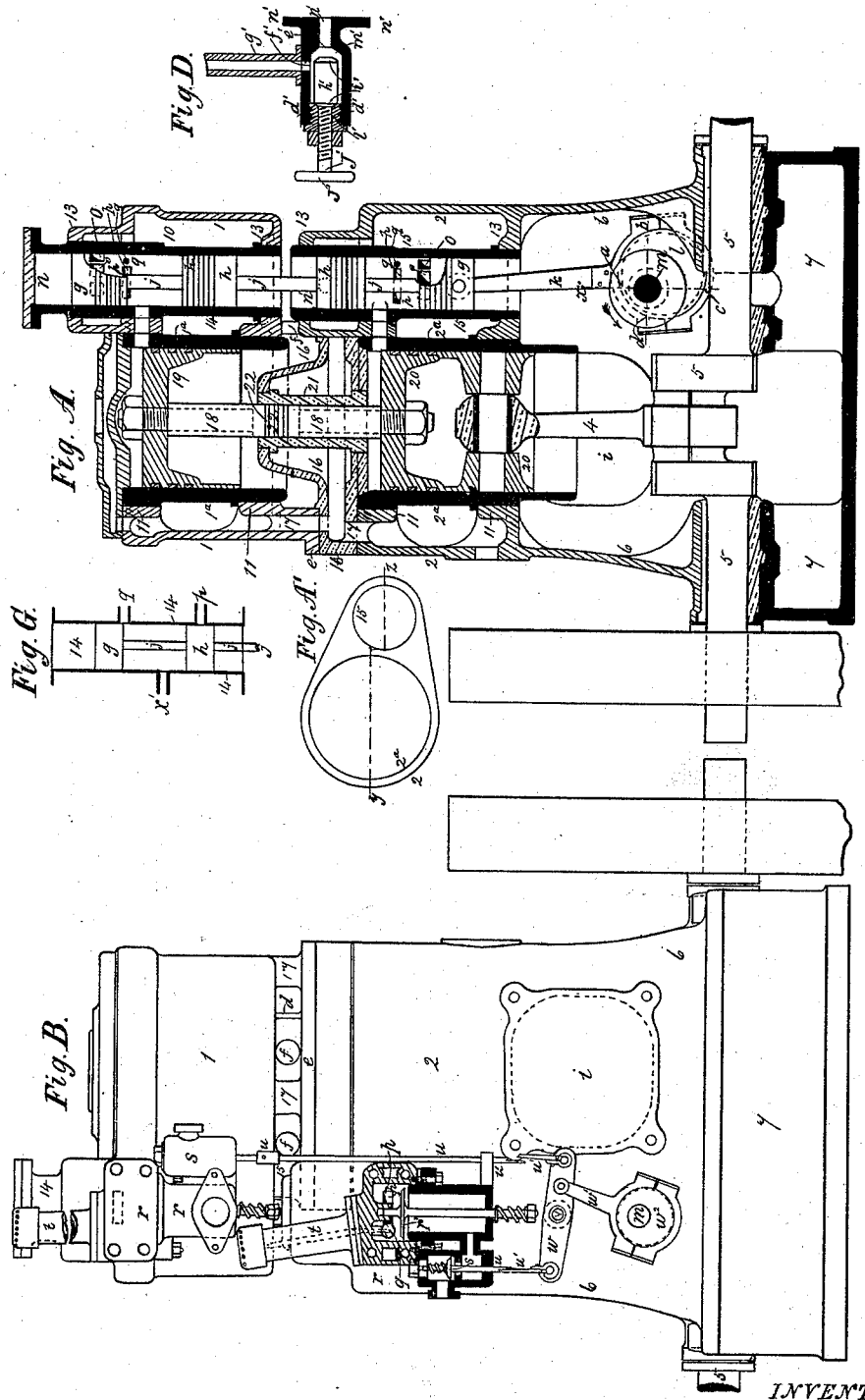
(No Model.)

P. BURT & G. McGHEE.

GAS OR COMBUSTIBLE VAPOR MOTOR ENGINE.

