No. 658,595. Patented Sept. 25, 1900.

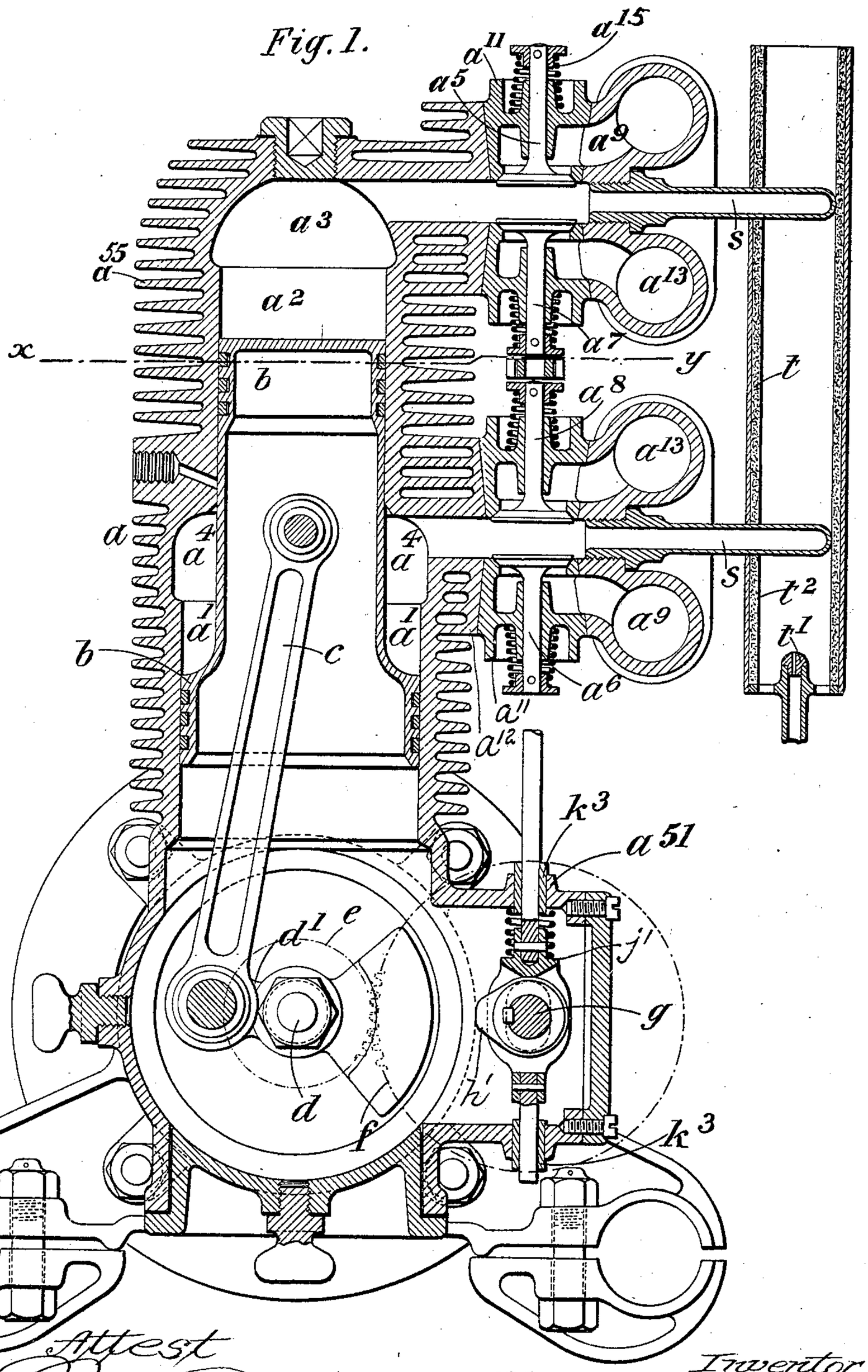
W. E. SIMPSON.

INTERNAL COMBUSTION MOTOR.

(Application filed Apr. 26, 1900.)

(No Model.) 3 Sheets—Sheet 1.

Fig. 1.



