(No Model.) 2 Sheets—Sheet 1.

H. ROBINSON.

GAS MOTOR ENGINE.

No. 346,687. Patented Aug. 3, 1886.

Fig. 1.

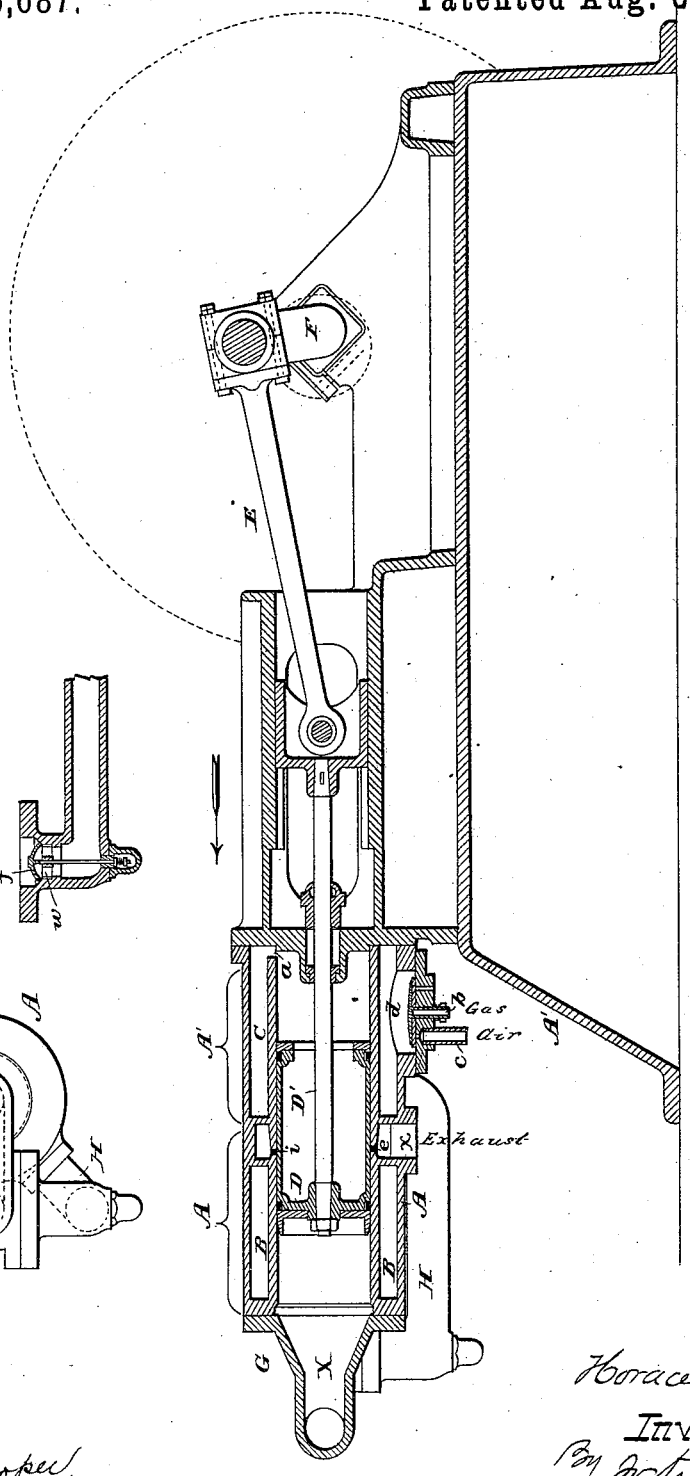


Fig. 4.

Fig. 3.

Attest:
Court. A. Cooper.
J. Campbell.

