No. 863,142.

PATENTED AUG. 13, 1907.

L. BOUDREAUX & L. VERDET.

EXPLOSIVE ENGINE.

APPLICATION FILED FEB. 24, 1906.

3 SHEETS—SHEET 1.

FIG. 1.

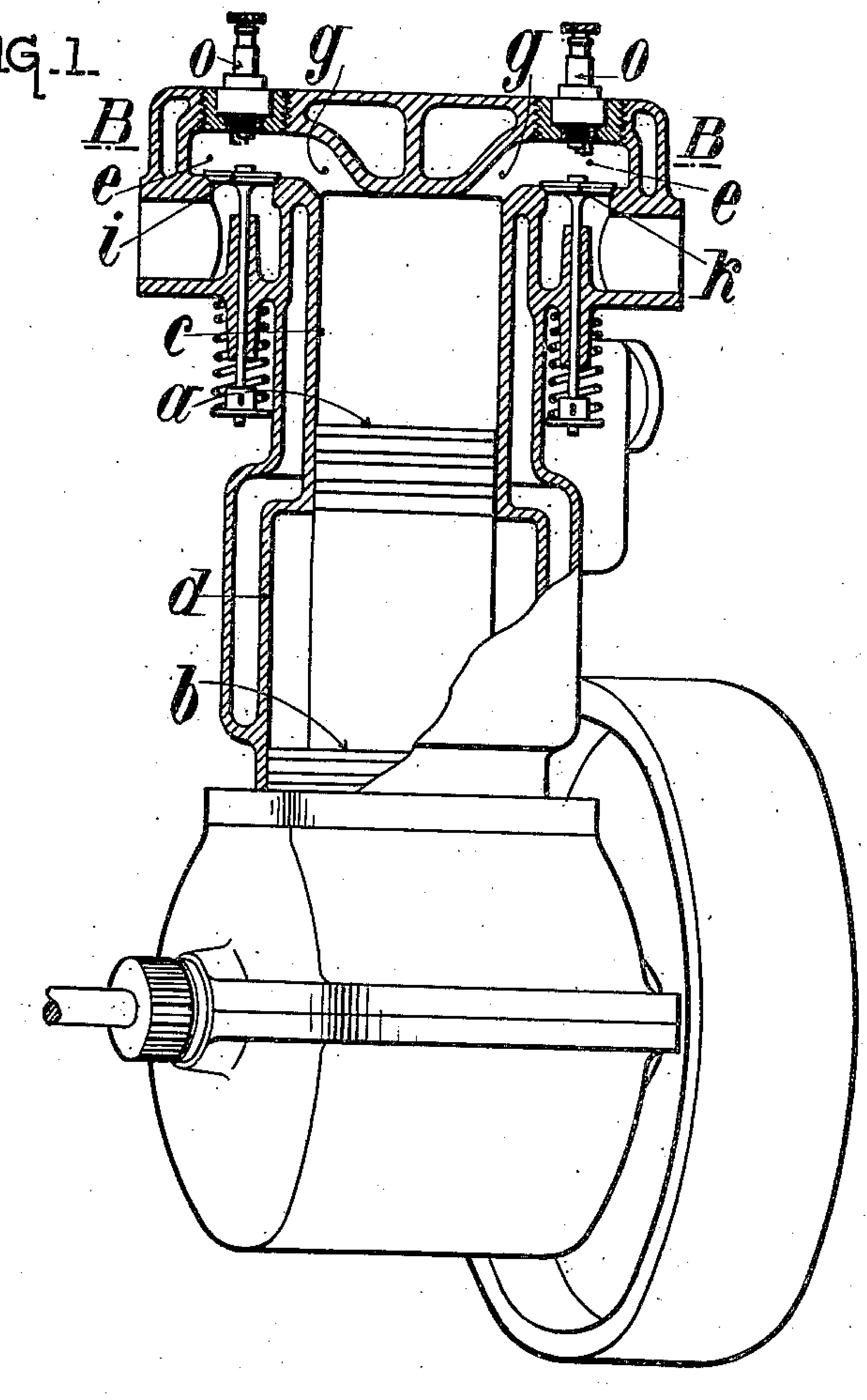
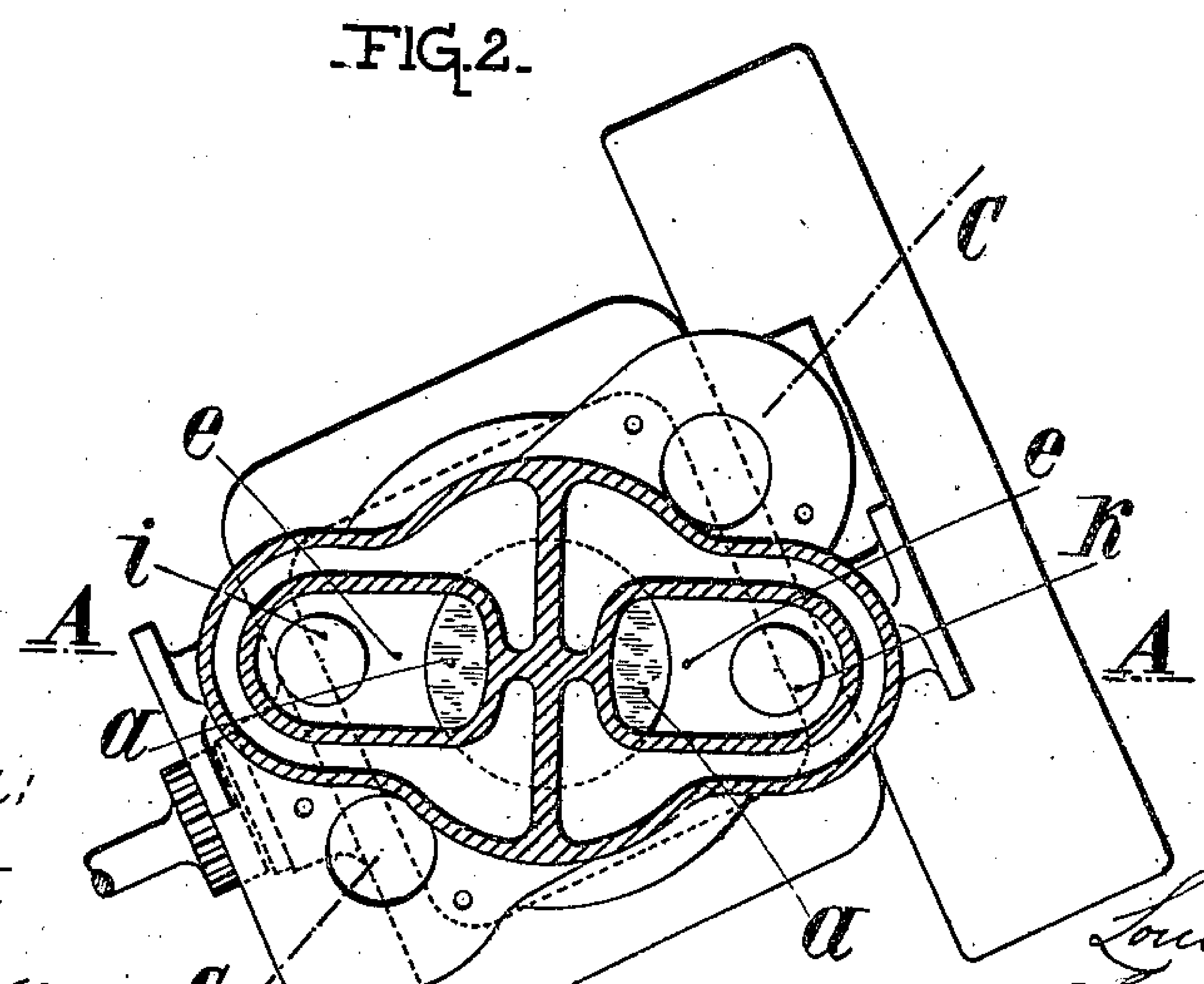


