

Feb. 17, 1948.

J. KALIX

2,435,968

MECHANISM FOR CONTROLLING HYDRAULIC FLOW

Filed July 25, 1944

3 Sheets-Sheet 1

Fig. 1.

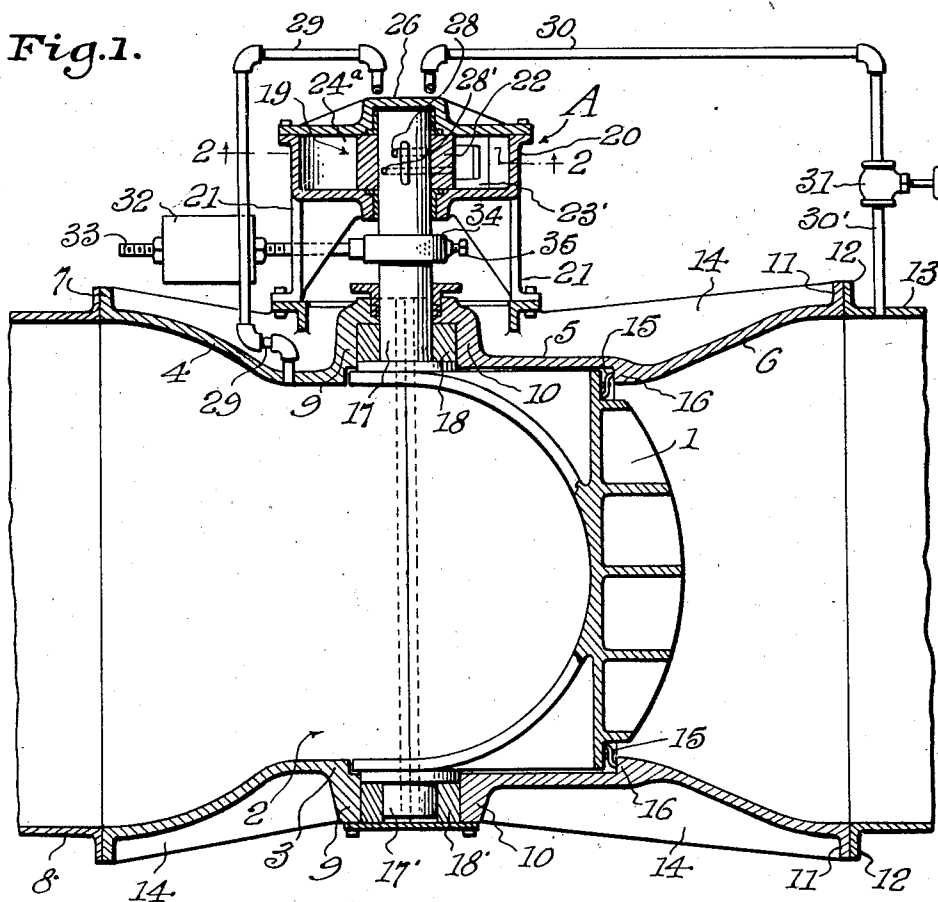


Fig. 2.

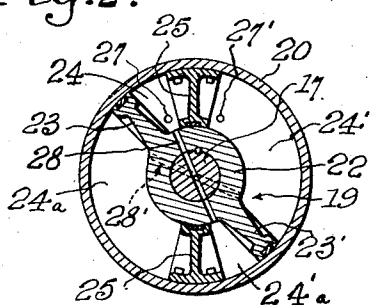
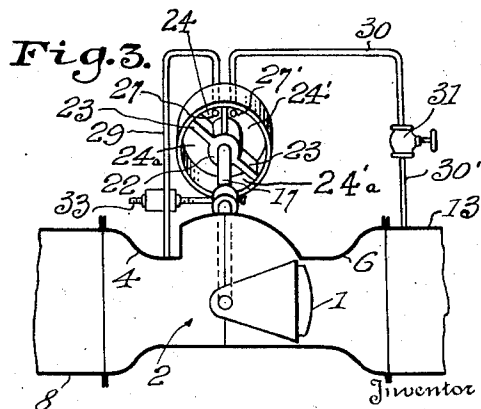


Fig. 3.



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Fig. 4.