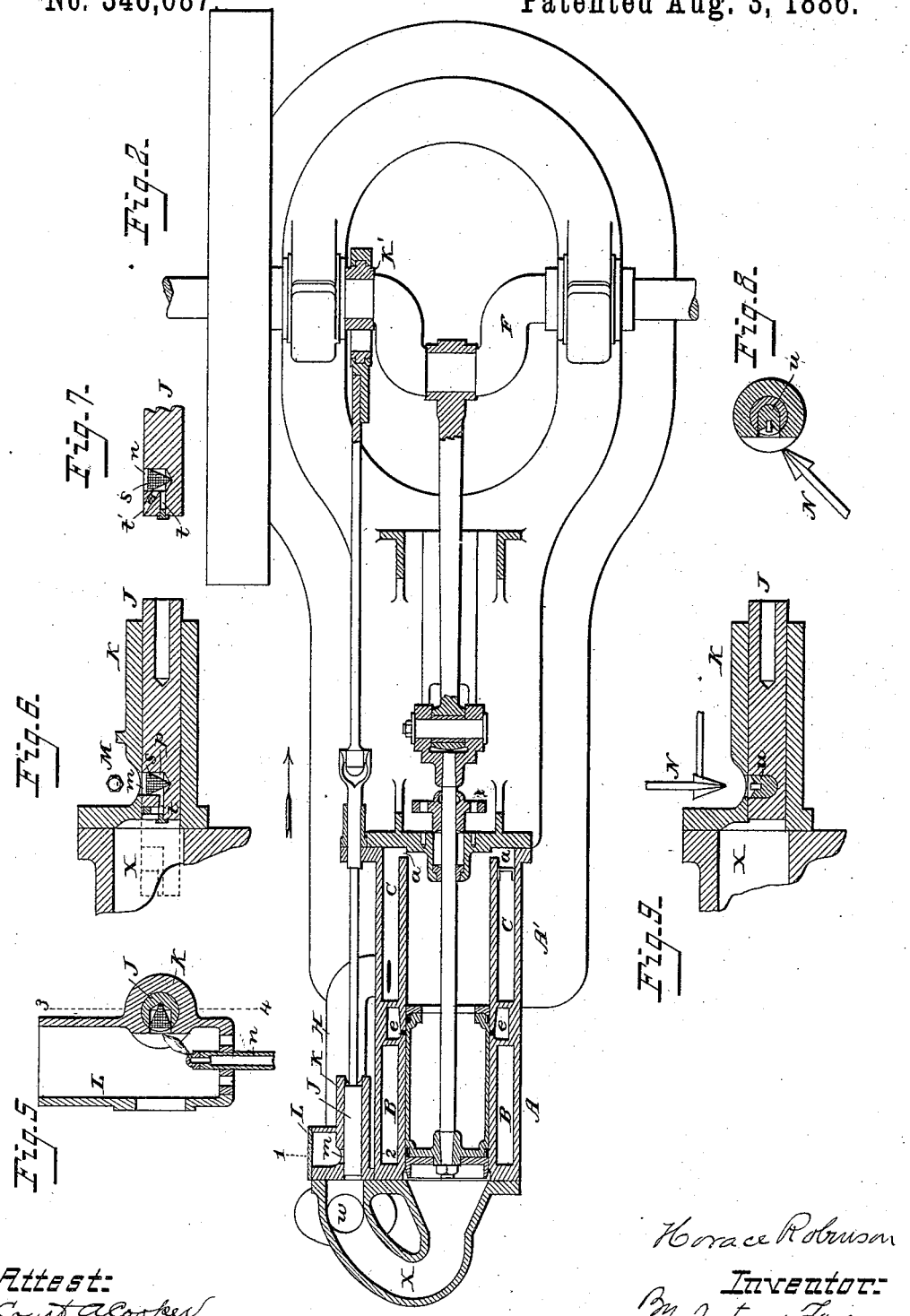
Horace Robinson.
Inventor.
By Dexter & Freeman
Attys

(No Model.) 2 Sheets—Sheet 2.

H. ROBINSON.

GAS MOTOR ENGINE.

No. 346,687. Patented Aug. 3, 1886.



Attest:
Court. A. Cooper.
J. Campbell.

Horace Robinson
Inventor:
By Foster & Freeman
Attys.

UNITED STATES PATENT OFFICE.

