

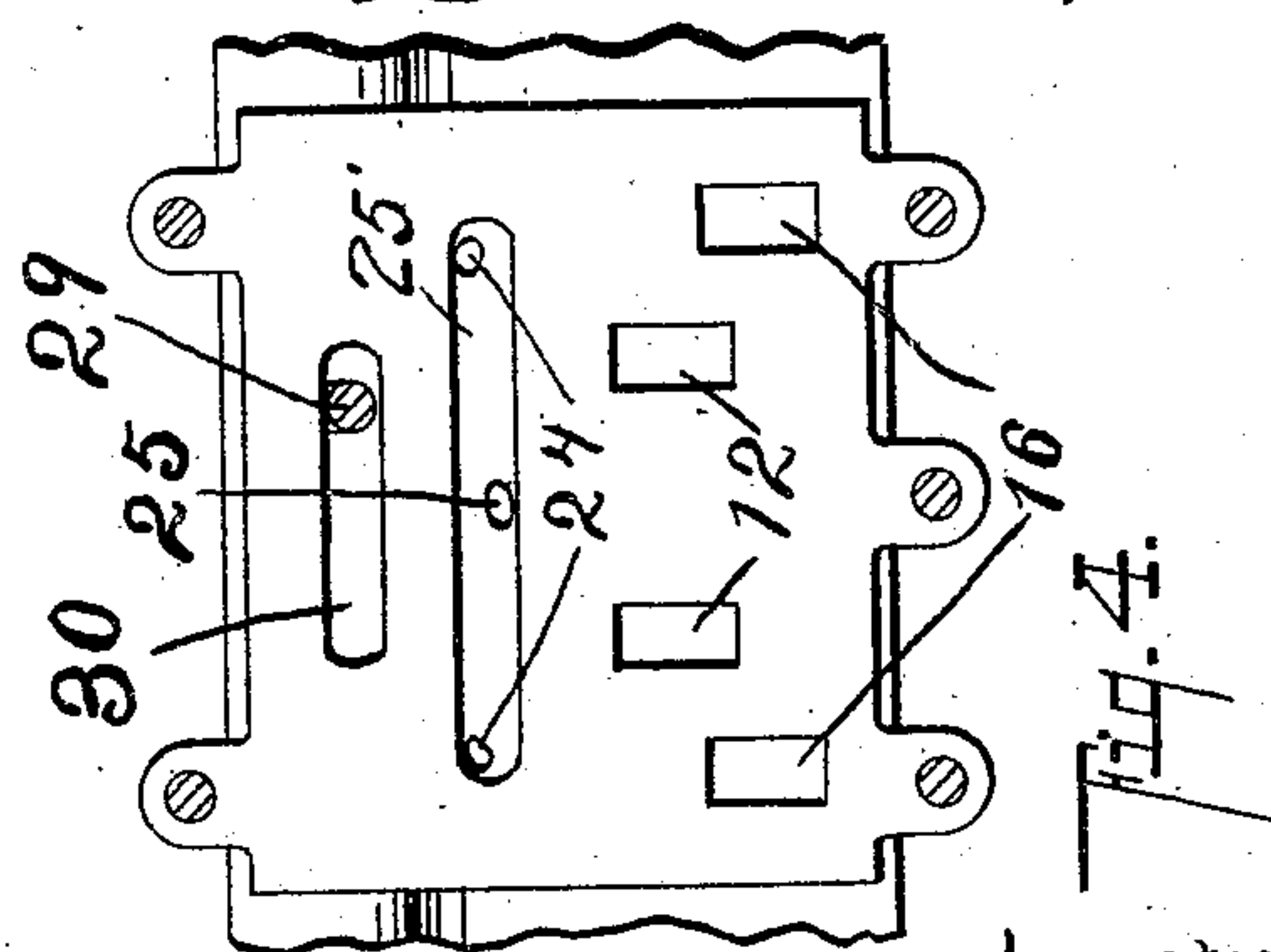
