No. 688,757. Patented Dec. 10, 1901.

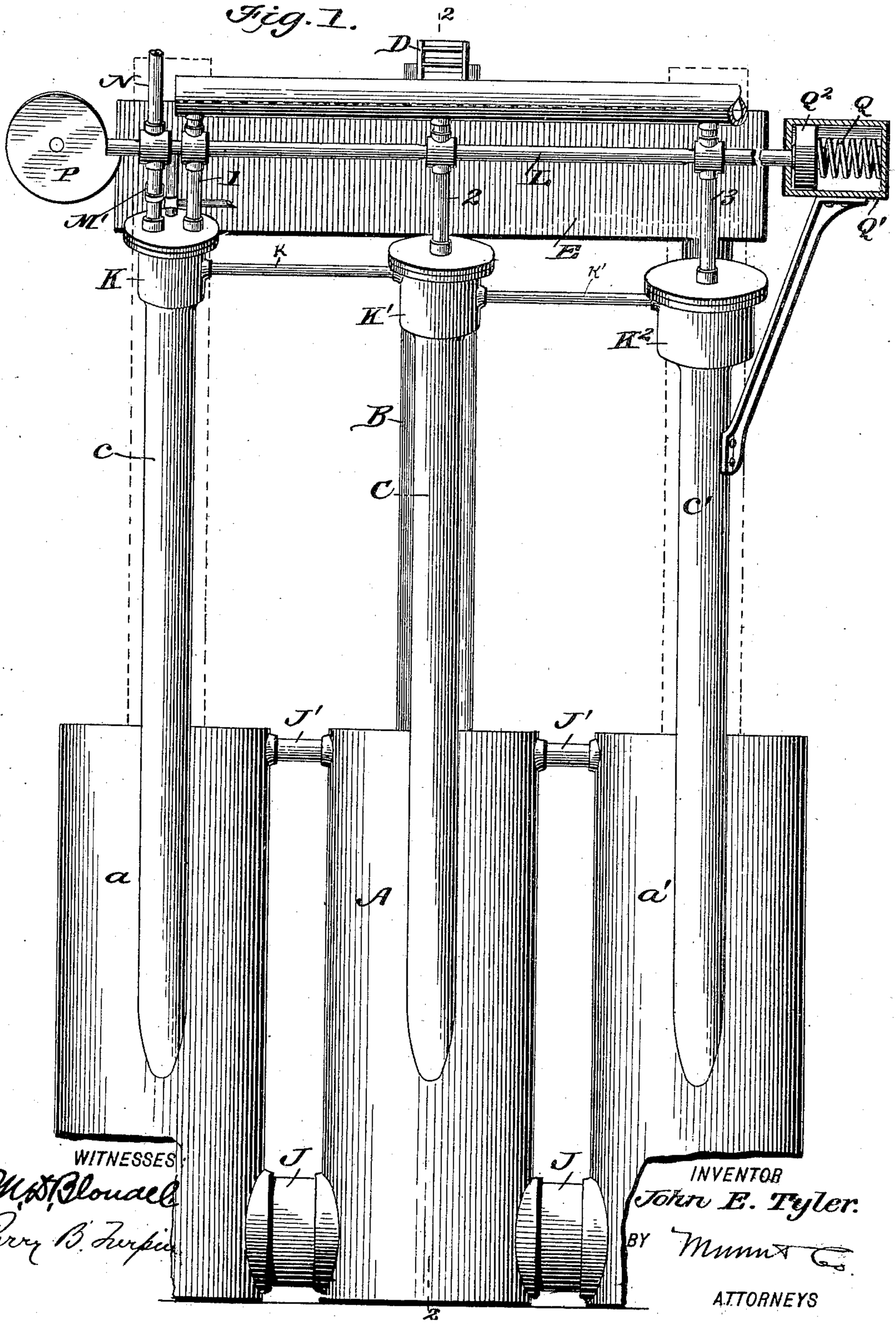
J. E. TYLER.

MOTOR APPARATUS.

(Application filed Feb. 11, 1901.)

(No Model.) 3 Sheets—Sheet 1.