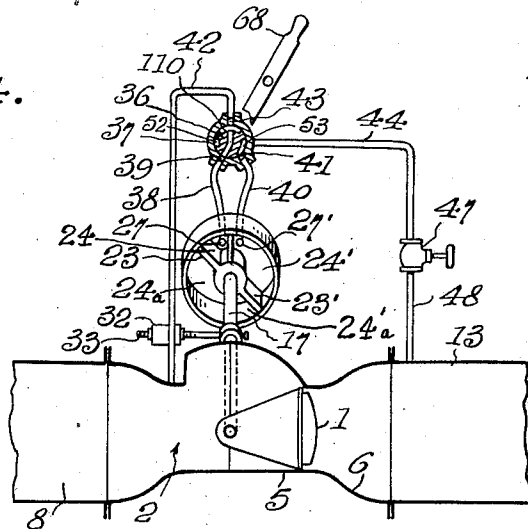
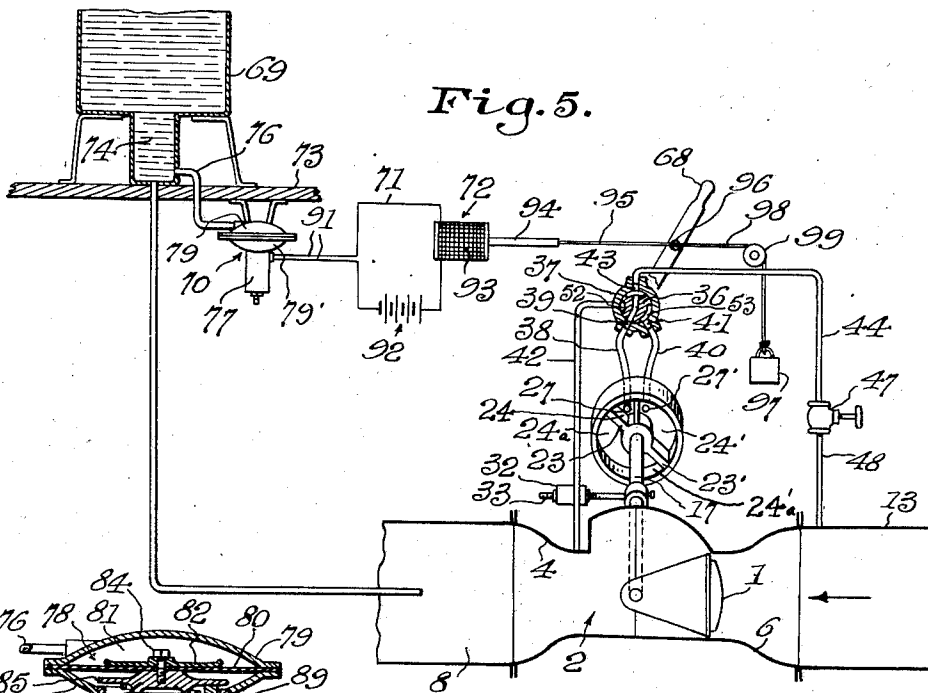


Fig. 5.



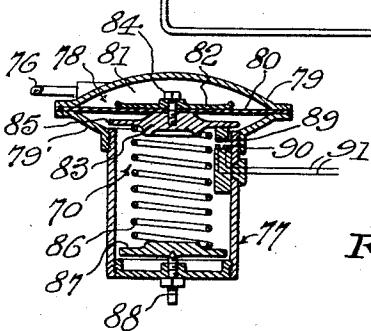
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Fig. 6.



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Fig. 7.

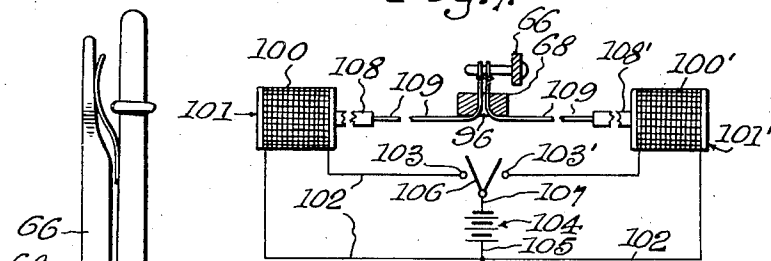


Fig. 8.

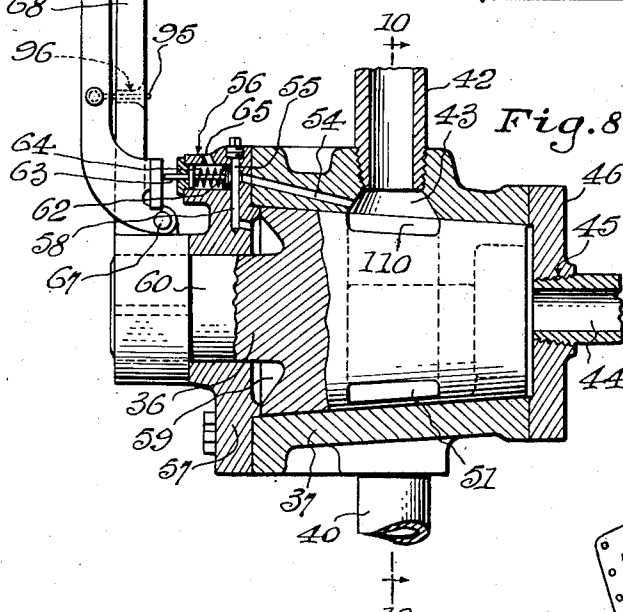


Fig. 9.

