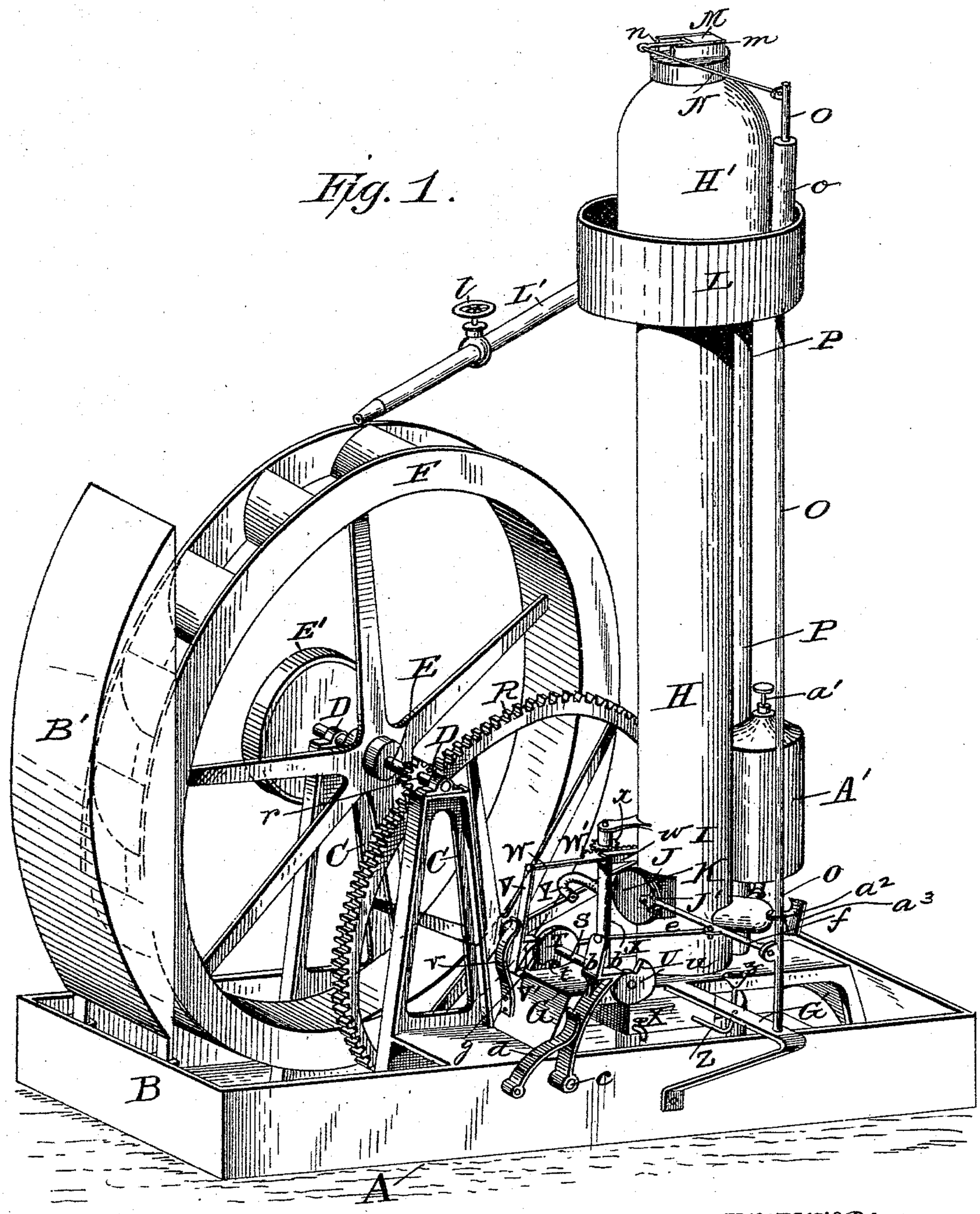
(No Model.) 5 Sheets—Sheet 1.

J. J. GULDHAUG.

MOTOR.

No. 515,674. Patented Feb. 27, 1894.

Fig. 1.



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his Attorneys.

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(No Model.) 5 Sheets—Sheet 2.

J. J. GULDHAUG.

MOTOR.

No. 515,674. Patented Feb. 27, 1894.

Fig. 2.

