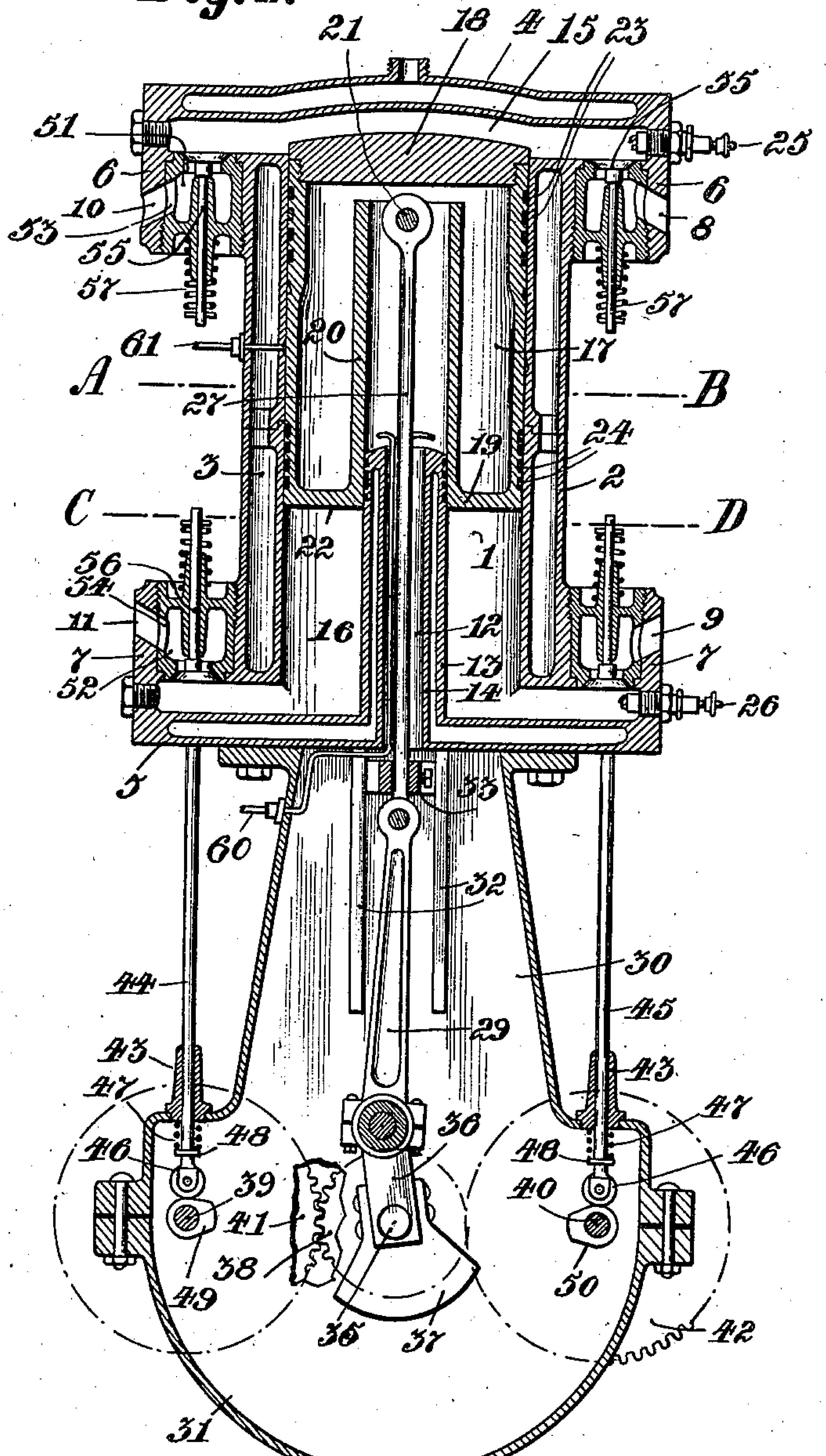
A. B. BROWN.
INTERNAL COMBUSTION ENGINE.
APPLICATION FILED SEPT. 7, 1909.

985,507.