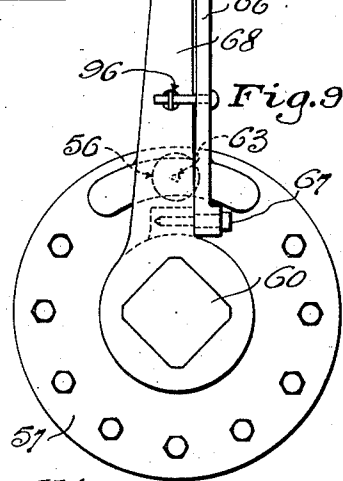


Fig. 11.

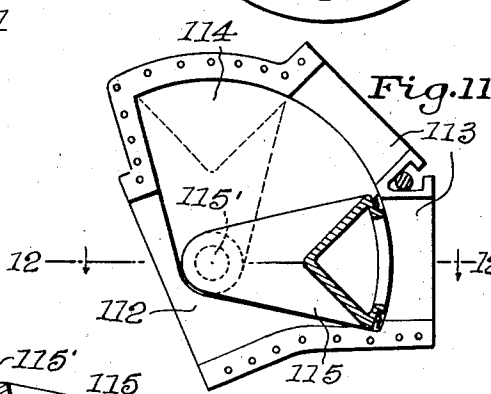


Fig. 10.

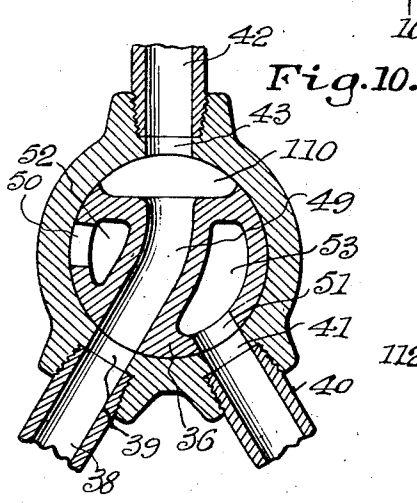
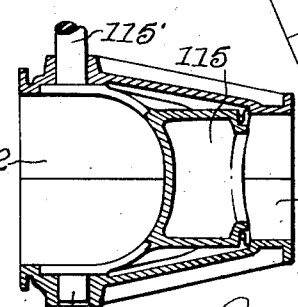


Fig. 12.



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UNITED STATES PATENT OFFICE

2,435,968

MECHANISM FOR CONTROLLING
HYDRAULIC FLOW

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Application July 25, 1944, Serial No. 546,461

6 Claims. (Cl. 137—139)

(Granted under the act of March 3, 1883, as
amended April 30, 1928; 370 O. G. 757)

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The invention described herein may be manufactured and used by or for the Government for governmental purposes, without payment to me of any royalty thereon.

This invention relates to an improved control mechanism for operating and handling gate valves employed for regulating the flow of water through penstocks, more particularly it is directed to an improved mechanism for actuating a gate valve of the type disclosed in the applicant's Patent No. 2,302,695, issued November 24, 1942.

One of the objects of the invention is to provide a gate valve operating mechanism which will eliminate disturbances such as vibration and hammering caused by vacuum and pressure during flow while the gate valve is in motion or in an intermediate stopped position.

Another object of the invention is to provide a gate valve operating mechanism which is economical in operation, efficient in use, and which is not liable to get out of order.

These and other objects of the invention will be apparent upon a consideration of the following detailed description when taken in conjunction with the accompanying drawings, in which:

Figure 1 is an enlarged fragmentary horizontal sectional view through a penstock and gate valve movably mounted therein and showing one form of the improved mechanism including a reciprocating piston mounted in a cylinder for operating and handling the gate valve;

Figure 2 is a detailed cross-sectional view taken on line 2—2 of Figure 1 through the piston and cylinder;

Figure 3 is a reduced diagrammatic view of the elements shown in Figure 1;

Figure 4 is a similar view to Figure 3 and including a pilot-cock which may be used in carrying out the invention;

Figure 5 is a similar view to Figure 4 and showing means including an electrical circuit containing a solenoid and diaphragm switch actuating mechanism to close or open the electrical circuit, said means remotely controlling the actuation of the pilot-cock for controlling the operation of the gate valve in the penstock, with a counterbalancing weight connected to the pilot-cock;

Figure 6 is an enlarged detail vertical sectional view through the diaphragm switch actuating mechanism;

Figure 7 is a diagrammatic view of an electrical circuit having dual solenoids connected thereto, which may be used for actuating the pilot-cock;

Figure 8 is an enlarged vertical sectional detail

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view of the pilot-cock partly in elevation and with its connected parts broken away;

Figure 9 is an end view thereof;

Figure 10 is a cross-sectional view of the pilot-cock taken on line 10—10 of Figure 8;

Figure 11 is a detailed vertical sectional view partly in elevation through a Y-fitting having a valve rotatably mounted therein which may be used if desired in carrying out the invention; and

Figure 12 is a horizontal sectional view taken on line 12—12 of Figure 11.