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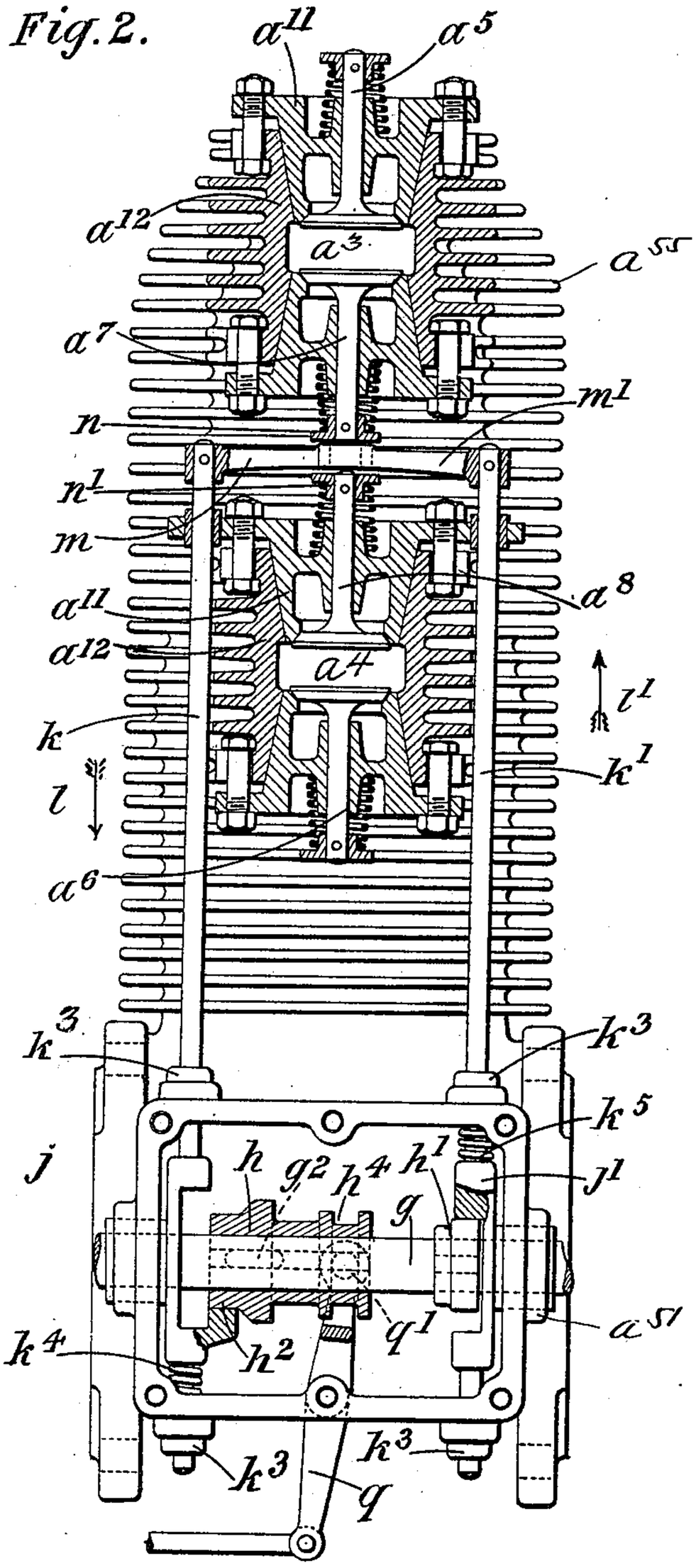
3 Sheets—Sheet 2.

Fig. 2.



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(No Model.) 3 Sheets—Sheet 3.

Fig. 3.