Patented Feb. 28, 1911.

2 SHEETS—SHEET 1.

Fig. 1.



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2 SHEETS—SHEET 2.

Fig. 2.

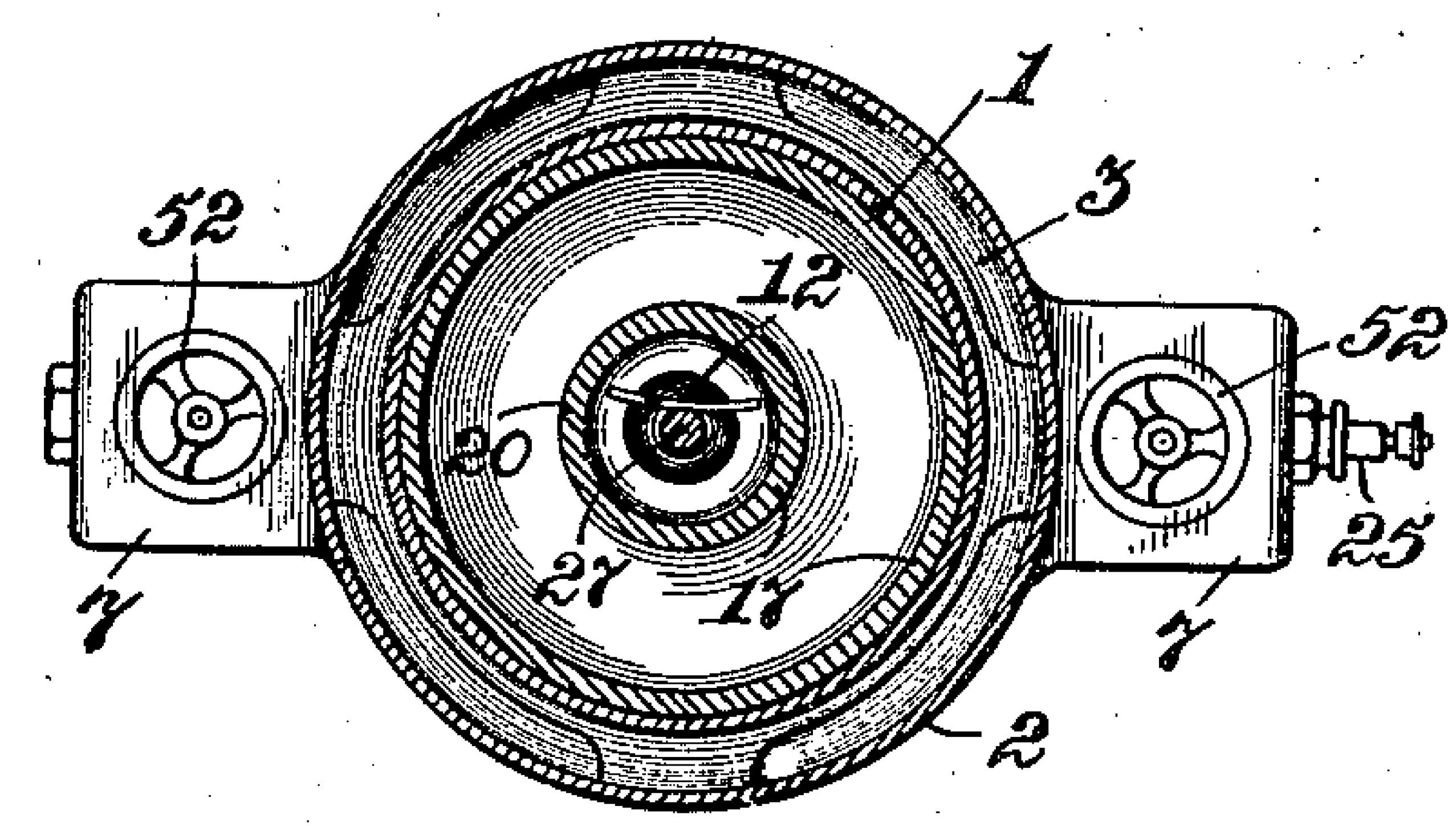


Fig. 3.