Referring more particularly to Fig. 1 of the drawings, a gate valve 1 to be operated by the improved mechanism indicated generally by A is positioned within a main conduit or penstock 2 for controlling the flow of water therethrough. The penstock 2 is substantially Venturi-shaped being constructed of an inlet section 3 including a flared upstream portion 4 and a seal section 5 including a flared downstream portion 6. The flared portion 4 of the inlet section 3 is provided with a flange 7 by means of which it may be attached to the inlet pipe 8. The opposite end of the section 3 carries a bearing portion 9 arranged to be bolted to a similar bearing portion 10 on the inner end of the seal section 5 and the outer end of the seal section 5 has a flange 11 by means of which it may be attached to the flange 12 on the outlet pipe 13. Strengthening ribs 14 may be provided if desired.

The gate valve 1 carries seal members 15 preferably of the type disclosed in the applicant's Patent No. 2,302,695, which seal members 15 are adapted to abut against a portion 16 of reduced diameter on the seal section 5 for stopping the flow of water through the seal section and the gate valve 1 is provided with trunnions 17 and 17' rotatably mounted in the bearings 9 and 10, respectively, formed by the portions 9 and 10 on the penstock 2. The trunnion 17 is made longer than the trunnion 17' and extends out through its bearing 10, with the outer end of the trunnion 17 being keyed to a piston 19 mounted to reciprocate in a cylinder or pressure chamber 20 mounted on the strengthening ribs 14 of the penstock 2, by brackets 21. The piston 19 consists of a hub 22 and two blades or wings 23 and 23' and the cylinder 20 is divided into compartments 24, 24a and 24' by means of the blades 23 and 23' and partitions 25, said partitions 25 being mounted on the cylinder 20 at their outer ends and frictionally engaging the hub 22 of the piston 19 at their inner ends, with the blade 23 of the piston working in the compartments 24 and 24a of the cylinder 20 and the blade

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23' working in the compartments 24' and 24'a of the cylinder as illustrated in Fig. 2. A cover 26 is mounted on the cylinder 20, which cover 26 has ports 27 and 27' therein, with the port 27 extending into the compartment 24 and the port 27' extending into the compartment 24'. The working compartments 24 and 24'a are interconnected in communication by means of a drilled hole 28 extending through the hub 22 of the piston 19 and trunnion 17 and the working compartments 24' and 24a are interconnected in communication with each other by means of a drilled hole 28'. One end of a conduit 29 is connected in communication with the port 27 in the cylinder cover 26 and leading into the compartment 24 of the cylinder 20, with the other end of the conduit 29 being connected in communication with the inlet penstock section 3 at the upstream side of the gate valve 1 and a conduit 30 is connected in communication with the port 27' in the cylinder cover 26, which port 27' leads into the compartment 24' of the cylinder 20, with the other end of conduit 30 being connected in communication with a conventional needle valve 31, which in turn is connected to the penstock outlet pipe 13 at the downstream side of the gate valve 1 by a conduit 30'. The trunnion 17 has a counterbalancing weight 32 mounted thereon, said counterbalancing weight 32 being adjustably mounted on the outer end of a shaft 33, which in turn is fixedly mounted at its inner end to a collar 34 secured to the trunnion 17 by screw 35.

Referring more particularly to Fig. 4, a pilot-cock 36 mounted in a housing 37 may be provided on the gate valve operating mechanism A, said pilot-cock 36 being of the same construction as disclosed in applicant's pending application Serial No. 528,544, filed March 29, 1944, entitled "Sluice gate and operating mechanism therefor," and again shown in detail in Figs. 8 to 10, inclusive, in the present application. In this arrangement a conduit 38 is connected at one end in communication with a port 39 of the pilot-cock housing 37, with the other end of the conduit 38 being connected in communication with the port 27 in the cover 26 of the piston cylinder 20, while a conduit 40 connects the port 27' in the cylinder cover 26 in communication with a port 41 of the pilot-cock housing 37. A conduit 42 is mounted at one end in a port 43 in the upper portion of the pilot-cock housing 37, with the other end of the conduit 42 being connected in communication with the inlet section 3 of the penstock and a conduit 44 is mounted at one end in a port 45 in the end wall 46, Fig. 8, of the pilot-cock housing 37, with the other end of the conduit 44 being connected in communication with a conventional needle valve 47, which in turn is connected in communication with the outlet pipe 13 by a conduit 48.

As shown in Figs. 8 to 10, inclusive, the pilot-cock 36 is of a substantially frusto-conical shape and rotatably mounted in its housing 37, with a passage 49 and ports 50 and 51 formed in the pilot-cock. The ports 50 and 51 lead into passages 52 and 53, respectively. The passage 49 extends transversely through the pilot-cock 36 and the port 50 and passage 52 are formed on one side of the passage 49 and the port 51 and passage 53 are formed on the opposite side thereof. A passage 54 in the pilot-cock housing 37 leads from the port 43 to an intake port 55 provided in a valve chamber 56 formed on an end wall 57 of the housing 37, said intake port 55 being connected in communication by means of a passage 58 with an annular channel 59 formed around

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the outer end of the pilot-cock 36 adjacent to a shaft portion 60 extending outwardly from one end of the pilot-cock 36 through the end wall 57 of the housing 37. A valve 62 is operatively positioned in the valve chamber 56, said valve 62 adapted to admit fluid under pressure from the passage 54 through the intake port 55 and to pass through passage 58 to the annular channel 59 in the pilot-cock 36.