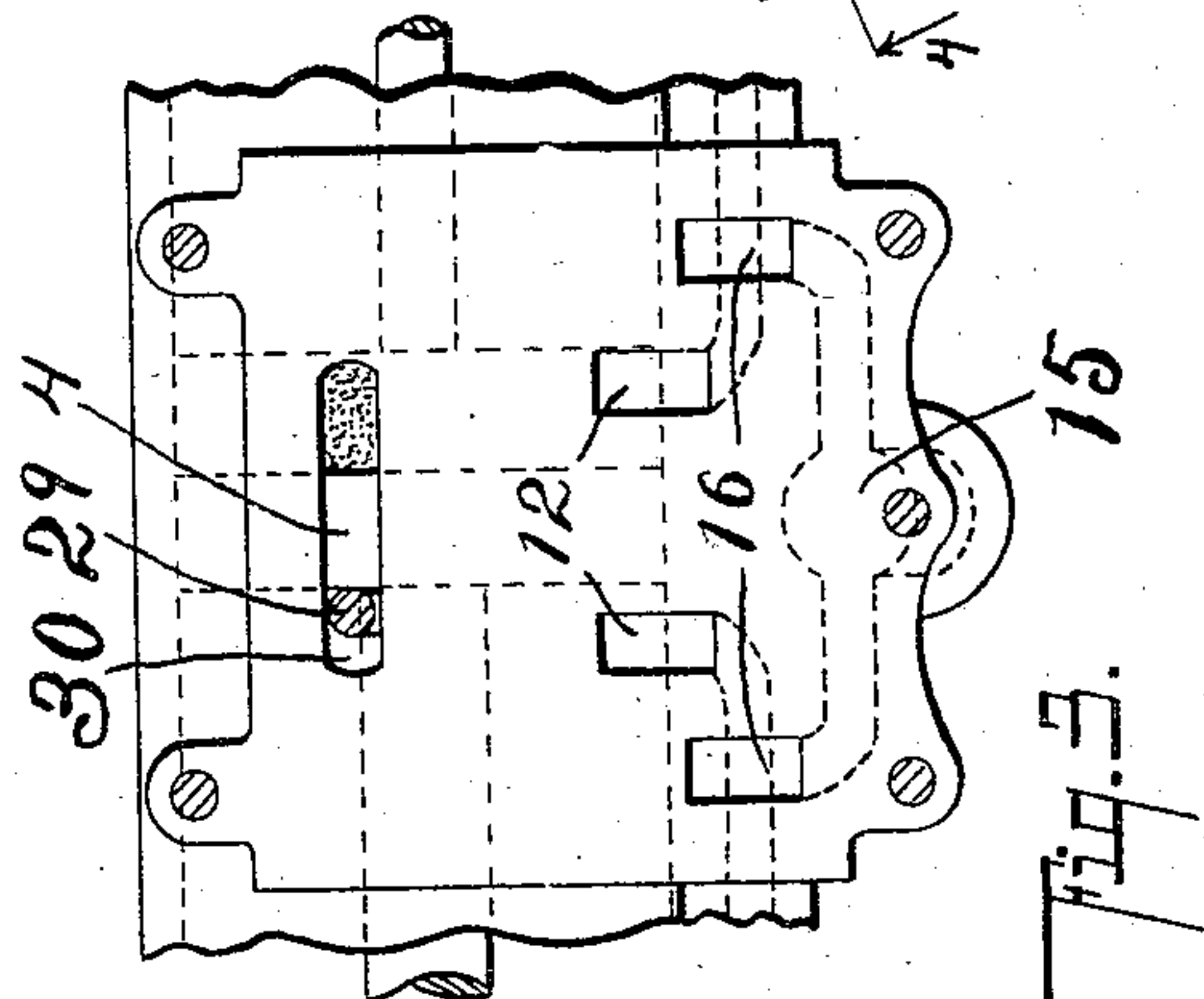
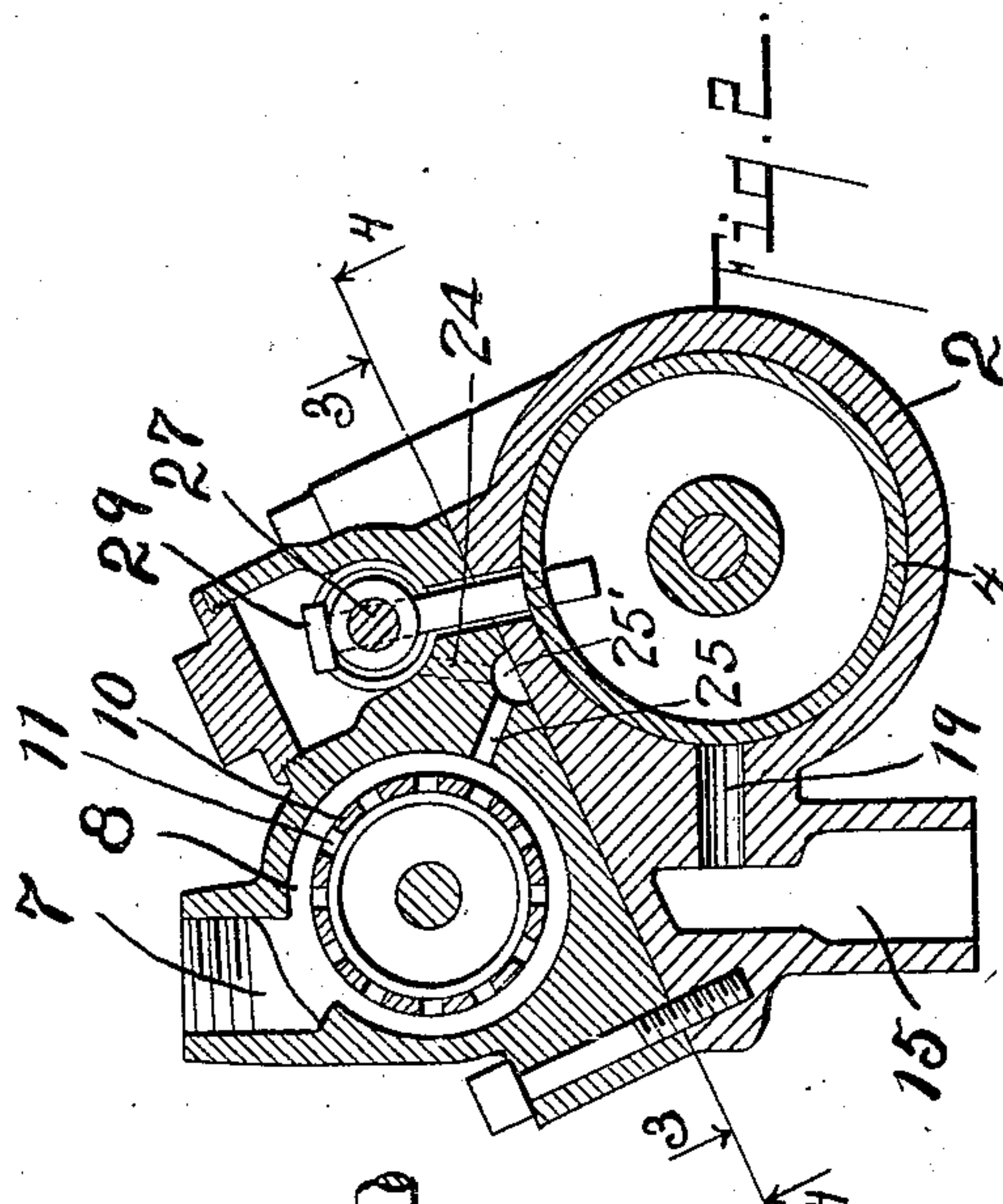
