(No Model.) 3 Sheets—Sheet 1.

L. H. NASH.

GAS ENGINE.

No. 334,039. Patented Jan. 12, 1886.

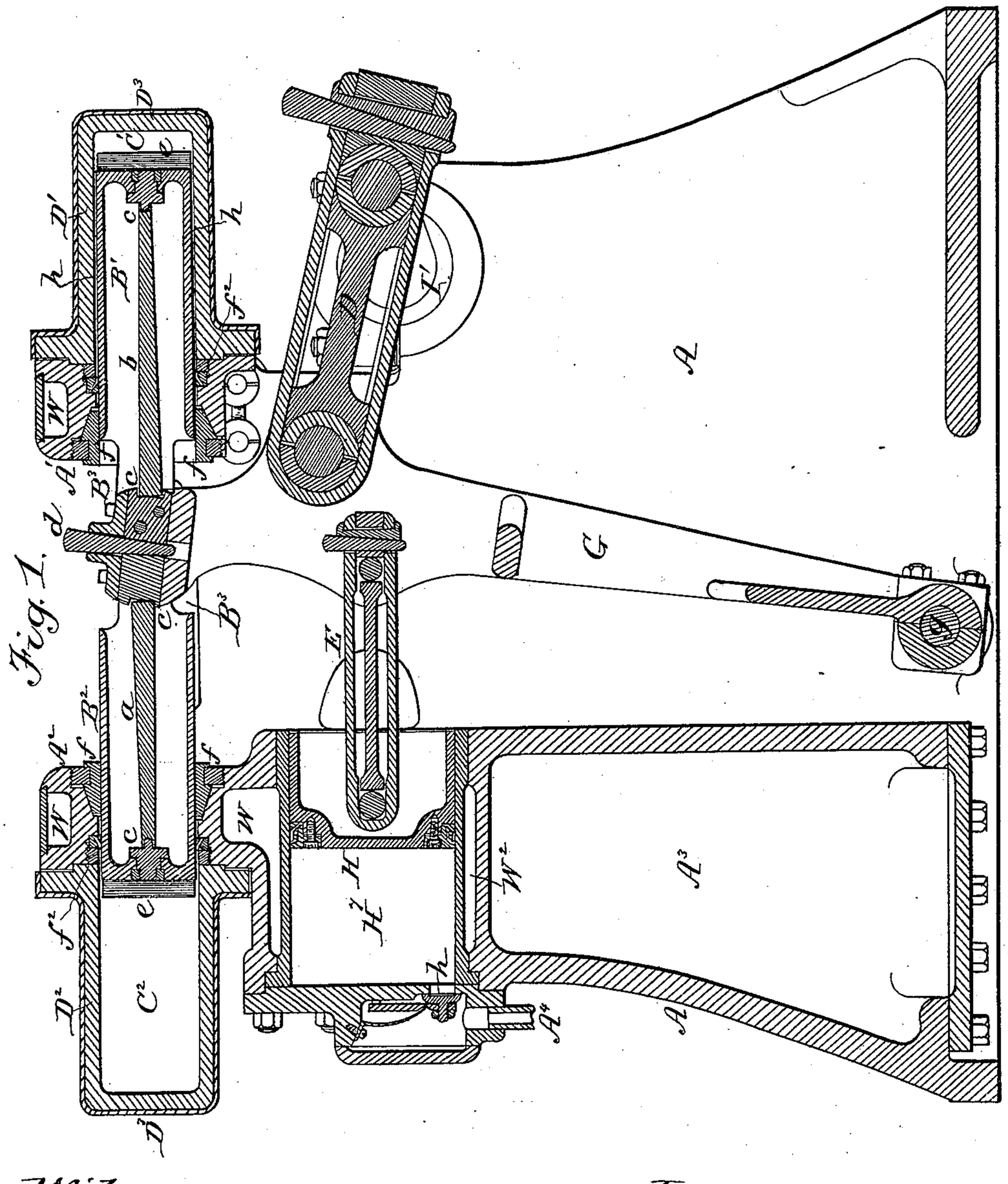

Fig. 1.