Fig. 1.



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(No Model.) 3 Sheets—Sheet 2.

Fig. 2.

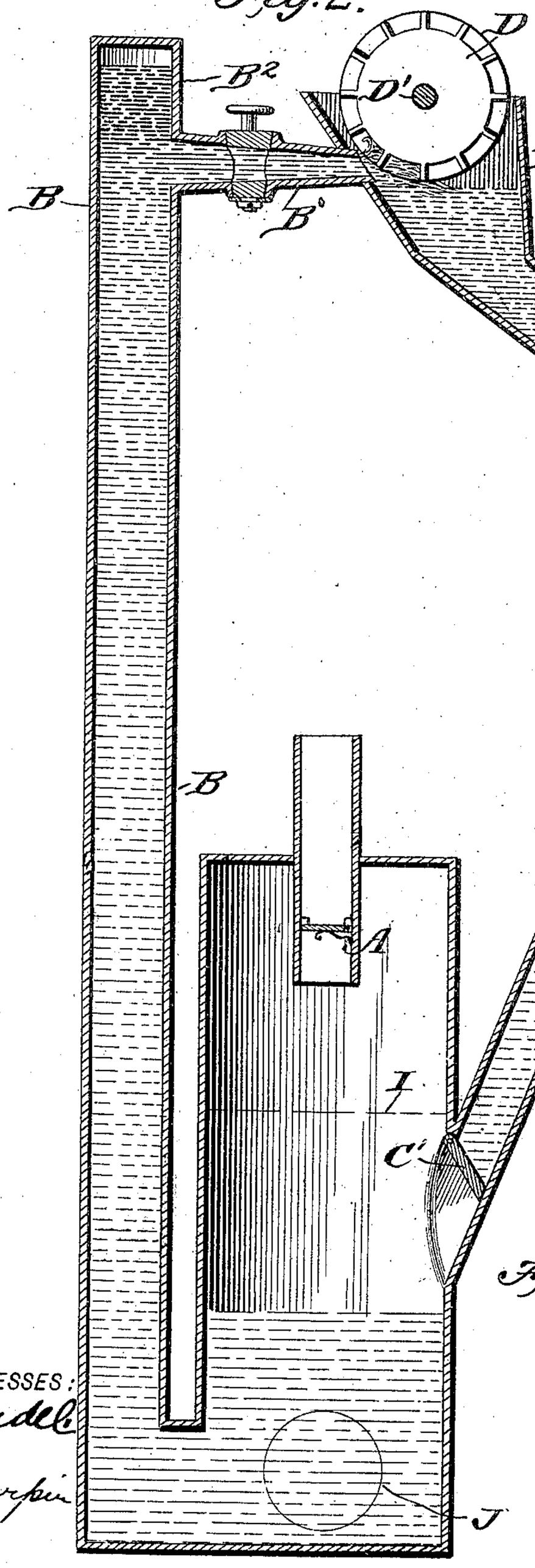


Fig. 7.

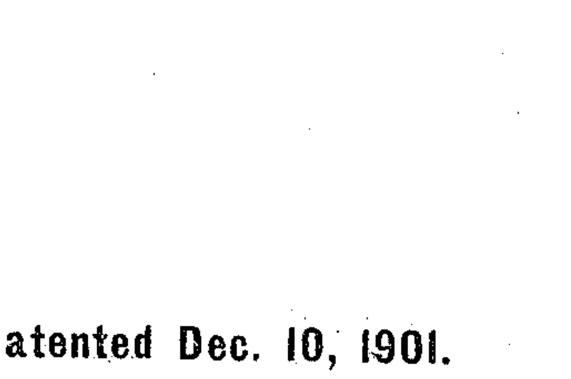


Fig. 3.

