No. 685,532. Patented Oct. 29, 1901.

J. SHRADLE.

REGULATING MECHANISM FOR HYDRAULIC ENGINES.

(Application filed Apr. 1, 1901.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1.

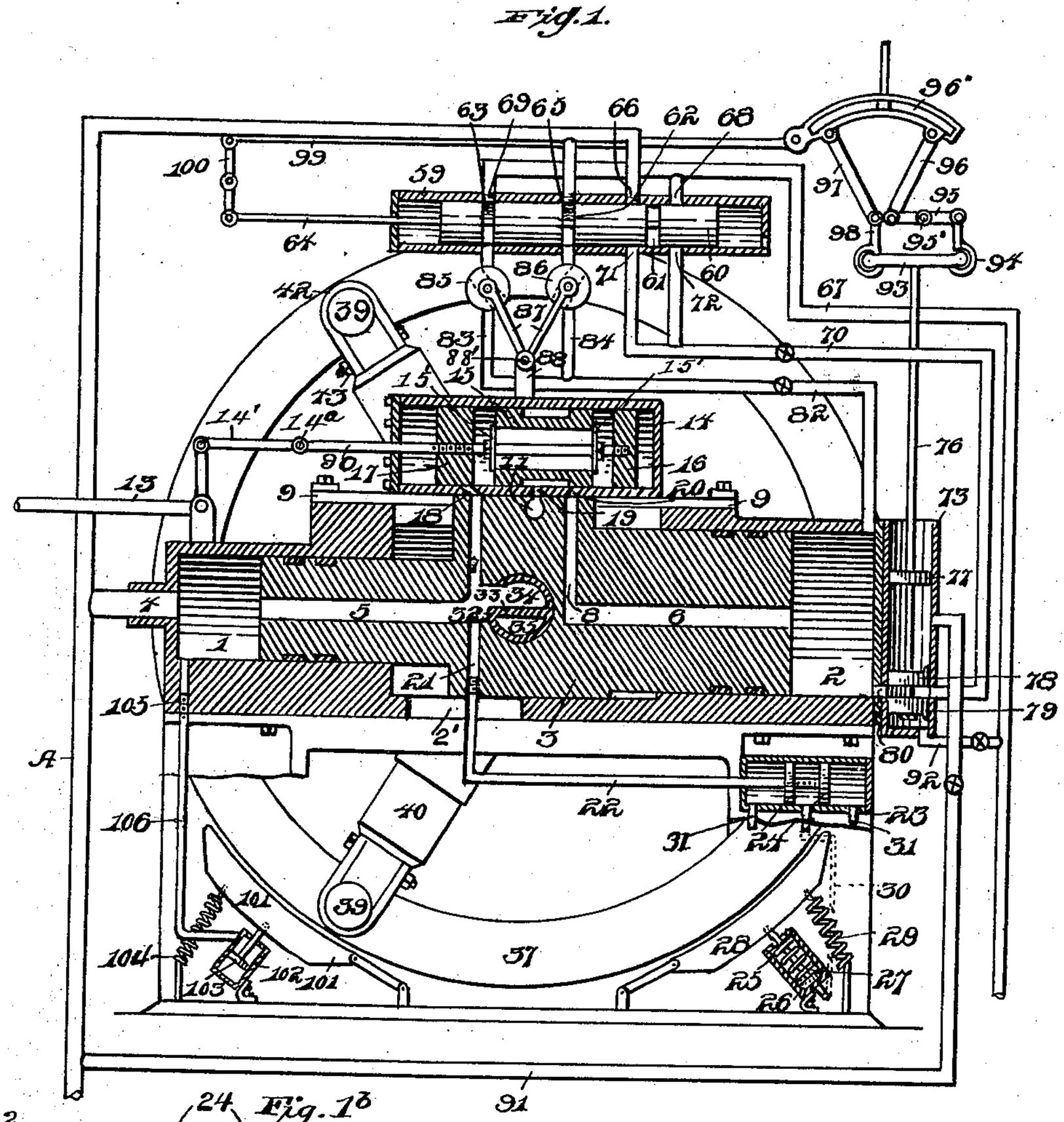


Fig. 1b.

