F. J. ZELLAR.

ENGINE.

APPLICATION FILED MAR. 27, 1913.

1,067,705. **Patented July 15, 1913.**

3 SHEETS—SHEET 1.

Fig. 1.

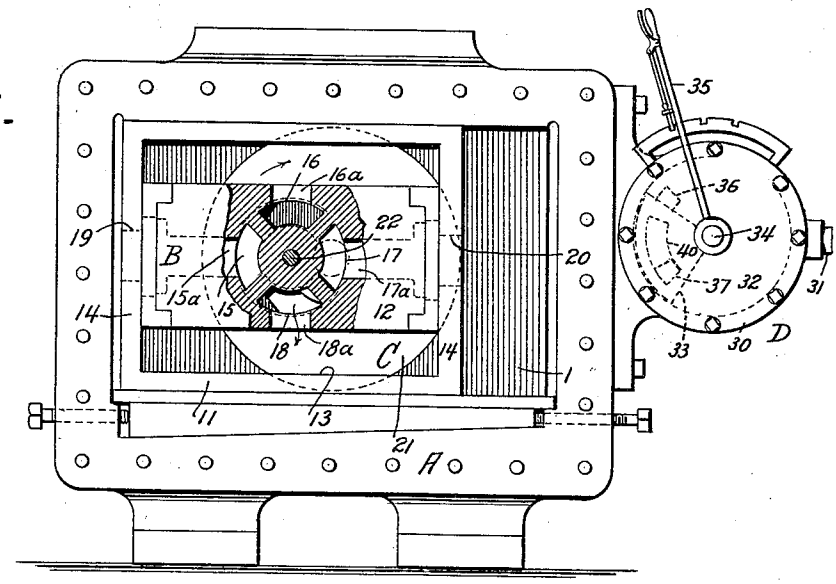
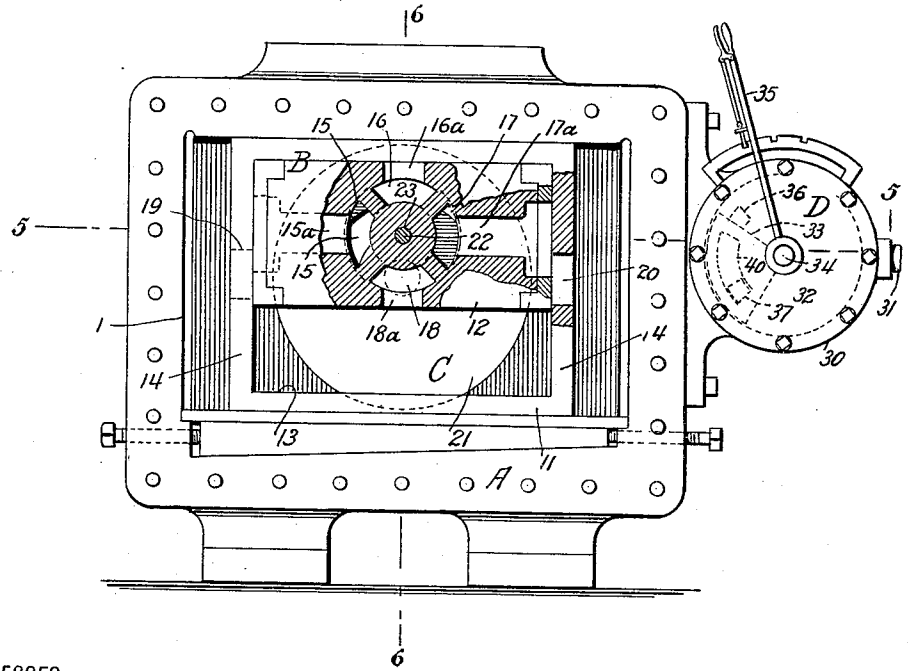


Fig. 2.



WITNESSES

William A. Goebel.

C. Bradway

INVENTOR

Frederick J. Zellar.