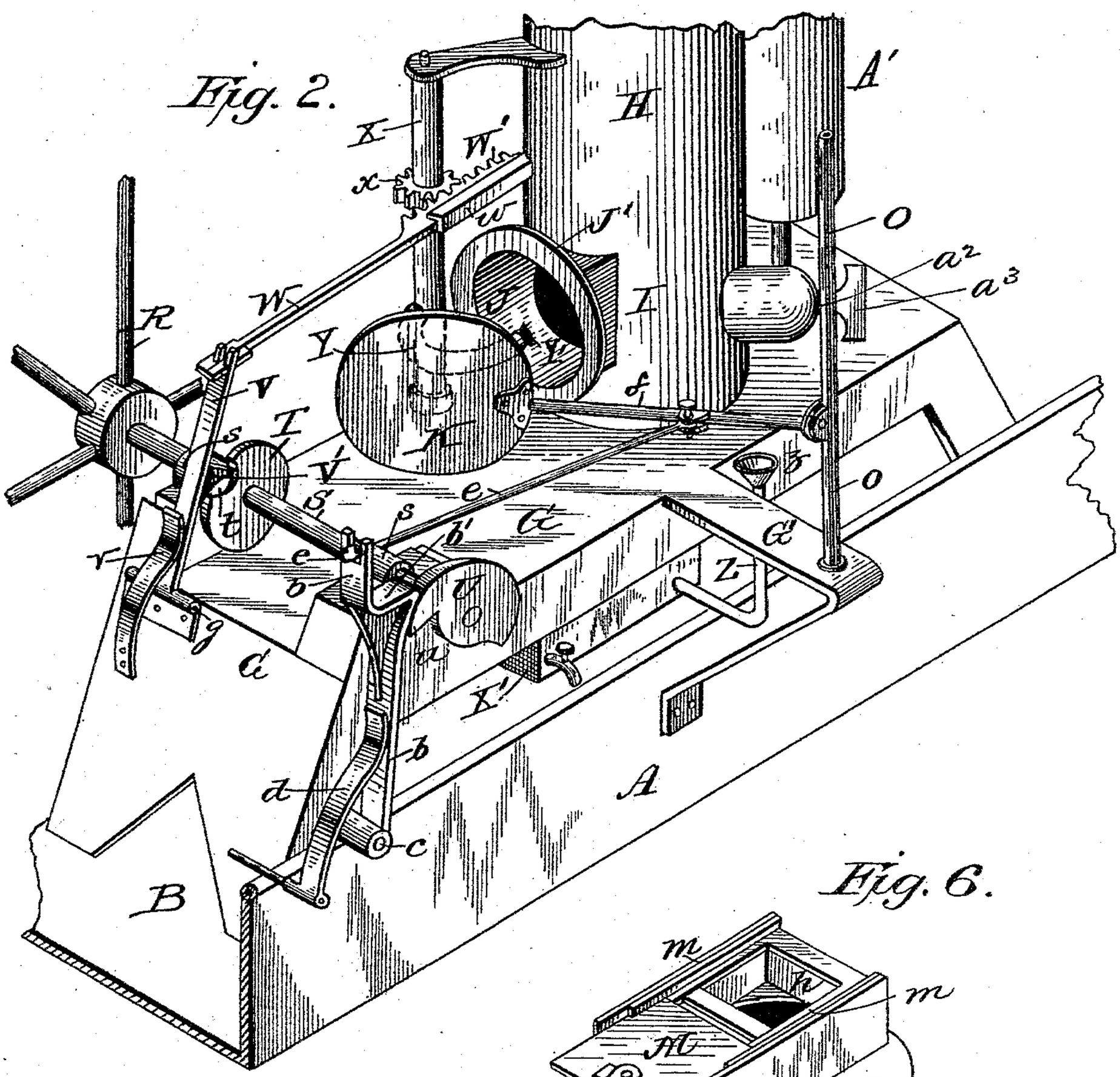


Fig. 6.

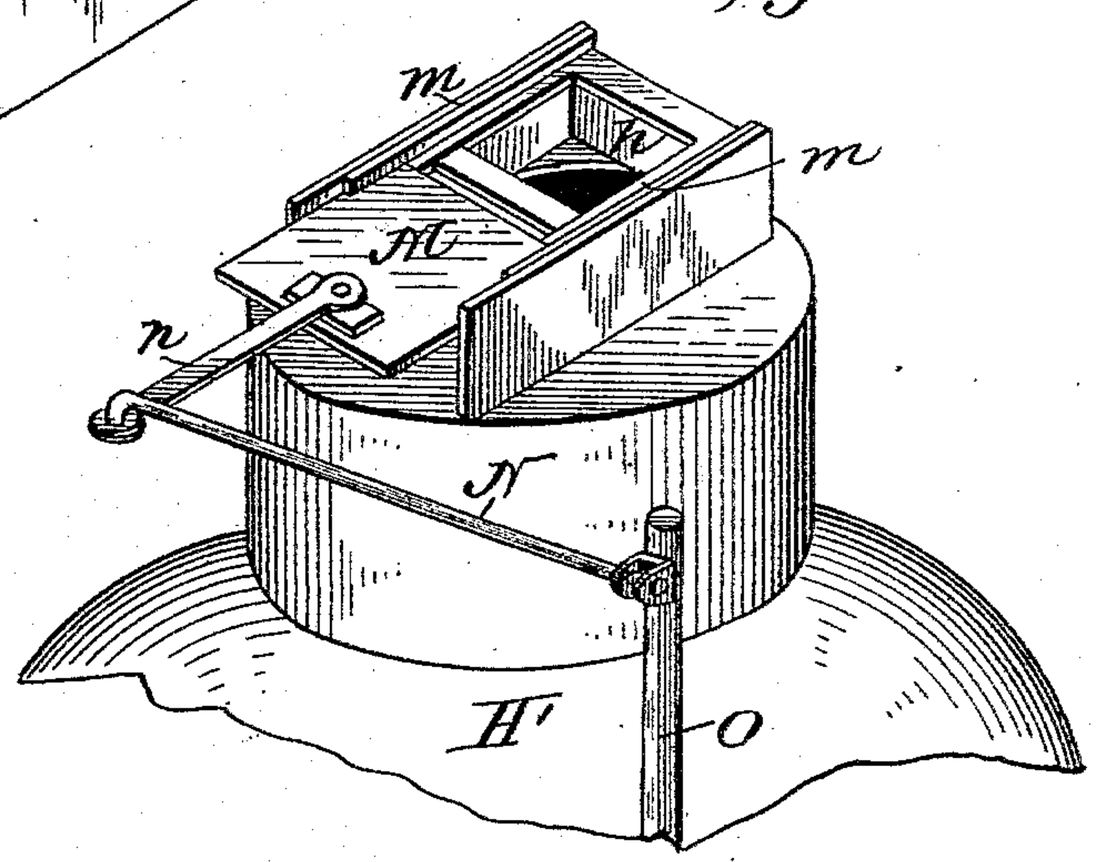
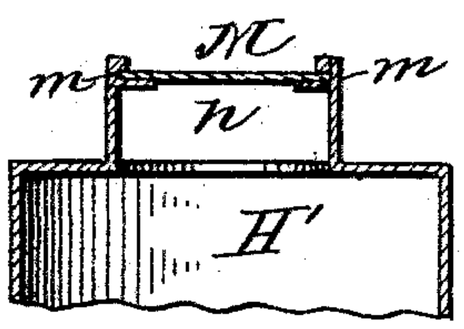


Fig. 7.