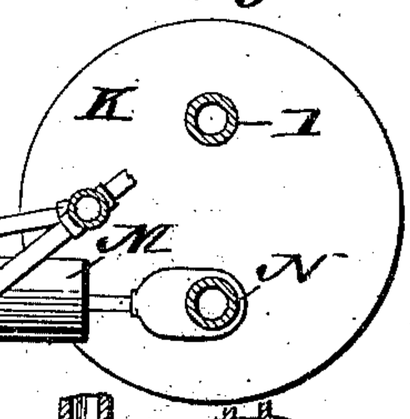
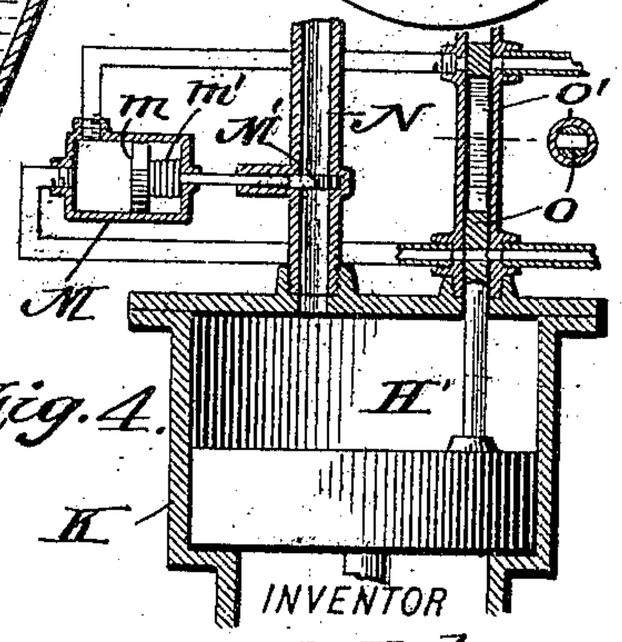


Fig. 4.



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(No Model.)

3 Sheets—Sheet 3.

Fig. 5.