FIG. 2.



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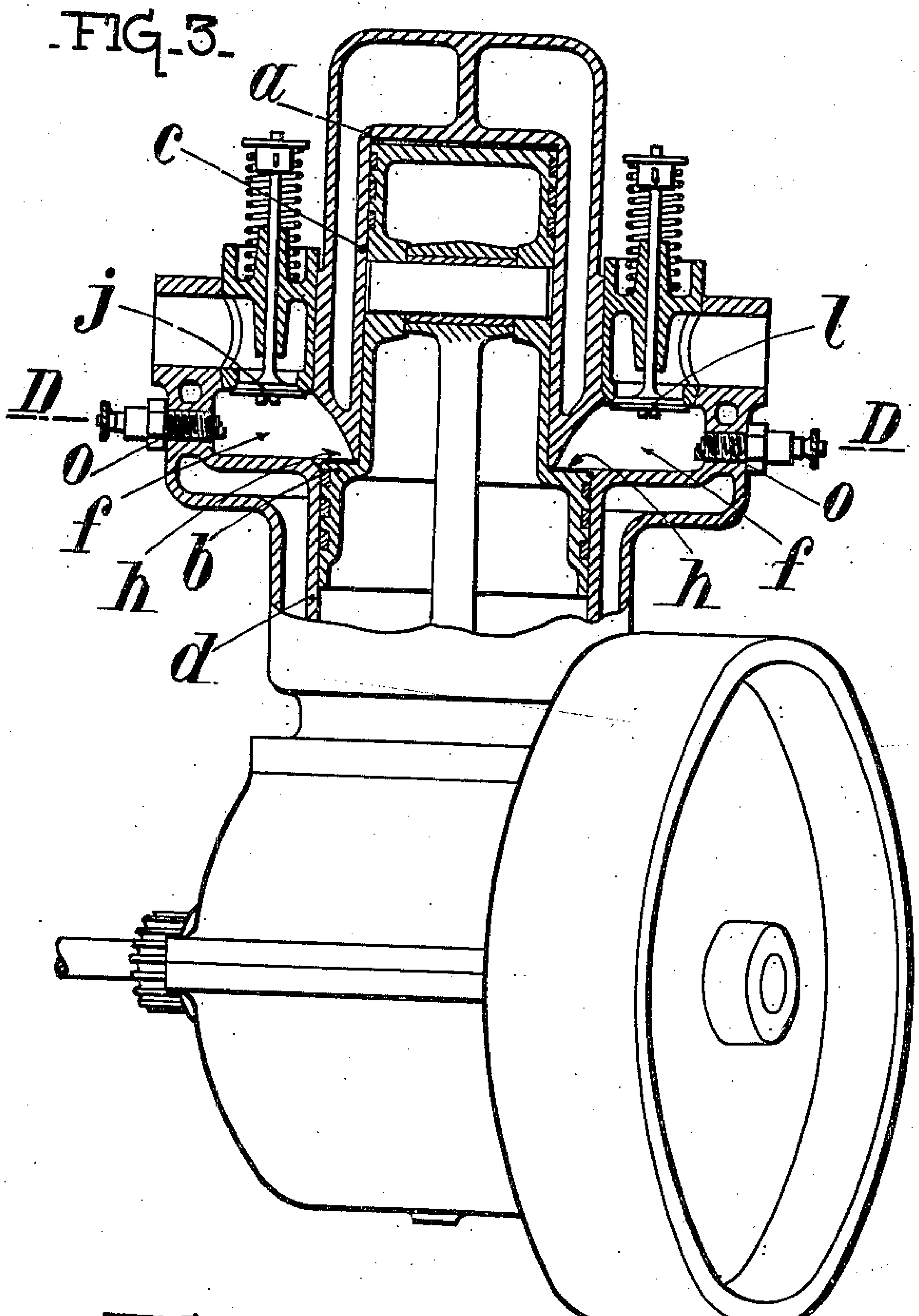
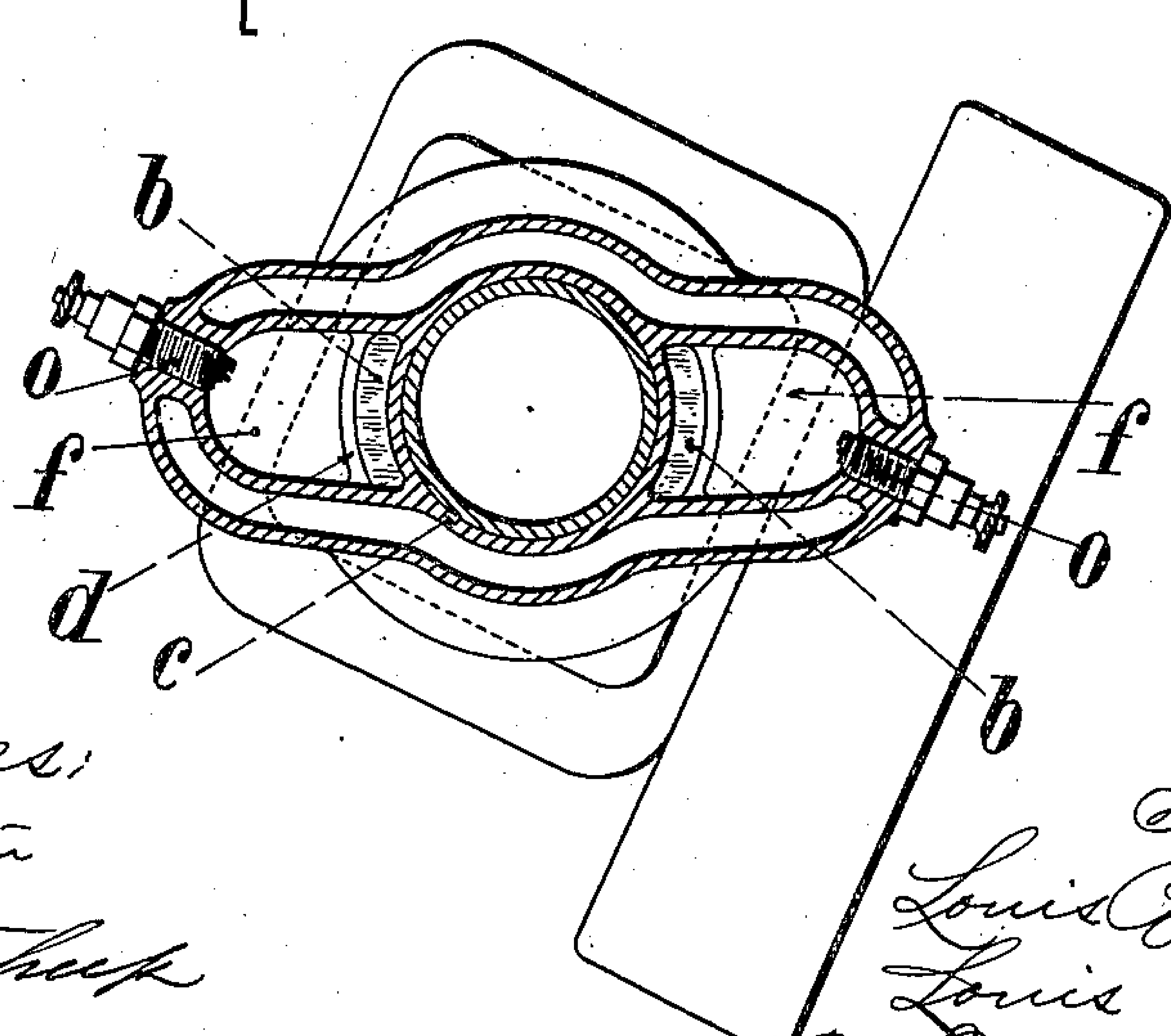
3 SHEETS—SHEET 2.