BY Munn & Co

ATTORNEYS

COLUMBIA PLANOGRAPH CO., WASHINGTON, D. C.

F. J. ZELLAR.

ENGINE.

APPLICATION FILED MAR. 27, 1913.

1,067,705.

Patented July 15, 1913.

3 SHEETS—SHEET 2.

Fig. 3.

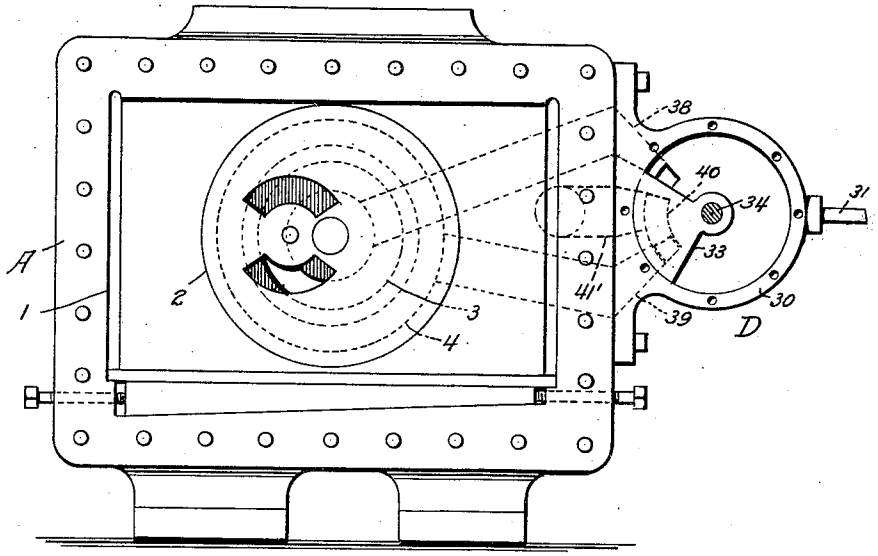
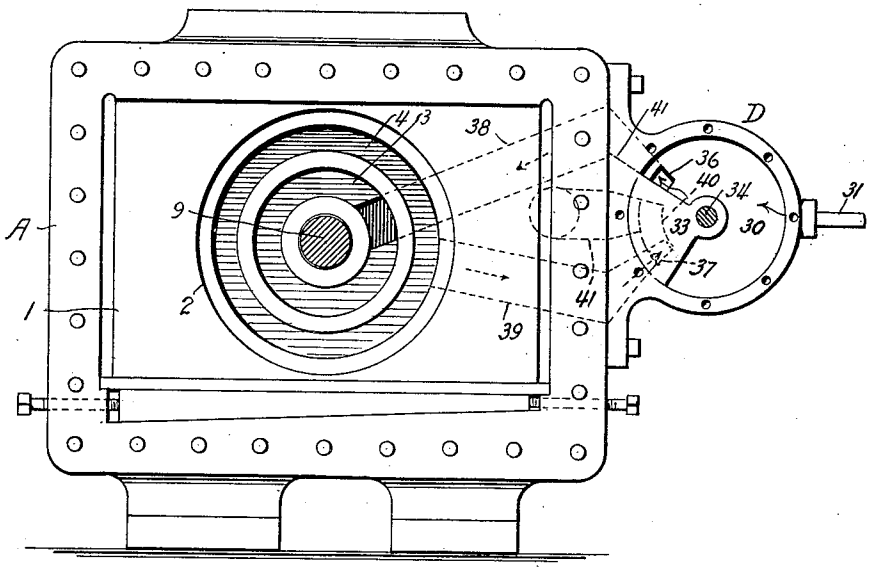


Fig. 4.



WITNESSES

William P. Goebel.

C. Bradway.

INVENTOR

Frederick J. Zellar

BY Munn & Co

ATTORNEYS

F. J. ZELLAR.

ENGINE.

APPLICATION FILED MAR. 27, 1913.

1,067,705.

Patented July 15, 1913.