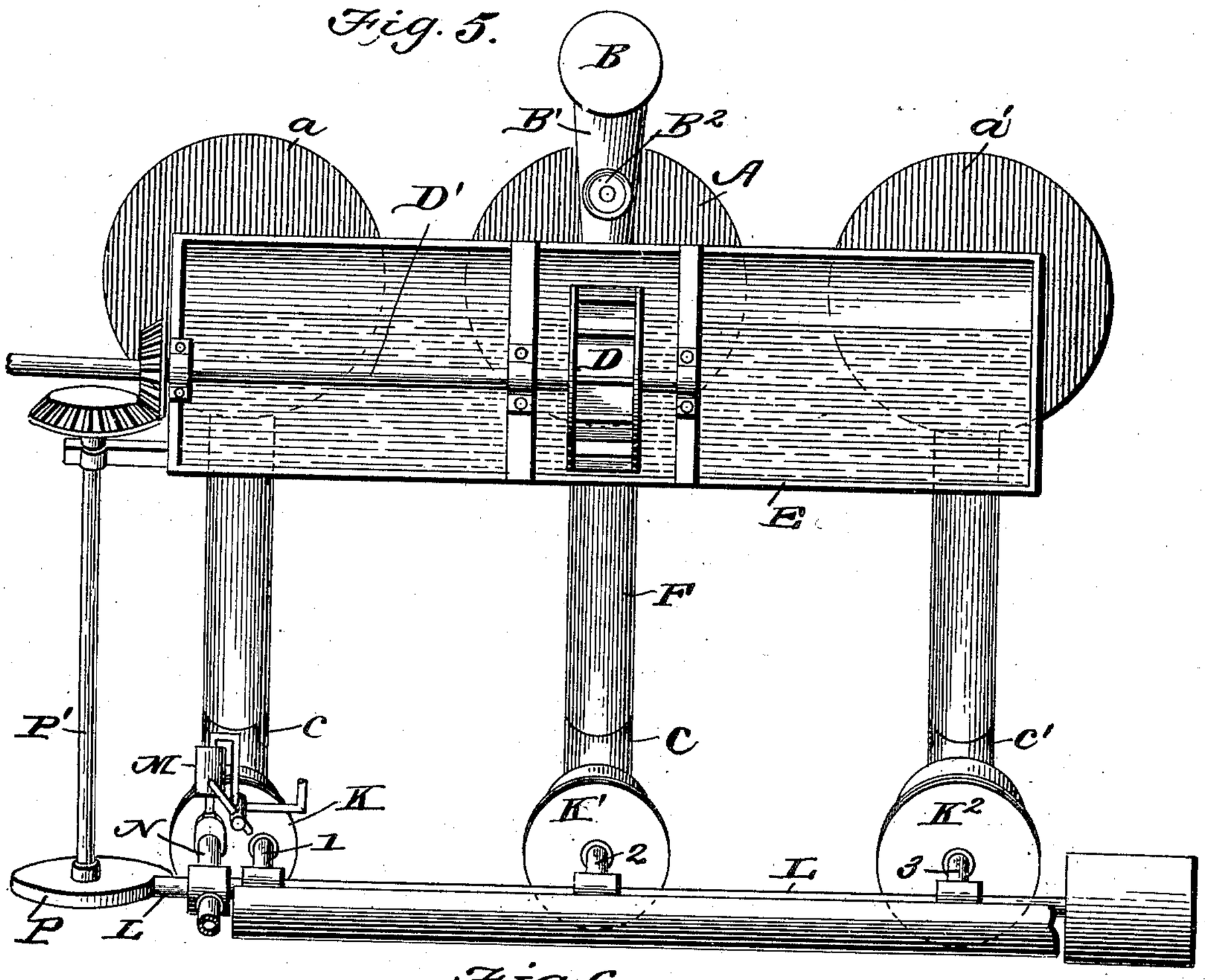
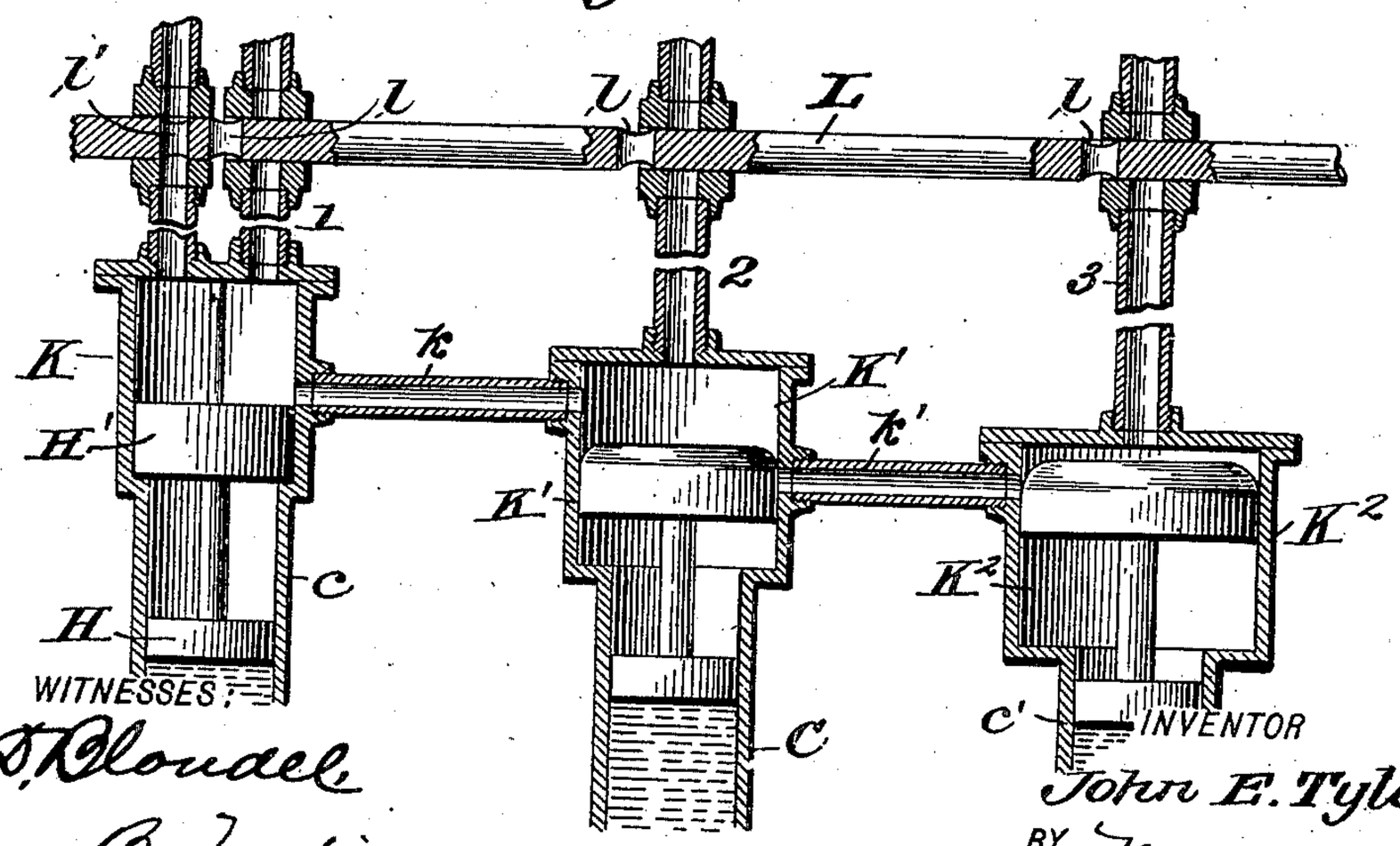