Witnesses:-
A. L. Church
A. E. Rawlings

Inventor:-
Lewis Hallock Nash
by Johnson & Johnson
Attys.

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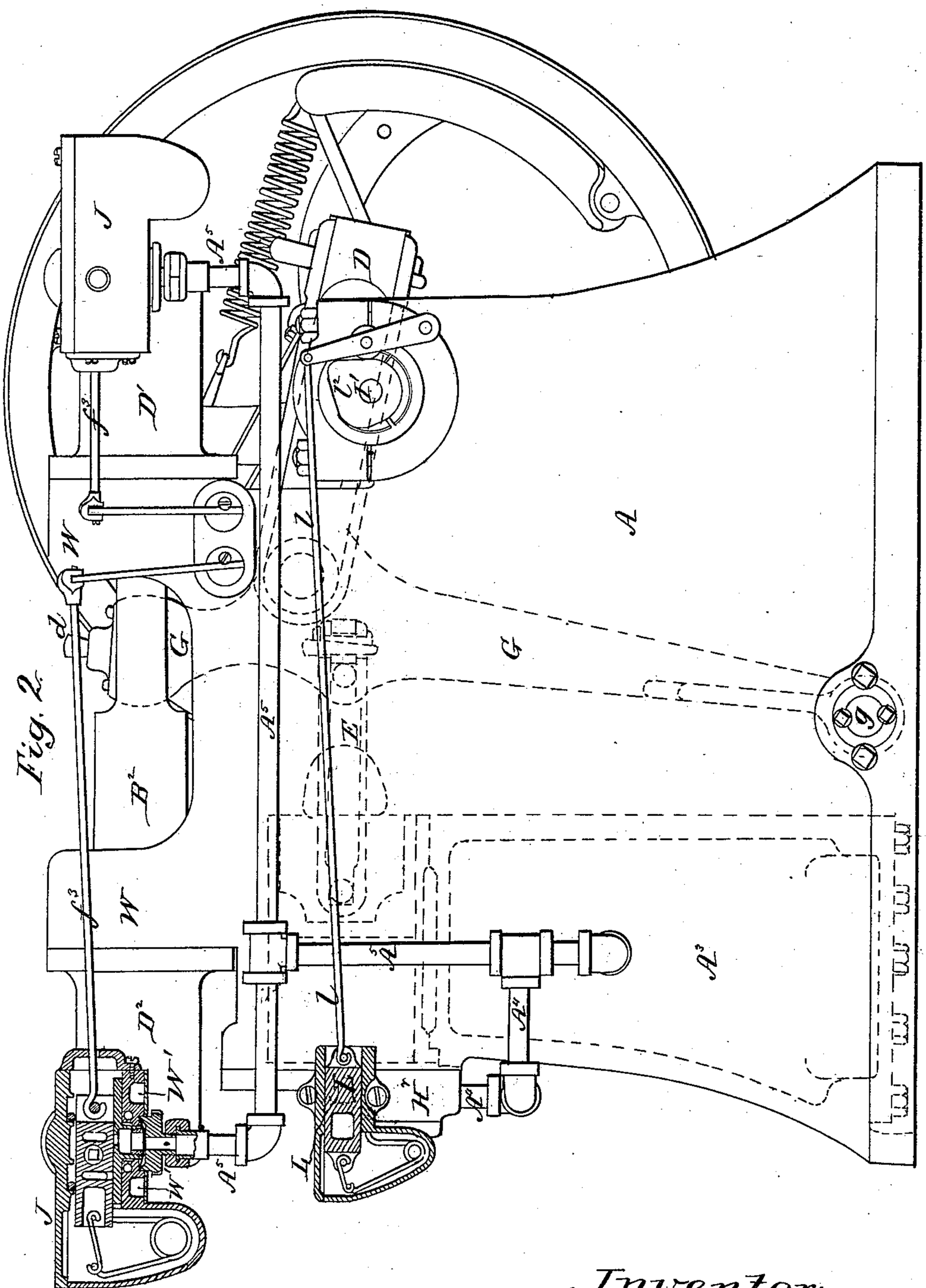

Witnesses:-
A Lockhart
A. E. Rawlings.