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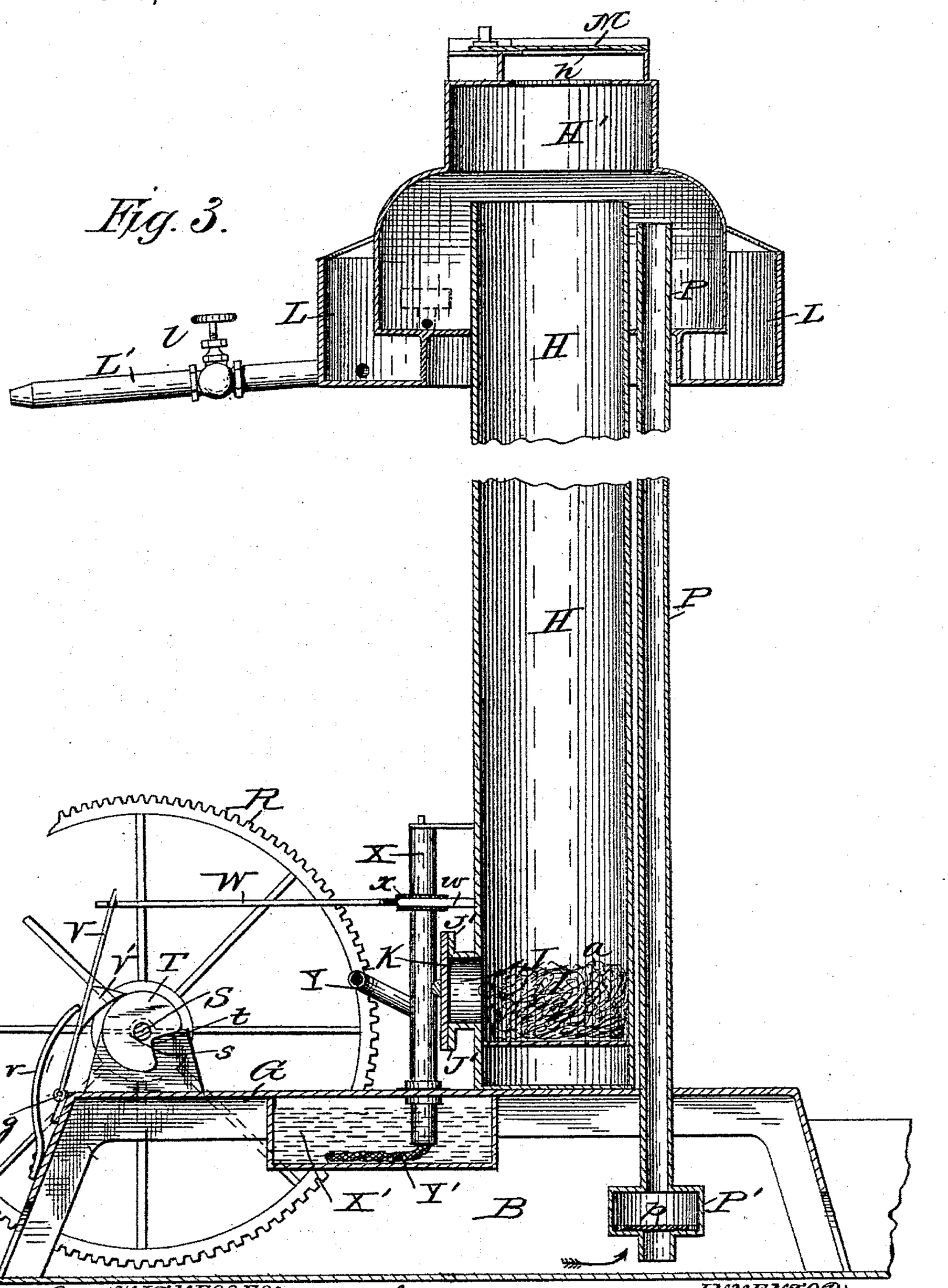
(No Model.) 5 Sheets—Sheet 3.

J. J. GULDHAUG.

MOTOR.

No. 515,674. Patented Feb. 27, 1894.

Fig. 3.



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(No Model.) 5 Sheets—Sheet 4.

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MOTOR.

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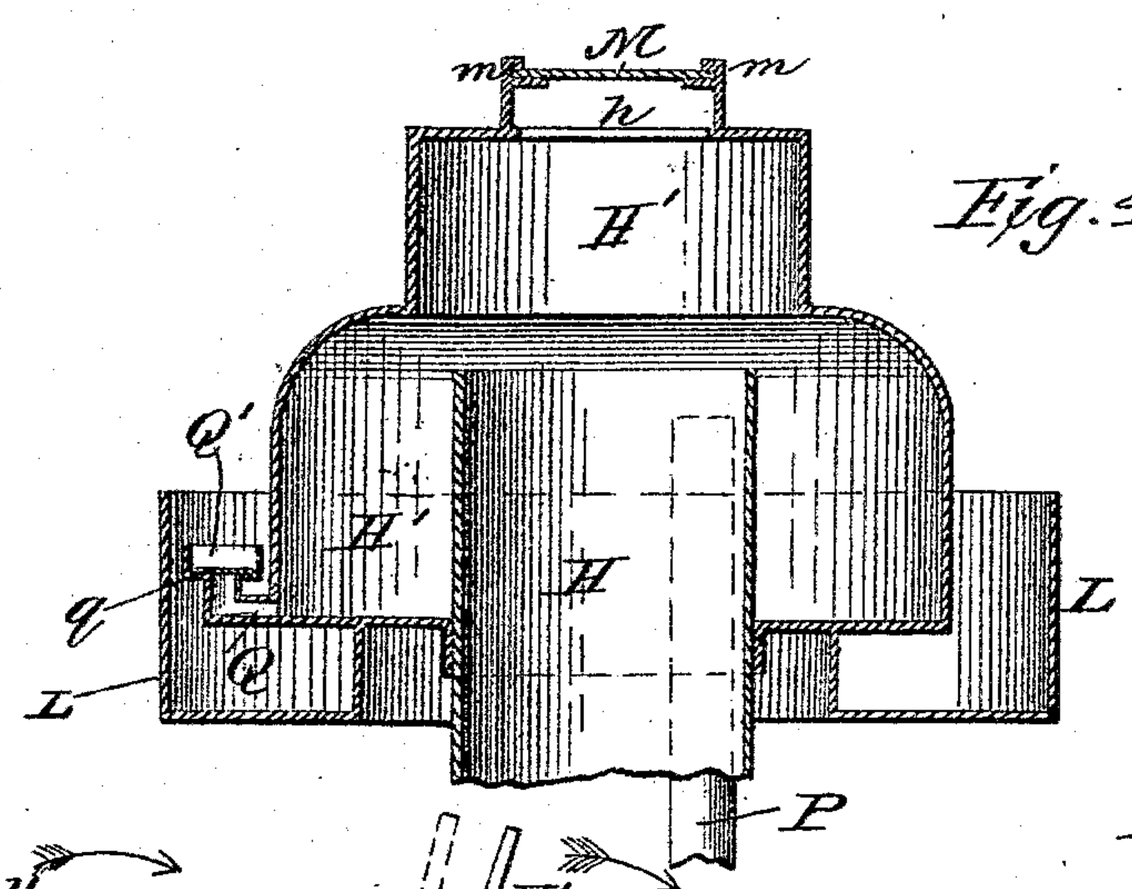


Fig. 4.