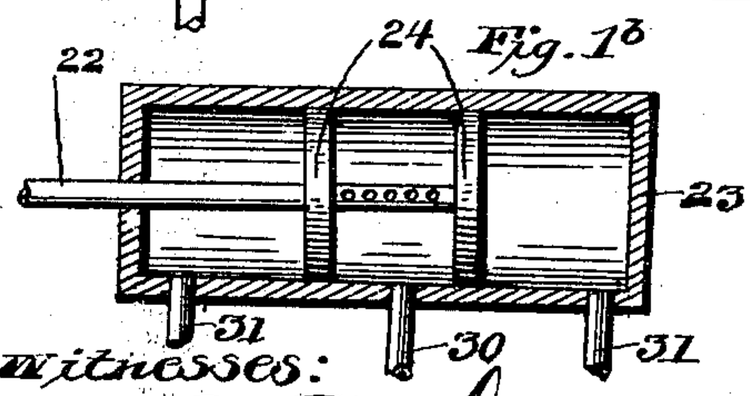
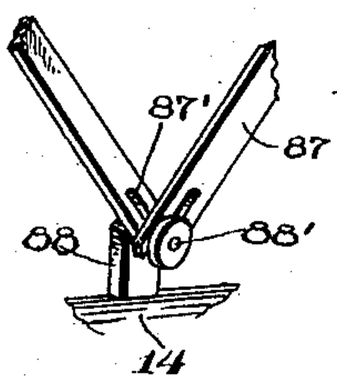


Fig. 1a.



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(No Model.) 2 Sheets—Sheet 2.

Fig. 2.

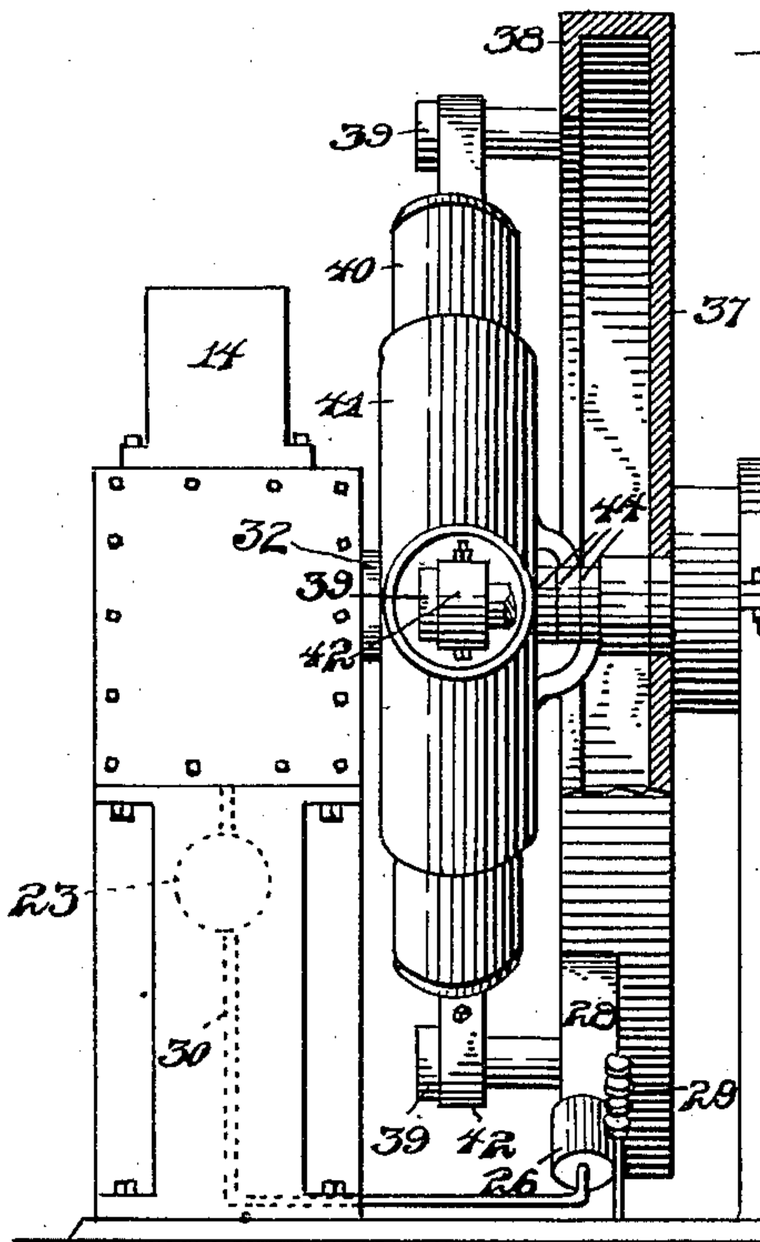
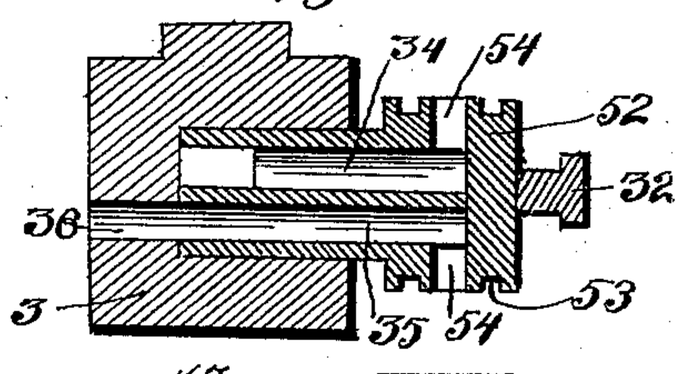


Fig. 2a.



