(No Model.)

C. C. WORTHINGTON.

GAS ENGINE PUMP.

No. 302,309. Patented July 22, 1884.

Fig. 1.

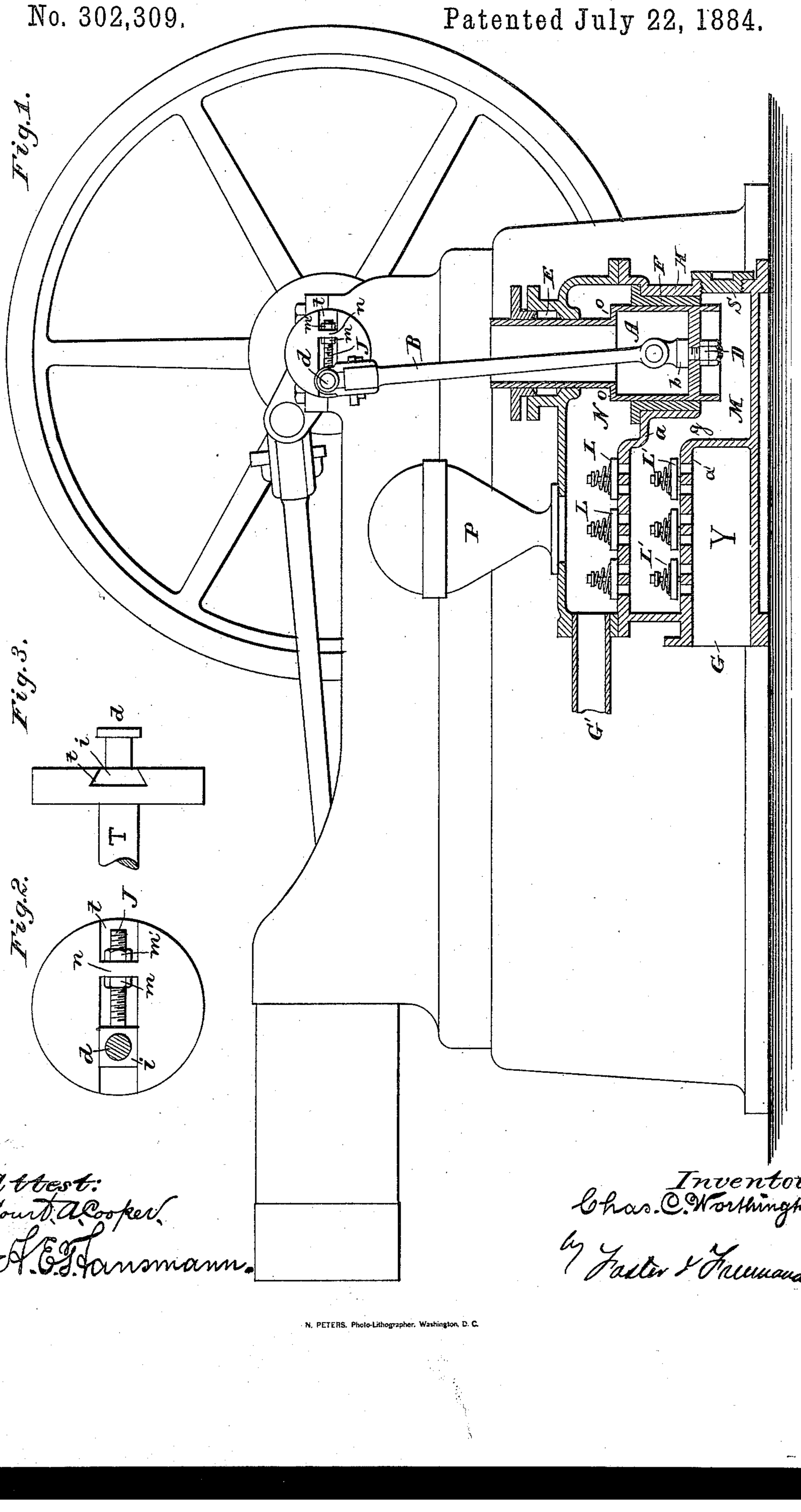

Fig. 3.

Fig. 4.

Attest:
Court. A. Cooper.
A. G. Tansmann.

Inventor:
Chas. C. Worthington
by Foster & Freeman Atty

UNITED STATES PATENT OFFICE.

CHARLES C. WORTHINGTON, OF IRVINGTON, NEW YORK, ASSIGNOR OF ONE-HALF TO WILLIAM E. HALE, OF CHICAGO, ILLINOIS.

GAS-ENGINE PUMP.

SPECIFICATION forming part of Letters Patent No. 302,309, dated July 22, 1884.

Application filed October 8, 1883. (No model.)

