(No Model.) 3 Sheets—Sheet 1.

T. POWERS.

HYDRAULIC MOTOR.

No. 345,446. Patented July 13, 1886.

Fig. 1.

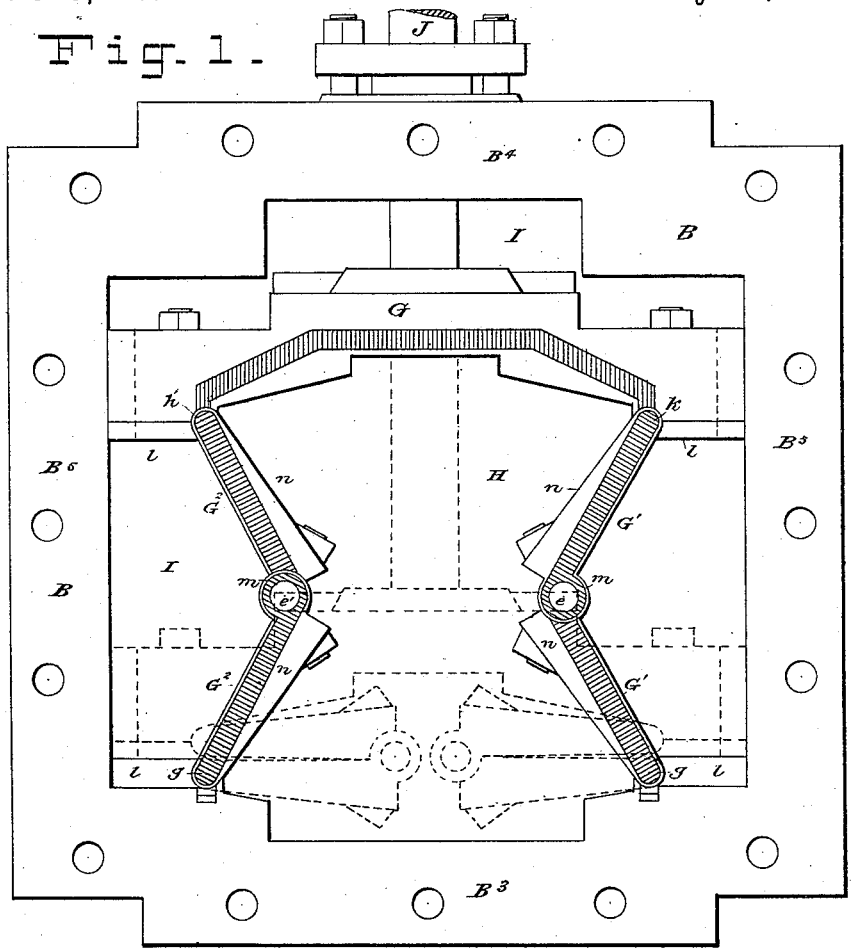
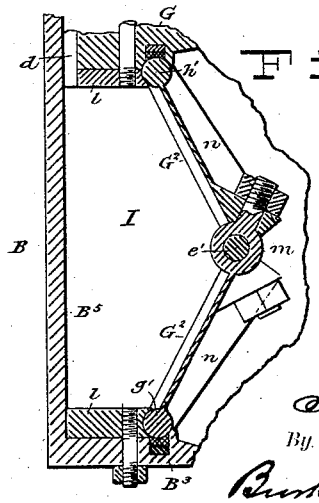


Fig. 6.



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(No Model.) 3 Sheets—Sheet 2.

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Fig. 2.

