No. 860,125. PATENTED JULY 16, 1907.

L. BOUDREAUX & L. VERDET.

FLUID PRESSURE MOTOR.

APPLICATION FILED MAY 16, 1903.

2 SHEETS—SHEET 1.

FIG. 1.

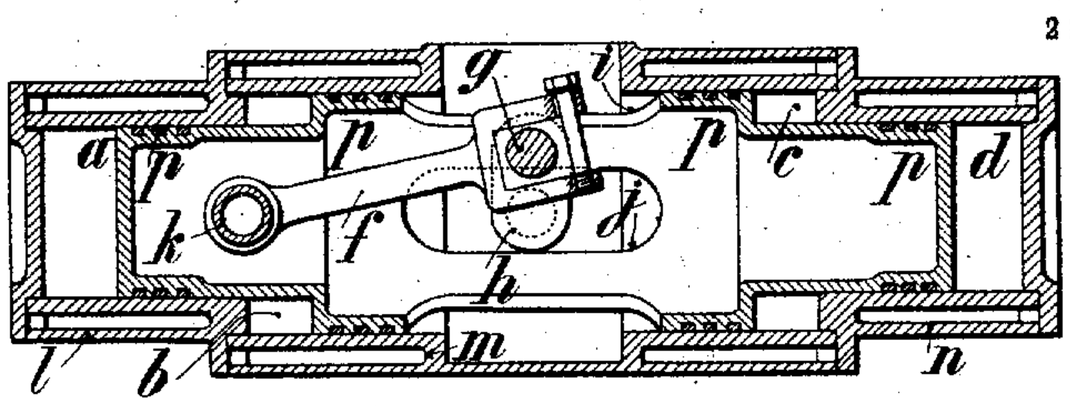


FIG. 2.

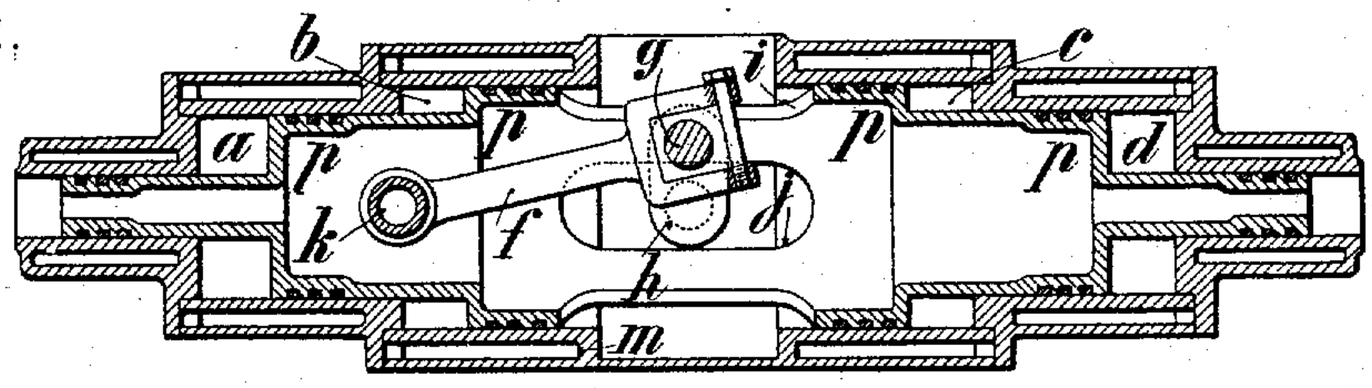


FIG. 3.