3 SHEETS—SHEET 3.

Fig. 5.

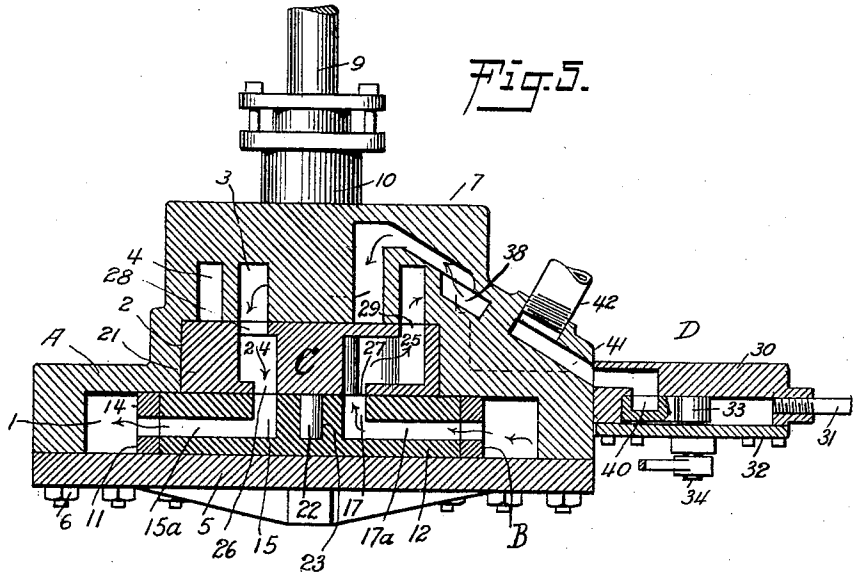


Fig. 6.

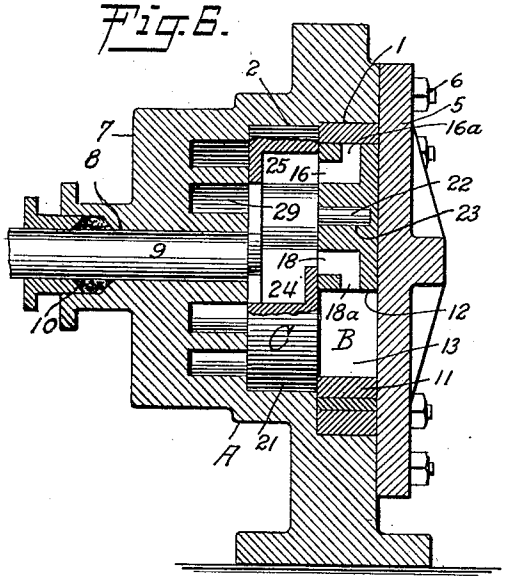


Fig. 7.

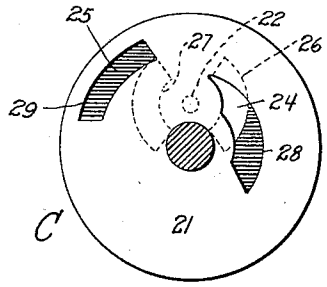


Fig. 8.

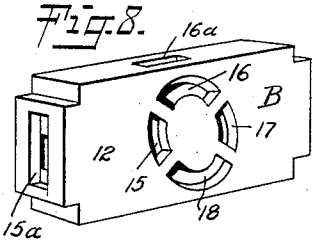
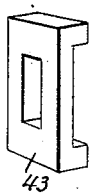


Fig. 9.



WITNESSES

William P. Goebel.

C. Bradway

INVENTOR

Frederick J. Zellar

BY Munn & Co

ATTORNEYS

COLUMBIA PLANOGRAPH CO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

FREDERICK JAMES ZELLAR, OF GRAND HAVEN, MICHIGAN, ASSIGNOR OF ONE-HALF TO DAKE ENGINE CO., OF GRAND HAVEN, MICHIGAN.

ENGINE.