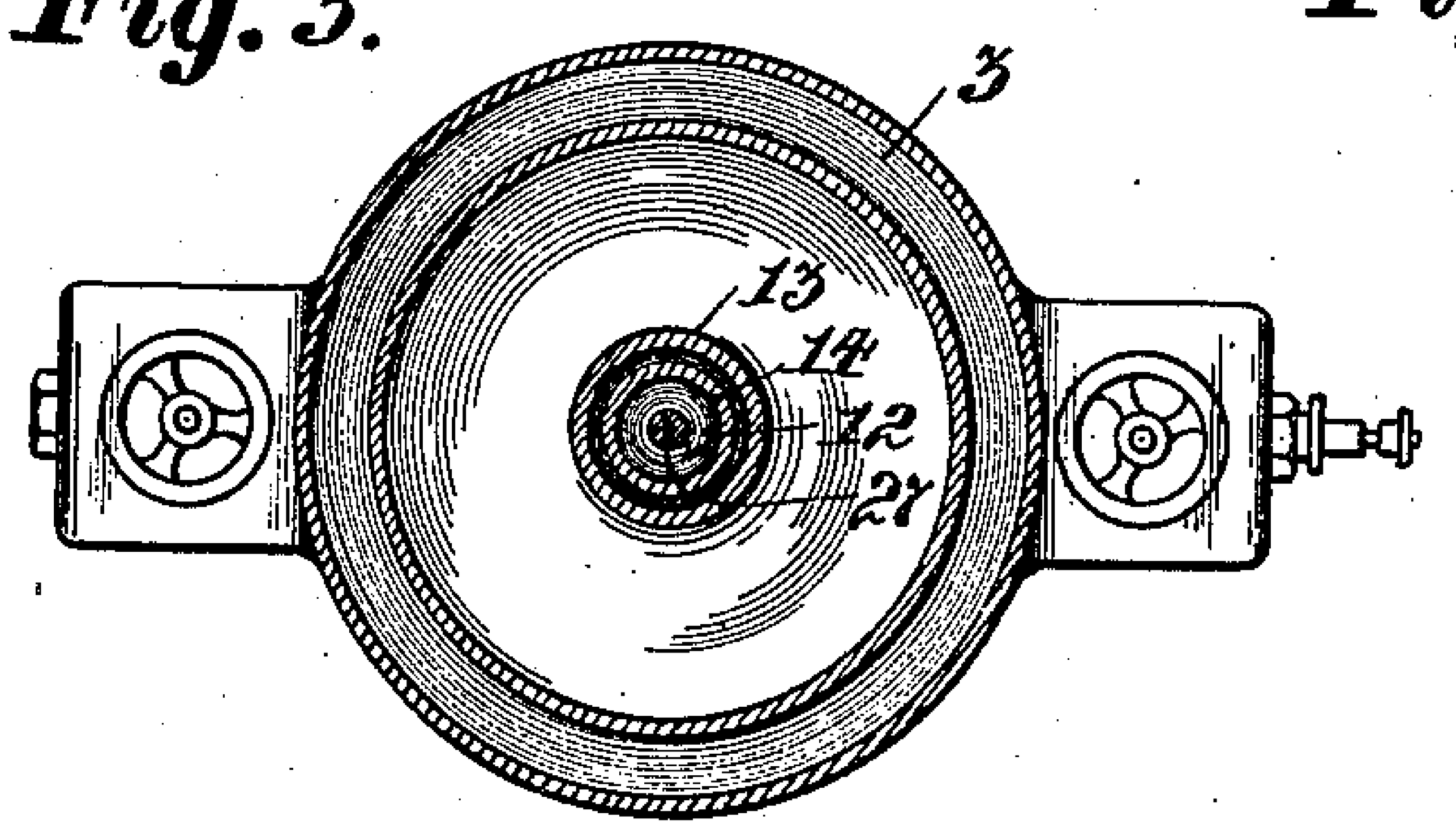


Fig. 4.

