L. F. LOFTUS.

EXPLOSIVE ENGINE.

APPLICATION FILED NOV. 17, 1908.

944,340. Patented Dec. 28, 1909.

4 SHEETS—SHEET 1.

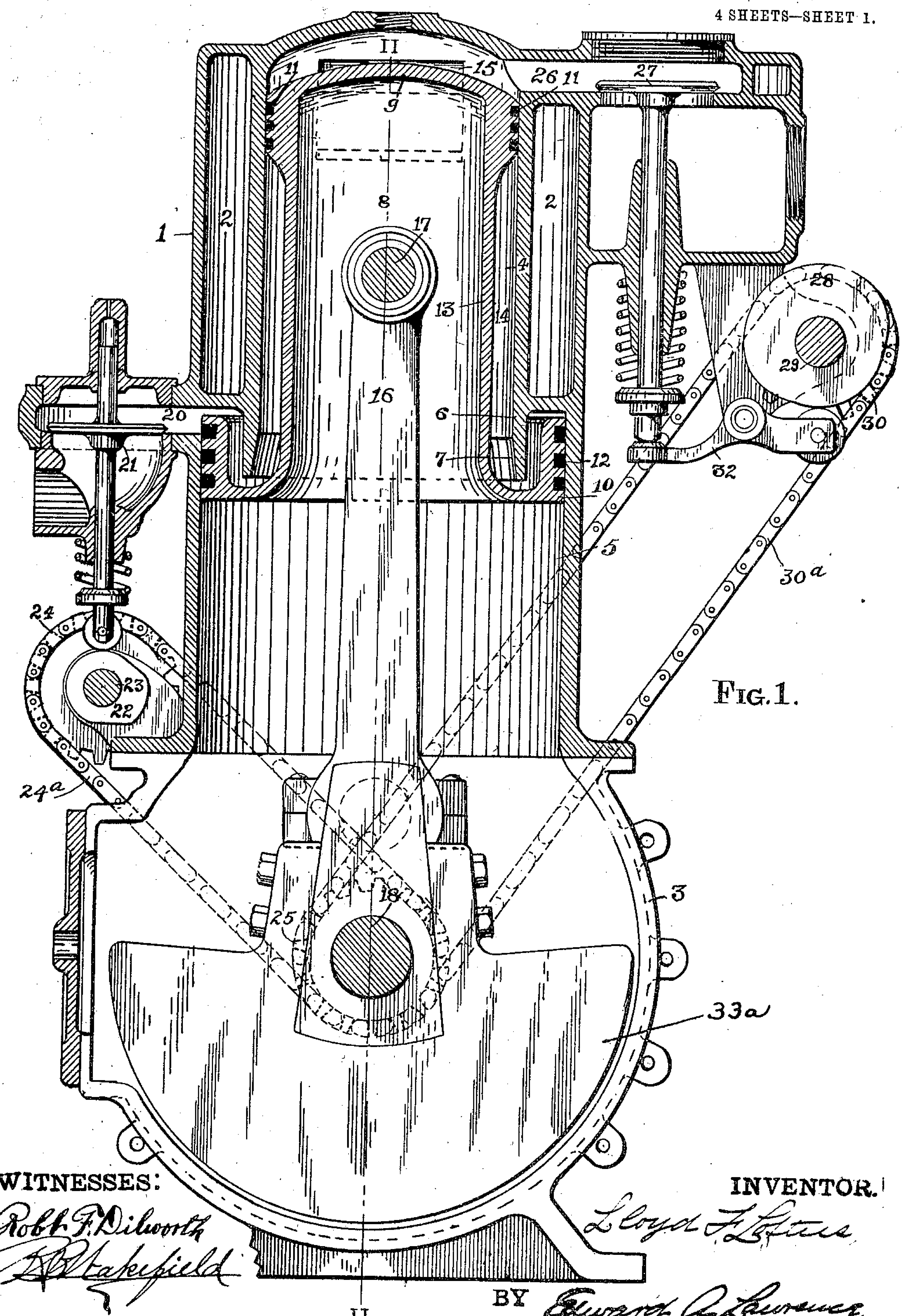

FIG. 1.

