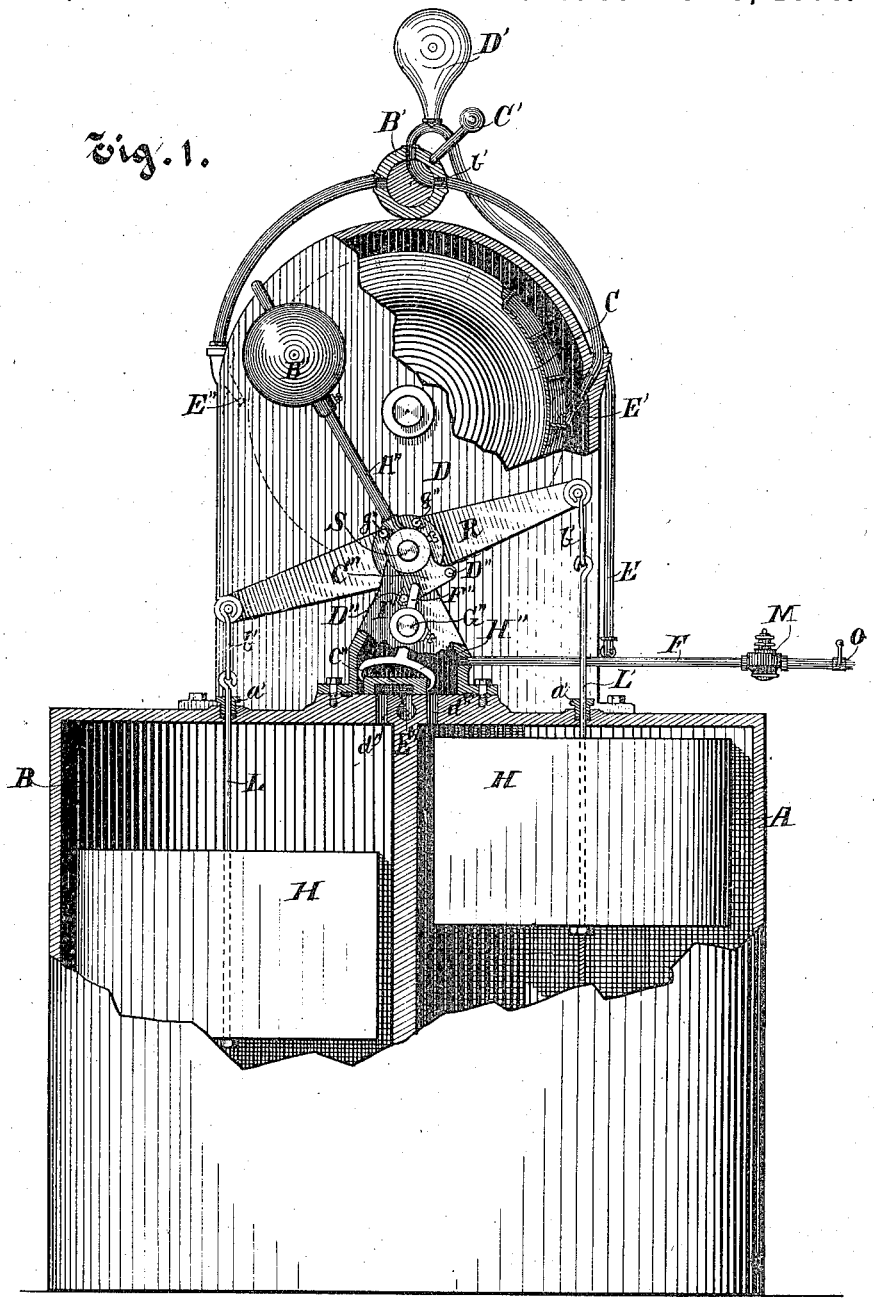
(No Model.) 3 Sheets—Sheet 1.