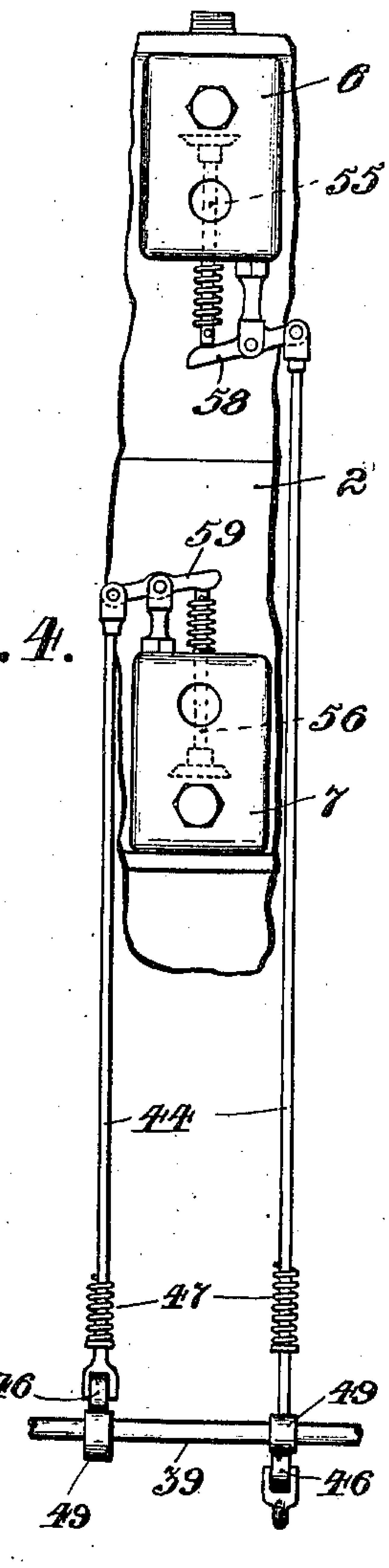
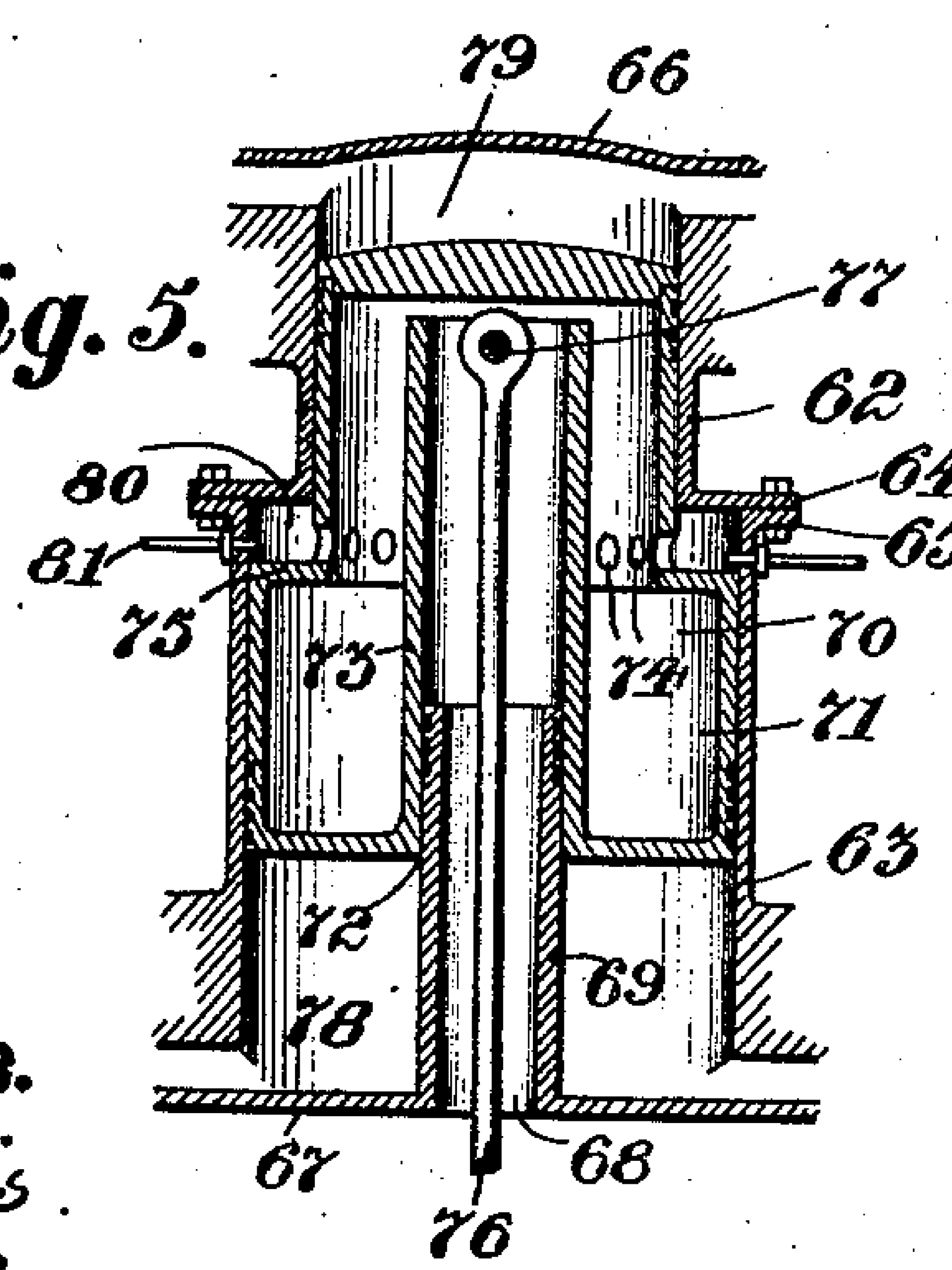


