No. 787,925. PATENTED APR. 25, 1905.

R. H. LAYTON & J. E. PFEFFER.

EXPLOSIVE ENGINE.

APPLICATION FILED MAY 14, 1903.

3 SHEETS—SHEET 1.

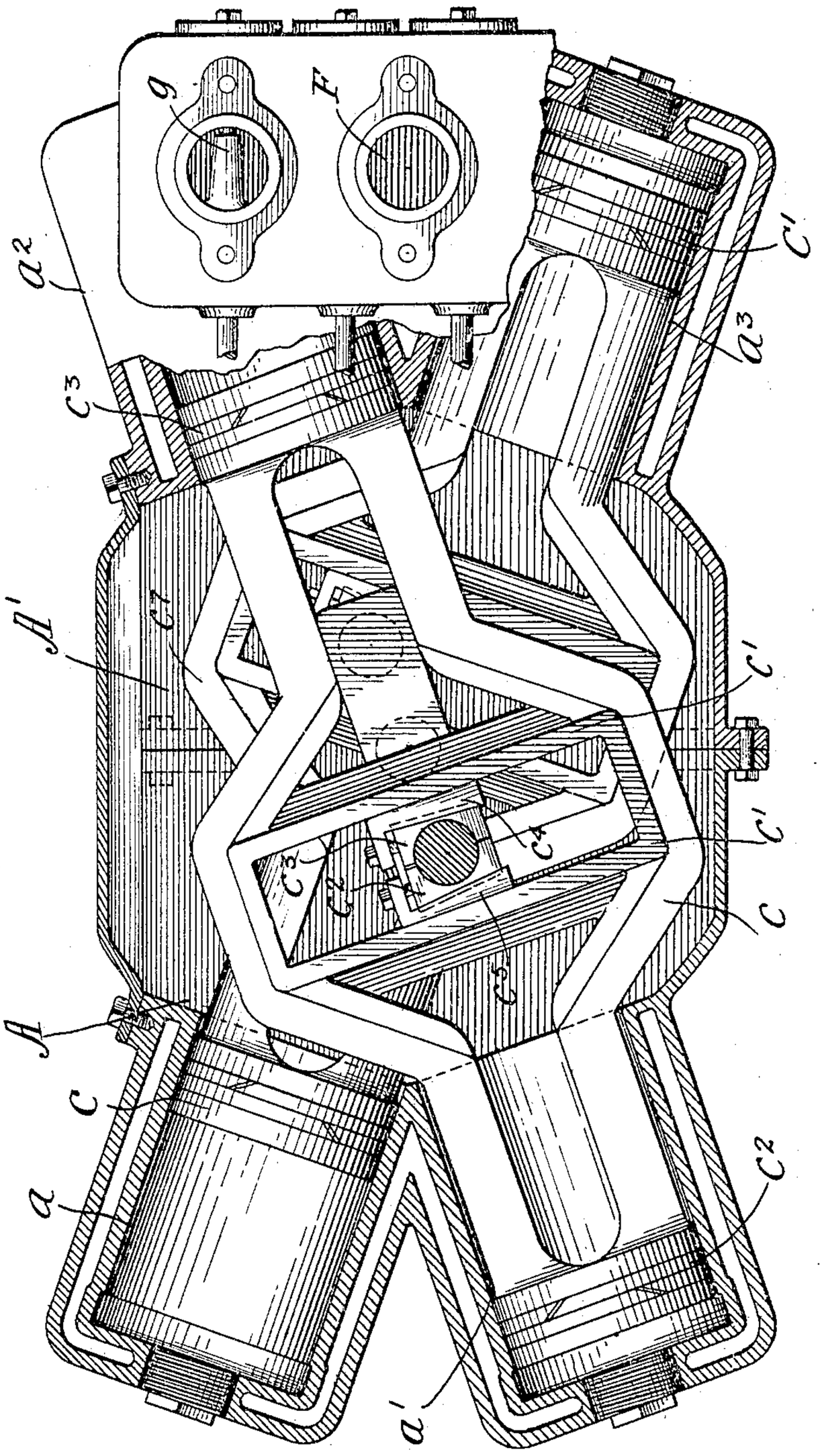

Fig. 1.

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John Larkins.

Inventors:
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By Charles H. Hilsatty.

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3 SHEETS—SHEET 2.

