No. 827,302. PATENTED JULY 31, 1906.

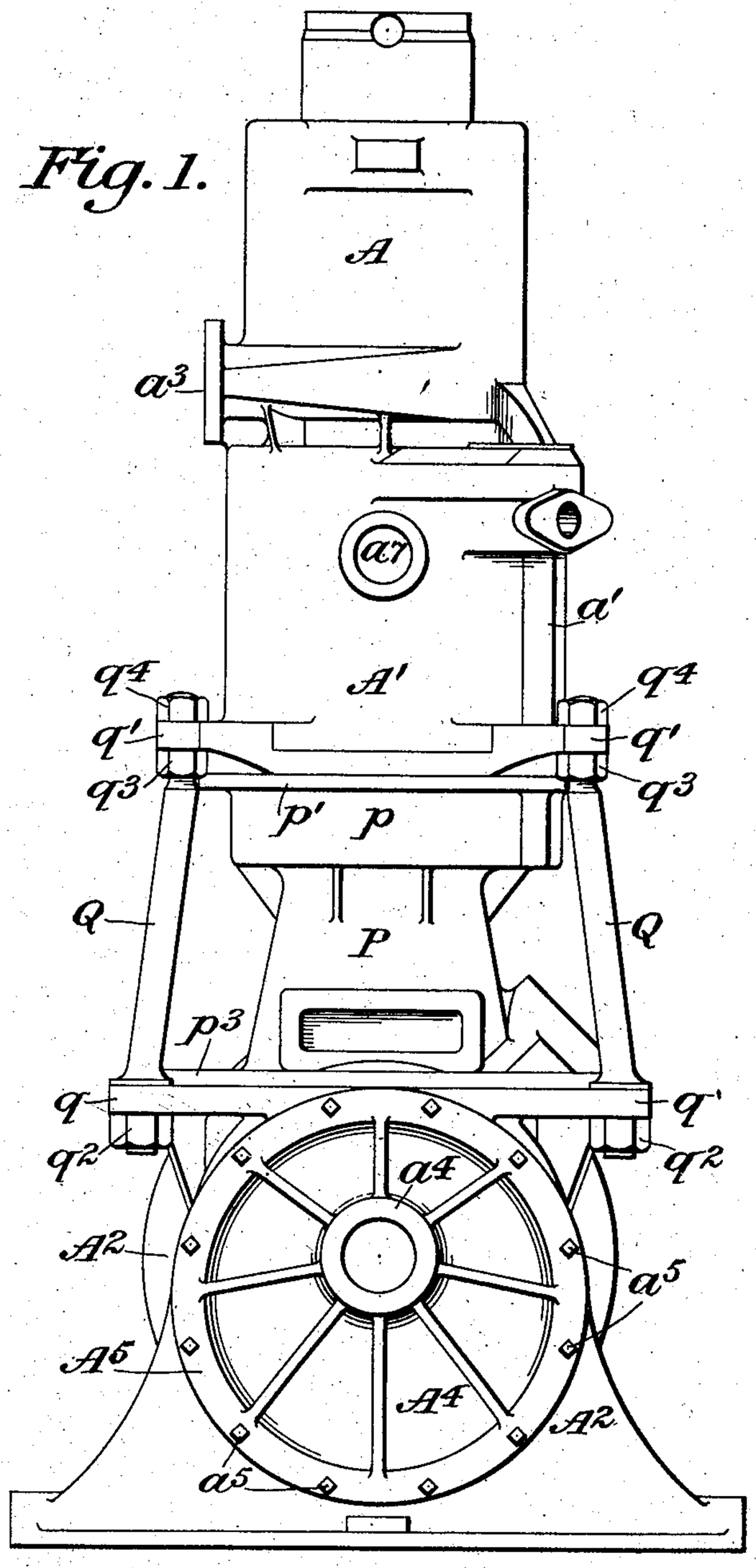
A. B. GOODSPEED.

INTERNAL COMBUSTION ENGINE.

APPLICATION FILED APR. 8, 1905.

3 SHEETS—SHEET 1.

Fig. 1.