The valve 62 having a valve stem 63 thereon is adapted to be pressed into engagement with the intake port 54 against the action of a spring 64 for closing the passage 58 to prevent fluid under pressure from passing therethrough and permitting the fluid in the annular channel 59 of the pilot-cock 36 to be exhausted through a port 65. The valve stem 63 extends outwardly from the valve chamber 56 and is adapted to be controlled by a lever 66 for actuating valve 62 against the action of spring 64, said lever 66 being pivoted at 67 to a handle 68 for rotating the pilot-cock 36 in the housing 37.

The pilot-cock 36 may be remotely controlled, if desired, by the apparatus disclosed in Fig. 5, which apparatus comprises a water tank 69, a switch mechanism 70 and an electrical circuit 71 containing a solenoid 72. The water tank 69 is suitably mounted on a platform 73 and has a well 74 depending from the bottom thereof, said well 74 being connected in communication with the inlet pipe 3 of the penstock 1 by a pilot tube or conduit 75 and connected in communication with the switch mechanism 70 by a conduit 76.

The switch mechanism 70 illustrated in detail in Fig. 6 consists of a housing 77 having an enlarged cover 78 mounted thereon, which cover 78 is constructed of upper and lower sections 79 and 79', respectively, with the upper section 79 being domeshaped. A diaphragm 80 is clamped between the sections 79 and 79' of the cover 78, whereby an upper chamber 81 is provided in the switch housing cover 78, with the conduit 76 being connected in communication with the compartment 81. The diaphragm 80 is provided with a disc 82 and to this is connected a member 83 by means of the screw 84. The member 83 has a circular flange 85 thereon spaced from the lower surface of the diaphragm 80 and adapted to contact with the upper end of the switch housing 77 against the action of a spring 86 in the housing 77, which spring 86 engages the member 83 at its upper end and abuts against a plate 87 at its lower end. A screw 88 is threadably mounted in the lower end of the switch housing 77, said screw 88 engages the plate 87 at its inner end for adjusting the tension of the spring 86. The member 83 carries an electrical contact 89 adapted to be moved into engagement with the contacts 90 for closing the electrical circuit 71 through conductors 91 having the battery 92 and the coil 93 for the solenoid 72 connected therein. The plunger 94 of the solenoid 72 is connected to the pilot-cock lever 66 by means of a rope or cable 95, which extends through an aperture 96 formed in the handle 68 of the pilot-cock 36 as shown in Fig. 8, whereby upon a current passing through the circuit 71, the solenoid coil 93 is energized and the plunger 94 is pulled inwardly thus actuating the lever 66 and moving the handle 68 for rotating the pilot-cock 36 in its housing 37 for a purpose which will hereinafter be described. Upon the solenoid 72 being deenergized the handle 59 is actuated in the reverse direction to operate the pilot-cock 36 to an inoperative position by means of a counterbalancing weight 97

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attached at one end of a rope or cable 98 engaging a pulley 99, with the other end of the rope or cable 98 being connected to the lever 66 through the aperture 96 in the handle 68 of the pilot-cock 36.

The lever 66 and handle 68 may be manually operated to control the operation of the pilot-cock 36 as illustrated in Fig. 7, wherein the coils 100 and 100' of solenoids 101 and 101', respectively, are connected in circuit by a conductor 102, with the ends of the conductor 102 being connected to electrical contacts 103 and 103'. One end of a battery 104 is connected to the conductor 102 by a conductor 105 and the other end of the battery is connected to a double-throw switch 106 by a conductor 107, which switch 106 is adapted to be manually actuated to either of the electrical contacts 103 or 103' for completing a circuit through the solenoid coils 100 or 100' from the battery 104. The solenoid coils 100 and 100' are arranged on opposite sides of the pilot-cock lever 66 and handle 68, with the plungers 108 and 108' of the solenoids 101 and 101' being connected to the lever 66 and handle 68 of the pilot-cock 36 by ropes or cables 109.

The Y-fitting 111, Figs. 11 and 12, may be used for joining dual pipelines and comprises an inlet opening 112, dual outlet opening 113 and a pocket 114. A valve 115 having trunnions 115' thereon is rotatably mounted on the Y-fitting 111 and is adapted to be actuated for opening or closing either of the outlet openings 113 in the Y-fitting and to seat in the pocket 114 when in an inoperative position, with both of the openings 113 unobstructed.