Fig. 5.



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UNITED STATES PATENT OFFICE.

ANDREW BETTS BROWN, OF LONDON, ENGLAND, ASSIGNOR TO WILLIAM ALBERT HICKMAN, OF PICTOU, CANADA.

INTERNAL-COMBUSTION ENGINE.

985,507. Specification of Letters Patent. Patented Feb. 28, 1911.

Application filed September 7, 1909. Serial No. 516,411.

To all whom it may concern:

Be it known that I, ANDREW BETTS BROWN, a subject of the King of Great Britain, and resident of 3 Bloomsbury street, in the city of London, East Center, England, have invented certain new and useful Improvements in Internal-Combustion Engines; and I do hereby declare that the following is a full, clear, and exact description of the same.

The invention relates to improvements in internal combustion engines, as described in the present specification and illustrated in the accompanying drawings that form part of the same.

The invention consists essentially in the novel construction and arrangement of parts, whereby a reciprocating movement is imparted to the piston by explosive impulses at each end of the cylinder and clear of the piston rod and whereby air at atmospheric pressure is admitted into the piston for cooling purposes.

The objects of the invention are to devise an engine substantially free from the jarring and vibratory movements incidental to that type of machine and generally to provide an arrangement of parts simple and cheap to construct and efficient in operation.

In the drawings, Figure 1 is a vertical sectional view of the engine. Fig. 2 is a cross sectional view on the line A—B in Fig. 1. Fig. 3 is a cross sectional view on the line C—D in Fig. 1. Fig. 4 is a side elevation of the valve arrangement and valve gear connections to an auxiliary shaft. Fig. 5 is a vertical sectional view of a modified form of cylinder and piston.

Like numerals of reference indicate corresponding parts in each figure.

Referring to the drawings, 1 is a cylinder encircled by the casing 2, said casing preferably forming part with said cylinder and inclosing the water jacket 3. The cylinder and casing 2 are here shown as formed in two parts for convenience in manufacture, though it must be understood that they may be made in any suitable manner. One of said parts is formed with the head 4 and the other with the head 5, said heads extending beyond the main portion of the cylinder and forming the valve pockets 6 and 7.

8 and 9 are inlet ports through the valve pockets 6 and 7 respectively.

10 and 11 are exhaust ports in the heads 4 and 5 respectively.