No. 550,674. Patented Dec. 3, 1895.



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GAS OR COMBUSTIBLE-VAPOR MOTOR ENGINE.

SPECIFICATION forming part of Letters Patent No. 550,674, dated December 3, 1895.

Application filed January 2, 1894. Serial No. 495,428. (No model.) Patented in England January 20, 1893, No. 1,277; in France February 13, 1894, No. 4,220, and in Switzerland February 15, 1894, No. 8,260.

To all whom it may concern:

Be it known that we, PETER BURT and GEORGE MCGHEE, engineers, citizens of Great Britain, residing at Glasgow, in the county of Lanark, Scotland, have invented a new or Improved Gas or Combustible-Vapor Motor Engine, (for which a patent has been obtained in Great Britain, No. 1,277, dated January 20, 1893; in France, No. 4,220, dated February 13, 1894, and in Switzerland, No. 8,260, dated February 15, 1894,) of which the following is a specification.

Our invention relates to improvements in gas or combustible-vapor motor engines; and the objects of our improvement are to construct a simple and efficient high-speed single-acting gas-motor engine having its principal working parts always in compression, so as to avoid knocking or backlash; to reduce the heating and friction of motor piston-rod, and to facilitate the renewal of igniting hot tubes while engine is working.

In order that our invention may be properly understood, we append the accompanying drawings, hereinafter described.

Figure A of the annexed drawings is a vertical section, on the lines *y z* of Fig. A′, of an engine constructed according to this invention; Fig. A′, a reduced diagrammatic part plan, and Fig. B a back elevation thereof. The other figures illustrate details hereinafter described.

Like reference numbers and letters refer to like parts throughout the drawings.

Referring to Figs. A and B of the drawings, the engine comprises two cylinders 1 2, mounted tandem system or concentric to each other, the piston-rod 18, pistons 19 and 20, connecting-rod 4, and crank and shaft 5 serving for each set of tandem cylinders. The extended part 6 of outer casing of cylinder 2 has two opposite manholes and doors *i* and is fixed to engine bed or seat 7, which serves as an oil-bath for crank 5 to work in, all in usual way. The top and bottom flanges 11 of cylinder-casings 1 and 2 are bored and truly fitted water-tight with liners 1^a 2^a, which, with the casings, form the water-jacketed motor-cylinders. Part of aforesaid casings 1 2 are formed bulged out and with flanges 13, which are also accurately bored and fitted water-tight with liners 14 15, thus constituting water-jacketed valve-cases. The two cylinder-cases 1 2 are bolted together, with the hollow cover 16 for cylinder 2 between them, which cover is formed with two or more water-ways 17 for the cooling-water to circulate into said cover and jackets 1 2 round the cylinder and valve-liners, the water being supplied thereto in usual way. To reduce heat and friction and to avoid stuffing-boxes or glands between the two cylinders, the tail motor piston-rod 18 is fixed into the two motor-pistons 19 20, concentric therewith, by screw-nuts in usual way and is made of sufficient diameter to slide easily within the liner 21 with as little clearance as practicable and formed with three or other number of grooves, into which are fitted ordinary flexible or expanding packing-rings 22, so as to make the rod 18 capable of reciprocating inside liner 21 practically fluid-tight, thus dispensing with a stuffing-box and gland. Otherwise said rod may be made thinner and with a piston thereon, as indicated by dotted lines, and having grooves fitted with packing-rings, as aforesaid. The hollow cover 16 is formed, as shown, with the ends sufficiently far apart to correspond to length of stroke of tail-rod 18 and is bored and accurately fitted water-tight with liner 21, which is kept cool when engine is working by the surrounding water. The bottoms of cylinder-casing 1 and piston 19 are open to the atmosphere, said casing being formed with ribs *d*, water-ways 17, and flange *e*, Figs. A and B, by which it is bolted to cover 16 and top of casing 2, leaving air-passages *f*, Fig. B, to inside of cylinder. The bottom casing has likewise air-passages (not shown) to bottom of piston 20. Each of the valve-liners 14 and 15 is fitted with a balanced piston-valve consisting of the larger piston *g*, which regulates the passage through the ports and the balancing-piston *h*, which are each fitted with packing-rings to keep them fluid-tight while working, the fluid-pressure acting equally on inner ends of both said pistons, counterbalancing each other.