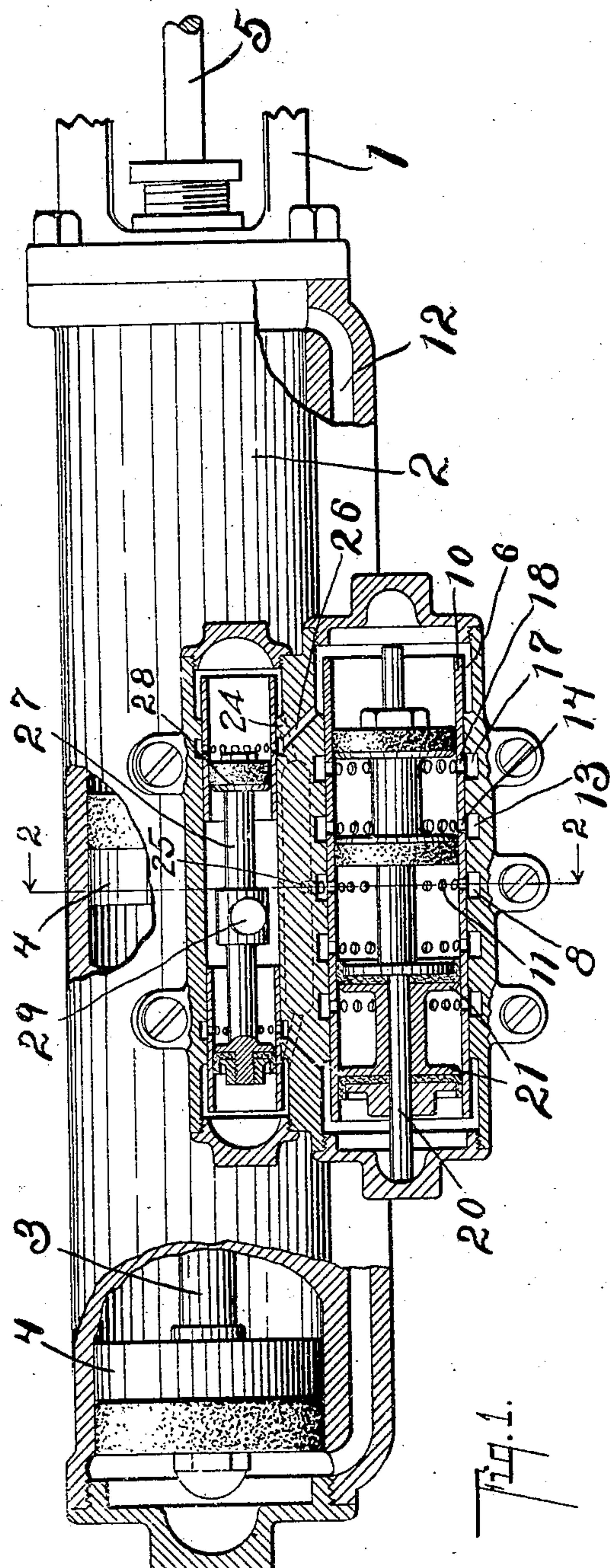
No. 880,737.