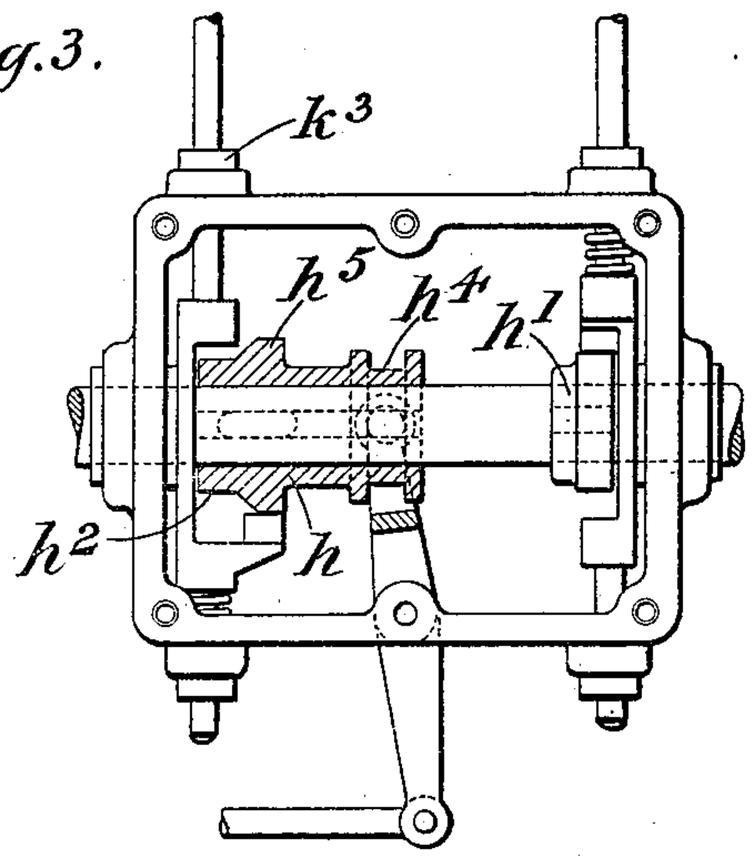

Fig. 4.

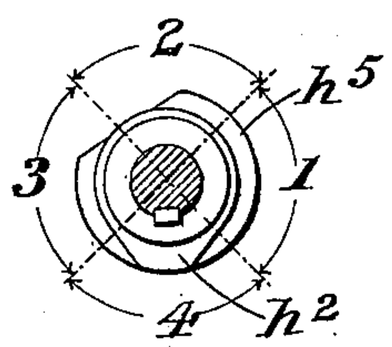

Fig. 5.

