has secured to it, arms 62^a which are arranged to engage arms 39, so that there is a lost motion connection between arms 62^a and 39, permitting the predetermined amount, for instance 75% of its entire movement, before the lever 39 is moved.

To the outer end or head of the cylinder valve 30 is connected a rod 34 extending through the head of the cylinder 27, and carrying at the outer end nuts against which bears a spring 35 coiled around the rod and also bearing on the head of the cylinder. The piston 21 of the motor W is recessed between its heads forming a chamber between the enlarged and reduced ends of the cylinder 24, and this chamber communicates through an upwardly extending drain pipe 42 with the drain pipe 29.

The pressure pipe 25 communicates through a pipe 44 with the enlarged end of the cylinder 24, and said pipe 44 is provided with a throttle valve 80 set so as to allow only a very limited flow through said pipe. Under normal operations, the play of the valve 5, to any extent which does not move it beyond say seventy-five per cent. of its closing movement will suffice to effect the desired control of the movements of the impact wheel but will not shift the cylinder valve 30 sufficiently to open the port 26. If however the load should be suddenly reduced, or reduced to such an extent that a more extended closing movement of the

valve 5 is required, (which movement if not compensated for would result in a sudden or undesirable increase of pressure in the casing A,) then the valve 30 will be shifted sufficiently to open the port 26 and the valve 8, which is normally closed, will begin to open and thus prevent such increase of pressure. This results from the outward swing of the arms 39 carrying the piston 32 and valve 30 with them, compressing the spring 35, and after the valve 5 has moved beyond the predetermined extent to the position shown in Fig. 1, opening the port 26 so that pressure in the enlarged end of the cylinder 24 is relieved by the escape of the contents to the drain, when the superior pressure in the reduced end will shift the piston 21 to the right and open the nozzle 2. This, however, will not result if the valve 5 is moved less than 75% of its movement to closing position, since the lost motion connection between levers 39 and 62 provides for a predetermined free movement of lever 62 and therefore of valve 5 before the lever 39 is operated. No opening of valve 8 will result if the valve 5 is closed to its full extent very gradually for then the outward swing of the arms 39 will carry the piston 32 so slowly to the right that the water in the cylinder valve 30 will flow through the right hand port 31 without moving said valve. A movement of the piston 32, however, more rapidly than the water can be displaced through the port 31 will carry the cylinder valve with the piston. The water displaced from the right of the valve 30 will flow through end ports of the cylinder to the drain pipe 42 which extends upward above the cylinder as shown in Fig. 2 so that water is retained therein by gravity. This pipe 42 is open at its upper end so as to discharge the water, but is high enough so as to furnish sufficient head to allow the water to flow back into cylinder valve 30. After the valve 8 has thus been moved back and prevents any sudden and undesirable rise of pressure in the casing A, the spring 35 will carry the valve 30 to the left and close the passage 26 gradually as the water flows through the port 31, and when the passage 26 is closed the water under pressure will flow slowly through the pipe 44 into the enlarged end of the cylinder 24 and the piston 21 will be gradually carried to the left and close the nozzle 2.

By the means described while the compensating valve is opened it is so regulated as to practically preserve the pressure in the casing so that the normal efficiency of the jet acting on the impact wheel is not interfered with, as is the case where the casing is supplied with a relief valve, but to prevent detrimental results from any abnormal and sudden increase of pressure in the casing A, an ordinary relief valve is arranged in a casing R which communicates with the casing A through a pipe 48, the water escaping through a discharge pipe 49.

It will be seen that while I secure the general results attained by the apparatus constituting the subject of my aforesaid application, the construction described above can be applied in those cases where the governor motor can act directly to control the main needle valve. It will further be seen that the governor motor also directs the operations of the control device, and that the control device is actuated by water pressure only in one direction, the spring in connection with the dash pot arrangement restoring the valve to closed position after allowing sufficient time for the motor to act to open the valve 8. It will be evident that any other available form of dash pot for permitting a change in the relative positions of the piston 32 and valve 30 may be used. For instance, the piston 32 may be perforated as shown in Fig. 3.