HORACE ROBINSON, OF MANCHESTER, COUNTY OF LANCASTER, ENGLAND.

GAS-MOTOR ENGINE.

SPECIFICATION forming part of Letters Patent No. 346,687, dated August 3, 1886.

Application filed June 19, 1884. Serial No. 135,421. (No model.) Patented in England January 10, 1880, No. 117; in France July 8, 1880, No. 137,698, and in Belgium July 10, 1880, No. 52,004.

To all whom it may concern:

Be it known that I, HORACE ROBINSON, a subject of Her Majesty the Queen of Great Britain, residing at Manchester, in the county of Lancaster, England, engineer, have invented certain new and useful Improvements in Gas-Motor Engines, of which the following is a specification.

My invention relates to that class of gas-engines in which the piston is moved by the explosion of a mixture of air and gas; and my invention consists in constructing the engine, as fully described hereinafter, so as to introduce the gases constituting a fresh charge without unduly mixing them with the spent gases, and so as generally to increase the efficiency and facilitate the operations of the engine.

In the drawings, Figure 1 is a longitudinal section of my improved gas-engine. Fig. 2 is a sectional plan. Fig. 3 is an end view of the cylinder; Fig. 4, a section of the inlet pipe and valve; Fig. 5, an enlarged section on the line 1 2, Fig. 2; Fig. 6, a section on the line 3 4, Fig. 5; Figs. 7, 8, and 9, sectional views showing modifications.

A is the working-cylinder of the engine, a prolongation of which constitutes a second cylinder, A′, the cylinder A inclosing the usual water-jacket, B, and the cylinder A′ inclosing a chamber, C, which constitutes a reservoir, and communicates with the interior of the cylinder A′ through an opening or port, *a*, at the forward end. A piston, D, secured to a piston-rod, D′, slides in both cylinders, and a connecting-rod, E, is jointed to the piston-rod and connected to the crank of the driving-shaft F. A gas-inlet tube, *b*, and an air-inlet tube, *c*, communicate with the chamber C, and the openings of both tubes are closed by a spring-seated valve, *d*. An annular exhaust-chamber, *e*, communicates with the exhaust *x*, and through an annular port or series of ports, *i*, with the forward end of the cylinder A, the said ports *i* being in such position as to be uncovered by the piston B as the latter approaches the limit of its forward movement. The back head, G, of the working-cylinder is so formed as to inclose a curved chamber, X, which decreases in size toward an admission-port, *w*, from which a pipe, H, leads to the chamber C and communicates therewith, and in the port *w* is a check-valve, *f*.

Any suitable form of igniter, electrical or mechanical, may be employed. I have shown a reciprocating valve cylinder or plunger, J, driven from an eccentric, K, on the driving-shaft, and constructed as hereinafter more fully set forth, to carry a flame into the rear portion of the chamber X. When the parts are in the position shown in Fig. 1, when the piston is traveling backward and out of the cylinder A′, it will tend to create a vacuum in the said cylinder, and the valve *d* will consequently rise, and air and gas will flow into the chamber C. As the piston reverses its movement and starts in the direction of the arrow, Fig. 2, under the force of an explosion of the gases, the mixture in the chamber C and in the tube H, communicating therewith, will be compressed, and will be maintained under pressure until the piston passes the ports *i*, when the exploded gases will escape through said ports into the exhaust, and the pressure in the chamber X and cylinder A′ will be so reduced that the gaseous mixture in the chamber C and pipe H will escape through the port *w* into the chamber X. As the chamber X is in free communication with the working-cylinder A, the exploded gases from the chamber X will be forced by the inflowing charge from the chamber X into the cylinder A, and to a greater or less extent from the latter to the exhaust, until the fresh mixture fills up a part or the whole of the igniting-chamber X, and remains therein unmixed to any extent with the spent gases. As the momentum of the fly-wheel carries around the driving-shaft and moves back the piston, the latter closes the exhaust and commences to compress the gases in the working cylinder and chamber X until the piston is at the limit of its rear motion, when the charge will be ignited and the piston again driven forward, as before. As the fresh charge flows in the rear end of the chamber X, and as the latter is contracted toward this end, the fresh gases will completely fill the contracted portion of said chamber without becoming mixed to any material extent with the spent gases, so that the fresh charge is not diluted and the