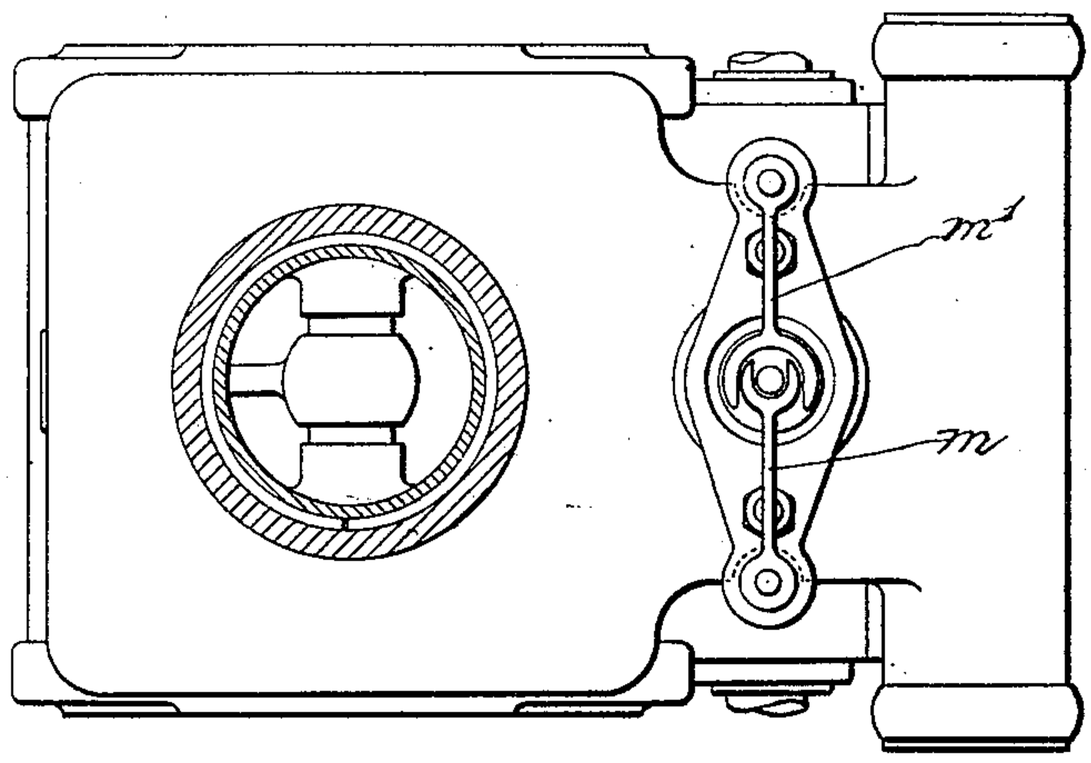

Fig. 6.

Fig. 7.

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UNITED STATES PATENT OFFICE.

WILLIAM EDMUND SIMPSON, OF LONDON, ENGLAND.

INTERNAL-COMBUSTION MOTOR.

SPECIFICATION forming part of Letters Patent No. 658,595, dated September 25, 1900.

Application filed April 26, 1900. Serial No. 14,489. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM EDMUND SIMPSON, a subject of the Queen of England, and a resident of 28 Victoria street, Westminster, London, England, have invented certain new and useful Improvements in Internal-Combustion Motors, (for which I have obtained a patent in Great Britain, No. 9,977, bearing date May 11, 1899,) of which the following is a specification.

This invention relates to the construction of gas and oil motors working on the "Otto" or four-stroke cycle, whereby such motors are capable of developing various degrees of power for working at various loads and whereby they are rendered particularly serviceable for the propulsion of vehicles. In such motors as at present employed for the propulsion of vehicles the economy is low on account, more particularly, of the fact that in order to provide a reserve of power for hill-climbing, for heavy loads, and for other varying conditions of service the size of the motor must be about twice that required under the ordinary conditions of working on the level, and the motor is consequently working during the greater part of the time under light load with poor economy, while, moreover, owing to the infrequency of the working impulses greater weight is necessary as the result of the greater fly-wheel power required. According to the present invention the power developed in the cylinder is divided so as to yield, preferably, two alternate effective impulses, so that thereby an impulse occurs at each outward stroke for working at full load, while either or any of the impulses in which the power is distributed may be dispensed with when working under light loads.

An important object of this invention is to insure that the thrust upon the connecting-rod shall be constantly in one direction, whereby knocking of the parts at high speed and wear and tear are consequently reduced.

The invention is embodied in a motor which is illustrated in the accompanying drawings, in which—

Figure 1 is a vertical section; Fig. 2, a front elevation, partly in section, showing the valve-operating mechanism. Fig. 3 is a part view corresponding to Fig. 2, showing the alternate position of one of the exhaust-valve cams. Fig. 4 is a detailed view, in side elevation, of the exhaust-valve cams, on which is indicated the cycle of operation. Fig. 5 is a plan on the line X X, Fig. 1. Figs. 6 and 7 are indicator-diagrams illustrative of the operation of the motor.

As illustrated in the accompanying drawings, the cylinder a is provided with an internal bore of varying diameter, the outer end a' being preferably about twice the area of the inner end A^2, and a compression-space a^4 being provided between the parts a' and a^2 and a further compression-space a^3 at the inner end of the cylinder. A shouldered trunk-piston b is provided in length and diameter to correspond with that of the cylinder a, having its inner and outer ends of a diameter corresponding to that of the parts a^2 and a' of the cylinder. Two independent working chambers are thus formed, one being at the inner end of the cylinder and the other in the annular space between the main body of the trunk-piston and the larger diameter of the outer end a' of the cylinder. The piston b is connected by a connecting-rod c to a crank d' on a crank-shaft d. The cylinder a and the valve-boxes are provided with a series of ribs for the rapid radiation of the heat developed in the cylinder.