In operation of the gate valve 1 by the mechanism A disclosed in Fig. 1, assume that water flowing through the penstock 2 has entered the conduit 29 and passed through the port 21 into the compartment 24 of the piston cylinder 20 and that some of the water from the compartment 24 has passed through the hole 28 into the compartment 24'a. With the water impinging against one side of the wing 23, the piston 19 tends to rotate the trunnion 17 in a direction to open the gate 1 and assuming that water has entered the conduit 30', passed through the needle valve 31 and led by the conduit 30 to the port 27' in the compartment 24' of the piston cylinder 20 and that some of the water from the compartment 24' has passed through the hole 28' into the compartment 24a; the water in the compartment 24' impinging against one side of the piston wing 23' tends to rotate the piston 19 in an opposite direction to rotate the trunnion 17 in a direction to close the gate 1. With the needle valve 31 and the gate valve 1 being open, the water pressure in the outlet pipe 13 is greater than the pressure of the water through the conduit 29 due to the greater cross-section of the outlet pipe 13 than that of the inlet section 3. This pressure difference is extended to the compartments 24' and 24a of the piston cylinder 20 and is sufficient to drive the piston wings 23 and 23' in a clockwise direction against the action of the water pressure in the compartments 24 and 24'a whereby the piston 19 is rotated in a direction to rotate the trunnion 17 in a direction to close the gate valve 1. With the water pressure in the compartments 24'a and 24' of the piston cylinder 20 being equal to the water pressure in the compartments 24' and 24a, the counterbalancing weight 32 may be adjusted on the shaft 33 to permit the gate valve 1 to be heavier and close in water standing still in the penstock

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2. The flow of the water through the penstock 2 creates the required pressure difference around the gate valve 1 with enough sensitiveness to open or keep open the gate valve through the action of the piston 19 in the cylinder 20. The water flow has a positive action on the gate valve and the backslip of the water flow is reduced thereby eliminating hammering, also the counterbalanced weight 32 is adapted to have the finest adjustment on the shaft 33 considering the slight amount of friction of the gate valve and current disturbances thereon. By adjusting the needle valve 31 the time of seating of the gate 1 may be controlled.

In order to close and open the gate valve 1 when desired or to give a positive opening to the gate for regulating the quantity of water flow and to reduce the pressure thereof, the gate operating mechanism A shown in Figs. 1 and 3 may be provided with the pilot-cock 36 as illustrated in Figs. 8 to 10, inclusive.

Upon rotating the pilot-cock 36 in its housing 37 by the handle 68 to the position indicated in Fig. 10, water under pressure from the inlet section 3 of the penstock 2 is caused to enter the conduit 42 and pass through the port 43 in the pilot-cock housing 37 to the enlarged cut-out portion 110 in the pilot-cock from where the water enters the passage 49, which communicates with the conduit 38 leading to the compartment 24 in the piston cylinder 20, thereby causing the piston 19 to rotate the trunnion 17 in a direction to cause the gate valve 1 to be operated to an open position or any intermediate position between its opened or closed positions. Some of the water under pressure is caused to enter the passage 54 in the pilot-cock housing 37 and to pass through the intake port 55 to the passage 58 and thence to the annular channel 59 formed on the pilot-cock 36, whereby the pilot-cock is forced axially inwardly into its housing 37 by the water pressure and locked in place therein. Before the handle 68 is turned the lever 66 is operated to force the stem 63 of valve 62 inwardly against the action of spring 64 closing the intake port 54 and permitting the water in the annular channel 59 of the pilot-cock 36 to be exhausted through port 65, whereby the water pressure on the pilot-cock 36 is removed, thus releasing the pilot-cock 36 from its locked position and permitting it to be turned in its housing.

Upon the gate valve 1 being opened water under pressure will enter the conduit 48 from the intake pipe 13 of the penstock 2 and pass up through the needle valve 47 to conduit 44, which conducts the water through the port 45 in the end plate 46 of the pilot-cock housing 37. The water passing through the port 45 enters the passageways 52 and 53 in the pilot-cock. The water entering the passage 53 passes through the port 51 from where it enters the conduit 40 leading to the compartment 24' of the piston cylinder 20. As the water pressure in the compartments 24' and 24a is greater than the water pressure in the compartments 24 and 24'a, the piston 19 is caused to rotate the trunnion 17 in a direction to close the gate 1. Some of the water from the conduit 42 enters the passage 54, thence through port 55 to the passage 58 where it enters the channel 59 to force the pilot-cock 36 inwardly in its housing to lock it in place therein, whereby the gate valve 1 may be positively held in a closed position. The needle valve 47 may be adjusted to control the rate of movement of the gate valve 1.