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3 SHEETS—SHEET 2.

Fig. 2.

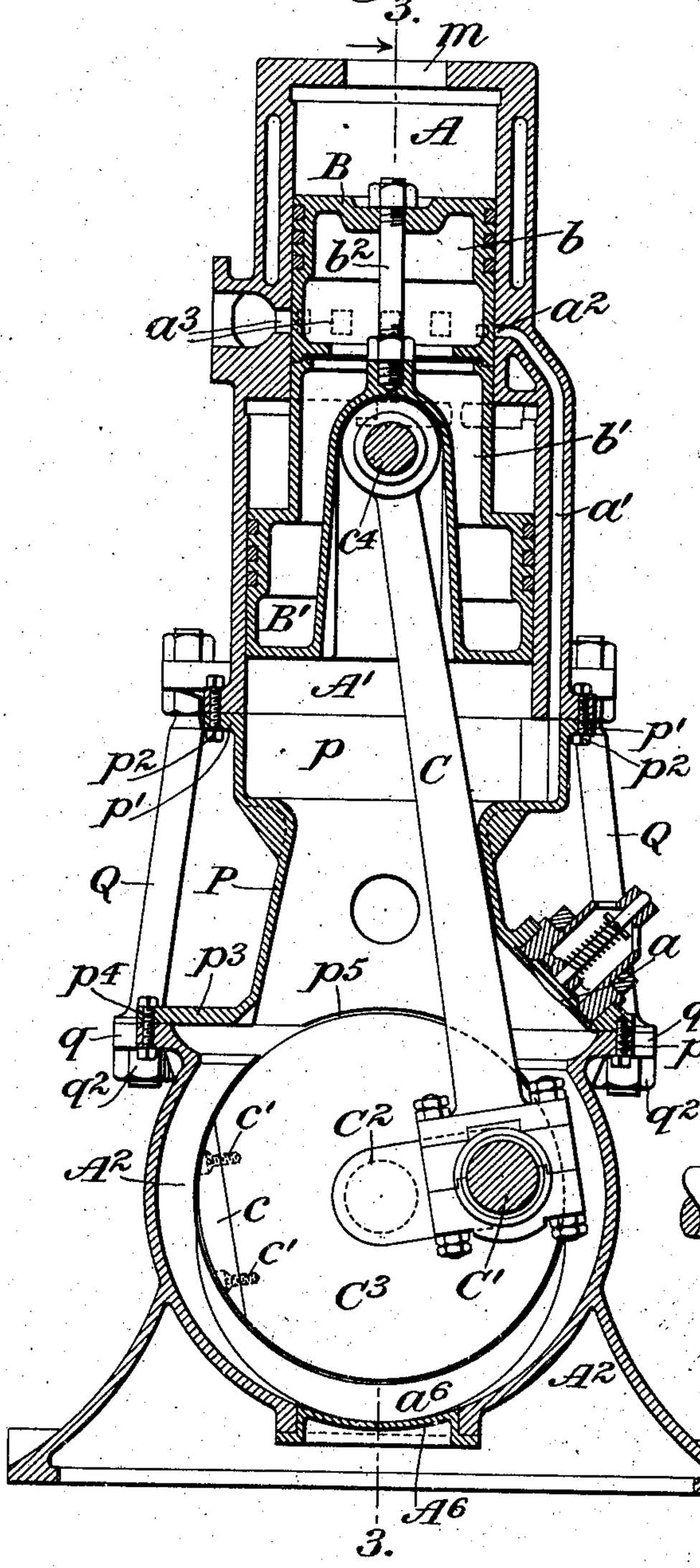
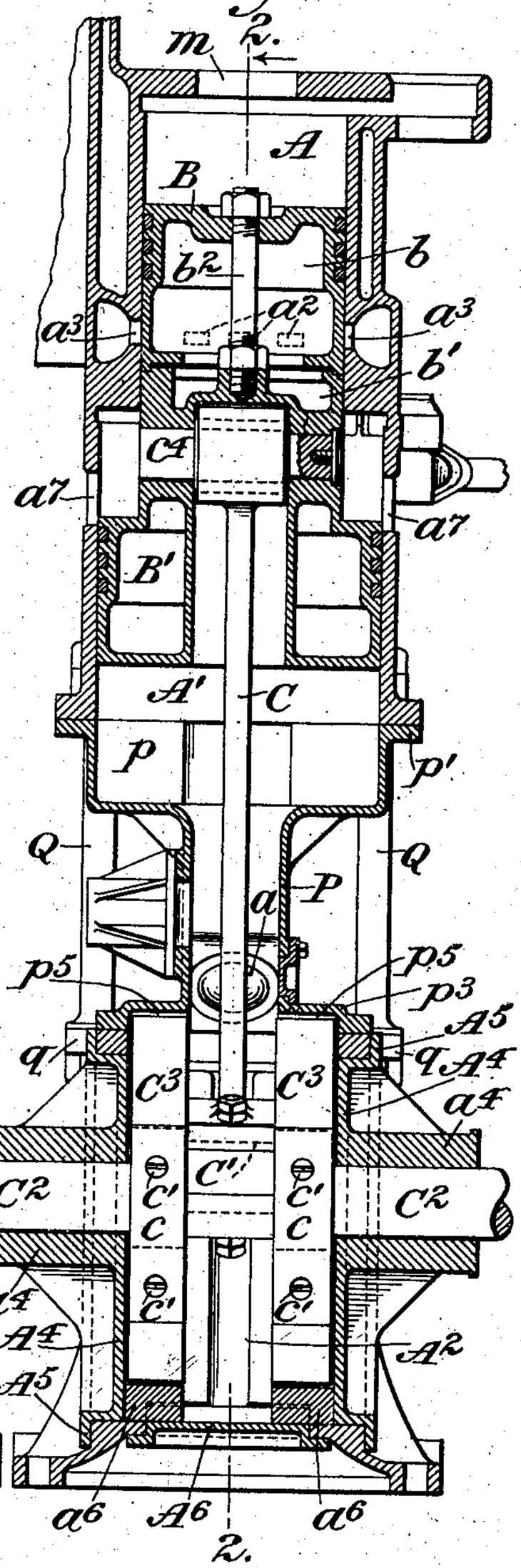