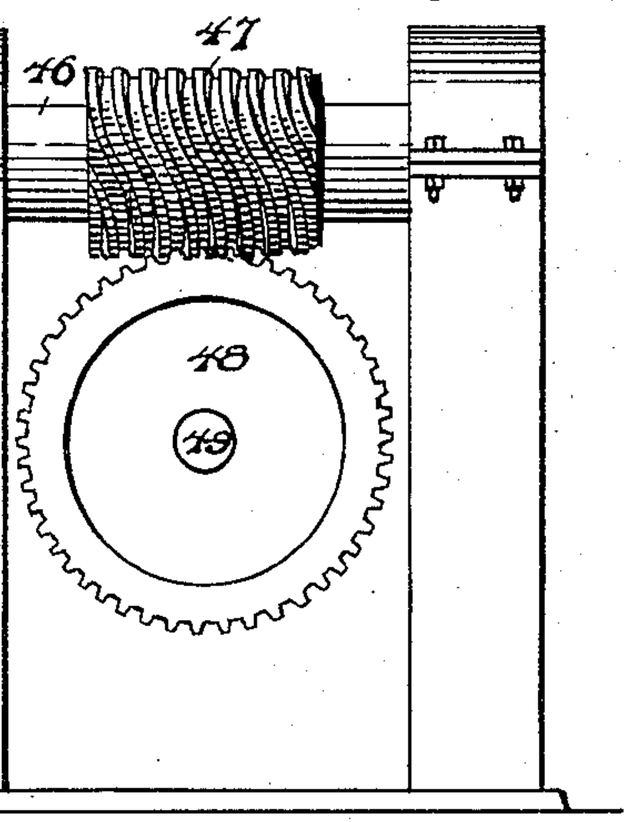


Fig. 3.

Fig. 4.

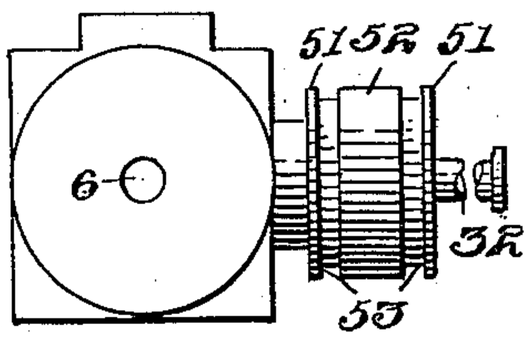
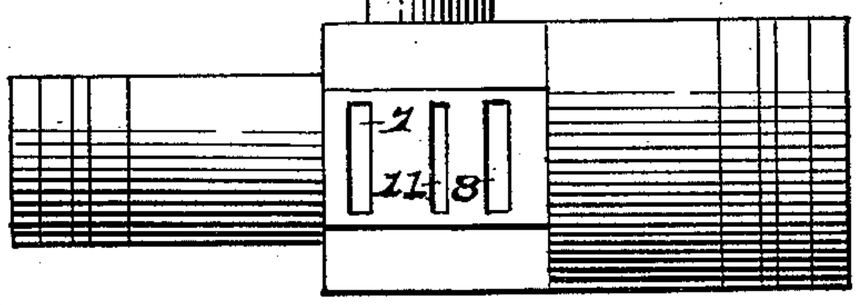


Fig. 5.



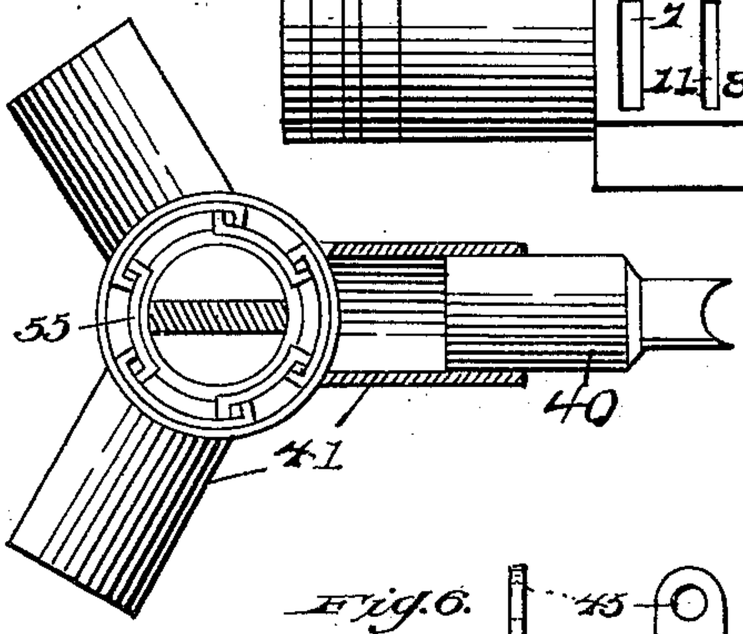


Fig. 8.