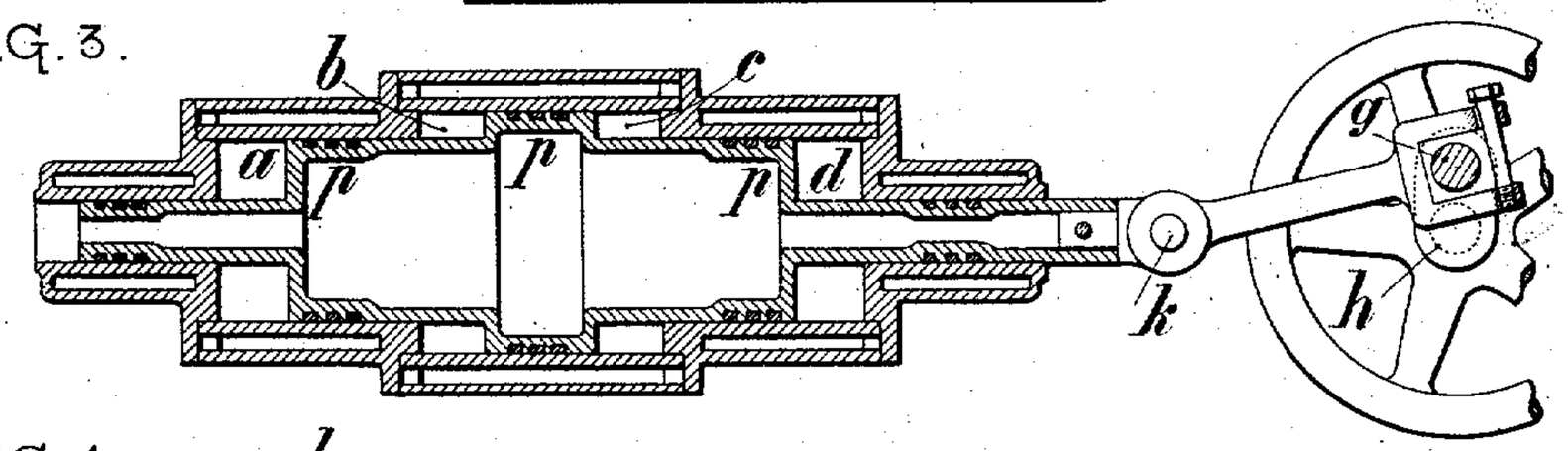


FIG. 4.

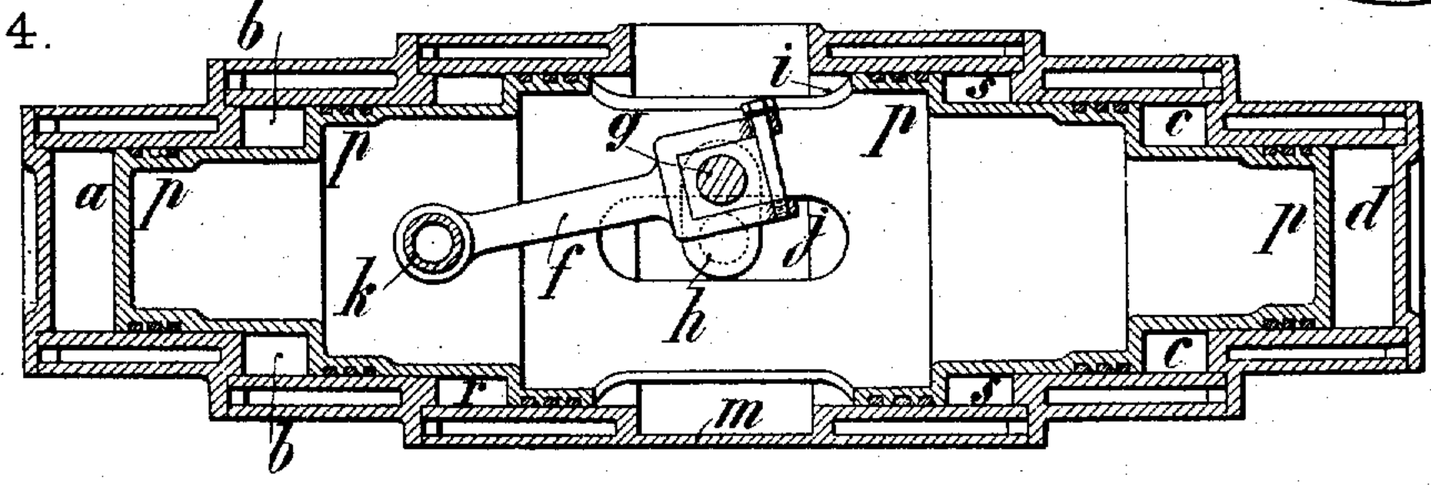


FIG. 5.