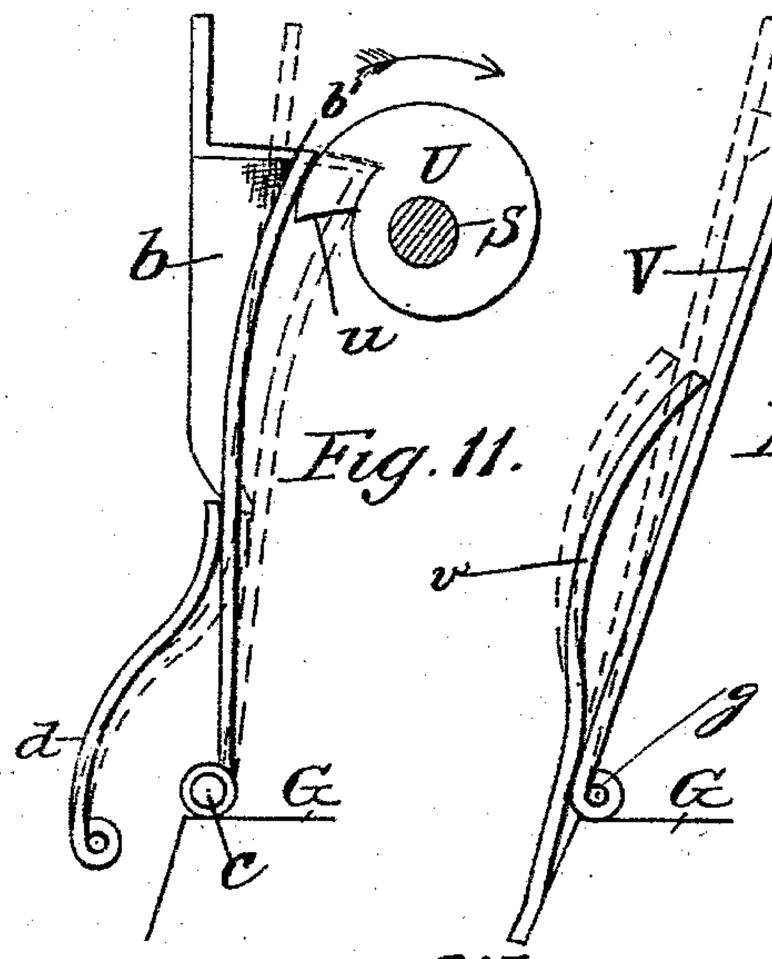


Fig. 11.

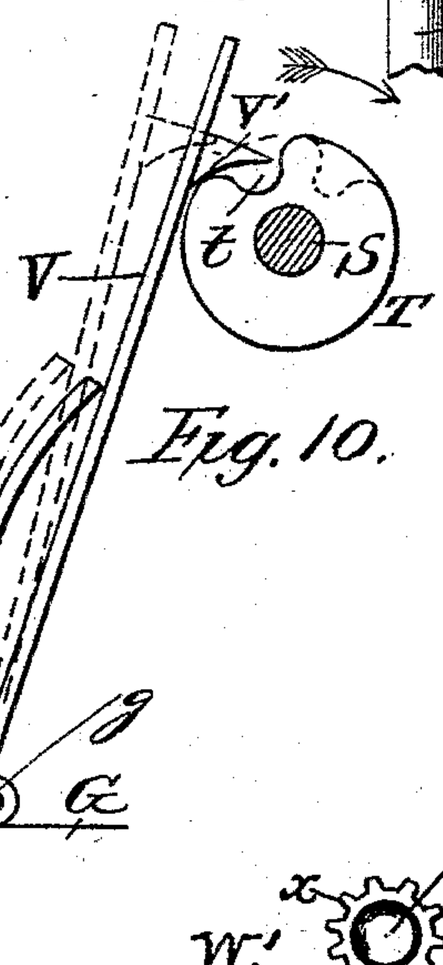
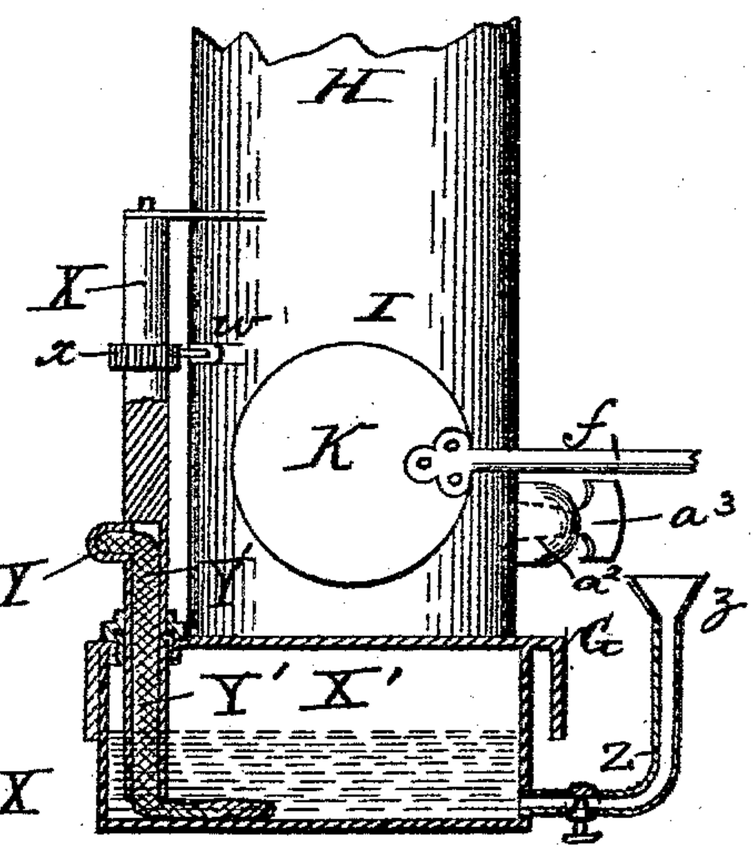


Fig. 10.

Fig. 9.



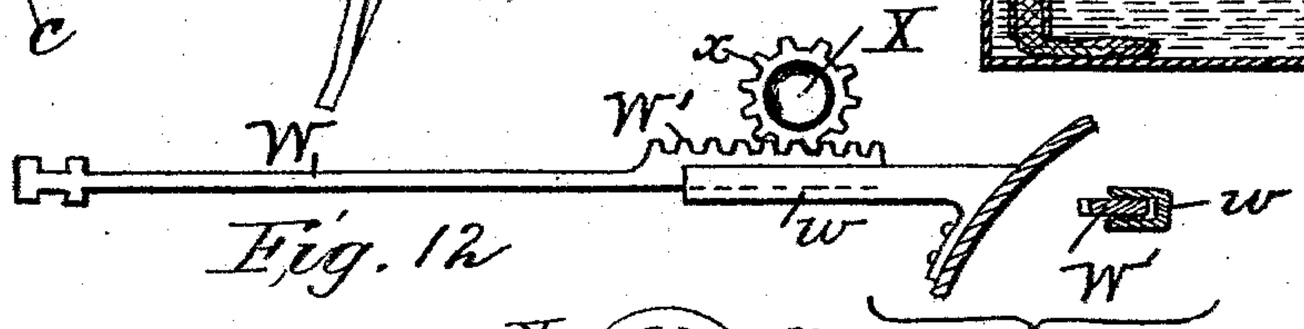


Fig. 12.