proportion of gases is maintained, thereby insuring absolutely their explosion at the proper time—a result which will not always ensue when the fresh charge is introduced among the spent gases at the end of the cylinder and is liable to become intermingled therewith. When the explosion takes place, the valve *f* is held firmly upon its seat, so as to resist any tendency of the gases compressed by the action of the pump in the chamber C to flow into the chamber X until the pressure in the latter is reduced by the opening of the exhaust, when the gases in the chamber C will be free to flow into or to be forced into the chamber X past the delivery-valve *f*. As the result of the above-described operations, the explosion of one charge causes the succeeding charge to be compressed in the chamber of the compression-pump, and the release of the exploded gases as the piston completes its operation causes the communication between the pump-cylinder and the ignition-chamber to be opened automatically, and the inflow of the new charge expels from the working-cylinder a corresponding amount of the spent gases, but without any material mixture of the inflowing gases and the spent gases, which latter remain in the working-cylinder. The return movement of the piston causes the new charge to be drawn into the pump-cylinder, and at the same time compresses the charge already in the explosion-chamber. The cylinder is thus supplied with a compressed charge prior to each forward movement of the piston. As the valve *w*, which admits the new charge, opens into the explosion-chamber, it will lift freely should the gas in the reservoir become ignited, so that the force of the explosion is against the yielding piston and is absorbed, instead of acting wholly against the walls and valves of the reservoir. If the explosion takes place when the piston is forward, the gases can blow out through the exhaust. Inasmuch as the working-cylinder and pump-cylinder are in connection and in line with each other and the same piston works in both, the friction and loss of power which would result from a double packing and the use of two pistons in separate cylinders are avoided, and the construction is simplified and the cost of manufacture is reduced. As the annular exhaust-chamber *e* is interposed between the two cylinders and between the water-chamber B and the pump-chamber C, the same are prevented from becoming overheated by the heat of the exhausted gases, and at the same time the mixture of air and gas introduced into the chamber C is raised in temperature, so that there is an increase of pressure and increased explosive effect when the charge is ignited. The pump-cylinder may be arranged alongside of the working-cylinder as a separate cylinder and provided with a separate piston, and different means of introducing the gases into the pump-cylinder and carrying them therefrom into the working-cylinder may be employed. I therefore do not limit myself to the arrangement shown. The igniting valve or plunger J slides in the cylinder K, opening at the end into the chamber X, and communicating through a port, *m*, at the side with a chimney, L, through the bottom of which extends a gas-tube, *n*, terminating in a burner, from which flows the igniting-flame in a position adjacent to the port *m*. The plunger J is provided with a chamber or recess, *p*, within which is a hollow bundle or cone, *s*, of wire-gauze or other foraminous material, with its apex toward the inner end of the recess, and with its open bottom toward the outer end, and a small passage, *t*, in the plunger J affords a communication which is constantly open between the chamber *p* and the chamber X. There may also be a second passage, *t'*, as shown in Fig. 7. When the valve or plunger J is in the position shown in Fig. 6, the recess *p*, containing the cone of wire-gauze, is in free communication with the open air through the port *m*, and the passage *t* permits the escape into the chamber *p* of a small portion of the gaseous mixture from the chamber X, which passes through the cone, and is ignited by the flame and burns within the cone. As the plunger moves inward to the position shown in dotted line, Fig. 6, the flame within the cone is carried into the ignition-chamber X, and thereby ignites the gases therein. It will be seen that the channel *t'* communicates with or opens at the side of the valve or plunger, so that but a limited quantity of gas can flow through the chamber *p* at first, but the quantity is increased as the valve passes into the chamber X, so as to insure the permanency of the flame during the movement of the plunger.