F. J. HUMPHREY.  
WATER MOTOR.

APPLICATION FILED JULY 17, 1907.

PATENTED MAR. 3, 1908.

2 SHEETS—SHEET 1.



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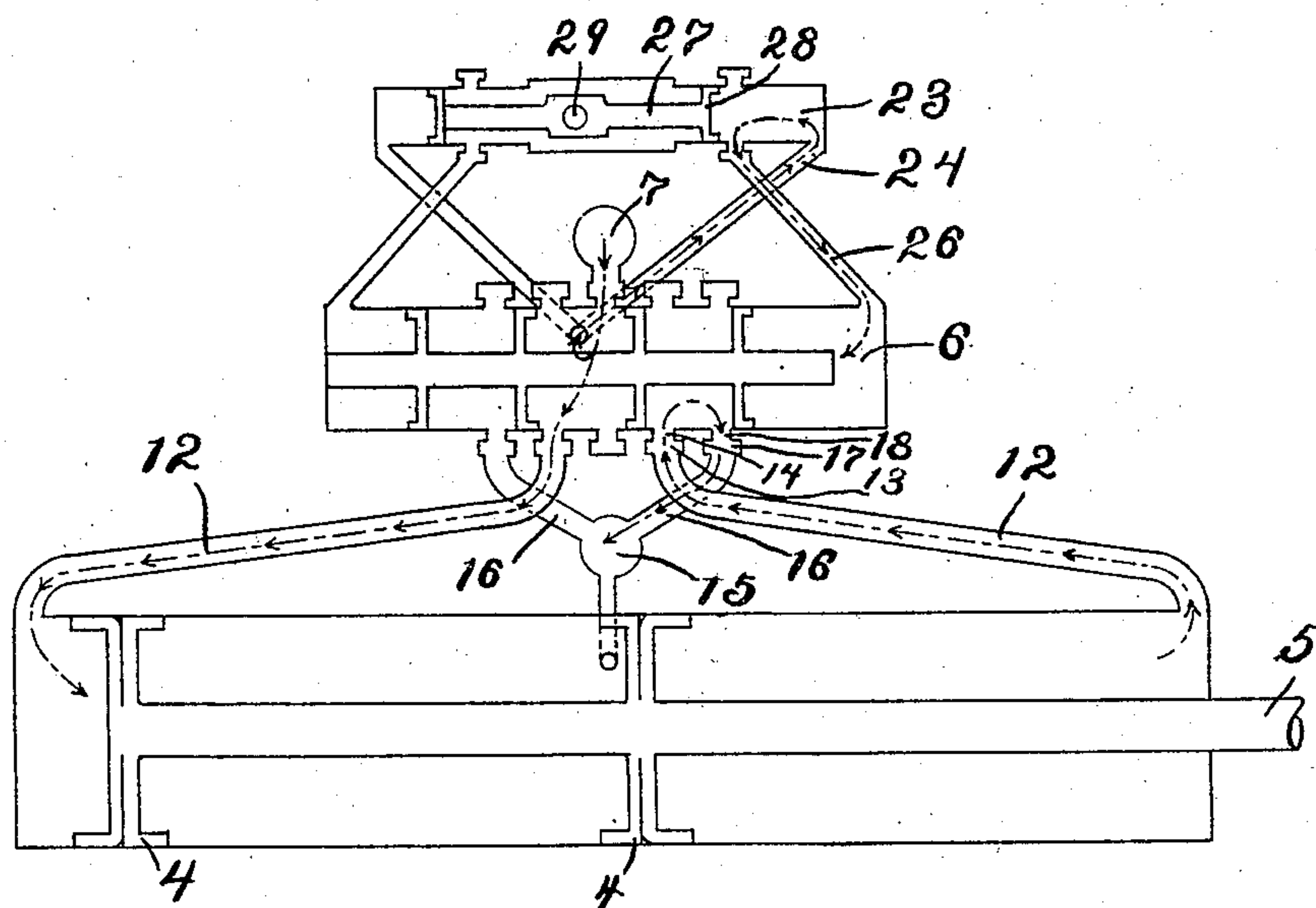


Fig. 5.