Inventor:-
Lewis Hallock Nash
by Johnson and Johnson
Attys.

(No Model.) 3 Sheets—Sheet 3.

L. H. NASH.

GAS ENGINE.

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Fig. 3.

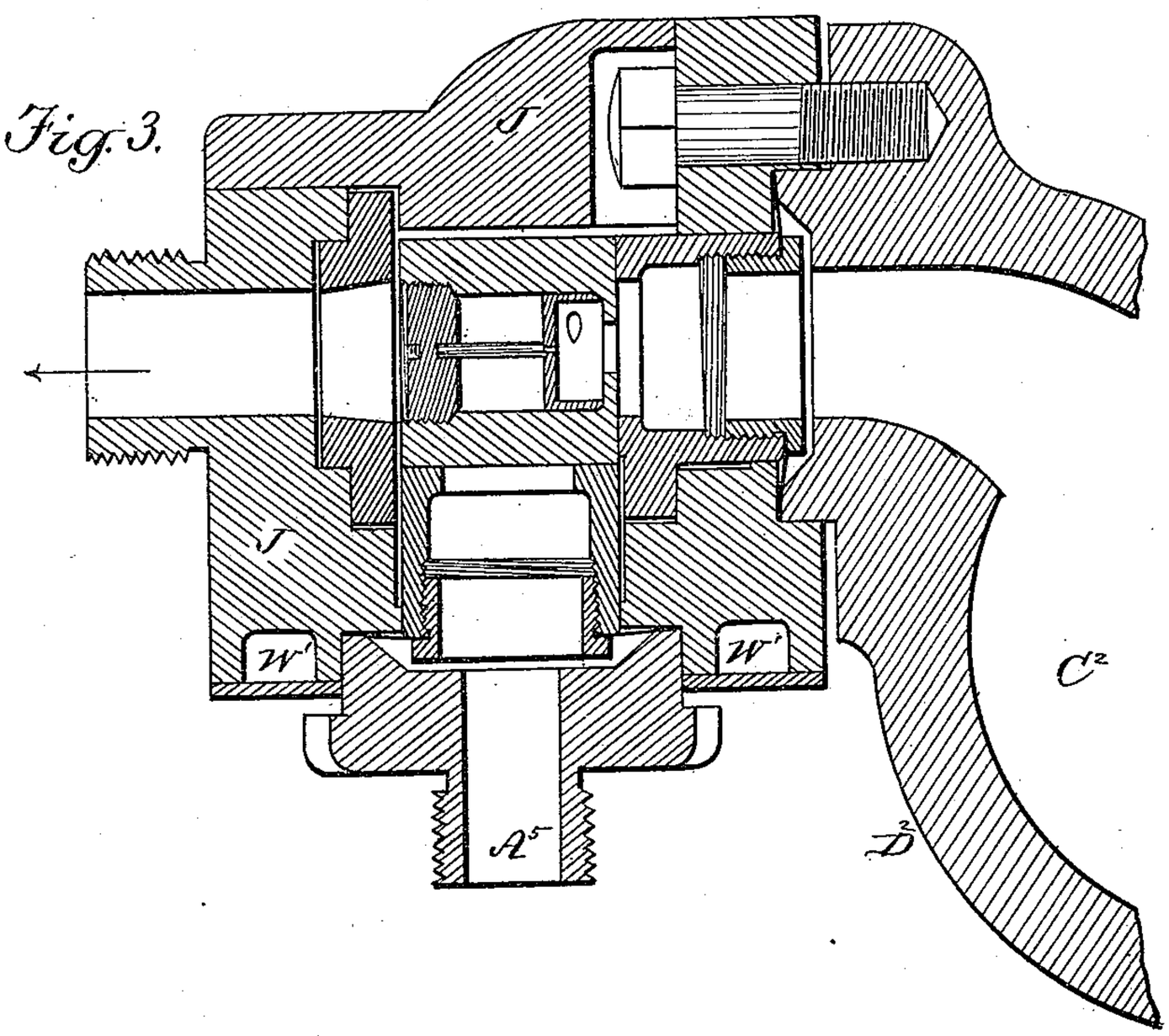
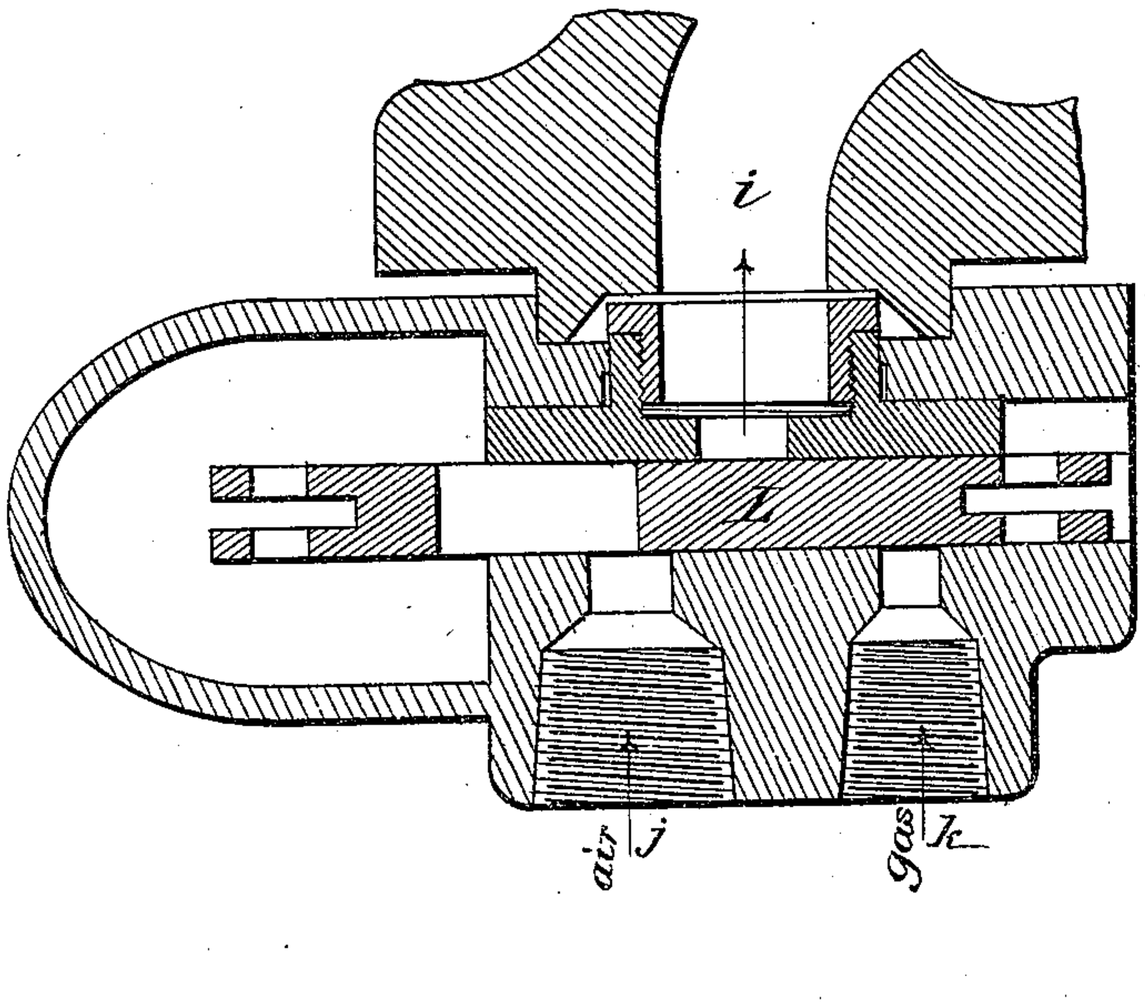