1,067,705. Specification of Letters Patent. Patented July 15, 1913.

Application filed March 27, 1913. Serial No. 757,120.

To all whom it may concern:

Be it known that I, FREDERICK J. ZELLAR, a citizen of the United States, and a resident of Grand Haven, in the county of Ottawa and State of Michigan, have invented a new and Improved Engine, of which the following is a full, clear, and exact description.

This invention relates to engines known as the double-reciprocating square piston type, such as that disclosed in United States Patent Number 395,039, granted to W. F. Dake, December 25, 1889; that is to say, the present invention relates to improvements in engines of that type in which rotary motion of the engine shaft is produced by a piston composed of two slidably-connected sections which reciprocate rectilineally as a unit by steam exerted alternately on opposite sides thereof, and in which the inner section reciprocates rectilineally in a direction at right-angles to the first-mentioned movement by steam admitted alternately at opposite sides of the inner section, the reciprocating movements taking place in such order as to produce rotary movement of the crank pin of the engine shaft.

The invention has for one of its objects to improve and simplify the construction and operation of engines of this character so as to be comparatively inexpensive to manufacture, of greater power for a given weight and size of engine, and so designed as to be reliable, efficient and economical in use.

Another object of the invention is the employment of a novel arrangement of means for admitting motive fluid to and exhausting it from the piston, the exhaust and admission ports being so designed that machining is reduced to a minimum, and the liability of leakage of steam overcome.

Another object of the invention is the provision of a combined crank disk and valve whereby the piston rotates the crank and whereby motive fluid is admitted to and exhausted from the piston chamber.

A further object of the invention is the provision of an engine of the type referred to capable of being reversed and of developing substantially equal power in rotating in either direction.

With these objects in view, and others as will appear as the description proceeds, the invention comprises various novel features of construction and arrangement of parts which will be more fully described hereinafter and set forth with particularity in the claims appended hereto.

In the accompanying drawings, which illustrate one embodiment of the invention, and wherein similar reference characters are employed to designate corresponding parts, Figure 1 is a side view of the machine with the front plate removed and a portion of the inner part of the piston in section to illustrate the details of construction, the piston being shown at the extreme left limit of its stroke; Fig. 2 is a similar view, showing the piston in mid position in its movement toward the right; Fig. 3 is a view similar to Fig. 1, with the piston removed; Fig. 4 is a view similar to Fig. 3, with the combined crank and valve removed to show the annular inlet and exhaust passages in the casing; Fig. 5 is a section on the line 5—5 of Fig. 2; Fig. 6 is a vertical section on the line 6—6 of Fig. 2; Fig. 7 is a view of a combined crank and valve; Fig. 8 is a perspective view of the body portion of the inner section of the piston; and Fig. 9 is a perspective view of one of the end slippers or shoes of said inner section of the piston.

Referring to the drawings, A designates the body of the casing, which is preferably, although not necessarily, a single-piece metal casting formed with a rectangular piston chamber 1, and a concentric cylindrical valve chamber 2 that has formed in its end wall concentric annular supply and exhaust chambers or ports 3 and 4, respectively. The piston chamber has one side open for permitting the interior to be machined and finished, said open side of the chamber being closed by a head or plate 5, which has a flat inner surface and which is secured to the body A by bolts 6. The head or wall 7 of the casing is provided with a bearing opening 8 for the engine shaft 9, there being a stuffing box 10 carried by the plate 7 to prevent leakage of motive fluid along the shaft.

Within the piston chamber 1 is the piston B, which is composed of a rectangular outer section 11 and an inner rectangular section 12 which slidably fits within the chamber 13 of the outer section and engages the end members 14 thereof, the inner section being considerably less in vertical dimension than the chamber 13, so that the inner section can

slide up and down in the outer section. The two sections of the piston will move together horizontally as a unit under the power of the motive fluid. The inner section 12 has at its center arcuate ports 15, 16, 17 and 18, which communicate respectively with diametrically arranged passages 15^a, 16^a, 17^a and 18^a in the inner section 12 of the piston. The passages 15^a and 17^a communicate through ports 19 and 20 with the opposite ends of the piston chamber, and the passages 16^a and 18^a communicate with the spaces inclosed by the two sections of the piston that are above and below the inner section.