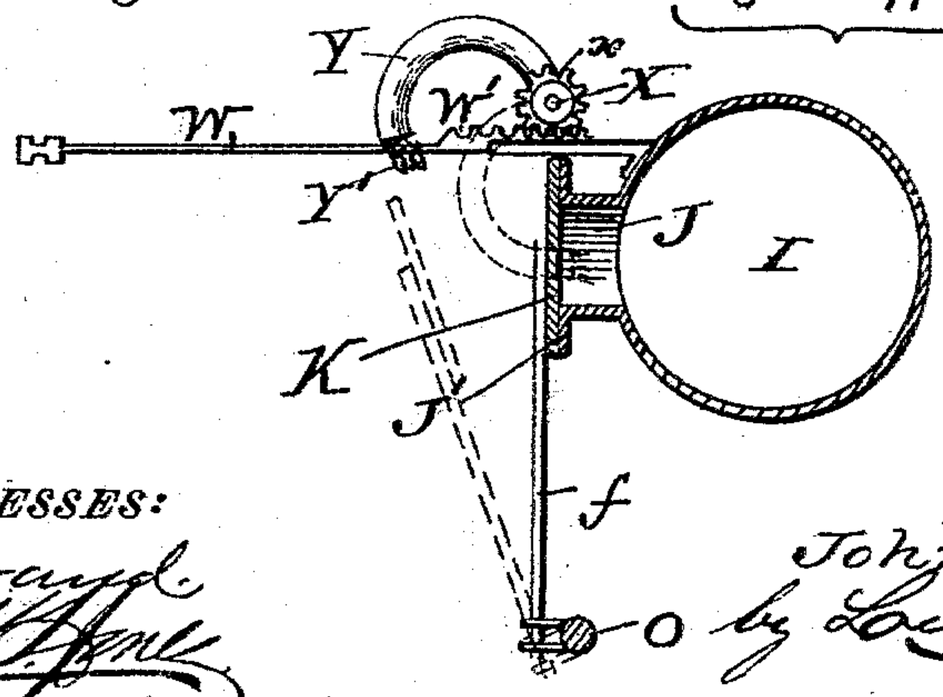


Fig. 13.

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J. J. GULDHAUG.

MOTOR.

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Fig. 8.

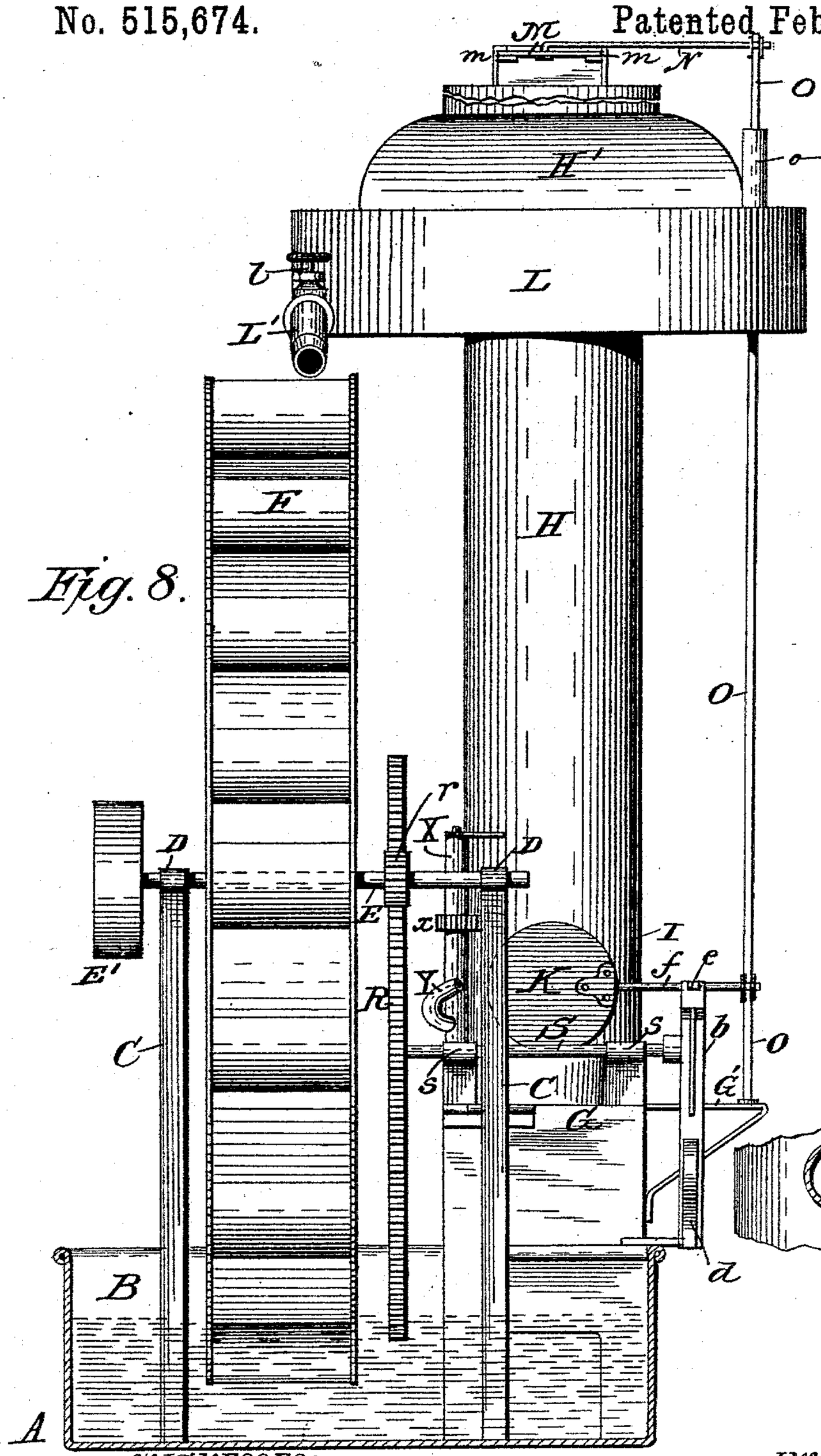
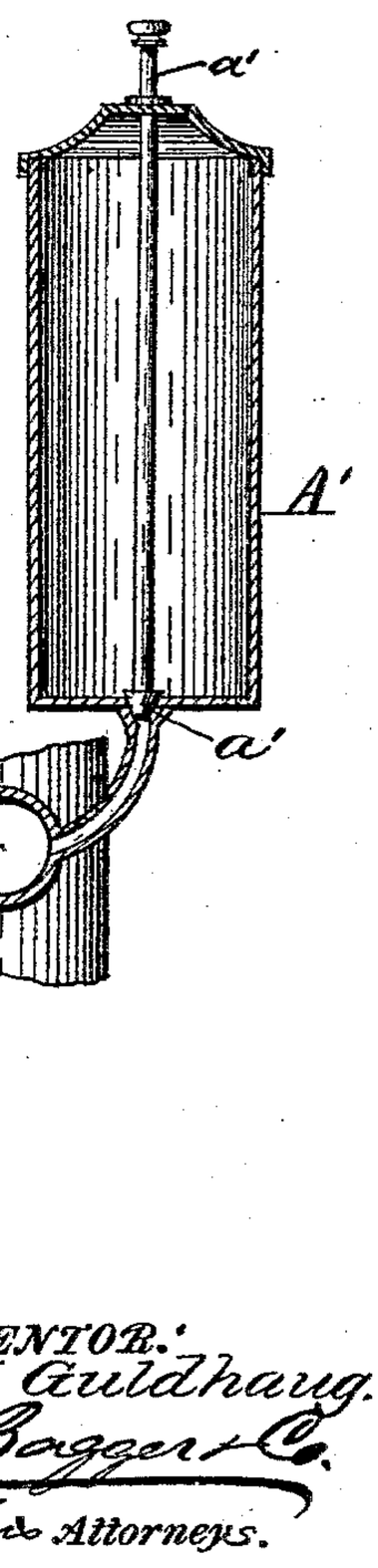


Fig. 5



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UNITED STATES PATENT OFFICE.