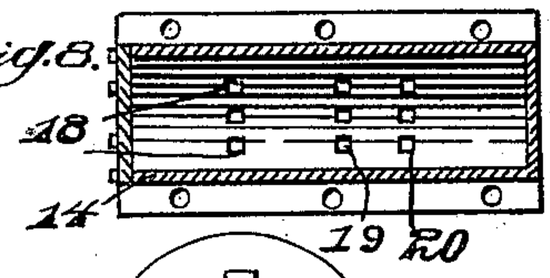


Fig. 9.

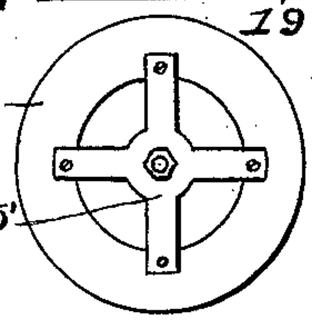


Fig. 6.

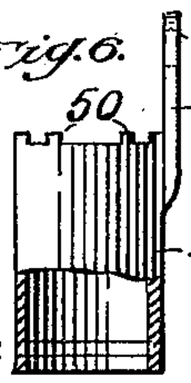
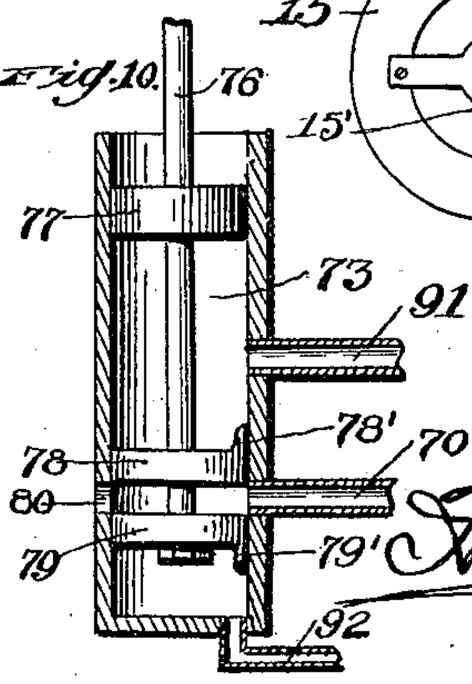


Fig. 7.

Fig. 10.



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UNITED STATES PATENT OFFICE.

JOHN SHRADLE, OF PITTSBURG, PENNSYLVANIA.

REGULATING MECHANISM FOR HYDRAULIC ENGINES.

SPECIFICATION forming part of Letters Patent No. 685,532, dated October 29, 1901.

Application filed April 1, 1901. Serial No. 53,817. (No model.)

To all whom it may concern:

Be it known that I, JOHN SHRADLE, a citizen of the United States of America, residing at Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in Regulating Mechanism for Hydraulic Engines, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention relates to certain new and useful improvements in regulating mechanism for hydraulic engines, and has for its main object to provide means in an engine of this type by which the amount of water employed will be governed entirely by the load on the engine, thereby absolutely preventing any waste of water in the operation.

Briefly described, the invention consists of a number of cylinders which are connected to a main driving-pin capable of being shifted eccentric with the main driving-wheel, to which the pistons working in the cylinders are connected. Regulating-valves and a ram control the travel of the pistons in the cylinders according to the load on the engine, thereby using water in proportion to the load. Means is provided for admitting water to a braking-cylinder to apply a brake when the cylinders are concentric, or, in other words, when the engine is in a stationary position, the starting of the engine releasing the brake. Braking means of an auxiliary or supplemental nature may also be provided to cause the engine to cease running in case of a sudden break or leakage of the pressure-supply.

In describing the invention in detail reference is had to the accompanying drawings, forming a part of this specification, and wherein like characters of reference indicate corresponding parts throughout the several views, in which—

Figure 1 is a central vertical sectional view of my improved engine, the main valve, controlling-valve, and automatic governing-valve and its mechanism being shown in position. Fig. 1ª is a detail perspective view of a part of the arms, the main-valve casing, and the arm and pin for operating the plug-valves. Fig. 1ᵇ is an enlarged longitudinal sectional view of the brake-valve casing, showing the valves and a part of the pipe that connects with the ram. Fig. 2 is an end view of the engine with a part of the flywheel in transverse vertical section and the automatic governor removed, as it would be if the engine is used for variable speed and hand control. Fig. 2ª is a transverse vertical sectional view of the ram and drive-pin. Fig. 3 is a top plan view of the regulating-ram. Fig. 4 is an end view of the same. Fig. 5 is an end view of the main driving-pin with its partition and one of the cylinders in section. Fig. 6 is a detail side elevation of one of the cylinders, partly in vertical section. Fig. 7 is a detail side elevation of one of the cylinders looking at the different side from that shown in Fig. 6. Fig. 8 is a longitudinal sectional view of the main-valve casing. Fig. 9 is an end view of the main valve with the end disk removed. Fig. 10 is an enlarged vertical sectional view of the governor-valve casing, showing in detail the disk valves therein.