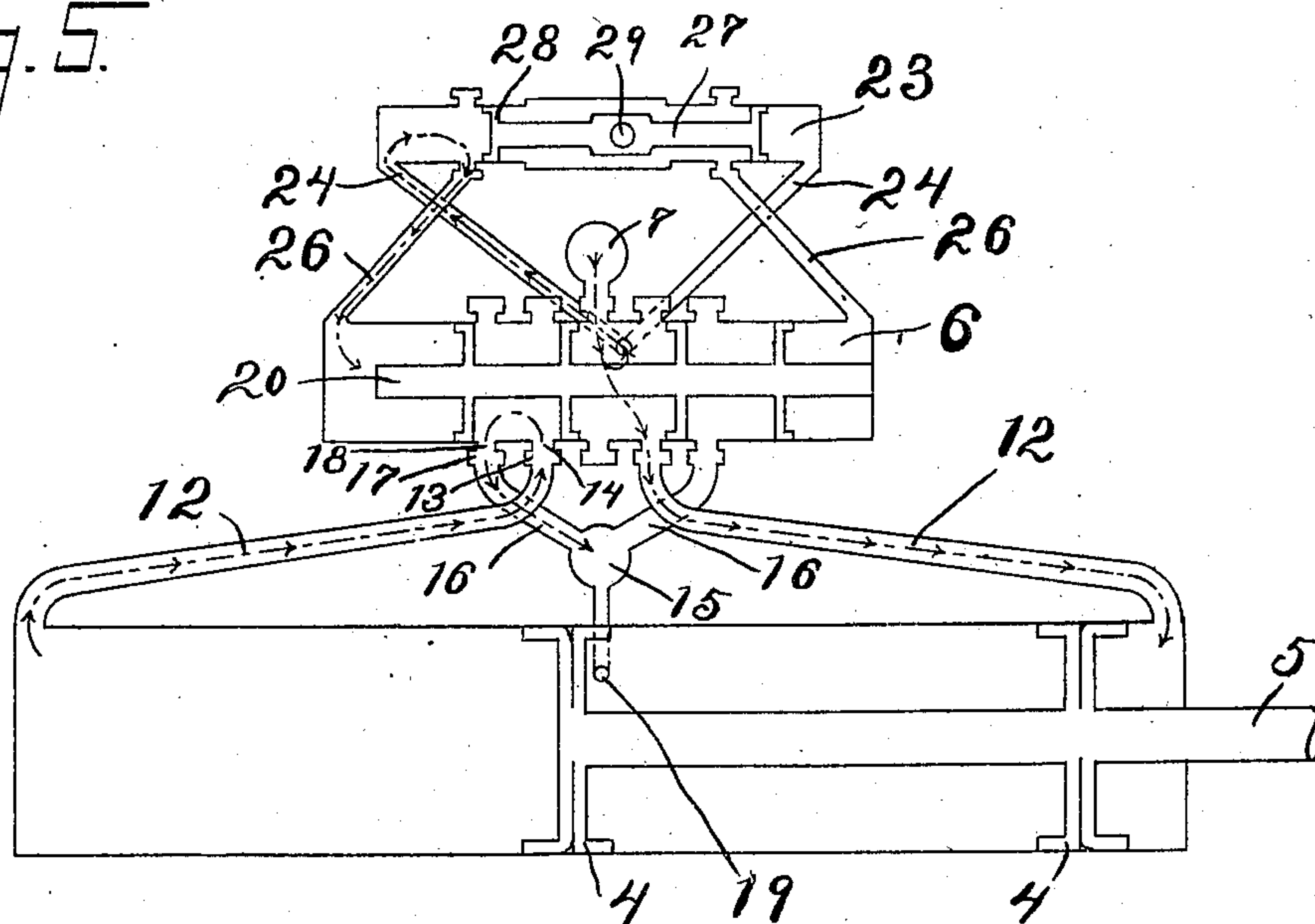


Fig. 6.

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# UNITED STATES PATENT OFFICE.

FREDERICK J. HUMPHREY, OF KALAMAZOO, MICHIGAN.

## WATER-MOTOR.

No. 880,737.

Specification of Letters Patent.

Patented March 3, 1908.

Application filed July 17, 1907. Serial No. 384,272.

*To all whom it may concern:*

Be it known that I, FREDERICK J. HUMPHREY, a citizen of the United States, residing at the city and county of Kalamazoo, State of Michigan, have invented certain new and useful Improvements in Water-Motors, of which the following is a specification.

This invention relates to improvements in water motors.

The main objects of this invention are, first, to provide an improved water motor which will perform a maximum amount of work with the power consumed; second, to provide an improved water motor which has a regular, even movement and one which may be started with the movable parts in any position which they may assume therein; third, to provide an improved water motor in which the shock of reversing is very slight so that the motor is practically noiseless and easy running; and fourth, to provide an improved motor, the parts of which are economical to produce, and easily assembled and disassembled, and reassembled should occasion require the same.

Further objects, and objects relating to details of construction, will definitely appear from the detailed description to follow.

I accomplish the objects of my invention by the devices and means described in the following specification.

The invention is clearly defined and pointed out in the claims.

A structure embodying the features of my invention is clearly illustrated in the accompanying drawing, forming a part of this specification, in which,

Figure 1 is a detail plan view of my improved water motor, partially in longitudinal section, to show the structural details and the relation of the parts; Fig. 2 is a transverse section taken on a line corresponding to line 2—2 of Fig. 1; Fig. 3 is a detail section taken on a line corresponding to line 3—3 of Fig. 2; Fig. 4 is a detail section taken on a line corresponding to line 4—4 of Fig. 2; and Figs. 5 and 6 are diagrammatic views showing the relation of the valves and the passage of water through the motor, Fig. 5 showing the position of the valves when the piston is at the left hand end of the stroke with the valves in their reversing position, and Fig. 6 showing the piston at the right hand end of the stroke with the valves in reversing position.

In the drawings, similar reference charac-

ters refer to similar parts throughout the several views, and the sectional views are taken looking in the direction of the little arrows at the ends of the section lines.

Referring to the drawings, 1 represents the supporting frame, which is here shown in detail only. The piston cylinder 2 is mounted at one end of the frame and the pump cylinder at the other. The pump cylinder, as it forms no part of this invention, is not here illustrated. The piston 3 is preferably provided with two heads 4, the piston rod 5 being adapted to connect the same to the pump. On one side of the piston cylinder is a main valve cylinder 6 to which the inlet or induction passage 7 is connected. The passage 7 is preferably provided with an annular delivery portion 8 having a plurality of discharge ports 11 through the cylindrical bushing 10 of the cylinder.

The valve cylinder 6 is connected by a pair of passages 12 to the piston cylinder, the passage 12 opening into the piston cylinder at each end thereof beyond or outside of the stroke of the piston. These passages are connected to the main valve chamber by means of the annular passages 13 and the ports 14. These ports 14 are located at each side of the inlet passage.

The main valve chamber is connected to the exhaust 15 by means of the passages 16, which terminate in the annular passages 17 and the ports 18, which ports are located at each side of the ports of the connecting passages 12 for the main valve cylinder to the piston cylinder.

The piston cylinder is connected to the exhaust by a passage 19, the passage 19 opening into the piston cylinder at a point within the stroke of its piston heads. This insures the draining of the piston cylinder and permits the equalizing of the pressure in the piston heads.

The main valve 20 is provided with a plurality of heads 21, which are adapted as the valve is shifted to alternately connect the passages 12 leading to the piston cylinder with the inlet and with the exhaust. With the main valve in the position shown in Fig. 1, the left hand passage is connected to the inlet while the right hand passage is connected to the exhaust, the main piston being at the initial point of its stroke.