12 is a passage in the head 5 formed by the inwardly extending walls 13 and 14 from the said head 5, said walls terminating intermediate of the length of the cylinder 1 and forming an annular explosion chamber 15 in which the usual explosion impulses occur intermittently with the explosion impulses in the explosion chamber 16 at the other end of the cylinder.

17 is the piston of a hollow type having the head 18 and the recessed head 19, the wall 20 of the recess in the head 19 extending inwardly into the piston and terminating adjacent to the head 18 and forming a passage into the interior of said piston.

21 is a pin rigidly secured to and extending between the sides of the wall 20 in proximity to the inner end thereof.

The recessed head 19 slides over the wall 13, the annular portion 22 of the piston entering the explosion chamber 15 and adapted to travel to the head 5.

23 are packing rings of any suitable type arranged between the cylinder 1 and the piston 17.

24 are packing rings of any suitable type arranged between the wall 20 and the wall 13.

It will now be seen that there are two explosion chambers, one at each end of the cylinder, two sets of inlet ports and two sets of exhaust ports, besides there is a clear air passage from the outside through the head 5 and the passage 12 into the piston 17 without any connection whatsoever with the said explosion chamber, therefore, the piston can be operated within the said cylinder from impulses at each end thereof and the proper connections made thereto quite clear of the exploding gases.

25 and 26 are sparking plugs of any suitable type and extending into the explosion chambers at each end of said cylinder and operatively connected to a suitable electric current supply.

27 is a piston rod at one end secured to the pin 21 and extending through the passage 12 and at the other end pivotally secured to the link 29.

30 is the casing of the crank chamber rigidly secured to the head 5 and closed in by the cap 31, said cap being securely bolted to and forming the head of said casing.

32 are guides secured to the sides of the casing 30.

33 is a block sliding in the guides 32 and

fixedly secured to the piston rod 27 at the lower end thereof.

35 is the main shaft extending through and supported on suitable bearings in the casing 30.

36 is a crank introduced into the main shaft 35 within the casing 30 and pivotally connected to the other end of the link 29.

37 is a counter-balance weight for the crank 36 supported by the shaft 35.

It will now be understood that on the operation of the piston 17 within the cylinder 1, the crank and consequently the main shaft is operated through the link connection of said crank with said piston rod, the block 33 sliding in the guide 32 and steadying the action of said rod and link.

38 are pinions mounted on the main shaft 35 and rotating therewith.

39 and 40 are auxiliary shafts suitably journaled and supported and extending through the casing 30.

41 are gear wheels mounted on the auxiliary shaft 39 and coacting with the pinions 38.

42 are gear wheels mounted on the auxiliary shaft 40 and coacting with the pinions 38 on the other side of the shaft 35.

43 are bearings extending through the wall of the casing 30 and forming guides for the valve gear rods 44 and 45.

46 are rollers suitably journaled at the ends of the rods 44 and 45 adjacent to the auxiliary shaft.

47 are helical springs encircling the rods 44 and 45 between the casing 30 and the stops 48.

49 and 50 are cams mounted on the auxiliary shafts 39 and 40 respectively and engaging the rollers 46 at each revolution of the said auxiliary shaft, thus raising the valve rods 44 and 45 for the purpose of operating the valves, said valve rods returning to their original position by the spring pressure of the springs 47.

51 and 52 are valve casings secured in the pockets 6 and 7 respectively and having the ports 53 and 54 respectively therethrough leading to and from the interior of the cylinder.

55 and 56 are valves spring-held to their seats in the casings 51 and 52 of the helical springs 57.

58 and 59 are rocker arms suitably supported and at one end pivotally secured to the rods 44 and 45 respectively and at the other end engaging the stems of the valves 55 and 56.

The valve gear herein described and also the arrangement and construction of the valves is quite subsidiary to the main features of the invention, in fact different forms of valve gear may be used, also the valves themselves may be materially changed in construction and arrangement and it is not intended in the present description to do more by such explanation of the valve gear and the valve than describe a working machine throughout. Other parts also may be considered as quite lacking in novelty, such as the packing and oiling arrangements except in so far as their application may be new in the specific purposes to which they are applied in the present invention.