Fig. 4.



WITNESSES

A. Lockhurst

A. E. Rawlings

INVENTOR

Lewis Hallock Nash

by Johnson & Johnson

Attorneys.

UNITED STATES PATENT OFFICE.

LEWIS HALLOCK NASH, OF BROOKLYN, ASSIGNOR TO THE NATIONAL METER COMPANY, OF NEW YORK, N. Y.

GAS-ENGINE.

SPECIFICATION forming part of Letters Patent No. 334,039, dated January 12, 1886.

Application filed August 20, 1885. Serial No. 174,893. (No model.)

To all whom it may concern:

Be it known that I, LEWIS HALLOCK NASH, a citizen of the United States, residing at Brooklyn, in the county of Kings and State of New York, have invented new and useful Improvements in Gas-Engines, of which the following is a specification.

My invention is directed to the production of a double-acting gas-engine of single-acting cylinders placed in line in which the gaseous mixture is ignited at each end of every stroke, whereby a double-ended plunger may be used to receive the impulses of the explosions in both cylinders at both the forward and backward movements of the double-ended plunger.

The objects of my improvements are to ignite the charge in a highly-heated combustion-chamber, and at the same time provide for a comparatively cool condition of the wearing-surfaces of the plunger and the valve, so as to be lubricated in the ordinary manner, to provide very compact operating connections for a double-ended plunger operated in a right line, and driving a connection moving in a curvilinear line, by the combined action of two single-acting cylinders, whereby to obtain a rotary or a rectilinear movement, or both, from the movement of the double-ended plunger, to operate a crank-shaft and an air-compression piston, working parallel with the double-ended plunger.

Referring to the accompanying drawings, Figure 1 represents a vertical longitudinal section of a double-acting gas-engine of single-acting cylinders, embracing my improvements; Fig. 2, an elevation of the same, showing one supply and a mixing valve for the combustible fuel in section. Fig. 3 shows in section the connection of the supply-valve case with the combustion-chamber. Fig. 4 represents a horizontal section of what I call the "mixing-valve" of the compression-cylinder, showing the inlet-passages for the gas and air, and the valve-connection with the compression-chamber.

The engine-frame A supports separate and distinct single-acting trunk-cylinders placed in the same horizontal line, within which operates a double-ended plunger, $B' B^2$, preferably cast in one piece, which has an opening, B^3, in the middle of its length, to receive the operating connection between the cylinders. The bearing-cylinders $A' A^2$ for the double-ended plunger are comparatively short and are provided with suitable packing-rings for maintaining a joint for the plunger, and constructed with a jacket, W, for the circulation of water for lowering the temperature of its wearing-surfaces. The combustion-chambers $C' C^2$ for each cylinder are formed by separate cylindrical caps or extensions $D' D^2$, the inner walls of which do not touch the plunger-trunks, and they may be externally covered with a non-conducting covering, D^3, and it is by this construction that I obtain a hot combustion-chamber with a comparatively cool bearing-cylinder. The engine-valve cases J are mounted directly upon the hot combustion-chamber caps $D' D^2$ and are provided each with cooling jackets W', which do not modify the temperature of the combustion-chambers. The water-jackets of the cylinders and of the valves may connect for a continuous flow, or they may have separate supply and discharge pipes. The valve-case is bolted to the combustion-chamber, so that very little heat from the latter will be communicated to the former, and a small cooling-jacket will be sufficient for the valve-case. A compression-cylinder, H', is placed in the frame, preferably beneath one of the power-cylinders, for compressing the charge for the engine. It is provided with a suitable air and gas inlet valve—such as that shown at L in Fig. 2—and a suitable discharge-valve—such as that shown at *h* in Fig. 1—by which the compressed products are discharged from the compressor into a reservoir, A^3, by the pipe-connections A^4, from whence the charges are conveyed by the pipes A^5 to the supply-valves placed at J. The reservoir A^3 is formed in the base of the frame, preferably beneath the compressor. The power-transmitting shaft I' is mounted in the frame beneath the other cylinder, and the connections of this shaft, the air-compressor piston, and the plunger I will now describe. These three things are connected to a rocker-arm, G, which is pivoted at *g* to the foot of the frame, and, rising from said pivot, passes at its upper end into the opening B^3 in the double-ended hollow plunger, to which it is connected by means of