# J. B. ERWIN.

## MOTOR.

No. 384,612. Patented June 19, 1888.

Fig. 1.




Witnesses.
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E. R. Inman.

Inventor.
James B. Erwin.

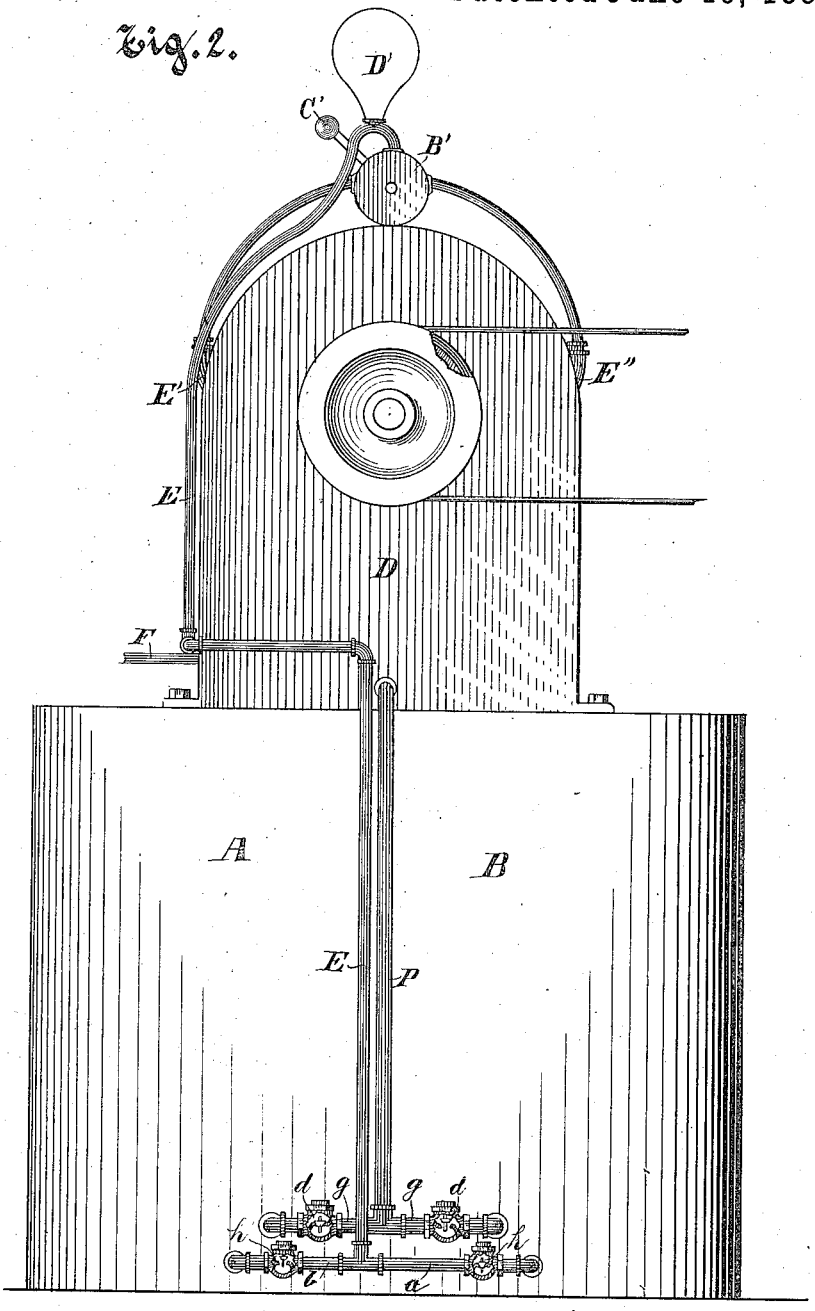
(No Model.) 3 Sheets—Sheet 2.

J. B. ERWIN.

MOTOR.

No. 384,612. Patented June 19, 1888.

Fig. 2.