-FIG-3-



-FIG-4-



Witnesses:
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3 SHEETS—SHEET 3.

FIG. 5.

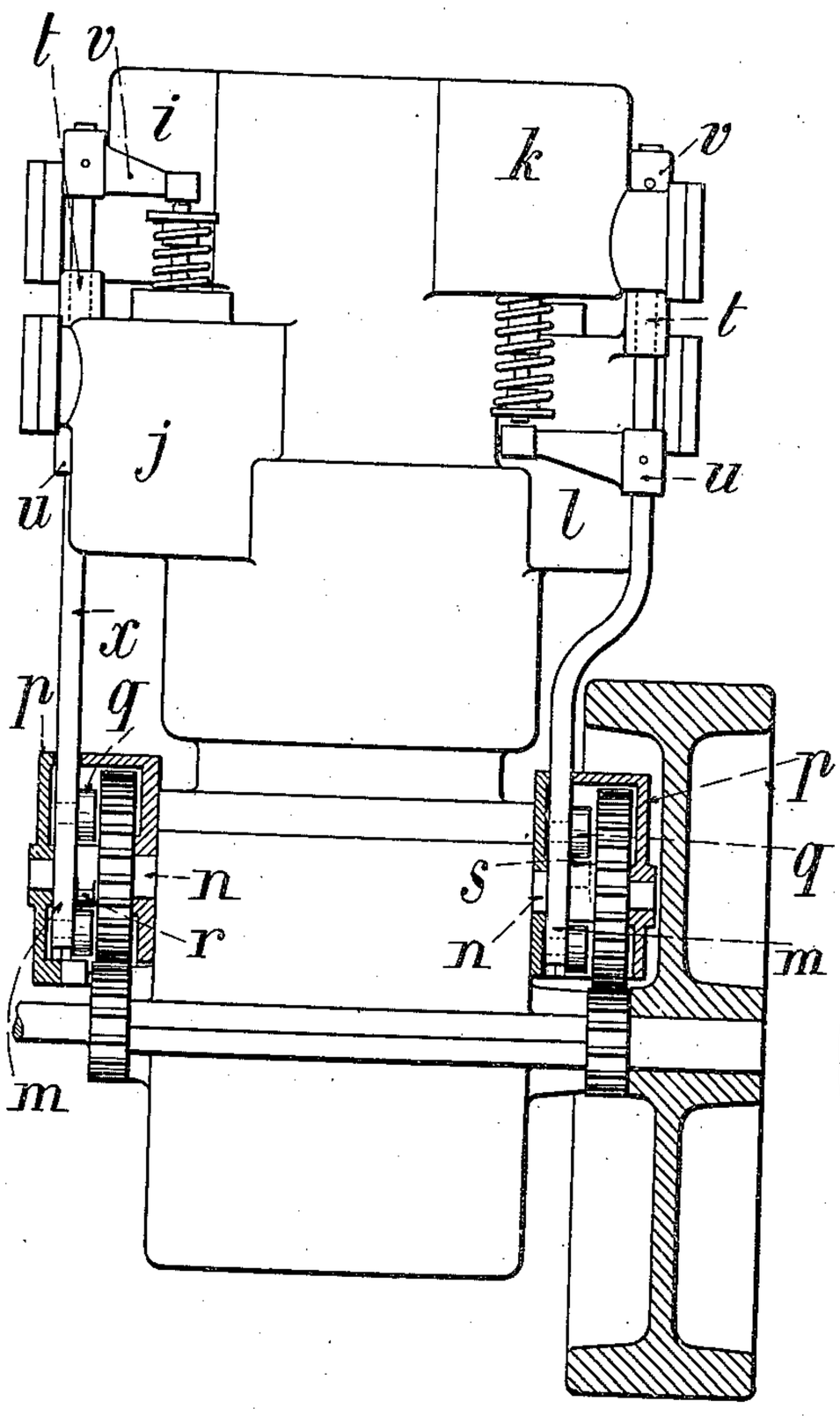
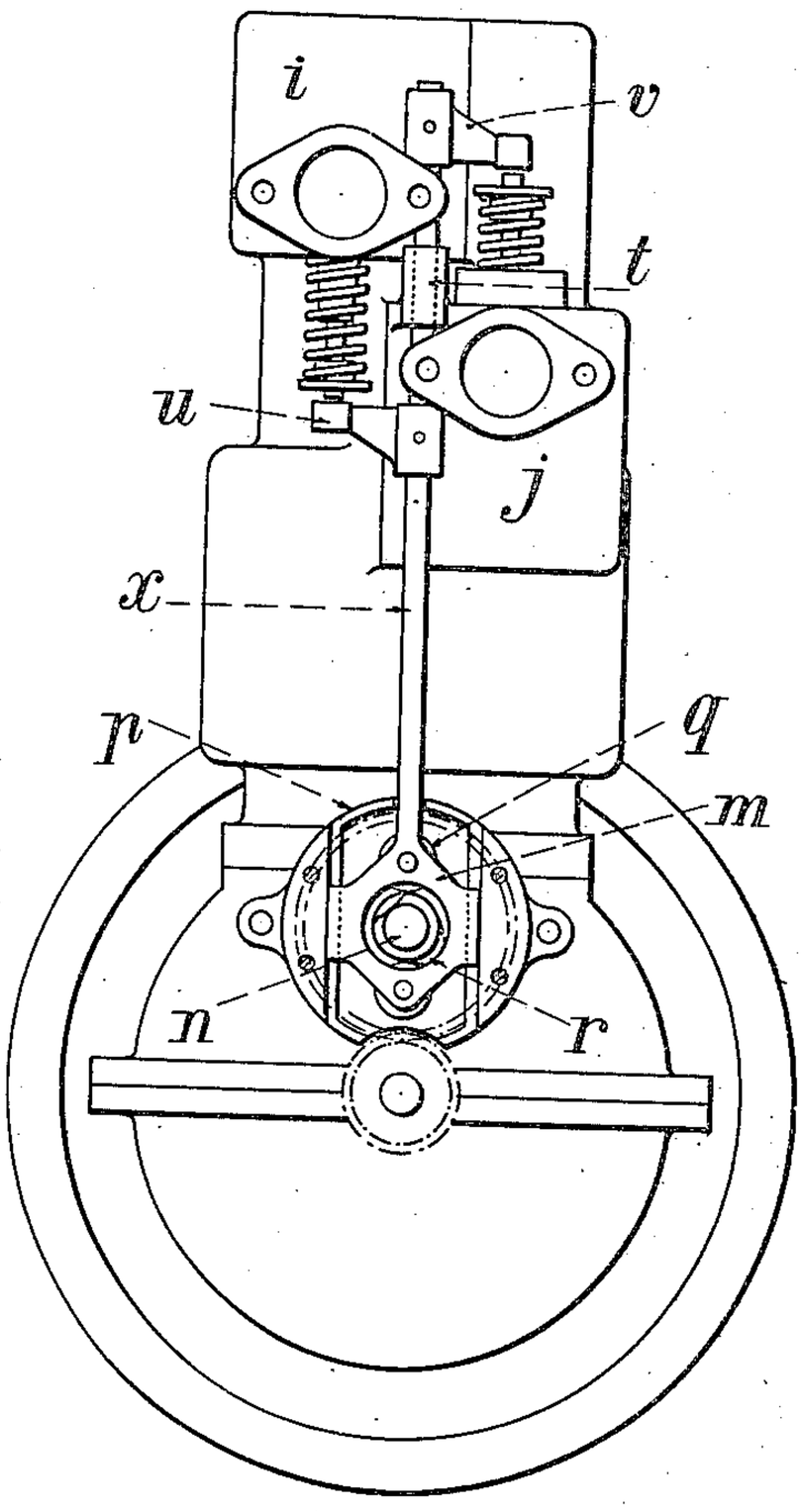