separate and distinct plunger-rods between the bearing-cylinders of the plungers, so as to drive the rocker-arm back and forth with the movement of the pistons. Between the pivot of the rocker-arm and its connection with the double-ended plunger, the crank-shaft and the air-compressor piston are connected to the rocker-arm by connecting-rods *a b*, standing in opposite directions, so that the back and forth movements of the rocker-arm G will drive the piston H of the air-compressor on one side of the rocker-arm and drive the crank-shaft I′ on its opposite side. This places the rocker-arm between the power-cylinder, the air-compressor, and the crank-shaft in a compact arrangement to utilize the rectilinear movement of the double ended plunger.

As the rocker-arm describes the arc of a circle struck from its pivot, it is necessary to provide connections with the double-ended plunger to accommodate such movement with the least amount of friction, and for this purpose I prefer to use connecting-rods *a* and *b* with rolling or rocking bearings *c c*, and provide for taking up the wear of such bearings by making one of the latter adjustable in the head of the rocker-arm by means of a key, *d*, or other suitable means. The double-ended plunger is a single hollow cylinder provided at each end with a suitable piston-head, *e*, and has an opening or slot, B^3, in the middle of its length to receive the rocker-arm and permit its connection and adjustment with the plunger connecting-rods. These rocker-bearing connections, which I prefer to use, require no lubrication, and reduce the friction of the piston-rod joints to a minimum. The separate and independent connecting-rods operate in the same plane, and by having abutting bearings upon the plunger-heads and upon the rocker-arm they act as a single connecting-rod to transmit the power of the double-plunger to the rocker-arm, to drive its non-pivoted end back and forth, and through its connecting-rod D drive the crank-shaft I′ to transmit the power, and by the connecting-rod E operate the air-compressor piston H to compress the charge for the engine.

By providing comparatively small bearing-cylinders for the double-ended trunk-plunger I am enabled to use comparatively long caps to form separate chambers for the combustion of the charge. These short cylinders are provided at their open ends with bearing-rings *f*, for taking up the wear of the trunk-plunger, while the inner end of the cylinder has packing-rings f^2 at its junction with the cap for forming tight joint. The plunger works through a comparatively cool bearing-cylinder into a hot combustion-chamber formed by the separate cap, the inner walls of which have a clearance-space, *h*, around the plunger, so that it has no contact with the combustion-chamber proper. This construction permits the combustion-chamber to become very hot, in order that the gases may lose no heat while doing their work, while the bearing part of the plunger will work in a comparatively cool cylinder. I prefer to place the valve-case J at the end of the cylinder-cap and provide it with a cooling-jacket, as stated. The provision of a short bearing-cylinder for the plunger, having a cooling-jacket independent of the cap forming the combustion-chamber, having no cooling-jacket and no contact with the plunger, and a valve-chamber having a cooling-jacket, gives the advantage of a hot chamber for the combustion of the charge and comparatively cool wearing-surfaces for the rubbing parts, so as to be lubricated, whereby the gases are burned in a very hot combustion-chamber, and little heat is abstracted by the walls of the cylinder, and a great saving in power is thereby obtained. The supply-valves for the combustion-chambers are operated by the connecting-rods f^3 and controlled by a governor device carried by the balance-wheel, and the mixing-valve for the compression-cylinder is operated and controlled by the connecting-rod *l* and cam l^2; but as these matters do not form part of my present invention a particular description of these parts is therefore deemed unnecessary. The air-compression cylinder is also provided with a cooling-jacket, W^2, which may be continuous with the cylinder-jacket, as shown. The reservoir A^3 is for the storage of a uniform mixture of gas and air, and it is from this reservoir that the power-cylinders are directly supplied by the valves through the pipe-connections A^4 and A^5. (Shown in Fig. 2.)