Fig. 3.



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3 SHEETS—SHEET 3.

Fig. 4.

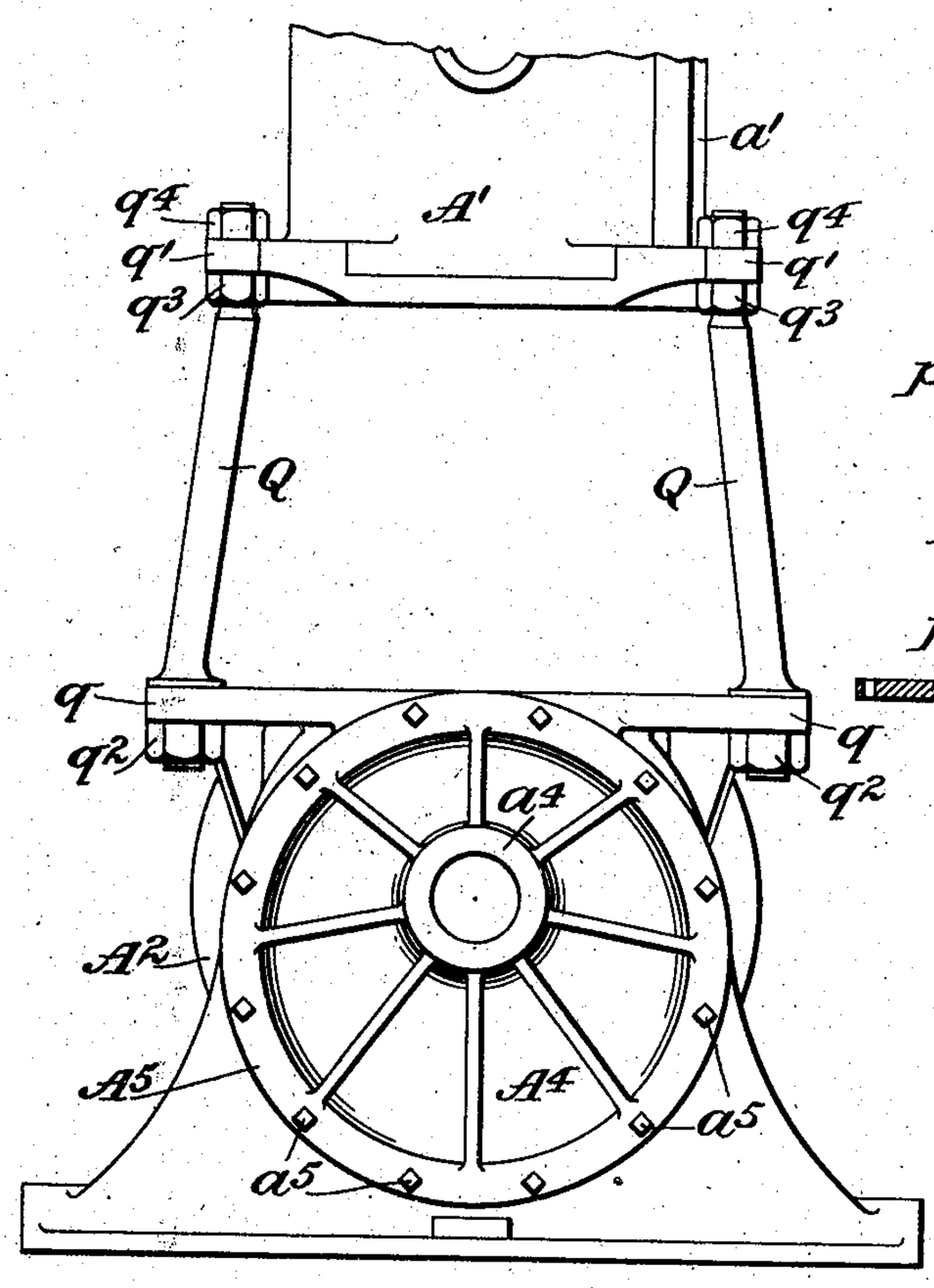
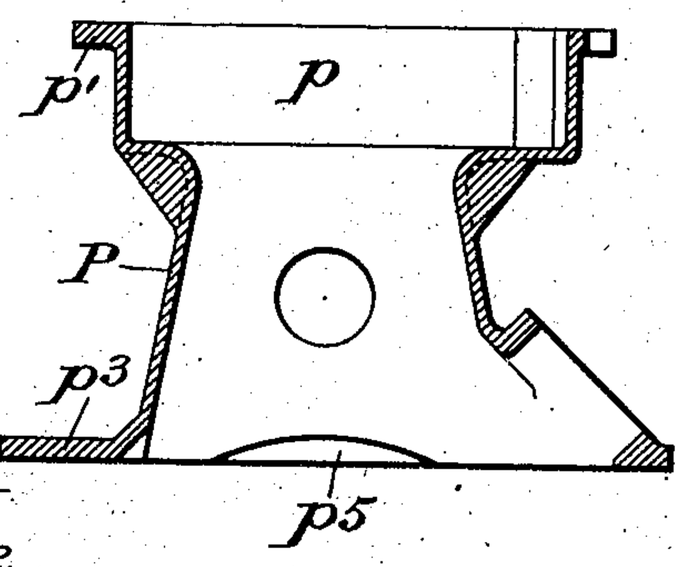


Fig. 5.



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UNITED STATES PATENT OFFICE.

ARTHUR B. GOODSPEED, OF ROSEVILLE, NEW JERSEY, ASSIGNOR TO INDUSTRIAL DEVELOPMENT COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

INTERNAL-COMBUSTION ENGINE.

No. 827,302. Specification of Letters Patent. Patented July 31, 1906.

Application filed April 8, 1905. Serial No. 254,426.