60 are tubes extending through the crank chamber casing 30 to a suitable oil supply and from the interior of said chamber through the passage 12 having their ends turned for the purpose of directing the flow of oil between the wall 13 and the wall 20.

61 are tubes extending through the casing 2, and the cylinder 1, from a suitable oil supply to suitable grooves in the wall of the piston 17 as customary in engine oiling.

In the operation of this engine in the first place the expansile fluid is admitted through the inlet ports 8 at one end of the cylinder in the usual manner, the compression stroke of the piston then occurs and following that the explosion by the spark as customary. In the meantime, and during this part of the operation, the piston has also been performing a suction stroke for the explosion chamber 16, with the result that expansile fluid is admitted through the inlet ports 9, therefore the impulse stroke from the explosion chamber 15 becomes the compression stroke in the explosion chamber 16. The spark in the explosion chamber 16 is then fired with the result that the impulse is directed from the other end of the cylinder to what it was in the former impulse stroke and this latter impulse stroke becomes in the explosion chamber 15, an exhaust stroke, the expansile fluid exhausting through the ports 10 as customary. The impetus of the machine now creates an exhaust stroke at one end of the piston to exhaust from the explosion chamber 16 through the ports 11 and at the other end of the piston in the chamber 15 a suction stroke which draws in the expansile fluid through the inlet ports 8. The impetus of the machine again carries the piston to the other end, that is to the explosion chamber 15 and compresses the charge in that chamber at the same time creating a suction and admitting the charge in the chamber 16 and precisely the same operation continues during the working of the engine, that is to say, the first suction stroke admits the expansile fluid at one end, the compression stroke immediately following and creating a suction stroke at the other end and the explosion in turn creating the compression stroke at the opposite end, thus during the operation of the machine there is one complete reciprocation of the piston between each round of impulses.

The operation of the valves need not be described at any length herein as the detailed description of the parts fully discloses the manner of their working. The cams 49 and 50 force against the rod and operate the valves, said cams being so shaped as to time the admission of the fluid to the cylinders at each end thereof.

It is clearly shown in the drawings and pointed out in the present description the manner in which the piston, itself formed into an annular chamber, slides into the annular explosion chamber in the cylinder, thus there is an annular face against which the explosion takes place for the impulse stroke from that end and the piston in performing this impulse stroke slides up to the other end of the cylinder but not beyond the wall 13, therefore no gas can escape except through the regular exhaust port, but there is a clear passage for the air from the outside into the piston, in consequence the said piston is naturally cooled. Further it may be said at no time is the piston rod 27 exposed to the effects of the explosion.

In Fig. 5, a slightly modified form of cylinder is shown with a corresponding piston. In this modified form, the invention is precisely the same, the intention being to equalize the impulses by presenting faces of the piston of equal surface area to the charges, and additional means of cooling. In said Fig. 5, 62 and 63 are the parts to the cylinder joined through the flanges 64 and 65, the part 63 being of larger dimensions than the part 62. 66 is the head of the cylinder corresponding to the head 4. 67 is the head of the cylinder corresponding to the head 5, having the central opening 68, from which the wall 69 extends inwardly corresponding to the wall 20. 70 is the piston having the large lower end 71, the central opening 72 in one head thereof, from which extends inwardly the wall 73. 74 are air holes through the piston arranged in a row around said piston immediately above the shoulders 75. 76 is a piston rod secured to the pin 77 adjacent to the top of the wall 73. In the operation of the invention in this particular form, the enlarged end of the piston operates in the part 63 of the cylinder, the annular portion of said piston sliding into the annular explosion chamber 78, while the other smaller end of the piston operates in the part 62 of the cylinder receiving its impulse at that end in the explosion chamber 79. The cool air entering through the central opening 72 of the piston will flow through the air holes 74 around the space 80 and during the period of the travel of said piston there is a slight suction created in said space, which has the effect of drawing in the lubricating fluid through the tubes 81. In all other respects the working of the engine is exactly the same as that described hereinbefore, with the exception that the impulses from the explosions are equalized by making the piston with its faces of substantially equal surface areas.