In the drawings, 1 and 2 represent cylinders of different diameters, in which is arranged a regulating-ram 3 of differential areas to correspond with the different diameters of the cylinders 1 and 2. The pressure-supply pipe A is connected to the inlet 4 of the cylinder 1, and the pressure of the water is always within this cylinder. The regulating-ram 3 is provided with longitudinal ports 5 6 and vertical ports 7 8.

9 indicates one of the two guides placed on top of the cylinders 1 and 2, one on each side of the ram, to hold the same from turning in the cylinders. These guides are fastened on ram-cylinders, as shown. Mounted on the ram 3 is a casing 14 for the main valve 15, which carries valve-disks 16 17, one at each end thereof. The bottom of this main-valve casing 14 is provided with ports 18, 19, and 20, which register with ports 7 and 8 of the ram and with an exhaust-port 11. The regulating-ram 3 is further provided with a vertical port 21, with which connection is made by pipe 22 to the valve-casing 23, supported at any suitable point upon the supports for the engine. This pipe 22 extends into the brake-valve casing 23 and has disks 24 mounted thereon, said pipe being perforated between the disks to permit the water to escape into the valve-casing 23. The cylinder 2 has a slot 2′ in the underneath side, through which

the pipe 22 extends and which permits the movement of this pipe with the ram 3. Connection is made from this valve-casing 23 to the brake-cylinder 25, in which are arranged a piston 26 and resistance-spring 27, the stem of the piston being connected to abrake-shoe 28, pivotally supported at its lower end upon the base of the engine. A spring 29 is connected to the rear face of the brake-shoe near its upper end and attached at its other end to a suitable point on the engine-frame. This spring 29 serves to normally hold the brake-shoe 28 out of engagement with the drive-wheel. Water is admitted from the brake-valve casing 23 to the brake-cylinder 25 through pipe 30, connecting the valve-casing and brake-cylinder. This valve-casing 23 is or may be provided with a suitable drip or drain pipe 31. Mounted centrally in the regulating-ram 3 is a driving-pin 32, divided by a central partition or wall 33 into an upper compartment 34 and a lower compartment 35. The lower compartment of this driving-pin is in communication with an exhaust-port 36 in the ram. The drive-wheel 37 in the illustration herein shown is made of a cast plate having one edge turned over and then inwardly, as at 38, and this flange or rim 38 carries wrist-pins 39, to which pistons 40, which operate in the cylinders 41, are connected. These pistons 40 have concave outer ends to engage the wrist-pins and are bound thereto by straps or stirrups 42, which are connected to the pistons by bolts 43. The cylinders each carry an integral strip 44, provided near its free end with an aperture 45 to receive the end of the drive-pin 32. A shaft 46 has a worm 47 thereof to be engaged by a gear 48 on the drive-shaft 49. This part of the mechanism will of course depend upon the particular use to which the engine is put. The present illustration shows means for driving any mechanism that may be desired. The cylinders 41 each carry teeth 50, these teeth being so arranged as to span flanges 51, which are formed on the hollow hub 52, carried by the drive-pin. This hollow hub 52 has packing-grooves 53 in its periphery and is provided with ports 54 above and below to permit the water to enter and leave the cylinders 41. In the packing-grooves 53 are arranged packing-rings 55, a desirable form of which I have found to be the one illustrated in Fig. 5, in which I form the rings in a number of sections with angular ends which overlap. Ports 54 in the under side of the drive-pin hub 52 and port 35 in the drive-pin, together with exhaust-port 36 in the ram, are always open to the atmosphere. Consequently cylinders 41 are always open to the atmosphere while they are traveling on the under side of the drive-pin, or, in other words, during their exhaust travel. The port 36 in the ram is in communication with a flexible exhaust-pipe. (Not shown.)

In Fig. 1 is shown the controlling-valve, by means of which the engine is controlled when running at a constant speed. Water-supply pipe A connects with the inlet 4 of the cylinder 1.