To all whom it may concern:

Be it known that I, ARTHUR B. GOODSPEED, a citizen of the United States, residing in Roseville, in the State of New Jersey, have invented certain new and useful Improvements in Internal-Combustion Engines, of which the following is a specification, reference being had to the accompanying drawings, forming a part hereof.

This invention relates to internal-combustion engines of the type in which the crank-chamber of the engine is inclosed and serves as a compressor in which air which is employed in the operation of the engine is put under an initial pressure. As engines of this type are usually constructed the total volume of the inclosed crank-chamber bears such a large relation to the volume displaced by the forward movement of the piston that the degree of compression attained in the crank-chamber is comparatively small and is materially less than the degree of pressure which might be used to advantage.

It is therefore one of the objects of this invention to improve the construction of engines of this type in such a manner as to reduce materially the comparative volume of the inclosed crank-chamber, so that a higher degree of compression therein can be obtained.

Other objects of the invention are to provide for the convenient assembling of the various parts of the engine, to secure a proper degree of strength and rigidity for the frame of the engine notwithstanding the reduction in volume of the crank-chamber, and otherwise to improve the construction, particularly with reference to the attainment of the objects above stated.

The invention will be more fully explained hereinafter with reference to the accompanying drawings, in which for the purposes of explanation of the nature of the invention it is illustrated as embodied in a convenient and practical form.

In the drawings, Figure 1 is a view in side elevation of an engine which embodies the present invention. Fig. 2 is a view in vertical section on the plane indicated by the line 2 2 of Fig. 3. Fig. 3 is a view in vertical section on the plane indicated by the line 3 3 of Fig. 2. Fig. 4 is a view in elevation of the lower portion of the engine with the contracted distance-piece removed. Fig. 5 is a detailed view in vertical section of the distance-piece.

The engine to which the present invention is shown in the accompanying drawings to be applied is of the same general construction and operation as the engine which is fully shown and described in application for Letters Patent of the United States, Serial No. 202,720, filed April 12, 1904.

The details of construction and operation are not necessary to be explained at length herein, since the present improvement is applicable to any engine in which the crank-chamber is inclosed to serve as a compressor. The general features of construction, however, will be briefly referred to. The engine is represented as having a working cylinder A with a compression-cylinder A′ in tandem therewith, while the piston B has an enlarged portion B′ to fit the compression-cylinder A′. The piston is connected by a pitman C with the crank-pin of the usual divided crank-shaft C^2, which has its bearings in the side walls of the crank-chamber, as hereinafter described. The crank-chamber may be provided with a suitable inlet-valve *a* and may be connected by a duct *a′* with an air-inlet port a^2, formed in the wall of the working cylinder A and arranged to be uncovered by the piston B as it approaches the limit of its forward stroke. Exhaust-ports a^3 may also be provided in the wall of the working cylinder to be uncovered by the piston.

In the present case the crank-pin C′ is preferably carried by crank-disks C^3, which occupy a greater volume of the crank-chamber A^2 than would crank-arms, and therefore reduce the volume in which compression can take place and increase the degree of compression. Each of such crank-disks preferably has a sector *c*, which is removable for a purpose presently to be described and may be secured in place by screws *c′*.

The crank-shaft C^2 has its bearings in suitable bearing-pieces a^4, eccentrically disposed in circular plates A^4, which form the end plates of the lower portion of the crank-casing A^2, the openings closed by said plates being of sufficient diameter to permit the introduction of the crank-disks C^3. The end plates are suitably flanged, as at A^5, to make a close fit with the casing A^2, the flanges be-

ing provided with bolts a^5 to engage the casing A^2 and secure the end plates in position. The plates are also dished, as clearly shown in Fig. 3, in order that they may approach closely to the adjacent faces of the crank-disk C^3, leaving as little space as consistent with free movement. In the bottom of the casing A^3 is formed a manhole or hand-hole, provided with a suitable cover A^6, secured to the casing by bolts to make a tight joint, as usual. When the engine is to be assembled, the crank-shaft is introduced through the casing A^2, with the disks C^3 thereon, and is then lifted to raise the disks into the recesses p^5. The end plates A^4 are then applied to the crank-shaft, rotated to bring the bearing-boxes to their highest positions, and then slipped into their seats in the casing and secured by bolts a^5. If desired, lune-shaped filling-pieces a^6 may be introduced through the hand-hole A^6 to partly fill the space beneath the crank-disks C^3 and still further reduce the volume of the crank-chamber, which, as will be seen, leaves practically little more air-space within the lower portion A^2 of the crank-chamber than is necessary for the movement of the crank C' and pitman C.