In remotely controlling the pilot-cock 36 by

means of the mechanism disclosed in Fig. 5, assuming that water is flowing under pressure through the penstock 2 in the direction as indicated by the arrow, the water enters the conduit 48, passes through the needle valve 47 and enters the conduit 44, which conducts the water to port 43 in the upper portion of the pilot-cock housing 37. From the port 43 the water enters the passage 49 and from the passage 49 the water enters the conduit 38 leading to the compartment 24 in the piston cylinder 20. The water under pressure also enters the conduit 42 which is connected in communication with the port 45 of the pilot-cock housing 37 and from the port 45 the water enters the passage 53 and leaves by port 51 from where it is conducted to the conduit 40 leading to the compartment 24' in the piston cylinder 20. The velocity of flow of the water in the penstock 2 causes the water to enter the pilot tube 75 and to pass up to the tank 69 through the well 74 and upon a predetermined height of the water in the tank 69, the pressure thereof is sufficient to cause the diaphragm 80 in the chamber 78 of the switch mechanism 70 to be depressed forcing the electrical contact 89 carried by the member 83 into engagement with the contacts 90, which completes the electrical circuit 71, thus energizing the solenoid coil 93, which pulls inwardly on the plunger 94 and actuates the pilot-cock handle 68 by means of the rope 95 against the action of the weight 97 to a position where the passages 49 and 53 of the pilot-cock 36 are moved out of communication with the conduits 38 and 40 leading to the compartments 24' and 24, respectively, and causing the passages 49 and 53 of the pilot-cock to be connected in communication with the conduits 40 and 38, respectively, leading to the compartments 24' and 24 whereby the water from the high pressure portion of the conduit entering the compartment 24' causes the piston 19 to be rotated in a direction closing the gate valve 1. Upon the gate valve 1 being closed the water in the well 74 and tank 69 is caused to flow back through the pilot tube 75 and empty into the penstock 2, whereupon the water pressure is released from the diaphragm 80 of the switch mechanism 70 causing the electrical contact 89 to be moved out of engagement with the electrical contacts 90, thus breaking the electrical circuit 71 and deenergizing the solenoid coil 93. Upon the solenoid coil 93 being deenergized the weight 97 pulls on the rope 98 actuating the lever 66 to release the pilot-cock 36 from its housing 37, permitting the handle 68 to be moved to its original position connecting the passage 49 of the pilot-cock in communication with the conduit 38 leading to the compartment 24 and the passage 53 in communication with the conduit 40 leading to the compartment 24' of the piston cylinder 20, whereby the water pressure entering the compartment 24 being greater than the water pressure in compartment 24', the piston 19 is rotated in a direction to open the gate valve 1 and water under pressure again enters the pilot tube 75 leading to the well 74 of the tank 69. Upon the water in the tank 69 reaching a certain level, the pressure thereof is again adapted to press down on the diaphragm 80 to complete the electrical circuit 71, for energizing the solenoid coil 93, to actuate the handle 68 and for rotating the pilot-cock to a position in which the conduits 42 and 44 are again connected in communication with the compartments 24 and 24'.

The lever 66 of the pilot-cock 36 may be actuated to release the pilot-cock from its locked

position in the pilot-cock housing 37 with the handle 68 rotating the pilot-cock in either direction by means of the dual solenoids 100 and 100' as illustrated in Fig. 7. By moving the double-throw switch 106 toward either of the electrical contacts 103 or 103' an electrical circuit is completed through portions of the conductor 102. Upon the switch 106 engaging the electrical contact 103, the electrical circuit is completed through the solenoid coil 101 and battery 104 to the switch, whereupon the plunger 108 of the solenoid 100 is pulled inwardly by means of the rope 109 actuating the lever 66 and the handle 68 to move the pilot-cock 36 to one position and upon throwing the switch 106 into engagement with the electrical contact 103', a circuit is completed through the solenoid coil 101' and the battery 104 whereby the plunger 108' of the solenoid 100' is pulled inwardly by means of the rope 109 actuating the lever 66 and handle 68 to move the pilot-cock 36 to another position.

The inlet opening 112 of the Y-fitting 111, Figs. 11 and 12, is adapted to be connected in communication with the outlet pipe 13, which Y-fitting 111 may be employed in joining dual pipe lines where any one of the pipe lines may be closed tight by the valve 115 or both of the pipe lines left open without interrupting the flow of water therethrough. On the reverse flow the valve 115 is double acting. The valve 115 serves to close a feed pipe to a power plant or the like, with a quick closure of the water supply by passing the water without change in velocity or quantity of the water from one pipe to another, whereby the destructive effects of hammering, surge, or burst of the pipe is eliminated. The valve 115 is adapted to seat in the pocket 114 when in an inoperative position. A spring held poppet valve (not shown) for admitting air into a feed pipe may be provided near the Y-fitting to destroy vacuum created by the quick closure of the valve. All of the features of the valve disclosed in applicant's above-mentioned Patent No. 2,302,695 and the operating mechanism disclosed in the present application may be embodied in the valve 115 if desired, particularly in large sizes.

It will thus be seen that there is herein provided a novel and useful form of gate valve operating mechanism which is well adapted for the purpose intended. Even though there has herein been shown and described the invention as comprising certain features of construction and operation of parts, it is nevertheless to be understood that various changes may be made therein, if the changes do not depart from the spirit or scope of the claims.