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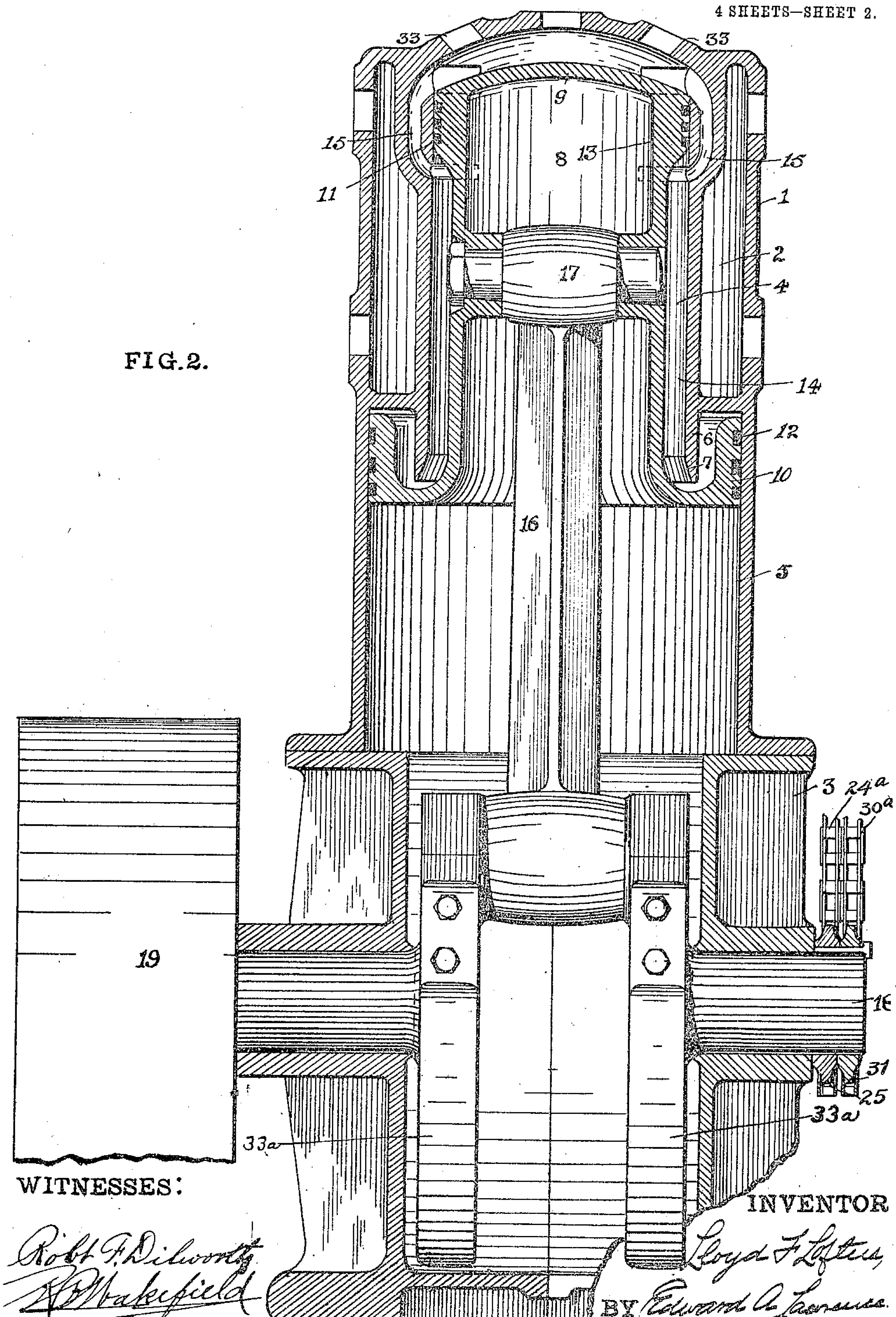
4 SHEETS—SHEET 2.