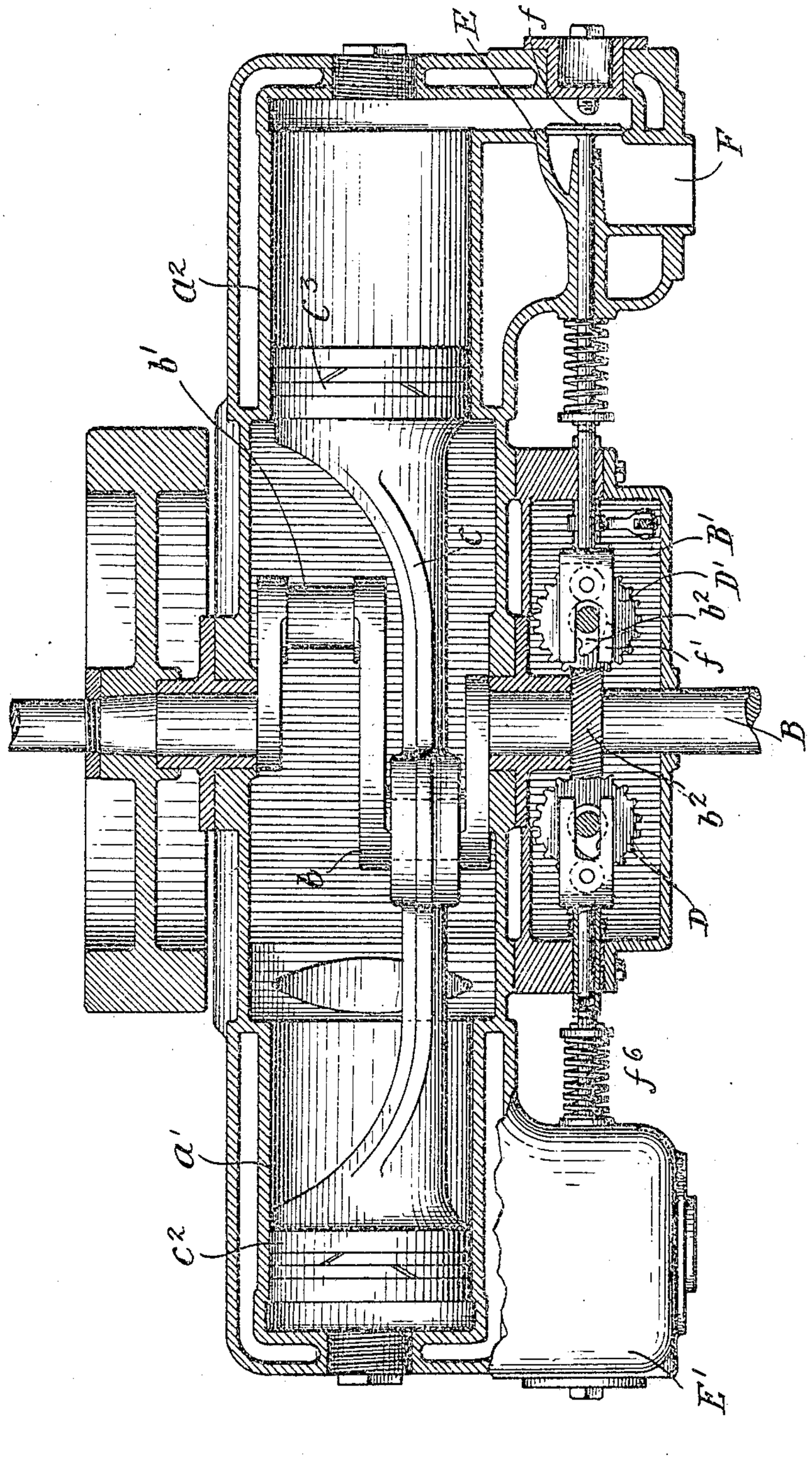

Fig. 2.

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3 SHEETS—SHEET 3.