59 indicates the valve-casing for the controlling-valve 60, said valve having ports 61, 62, and 63 and having an operating-rod 64 connected to the outer end of the valve. The water-supply pipe A connects with the controlling-valve through ports 65 66, and the water-discharge pipe 67 connects with the controlling-valve through port 68 and through port 69. The controlling-valve is connected by pipe 70, communicating through ports 71 72, with the governor-valve 73, which controls the admission of water to the cylinder 2 of the regulating-ram. Arranged in the governor-valve 73 is a piston-rod 76, having pistons 77 78 79 thereon. The valve is provided with a port 80, admitting water to enter from the governor-valve 73 to the cylinder 2. The pipe 82 communicates with the cylinder 2 near its rear end, and this pipe has two branches 83 84, connecting the same with the controlling-valve. In the pipes 83 84 are arranged plug-valves 85 86, the stems of which are connected to arms 87, the free ends of which arms are bifurcated, as at 87′, Fig. 1ª, and engage with the pin 88′, carried by an arm 88, secured to the valve-casing 14. As the valve-casing 14 slides the pin 88′ actuates the arms 87 to open or close the valves 85 86, according to the direction in which the casing 14 is moved. The governor-valve 73 is also connected by the pipe 91 to the inlet supply-pipe A. This governor-valve 73 is provided at its lower end with a suitable drain or drip pipe 92. The piston-rod 76 has a T-shaped head 93, the one end of which is engaged by the link 94, pivoted to one end of the lever 95, which lever is pivotally mounted at its center, and has its other end pivotally connected to one side of the link 96′ through rod 96. The other rod 97 is connected by the short link 98 to the opposite end of the T-shaped head 93 of the piston-rod 76. The governing mechanism of the engine is connected by rod 99 and lever 100 to the operating-rod 64 of the controlling-valve, whereby the governor will be made to act on the governing-valve either direct or through pivoted lever 95, so that the piston-rod 76 will be moved within the governor-valve, so as to open or close certain ports to supply the water in the desired quantity or discharge the same, as will be described. Water enters through the pressure-supply pipe A and inlet 4 into the cylinder 1, and from these through port 5 to upper chamber 34 in the drive-pin 32, and thence through ports 54 (see Fig. 3) to power-cylinders. As long as the drive-pin 32 is concentric with the driving-wheel 37, in which position it is shown in Fig. 1, the engine is stationary. By moving the driving-pin 32 to the right or left water will act on the piston 40 farthest in in its cylinder, pressing it outwardly, and rotate the drive-wheel 37, to which the piston is connected, to the left or

right. After the piston passes the longest stroke the ports in the cylinder will register with the ports in the under side of the drive-pin 32 and let the water out of the cylinder through the lower chamber 35 of the drive-pin 32 and through exhaust. As the centers of the pin 32 and drive-wheel 37 diverge from each other the stroke of the pistons increases and also the power of the engine, so that by moving the drive-pin in or out from the center the power will vary, increasing or decreasing, and at the same time control the consumption of water. The movement of the drive-pin 32 is accomplished by reason of its being arranged in the regulating-ram 3, and pressure is always within the cylinder 1 against the smaller end of this ram. The cylinder 2 can be connected to either the pressure-supply pipe or exhaust. This can be accomplished in two ways. If the engine is to be run at an irregular speed and is to be controlled by hand, valve 15 is used; but if the engine is to run at a regular speed automatic regulation is accomplished by using the controlling-valve. In order to regulate the engine by hand, valves in passages 70, 82, 91, and 92 are closed. Then to move the regulating-ram 3 to the left valve 15 is pulled by its rod 90, which is connected to bell-crank lever 13 through link 14′ until ports 18 20, which register with ports 7 8 in ram 3, are uncovered and governor is disconnected from link 96′. Water will then enter through port 5 and through ports in the main valve 15, through port 20, passage 8, and port 6 to the cylinder 2. It will be observed that the water may freely pass through the valve 15, as the valve-body is hollow and its ends only partially closed by means of spiders 15′, as shown in end view in Fig. 9 of the drawings. On account of the larger area of the ram in cylinder 2 pressure will force the ram to the left until the ports in the ram are closed again by the main-valve disk 15. To further move the ram, this operation will be repeated. In order to move the ram to the right, the valve 15 is pushed to the right until ports 6 and 8 and exhaust-port 11 will be in communication through the cavity in the center of main valve, when pressure against the smaller area of the ram will force the ram to the right, discharging water through ports 6 and 8, the center cavity of the valve and port 11, and to exhaust. The ram will travel to the right until port 6 is cut off from communication with exhaust. To further move the ram to the right, the operation is repeated and the ram will move in exact proportions to the amount that the main valve is moved and nearly simultaneously with the movement of said main valve. Thus it will be seen that the engine will vary in power according to the amount valve 15 is moved and can be reversed and regulated at will.

To operate the engine at a constant speed, automatic control is used. Valve 15 is placed to cover ports 7 and 8 in ram and rod 90 is disconnected at joint 14ª and clamped to a stud (not shown) carried by the casing 14, so valve 15 cannot move in casing 14. Then valves in passages 70, 82, 91, and 92 are opened and governor connected to link 96′.