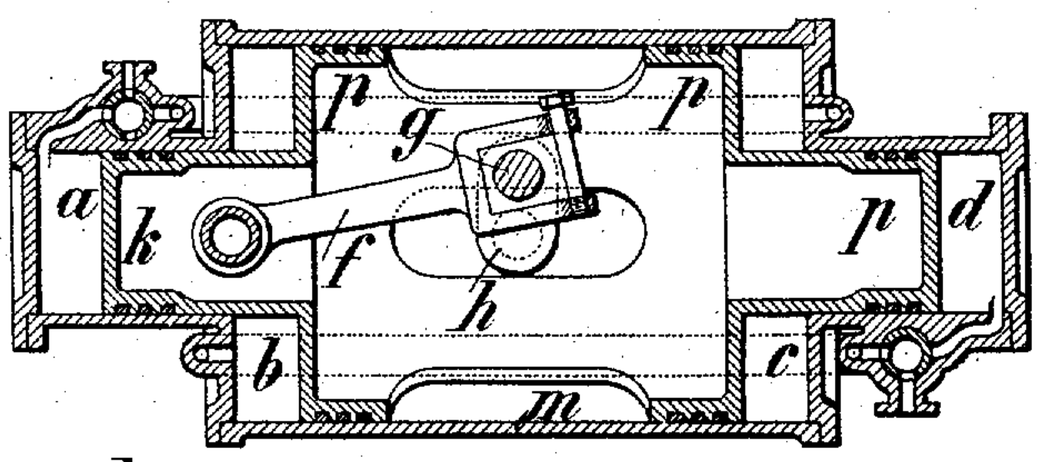
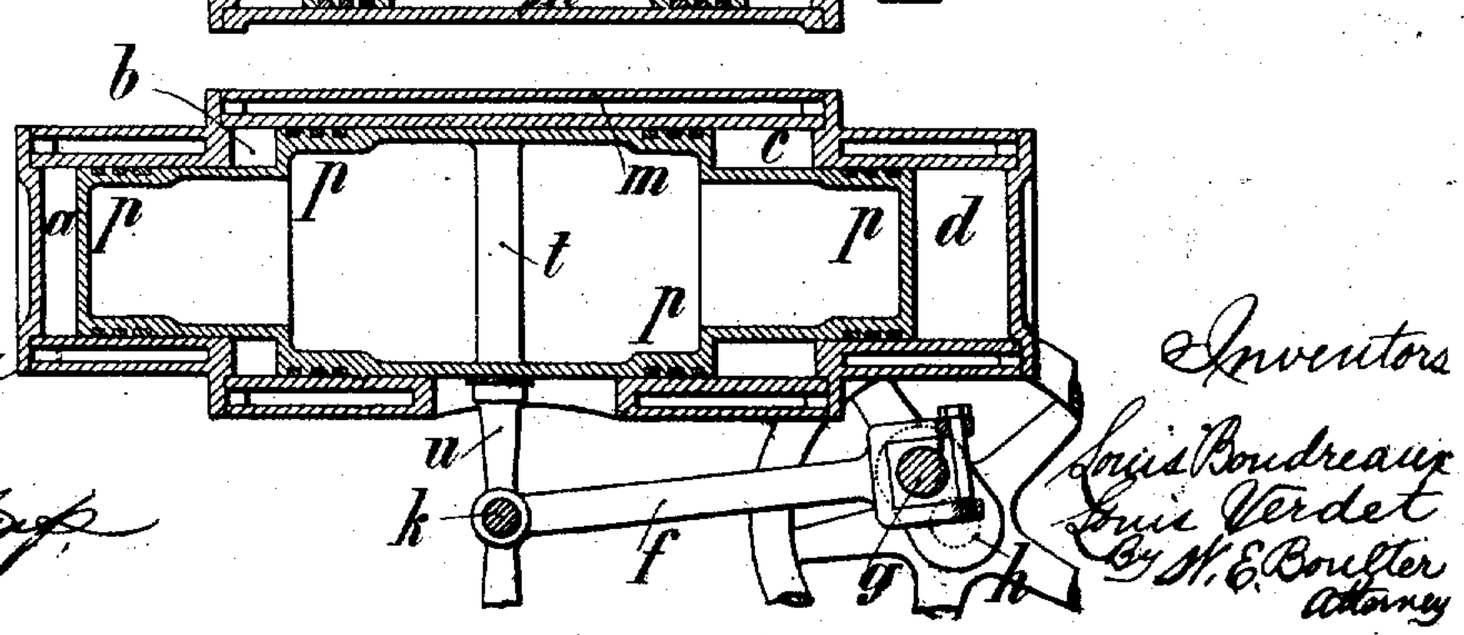


FIG. 6.