To all whom it may concern:

Be it known that I, CHARLES C. WORTHINGTON, a citizen of the United States, and a resident of Irvington, in the county of Westchester and State of New York, have invented certain new and useful Improvements in Gas-Engine Pumps, of which the following is a specification.

The object of my invention is to avoid the use of gears, belts, and like appliances in operating pumps from gas-engines and other engines running at high speeds; and my invention consists in constructing and adapting the pump for use in connection with a rapidly-reciprocating piston or plunger, and within a contracted space, in the manner fully described hereinafter, so as to avoid the objections heretofore incident to the use of quick-moving pistons in operating on non-elastic fluids.

In the drawings, Figure 1 is a sectional elevation of my improved pump, showing the same applied to be operated directly from the shaft of a gas-engine. Fig. 2 is a detached face view of the crank-wheel of the engine. Fig. 3 is an edge view of the parts shown in Fig. 2.

Where rapidly-moving engines have been employed as motors for the purpose of lifting or putting in motion water or other liquids, it has heretofore been common to communicate the motion to the pump from the engine by belts, gears, levers, or other appliances in such manner as to reduce the speed or impart a comparatively slow motion to the pump. This reduction in speed is essential, as sudden movements of the non-elastic fluid result in forcible impacts against the sides of the casing, in violent seating of the valves, in objectionable noise, and serious straining of the parts. While these objections are obviated to a greater or less degree by operating the pump slowly, the necessity of employing appliances for reducing the speed is most objectionable, as they increase the complexity and cost of the apparatus, result in lost motion and noise and wear, and decrease the capacity of the pump. Under ordinary circumstances, where there is unlimited space, it is most difficult and often impossible to secure the direct action of a piston by a rapidly-revolving shaft, and at the same time avoid the difficulties incident to such rapid movement; but the difficulties are greatly increased in combining a pump of such character with a gas-engine or other like engine. These difficulties arise from the limited space within which the pump must be arranged, in connection with the necessity of imparting an extended motion to the piston and of avoiding the objections incident to the use of short connecting-rods. This will be apparent from an inspection of the engine illustrated in the drawings, where it will be seen that it is necessary to include in the comparatively small height between the shaft and the floor, or base on which the bed-plate rests, the cylinder, piston, connecting-rod guides, and ports.

I have adapted the pump to the requirements of such a situation, and have overcome the above set forth difficulties and secured the desired results by the construction which I will now describe. The pump-piston is necessarily below the driving-shaft T, carrying the crank *d*, by which the piston is operated. To avoid the necessity of using a cross-head, guides, and a short connecting-rod, I employ a hollow plunger or trunk, A, which is a differential plunger, for the purpose described hereinafter, and set it as low as possible, while leaving sufficient space below its lower end, so as to increase the length of the connecting-rod B, thereby avoiding lateral thrust, and consequent friction, wear, and loss of power. The pump-case H is arranged with its bottom flush with that of the base of the machine and below the shaft T, and the lower enlarged part of the plunger A reciprocates in a bearing, F, formed in a partition, *a*, dividing the chest H into an inlet-chamber, M, and outlet-chamber N. The upper reduced end of the plunger reciprocates through an ordinary stuffing-box, E. In the partition *a* are ports with seats for a series of spring-seated valves, L, and a like series of valves, L′, is adapted to seats of inlet-ports in a partition, *a*′, which ports afford communication between the chamber M and the inlet-pipe G, and the chamber N communicates with the outlet-pipe G′ and with an air-drum, P. The difference in diameter between the two

parts of the plunger is such that the area of the shoulder *o* thus formed will be equal to half the area of the end of the plunger. Therefore, of the volume of water drawn into the chamber M on the upward motion of the plunger and forced into the chamber N on its downward motion, one half will supply the place above the partition *a*, vacated by the enlarged portion of the plunger. The other half will be discharged from the outlet G. On the reverse or upward movement the amount of water displaced on the entrance of the enlarged part of the plunger into the chamber N will be discharged from the outlet.

It will be seen that, although the pump is double-acting, there is but one series of inlet-valves and but one series of outlet-valves, the water passing from the lower to the upper end of the piston, traversing the same openings as that which goes to the discharge-outlet, the single set of force-valves being in action only at every alternate stroke. In this respect the pump differs from double-acting pumps where there are two sets of force-valves and two sets of suction-valves, one or the other of the two sets of force-valves being in action and being seated upon each stroke of the plunger. As a result of this construction, the number of valve-actions is reduced, the water-passages are direct and but little obstructed, there is abundant room for the valves, and such an extended valve area that each valve need have but a limited movement to secure a free flow of the water, and there is therefore no violent seating of the valves and ramming of the water, even under the most rapid actions of the plunger.