To move the regulating-ram to the left, the controlling-valve is moved to the left to its fullest extent. When in that position, port 61 in controlling-valve 60 will register with ports 66 71 and water will then enter through pipe A, through ports 66, 61, and 71, and pipe 70 into governor-valve 73, and through port 80 into cylinder 2 against the larger area of the ram 3, pressing it to the left. The governor-valve is connected with the governor proper by a link-motion, heretofore described, the one link transmitting motion from the governor direct to the governor-valve and the other side of the link transmitting the motion of the governor to the governor-valve through the lever 95, pivoted at its center. It will be observed that by moving the controlling-valve to the left the link will be thrown to the right, thereby leaving the governor to act directly on the governor-valve through straight connections. As ram 3 is pushed to the left power is given to the engine. As soon as the desired speed has been obtained the governor will pull up the governor-valve until disk 79 closes port 80, thereby cutting off pressure from the larger area of the ram. Should the load be suddenly thrown off, the governor will pull governor-valve still farther up until disk 79 has traveled past port 80, this opening said port and permitting the water in the cylinder 2 to flow through port 80 and drain-pipe 92, while the pressure of the smaller area of the ram will force the ram backwardly until the proper speed is obtained again, when the disk 79 will again cover port 80. It will be noted that when the controlling-valve is in the extreme left position every port will be closed except ports 66, 61, and 71. It will be observed that the regulating-ram 3 in traveling to the left opens, through the medium of arm 88 and arms 87, the plug-valve 85. The normal running position therefore of the engine when moving to the left is with disk 79 covering the port 80. To stop the engine, the controlling-valve 60 is pushed back to center, when water will be discharged from cylinder 2 through pipe 82, port in valve 85, and through the registering-ports in the controlling-valve and discharge-pipe 67. The ram 3 will then be pushed to the right until the connection, with valve 85 turns said valve, so as to close this port, when the ram will be in the center position. To move the regulating-ram to the right, the controlling-valve is pushed to the right until said port 61 in the controlling-valve 60 registers with ports 68 72, when water will be forced out of the larger cylinder, through port 80, pipe 70, and ports 72 61 68, into discharge-pipe 67, and the ram will travel to the right, opening the plug-valve 86. When the controlling-valve is to

the right, the governing-link is pulled to the left, thus leaving the governor to act on governor-valve through link and lever 96, thereby reversing the motion of the governor-valve. When the desired speed has been obtained in this position, the governor-valve will have been pushed down until disk 78 covers port 80, thus closing the port and preventing the escape of any more water from cylinder 2. Should the load be suddenly thrown off, the valve-disk 78 will open passage 80 to space between valve-disks 77 and 78, which is always in communication with pressure-pipe A through pipe 91. Pressure will then enter port 80, pushing the ram to the left until speed is normal again, when disk 78 will again cover port 80. During the time port 80 is open, as described, the exhaust through pipe 70 is closed by the abutment 78′ on the disk 78, the disk 79 being likewise provided with an abutment 79′. To stop the engine, the controlling-valve is moved back to center, when water will enter, through pressure-pipe A, through port 65 in controlling-valve, through port in valve 86, and pipe 82, into cylinder 2, pushing the ram to the left until the connections between ram and valve 86 close said valve, when the ram will be again in the center.

It will be observed from the foregoing description that the regulation of this engine is entirely automatic. The simple movement of the controlling-valve to the right or left will start the engine to the right or left, respectively.

In order to stop the engine quickly, I preferably employ an automatic brake, (shown in Fig. 1,) heretofore described. When the ram 3 is in center position, water will enter through port 21 and pipe 22 into valve 23, through the perforations in the end of pipe 22, between the two disks 24, and through pipe 30 to the cylinder 25, overcoming the tension of the spring 29 and applying the brake-shoe 28 to the periphery of the drive-wheel 37. The spring 29 pulls the brake-shoe away from the wheel, when the water-pressure in the cylinder 25 is relieved. As pipe 22 is screwed into port 21 in the ram 3, it will be observed that this pipe, together with the disks 24, moves with the ram, and as the latter is moved to one side the disks 24 will uncover the port from the cylinder, letting the water out of the brake-cylinder through drips 31 placed therein. When the regulating-ram is in the center, cylinder 25 will be in communication with pressure-pipe through pipe 30, cylinder 23, pipe 22, and port 21. In Fig. 1 I also show an emergency-brake, which it may be preferable to use when employing the engine for certain purposes. This brake consists of a shoe 101, which is pivoted at its lower end to the base of the engine. The pressure-cylinder 102 is supported from the base of the engine and has a piston 103 therein with its rod connected to the brake-shoe 101. A compression-spring 104 is connected at its lower end to the engine-frame and at its upper end to the back of the brake-shoe. A port 105 is provided in the cylinder-casing and leads into the cylinder 1. Into this port is threaded a pipe 106, which connects with the cylinder 102.