The advantages of this invention will be manifest to those skilled in the art, as the piston being driven from each end of the cylinder is in a way balanced, though reciprocating, that is to say, it is cushioned at each end, either by the expansile fluid or the exhaust gases, and this accomplishes, not only great efficiency, but absolute smoothness in running, which is essential in this type of engine, particularly when it is taken into consideration the uses to which they are applied.

What I claim as my invention is:

1. In an internal combustion engine, a cylinder having at each end thereof an inlet and exhaust, a central opening through one head and a tubular wall extending inwardly from the edge of said opening, said tubular wall forming an air passage and an annular explosion chamber at that end of the cylinder, a hollow piston having an opening in one head thereof and a tubular wall extending inwardly into the hollow of said piston from the edge of said opening and forming a telescopically arranged continuation of the aforesaid tubular wall for the passage of air into the annular chamber within said piston, and valves at each end of said cylinder arranged at said inlet and exhaust openings.

2. In a device of the class described, in combination, a cylinder having inlets and exhausts at each end thereof and an inwardly extending wall from a central opening through one of the heads thereof forming a passage therethrough and an annular explosion chamber therearound, a hollow piston having an inwardly extending wall sliding over the aforesaid wall, means for packing arranged between said walls, means for packing arranged between the walls of said cylinder and said piston, oil tubes leading from a suitable oil supply and extending through said passage, a piston rod secured to said piston and extending through said passage, a guide block secured to said piston rod, guides for said guide block suitably supported, a crank shaft, a link joining said piston rod to said crank shaft, valves controlling the admission and exhaust of fluid to the explosion chambers of said cylinder, and a suitable valve gear.

3. In a device of the class described, in combination, a cylinder having inlets and exhaust openings at each end thereof, an enlarged part, a central opening in the head of said enlarged part and a wall extending inwardly from the edge of said opening forming a passage therethrough and an annular explosion chamber therearound, a pis-

ton having one part thereof enlarged, a central opening in the head of the enlarged portion and a wall extending inwardly from the edge of said opening sliding over the aforesaid inwardly extending wall in the cylinder, said enlarged portion of said piston operating in the enlarged portion of said cylinder, the other portion of said piston operating in the other portion of said cylinder, a piston rod secured to said piston and extending through said passage, a crank shaft, a link connecting said piston rod to said crank shaft, valves controlling the admission and exhaust of fluid to and from the explosion chambers in said cylinder, and a suitable valve gear.

4. In a device of the class described, in combination, a cylinder formed of two parts of different dimensions, one of said parts having an opening in the head thereof and a wall extending inwardly from said opening, a hollow piston correspondingly formed to operate in said cylinder and adapted to slide over the aforesaid inwardly extending wall, said piston having a plurality of air holes therethrough in a circumferential row adjacent to the enlarged portion thereof, and tubes leading through the wall of the cylinder adjacent to the joint formed between the two parts thereof.

5. In a device of the class described, in combination, a cylinder and a hollow piston traveling therein forming explosion chambers at each end of said cylinder, said piston being formed with an opening at one end and an inwardly extending wall therefrom and an annular face around said opening of substantially equal surface area to the ordinary face at the other and reduced end and holes through the wall intermediate of its length, and said cylinder having suitable inlets and outlets at each end thereof and its parts of different diameter securely bolted together and openings thereinto adjacent to the joint of said parts, and an opening in one head thereof having a wall extending into the aforesaid inwardly extending wall in the piston and forming the cylinder at that explosion end into an annular chamber of corresponding size to the aforesaid annular face.

6. In an internal combustion engine, a cylinder and a hollow piston traveling in said cylinder, said piston having a walled passage extending thereinto adapted to permit the admission of air into the annular chamber formed by said wall and outer walls, said cylinder being arranged with explosion chambers at each end thereof and at one end with a walled passage into said piston independent of the explosion chamber telescopically arranged in relation with the aforesaid walled passage.

Signed at the city and district of Montreal, Quebec, Canada, this 2nd day of September, 1909.

ANDREW BETTS BROWN.

Witnesses:
P. SHEE,
G. H. TRESIDDER.