JOHN JOHNSON GULDHAUG, OF STOUGHTON, WISCONSIN, ASSIGNOR OF ONE-HALF TO LEVI KITTILSEN, OF SAME PLACE.

MOTOR.

SPECIFICATION forming part of Letters Patent No. 515,674, dated February 27, 1894.

Application filed May 20, 1893. Serial No. 474,864. (No model.)

To all whom it may concern:

Be it known that I, JOHN JOHNSON GULDHAUG, a citizen of the United States, and a resident of Stoughton, in the county of Dane and State of Wisconsin, have invented certain new and useful Improvements in Motors; and I do hereby declare that the following is a full, clear, and exact description of the invention, which will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, which form a part of this specification, and in which—

Figure 1 is a perspective view of my motor, complete. Fig. 2 is a perspective detail view, on an enlarged scale, of the lower part of the air reservoir, with its furnace, igniting apparatus, and the mechanism for operating the same. Fig. 3 is a sectional view, on a vertical plane, through the middle of the air or vacuum cylinder with its enlarged air chamber, water tank or reservoir, vertical water pipe, and the furnace appertaining to the air cylinder. Fig. 4 is a sectional detail view, on a vertical plane, of the upper automatic valve appertaining to the water feed-pipe and water tank. Fig. 5 is a vertical sectional view through the middle of the oil-tank which supplies the furnace. Fig. 6 is a detail view, in perspective, of the sliding air-valve at the top of the air or vacuum cylinder. Fig. 7 is a transverse sectional view of the same. Fig. 8 is an end elevation of the motor. Fig. 9 is a vertical sectional view through the igniting apparatus and its tank. Figs. 10 and 11 are detail views of the cams T and U (to be hereinafter described), and the spring-actuated tappets which engage with, and are operated by, said cams. Fig. 12 is a detail view of the toothed rack and pinion for operating, intermittently, the igniting device; and Fig. 13 is a sectional detail view, on a horizontal plane, through the furnace with its air-tight door or valve; the dotted lines indicating the position of the door when open to admit the burner of the intermittently-operating igniting-device.

Like letters of reference denote corresponding parts in all the figures.

This invention relates to hydro-pneumatic motors for operating machinery of any kind, and consists in a novel combination of a water wheel, an upper water tank or feeding reservoir, a lower discharge tank or receiving reservoir, and a vacuum apparatus adapted, by atmospheric pressure, to lift a column of water from the lower to the upper reservoir, whereby I construct a prime mover, which may be used for turning a shaft, and thereby impart motion to machinery, in the same manner as a steam-engine or any other form of prime mover, but at a greatly reduced cost as compared with the expense of running a steam-engine, electric motor, or any other form of artificial power now in use, which, directly or indirectly, depends upon the consumption of coal or other fuel to furnish the motive power.

Referring to the drawings, the letter A denotes the base of the machine, which forms a shallow tank, B, and supports two pillars, C C, the upper ends of which are provided with journal boxes, D D, in which the main shaft, E, of the over-shot water wheel F is journaled. At one end of the tank is a raised platform, G, upon which is erected a tall hollow cylinder H, the lower part of which, resting on the platform, forms a furnace or fire-chamber, I, having an opening or inlet J, closed by a hinged door K. The opening J is encircled by an annular rim or flange J′, the face of which is ground perfectly smooth and even so as to form an air-tight joint or closure with the hinged door K. Or, if preferred, the annular rim J′ may be provided with an elastic packing or gasket of asbestus or other elastic material that will resist the action of heat, so that the inlet J will be closed practically air-tight when the door is shut. The upper end of the vertical cylinder H supports an air chamber H′, the outside of which is encircled by a water tank L, placed a short distance below it.

In the top of the air cylinder H is an opening *h*, which may be closed practically air-tight by a valve M, sliding in the parallel ways *m m*, and articulated by a short connecting-rod *n* to an arm N, the other end of which is fastened at right angles in an upright shaft O, inserted through a vertical tubular bearing *o* on one side of the air chamber H′ and passing through the bottom of the water tank L.

On one side of the air or vacuum cylinder H, on the outside, is placed a vertical water pipe P, the lower end of which dips down into the lower tank or reservoir B to within a short distance of its bottom, where it is provided with a valve-chamber P′ containing an automatic valve *p*, adapted to be lifted from its seat by pressure on the under side, so as to open the inlet to pipe P from tank B. The upper end of pipe P passes through the bottom of and opens into the enlarged air chamber H′, between it and the annular water tank L. In the bottom of the enlarged annular air-chamber H′ is a pipe, Q, which extends into the water tank L, where it is bent upwardly at right angles to form an elbow, the enlarged upper end Q′ of which forms a seat for the gravity-valve *q*.