The trip valve chamber 23 is arranged parallel with the main valve and the piston cylinder preferably above the piston



cylinder. The trip valve cylinder is connected with the annular delivery portion 8 of the inlet or induction passage 7 by means of the passages 25, 25' and 24. The passages 24 open into the trip cylinder at the outer ends thereof. The passage 25' is, for convenience in manufacture, in the form of a groove in the bottom of the casting, as illustrated in Fig. 4, and serves to connect the passage 25 to the passages 24. The trip valve cylinder is connected to the main valve cylinder by means of the passages 26 which open into the main valve chamber at points beyond the stroke of its valve, so that the water may pass through the passages 24 to the trip valve chamber, thence through the passages 26 to the outer end of the main valve cylinder for actuating the main valve, which in turn controls the passage of water to the main cylinder, as described, and connects the same with the exhaust. The trip valve 27 is provided with a pair of heads 28 adapted as the trip valve is shifted to alternately connect or disconnect the passages 24 and 26. This trip valve is actuated from the piston, being preferably provided with a tappet pin 29 projecting through a suitable slot-like opening 30 into the piston cylinder, (see Figs. 2, 3 and 4,) so that it is engaged by the heads 4 of the piston as the same reciprocates, thus shifting the trip valve, which in turn controls the main valve, which in its turn controls the piston, as has been described.

The water from the ends of the main valve cylinder exhausts through the passage 26 and the trip valve chamber and into the piston cylinder through the slot 30 provided for the tappet, the water escaping from the piston cylinder through the passage 19, as described.

The piston valve cylinders are preferably formed of two castings divided on the line 3—3 of Fig. 2, which enables the easy forming of the passages as described, either by means of cores in the casting or by drilling and cutting away. This arrangement facilitates the manufacture and also affords ready access to the parts in case it is necessary to disassemble for the purpose of repair or the like.

My improved motor is as stated comparatively economical to produce and may be readily assembled or disassembled, as stated. The motor may be readily started by the turning on of the water, no matter in what position the movable parts may be, as it is impossible for them to become so located but that the main valve will be shifted in one direction or the other.

My improved motor is reversed with comparatively little shock, so that it is comparatively noiseless. I have illustrated and described the same in detail in the form preferred by me on account of its structural simplicity and economy. I am, however, aware that it is capable of considerable vari-

ation in structural details without departing from my invention.

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

1. In a water motor, the combination with a motor cylinder of a double-headed piston therefor; a main valve cylinder; a centrally-located inlet passage for said main valve cylinder; connecting passages for said main valve cylinder and said motor cylinder, opening into said main valve cylinder at each side of the said inlet passage and into the said motor cylinder at points outside of the stroke of the piston heads thereof; a main exhaust passage; a pair of exhaust connecting passages for said main valve cylinder and said main exhaust passage, opening into said main valve cylinder at each side of the said motor and main valve cylinder connecting passages; a main valve having four heads adapted to alternately connect said connecting passages for said motor and main valve cylinders to the said inlet and exhaust passages of said main valve cylinder; a trip valve cylinder; connecting passages for said trip valve cylinder to said inlet passage; connecting passages for said trip valve cylinder to said main valve cylinder, opening into the same at points beyond the stroke of the said valve thereof; a double-headed trip valve arranged in said trip valve chamber, adapted to alternately connect and disconnect the said connecting passages for said trip valve cylinder to said main valve cylinder to the said connecting passages for said trip valve cylinder to the said inlet passages; a tappet on the said trip valve projecting into the said motor cylinder to be engaged by the said piston heads for shifting the trip valve; and a passage connecting said motor cylinder to said exhaust passage opening into said motor cylinder at a point within the stroke of the said piston heads, for the purpose specified.

2. In a water motor, the combination with a motor cylinder, of a double-headed piston therefor; a main valve cylinder; a centrally located inlet passage for said main valve cylinder; connecting passages for said main valve cylinder and said motor cylinder, opening into said main valve cylinder at each side of the said inlet passage and into said motor cylinder at points outside the stroke of the piston heads thereof; a pair of exhaust passages for said main valve cylinder, opening into said main valve cylinder at each side of the said motor and main valve cylinder connecting passages; a main valve having four heads adapted to alternately connect said connecting passages for said motor and main valve cylinders to the said inlet and exhaust passages of said main valve cylinder; a trip valve cylinder; connecting passages for said trip valve cylinder



to said inlet passage; connecting passages for said trip valve cylinder to said main valve cylinder, opening into the same at points beyond the stroke of the said valve thereof; a double-headed trip valve arranged in said trip valve chamber, adapted to alternately connect and disconnect the said connecting passages for said trip valve cylinder to said main valve cylinder to the said connecting passages for said trip valve cylinder to said inlet passages, and a tappet on said trip valve projecting into the said motor cylinder to be engaged by the said piston heads for shifting the trip valve, for the purpose specified.