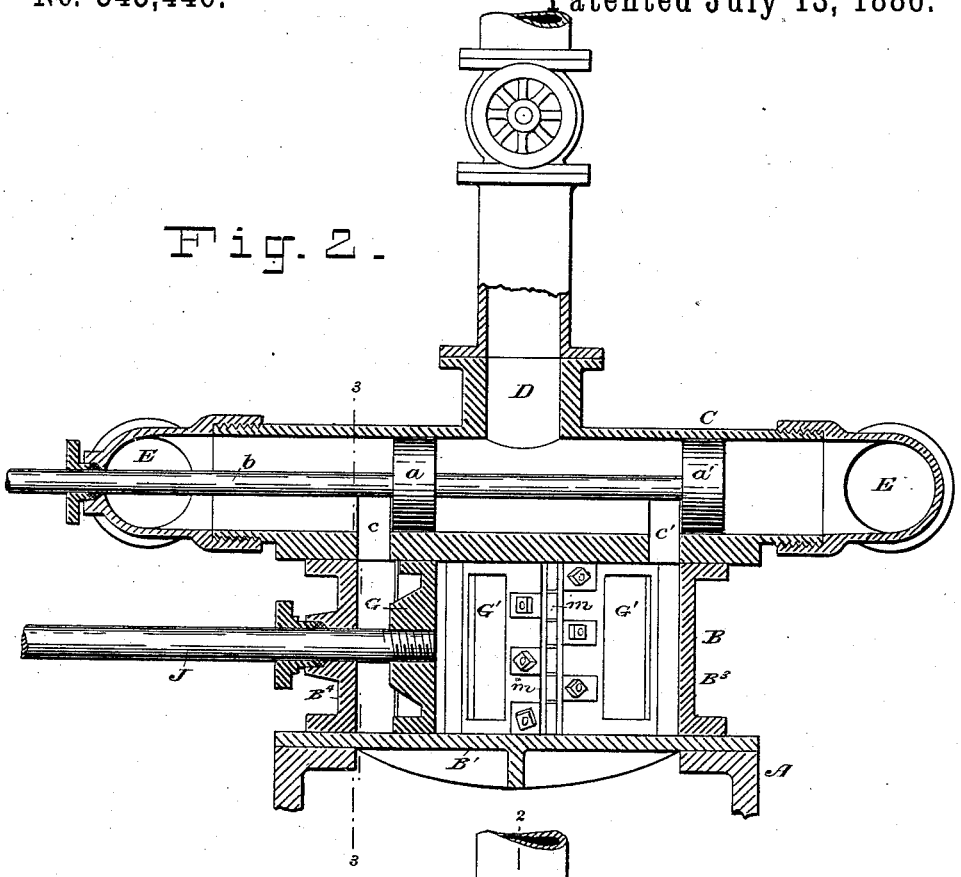
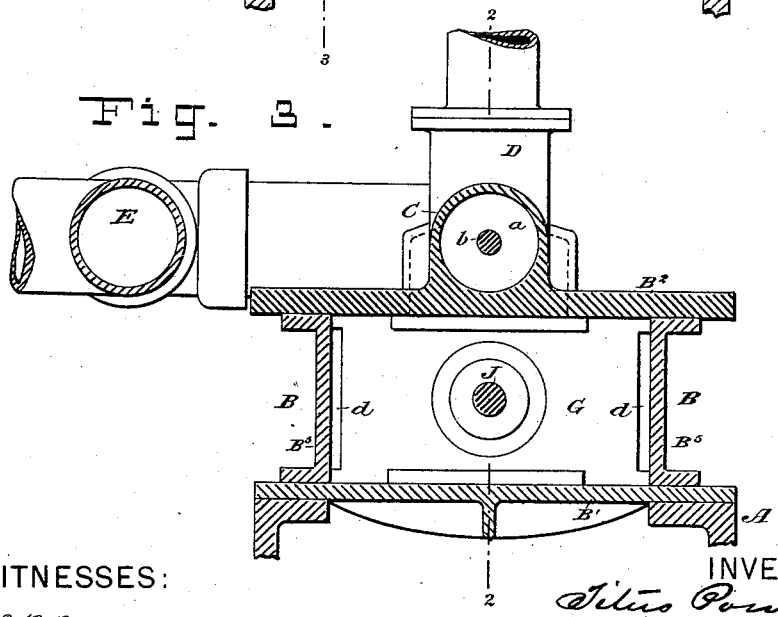


Fig. 3.



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(No Model.) 3 Sheets—Sheet 3.

T. POWERS.

HYDRAULIC MOTOR.

No. 345,446. Patented July 13, 1886.

Fig. 4.

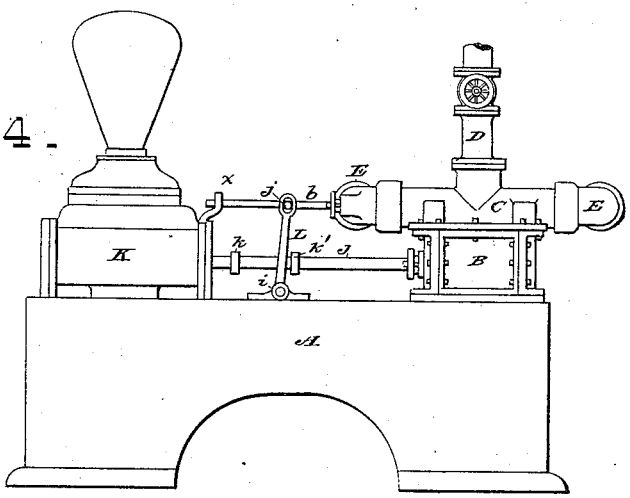
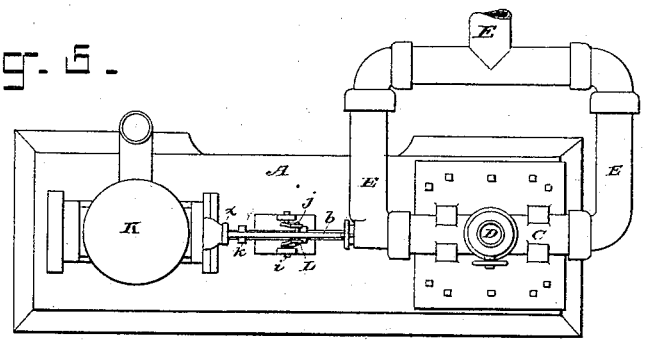


Fig. 5.