In Fig. 4 the mixing-valve connection with the compressor is shown by the passage *i* in the cylinder-head, while the air-passage is shown at *j*, and passage for the gas is shown at *k*, so that as the valve L is reciprocated a certain portion of air will be sucked into the cylinder and a certain portion of gas will also pass therein.

An important advantage in my double-acting gas-engine is in combining two open-ended cylinders with a single double-ended plunger, so as to avoid the necessity for stuffing-boxes for either cylinder and maintain cool piston-connections, as contradistinguished from a double-acting gas-engine having a piston-rod extending through one of the combustion-chambers, which is exposed to the intense heat of the gas and must work in stuffing-boxes.

I have shown and described a short bearing-cylinder for the plunger-trunk and a comparatively long cap forming combustion-chamber and joint-forming rings secured in the short cylinder, and it is by this construction that I obtain the advantage of a long hot combustion and a short bearing cylinder, greatly lessening the weight and expense of the engine, and also the advantage of avoiding the expense of forming a perfectly-true cylinder, since the packing-rings form the joint upon the plunger-trunk.

The specific construction of bearing-pin connecting-rods and connecting-rods for pistons

having rolling or rocking bearings is not claimed herein, as such devices are made the subject of separate and distinct applications for patents made by me.

I have stated the advantages of a short comparatively cool bearing-cylinder having a separate cap forming combustion-chamber having a greater interior diameter than the bearing-cylinder, and joint-forming rings in the said short cylinder, and it will be seen that such construction gives a bearing-cylinder much shorter than the stroke of the engine, and that a long plunger works within a long combustion-chamber which is maintained at a high heat.

I claim—

1. The combination, in a gas-engine, of a double-ended plunger with bearing-cylinders therefor placed in line, having cooling-jackets and separate combustion-chambers formed of non-jacketed cylinder-caps having their inner walls free of contact with the plunger-trunks, and suitable operating connections for the double-ended plunger and power-transmitting crank, substantially for the purpose specified.

2. The combination, in a gas-engine, of a double-acting piston or plunger with a combustion-cylinder chamber for each end of said plunger, and a pivoted rocker-arm having suitable connections with the said plunger between the open ends of said cylinder-chambers, and suitable connections with the crank-shaft between the plunger and pivot of said rocker-arm, substantially as described, for the purpose specified.

3. The combination, in a gas engine, of a bearing-cylinder having a water-cooling jacket and a combustion-chamber formed thereon by a separate cap, with an induction-valve case having a water-jacket mounted upon the hot combustion-chamber, whereby the bearing-cylinder and the supply-valve are prevented from being unduly heated while the combustion-chamber is maintained highly heated, substantially as described, for the purpose specified.

4. In combination, in a gas-engine, a bearing-cylinder, a plunger, a separate cap forming combustion-chamber, and joint-forming rings having a bearing upon said plunger, the said cylinder having a length less than the stroke of the engine, the said cap forming combustion-chamber having an interior diameter greater than that of the plunger, to allow the latter to operate therein, and maintained at a greater heat than said cylinder, substantially as described, for the purpose specified.