Having thus described my invention, what I claim as new and wish to secure by Letters Patent is:

1. A device of the character described, comprising a main conduit having a restricted portion, a gate valve in and rotatably mounted on said conduit, a pressure chamber divided into compartments, a rotary piston arranged within said chamber and operating in said compartments, said piston connected to actuate said gate valve to an open and closed position, an adjustable counterbalancing weight for said gate valve, said gate valve adapted to close under its own weight in still water against the action of said counterbalancing weight, and means including a manually actuated pilot-cock connecting a low pressure portion and a high pressure portion of the conduit in communication with said

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compartments of the chamber whereby said piston is actuated to operate the gate valve to automatically control the rate of flow through the conduit.

2. A device of the character described, comprising a main conduit having a restricted portion, a gate valve in and rotatably mounted on said conduit, a pressure chamber divided into compartments, a rotary piston arranged within said chamber and operating in said compartments, said piston connected to actuate said gate valve to an open and closed position, an adjustable counterbalancing weight for said gate valve, said gate valve adapted to close under its own weight in still water against the action of said counterbalancing weight, means including a pilot-cock connecting a low pressure portion and a high pressure portion of the conduit in communication with said compartments of the chamber whereby said piston is actuated to operate said gate valve to automatically control the rate of flow through the conduit, automatically actuated means for remotely controlling the action of said pilot-cock.

3. A device of the character described, comprising a main conduit having a restricted portion, a gate in and rotatably mounted on said conduit, a pressure chamber divided into compartments, a rotary piston arranged within said chamber and operating in said compartments, said piston connected to actuate said gate to open and closed positions, an adjustable counterbalancing weight for said gate, said gate adapted to close under its own weight in still water against the action of said counterbalancing weight, a manually actuated pilot-cock, conduits connecting the pilot-cock in communication with said compartments, conduits connecting a low pressure portion and a high pressure portion of the main conduit with said pilot-cock whereby said piston is actuated to operate the gate to automatically control the rate of flow through the main conduit, and a valve on the conduit connecting the high pressure portion of the main conduit to said pilot-cock, said valve adapted to control the pressure from said high pressure portion of the main conduit whereby the actuation of said gate may be regulated.

4. A device of the character described comprising a main conduit having a restricted portion, a gate valve in and rotatably mounted on said conduit, a pressure chamber divided into compartments, a rotary piston arranged within said chamber and operating in said compartments, said piston connected to actuate said gate valve to open and closed positions, an adjustable counterbalancing weight for said gate valve, said gate valve adapted to close under its own weight in still water against the action of said counterbalancing weight, means including a pilot-cock connecting a low pressure portion and a high pressure portion of the conduit in communication with said compartments of the chamber, whereby said piston is actuated to operate said gate valve to automatically control the rate of flow through the conduit, and automatically actuated means including a switch mechanism connected to remotely control the action of said pilot-cock.

5. A device of the character described comprising a main conduit having a restricted portion, a gate valve in and rotatably mounted on said conduit, a pressure chamber divided into compartments, a rotary piston arranged within said chamber and operating in said compart-

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ments, said piston connected to actuate said gate valve to open and closed positions, an adjustable counterbalancing weight for said gate valve, said gate valve adapted to close under its own weight in still water against the action of said counterbalancing weight, means including a pilot-cock connecting a low pressure portion and a high pressure portion of the conduit in communication with said compartments of the chamber, whereby said piston is actuated to operate said gate valve to automatically control the rate of flow through the conduit, and automatically actuated means for remotely controlling the action of said pilot-cock, said automatically actuated means including a liquid container, a switch mechanism connected in communication with said liquid container, a solenoid connected to actuate said pilot-cock and connected to be actuated by said switch mechanism for actuating said pilot-cock.

6. A device of the character described comprising a Venturi-shaped main conduit having an inlet of least cross-section and an outlet of greatest cross-section, a gate valve operatively mounted in said conduit for controlling flow of water therethrough, said gate valve including trunnions mounted on said conduit, a pressure chamber, partitions provided within said chamber, a rotary piston including a hub and blades operatively arranged within said chamber and rotatably mounted on one of said gate trunnions for rotatably operating said gate valve to open and closed positions, said piston hub removably engaging said partitions, said partitions and piston hub dividing the pressure chamber into dual compartments and said piston blades dividing each of said dual compartments into other compartments, passages formed in said last-mentioned gate trunnion and said piston hub, one of said passages connecting one of said compartments in communication with another compartment and another of said passages connecting a third compartment in communication with a fourth compartment, counterbalancing means for said gate valve, said counterbalancing means mounted on said last-mentioned gate trunnion, said gate valve adapted to close in still water against the action of the counterbalancing means, means connecting the outlet of greatest cross-section of the conduit in communication with one of said compartments to rotate said piston in one direction to actuate the gate valve to a closed position, and means connecting the inlet of least cross-section of the conduit in communication with another of said compartments to rotate the piston in another direction to actuate said gate valve to an open position.

JOHN KALIX.

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2,054,258	Kinzie	Sept. 15, 1936
2,295,667	Kinzie	Sept. 15, 1942
2,357,341	Miner	Sept. 5, 1944