Witnesses.

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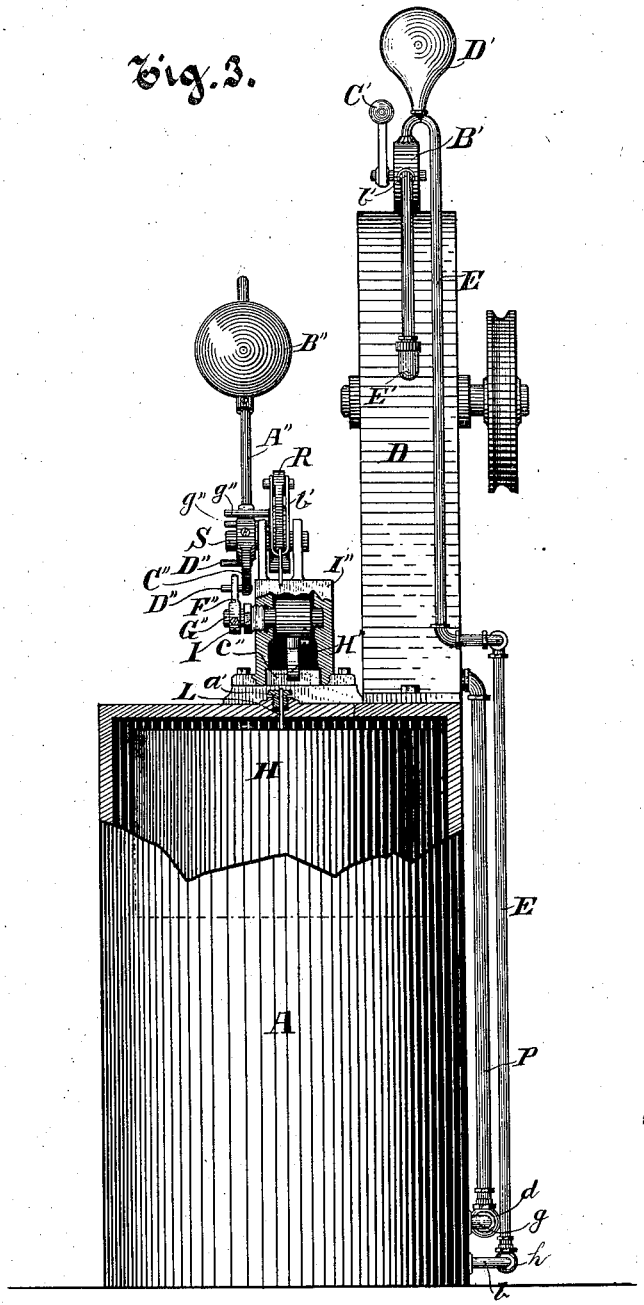
(No Model.) 3 Sheets—Sheet 3.

# J. B. ERWIN.

## MOTOR.

No. 384,612. Patented June 19, 1888.

Fig. 3.




Witnesses.

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# UNITED STATES PATENT OFFICE.

JAMES B. ERWIN, OF MILWAUKEE, WISCONSIN.

## MOTOR.

SPECIFICATION forming part of Letters Patent No. 384,612, dated June 19, 1888.

Application filed March 31, 1887. Serial No. 233,109. (No model.)

*To all whom it may concern:*

Be it known that I, JAMES B. ERWIN, of Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented new and useful Improvements in Motors; and I do hereby declare the following to be a full, clear, and exact description of said invention, reference being had to the accompanying drawings, and to the letters or figures of reference marked thereon, which form a part of this specification.

The object of my invention is to provide a device by which the same water or other liquid, under compressed air, steam, or other pressure, may be forced in a continuous stream in the same direction through a discharge pipe or duct and discharged in the same direction upon the motor-wheel, and said wheel driven forward continuously in the same direction by said water or other liquid with a rapid uniform movement; also, by which the water thus forced may be changed in its course from one side of the motor-wheel to the other, and the motion of the wheel thereby reversed, without changing the course of the steam or other pressure upon the water. Notwithstanding the fact that my motor or engine is equally adapted to be used with compressed air, gas, or steam acting through the medium of oil, water, or other liquid, I will, to abbreviate the description, describe the same as a hydropneumatic motor.