It will be observed that the spring 104 will serve to normally press the brake-shoe 101 toward the wheel. The inlet from pipe 106 into the cylinder 102 is in front of the piston 103, and the pressure of the water therefore within the cylinder 102 serves to normally overcome the tension of the spring 104 and hold the wheel out of braking engagement. In case, however, of the bursting of the pipe or like accident the tension of the spring 104 will serve to instantly seat the brake-shoe against the wheel to hold the load of the engine. This form of braking would only be used in special use to which the engine might be put, particularly when used for elevators, where the drum would be placed directly upon the driving-shaft.

Having fully described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In a hydraulic engine, a regulating-ram having ends of differential diameters, a cylinder of different diameters in which said ram operates, a port in said ram, a pressure-supply pipe in communication with the cylinder, a controlling-valve connected to the pressure-supply and to the exhaust, a governing-valve connected to the pressure-supply, to the cylinder and to the controlling-valve, and means intermediate the larger end of the ram-cylinder and the controlling-valve cylinder and operative by the ram for the purpose set forth.

2. In a hydraulic engine, a regulating-ram having ends of differential areas, a cylinder in which said ram operates, ports in said ram, a pressure-supply pipe in communication with the cylinder, a controlling-valve connected to the pressure-supply and to the exhaust, a governing-valve in communication with the pressure-supply, the cylinder and the controlling-valve, means intermediate the ram-cylinder and the controlling-valve and operative by the ram for controlling the passage of water, and a brake mechanism in communication with the pressure-supply through the ram, substantially as described.

3. In a hydraulic engine, a regulating-ram operating in a cylinder of different diameters, a port in said ram, a main driving-pin extending into the ram, said pin having an upper and a lower chamber, cylinders mounted on said pin and in communication with the chambers in the drive-pin, pistons operating in said cylinders, and a fly-wheel to which said pistons are connected, combined with a controlling-valve connected to the water-pressure and to the exhaust, a governing-valve in communication with the cylinder and with said controlling-valve, valves in the connections between the ram-cylinder and controlling-valve cylinder, and means operative by the

ram for controlling said valves, substantially as described.

4. In a hydraulic engine, a regulating-ram of differential areas provided with ports, a pressure-supply communicating with the cylinder in which said ram operates, a main driving-pin carried by said ram and provided with an upper and lower chamber, cylinders mounted on said driving-pin and in communication with the chambers thereof, pistons operating in said cylinders, and a drive-wheel to which said pistons are connected, combined with a controlling-valve connected to the pressure-supply and to the exhaust, a governing-valve connected to the cylinder of the ram, to the pressure-supply and to the controlling-valve, and means intermediate the ram-cylinder and the controlling-valve cylinder and operative by the ram, for the purpose set forth.

5. In a hydraulic engine, a regulating-ram of differential areas, a port in said ram, a cylinder of different diameters in which said ram operates, a main driving-pin extending into the ram and provided with an upper and a lower chamber, cylinders mounted on the drive-pin and in communication with the chambers of said pin, pistons operating in said cylinders, and a drive-wheel to which said pistons are connected, combined with a controlling-valve connected to the pressure-supply and to the exhaust, a governing-valve in communication with the cylinder of the regulating-ram, the pressure-supply and the controlling-valve, and means intermediate the larger end of ram-cylinder and the controlling-valve cylinder and operative by the ram for the purpose set forth.

6. In a hydraulic engine, a cylinder of different diameters, a pressure-supply pipe connected to the smaller diameter of said cylinder, a regulating-ram of different diameters in said cylinder, ports in said ram, a driving-pin carried by the ram, a controlling-valve in communication with the pressure-supply and the exhaust, a governing-valve in communication with the pressure-supply and with the larger diameter of the cylinder valves in the connection between the larger end of the ram-cylinder and the controlling-valve cylinder, means operative by the ram for actuating said valves, and a brake in communication with the cylinder at its smaller diameter, substantially as described.

7. In a hydraulic engine, a cylinder of different diameters connected to a pressure-supply, a regulating-ram of different areas operating within said cylinder, a port in said ram, a controlling-valve in communication with the pressure-supply and the exhaust, valves intermediate the ram-cylinder and the controlling-valve cylinder and operative by the ram for controlling the passage of water, a governing-valve in communication with the cylinder, with the controlling-valve, and with the pressure-supply, and means connected to the governor mechanism of the engine for operating said governor-valve, substantially as described.

8. In a hydraulic engine, a cylinder of different diameters connected to a pressure-supply, a regulating-ram of different areas operating in said cylinder, ports in said ram, a main-valve casing mounted on the ram and provided with ports, a main valve in said casing, and means for operating said valve, substantially as described.

In testimony whereof I affix my signature in the presence of two witnesses.

JOHN SHRADLE.

Witnesses:
JOHN NOLAND,
A. M. WILSON.