5. The combination of the bearing-cylinders placed in line and separate cap forming combustion-chambers, with a double-end plunger, the separate plunger connecting-rods *a b*, and an air-compression cylinder arranged parallel with the bearing-cylinder, with a pivoted rocker-arm, G, connecting said plunger between the open ends of said cylinders, the crank-shaft connecting-rod D, and compressor connecting-rod E, whereby the combined power of the cylinders is transmitted in a rotary motion for the crank-shaft and a reciprocating motion for the compressor, substantially as described.

6. The combination of the power trunk-cylinders arranged in line, the double-ended plunger, and the rocker-arm, with the connecting-rods D and E, the compression-cylinder, the storage-chamber, the engine supply-valves, and the supply-connections for the charge for both cylinders, substantially as described.

7. A gas-engine composed of two power-cylinders placed in line, each having a combustion-chamber, and a rigid double-ended piston or plunger having power-transmitting connections adapted to rock upon contact-bearings upon each piston-head and upon the said power-connections, substantially as described.

8. The combination, in a gas-engine, of two power-cylinders placed in line, and a piston or plunger for each cylinder rigidly connected, having power-transmitting connections adapted to rock upon contact-bearings at their points of connection, and a compression-pump connected with said piston-rocking connections, substantially as described, for the purpose specified.

9. The combination, in a gas-engine, of a double-ended plunger, with bearing-cylinders therefor placed in line, and separate combustion-chambers formed of cylinder-caps having their inner walls free of contact with the plunger-trunks, and suitable operating-connections for the double-ended plunger and power-transmitting crank, substantially as described, for the purpose specified.

10. The combination, in a gas-engine, of two power-cylinders placed in line, and jointed connected pistons or plungers for each cylinder, with an independent cylinder and piston arranged below one of said power-cylinders, a power-transmitting shaft arranged below the other power-cylinder, and suitable connections for the moving parts, substantially as described.

11. The combination, in a gas-engine, of two short bearing-cylinders arranged in line, with a piston or plunger for each cylinder, having a stroke greater than the length of said cylinder, a combustion chamber forming cap for each cylinder, and suitable operating-connections for said plungers, substantially as described, for the purpose specified.

12. The combination, in a gas-engine, of two power-cylinders placed in line, and connected pistons or plungers for each cylinder, with a storage supply-chamber, and suitable supply-connections for the charge for both cylinders, substantially as described.

13. The combination, with the power-cylinders, each having a combustion-chamber placed in line and a separate piston for each cylinder, of a connecting-rod device for said pistons, consisting of separate and independent connecting-rods, and a vibratable or rocking arm

having bearing-surfaces for the abutting ends of said connecting-rods, substantially as described, for the purpose specified.

14. The combination, with the power-cylinders placed in line and a piston for each cylinder, of a rocking or vibratable arm having bearing-seats on opposite sides, and independent connecting-rods having rolling or rocking contact-seats upon the vibratable arm and upon the pistons, substantially as described, for the purpose specified.

15. The combination, with the power-cylinders placed in line and a piston for each cylinder rigidly connected, of a pivoted arm having its non-pivoted end entering an open way in said rigid piston connection at or about the middle of its length, provided with curved bearings on opposite sides, and independent connecting-rods having abutting end bearings upon the moving parts, substantially as described, for the purpose specified.

16. The combination, with two power-cylinders, each having a combustion-chamber placed in line and rigidly-connected pistons for each cylinder, of a pivoted arm having a fixed and an adjustable bearing, the independent rods connecting the pivoted arm, and an adjusting device for said rocker-arm bearing, substantially as described, for the purpose specified.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

LEWIS HALLOCK NASH.

Witnesses:
A. E. H. JOHNSON,
J. W. HAMILTON JOHNSON.