Bearing against the piston is the crank C, fastened to the crank shaft 9, this crank being in the form of a disk 21, which has a crank pin 22 that extends in a central opening 23 in the inner section of the piston, the crank pin being eccentric to the axis of the shaft 9, so that by movement of the inner section of the piston, back and forth in directions at right-angles to each other, the crank shaft will be rotated. This crank disk C is also the valve for admitting to and exhausting from the piston cylinder the motive fluid. For this purpose the disk 21 has two passages 24 and 25, which passages in the surface presented to the piston terminate in ports 26 and 27 which are adapted to register with the arcuate ports 15, 16, 17 and 18 of the inner section of the piston, while the opposite ends of the passages 24 and 25 terminate in ports 28 and 29 which are located at different radial distances from the axis of the crank of the disk 21, so that the port 28 will register with the annular inlet passage 3 of the engine body A, while the port 29 will register with the annular exhaust passage 4. Thus, as the crank disk or valve 21 rotates, the ports 28 and 29 will be in permanent communication with the passages 3 and 4, and the ports 26 and 27 will register with oppositely-disposed passages in the inner section of the piston.

At one end of the engine is a valve mechanism D for controlling the admission and exhaust of motive fluid for the purpose of determining the direction of rotation, and also for starting or stopping the engine. This valve mechanism comprises a casing 30 which is connected by a supply pipe 31 with a source of motive fluid; and the casing, one side of which is open and has a removable plate 32, contains an oscillatory plate valve 33 provided with a central stem 34 that is connected with a controlling lever 35. In the casing are ports 36 and 37 that are connected respectively by passages 38 and 39 with the annular passages 3 and 4, said passages 38 and 39 being cored in the valve casing 30 and piston casing A. The valve 33 is adapted to cover both ports 36 and 37 when the power of the engine is to be cut off, and to cover one port while the other is open, so as to permit steam to pass through said open port, and thence to the piston. The port that is closed against the admission of steam communicates by a port 40 in the side of the valve 33 with an exhaust passage 41 cored out in the body A of the engine, and connected with an exhaust pipe 42.

As shown in Figs. 8 and 9, the ends of the inner section 12 of the piston are provided with renewable slippers or shoes 43 as engage the end members 14 of the outer section.

In the operation of the engine, when the valve 33 is in the position shown in Figs. 3 and 4, steam is admitted through the passage 38 to the inner annular passage 3, and thence passes through the passage 24 of the crank disk 21 or valve to the port 18 of the inner section of the piston when such section is in the position shown in Fig. 1. Steam acts between the lower side of the inner section 12 and the bottom of the outer section 13, forcing the inner section upwardly to the position shown in Fig. 2, thereby imparting a quarter rotation to the crank shaft in a clockwise direction, it being understood that the steam at the upper side of the inner section 12 of the piston escapes through the passage 25 of the crank disk and valve to the outer annular passage 4, and thence through the passage 29, ports 37 and 40 and passage 41 to the exhaust pipe. The relative position of the crank disk and valve and piston having changed, the steam will pass from the inlet passage 24 of the valve through the port 15, passage 15^a and port 19, whereby the steam acts on the left end of the piston, so as to force the two sections thereof as a unit toward the left, the course of the incoming steam, as well as the outgoing steam, being shown by the arrows in Fig. 5. The crank shaft will be given another quarter turn, and thereafter steam will be admitted to the upper side of the inner section to impart another impulse to the crank shaft, and then steam is admitted to the right side of the piston, so that the piston will be returned to the position shown in Fig. 1. By reversing the position of the valve 33 the crank shaft can be given an anti-clockwise rotation.