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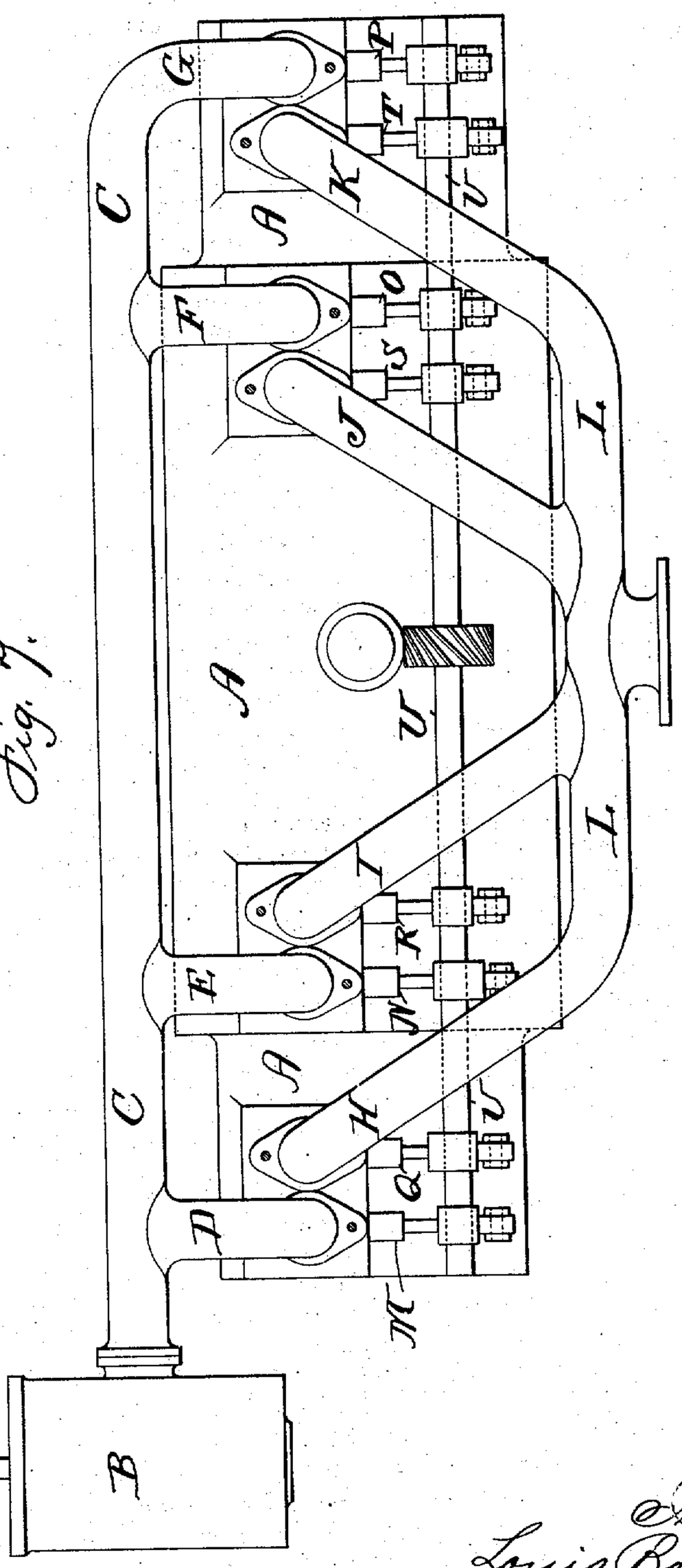
2 SHEETS—SHEET 2.

Fig. 7.



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UNITED STATES PATENT OFFICE.

LOUIS BOUDREAUX AND LOUIS VERDET, OF PARIS, FRANCE.

FLUID-PRESSURE MOTOR.

No. 860,125. Specification of Letters Patent. Patented July 16, 1907.

Application filed May 16, 1903. Serial No. 157,453.

To all whom it may concern:

Be it known that we, LOUIS BOUDREAUX and LOUIS VERDET, both citizens of the Republic of France, and residing at Paris, in France, have invented a certain new and useful Fluid-Pressure Motor, of which the following is a specification.

This invention relates to an engine which may be constructed in various ways and driven by explosions of a mixture of hydro-carbon vapors and air or by that of any suitable gas and air or by steam, compressed air or any other suitable compressed fluid. This engine can be built either as a four-stroke or two-stroke engine, and is chiefly characterized by its having four chambers constituting, either, in the case of a four-stroke engine four explosion chambers, or in the case of a two-stroke engine two air- and gas-suction chambers and two explosion chambers. The explosion acts on pistons connected together and working in the said chambers, said pistons transmitting the movement to the crank shaft by means of a single connecting rod and a single crank or any other suitable device of the same kind.