FIG. 6.



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UNITED STATES PATENT OFFICE.

LOUIS BOUDREAUX AND LOUIS VERDET, OF PARIS, FRANCE.

EXPLOSIVE-ENGINE.

No. 863,142. Specification of Letters Patent. Patented Aug. 13, 1907.

Application filed February 24, 1906. Serial No. 302,737.

To all whom it may concern:

Be it known that we, LOUIS BOUDREAUX and LOUIS VERDET, citizens of the French Republic, residing at Paris, in France, have invented certain new and useful Improvements in Explosion-Engines, of which the following is a specification.

This invention relates to improvements in explosion engines with differential pistons arranged and working in common cylinders, for the purpose of increasing the efficiency of these engines, while preserving the great advantages that they have over ordinary engines with separate cylinders.

The reasons for which the annular cylinder charge of an engine with differential piston of well known constructions, does not give, with equal surfaces, a thermal efficiency as high as the efficiency of a cylinder charge of an engine with separate pistons, are as follows:—In an engine with differential piston of well known construction, the chamber for the explosion of the annular cylinder charge comprises two portions: a gaseous mass compressed in the valve chest, and an annular space formed round the portion of small diameter of the piston when the latter is at the end of its stroke. The result is that the ignition of the gases compressed in these two spaces, requires time proportional to the distance separating the point at which the said ignition takes place, from the diametrically opposite point of the annular space, so that this ignition takes place slowly. These drawbacks do not exist in a compression chamber of ordinary cylinder, in which the spaces are more compact, and in which the mass of compressed gases is less spread out.