In the construction shown in Fig. 4, the general arrangement of the casing, nozzles, valves, motor W and control device V is similar to that shown in Figs. 1 and 2, but the valve 5 instead of being controlled by the motor of the governor is controlled by a hydraulic motor P having a differential cylinder 50 and differential piston 51, the smaller end being under pressure admitted through a pipe 52 shown in dotted lines, which is applied from any suitable source as from a pressure pipe leading also to a port 74 and which pressure is communicated to the small end of the motor W through a pipe 53, and the stem 7 of the valve 5 is provided with a tappet 54 which by contact with the yoke arm 55 upon the shaft 40 rocks the latter as the valve 5 after a predetermined extent of motion approaches its closing position, and through the medium of the arms 39 then shifts the valve 32 as before described. The motor P is provided with a control device N consisting of a cylinder having an inlet port 74 midway between the ends, receiving pressure from the main, and with end exhaust ports 66 and 71 and having a valve with two pistons 56, 57, upon the stem 58 connected by a link to a lever 59, pivoted to stem 7, which may be operated by a lever 60, which may be a hand lever or said lever 59 may be operated by any suitable connection with a governor. The hand lever may be fixed in position by the detachable pin 90 extending from said lever into a frame 91 of the control device. The valve of the control device N controls a port 70 by which the motor fluid may pass to or from the enlarged end of the cylinder 50, and also a port 75 communicating with the pipe 76, leading to the enlarged end of the cylinder of the motor W. Upon moving the lever 60 from the position Fig. 4 to the

left, the valve of the control device N is shifted to the left so as to put the port 70 in communication with the exhaust 71 when the superior pressure from the pipe 52 on the reduced end of the piston 51 through a port 89 will shift it to the right and increase the jet and the power applied to operate the impact wheel. As the piston 51 travels to the right, however, it swings the lever 59 to the right and gradually carries the valve of the control device N to the right and the piston 57 closes the port 70 so that the valve 5 will remain in the position which it finally assumes and until the lever 60 is again moved to the left. On moving the lever 60 from the position shown in Fig. 4 to the right, the port 70 is brought into communication with the port 74 communicating with the pressure pipe so that the pressure upon both ends of the piston 51 is the same but as the right hand end is of greatest diameter, the piston and the valve 5 will be carried to the left until the valve of the control device N is brought to a position to close the port 70. The piston 56 of the control valve also controls the port 75 communicating with the pipe 76 leading to the large end of the cylinder of the motor W, which port 75 is opened when the valve of the control device N is shifted to the left to open the valve 5, so that pressure is admitted to the right hand end of the motor W and then closes the valve 8. A pipe 42 communicates with the exhaust port 66, also with an exhaust port 81 of the cylinder P, and an exhaust port 86 of the cylinder of the motor W and with the drain pipe 29.

The different parts are so arranged, as in the other construction, that any movements of the valve 5 carrying it through about seventy-five per cent. of its travel will have no effect upon the valve 8 or the control device thereof. The tappet 54 is so located that it will not strike arm 55 until valve 5 and its stem 7 have moved 75 per cent. of their movement to closing position, so that valve 30 will only be opened during the last 25 per cent. of the closing movement of 5, and then only when the closing movement during this latter period is sufficiently rapid to cause the piston 32 to operate the valve 30. A slow closing movement of the main valve 5, even if the valve moves from wide open position to completely closed position, will not affect the valve 8, but this valve 8 will only be opened when there is a quick closing movement of valve 5 during the last 25 per cent. of its closing movement. The operations upon the valve 8 in connection with the valve 5 through the medium of the motor W and control device V are the same as in the construction of Figs. 1 and 2. It will be seen, however, that in the construction of Fig. 4, the valve 5 is operated by a motor which is independent of the governor, while in the other construction the governor constituting part of the motor is the means of shifting the valve. It will also be seen that in each case, the motor which operates the valve 5 is also the means of shifting the control device of the second motor. The compensating nozzle does not come into operation at all during the normal movements of the main valve mechanism, but operates only in case of a sudden increase of speed and then only when the main valve mechanism is moved beyond a predetermined limit to closed position.

I do not here claim any feature herein shown and also shown and claimed in my aforesaid Patent No. 941,440, and relating broadly to the general combination of the two nozzles, independent valves and operating means.