In place of the gauze, a block of refractory material, *u*, may be inserted in the chamber *p* in a position to be heated by a jet or flame from a blow-pipe, N, Figs. 8 and 9, when the valve is in its outward position, and to ignite the charge in the chamber X when the valve moves inward.

Although I have described the exhaust-port as being uncovered by the movement of the piston, a sliding or other valve may be used for this purpose in connection with the other features of my invention.

Without limiting myself to the precise construction and arrangement of parts shown, I claim—

1. A gas-engine provided with an inlet-port for the charge, and with a chamber at the rear of the point reached on the backward stroke of the piston and contracted, and with a reservoir containing an explosive mixture, communicating with the contracted chamber through an opening closed by a valve, substantially as set forth.

2. The combination, in a gas-engine, of a working-cylinder having an exhaust at the forward end, an inlet-port centrally at the rear end, and an explosion-chamber between the inlet-port and the rear end of the cylinder, de-

creasing in diameter from its point of connection with the cylinder, substantially as described.

3. The combination, with the working-cylinder of a gas-engine, of a casing containing a chamber communicating centrally at the rear end with the inlet-port and expanding toward the end connected with the cylinder, and a casing containing a reservoir communicating with the contracted end of the rear chamber, substantially as described.

4. A gas-engine provided with a reservoir containing a charge of mixed gases under pressure, with a cylinder having exhaust-ports arranged to be uncovered by the piston as it approaches the end of its forward movement, and an explosion-chamber communicating centrally at one end with the reservoir and at the other with the cylinder, and expanded toward the cylinder end, substantially as described.

5. A gas-engine provided with a working-cylinder having ports arranged to be uncovered as the piston reaches the limit of its forward movement, and with a surrounding chamber communicating with said ports and with the exhaust, substantially as described.

6. A gas-engine provided with a working-cylinder, an exhaust communicating with a chamber surrounding the cylinder, and with an annular port or series of ports arranged to be uncovered by the piston on the termination of its forward movement, and forming a communication between the cylinder and the exhaust-chamber, substantially as described.

7. A gas-engine provided with a working-cylinder and compression-cylinder in line, ports admitting gas and air to the compression-cylinder, a piston reciprocating in both cylinders, and a communication between the compression-cylinder and the rear end of the working-cylinder, and with inlet and exhaust ports, substantially as set forth.

8. The combination, with a working-cylinder, reservoir, a communication between the reservoir and working-cylinder provided with a self-acting valve, and exhaust-ports at the forward end of the cylinder, substantially as set forth.

9. The combination of the compression-cylinder, working-cylinder having the exhaust at the forward end, reservoir of explosive mixture, and the communication between the working-cylinder and the reservoir-cylinder, provided with a check-valve opening toward the working-cylinder, substantially as set forth.

10. The combination, in a gas-engine, of a working-cylinder and compression-cylinder in line, ports admitting gas and air to the compression-cylinder, and a piston common to both cylinders, and an exhaust-chamber arranged between the cylinders, substantially as set forth.

11. The combination of the valve J, provided with a passage, chamber *p*, and foraminous cone *s*, and valve-cylinder K, having a port, *m*, opposite an igniting-burner, substantially as described.

HORACE ROBINSON.

Witnesses:

JOHN C. WALKER,
Solicitor, Manchester.

CHAS. J. VICKERS,
Clerk to Bowden & Walker, Solicitors, Manchester.

Correction in Letters Patent No. 346,687.

It is hereby certified that Letters Patent No. 346,687, granted August 3, 1886, upon the application of Horace Robinson, of Manchester, England, for an improvement in "Gas-Motor Engines," was erroneously issued to said Robinson instead of to *Philip Middleton Justice, of London, England*, assignee of the entire interest in said invention; that the proper correction has been made in the files and records of the case in the Patent Office, and should be read in the Letters Patent to make it conform thereto.

Signed, countersigned, and sealed this 17th day of August, A. D. 1886.

[SEAL.]

H. L. MULDROW,
Acting Secretary of the Interior.

Countersigned:

R. B. VANCE,
Acting Commissioner of Patents.