FIG. 2.



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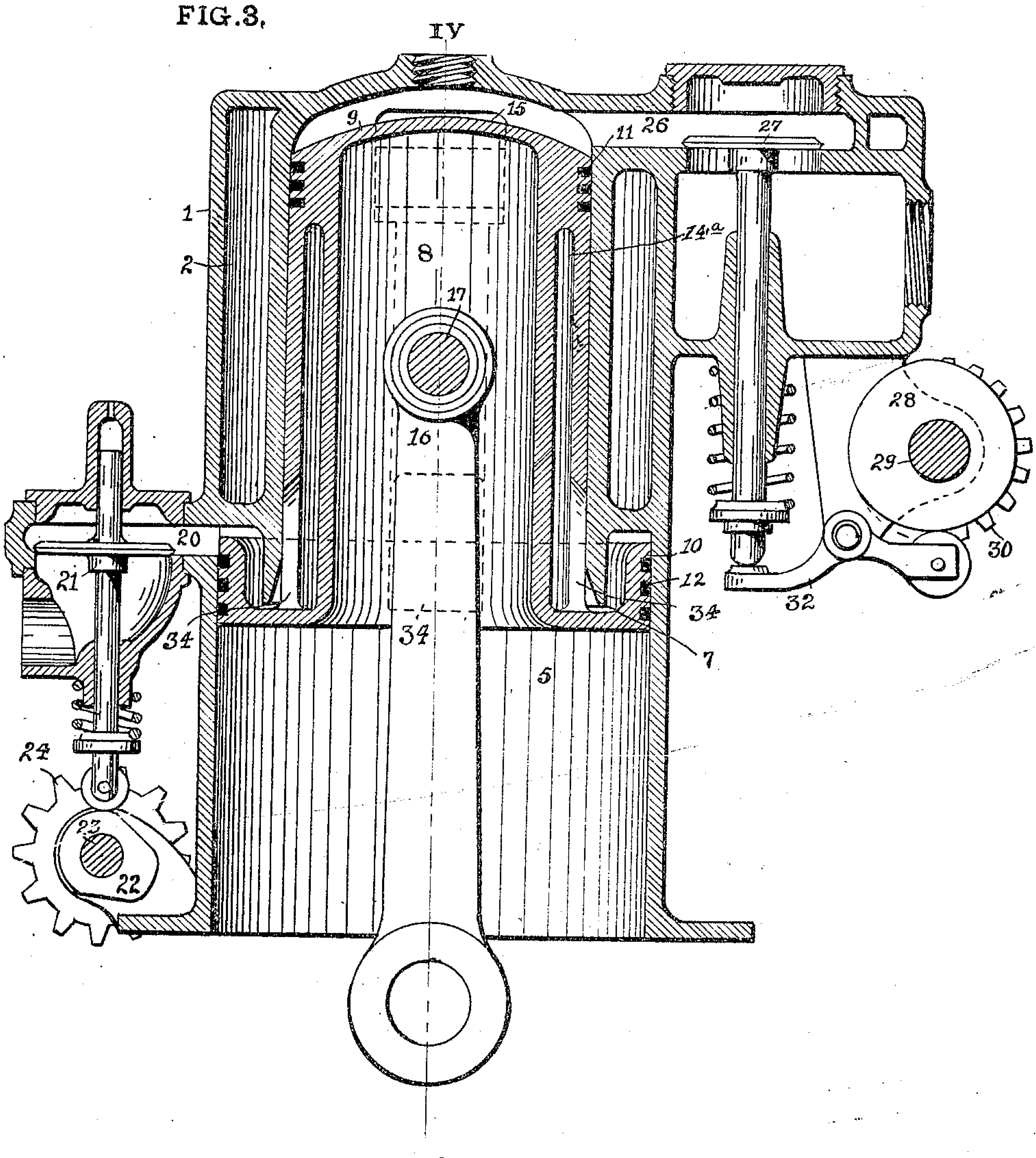
4 SHEETS—SHEET 3.

FIG.3.