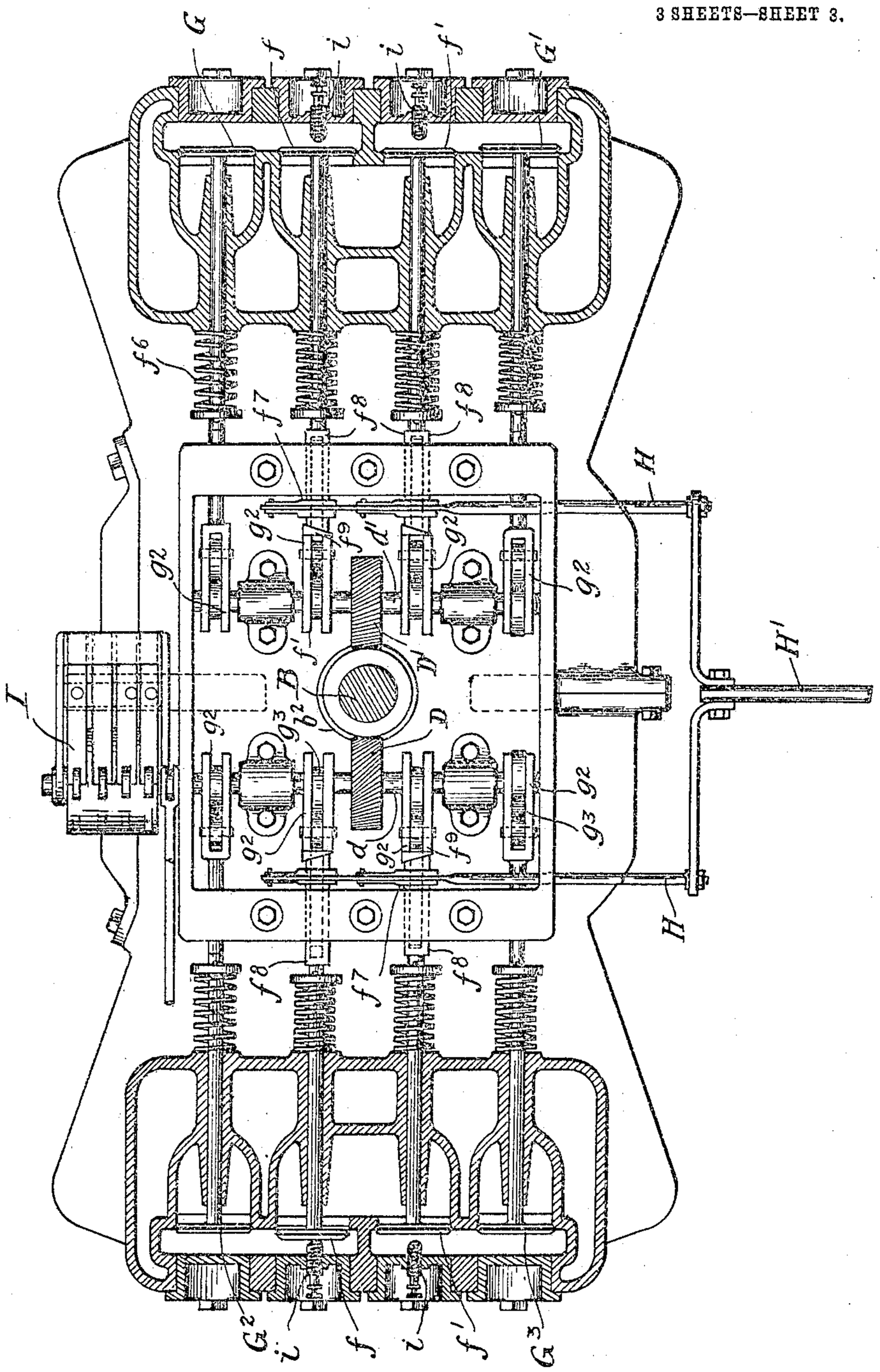

Fig. 3.

Witnesses:
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No. 787,925. Patented April 25, 1905.

UNITED STATES PATENT OFFICE.

RAWSON H. LAYTON AND JOHN E. PFEFFER, OF SOUTH BEND, INDIANA.

EXPLOSIVE-ENGINE.

SPECIFICATION forming part of Letters Patent No. 787,925, dated April 25, 1905.

Application filed May 14, 1903. Serial No. 157,185.

To all whom it may concern:

Be it known that we, RAWSON H. LAYTON and JOHN E. PFEFFER, citizens of the United States, and residents of the city of South Bend, county of St. Joseph, and State of Indiana, have invented certain new and useful Improvements in Explosive-Engines; and we do hereby declare that the following is a full, clear, and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

This invention relates to an explosive-engine, and more particularly to an explosive-engine comprising alined cylinders having connected pistons reciprocating simultaneously.