In engines of this general type, as generally constructed, the cylinder is extended to meet the main portion of the crank-casing, whereby a considerable air-space is formed. In the present case, however, the portion of the engine-casing between the cylinder, or that part which is actually traversed by the piston and the crank-casing proper, is formed as an indepenent part P, which while forming a part of the engine-casing and a part of the crank-chamber, is otherwise a mere distance-piece. As shown, it is formed at one end, as p, to conform to the end of the cylindrical portion of the engine-casing—that is, to the compression-cylinder A'—the meeting portions being suitably flanged, as at p', so that they may be secured together by bolts p^2. At its other end the intermediate portion P is suitably formed and flanged, as at p^3, to conform to the upper portion of the crank-casing A^2 and to be secured thereto by bolts p^4. Between the two end portions p and p^3 this intermediate portion is flattened, as clearly shown in Fig. 3, to conform somewhat closely to the path of the pitman C, so that the air-space in which compression can take place is reduced to a practical minimum. The inlet-valve a is preferably located in the intermediate casing P, as shown in Fig. 2, the opening in which such inlet-valve is secured being of such size as to serve as a hand-hole in the assembling of the engine. The flanged base p^3 of the portion P is raised and recessed somewhat, as shown at p^5 in Figs. 3 and 5, to accommodate the crank-disks C^3 when they are raised to their highest positions, as shown in Fig. 3. It will also be observed upon reference to said figure that the crank-disks rise above the line of union between the casing P and the casing A^2, and as the casing P must be capable of removal when the crank-disks are in position the removable sectors c, previously referred to, are provided. Through the hand-hole formed to receive the inlet-valve a the screws c' can be applied to or removed from the sectors c and the sectors themselves be applied to or removed from the crank-disks.

The intermediate portion or distance-piece P of the casing is not of such form as to properly support the parts above it in an engine of the type shown in the drawings without being made unduly heavy, and, moreover, must be capable of removal independently of the parts above and below it in order to permit the convenient assembling of the engine. Accordingly, independent provisions must be made for the support of the working cylinder A and compression-cylinder A' from the base and crank-chamber A^2. To this end outside rods Q are provided for the support of the compression-cylinder A' and the working cylinder A from the base A^2, such rods being suitably spaced to permit the withdrawal of the portion P of the engine-casing. The rods engage the head of the crank-shaft casing A^2, as at q, and suitable lugs, as at q', projecting from the casing A', the rods being threaded to receive nuts, as at q^2, below the head q, and as at q^3 and q^4, below and above the lugs q'.

By proper rotation of the nuts q^3 below the lugs q' the upper portion of the casing can be raised slightly, so as to relieve the portion P and permit it to be withdrawn readily.

For the convenient assembling of the engine the working piston B is made in two parts b and b'. The lower part b' is formed with the compression-piston B', is chambered to receive the upper end of the pitman C, and is apertured laterally to receive the pin c^4, which also passes through the head of the pitman. The engine-casing is provided with hand-holes, as at a^7, through which the pin c^4 can be inserted when the aperture in the piston and the head of the pitman-rod are brought into line therewith, suitable covers being provided for these hand-holes, as will be understood. The upper portion b of the piston is suitably formed to fit upon the end of the portion b' and is held in place by a bolt b^2, which is inserted through the axial inlet-port m in the head of the cylinder.