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4 SHEETS—SHEET 4.

FIG.4.

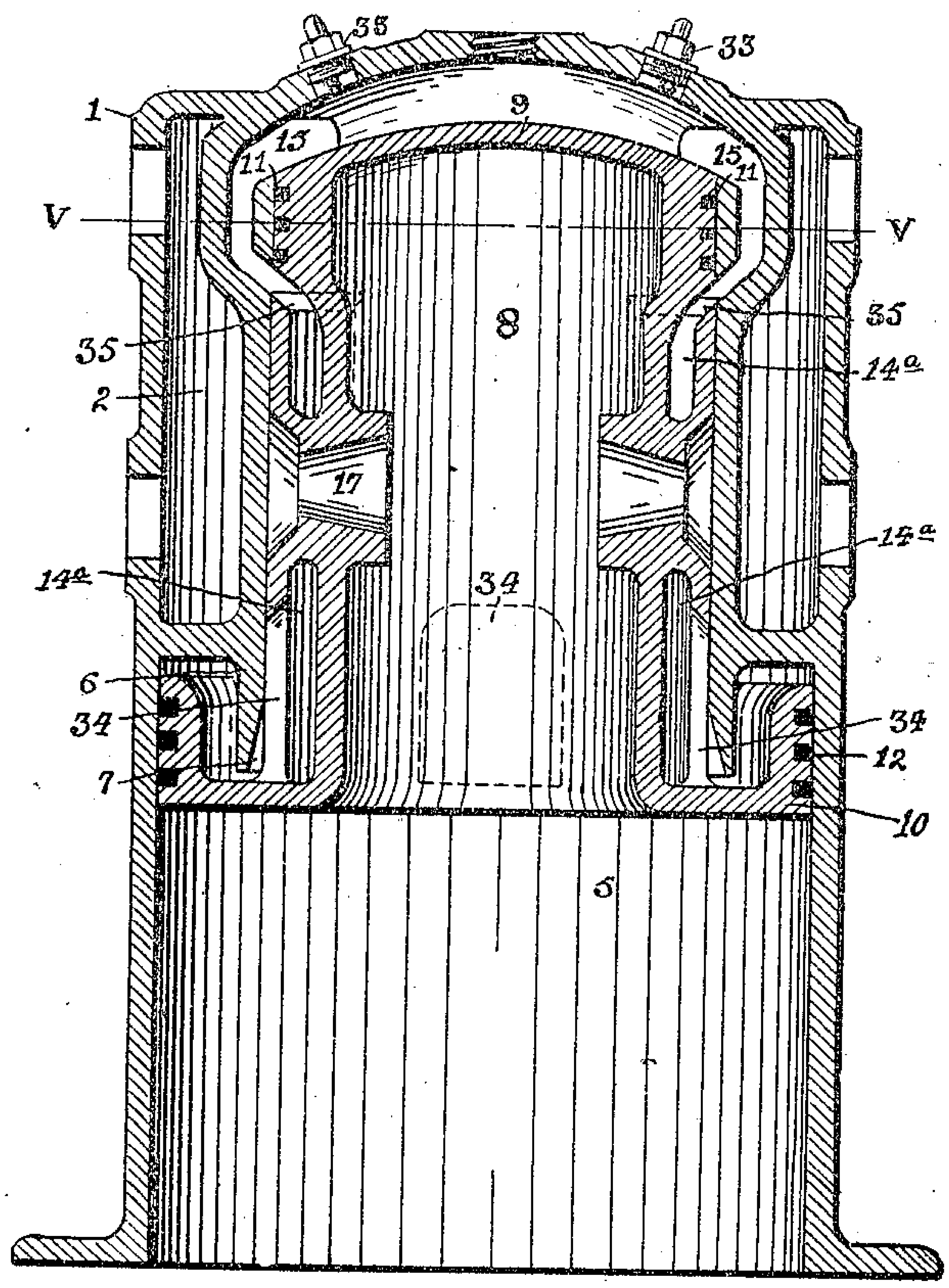
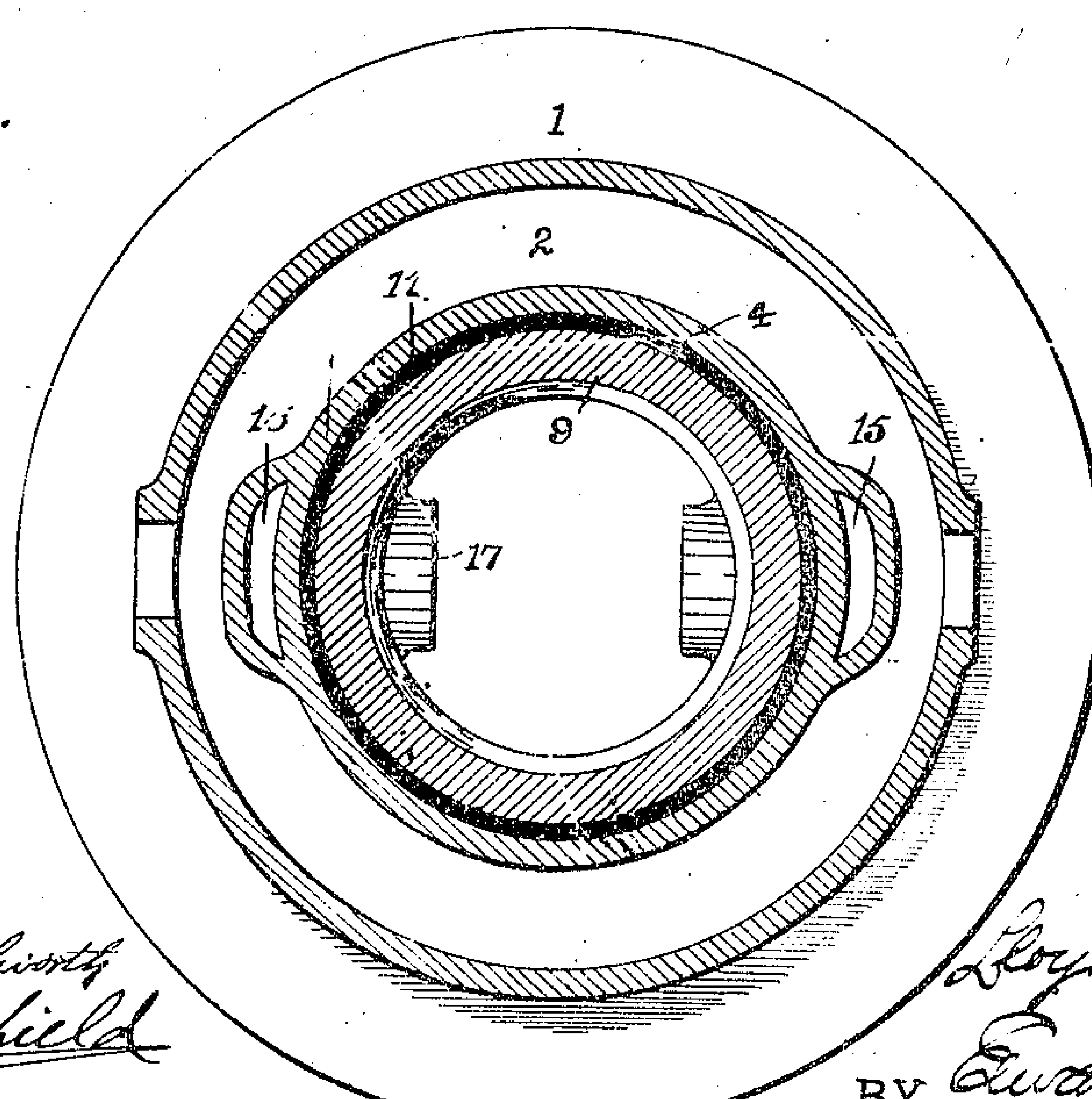