As shown at Fig. A, all the pistons *g h* are fixed on same valve-rod *j*, which is attached at one end to and reciprocated by connecting-rod *k* and eccentric *l* on valve-shaft *m*. Said

valve-shaft is revolved in ordinary bearings in engine-frame 6 at half the speed of main shaft 5 by means of the usual two to one spiral gearing, (not shown,) the shaft *m* lying at right angles to shaft 5, all in well-known manner to suit the ordinary four-stroke or Otto cycle.

In order to keep the valve and connecting rods *j k* always in thrust, so as to avoid knocking, the top of valve-liner 14 is fitted with a cover *n*, thus forming an air-cushioning chamber against the air in which the piston *g* in rising bears, thus tending to keep the connecting-rod and bearing-strap down against the eccentric *l*.

On Fig. A part of the valve-piston *g* is indicated as broken away in order to show clearly the oblong-shaped exhaust-port *o*, oblong explosive-mixture-admission port *p*, and round ignition-port *q*, which are formed in each valve-case and its liner, respectively, at the positions indicated, the exhaust-port *o* being preferably grated to allow of packing-rings sliding thereover.

The exhaust-port *o* leads to an exhaust-pipe, (not shown,) the admission-port *p* to an ordinary gas-and-air-mixing chest *r*, which has an ordinary gas-inlet valve *s* affixed thereto, and the ignition-port *q* to an incandescent or hot tube inside an ordinary Bunsen-burner case *t*. (Indicated at Fig. B.)

The gas-inlet valves are arranged so that their spindles *u* shall be on opposite sides of a projecting stud *v*, fixed on engine-frame. On said stud *v* is fulcrumed at its center a lever *w*, which is connected to and oscillated by the rod *w'*, worked by the eccentric w^2 on valve-shaft. On each end of said lever is fitted a gas-engine pawl or kicker *u'*, which fits against the end of its respective gas-valve spindle *u*, which it actuates in usual way, the said valve *s* being thereby opened and shut alternately.

Referring to the eccentric *l*, Fig. A, revolving, as shown by arrow, and shown as divided into four parts representing the travel thereof during each engine stroke, and following out the motion thereof and of the pistons *g* over the ports *o p q*, it will be seen that while the arc *a b* of the eccentric is moving past the point *x* on center line of rod *j* the motor-pistons 19 20 are respectively on the impulse and pumping outstrokes. While the arc *b c* is passing point *x* said pistons are respectively on the exhaust and compression instroke. While arc *c d* is passing point *x* said pistons 19 20 are respectively on the inhaling and impulse outstroke, and while arc *d a* is passing point *x* the said pistons 19 20 are respectively on the compressing and exhaust instroke. The eccentric w^2 is set so as to open the gas-supply valves alternately while arcs *a b* and *c d* of eccentric *l* are passing the point *x*.

The engine operates as follows: The cycle of each motor-cylinder is the ordinary four-stroke—*i. e.*, that of Beau de Rochas or Otto. Assuming the motor-pistons to be in full stroke, as shown at Fig. A, and the space at end of cylinder 1 and between valve-pistons *g h* charged with compressed explosive mixture and the eccentric *l* revolving as indicated by arrow, the top valve *g* is thus raised until it uncovers the ignition-port *q*, thus allowing said compressed charge to be ignited, the piston 19 being thereby driven out to end of its stroke, by which time the valve *g* shall have been raised sufficiently to uncover exhaust-port *o*, through which the products of combustion are now driven during the return stroke of piston 19, the mixing-chests having each a non-return valve. When the piston 19 has again fully returned, the piston *g* will have just covered the exhaust-port *o*, the admission-port *p* being still open, through which the explosive mixture is now inhaled during the next outstroke of piston 19, the pawl *u'* meanwhile having just been raised by the eccentric w^2 and opened the gas-supply valve *s*. During the next instroke of motor-piston 19, the piston *g* having meanwhile covered and shut both admission and ignition ports *p q*, the said explosive charge is compressed until the motor-piston 19 is full in, by which time the ignition-port *q* shall just have been uncovered, thus allowing the charge to be ignited, when the same cycle of operations begins again as just herein described. The motor-piston 20 operates in the same manner, only while the motor-piston 19 is on the impulse outstroke the piston 20 is on the explosive-mixture-inhaling outstroke. The connecting-rod 4 thus conveys an impulse every revolution to the crank and shaft 5 and is always inthrust on the outstroke by virtue of one or the other of the motor-pistons 19 and 20 being on the charge-compressing instroke, thus allowing the engine to run at a high speed without undue backlash or knocking of working parts.