Fig. 6.



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UNITED STATES PATENT OFFICE.

JOHN E. TYLER, OF ROXOBEL, NORTH CAROLINA.

MOTOR APPARATUS.

SPECIFICATION forming part of Letters Patent No. 688,757, dated December 10, 1901.

Application filed February 11, 1901. Serial No. 46,828. (No model.)

To all whom it may concern:

Be it known that I, JOHN E. TYLER, a citizen of the United States, residing at Roxobel, in the county of Bertie and State of North Carolina, have made certain new and useful Improvements in Motor Apparatus, of which the following is a specification.

My invention is an improvement in motor apparatus of the general class illustrated in my former patent, No. 631,238, dated August 15, 1899; and the present invention consists in certain novel constructions and combinations of parts, as will be hereinafter described and claimed, whereby I am able to utilize motion given a descending column of water in connection with a tank containing compressed air to operate an ascending column of water in a pipe leading from the main tank containing compressed air, and thereby operating a water-wheel by which motion may be given to any desired machinery; and the invention includes, preferably, a combination of supply-pipes leading to their respective main air-tanks, a discharge-pipe leading from one of such tanks, and a compound expansion-engine whereby the pistons operating to give momentum to the columns of water in the several supply-pipes may be operated expansively, all as will be hereinafter described.

In the drawings, Figure 1 is a front elevation, partly in section and partly broken away, illustrating my invention embodied in a series of connected main tanks, with their supply-pipes, and a discharge-pipe leading from one of the tanks to discharge to the water-wheel. Fig. 2 is a vertical longitudinal section on about line 2 2 of Fig. 1. Fig. 3 is an end view, and Fig. 4 a sectional view, of one of the piston-cylinders and its connected parts, showing the cut-off for stopping the supply of steam when the piston in the first cylinder has reached its lowermost position in order to permit the steam to operate expansively in the succeeding cylinders. Fig. 5 is a top plan view of the apparatus. Fig. 6 is a detail sectional view illustrating the compound-engine construction, and Fig. 7 is a detail view illustrating the valves employed in the tubes connecting the trough with the supply-pipes leading to their several main tanks.

It should be understood that my invention could be carried out and operated in connection with a single main tank A, one discharge-pipe B, and one supply-pipe C—such as shown, for instance, in Fig. 2—and while I prefer to employ the plurality of parts shown in Figs. 1 and 5 I do not wish to be limited in the broad features of my invention thereto.