FIG.5.



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UNITED STATES PATENT OFFICE.

LLOYD F. LOFTUS, BOROUGH OF KNOXVILLE, PENNSYLVANIA, ASSIGNOR OF ONE-THIRD TO CHARLES E. MacCANN AND ONE-THIRD TO JOHN SOELLN, OF ALLEGHENY COUNTY, PENNSYLVANIA.

EXPLOSIVE-ENGINE.

944,340. Specification of Letters Patent. Patented Dec. 28, 1909.

Application filed November 17, 1908. Serial No. 463,078.

To all whom it may concern:

Be it known that I, Lloyd F. Loftus, a citizen of the United States, and residing in the borough of Knoxville, in the State of Pennsylvania, have invented or discovered new and useful Improvements in Explosive-Engines, of which the following is a specification.

My invention consists in new and useful improvements in explosive engines, more particularly relating to "two cycle" engines. Means are provided for admitting the fuel directly into the cylinder and compressing the same therein before the charge is admitted to the explosion chamber, the products of combustion resulting from the previous explosion being thoroughly exhausted before the new charge is admitted.

Many of the novel features and arrangements of parts will appear from the following description.

In the accompanying drawings Figure 1 is a longitudinal section of my improved engine; Fig. 2 is a similar view along the line of II—II in Fig. 1, the piston in both cases being shown at its extreme inward position; Fig. 3 is a view similar to Fig. 1 of a modification; Fig. 4 is a view similar to Fig. 2 of said modification and Fig. 5 is a cross section along the line V—V in Fig. 4.

The following is a detailed description of the drawings which are merely illustrative of a practical embodiment of my invention and not intended to limit the scope of the same to the construction shown.

1 is the cylinder, preferably provided with circumferential water jackets 2—2, and having its closed end rounded as shown in the drawings, whereby the same is externally convex and internally concave.

3 is the crank shaft case preferably secured to the outer end of cylinder 1. The bore of cylinder 1 adjacent to its inner end is of less diameter as at 4, than the remainder 5 of the cylinder, the smaller bore 4, being extended into the larger bore 5, by means of annular extension 6, preferably beveled at its extremity as at 7.

8 is the piston preferably hollow, having two heads, the inner head 9 being of proper diameter to fit the bore 4, and the outer head, 10, being of proper diameter to fit the bore 5. The inner head 9 of the piston is convex to correspond to the cylinder end, as shown. 11—11 are packing rings carried by head 9 of piston 8 to form a gas tight joint with the bore 4, and 12—12 are similar rings on head 10 to form a gas tight joint with bore 5. The portion of the piston 8 between heads 9 and 10 is of still less diameter, so that an annular chamber or space, 14, is formed between the portion 13 of the piston and the wall of the cylinder. The portion 13 of smallest diameter of piston 8 is extended outwardly within the head 10 to receive the annular extension 6 when the piston is at its inmost position.

It is evident that the annular chamber 14, being the space between the piston and the cylinder wall, will shift with the motion of the piston, so that while the piston is moving outwardly, said chamber 14 will gradually increase in capacity as a greater length of the bore 5 becomes opposed to the portion 13 of the piston 8, and while the piston is moving inwardly, said chamber 14 will decrease in capacity as a greater length of the bore 4 becomes opposed to the portion 13 of the piston. It is evident that the annular chamber 14 is formed between the portion 13 of the piston and the bores 4 and 5 of the cylinder.

15 is a by-pass or passage formed in the wall of the cylinder 1 and so located as to register with the chamber 14 when the piston approaches its inmost position, thus establishing communication between said chamber 14 and the explosion chamber formed between the piston and the cylinder end. The outlet end of by-pass 15 opening into the explosion chamber is of greater capacity than the inlet end of said by-pass which communicates with annular chamber 14. Two by-passes, diametrically opposite each other are preferably provided.

16 is the connecting rod, pivoted at its inner end to cross head 17 in the interior of piston 8, and at its outer end to crank-shaft 18 in casing 3. 19 is the band wheel mounted on said crank-shaft outside of said casing.