We would here remark that the particular arrangement or position of ports as shown in liners 14 15 in Fig. A may be varied—as, for instance, referring to diagram G of liner 14, wherein the cylinder-port is indicated at *x'*, the ignition-port *q* and the inlet-port *p* may be about located as therein shown and respectively controlled by the pistons *g* and *h*, or said ports *q p* may be transposed and the exhaust-port *o* in liner be dispensed with and an exhaust-port communicating with inside of cylinder and controlled by a separate valve in usual manner provided, and the non-return valve *r'* in mixing-chest *r*, Fig. B, may be dispensed with by virtue of the inlet-port *p* being placed so as to be uncovered only during the inhaling stroke of motor-piston.

Fig. D illustrates improved means for facilitating the renewal of the igniting hot tube *g'* of one cylinder while the other cylinder is driving engine. A hollow case *d'* is fixed by the flange *n'* with the orifice *e'* over or open to the ignition-port *q* of engine valve-case and has another orifice *f'*, over and open to

which is fitted the hot tube g', which is kept incandescent hot in the ordinary way. The case d' is fitted with a pin-valve h', which is ground on both faces i', so as, when full outward, to bear against a ground face of cover l' and prevent escape past screw j and when screwed full inward to bear against ground face m' of case d', and thereby close communication between port q and inside of hot tube g', which said tube may then be withdrawn and replaced by a new tube, which when again fixed in place, the pin h' is screwed out by screw and hand-wheel j' to position shown, thus again opening passage.

What we claim, and desire to secure by Letters Patent of the United States, is—

1. A gas or combustible vapor motor engine, comprising two motor cylinders 1 and 2 fitted respectively with pistons 19, 20, and open at one end to atmosphere; piston rod 18 working fluid-tight through cylinder cover 16; casings 14, 15, each having ports o, p, q, controlled by a piston g, on rod j, wrought by valve shaft m geared two to one with crank shaft 5: all arranged, combined and operating, substantially as hereinbefore described, and shown.

2. The combination, with a gas engine comprising a motor cylinder 2 having a piston 20 and connecting-rod 4, giving one impulse every two revolutions to a crank-shaft 5; of a second motor cylinder 1, mounted concentric with cylinder 2 and open at its inner end to atmosphere, and fitted with a piston 19 on piston rod 18, having packing rings 22 sliding inside a liner 21 in cylinder cover 16 and having a valve case with ports o, p, q, controlled by a piston valve g; all arranged and operating substantially as hereinbefore set forth, and shown at Figs. A and B.

3. In a gas engine comprising two four stroke cycle motor cylinders and pistons, the combination with each cylinder and communicating therewith, of a valve case having located about midway therein a motor fluid inlet port p and alongside said port p a small ignition port q, and also toward the controlling valve g an exhaust grated port o, said ports being controlled by a balanced piston valve g on a rod reciprocated by mechanism geared two to one off crank shaft, all as and for the purposes described and shown at Fig. A.

4. In a gas engine, the combination of two four stroke cycle motor cylinders communicating each with a valve chamber having toward one end a motor fluid inlet port p, controlled by a piston valve h, and toward the other end of said case an igniting port q controlled by a balance piston valve g; and the cylinder port x' being located midway; all as and for the purposes set forth and shown at Fig. G.

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