In the drawings, Figure 1 is a longitudinal section of one form of construction of the engine. Fig. 2 a longitudinal section of an engine shown in Fig. 1 modified so as to insure the cooling of driving parts. Fig. 3 is a longitudinal section of the construction shown in Fig. 2, the driving gear being arranged externally. Fig. 4 is a longitudinal section of the engine according to this invention arranged to be driven by explosion of a mixture of air and gas, these two fluids being compressed separately in the engine and by it. Fig. 5 is a longitudinal section of the same motor for working as compound by the expansion of any suitable compressed fluid, such as, for instance, steam, air, etc. Fig. 6 is a longitudinal section of the same engine, in which the driving gear is outside the cylinder instead of being inside as in Figs. 1, 2, 4 and 5. Fig. 7 is an elevation illustrating the carbureter and the motor with its inlet and exhaust valves and pipes and the shaft and cams for operating the valves.

A construction according to this invention is illustrated, by way of example, in Fig. 1 of the accompanying drawing which shows the engine in longitudinal section. The engine comprises a single cylindrical piston *p* reduced at both ends. The cylinders *l m n* are concentric and are also of different diameters corresponding to the sizes of the pistons. The piston *p* slides backwards and forwards in cylinders *l m n*. Owing to this arrangement there are four chambers *a b c d*. The piston *p* is shown in the drawing cast in one piece but it can of course be made in several pieces joined together. In the construction illustrated, a connecting rod *f* pivoted at *k* to the piston *p*, transmits the movement to the shaft *h* of the fly-wheel through the crank *g*, but it is obvious that any other suitable gear, internal or external, could be adopted, the arrangement of the motor remaining the same. The piston *p* is provided in the center with two slots *i*, sufficient for the passage of the crank *g*, and connecting rod *f*, and two other slots *j* for the crankshaft *h* of the engine.

In Fig. 7, A indicates the motor, B the carbureter with a branch tube C, with which communicate the inlet tubes D E F G of the cylinders. H I J K are respectively the exhaust pipes of the cylinders, which communicate with a common exhaust tube L. The inlet and exhaust are respectively controlled by valves M N O P for the admission and Q R S T for the exhaust, said valves being operated by cams, keyed on a shaft U driven from the engine.

The working of this engine when used as an explosion engine, is as follows:—

First. As a four-stroke engine.—In this case each of the chambers *a b c d* serves as a chamber of a four-stroke engine and constitutes a cylinder. The valve gear and the ignition are arranged and combined in such a manner that explosions take place in succession, so that one explosion brings about compression in the chamber in which the explosion is to take place next, this compression being effected without utilizing the momentum of the fly-wheel which is always necessary in other engines which have their cylinders side by side. In the construction shown in Fig. 1 explosions take place as follows:—first in *a*, second in *c*, third in *b*, fourth in *d*, and so on, or: first in *a*, second in *d*, third in *b*, fourth in *c*, and so on. But in both cases an explosion in one cylinder is always opposed by a compression in another cylinder.

Second. As a two-stroke engine.—The chambers *a* and *d* are explosion chambers: the chambers *b* and *c* are air- and gas-suction-chambers such as are commonly used in two stroke engines, whence their mixture can be forced direct into *a* and *d*, or into intermediate tanks. Of course, the functions of the chambers could be inverted.

In the construction shown in Fig. 2, the outside chambers *a d*, which, in the engine shown in Fig. 1, are closed, are formed with ports, whereby the central portion of the engine can be made to communicate with the atmosphere through a hollow extension of the piston, this affording natural ventilation of the inside of the engine by the reciprocating movement of the piston *p*.

The construction shown in Fig. 3 differs from that in Fig. 2 merely in that its driving gear being outside, the connecting rod *f* being connected to one of the hollow extensions of the corresponding piston, said parts forming a kind of hollow piston rod.

In the construction illustrated in Fig. 1 if the engine is to be used as a two-stroke motor, the compression of the gaseous mixture can be effected through the intermediary of the chambers *b* or *c* only in an auxiliary

tank, from which said mixture is successively supplied to the outside chambers *a*, and *d*. This arrangement is very suitable for liquid hydro-carbons, but when it is desired to use, as driving medium, ordinary gas, it is necessary to have a separate compressing chamber for air, and another for gas. This latter construction is shown in Fig. 4 from which it will be seen that the two parts of the motor, situated on each side of the central axis, each comprise a first explosion chamber *a* or *d*, a second chamber *b* or *c*, for compressing air and a third chamber *r* or *s* for compressing gas. In this construction, the gas and air are compressed during one stroke of the motor in the chambers arranged at the side opposite that in which the mixture acts, so that the actions tend to balance each other. The special arrangement of this engine with several opposite concentric chambers acting on a common central transmission gear, is also applicable to engines with simple or multiple expansion of any suitable fluid, steam, compressed air etc:. The chief advantage of this arrangement is the suppression of piston rods passing through stuffing boxes on the cylinder covers as well as of cross heads. This results in a considerable decrease of weight and friction. The expansion chambers of the motor can, in that case, be combined so as to obtain in the same cylinder simple, double or triple expansion, according to their number and arrangement.

