

UNITED STATES PATENT OFFICE.

JOHN HENRY HAMILTON, OF SANDIACRE, ENGLAND.

GAS MOTOR-ENGINE.

SPECIFICATION forming part of Letters Patent No. 621,526, dated March 21, 1899.

Application filed December 28, 1897. Serial No. 663,842. (No model.)

To all whom it may concern:

Be it known that I, JOHN HENRY HAMILTON, a subject of the Queen of Great Britain and Ireland, and a resident of Sandiacre, in the county of Derby, England, have invented certain new and useful Improvements in Gas Motor-Engines, (for which I have obtained a patent in Great Britain, No. 21,120, dated November 7, 1893,) of which the following is a specification.

This invention relates to four-stroke-cycle gas-engines of the scavenger-charge kind, for which a British patent, No. 6,015 of 1890, was granted to me. In these engines a charge of air is employed to scavenge or sweep out the products of combustion from the motor-cylinder after each working stroke, a two-diameter or differential piston working in cylinders of two diameters placed in line with each other serving as both motor and air-pump, being adapted to draw air into the larger part of the cylinder during the outward stroke and discharge it through the combustion-chamber during the exhaust-stroke or a part thereof; and the essential feature of this invention is the combination of such a differential piston and cylinder and another motor cylinder and piston placed in line or "tandem" with the differential cylinder, the piston of the second motor-cylinder being connected to the enlarged end of the differential piston by means of rods at each side, and the space in the air-pump being in communication with the back of the admission-valves of both motor-cylinders by means of a passage, preferably consisting in part of a detachable tube adapted to act when in place as a tie between the motor-cylinders.

The valve-gearing is so arranged that explosions occur alternately in the motor-cylinders. Thus instead of the air being compressed and re-expanded on each alternate stroke of the air-pump it is discharged on each back stroke—viz., through the combustion-chamber of the front motor-cylinder on one back stroke and through that of the rear motor-cylinder on the next back stroke. All the valves may be operated from one side shaft.

I will now proceed to describe my invention with reference to the accompanying drawings, in which—

Figure 1 represents a horizontal sectional elevation, and Fig. 2 a sectional plan, of a gas-engine constructed in accordance therewith.

Two motor-cylinders K and L are placed in line with each other and with another larger cylinder M, in which works the enlarged end A' of the front piston A. The latter carries the gudgeon or pin C, to which is jointed the connecting-rod. It has also secured to it the side rods B B, the latter being preferably in the horizontal axial plane, as illustrated. These side rods are connected, as shown, to the large end A' of piston A (the function of which, as above stated, is to act as an air-pump) and pass backward alongside the motor-cylinder L, preferably through spaces in the jacket thereof, as illustrated, and are connected at their rear ends to the cross-head D, which may be cast in one with the back motor-piston P or secured to the latter by bolts. The ends of this cross-head may be provided with slippers working in guides, as shown at E, for guiding the front end of the piston P.

The air-inlet may be a grid flap-valve of the kind described in my British complete Specification No. 6,015 of 1890. It is shown at F, and consists of grids g, every alternate one of which has bolted to it a flexible strip a, of india-rubber or the like, of sufficient width to cover the openings between the next adjacent grids. A passage X X conducts the air to the cylinders K, L, and M.

The part T of the air-passage between the cylinders K and L may be removable, so as to allow of the easy withdrawal of the piston P, and when in place it forms a top tie for holding the cylinders together.

The admission-valves for gas and air are shown at G and G' and the exhaust-valves at H H'. These may be of any suitable kind. The former may be advantageously arranged as described in my British complete Specification No. 4,189 of 1892, and both admission and exhaust valves may be operated from one side shaft through cams and levers in the usual way, the cams and operating mechanism being arranged so that when one piston is making its explosion-stroke the other is making its suction-stroke.

The action of the engine is as follows: Supposing the pistons to be commencing their

forward stroke, as shown, and that this is the explosion-stroke of the rear piston P and the suction-stroke of the front piston A, air is then drawn in through the valve F, part of it passing through the valve G to the front motor-cylinder and part to the annular space Y behind the enlarged end A' of the piston A. On the return stroke, the exhaust-valve H' of the cylinder K being opened, the admission-valve G' being also opened after the pistons have made a portion of the return stroke, the air in the space Y is first slightly compressed—say to two pounds per square inch above atmospheric pressure—and then passed through the valve G' into the cylinder K, mixing with and expelling the products of combustion therefrom. The exhaust-valve H' is not closed till after the crank has passed the dead-center, thus allowing time for the pressure in the cylinder K and space Y to fall nearly to atmospheric pressure. The gas-valve of the cylinder K is now opened and the same series of operations are repeated, only that the front cylinder now makes its explosion-stroke and back cylinder its suction-stroke. There is thus an explosion at each forward stroke when working at full power.