3. In a water motor, the combination with a motor cylinder of a double-headed piston therefor; a main valve cylinder; a centrally-located inlet passage for said main valve cylinder; connecting passages for said main valve cylinder and said motor cylinder, opening into said main valve cylinder at each side of the said inlet passage and into said motor cylinder at points outside of the stroke of the piston heads thereof; a main exhaust passage; a pair of exhaust connecting passages for said main valve cylinder and said main exhaust passage, opening into said main valve cylinder at each side of the said motor and main valve cylinder connecting passages; a main valve having four heads adapted to alternately connect said connecting passages for said motor and main valve cylinders to the said inlet and exhaust passages of said main valve cylinder; a trip valve cylinder; connecting passages for said trip valve cylinder to said inlet passage; connecting passages for said trip valve cylinder to said main valve cylinder, opening into the same at points beyond the stroke of the said valve thereof; a double-headed trip valve actuated by said piston, adapted to alternately connect and disconnect the said connecting passages for said trip valve cylinder to said main valve cylinder to the said connecting passages for said trip valve cylinder to the said inlet passages; and a passage connecting said motor cylinder to said exhaust passage opening into said motor cylinder at a point within the stroke of the said piston heads, for the purpose specified.

4. In a water motor, the combination with a motor cylinder, of a double-headed piston therefor; a main valve cylinder; a centrally-located inlet passage for said main valve cylinder; connecting passages for said main valve cylinder and said motor cylinder, opening into said main valve cylinder at each side of the said inlet passage and into said motor cylinder at points outside of the stroke of the piston heads thereof; a pair of exhaust passages for said main valve cylinder opening into said main valve cylinder at each side of the said motor and main valve cylinder connecting passages; a main

valve having four heads adapted to alternately connect said connecting passages for said motor and main valve cylinders to the said inlet and exhaust passages of said main valve cylinder; a trip valve cylinder; connecting passages for said trip valve cylinder to said inlet passage; connecting passages for said trip valve cylinder to said main valve cylinder, opening into the same at points beyond the stroke of the said valve thereof; and a double-headed trip valve actuated by said piston, adapted to alternately connect and disconnect the said connecting passages for said trip valve cylinder to said main valve cylinder to the said connecting passages for said trip valve cylinder to the said inlet passages, for the purpose specified.

5. In a water motor, the combination with a motor cylinder of a piston therefor; a main valve cylinder; a centrally located inlet passage for said main valve cylinder; connecting passages for said main valve cylinder and said motor cylinder, opening into said main valve cylinder at each side of the said inlet passage and into said motor cylinder at points outside of the stroke of the piston thereof; a main exhaust passage; a pair of exhaust connecting passages for said main valve cylinder and said main exhaust passage, opening into said main valve cylinder at each side of the said motor and main valve cylinder connecting passages; a main valve adapted to alternately connect said connecting passages for said motor and main valve cylinders to the said inlet and exhaust passages of said main valve cylinder; a trip valve cylinder; connecting passages for said trip valve cylinder to said inlet passage; connecting passages for said trip valve cylinder to said main valve cylinder, opening into the same at points beyond the stroke of the valve thereof; a trip valve arranged in said trip valve chamber, adapted to alternately connect and disconnect the said connecting passages for said trip valve cylinder to said main valve cylinder to the connecting passages for said trip valve cylinder to the said inlet passages; a tappet on said trip valve projecting into the said motor cylinder to be engaged by the said piston for shifting the trip valve; and a passage connecting said motor cylinder to said exhaust passage, for the purpose specified.

6. In a water motor, the combination with a motor cylinder, of a piston therefor; a main valve cylinder; a centrally located inlet passage for said main valve cylinder; connecting passages for said main valve cylinder and said motor cylinder, opening into said main valve cylinder at each side of the said inlet passage and into said motor cylinder at points outside of the stroke of the piston thereof; a pair of exhaust passages for said main valve cylinder, opening into said main



valve cylinder at each side of the said motor and main valve cylinder connecting passages; a main valve adapted to alternately connect said connecting passages for said motor and main valve cylinder to the said inlet and exhaust passages of said main valve cylinder; a trip valve cylinder; connecting passages for said trip valve cylinder to said inlet passage; connecting passages for said trip valve cylinder to said main valve cylinder, opening into the same at points beyond the stroke of the said valve thereof; a trip valve arranged in said trip valve chamber, adapted to alternately connect and disconnect the said connecting passages for said trip valve cylinder to said main valve cylinder to the said connecting passages for said trip valve cylinder to the said inlet passages; and a tappet on said trip valve projecting into the said motor cylinder to be engaged by the said piston for shifting the trip valve, for the purpose specified.

7. In a water motor, the combination with a motor cylinder of a piston therefor; a main valve cylinder; a centrally-located inlet passage for said main valve cylinder; connecting passages for said main valve cylinder and said motor cylinder, opening into said main valve cylinder at each side of the said inlet passage and into said motor cylinder at points outside of the stroke of the piston thereof; a main exhaust passage; a pair of exhaust connecting passages for said main valve cylinder and said main exhaust passage, opening into said main valve cylinder at each side of the said motor and main valve cylinder connecting passages; a main valve adapted to alternately connect said connecting passages for said motor and main valve cylinder to the said inlet and exhaust passages of said main valve cylinder; a trip valve cylinder; connecting passages for said trip valve cylinder to said main valve cylinder, opening into the same at points beyond the stroke of the said valve thereof; a trip valve actuated by said piston, adapted to alternately connect and disconnect the said connecting passages for said trip valve cylinder to said main valve cylinder to the said connecting passages for said trip valve cylinder to the said inlet passages; and a passage connecting said motor cylinder to said exhaust passage, for the purpose specified.