At one end of the water tank L is a pipe L′, having a cock, *l*, for controlling the outflow of water from the tank onto the buckets of the overshot water wheel F; the water being discharged from the buckets of the wheel, as this revolves, into the bottom tank or receiving tank B. Upon the main shaft E, which revolves with the water wheel, and constitutes the main drive-shaft of the motor, is a pinion *r*, which meshes with a cog wheel R, the shaft S of which is journaled in boxes, *s s*, supported by short posts or bearings on the platform G. Upon the revolving shaft S are keyed, or otherwise fastened, two cams, T and U, one of which (T) operates the intermittent igniting device, while the other (U) works the intermittently operating door K and top-valve M, as follows: At one end of the platform G is hinged, at *g*, a vertical arm V, which is forced by a spring, *v*, against the cam T, so that its tappet or projection V′ will bear at all times against the periphery of the cam. To the upper end of this hinged arm V, above its tappet, is articulated a rod W, the farther or free end of which forms a toothed rack, W′, the smooth side of which plays horizontally in a stationary guide *w*, while its toothed side engages a pinion *x* on the tubular stem X of the igniter. This device consists of a vertical tube, the upper end of which is pivoted in an arm or bearing which projects laterally from the vertical air cylinder H, while its lower end (see Fig. 9) extends loosely down into the oil reservoir X′, below platform G, through an opening in the top of said reservoir, so that a reciprocatory rotary motion may be imparted to the vertical tube X. On one side of this tube is a projecting tubular finger, Y, through which the wick Y′ projects; the lower end of the wick dipping into the oil reservoir X′. The wick-tube Y is so bent and arranged that, when the door K of the air or vacuum cylinder H is opened, it will, by the part-revolution of tube X, be projected with its free end through the opening J into the furnace-chamber I in the lower end of the cylinder, as shown in dotted lines in Fig. 13. In other words, this tubular finger Y, with its wick Y′ (which is kept constantly ignited) forms the burner of the igniting device, which is supplied with oil from the small tank or reservoir X′. The latter has a tube Z, terminating in a small funnel *z*, through which it can be replenished with oil when desired. As the jet of flame need not be larger than the jet of an ordinary cigar lighter, even in a full-size working machine of the largest capacity, a very small quantity of oil is consumed by the constantly burning igniting device. If desired, gas may be used for this purpose instead of oil or other liquid fuel. As cam T revolves, its periphery will bear against the spring-actuated tappet V′ until the cam-recess *t* is reached, when spring *v* will force arm V in the direction of the arrow shown in the detail views, Figs. 10 and 11, thus turning the vertical igniter stem X in its bearings so that the end of the burner Y will be suddenly projected through the now open door into the fire-chamber or furnace I, which results in the ignition of a batch of tow or cotton-waste, *a*, saturated with naphtha, kerosene, or some other highly inflammable burning fluid. The burner is then immediately withdrawn again by the rounded part of the cam T striking the tappet V′, so as to pull upon rod W and its rack W′, which partly rotates the vertical igniter-tube back into its normal position so as to quickly withdraw finger Y from the furnace. In other words: it will be seen that the cam T, in conjunction with the spring-actuated arm V, rack W′ and pinion *x*, operates to intermittently project the ignited burner Y through the open door into the furnace or fire-chamber in the bottom of the vacuum cylinder H, where it is kept for an instant only (just sufficient to touch and ignite the inflammable material with which it comes in contact), after which it is again immediately withdrawn, at the same instant as the air-tight door K is closed. The intermittent opening and closing of door K is effected by the other cam U, which also intermittently, and simultaneously therewith, opens and closes the air-tight top valve M, in the following manner: Against the periphery of cam U bears an arm, *b*, hinged at its lower end upon a stud, *c*, projecting laterally from the platform G, and pressed against by a spring *d*; *i. e.*, this spring *d* forces the free end of arm *b* against the periphery of the cam, so that its tappet *b′* will always be in contact with the cam. To the upper end of arm *b* is articulated a rod *e*, the other end of which is hinged to an arm *f*, fastened to and extending laterally from the vertical shaft O; said shaft being stepped at its lower end, movably, in a bracket or bearing, G′, which projects laterally from the platform G, while its upper end, after passing through the tubular guide or bearing, *o*, has fastened to it, at right angles, the arm N which operates the slide-valve M at the top of cylinder H. It will thus be seen that when rod *e* is pulled upon, by the lip *u* of cam U striking (as the cam revolves) the tappet

b' on arm b, the upright shaft O will be so turned in its bearings as to open, simultaneously, the door K at the lower end of cylinder H, and the valve M at the upper end thereof; and this will take place once during each revolution of cam U, viz: when its lip u reaches and strikes the tappet. But the moment the lip on the cam has passed the tappet, arm b, impelled by the spring d, will fly back into its normal position and thereby, through the intervention of the connecting-rod e, tilt or partly rotate rod O so as to again and simultaneously close both the door K and the top air-valve M. And the position of the two cams T and U upon shaft S, relative to each other, is such that the movements of door K and valve M are so timed that both will open at the precise moment when the ignited burner Y of the igniting device is projected into the fire-chamber I. In other words: at the precise moment—but at no other time—when door K and valve M are thrown wide open by the operation of cam U and its adjuncts, cam T will—through the intervention of arm V, tappet V', rod W, rack W', and pinion x—project the burner Y into the furnace through the open door. The next instant, the burner is withdrawn by the return-stroke of rack W', and, simultaneously with the withdrawal, the door K and valve M are closed air-tight, and kept so closed until, on the next revolution of the operating-cams T and U, this performance of opening the door momentarily for the ignition of the inflammable material a, shall be repeated. At some convenient point (in the present instance, adjacent to and near the lower end of the air cylinder), is located a supply tank or reservoir, A', for supplying naphtha, oil, or other liquid fuel to the fire-chamber or furnace I; the flow of oil being regulated by a valve a'. In order to prevent splashing of water from the bucket wheel during the revolutions of the same, when the motor is used in-doors, I provide it with a shield, B', which will deflect the water as it escapes from the buckets down into the shallow receiving tank B.

Having now described the construction of my motor, I shall proceed to describe its operation, which is as follows: A suitable quantity of cotton waste, tow, or other inexpensive inflammable and absorbent material, is thoroughly saturated with naphtha or kerosene and placed in the bottom of the fire-chamber I in the lower part of the air or vacuum cylinder H, as shown at a. The supply tank A' is filled with oil, or whatever other kind of liquid fuel it is desired to use, and the tank B is filled with water, level, or nearly so, with the under side of the bucket wheel, so that the valve-chamber P' at the lower end of the vertical water pipe P will be submerged below the level of the water. Through an opening a^2 in one side of the fire-chamber (which said opening is normally kept closed air-tight by a closely-fitting plug or stopper a^3) I insert a lighted torch or taper, thus igniting the inflammable material a, after which the aperture a^2 is closed immediately by reinserting the stopping-plug a^3. The flash of flame produced by the ignition of the material a partly consumes and partly expels, through the open top of the cylinder, the atmospheric air within the cylinder and its connecting annular air chamber H', thus creating a partial vacuum in these parts and also in pipe P, which, as we have seen, opens up into the annular air chamber H' at the upper end of cylinder H. This vacuum causes the water in tank B, by atmospheric pressure, to open valve p in the submerged valve-chamber P' and rise through pipe P up into the air-chamber H', from which it escapes through the elbow pipe Q Q' and its valve q out into the upper annular water tank L. Meanwhile, and while this takes place, the water wheel F has been started by pouring a, for that purpose sufficient, quantity of water into the upper tank L, which runs out through pipe L' (the cock or valve l of which has been opened); so that before all the water in tank L has run out, a fresh supply of water has been fed up into the upper tank from the bottom tank through pipe P, chamber H' and the elbow Q Q'. The motor having now been fairly started, it will, by the hereinbefore described combination of cog-wheels, cams, tappets, and other co-operating parts, automatically and intermittently open the door K and valve M, to permit of the ignition, by the intermittently-operating igniting-device, of the inflammable material a placed in the fire-chamber I, which is again immediately extinguished by the automatic and intermittent simultaneous closing of the door K and the upper air-valve M. In this manner, a succession of flashes will be produced in the fire-chamber I and air cylinder H, resulting in an intermittent vacuum in cylinder H and its connecting air chamber H', at each of which periods a volume of water will be drawn up (due to the pressure of the atmosphere on the water in tank B) through the vertical pipe P and fed into the water tank L, from which it escapes through pipe L' over the wheel F back into the bottom tank B. The same volume of water maintains this circuit as long as the motor remains in operation, which will be as long as the fire-chamber is kept supplied with liquid fuel. It is not intended that the cotton waste or other absorbent material, a, shall burn; but this is merely intended as a wick or absorbent for the naphtha, oil, or other liquid fuel, which is supplied to the fire-chamber as occasion requires from the supply tank or reservoir A'. As the ignition lasts a moment only, merely long enough to create a flash of flame up through the vertical cylinder, after which the flame is immediately extinguished by the automatic and simultaneous closing of the air-tight door K and valve M, only a very small quantity of fuel will be consumed at each ignition and flash, so that a single barrel of oil will last a long

time, even with the largest size motors. The wick Y′ of the igniting device is, on the other hand, kept constantly ignited and not suffered to go out; but as this is a very small jet of flame (not larger, as I have already stated, than the flame of an ordinary cigar lighter) the consumption of oil by the igniter is merely nominal.