20 is the fuel inlet port in the wall of cylinder 1, preferably adjacent to the inner end of bore 5. 21 is a spring actuated valve controlling said port, and 22 is a cam rigidly mounted on shaft 23 suitably journaled from cylinder 1. The cam 22 serves to force said valve open against spring pressure to admit fuel through port 20 at the proper intervals. Rotation is imparted to shaft 23 by means of

sprocket wheel 24 rigidly mounted on said shaft and connected by a chain 24^a to the sprocket wheel 25 on crank-shaft 18.

26 is an outlet port in the wall of cylinder 1 adapted to exhaust the products of combustion from the explosion chamber after each explosion. 27 is the spring actuated valve controlling said port.

28 is a cam rigidly mounted on shaft 29 suitably journaled from cylinder 1. 30 is a sprocket wheel rigidly mounted on shaft 29 and connected with sprocket wheel 31 on crank-shaft 18 by chain 30^a so that the desired rotation may be imparted to said cam 28.

32 is a lever pivoted intermediate of its length to a portion of the cylinder 1 and engaging the stem of valve 27 and cam 28 whereby the rotation of said cam opens said valve against the spring pressure at the proper intervals.

33—33 represent a pair of sparking plugs set in the curved end of cylinder 1, a sparking plug being preferably located adjacent to each by-pass 15, so as to shoot a spark through the charge and thoroughly ignite the same.

33^a—33^a represent counterweights on the crank shaft to balance up the force of the explosion and prevent wearing unevenly the bearings, cylinder-bore and piston rings.

Assuming that the piston is at its inmost position, as shown in the drawings, and a charge has just been exploded, the operation of my engine is as follows. When the piston begins its outward stroke, the exhaust port 26 remains closed by valve 27. The outward movement of the piston rapidly increases the capacity of the annular chamber 14. The inlet valve 21 is opened as soon as the piston has moved outwardly to the extent that the chamber 14 ceases to register with the by-pass 15, admitting fuel to chamber 14, from the fuel supply. As the chamber 14 is rapidly increasing in capacity, the effect is to suck in the fuel through the open port 20. When the piston reaches its outmost position, the cam 22 has turned sufficiently to allow the valve 21 to close the port 20 and cut off the admission of fuel, thus confining the charge in chamber 14. As the piston begins its inward stroke, the cam 28 turns into the proper position to open exhaust port 26 so that the products of the last explosion are driven out by the advancing piston. When the piston has advanced sufficiently for the chamber 14 to register with the inlet end of by-pass 15, the exhaust port is closed and remains closed until the next inward stroke of the piston. The inward movement of the piston decreases the capacity of chamber 14, thus compressing the charge of fuel in said chamber until the said chamber registers with the by-pass 15 thus permitting the contents of said chamber to pass through the said by-pass into the explosion chamber.

The sparking plugs may be operated and the charge exploded at the end of the inward stroke of the piston, in which case the fuel tends to back-fire into the chamber 14 through the by-pass 15, but owing to the fact that the outer end wall of said chamber 14 is of greater area than the inner end wall of the same, the impact of the explosion on the face of the piston will be aided and not impeded. By timing the explosion, however, to the point when the outward movement of the piston shifts the chamber 14 out of registration with the by-pass 15, the explosion will be confined to the explosion chamber and the back-fire will be avoided. The cylinder end, being rounded as shown, greater strength is obtained with less thickness of metal in the cylinder. The convex piston head 9 makes possible a contracted explosion chamber, notwithstanding the curved cylinder end. The convex cylinder end enables the exploding spark to bridge the space between the by-passes and thoroughly ignite the charge throughout the entire explosion chamber. Owing to the form of the explosion chamber, method of admitting the charge thereto, and the method of exploding the same, the explosion is complete and properly centered on the piston head, causing less wear on the piston rings and cylinder bore, and obviating choking up the by-passes.