Without limiting myself to the construction and arrangement shown, I claim:—

1. The combination in an impact water motor, of a casing having two nozzles and valves therefor, a motor and lever connections for operating the main valve, a separate motor for the second valve, a control device for the latter motor, and means for actuating the control device from the motor that actuates the main valve, substantially as set forth.

2. The combination in an impact water motor, of a casing having two nozzles and two valves, a motor for the second valve, a control device for said motor, and a motor connected to actuate said control device and also to shift the main valve, substantially as set forth.

3. The combination in an impact water motor, of a casing having two nozzles and valves, a governor provided with a motor, a motor for the second valve, a control device for the latter motor, and connections whereby the first valve and the control device are both actuated from said governor motor, substantially as set forth.

4. In an impact water motor, the combination of a casing having two nozzles and valves, a governor provided with a motor, connections whereby the main valve is controlled from the said motor, a motor for actuating the valve of the other nozzle, a control device for the latter motor, and means for operating the control device from the governor motor, substantially as set forth.

5. The combination with the casing, main and compensating nozzles and valves of an impact water motor, of a motor for actuating the compensating valve, a control device for said motor, a lever connected with the stem of the main valve and with a valve of the control device, and a motor for operating said lever, substantially as set forth.

6. The combination with the casing, main and compensating nozzles and valves of an impact water motor, of a motor for actuat-

ing the compensating valve, a control device for said motor, a lever connected with the stem of the main valve and with a valve of the control device, a motor for operating said lever, and a speed governor controlling the operations of the last named motor, substantially as set forth.

7. The combination with the casing, its main and compensating nozzles and main and compensating valves for said nozzles, of a differential motor having a differential piston connected with the compensating valve, means for maintaining the smaller piston head under pressure, a control device communicating with the enlarged end of said motor, and provided with a controlling valve controlling the flow from said end, and means for shifting said controlling valve to discharge from said end as the main valve closes its nozzle, substantially as set forth.

8. The combination with the supplemental or compensating nozzle and valve of an impact water motor, of a motor for said valve, a control device having a cylinder communicating with one end of the motor cylinder, and with a discharge port, a valve for opening and closing said communication and port, a governor and connection for shifting the latter valve in one direction, and a spring for moving it in the other direction independently of said connections, substantially as set forth.

9. The combination with the compensating valve and the motor for controlling the compensating valve of an impact water motor, of a control device provided with a cylinder valve, a piston sliding in said valve, means for shifting said piston, means for permitting the slow flow of water to permit the gradual change in relative position of the piston and valve, a governor and means for shifting the piston therefrom in one direction, and a spring and connections for shifting the cylinder valve in the opposite direction, substantially as set forth.

10. The combination in an impact water motor, of a casing having two nozzles and two valves, a motor for each valve, a control device for the motor of the second valve, and means whereby said control device is put in operation from the first motor as the first valve approaches a closed position, substantially as set forth.

11. The combination with the casing, main and compensating nozzles and valves of an impact water motor, of a motor for actuating the compensating valve, a control device for the said motor, and a lever connection between the stem of the main valve and a valve of the control device, substantially as set forth.

12. The combination with the casing, nozzles and main and compensating valves, of a differential motor having a differential piston connected with the compensating valve, means for maintaining the smaller piston head under pressure, a control device communicating with the enlarged end of the motor, and provided with a valve controlling the flow from said end, and means for supplying the said end with water under pressure, substantially as set forth.

13. The combination with the supplemental or compensating nozzle and valve of an impact motor, of a motor for said valve, a control device having a cylinder communicating with one end of the motor cylinder and with the discharge port, a valve for opening and closing said communication and port, a motor for shifting the valve of the control device in one direction, and a spring for moving it in the other direction independently of said motor, substantially as set forth.

14. The combination with the supplemental or compensating nozzle and valve of an impact motor, of a motor for said valve, a control device having a cylinder communicating with one end of the motor cylinder and with the discharge port, a valve for opening and closing said communication and port, a motor for shifting the valve of the control device in one direction, a spring for moving it in the other direction independently of said motor, and means for admitting water under pressure to the enlarged end of the valve motor, substantially as set forth.