In assembling the engine shown in the drawings the upper portion A A' of the casing is raised to position above the lower portion or crank-shaft casing A^2, and the supporting-rods Q are placed in position, the nuts q^3 q^4 being so adjusted as to hold the upper portion of the casing slightly above its normal position. The portion b of the piston is then inserted and raised into the cylinder, followed by the portion b', which is of such length as to permit it to be readily intro-

duced between the upper and lower portions of the casing. When the portion b' is brought to proper position, the pitman-rod C is inserted, having first been passed through the distance-piece or intermediate portion P, and the pin c^4 is put in place. The distance-piece or intermediate portion P may then be secured in position. The crank-shaft C^2, with the crank-disks C^3 fixed thereon, but without the sectors *c*, is inserted through the openings of the crank-shaft casing and lifted, as before described, and the end plates are rotated to bring the bearing-boxes uppermost and secured in position by the application of the bolts a^5. The lower end of the pitman-rod is connected to the crank-pin C', and the sectors *c* are applied to the crank-disks, the hand-hole of the inlet *a* permitting the work to be done, and the lune-shaped filling-pieces a^6 are inserted through the hand-hole at A^6, if desired. In removing the distance-piece P the pitman C, having been disconnected from the crank-pin and from the piston, is dropped down through the hand-hole A^6 until its upper end is below the lower end of the distance-piece P, thereby permitting the distance-piece to be withdrawn.

It will be evident that with such a structure as that shown in the drawings and described above the air-space in the inclosed crank-chamber and connections is reduced as compared with that of internal-combustion engines as usually constructed, so that the degree of compression which can be obtained is relatively high. At the same time the strength of the entire structure is preserved and convenience in assembling is promoted. It will be understood, of course, that it is not intended to limit the invention to the precise construction shown in the drawings, as the details thereof can be varied to suit different conditions of use.

I claim as my invention—

1. In an internal-combustion engine, the combination of a cylinder, crank-casing, a piston, a crank-shaft, a connecting-rod, an intermediate portion of the casing having its ends conformed to the cylinder portion and the crank-casing respectively, and the portion between its ends reduced in width to conform to the path of the connecting-rod, and supporting-rods secured to the cylinder portion and the crank-casing respectively, substantially as described.

2. In an internal-combustion engine, the combination of a casing comprising a cylinder portion, a crank-casing and an intermediate removable portion and a piston of greater length than said removable portion and formed in two parts with means to secure said parts together, substantially as described.

3. In an internal-combustion engine, the combination of a casing comprising a cylinder portion, a crank-casing and a removable intermediate portion, supporting-rods secured to said cylinder portion and said crank portion respectively and a piston having a length greater than the length of said removable portion and formed in two parts with means to secure said parts together, substantially as described.

4. In an internal-combustion engine, the combination of a casing comprising a working cylinder portion and a compression-cylinder portion in tandem therewith, a crank-casing, and an intermediate removable portion, a crank-shaft, a connecting-rod, and a piston composed of two parts secured together, one of said parts comprising the compression-piston and a portion of the working piston with means to connect the connecting-rod thereto, and the other part comprising the remainder of the working piston, substantially as described.

5. In an internal-combustion engine, the combination of a casing having a closed crank-chamber with open ends and end plates adapted to said ends and provided with bearings for the crank-shaft disposed eccentrically therein, substantially as described.

6. In an internal-combustion engine, the combination of a casing having a closed crank-chamber with open circular ends and end plates adapted to rotate in said open ends and having eccentrically-disposed bearings for the crank-shaft, substantially as described.

7. In an internal-combustion engine, the combination of a casing comprising a cylinder portion, a crank-casing and a removable intermediate portion, supporting-rods secured to said cylinder portion and crank-casing respectively, a crank-shaft with crank-disks thereon and means to support said crank-shaft with the crank-disks projected above the plane of union between the crank-casing and the intermediate portion, said crank-disks having removable sectors, whereby said intermediate portion of the casing may be removed or replaced while the crank-shaft is in position, substantially as described.

This specification signed and witnessed this 5th day of April, A. D. 1905.

ARTHUR B. GOODSPEED.

In presence of—

ANTHONY N. JESBERA,
W. B. GREELEY.