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UNITED STATES PATENT OFFICE.

TITUS POWERS, OF NEW YORK, N. Y., ASSIGNOR OF FOUR-FIFTHS TO DELAVAN C. SCOVILLE AND HENRY TIMM, OF SAME PLACE.

HYDRAULIC MOTOR.

SPECIFICATION forming part of Letters Patent No. 345,446, dated July 13, 1886.

Application filed August 27, 1885. Serial No. 175,457. (No model.)

To all whom it may concern:

Be it known that I, TITUS POWERS, a citizen of the United States, and a resident of the city, county, and State of New York, have invented certain Improvements in Motors, of which the following is a specification.

My invention relates to that class of engines or motors wherein a rectilinear motion is imparted by a fluid under tension or head. This rectilinear motion may be communicated direct, or be converted into rotary motion by means of any of the well-known devices for this purpose.

The characteristic feature of my motor is, that it employs an expanding chamber upon the walls of which the fluid acts both internally and externally—internally to expand and externally to contract the chamber—thus rendering the motor double-acting.

My motor comprises, essentially, an expanding chamber to which the fluid under tension is admitted. The expansion is lateral and in three directions; but the expansion in two directions is communicated at right angles in the third direction, in order to augment the direct pressure in this latter direction. The expanding chamber is inclosed in an exterior tight chamber, and the fluid is admitted alternately to the interior and the exterior of the expanding chamber. Suitable cocks or valves are employed to control the ingress and egress of the fluid, and a rod attached to the moving face of the expanding chamber serves to communicate the motion to other mechanism.

In the drawings which serve to illustrate my invention I have shown it provided with an automatically-operated valve to admit a liquid—usually water—under a head or tension.

Figure 1 is a plan of the motor with the top plate and valve mechanism removed. The full lines show the chamber expanded nearly to the end of its outstroke, and the dotted lines show it contracted or collapsed, as it will be at the end of its instroke. Figs. 2 and 3 are views of the motor drawn to a scale one-half the size of Fig. 1. Fig. 2 is a longitudinal vertical mid-section in the plane indicated by line 2 2 in Fig. 3, and Fig. 3 is a transverse vertical section in the plane indicated by line 3 3 in Fig. 2. Fig. 4 is a side elevation of the motor as applied to a direct-acting pump of any kind, and Fig. 5 is a plan of the same. Fig. 6 is a detached sectional detail view that will be hereinafter explained.

A represents a bed-plate of any kind to support the motor.

B represents, in general, the outer chamber, which contains the expanding chamber. This chamber B is made tight to prevent leakage. The chamber B usually has the rectangular form shown.

B′ is the bottom plate of chamber B. B^2 is the top plate, B^3 is the back plate, B^4 is the front plate, and B^5 B^5 are the sides.

C is the valve-chamber, made cylindrical, and usually cast in one piece with the top plate, B′. The valve comprises two pistons, *a a′*, made to fit the base of chamber C, and provided with a suitable valve-stem, *b*, which passes out of the chamber through a packed opening, in the usual way. In the bottom of the valve-chamber, and opening into the outer chamber, B, through its top plate, are the two ports *c* and *c′*, for the ingress and egress of the fluid. These are controlled by the valve.

D is the inlet for the fluid under pressure, and E E are the exhaust-outlets at the end of chamber C. These may be brought together, as shown in Fig. 5, to form one outlet.

Within the chamber B is an expanding chamber. This expanding chamber comprises three moving parts, and the top plate, B^2, bottom plate, B′, and back plate, B^3, of chamber B may be considered as fixed parts of said expanding chamber, as they are essential to its operation. The three moving parts of the expanding chamber comprise the front G and the sides G′ G′ and G^2 G^2. The front G fits tightly between the plates B′ and B^2, and is guided in its movements to and fro between the sides B^5 B^5; but openings *d d* are left at its sides (see Fig. 3) for the free passage of the fluid. The toggle-like sides of the expanding chamber are constructed each of two plates hinged together somewhat like the leaves of a butt-hinge. As these sides are constructed alike, a minute description of one will be sufficient. The plates G′G′ are hinged together at *e*. The other edge of one of the plates is hinged to the back plate, B^3, at *g*, and the other edge of the other plate is hinged to the front G at

h. The plates G^2 G^2, which form the other side, are hinged at *e'*, *g'*, and *h'*. As the chamber collapses, as seen by dotted lines in Fig. 1, the plates forming the sides fold together inward, and as it expands they straighten out, as indicated by the full lines in the same figure. The plates forming the folding sides, as well as the front G, fit tightly between the top and bottom plates, B^2 B', in order to prevent leakage, and they as well as the front may be properly packed. The shaded surface in Fig. 1 represents the packing.