Figure 1 of the accompanying drawings represents a front view of my invention, part in section. Fig. 2 represents a rear view, part in section. Fig. 3 represents a side view, part in section.

Like parts are represented by the same reference-letters.

A and B are the water-receivers, which may be formed together, as shown, in a single casting, subdivided into two compartments by a partition; or two separate cylinders may be substituted therefor.

C is a motor-wheel, which is supported upon a shaft in the ordinary manner within the inclosing-case D. One of the receivers, A, being filled with water, compressed air is conducted thereto through the pipe F, whereby the water is forced out of such receivers A with a pressure equal to the pressure of the air upon it, when it passes out through the branch pipe *b* and up through the pipe E, and is discharged through one of the nozzles E′ upon the motor-wheel C within the case D, and from thence it passes into the water-receiver B. The course of the water is thus continued until the contents of the receiver A have passed into the receiver B, when the course of the water is reversed from said receiver B to the receiver A by reversing the course of the compressed air, which air may be reversed by a great variety of well-known devices. When the air is reversed from the empty receiver A to the receiver B, the water is forced from the receiver B to the receiver A, as before, through said case D and upon said motor-wheel, passing through the branch pipe *a* and the main pipe E, when it returns, as before, from said wheel-inclosing case to the water-receiver A. Thus it is obvious that the same water may be caused to flow in a continuous stream upon the motor-wheel rapidly over and over again, so long as the air or other pressure is thus applied thereto. The branch pipes *a* and *b* are each provided with ordinary check-valves, *h h*, which prevent the return of the water through them. The water passes from the motor-case D to the respective receivers A and B through the pipe P and branches *g g*. The branches *g g* are also provided with ordinary check-valves, *d d*, which permit the water to enter the receivers, but prevent it from returning therefrom. The motor-wheel and its inclosing-case are preferably located above the water-receivers A and B, as shown, so that the water will flow from said case into said receivers of its own gravity. As the water passes from the motor-case D to either of the water-receivers A or B, it becomes necessary to exhaust the compressed air from such receiver as the water enters it.

The compressed air may be controlled in its course both to and from said water-receivers by a single three-way cock, or, as stated, by a variety of devices, which may be operated by hand or other exterior power. I have, however, shown a preferred form of device for automatically controlling the direction of the air by the action of floats located in said receivers A and B.

H H are the floats by which the air-control-

ling valves are actuated, one of which floats is located in each of said receivers, and both are supported by the same lever R upon the same pivotal support S. The floats H H are connected with the lever R by rods L and L'. The rods L and L' extend upward from the floats through the stuffing-nuts $a'$ $a'$, and are connected with the lever R by links $b'$ $b'$. The floats H H are of equal bulk and weight, and they counterbalance each other upon the central pivotal support S, owing to which fact one counteracts the gravity of the other, and they virtually weigh nothing, and consequently they may be made of solid iron or any other material which is preferably of greater specific gravity than the surrounding water.

It is obvious that when the water in the receivers A and B stands below the floats, as is the case part of the time during the transmission of the water from one receiver to the other, the floats remain at rest; but as soon as the water rises in one of the receivers up to and around the float therein said float will gradually ascend, while the counterbalancing-float descends, whereby one end of the lever R will be drawn downward and the other upward by the descending float with a force equal to the weight of the water displaced by the float in the full receiver, when the float in the full receiver will be drawn up as the water rises around it by the gravity of the opposite float in the empty receiver. The motion of the lever R as it oscillates upon its pivotal support S is communicated, as hereinafter described, to the air-controlling valve $c''$ within the valve-chamber I'', whereby said valve $c''$ is caused to reciprocate horizontally across the air-controlling ports $d''$ $d''$ and E''', which ports $d''$ $d''$ communicate between said valve-chamber I'' and the respective water-receivers A and B, whereby communication is alternately opened between the respective receivers A and B and the valve-chamber I'', while the same movements of the valve $c''$ which open communication to one of the receivers A or B also open communication between the other receiver and the exhaust-duct E''', thus permitting the air to escape from one of said water-receivers as the water is driven thereto from the other receiver, as described, through the wheel-inclosing case.