8. In a water motor, the combination with a motor cylinder of a piston therefor; a main valve cylinder; a centrally-located inlet passage for said main valve cylinder; connecting passages for said main valve cylinder and said motor cylinder, opening into said main valve cylinder at each side of the said inlet passage and into said motor cylinder at points outside of the stroke of the piston thereof; a pair of exhaust passages for said main valve cylinder opening into said main valve cylinder at each side of the said

motor and main valve cylinder connecting passages; a main valve adapted to alternately connect said connecting passages for said motor and main valve cylinders to the said inlet and exhaust passages of said main valve cylinder; a trip valve cylinder; connecting passages for said trip valve cylinder to said inlet passage; connecting passages for said trip valve cylinder to said main valve cylinder, opening into the same at points beyond the stroke of the said valve thereof; a trip valve actuated by said piston adapted to alternately connect and disconnect the said connecting passages for said trip valve cylinder to said main valve cylinder to the said connecting passages for said trip valve cylinder to the said inlet passages, and a tappet on said trip valve, projecting into said motor cylinder chamber to be engaged by said piston for shifting said trip valve, for the purpose specified.

9. In a water motor, the combination with a motor cylinder of a piston therefor; a main valve cylinder; an inlet passage for said main valve cylinder; connecting passages for said main valve cylinder and said motor cylinder; a main exhaust passage; a pair of exhaust connecting passages for said main valve cylinder and said main exhaust passage; a main valve adapted to alternately connect said connecting passages for said motor and main valve cylinders to the said inlet and exhaust passages of said main valve cylinder; a trip valve cylinder; connecting passages for said trip valve cylinder to said inlet passage; connecting passages for said trip valve cylinder to said main valve cylinder; a trip valve actuated by said piston adapted to alternately connect and disconnect the said connecting passages for said trip valve cylinder to said main valve cylinder to the said connecting passages for said trip valve cylinder to the said inlet passages; and a passage connecting said motor cylinder to said exhaust passage, for the purpose specified.

10. In a water motor, the combination with a motor cylinder of a piston therefor; a main valve cylinder; an inlet passage for said main valve cylinder; connecting passages for said main valve cylinder and said motor cylinder; a pair of exhaust passages for said main valve cylinder; a main valve adapted to alternately connect said connecting passages for said motor and main valve cylinders to the said inlet and exhaust passages of said main valve cylinder; a trip valve cylinder; connecting passages for said trip valve cylinder to said inlet passage; connecting passages for said trip valve cylinder to said main valve cylinder; a trip valve actuated by said piston adapted to alternately connect and disconnect the said connecting passages for said trip valve cylinder to said main valve cylinder to the said con-



necting passages for said trip valve cylinder to the said inlet passages, and a tappet on said trip valve, projecting into said motor cylinder chamber to be engaged by said piston for shifting said trip valve, for the purpose specified.

11. In a water motor, the combination with a motor cylinder of a piston therefor; a main valve cylinder; an inlet passage for said main valve cylinder; connecting passages for said main valve cylinder and said motor cylinder; an exhaust passage for said main valve cylinder; a main valve adapted to alternately connect said connecting passages for said motor and main valve cylinders to the said inlet and exhaust passages of said main valve cylinder; a trip valve cylinder; connecting passages for said trip valve cylinder to said inlet passage; connecting passages for said trip valve cylinder to said main valve cylinder; a trip valve actuated by said piston adapted to alternately connect and disconnect the said connecting passages for said trip valve cylinder to said main valve cylinder to the said connecting passages for said trip valve cylinder to the said inlet passages, and a tappet on said trip valve, projecting into said motor cylinder chamber to be engaged by said piston for shifting said trip valve, for the purpose specified.

12. In a water motor, the combination with a motor cylinder of a piston therefor; a main valve cylinder; a centrally located inlet passage for said main valve cylinder; connecting passages for said main valve cylinder and said motor cylinder, opening into said main valve cylinder at each side of the said inlet passage and into said motor

cylinder at points outside of the stroke of the piston thereof; a main exhaust passage; a pair of exhaust connecting passages for said main valve cylinder and said main exhaust passage, opening into said main valve cylinder at each side of the said motor and main valve cylinder connecting passages, a main valve adapted to alternately connect said connecting passages for said motor and main valve cylinders to the said inlet and exhaust passages of said main cylinder; a trip valve cylinder; connecting passages for said trip valve cylinder to said inlet passage; connecting passages for said trip valve cylinder to said main valve cylinder, opening into the same at points beyond the stroke of the valve thereof; a trip valve arranged in said trip valve chamber, adapted to alternately connect and disconnect the said connecting passages for said trip valve cylinder to said main valve cylinder to the connecting passages for said trip valve cylinder to the said inlet passages; a tappet on said trip valve projecting into the said motor cylinder to be engaged by the said piston for shifting the trip valve; and a passage connecting said motor cylinder to said exhaust passage opening into the said motor cylinder at a point within the stroke of the said piston, said trip valve being adapted to exhaust into said motor cylinder, for the purpose specified.

In witness whereof, I have hereunto set my hand and seal in the presence of two witnesses.

FREDERICK J. HUMPHREY. [L. S.]

Witnesses:

OTIS A. EARL,  
CLARA E. BRODEN.