The object of the invention is to provide a construction whereby two or more of such engines can be arranged side by side and coupled on the same shaft with each other, so as to avoid, in effect, the dead-center.

It is also an object of the invention to provide simple and durable valve-operating mechanism whereby the explosive mixture is automatically delivered to the cylinders when required.

The invention consists in the matters hereinafter described, and more fully pointed out and defined in the appended claims.

In the drawings, Figure 1 is a view, partly in side elevation and partly in central vertical section, of a device embodying our invention. Fig. 2 is a central horizontal section of the same, showing the parts in plan view. Fig. 3 is a view partly in side elevation and partly in vertical longitudinal section, said sections being taken through the valve-chest.

As shown in said drawings, the engine-frame consists of the castings A and A′, each comprising two integral cylinders a a' and a^2 a^3, cored to provide a water-jacket and disposed one over the other and arranged obliquely with each other. Said castings forming the frame are flanged at their adjacent ends and rigidly bolted together, providing an intermediate chamber, as shown in Fig. 1. When so secured, the cylinders a a^3 are in alinement, as are also the cylinders a' a^2. Said pairs of cylinders are thus arranged obliquely with respect to each other. A central shaft B extends through the frame intermediate the cylinders, as shown in Fig. 2, and within said intermediate chamber a double crank b b' is provided thereon. The pistons C^2 C^3 in the cylinders a' a^2 are integrally connected by the yoked piston-rods c, within the yoke of which are secured transverse parallel guides c', through which the crank b extends and on which is provided an adjustable bearing fitting closely between said guides. Said bearing comprises the complemental half-boxes c^2 c^3, wedge-shaped on their sides adjacent to the guides and which are engaged between wedge-shaped side members c^4 c^5, each of which is provided with a flange at the top extending transversely of the box and in which is provided a set-screw adapted to wedge the box firmly in said slide members. In the same manner the cylinders a' a^2 are provided with the pistons C and C′, the yoke c of which is provided with guide-slides similar to those before described and through which passes the crank b', journaled in boxing similar to that described on the crank b. The boxing or bearing for each crank is adapted to slide freely between the guides. The yokes connecting the pistons are offset laterally from each other, as shown in Fig. 2, permitting the same to reciprocate simultaneously.

From the construction described it is obvious that a charge being exploded simultaneously in the cylinders a' a^3 or a a^2 causes said pistons to reciprocate oppositely at the same moment, and, as shown in Fig. 1, the explosion last occurred in the cylinder a a^2 driving the pistons to the inward limit of movement and the pistons C^2 and C′ to the outermost limit of their travel and in position to be driven inwardly by the charge at the explosion end of the cylinder.

Any preferred arrangement of valves and sparkers may be used or employed. As shown, however, a compartment B′ is provided on the side of the engine and through which the shaft B extends and in which the actuating mechanism for the valves is located. A spiral gear b^2 is secured on said shaft within said com-

partment, meshing with similar gears D D′, which are secured on vertical shafts *d d′*, journaled in said compartment B′, and causing said shafts to rotate with the rotation of the shaft B. Valve-chests E′ are provided on each end of the engine, each provided with inlet ports or passages F, in which connects the supply-pipe leading from the mixing-chamber. (Not herein shown.) Said inlet-passage is controlled by an inwardly-opening valve *f*, the stem of which extends through the valve-chest in proximity with the shaft *d*, and shaft *d′* is provided at its inner end with a yoke *f′*, which engages around said shaft and in which is journaled an antifriction-roller. (Shown in dotted lines in Fig. 2.) A cam or tappet-arm f^2 is secured on said shaft within the yoke in position as the shaft rotates to engage said roller, forcing the stem of the valve *f* inwardly and opening the valve, thereby permitting the flow of the hydrocarbon mixture into the cylinder.

Exhaust-valves G G′ G^2 G^3 are also positioned to open the exhaust-passage *g*, leading from each cylinder, and each of said valves is provided with an inwardly-directed stem similar to that already described and likewise provided with a yoke (indicated by g^2) having a roller therein, as before described, adapted to be engaged by the tappet-arms or cams g^3, secured on the shafts *d d′* within the yokes. Said tappet-arms are so set on the shafts to actuate the valves rythmically, opening the appropriate inlet-passage when the pistons in the cylinders with which said valves communicate are in proper position to permit the inflow of the hydrocarbon mixture and closing the same under the action of the spring f^6, positioned on the stem, as shown in Fig. 3, and which bears against a part of the valve-chest and a collar on said stem acting to hold the valves normally closed.