The side of the lever R is provided with two stops, $g''$ $g''$, which, as said lever oscillates, are brought into contact with the respective sides of the weighted two-armed lever A'', whereby said lever A'', with its weight B'', is carried upward from the inclined position shown in Fig. 1 to and slightly past the vertical, above the pivotal support S, as said lever R is moved, as heretofore described, by the action of the floats. When said lever A'' is thus carried to and slightly past the vertical, as mentioned, it drops of its own gravity upon the other side, whereby a quick positive motion is produced, which is communicated from the short arm C'' of said lever, through the stops D'' D'', lever F''', shaft G'', and the two-armed lever H'', to said reciprocating valve $c''$. The lever A'' is supported and turns upon the same pivotal support S with the lever R. The shaft G'' extends across the interior of the valve-chamber I'', and protrudes therefrom forward through the stuffing-nut I. The two-armed lever H'' is rigidly affixed to said shaft G'' upon the inside of the chamber I'', and the lever F''' is rigidly affixed to the exterior end of the shaft G''. The upper end of the lever F''' is located between the stops D'' D'' in such a position that as said lever A'' is thrown from one side to the other past the vertical, motion will be communicated thereto from said stops D'' D'', whereby said lever F''' is alternately inclined toward the right and left, and the motion thus communicated to it is transmitted therefrom through the shaft G'' and the two-armed lever H'' to the reciprocating valve $c''$, whereby said valve $c''$ is alternately moved toward the right and left, as stated, as the respective receivers A and B are alternately filled with water, and whereby the compressed air is always conducted to the full receiver, while it is simultaneously permitted to exhaust from the empty receiver. The stops D'' D'' are affixed to the side of the short arm C'' at a slight distance apart from each other, upon the respective sides of the lever F''', whereby the valve $c''$ is permitted to remain at rest until the lever A'' has commenced to drop of its own gravity past the vertical, when said valve $c''$ is given a quick positive movement. By thus providing an open space between the stops D'' D'' upon the respective sides of the lever F''', as shown, the lever A'' is permitted to reach and drop a slight distance past the vertical before said stops D'' are brought in contact with said lever F''', whereby the required momentum of the weight B'' is attained before it is met with the resistance of the sliding valve $c''$, and whereby said valve $c''$ is given a quick positive movement, as mentioned.

O is an air-cock, by which the admission of air from the air-reservoir to the motor is controlled.

M is a pressure-regulator, by which the air-pressure in the motor is controlled and regulated to any desired pressure less than that of the reservoir or supply. When desirous to provide for reversing the rotary movements of the motor-wheel, two separate discharged nozzles, E' and E'', are provided—one upon each side of the wheel—whereby by reversing the course of the water from one nozzle to the other the motion of the wheel is reversed.

B' represents a three-way cock, by which the course of the water is both stopped and reversed from one side to the other of said wheel, as mentioned. When the handle C' of the cock is inclined toward the right, as indicated, water passes from the pipe E out through the passage $b'$ of the faucet into the nozzle E'. When the handle is in the vertical position, the cock is closed and the motor is thereby

stopped, and when turned toward the left the duct *b'* opens communication between said pipe E and the nozzle E''.