In the construction shown the main tank A has leading from it the upwardly-extending discharge-pipe B, which communicates at its lower end with the tank A, at or near the bottom of the latter, and leads upwardly to a proper height, it may be, say, from sixteen feet or less upward to any desired height, terminating at its upper end above the upper end of the tank A, as shown in Fig. 2. Near its upper end the pipe B is provided with a discharge-nozzle B′, controlled by a valve discharging to a water-wheel D, which may be of any approved style. The valve controlling this nozzle B may be used for the purpose of starting or stopping the motor. It will be noticed that the pipe B is extended at B^2 above the point of connection of the nozzle B′, affording an air-cushioning space above the water in the discharge-pipe B and rendering the flow of water from the nozzle B′ steadier; but, if desired, the nozzle may lead directly from the upper end of the discharge-pipe B. The water from the wheel D discharges to the trough E, whence it is conducted in the connecting-pipe F and discharges to the supply-pipe C near the upper end of the latter. The connection F is controlled by downwardly-opening check-valves F′, which may open to permit the flow of water to the supply-pipe C, but will close and check the flow of water in the opposite direction, as when pressure is exerted upon the column of water in the supply-pipe by the operation of the piston H, as shown in Fig. 2. The pipe C, above the point of connection of pipe F therewith, is formed or provided with a cylinder in which the piston H operates, and the piston H is operated by a piston H′, with which it is connected, the latter being preferably of greater area than piston H and operated by steam or other power, as more fully described hereinafter. At its lower end the pipe C opens into the main tank A at a point which may be above or below the normal surface of the water in the tank A; but the surface of the water in

the tank A must be above the connection of the pipe B with said tank, so that water stands normally in the tank A, above the connection of the discharge-pipe B therewith. Ordinarily the level of water in the tank A will be as shown in Fig. 2, and in some instances the water may rise and reach a level such as indicated by dotted lines I in Fig. 2. At its juncture with the main tank the supply-pipe C is controlled by a downwardly-opening check-valve C′, which may open to permit the passage of the water into the tank when pressure is applied by the piston H, but will close to prevent the passage or escape of compressed air up the tube C. In practice compressed air is supplied to the tank A above the water therein by means of any suitable air-compressor, and in practice I store compressed air in this tank at a suitable pressure, ordinarily of about five hundred pounds to the square inch. Usually I adjust the pressure or tension of the compressed air in the tank A in the proportion of about one to two relatively to the pressure upon the piston H—that is to say, if the pressure exerted by the under side of the piston H is one thousand pounds per square inch the tension of the compressed air in the tank A will be about five hundred pounds to the square inch.

For my motor to give the best results it is desirable that the water from the supply-pipes should rush into the main tanks with considerable velocity. When the pistons make a downward stroke, the greater the velocity imparted by them to the water in the supply-pipes the greater will be its momentum, and consequently the greater will be the quantity of water that will enter the main tanks from the supply-pipes after the pistons have completed their working stroke and ceased to act upon the water in the said pipes. For the pistons to impart sufficient velocity to the water in the supply-pipes the pressure per square inch exerted by the pistons on the water in the said pipes must greatly exceed the pressure per square inch exerted by the compressed air in the main tanks against the incoming water. Therefore if the compressed air in the main tanks is under a tension of about five hundred pounds to the square inch the pressure per square inch exerted by the pistons on the water in the supply-pipes should be about one thousand pounds or more.

In starting the apparatus water may be supplied to the tank A and to the discharge and supply pipes to any suitable height, and compressed air may then be supplied to the upper portion of the tank A and will tend to adjust the water to about the conditions shown in Fig. 2. Then the compressed air will operate to force the water in the discharge-pipe B upwardly and discharge it from its nozzle B′, causing it to operate the wheel D and pass on through the connection F to the supply-pipe C. If now the piston H be timed to properly operate, it will be given a forcible downward movement and will impart by its sharp downward stroke a downward movement to the column of water in the pipe C, which will operate to give suitable momentum to the water below it, and consequently when the said piston reaches the end of its stroke the water below it will continue to move until its momentum is overcome by the pressure of the air within the tank A; when the valve C′ will be closed and the surplus water in the tank A will be forced upwardly out of the discharge-pipe B, and the operation will proceed as before, it being understood that the column of water in the supply-pipe C is elastic and slightly compressible and will operate by its compression, as well as by its momentum, to secure a discharge of the water from the supply-pipe C to the tank A. As the water under the piston H will continue to move after the piston has completed its stroke and until its momentum is overcome, a vacuum will be formed under said piston, into which the water from the connection F will flow, as will be readily understood from Fig. 2.