Upon the main shaft E may be secured a pulley (or cog-wheel) E′ for operating the machinery which is to be driven by the motor; said shaft E constituting the main drive-shaft of the motor in its capacity of a prime mover.

It will be obvious that I am not limited to the use of an overshot water wheel, but that other forms of water motors are equally well adapted to my purpose; for example, a turbine may be substituted for the overshot wheel, if desired. Nor do I confine myself to the precise construction and arrangement of details as herein specified, as, for example, the form of the igniting device, and the mechanism for operating it, may be varied in different ways without departing from the spirit of my invention. It will also be obvious that any suitable liquid (for example, a mixture of water and glycerine, or water and alcohol, to prevent freezing in cold climates) may be used for running the bucket-wheel, instead of water.

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

1. In a hydro-pneumatic motor, the combination with the upper or feed tank and the lower or receiving tank of an intermediate vacuum water-elevator or apparatus provided with a fire-chamber or furnace, with valves for alternately admitting and permitting the escape of air, an igniting device operating intermittently and synchronously with said valves, and a water motor; substantially as and for the purpose shown and set forth.

2. In a hydro-pneumatic motor, the combination with the upper or feed tank and lower or receiving tank of an intermediate vertical air-tight cylinder having a furnace at its lower end, an enlarged air-chamber at its upper end, a pipe connecting the lower or receiving tank with said air-chamber, an intermittently operating valve permitting the escape of air at the upper end of the air-chamber, an intermittently operating valve for supplying air to the furnace, and a water-motor located between the upper and lower tanks; substantially as and for the purpose shown and set forth.

3. In a hydro-pneumatic motor, the combination with the upper or feed tank and the lower or receiving tank of an intermediate vertical air-tight cylinder having an interior furnace for establishing a vacuum therein, an intermittently operating valve for supplying air to the furnace, an intermittently operating exhaust air-valve, an intermittently operating igniting device whereby the fuel in the furnace is alternately ignited and again extinguished, a water pipe connecting the lower with the upper tank, and a water motor located between the two tanks; substantially as and for the purpose shown and set forth.

4. The combination, in a hydro-pneumatic motor, with the lower or receiving tank of a vertical vacuum-cylinder provided at its upper end with an enlarged air-chamber, an annular water tank encircling said air-chamber, a vertical water-pipe connecting the air-chamber with the lower receiving tank, a gravity-valve located within the immersed end of said pipe, a pipe connecting the air-chamber with the encircling annular water tank, a gravity-valve seated in said pipe and a water wheel or motor placed between the upper and lower tanks; substantially as and for the purpose shown and set forth.

5. The combination, in a hydro-pneumatic motor, of a water motor, an upper supply or feeding tank, a lower discharge or receiving tank, a vacuum-pump or apparatus adapted to lift by atmospheric pressure water from the lower to the upper tank, and provided with valves for alternately admitting and exhausting the atmospheric air, a furnace located within said apparatus, and an intermittently-operating igniting-device; substantially as and for the purpose shown and set forth.

6. The combination, in a motor or prime mover, of a water motor, an upper supply or feeding tank, a lower discharge or receiving tank, a vacuum-pump connecting said two tanks and provided with a fire-chamber or furnace for creating a vacuum, valves for simultaneously opening and closing the top and bottom of the vacuum apparatus, and an igniting device operating intermittently and alternately with the opening and closing of the valves; substantially as and for the purpose shown and set forth.

7. A vacuum-pump or water-lifting apparatus, comprising the air cylinder H having at its upper end the enlarged air chamber H′ and at its lower end the fire-chamber or furnace I, in combination with the simultaneously operating doors or valves K and M, intermittently-operating igniting-device X Y, located opposite to the furnace-door, annular water-tank L surrounding the enlarged air-chamber at the upper end of the cylinder, water-pipe P connecting said air-chamber with the lower or receiving-tank, and pipe Q Q′ connecting the air-chamber with the exterior annular water-tank and provided with the self-acting valve *q*; substantially as and for the purpose shown and set forth.

8. The combination of the vertical vacuum-cylinder H having the enlarged air-chamber H′ provided with the opening *h* and slide-valve M, furnace or fire-chamber I having opening J provided with the hinged door K, the described mechanism for actuating simultaneously the valve M and door K, water pipe P connecting the lower tank with air-chamber H′, gravity-valve *p* located in said pipe, an-

nular upper tank L, provided with the discharge pipe L′, water pipe Q Q′ connecting said tank with the air-chamber, gravity-valve *q* located within said pipe, water-wheel F, lower or receiving tank B, and the intermittently operating igniting device X Y; all constructed, arranged and combined to operate substantially in the manner and for the purpose herein shown and described.

9. The combination of the water wheel F having shaft E provided with the pinion *r;* cog-wheel R having shaft S carrying the cam T; spring-actuated arm V having tappet V′ engaging said cam; connecting-rod W having the horizontally sliding toothed rack W′; rotary igniter X provided with the laterally projecting wick-tube or burner Y, and having a circumferential pinion *x* engaging rack W′; and vacuum-cylinder H provided with the furnace or fire-chamber I having an opening J and door K in alignment with the wick-tube of the rotary igniter; substantially as and for the purpose herein shown and described.

10. The combination of the water wheel F having shaft E provided with the pinion *r;* cog-wheel R having shaft S carrying the cam U; spring-actuated arm *b* having tappet *b′* engaging said cam; connecting-rod *e;* upright shaft O having arms *f* and N; hinged door K; connecting-rod *n;* sliding valve M; and air or vacuum-cylinder H having apertures J and *h;* and provided with the interior furnace or fire-chamber I; substantially as and for the purpose herein shown and described.

In testimony that I claim the foregoing as my own I have hereunto affixed my signature in presence of two witnesses.

JOHN JOHNSON GULDHAUG.

Witnesses:
BEN. E. WAIT,
W. G. PARGETRE.