Each working chamber is provided with a set of inlet and exhaust valves a^5 and a^6 and a^7 and a^8, respectively. The inlet-valves a^5 and a^6 are preferably of the suction type and are each mounted within a valve-box a^{11}, suitably bolted to the casing a^{12}, which is integral in one casting with the cylinder a, and each of the valves is held to its seat by such means as a spiral spring a^{15}, abutting, respectively, against the valve-box and a collar fixed to the outer extremity of the valve-spindle. The mixture of vapor and air from the carbureter passes through the inlet-valves from and through the passages a^9 in the casing. Both of the exhaust-valves a^7 and a^8 are preferably provided of the same form as the inlet-valves and are mounted in position opposite to them in the valve-casings a^{12}, and each controls the exhaust-passage a^{13} within the valve-casings, and the valves are operated alternately by a mechanism hereinafter described.

The explosive charge for each of the working chambers may be drawn from a carbureter of any suitable form, in which light oil is preferably employed, the carbureter being connected by suitable pipe connections to the valve-casings a^{12}, by which the mixture of gas and air is enabled to pass through the passages a^9 through the respective inlet-valves a^5 and a^6 to the working chambers.

The valve mechanism is operated from the cam-shaft g, which is mounted in the frame a^{51}, provided in one casting with the cylinder a. The cam-shaft g is driven by the usual two-to-one gear e and f and has mounted thereon two cams h and h', one of which, h', operates the exhaust-valve a^7 by raising the yoke j' and the connecting-rod k' in the direction of the arrow l', the yoke j' and rod k' sliding within guide-bearings k^3. The yoke j' is so slotted as to encircle the shaft g, as illustrated in Fig. 1, the slot being of such dimensions as to permit of the necessary vertical movement. The bearing-face of the yoke is held in contact with the cam h' by means of the spring k^5. The other cam h operates the valve a^8 by pulling downward the yoke j, which is adjacent to it and which also encircles the shaft g in the direction of the arrow l, the yoke being connected to the connecting-rod k and the yoke and rod being guided within guide-bearings k^3. The yoke is maintained in contact with the cam h by means of the spiral spring k^4. The rods k and k' are provided, respectively, with arms m and m', adapted to press upon the collars n and n', secured to the stems of the respective exhaust-valves a^7 and a^8. In order to minimize the distance between the collars n and n' of the valve-stems, the arms m and m' are arranged to work one within the other, as illustrated in the plan, Fig. 5. It will thus be understood that the respective cams h and h' cause the valves a^7 and a^8 to alternately open upon the backward movement of the trunk-piston b at intervals of half a revolution of the shaft g, thereby permitting of the exhaust-gases being discharged, respectively, from the working chambers a^3 and a^4. Thus at each rearward movement of the piston the explosive charge in one or other of the chambers will be compressed, so that thereby the connecting-rod will be put in compression in each of the backward as well as the forward strokes of the piston, maintaining thereby a constant thrust. Means are provided for throwing either of the working chambers a^3 and a^4 out of action when the load is light; but it is most important that the constant thrust upon the connecting-rod c before referred to shall be insured, although a chamber is so thrown out as to prevent undue vibration and wear of the bearings, which would otherwise occur. Thus when a chamber is thrown out of action by cutting off the supply from the carbureter the valve-gear may continue to work, so that the piston will continue to draw in air only and to compress it up to or partly up to the ordinary pressure of compression and to discharge it through the exhaust-valve in the same manner and in the same time as would be done with the products of an explosion in ordinary working. This is shown in an imaginary indicated diagram, Fig. 6, in which the dotted line o is the expansion line or working line, while the full lines o' show the compression and reëxpansion of the air when the supply of gas or vapor is cut off. It is preferred, however, to effect the throwing out of action of a chamber by keeping the exhaust-valve open and allowing the piston to draw in and expel products from and into the exhaust-pipe alternately and to allow the exhaust-valve to close before the end of what in ordinary working would be the compression-stroke, whereby a quantity of the said products is compressed to maintain the outward thrust. The necessary means for accomplishing this is illustrated in Figs. 1, 2, 3, and 4 of the drawings, in which the cam h is so arranged and provided as to permit of the exhaust-valve a^8 to be thus opened for putting out of action the working chamber a^4. In Fig. 2 the cam h for operating the exhaust-valve a^8 is shown in ordinary working position, in which the part h^2 of the cam bears on the yoke j, so as to open the valve during the exhaust-stroke. When, however, it is desired to throw the chamber a^4 out of action, the cam h is moved laterally upon the shaft g to the position indicated in Fig. 3. This is accomplished, for example, by arranging the cam h to slide upon a feather g^2 on the shaft g and providing the cam with a groove h^4, within which rollers or projections q' upon the bifurcated extremity of a lever q engage, so that upon the movement of the aforesaid lever the cam may be thus laterally adjusted into the position indicated in Fig. 3. The part h^5 of the cam (clearly seen in Fig. 4) bears on the yoke, so that the exhaust-valve is kept open for a longer period, being allowed to close only at the proper time for effecting a compression sufficient to maintain the constantly-outward thrust, as before described. It will thus be understood that as the exhaust-valve remains open throughout the suction-stroke and more the inlet-valve a^6 will fail to open, and thereby an explosive charge will not be taken into the chamber a^4. The detail of the cam h in Fig. 4 shows the respective operating parts h^2 and h^5 of the cam, having regard to the cycle of operation, which is indicated in that figure by the numerals 1, 2, 3, and 4, in which 1 represents the suction-stroke; 2, the compression-stroke; 3, the working stroke, and 4 the exhaust-stroke. Fig. 7 shows an imaginary diagram for the chamber a^4 when the exhaust-valve is maintained open, as before described, in which the dotted lines p indicate the action in normal working, while the full lines p' show