Fig. 5 shows a construction of a double expansion engine for steam or other expansive fluid, in which the fluid having acted in *a*, is admitted into *c* so as to act at low pressure, on the return of the piston, simultaneously with high pressure steam admitted into *d*.

The various constructions with driving gear inside the cylinder would be, of course, equally well arranged with that gear outside, in a manner different from that shown in Fig. 3. Such an arrangement, shown in Fig. 6, consists in providing the piston *p*, in the center with a cross bar *t* projecting on one side beyond the piston by an arm *u* to which is connected the rod *f*, the other end of which acts on the crank *h* of the shaft *g* suitably supported outside the engine. In this construction a single opening in the cylinder *m* is sufficient for the passage of the arm *u* of the cross bar *t*. This arrangement enables two, or any desired number of, engines according to this invention to be connected to the same shaft by means of a single connecting rod coupled to a rod to which all the pistons are connected. By arranging the driving gear outside the engine, it is very easy to cool the piston in the case of an explosion engine by means of a suitable liquid.

In the construction shown in Fig. 3 the liquid can circulate through one of the ends of the piston while in the construction shown in Fig. 5 the liquid could be introduced laterally through a recess at any point in its middle, either by means of a pump operated from the piston, or by a flexible hose.

What we claim as new and desire to secure by Letters Patent is:—

1. An internal combustion engine comprising a main centrally arranged cylinder, two other cylinders of smaller diameter than, and arranged at the ends of, said main cylinder, and two cylinders of smaller diameter than and arranged at the outer ends of said cylinders in combination with a tubular multiple piston, having stepped portions sliding in the cylinders respectively, packing devices carried by each of the said stepped portions, a single pitman member attached to said multiple piston and a crank shaft driven thereby substantially as set forth.

2. In an internal combustion engine comprising a main centrally arranged cylinder, two other cylinders of smaller diameter than, and arranged at the ends of, said main cylinder, and two cylinders of smaller diameter than and arranged at the outer ends of said cylinders in combination with a tubular multiple piston, having stepped portions sliding in the cylinders respectively, packing devices carried by each of the said stepped portions, a single pitman member attached to said multiple piston and a crank shaft centrally situated in the main cylinder substantially as set forth.

3. The combination, with a main, centrally arranged, cylinder, two other cylinders arranged at the ends of said main cylinder and two cylinders, arranged at the end of said cylinders, of a tubular multiple piston having bearing surfaces which slide in the five aforesaid cylinders, a single pitman member attached to said multiple piston and a crank shaft driven thereby substantially as set forth.

4. The combination, with a main, centrally arranged, cylinder, two other cylinders arranged at the ends of said main cylinder and two cylinders, arranged at the end of said cylinders, of a tubular multiple piston having bearing surfaces which slide in the five aforesaid cylinders, a single pitman member attached to said multiple piston and a crank shaft centrally arranged in the main cylinder substantially as set forth.

5. An internal combustion engine comprising a main centrally arranged cylinder, two other cylinders of smaller diameter than, and arranged at the ends of, said main cylinder, and two rearwardly closed cylinders of smaller diameter than and arranged at the outer ends of said cylinders in combination with a tubular multiple piston, having stepped portions sliding in the cylinders respectively, packing devices carried by each of the said stepped portions, a single pitman member attached to said multiple piston and a crank shaft driven thereby substantially as set forth.

6. In an internal combustion engine comprising a main centrally arranged cylinder, two other cylinders of smaller diameter than and arranged at the ends of, said main cylinder, and two rearwardly closed cylinders of smaller diameter than and arranged at the outer ends of said cylinders in combination with a tubular multiple piston, having stepped portions sliding in the cylinders respectively, packing devices carried by each of the said stepped portions, a single pitman member attached to said multiple piston and a crank shaft centrally situated in the main cylinder substantially as set forth.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

LOUIS BOUDREAUX.
LOUIS VERDET.

Witnesses:
LOUIS SULLIGER,
J. ALLISON BOWEN.