To maintain a continuous unbroken stream of water under full pressure upon the wheel during the brief interval that the air-valves are reversing, I have provided an air-chamber, B', which holds a quantity of water beneath the compressed air in said chamber, which water is driven by the compressed air therefrom down into the discharge-nozzle as soon as there is a diminution of pressure in the pipe E, thus maintaining a steady unbroken stream of water upon the wheel. The method herein described of forcing the same water or other liquid under air or other gaseous fluid pressure in a continuous stream in the same direction to and upon the same motor-wheel is my invention, and I hereby reserve my right to procure a separate patent therefor.

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

1. In a hydropneumatic motor, the combination of a motor-wheel, a wheel-inclosing case, into which case water is forced by the expansive force of compressed air alternately from one and then the other of two separate air-tight water-receivers, two air-tight water-receivers, from one and then the other of which the same water is alternately forced by the direct expansive force of compressed air within such receivers into said wheel-inclosing case, water-ducts provided with checks communicating from said water-receivers into said wheel-inclosing case and from said wheel-inclosing case back to said water-receivers, an air-pipe communicating from a supply with both of said water-receivers, and mechanism for controlling the course of the air alternately to and from each of said water-receivers, substantially as set forth.

2. In a hydropneumatic motor, the combination of two separate liquid-receivers communicating with each other through a third receiver or wheel-inclosing case, a wheel-inclosing case, two branch pipes having return-checks communicating from said liquid-receiver through a single pipe with said wheel-inclosing case, and a single pipe communicating from said wheel-inclosing case through two separate branch pipes having return-checks with each of said liquid-receivers, substantially as and for the purpose specified.

3. In a hydropneumatic motor, the combination of two liquid-receivers, A and B, two branch pipes, *a* and *b*, communicating from the respective receiver A and B with the single pipe or duct E, pipe or duct E, water-controlling cock B', and branch pipes or nozzles E' and E'', communicating between said cock and the wheel-inclosing case D upon the respective sides of the wheel, whereby the course of the water may be turned from one side of said wheel to the other and the rotary movement of the wheel reversed, substantially as set forth.

4. In a hydropneumatic motor, the combination of the wheel-inclosing case D, provided with a motor-wheel, two liquid-receivers, A and B, from one and then the other of which water is alternately forced into said wheel-inclosing case D, valve-chamber I, communicating through ports with the respective receivers B and C, reciprocating slide-valve *c''*, two counterbalanced oscillating floats, H H, located, respectively, in the respective receivers B and C, and suspended by rods from the same supporting-lever, and mechanism for communicating motion from said oscillating floats to said reciprocating valve, whereby, as said floats oscillate in said water-receivers, the same water is forced alternately from one and then the other of said floats containing water-receivers upon a wheel in said wheel-inclosing case, substantially as and for the purpose specified.

5. In a hydropneumatic motor, the combination of the liquid-receivers A and B, valve-chamber I'', communicating from a single air-pipe, F, with the respective liquid-receivers A and B, past the air-controlling valve *c''*, lever R, pivotal support S, valve-rods L L, communicating between said lever R and the interior of said receivers A and B through the stuffing-nuts *a'*, floats H H, counterbalanced in their respective chambers upon the same pivotal support or lever R, located upon the exterior of said chambers, two-armed lever A'', mounted upon the same pivotal support S with the lever R, pivotal support S, stops *g'' g''*, projecting from said lever R upon the respective sides of said lever A'', stops D'' D'', projecting from the side of the short arm C'' of said lever A'', upon the respective side of the lever F'', lever F'', affixed at one end of the pivotal shaft G'' upon the exterior of the valve-chamber I'', pivotal shaft G'', extending across the interior of the valve-chamber I'', stuffing-nut I, surrounding the protruding end of said shaft G'', lever H'', affixed to the inner end of said shaft G'', and air-controlling valve *c''*, adapted to be operated by contact with said lever H'', all substantially as and for the purpose specified.

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

JAMES B. ERWIN.

Witnesses:
C. T. BENEDICT,
C. H. KEENEY.