15. The combination with the compensating valve and motor of an impact water motor, of a control device provided with a cylinder valve, a piston sliding in said valve, means for permitting the slow shifting of the piston independently of the valve, a motor for operating said piston in one direction, and a spring for moving the valve in the other direction, substantially as set forth.

16. The combination with a hydraulic motor provided with valve mechanism, of a compensating device having a discharge port and valve, means adapted to be operated from a speed governor, and having a lost motion connection with said valve mechanism, constructed and arranged to cause the said compensating valve to be shifted to open its port only when the said valve mechanism is shifted beyond normal limits, and a device in said connection constructed to come into effective operation only when the movement of the valve mechanism exceeds a predetermined speed.

17. The combination with a hydraulic motor provided with valve mechanism, of a compensating device having a discharge port and valve, and means, including a cataract device, adapted to be operated from a speed governor and constructed and arranged to cause the said compensating valve

to be shifted to open its port only when the motor valve moves beyond a predetermined speed and limit in closing.

18. In a hydraulic motor, the combination with main and compensating nozzles and valves therefor, of a motor for said compensating nozzle valve, regulating means for said motor, and a lost motion connection between said regulating means and said main nozzle valve.

19. In a hydraulic motor, the combination with main and compensating nozzles and valves therefor, of a motor for said compensating nozzle valve, regulating means for said motor, and a cataract device connecting said regulating means and said main nozzle valve.

20. In a hydraulic motor, the combination with main and compensating nozzles and valves therefor, of a motor for said compensating nozzle valve, a regulating valve for said motor, and a lost motion connection between said regulating valve and said main nozzle valve.

21. In a hydraulic motor, the combination with main and compensating nozzles and valves therefor, of regulating means for said main valve, a motor for said compensating nozzle valve, a regulating valve for said motor, and connections between said regulating means and said regulating valve including a cataract device.

22. The combination with a hydraulic motor, of a water supply pipe, a bifurcated nozzle rigidly secured thereto, and having an outlet opening for the impact stream in one branch thereof, a valve working within said branch of the nozzle for varying the outlet area thereof for the discharge of an impact stream, a valve stem projecting beyond the nozzle, governor mechanism for actuating said stem to move the valve to open and close the outlet for the impact stream, an overflow outlet in the opposing branch of the nozzle less in area than the outlet for the impact stream, a valve for controlling the overflow outlet of the nozzle, means including lost-motion mechanism for actuating said valve to open the overflow outlet after the main valve has moved to a limited extent, said actuating means and said valve being constructed and arranged to permit the gradual closing of the same.

23. The combination with the nozzle and valve of an impact motor apparatus, of a supplemental nozzle and valve, of less area than the main valve, a governor and connections to shift the main valve independently of the supplemental valve according to the normal load changes on the motor, and means for actuating the supplemental valve independently after partial closing of the main valve to prevent detrimental increase of pressure in the apparatus.

24. The combination with the casing and main and supplemental valves and ports, of means for shifting said valves constructed to permit a partial closing of the main valve without opening the supplemental valve, and the opening of the latter valve as the main valve approaches the termination of its closing movement.

25. The combination with the casing and main and supplemental ports and valves, of a speed governor and devices for actuating and controlling said valves, said devices being constructed to permit a partial closing of the main valve without opening the supplemental valve and to open the latter valve as the main valve approaches the termination of its closing movement.

26. The combination with the casing and main and supplemental ports and valves, the latter less in cross sectional area than the former, of means for shifting said valves constructed to permit a partial closing of the main valve without opening the supplemental valve and to open the latter valve as the main valve approaches its closing movement.

27. The combination with a hydraulic motor provided with valve mechanism, of a compensating device having a discharge port and valve, and means including a yielding member adapted to cause the said compensating valve to be shifted to open its port only when the motor valve moves beyond a predetermined speed and limit in closing.

28. In a hydraulic motor, the combination with main and compensating nozzles and valves therefor, of lost motion mechanism connected to said main nozzle valve and controlling means for said compensating nozzle valve operated by said lost motion mechanism and constructed to come into operation only when the movement of the valve for the main nozzle exceeds a predetermined speed.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

WILLIAM A. DOBLE.

Witnesses:

CHARLES E. FOSTER,

GEO. W. REA.