the compression and reëxpansion of the gases or products when the chamber is thrown out of action and no impulse is obtained.

It is preferred to effect the ignition of the explosive charges by means of incandescent tubes *s*, which are screwed into the valve-casing a^{12} in the space between the inlet and exhaust valves a^5 and a^7 and a^6 and a^8, respectively. The incandescent tubes are preferably heated by means of a single tube *t*, through which their extremities transversely protrude, as illustrated in Fig. 1. Any ordinary Bunsen burner or jet *t'* is provided and the tube lined with refractory material t^2. By such an arrangement both of the ignition-tubes employed are maintained in the heated condition by means of a single tube.

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

1. An internal-combustion motor, having in combination a cylinder of varying bore, a trunk-piston to form with said cylinder working chambers, an inlet-valve for each of the working chambers through which a gaseous explosive charge may be admitted into each of the said chambers, and an exhaust-valve for each of the working chambers, through which the products of combustion may be discharged, and means for holding open one of the exhaust-valves for the whole cycle of operations except and until almost the end of the ordinary compression-stroke, for the purposes and substantially as described.

2. In an internal-combustion motor in combination a cylinder having the outer end of a larger internal diameter than the inner end, a trunk-piston having its outer end of a larger diameter than its inner end, and of dimensions corresponding to the internal dimensions of the cylinder to form with said cylinder a working chamber at the inner end thereof and a second annular working chamber, an inlet-valve admitting a gaseous explosive charge into said working chambers, and an exhaust-valve through which the products of combustion may be discharged, and means for holding open one of the exhaust-valves for the whole cycle of operations except and until almost the end of the ordinary compression-stroke for the purposes and substantially as described.

3. In combination in an internal-combustion motor, a cylinder of varying bore, a trunk-piston to form with said cylinder working chambers, a connecting-rod and valve mechanism with means for controlling the same to supply the said chambers alternately with fuel or to cut off either chamber from its fuel-supply and to admit a non-explosive charge to the chamber thus cut off which charge is then compressed to maintain the thrust on the connecting-rod substantially as described.

4. In combination in an internal-combustion motor, a cylinder of varying bore, a trunk-piston to form with said cylinder working chambers, a connecting-rod and inlet and outlet valve mechanism with means for controlling the same to cut off either chamber from its fuel-supply and to permit the same to exhaust until almost the end of the ordinary compression-stroke, to maintain the thrust on the connecting-rod, substantially as described.

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

WILLIAM EDMUND SIMPSON.

Witnesses:
WILLIAM EDWARD EVANS,
ELLIS OWEN.