As the scavenging charge of air is discharged through the combustion-chamber of one or other of the motor-cylinders at each return stroke, such a large clearance-space as is described in my specification No. 6,015 of 1890, above referred to, is unnecessary; but I prefer to make the clearance-space such that the admission-valves of the motor-cylinders need not be opened before nearly half the exhaust-stroke has been completed.

As the pressure in the space Y is always low, stuffing-boxes for the rods B B are unnecessary. The said rods may work through long bushes V V instead, and these bushes may have light spring packing-rings inserted.

It is obvious that the two motor-pistons might be connected directly by one central rod passing through a stuffing-box in the back end of the front motor-cylinder; but I consider the arrangement above described to be the best.

I would here state that I do not lay any claim to the mere use of side rods for connecting tandem pistons with the object of avoiding the known difficulty of packing glands for piston-rods extending through the motor-cylinder, as that is in itself old.

Having now described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. A gas motor-engine of the four-stroke-cycle type having a differential cylinder and piston adapted to serve as motor-cylinder and air-pump, a second motor cylinder and piston and means for reciprocating both the pistons simultaneously, admission and exhaust valves for both the motor-cylinders and means for operating them, combined for the purposes described with a passage for placing both admission-valves in communication with

the air-pump of the differential cylinder and an air-inlet valve, the engine being so arranged that air is admitted to the air-pump during the outward stroke and during the inward stroke compressed and discharged through the combustion-chamber of that cylinder from which the spent gases are being exhausted substantially as and for the purposes described.

2. A gas motor-engine of the four-stroke-cycle type having a motor-cylinder, a piston, having an enlarged cylindrical end, and means for reciprocating it, admission and exhaust valves therefor and means for operating them, and a second cylinder in line with the first, combined for the purposes described, with a piston having a cross-head such as D formed on it or attached to it and arranged as specified, and side rods secured at one end to the cross-head and at the other end to said enlarged part of the first motor-piston all adapted to operate substantially as described.

3. A gas motor-engine of the four-stroke-cycle type, consisting of the combination for the purposes described of a motor-cylinder such as L, a larger cylinder M, a differential piston A adapted to work in both cylinders L and M, a second cylinder K in line with the first cylinder L, a piston P working in cylinder K, a cross-head D on said piston P, side rods B B for connecting the pistons A and P and means for reciprocating the said pistons, admission and exhaust valves to both motor-cylinders, a passage I leading from the space Y in the cylinder M through a passage T preferably in the form of a detachable tube to the admission-valves of the motor-cylinders and a valve F for admitting air to passage X and space Y all arranged and combined, substantially as described.

4. A gas motor-engine of the four-stroke-cycle type having a differential cylinder and piston adapted to serve as motor-cylinder and air-pump, a second motor cylinder and piston, admission and exhaust valves for both the motor-cylinders, and means for operating them alternately at the proper times, combined for the purposes described with a passage for placing both admission-valves in communication with the air-pump of the differential cylinder, and an air-inlet valve, the parts of the engine being so arranged that air, admitted to the air-pump during the outward stroke, is during the inward stroke, compressed and discharged through the combustion-chamber of that cylinder from which the spent gases are being exhausted, substantially as and for the purposes described.

5. In a gas motor-engine of the four-stroke type, the combination of two motor-cylinders placed tandemwise, the front cylinder having an enlarged fore end, a differential piston having an enlarged front end, working in said enlarged fore end of the front cylinder and acting as an air-pump for discharging a scavenger air charge alternately through the combustion-chamber of both motor-cylinders,

a cross-head connected to the rear piston, side rods connecting the enlarged end of the front piston and the cross-head of the rear piston and passing through passages in the front motor-cylinder or its jacket, admission and exhaust valves for both motor-cylinders and mechanism for operating same at the proper times, substantially as above described.

6. A gas motor-engine of the four-stroke-cycle type, consisting of the combination for the purposes described of a motor-cylinder such as L, a larger cylinder M, a differential piston A A' adapted to work in both cylinders L and M, a second motor-cylinder K in line with the first motor-cylinder L, a piston P working in cylinder K, fitted with a cross-

head D, side rods B B for connecting the piston A with the cross-head D, admission and exhaust valves to both motor-cylinders, a passage I leading from the space Y in the cylinder M through a passage T, preferably in the form of a detachable tube, to the admission-valves of the motor-cylinders K and L, and a valve F for admitting air to the passage X and space Y, all arranged and combined, substantially as described.

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

JOHN HENRY HAMILTON.

Witnesses:

HAROLD G. NIGHTINGALE,
THOS. HEATH.