In the modification shown in Figs. 3, 4 and 5, the piston 8 has no portion 13 of reduced diameter but the diameter of the head 9 is maintained throughout the piston except in the case of head 10, as shown. 14^a is an annular auxiliary compression chamber cast or otherwise formed in the wall of the piston 8. 34—34 are ports leading through the outer wall of said piston into the lower portion of said chamber 14^a. 35—35 are similar ports leading from the top of said chamber through the outer wall of piston 8 and adapted to register with by-passes 15—15 when the piston approaches its inmost position.

The operation of the modified form of piston is similar to that explained in connection with Figs. 1 and 2. The fuel, however, is admitted to the space between the piston and the outer bore 5 of the cylinder through the inlet port 20 during the outward stroke of the piston and is compressed during the upward stroke and forced into said chamber 14^a through the ports 34—34, from which chamber 14^a the charge passes through ports 35—35 and by-passes 15—15 into the explosion chamber when said by-passes register with said ports.

Although I have, for the sake of clearness, minutely described the construction shown in the drawings, I do not wish to limit myself thereby but claim broadly.

1. In an explosive engine, a cylinder having a larger and a smaller bore and a convex closed end, a two headed piston adapted to fit said bores, the inner head thereof being convex to correspond to said cylinder end, said structure providing an annular chamber between said piston and said cylinder in which the charge may be compressed before admission to the explosion chamber, a valve adapted to admit the fuel from the fuel supply to said annular chamber during the outward stroke of the piston, means for exhausting the products of combustion from the explosion chamber during the inward stroke of the piston, a pair of oppositely disposed valveless by-passes through the wall of the smaller cylinder bore in position to communicate with the annular chamber at the end of the inward stroke of the piston whereby the compressed charge is admitted to the explosion chamber at this point in the stroke, and sparking plugs extending into the explosion chamber at points one adjacent to each of said by-passes.

2. In an explosive engine, a cylinder having a larger and a smaller bore, a two headed piston adapted to fit said bores whereby an annular chamber is formed between said cylinder and said piston, a valve adapted to admit fuel from the fuel supply into said annular chamber during the outward stroke of the piston, a second annular chamber contained within the wall of the piston, ports in the wall of the piston for the passage of the charge from said first annular chamber to said second annular chamber during the inward stroke of the piston, ports leading from the upper portion of said second annular chamber, by-passes through the wall of said cylinder adapted to register with said last mentioned ports at the end of the inward stroke of the piston whereby the charge is admitted to the explosion chamber, and means for exploding the charge in the explosion chamber.

3. In an explosive engine, a cylinder having a larger and a smaller bore, a two headed piston adapted to fit said bores whereby an annular chamber is formed between said cylinder and said piston, a valve adapted to admit fuel from the fuel supply into said annular chamber during the outward stroke of the piston, a second annular chamber contained within the wall of the piston; ports in the wall of the piston for the passage of the charge from said first annular chamber to said second annular chamber during the inward stroke of the piston, ports leading from the upper portion of said second annular chamber, by-passes through the wall of said cylinder adapted to register with said last mentioned ports at the end of the inward stroke of the piston whereby the charge is admitted to the explosion chamber, means for exploding the charge in the explosion chamber, and means for expelling the products of combustion from the explosion chamber during the inward stroke of the piston.

4. In an explosive engine, a cylinder having a larger and a smaller bore and a convex closed end, a two headed piston adapted to fit said bores, the inner head thereof being convex to correspond to said cylinder end, said structure providing an annular chamber between said piston and said cylinder in which the charge may be compressed before admission to the explosion chamber, a valve adapted to admit fuel from the fuel supply to said annular chamber during the outward stroke of the piston, means for exhausting the products of combustion from the explosion chamber during the inward stroke of the piston, a valveless by-pass through the wall of the smaller cylinder bore in position to communicate with the annular chamber at the end of the inward stroke of the piston whereby the charge is admitted to the explosion chamber at the end of the inward stroke of the piston, means for exploding the charge in the explosion chamber, and a counter balanced crank shaft pivotally connected to said piston.

Signed at Pittsburg, Pa., this 10th day of November, 1908.

LLOYD F. LOFTUS.

Witnesses:
J. H. HARRISON,
EDWARD A. LAURENCE.