This invention has for its object to avoid these drawbacks inherent to the well known engines with differential pistons by employing the construction illustrated in the accompanying drawings and described hereinafter. This arrangement is shown, by way of example, in the accompanying drawing, in which:—

Figure 1 shows an engine comprising the said device, in vertical section along an oblique plane relatively to the axis, that is to say on line A—A of Fig. 2 which is a horizontal cross-section of the said engine on line B—B of Fig. 1. Fig. 3 is another vertical section on line C—C of Fig. 2. Fig. 4 is a horizontal cross-section on line D—D of Fig. 3. Fig. 5 is an elevation partly in section showing the means for operating the inlet and exhaust valves. Fig. 6 is a side elevation of Fig. 5.

According to this invention, the two operative faces *a b* of the differential piston (*a* the circular and *b* the annular face) at the end of the compression and exhaust stroke, come nearly in contact with the corresponding ends of the two portions *c d* of the cylinder. The explosion chambers of each of the cylindrical portions *c d* are constituted by a suitable number of spaces *e e* and *f f*, opening into the said portions through openings *g* and *h* of suitable cross-section. These spaces *e e* and *f f* are each provided with an ignition device *o* and controlled by the suction valves *i j* and exhaust valves *k l*. Owing to this arrangement, when the compression is complete, the entire charge of gas is forced into each of the chambers *e e* and *f f*, so that at the moment of ignition, the gaseous masses, confined in these chambers, explode in the minimum of time and with the maximum of energy. It will be sufficient therefore to give to the engine, according to its speed of rotation, the lead required for the total ignition of the gaseous masses, in order that the said ignition should take place at the moment when the piston arrives at the end of its stroke. Immediately after the explosion, the piston continuing its stroke, the gases expand on each of the operative faces of the differential piston and produce their driving effort. Moreover, it must be pointed out that, by dividing the explosion chamber into a more or less great number of equidistant chambers, each provided with an ignition device, a more normal distribution of the forces on each of the operative faces of the differential piston is obtained. This division or distribution of the explosion chamber into several equidistant and compact chambers, also enables the ignition speed to be accelerated by reducing the distance to be traveled by the flame.

The controlling gear for the admission and exhaust valves, arranged respectively on each side of the motor, can be of any suitable kind as for example that represented in Figs. 5 and 6.

According to this arrangement, for each group of valves *i*, *j*, or *k*, *l*, there is arranged around a half-speed shaft *n*, a frame *m* moving vertically in the slides of a box *p* fixed on the gear-case of the motor. This frame *m* carries two rollers *q* arranged one on either side of the shaft *n*, and adapted to come into contact with a cam *r* or *s* on said shaft. The frame *m* carries a rod *x* suitably guided in a bearing *t* and provided above and below this bearing with tappets *u* and *b*. When the cams *r* and *s* act respectively on the corresponding frames *m* to cause them to rise, the lower tappets *u* operate the rods of the valves of the cylinder of small diameter, while, when the cams *r* and *s* cause the frames *m* to descend, the upper tappets *v* act on the rods of the valves of the cylinder of large diameter. The tappets *u* and *v* on each rod *x* are arranged in such a manner as normally not to touch the rods of the two valves, so that these remain closed when the frame is in its medium position relatively to the shaft *n*.

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

In an explosion engine the combination of a differential cylinder a differential piston adapted to reciprocate within the cylinder, an inlet and an outlet valve in communication with the lesser portion of the cylinder bore and an inlet and an outlet valve in communication with the larger portion of the cylinder bore, a plurality of explosion chambers some in communication with the lesser portion of the cylinder, and the others in communication with the larger portion of the cylinder, said explosion chambers opening into the cylinder at points immediately above the faces of the piston when the latter is at the end of its in-stroke, and an ignition device arranged in each explosion chamber.

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

LOUIS BOUDREAUX.
LOUIS VERDET.

Witnesses:
HANSON C. COXE,
GEORGES BONNEUIL.