The use, in connection with the rapidly-reciprocating plunger, of a plurality of inlet and outlet valves is a matter of much importance. In pumps where but a single inlet and a single outlet valve are employed the entire volume of water displaced at each operation passes through such valve, necessarily lifting it to a considerable extent and causing it to seat on the next action with great force and with a violent shock. By providing extended valve-openings the water current is subdivided into small streams flowing slowly and passing easily from one chamber to the other, lifting but slightly the valves, which therefore may be made small in size, and will take their seats without violence, however rapidly the motion of the plunger may be reversed. As a plunger of comparatively large size may be thus employed, and as it operates with great rapidity, it will lift corresponding large bodies of water. It thus becomes necessary to provide capacious water inlet and outlet passages. In most pumps taking water at the lower ends, the inlet-pipe is below the limit of the piston's descent; but it has been shown that where the piston is below, and operated directly by the crank on the main shaft, it must descend as close to the bottom of the casing as practicable, necessitating an inlet-pipe communicating with the casing below the base of the engine, or a different construction than those heretofore employed. As any projection below the base would necessitate the cutting away of the floors or platforms on which the engines rest, I provide the required inlet by placing the partition *a'* at such a height above the bottom of the casing so as to form an intervening chamber, Y, of the required capacity to supply all the ports above, and also secure an opportunity to put the inlet-opening G at the end of the case above the bottom.

To secure a communication between the chamber above the partition *a'* and the end of the plunger, I form a channel, *g*, leading downward, as shown, past the end of the chamber Y. The partition *a*, supporting the second set of valves, is placed at a convenient distance above the partition *a'*, both partitions being therefore above the limit of the downward motion of the plunger, so that ample channels and chambers are secured without limiting the downward throw of the plunger, or providing any inlet connections below the line of the bottom of the casing.

By the construction, arrangement, and adaptation of parts above described I am enabled to drive a plunger of comparatively large diameter directly from the rapidly-revolving main shaft, confine the number of valve movements to the lowest limit, reduce the extent of these movements to a minimum, and avoid shocks therefrom, and secure ample passage-way for the flow of the large volume of water set in rapid motion by the pump, while confining the dimensions of the casing and accessories to the limited space between the base and the crank-shaft.

The connecting-rod B is attached to the plunger through the medium of an eyebolt, *b*, extending through the lower end or head of the plunger and fastening by nuts, keys, or any suitable device, D, whereby to permit the connection to be readily secured or removed, easy access being had thereto through a conveniently-arranged hand-hole, *s*, in the casing H.

To vary the throw of the crank to which the rod B is connected, so that the work done by the pump may be increased or diminished by lengthening or shortening its stroke, I make the wrist-pin *d* radially adjustable in respect to the shaft in any suitable manner. For instance, the wrist-pin is connected to a slide, *i*, capable of radial adjustment in a guide-slot, *t*, in the crank-wheel by means of a screw-rod, J, passing through a web, *n*, and provided with adjusting-nuts *m m'* on opposite sides of said web.

I do not limit myself to the use of a trunk-plunger, as a solid plunger might be employed with the effect above named; but I prefer to make the plunger hollow and to connect the rod B to the lower end, as thereby all slide-rests and plunger-rod stuffing-boxes are done away with, and the lateral strains from lateral thrust of the connecting-rod are brought

against the broad bearing F of the plunger, where they produce but little effect. This plunger-bearing may be a solid metal sleeve fitted to an opening in the partition *a*, as shown; or a stuffing-box bearing may be used.

Although the pump above described may be connected to the driving-shaft of any ordinary engine, it is especially adapted for use with gas-engines which are driven at a high rate of speed.

It will be apparent that the pump constructed as above described may be used whenever it is desirable to secure an extended throw of the plunger or piston, the space within which to operate the pump being limited.

I claim—

1. The combination, with a high-speed engine, of a crank upon the driving-shaft, a differential trunk-plunger connected to said crank by a rod attached to the end of said plunger, a casing divided into chambers by partitions, both arranged above the point reached by the plunger on its descent, and a plurality of ports provided with valves in each partition, substantially as and for the purpose set forth.

2. The combination, with the operating crank-shaft, of a casing, H, divided by partitions, each containing a plurality of ports provided with valves, a differential plunger sliding in a bearing in the upper partition, and an inlet communicating with a chamber below the lower partition, and a channel connecting the space above the lower partition with that below the plunger, substantially as and for the purpose set forth.

3. The combination of a crank upon the shaft of a driving-engine and a pump arranged between the shaft and base line of the engine, and provided with a differential plunger connected to said crank, and with an inlet-chamber, Y, and two chambers above the same and above the lower limit of the plunger's movement, connected by ports provided with valves and with inlet and outlet openings, substantially as set forth.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

CHAS. C. WORTHINGTON.

Witnesses:
ALEX. D. CHEW,
B. W. PIERSON.