In the operation of an apparatus involving but a single air-tank and one supply-pipe C and one connection F it is only necessary to time the admission of power to the piston H′ to secure the operation before described, and this may be readily accomplished by the means presently described in connection with the compound expansion-engine; but when several air-tanks are employed, as well as a battery of supply-pipes leading thereto, it becomes necessary to time the operation of the several pistons for imparting movement to the column of water in the several supply-pipes in such manner as to secure the proper operation thereof, as desired. Thus in the operation of the compound expansion-engine pressure is admitted to the several cylinders successively and is exhausted therefrom simultaneously in the final exhaust.

Referring now to the construction shown in Figs. 1 and 5, it will be noticed that I employ several main tanks A, a, and a' and provide supply-pipes C, c, and c' in connection with the several main tanks, while I only provide one discharge-pipe and arrange that to discharge from the central main tank, connections J being provided between the main tanks at their lower ends, to permit the circulation of water, and connections J′ being provided at the upper ends of said tanks to permit the circulation of air at such points, so the water pressure or level and the air-pressure in the several tanks will be the same throughout the apparatus. It will be noticed from Fig. 1 that I provide cylinders in connection with each of the supply-pipes C, such cylinders K, K′, and K² being arranged in series, the cylinder K exhausting by pipe k to the cylinder K′ and the latter exhausting by pipe k' to the cylinder K², and the several cylinders being provided with discharge-pipes 1, 2, and 3 for the final exhaust, which may be effected simultaneously from the sev-

eral cylinders, as desired. If now proper valve mechanism be provided for admitting pressure to the primary cylinder K and the piston H′ in such cylinder be operated to its lowermost position, the steam therein will pass through the pipe *k* and operate expansively in the second cylinder K′ to force its piston downward, and when such piston has reached its lowermost position the steam will pass from the cylinder K′ into the cylinder K^2 and operate therein expansively to operate its cylinder in turn. It will be noticed the pistons in the cylinders K, K′, and K^2 gradually increase in size, as is usual in compound expansion-engines. The valve mechanism is shown in Fig. 6 and includes a rod L, suitably ported at *l* and movable longitudinally across the pipes 1, 2, and 3 when the rod L is moved to the right from the position shown in Fig. 6. In the position of parts shown in Fig. 6 the supply-port *l′* is shown in full register with the steam-pipe leading to the primary cylinder K. This rod L has four ports—one for the pipe leading from the boiler and one for each of the three pipes through which steam escapes from the cylinders. It will be understood, however, that if the construction shown in Fig. 6 were employed without any cut-off for shutting off the supply of steam through the supply-pipe to the primary cylinder the live steam would continue to flow into the primary cylinder and thence into the secondary cylinders after the piston in the primary cylinder had reached its lowermost position. I therefore provide means for cutting off the supply of steam to the primary cylinder when the piston thereof has reached its lowermost position, which cut-off mechanism may be as shown in Figs. 3 and 4, in which is presented a cut-off including a cylinder M, having its piston *m* connected with a cut-off valve M′, operating across a pipe N for supplying live steam to the primary cylinder K. Steam is admitted to the cylinder M by a valve O, operating in a pipe or valve-casing O′ and ported to admit steam to the cylinder M when the piston H′, carrying the valve O, has reached its lowermost position, as shown in Fig. 4. Thus the pressure of steam acting upon the piston *m* will operate to cut off the supply of live steam to the cylinder K, and when the supply of steam to the piston *m* is cut off by the upward movement of the valve O the piston *m* will be operated by a spring *m′* to reopen the cut-off valve M′ and leave the pipe N unobstructed, except for its sliding valve L, as before described. This sliding valve L is operated by a cam-disk P on a shaft P′, which is geared with the shaft D′ of the water-wheel D, so the operation of the water-wheel will effect a proper movement of the rod L in one direction, the movement of the rod in the opposite direction being effected by means of the spring Q, (shown in Fig. 1,) operating, preferably, within a casing, as shown. Manifestly the casing Q′, as shown in Fig. 1, may be an air-cylinder, and the piston Q^2 may be packed therein and operated by compressed air instead of by the spring Q, and this may be preferred in the practical operation of the apparatus.