H represent the interior space circumscribed by the moving parts of the expanding chamber and by the plates B', B^2, and B^3.

I I represents the space within the outer chamber, B, and exterior to the expanding chamber.

J is a rod connected to the front G of the expanding chamber, which passes out through a packed opening in the outer chamber, B. This rod communicates the motion of the expanding chamber to the mechanism to which the power is to be applied.

In Fig. 1 I have shown the two toggle-like sides arranged directly opposite each other, so that when folded each extends about half-way across the chamber, the hinges nearly meeting. This arrangement is not, however, absolutely essential. For example, by detaching side G^2 from plate G at *h'* and side G' from plate B^3 at *g*, plate G could be moved forward, carrying side G' with it. It is easy to see, then, that plate G could be constructed to extend back to the hinging-point *h'* by merely thickening that side, and that plate B^3 could be similarly constructed to extend forward to the hinging-point *g*. In such a construction the folding sides may of course extend more than half-way across the chamber when folded.

No particular form of valve is required; but I will describe the operation of my motor with reference to that form of valve shown. The port *c* opens into the chamber B exterior to the expanding chamber, and the port *c'* opens into the interior H of the latter chamber.

Referring to Fig. 2, port *c'* is open to the inlet D, and is admitting fluid under tension or head to the interior H of the expanding chamber, and port *c* is open to the exhaust E. The chamber is expanding, and the front G of same near the end of its outstroke. By referring to Fig. 1, which shows the same position of the parts, it will be seen that the fluid entering H presses outward in all directions, acting not only directly on the front G, but upon the inner faces of the toggle-like sides, tending to press them outward and straighten them. This transmits the lateral pressure on the sides at right angles to the front G, thus exerting on the latter a combined pressure greatly in excess of that which would be exerted on the front G alone. When the chamber has fully expanded and the front G has reached the farthest point of its travel, the valve shifts, the interior H is opened to the exhaust, and the exterior I is opened to the fluid under tension. The fluid now acts to collapse the expanding chamber, the pressure being applied directly on the outer faces of its front and sides. The inward pressure on the folding sides is again transmitted at right angles to the front G, thus augmenting the pressure tending to drive it back or inward. Thus by alternately admitting the fluid to the interior and exterior of the expanding and collapsing chamber reciprocating movement of the rod J is obtained.

Any of the well-known automatic valve-shifting mechanisms may be used.

In Figs. 4 and 5, K represents any kind of pump, the piston of which is connected to rod J. The valve-stem *b* has a bearing at *x* on the pump. L is a lever mounted on a rocking fulcrum at *i*, and the forked and slotted upper end of this lever engages a pin or stud, *j*, on the valve-stem. On the rod J are fixed two tappets, *k k'*, which strike the lever L alternately, and shift the valve in a manner that will be well understood.

Fig. 6 is a horizontal section through one side of the expanding chamber, designed to illustrate the form of the plates and the mode of hinging. The edges of the plates where they are hinged to back plate, B^3, and the front G, respectively, are made rounded or cylindrical, in order to fit in sockets formed in the said back plate and front G, and in retaining plates or keepers *l*, secured in place by screws. The hinging-eyes *m m* on those edges of the plates that are connected together may be formed integrally with the plates, but I have herein shown them constructed separately and attached to the plates by nuts and screws. At the tops and bottoms of the plates forming the sides of the expanding chamber I prefer to provide projecting flanges *n n*, which are inturned merely to provide a broader bearing at the points where the plates play over the top and bottom plates, B^2 and B'.

It will be obvious that by alternately admitting and exhausting the fluid from either the interior H or the exterior I of the expanding chamber it will operate as a single-acting motor.

I do not wish to limit myself to the particular features of construction of the several parts herein shown, as these may be varied somewhat without departing materially from my invention.

Having thus described my invention, I claim—

1. As a motor or engine, the combination, with an expanding and contracting chamber of substantially the character described, of an outer tight chamber exterior to the expanding chamber, and means, substantially as described, for controlling the ingress and egress of the fluid to and from the said expanding

chamber, and the outer chamber exterior to the expanding chamber and inclosing same, as set forth.

2. A motor comprising the tight chamber B, the expanding chamber composed of the front G and folding sides, hinged substantially as shown, and arranged within chamber B, the rod J, and a valve to control the ingress and egress of the fluid, all combined and arranged substantially as described.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

TITUS POWERS.

Witnesses:
ARTHUR C. FRASER,
GEO. BAINTON.