From the foregoing description taken in connection with the accompanying drawings, the advantages of the method of operation and of the apparatus shown will be readily understood by those skilled in the art to which the invention appertains, and while I have described the best embodiment thereof I desire to have it understood that the apparatus shown is merely illustrative, and that such changes may be made when desired as are within the scope of the appended claims.

Having thus described my invention, I

claim as new and desire to secure by Letters Patent:

1. An engine comprising a casing including a piston chamber, a piston slidably mounted in the casing and on the ends of which motive fluid acts alternately for reciprocating the piston, and consisting of inner and outer sections between which the motive fluid for reciprocating the inner section acts, and a combined valve and crank controlling the admission and exhaust of fluid to and from the piston chamber and connected with the piston to receive rotation from the latter.

2. An engine comprising a casing including a piston chamber, a piston slidably mounted in the casing and on the ends of which motive fluid acts alternately for reciprocating the piston, and consisting of inner and outer sections between which the motive fluid for reciprocating the inner section acts, a combined valve and crank controlling the admission and exhaust of fluid to and from the piston chamber and connected with the piston to receive rotation from the latter, said combined valve and crank having separate passages, and annular passages in the said casing having constant communication with the first mentioned passages.

3. An engine comprising a casing including a piston chamber, a piston slidably mounted in the casing and on the ends of which motive fluid acts alternately for reciprocating the piston, and consisting of inner and outer sections between which the motive fluid for reciprocating the inner section acts, a combined valve and crank controlling the admission and exhaust of fluid to and from the piston chamber and connected with the piston to receive rotation from the latter, a crank shaft connected with the combined valve and crank, and admission and exhaust passages in the wall of the casing in concentric relation to the shaft communicating with the passages of the combined valve and crank.

4. An engine comprising a casing inclosing a piston chamber, a piston mounted therein and on the ends of which fluid alternately acts to reciprocate the piston, said piston consisting of an inner section adapted to reciprocate in the outer section by fluid acting alternately on opposite sides of the inner section, a crank connected with the inner section of the piston to be rotated thereby, inlet and exhaust passages in the piston, separate passages carried by the crank for communicating with the piston passages to admit steam to one of the said passages while exhausting steam from the other passage, and separate passages in the wall of the casing permanently communicating with the respective passages on the crank.

5. An engine comprising a casing, a shaft therein, annular passages concentric with the shaft for the inlet and exhaust fluid respectively, a valve on the shaft having passages communicating respectively with the first mentioned passages, and a piston having a plurality of passages arranged to communicate with the passages of the valve in a predetermined order, said valve being located between the piston and the wall of the casing having the first mentioned passages.

6. An engine comprising a casing, a shaft therein, annular passages concentric with the shaft for the inlet and exhaust fluid respectively, a valve on the shaft having passages communicating respectively with the first mentioned passages, a piston having a plurality of passages arranged to communicate with the passages of the valve in a predetermined order, said valve being located between the piston and the wall of the casing having the first mentioned passages, and a connection between the piston and valve for rotating the latter by the piston.

7. An engine comprising a casing, a shaft therein, annular passages concentric with the shaft for the inlet and exhaust fluid respectively, a valve on the shaft having passages communicating respectively with the first mentioned passages, a piston having a plurality of passages arranged to communicate with the passages of the valve in a predetermined order, said valve being located between the piston and the wall of the casing having the first mentioned passages, and a reversing valve for connecting either of the first mentioned passages with a source of supply.

8. An engine comprising a casing, a plurality of annular passages in one wall thereof, a crank, a piston, a connection between the piston and crank and eccentric to the axis of the latter, said piston having a plurality of passages open in one face of the piston and disposed in a circle concentric to said connection between the piston and crank, and passages extending through the crank from one side to the other, the latter passages at one end communicating with the annular passages of the casing and at the other end with the passages of the said piston for admitting fluid to and exhausting it from the piston.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

FREDERICK JAMES ZELLAR.

Witnesses:
MAX GLAZAT,
THOMAS RYCOMGA.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."