In the operation of the described construction it will be seen the several pistons will operate upon their respective columns of water in quick succession. As a matter of fact, they might operate simultaneously, except for their operation by the expansion of the exhaust-steam from the preceding cylinders, and their operation is practically simultaneous, they forcing their columns of water downwardly into their respective main tanks and such water being forced upwardly through the discharge-pipe B, leading from the central main tank, as before described.

Where desired, the number of supply-pipes may be varied, it being understood that where they are multiplied to any great extent the size of the discharge-pipe may be increased accordingly, or, if desired, discharge-pipes may be provided in connection with each of the main tanks and operate upon individual water-wheels secured upon the same shaft, as will be understood from dotted lines in Fig. 1.

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

1. An apparatus substantially as described, comprising a main tank closed at the top and arranged and adapted to receive and retain within its upper portion compressed air supplied thereto, a discharge-pipe leading upward from said main tank, an outlet water duct or nozzle at or near the top of said discharge-pipe and leading therefrom to a water-wheel, a valve by which to control the passage of water through said outlet duct or nozzle, a water-wheel to which water is discharged from said discharge-pipe through said duct or nozzle, an upper tank receiving the water from said wheel, a pipe conducting the water from said upper tank to a supply-pipe, a supply-pipe receiving the water from said upper tank and discharging downward into said main tank, and a piston arranged to operate upon the water in said supply-pipe, substantially as set forth.

2. The combination substantially as described of the main tank closed at its top and arranged and adapted to receive and retain within its upper portion compressed air supplied thereto, a discharge-pipe leading upward from the main tank, a supply-pipe leading downward to the main tank and arranged to receive the water discharged by the discharge-pipe, a piston arranged to operate upon the column of water in the supply-pipe, power devices for operating said system, means operated upon by the water discharged from the discharge-pipe, and connections between said means and the devices supplying power to operate the piston whereby to control the operation of such piston substantially as set forth.

3. An apparatus substantially as described, comprising a main tank closed at the top and arranged and adapted to contain compressed air in its upper portion, a discharge-pipe leading upward from said main tank, an outlet water duct or nozzle at or near the upper end of said discharge-pipe and leading therefrom, a water-wheel to which water is discharged through said duct or nozzle, an upper tank elevated above said main tank, said upper tank receiving the water from said wheel, a supply-pipe receiving the water from said upper tank and discharging such water downward into said main tank, and a piston arranged to operate upon the water in said supply-pipe, substantially as set forth.

4. A motor apparatus substantially as described comprising a main tank, a series of supply-pipes discharging thereto and adapted to contain columns of liquid, pistons operating upon the columns of liquid in the said pipes, and a compound expansion-engine having the pistons of its primary and secondary cylinders connected with the first said pistons and discharge-pipes leading upward from the main tank and arranged to supply the water to the upper ends of the supply-pipes which discharge downward to said main tank, substantially as set forth.

5. In an apparatus substantially as described, the combination of the main tank, the upper tank, a discharger from the main tank to the upper tank, a series of supply-pipes leading to the main tank, the series of pistons for operating upon the columns of water in said supply-pipes, feeding connections between the upper tank and the supply-pipes, the compound expansion-engine having its several pistons arranged to operate the pistons of the supply-pipes, and a cut-off in connection with the primary cylinder whereby to shut off the supply of steam when the piston of said cylinder has reached the end of its stroke whereby to permit the steam to operate expansively in the secondary cylinders, substantially as set forth.

6. A motor apparatus substantially as described, comprising a plurality of main tanks, a single upper tank, a discharge-pipe leading upward from the main tank, and discharging into the upper tank, a number of supply-pipes leading from the upper tank downward to the main tank, a number of pistons operating upon the fluid in the supply-pipes, whereby to forcibly discharge such fluid to the main tank, and a compound expansion-engine for operating the said pistons, substantially as set forth.

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