Adjusting means are shown whereby the opening of the inlet-valves *f* can be regulated. For this purpose a crank-arm f^7 is provided on a sleeve f^8, which receives the inner end of the stem of each inlet-valve and which also engages a short stem on the yoke *f′* thereof, on which is provided an inclined cam f^9, against which the similarly-shaped inner end of said sleeve presses. Rods H H connect with said crank-arms f^7 and are connected at their ends with the rod or lever H′, enabling said sleeves to be turned, thereby adjusting the operation of the inlet-valves simultaneously to a desired degree of opening. The sparker I may be of any desired type and in operation connects with the plugs *i* in the usual manner.

The operation is as follows: The engine constructed as described comprises two sets of cylinders, in which the connecting-rods for the pistons cross each other, though the cylinders at each end are located one above the other. The angle at which the cylinders are set to each other is such that there is no position of the cranks at which the same will be simultaneously on center. The yoked construction of the piston-rods affords the most efficient application of the energy generated by the explosions at each end of the cylinder, and inasmuch as the explosions are simultaneous at opposite ends of the engine the construction is perfectly balanced at all times. The valve-gear is simple in construction and not likely to get readily out of order and at the same time readily adjustable; but obviously any arrangement of valves and valve mechanism and any preferred sparker may be used and many details of construction may be varied without departing from the principles of this invention.

We claim as our invention—

1. In an engine the combination with a plurality of cylinders arranged one above the other in pairs radially of a common center, and obliquely with adjacent cylinders, of a piston in each cylinder, a shaft extending between the cylinders, cranks thereon, a piston-rod rigidly connecting oppositely-disposed pistons on opposite sides of the shaft, transverse guides carried on the piston-rods, a sliding box in the guides of each rod each engaging on one of the cranks, and valve-controlled operating-ports for the engine.

2. The combination in an explosive-engine, of cylinders arranged in alinement with each other in pairs, each pair of cylinders crossing the other obliquely at a common center, a piston in each cylinder, a shaft, oppositely-disposed cranks thereon between the cylinders, a yoked piston-rod connecting the oppositely-disposed pistons, and transverse guides in said yokes in which the cranks have bearing and means for admitting the explosive mixture successively into one of each pair of cylinders.

3. The combination in a gasolene-engine, with a frame comprising two castings adapted to be bolted together along a central line, of two cylinders at the outer end of each casting arranged obliquely with and one above the other and in alinement with a corresponding cylinder on the other castings, pistons in said cylinders, a yoked piston-rod rigidly connecting oppositely-disposed pistons and crossing each other at the center, transverse guides carried centrally on each piston-rod, a shaft extending centrally through the engine, oppositely-disposed cranks thereon and having sliding engagement in said guides and valves arranged to admit a charge into corresponding cylinders at each end of the engine thereby preventing said cranks being simultaneously at a dead-center.

4. The combination with obliquely-arranged pairs of oppositely-disposed cylinders, of a piston in each cylinder, a yoked piston-rod connecting each pair, a bearing-block adapted to reciprocate transversely of each yoke, a transverse shaft, cranks thereon en-

gaging in said blocks and slidable transversely of the yokes therewith.

5. In an engine the combination with oppositely-disposed pairs of cylinders arranged obliquely with respect to each other and one above the other, of pistons therein, piston-rods connecting corresponding pistons, transverse guides on each piston-rod, a slidable bearing-box in each set of guides, a shaft extending between the cylinders, a crank engaging in each bearing-box and means providing opposite impulses in one of the cylinders of each pair simultaneously and successively.

6. In an engine the combination with a central shaft provided with a plurality of cylinders arranged in the same vertical plane radially with respect to the shaft, and obliquely with respect to each other, oppositely-disposed pistons in said cylinders, rigid piston-rods connecting the same, cranks on said shaft engaging the piston-rods, said piston-rods at the center being disposed laterally to permit the same to cross each other and valves operated from the shaft and acting to control the inlet of the operating-fluid.

In testimony whereof we have hereunto set our hands in the presence of two subscribing witnesses.

RAWSON H. LAYTON.
JOHN E. PFEFFER.

Witnesses:
C. W. HILLS,
ALFRED C. ODELL.