No. 668,250. Patented Feb. 19, 1901.

S. M. ZURAWSKI.

EXPLOSIVE ENGINE.

(Application filed Dec. 21, 1899.)

(No Model.)

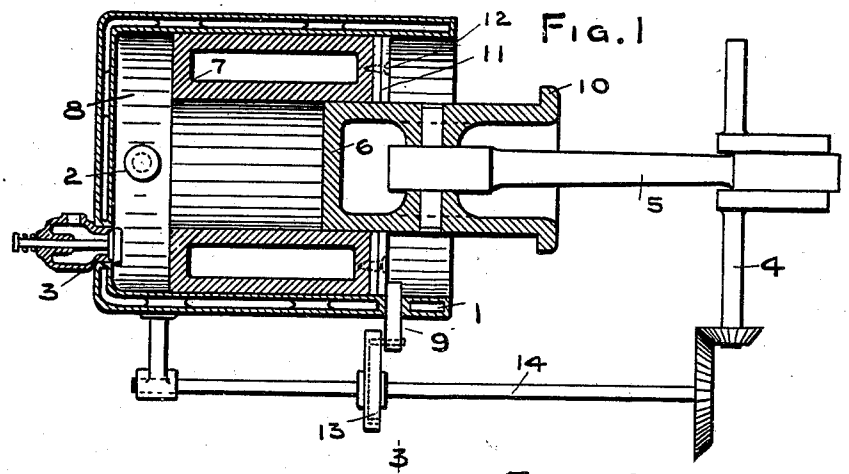


FIG. 1

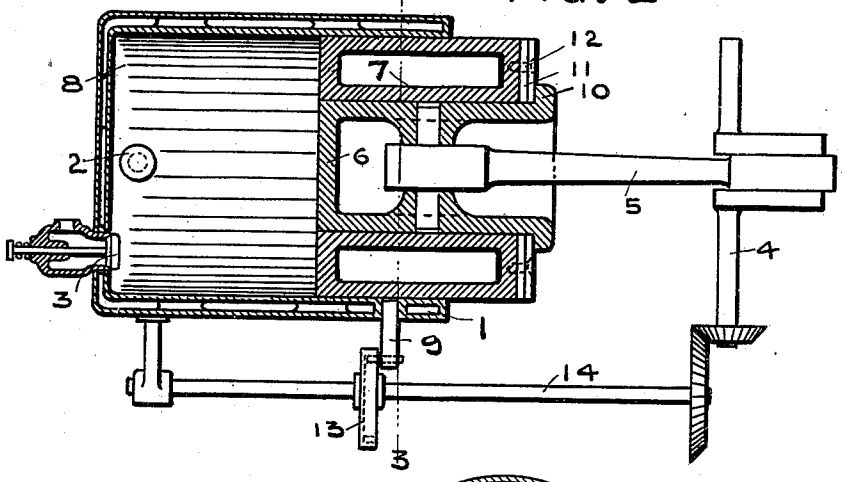


FIG. 2

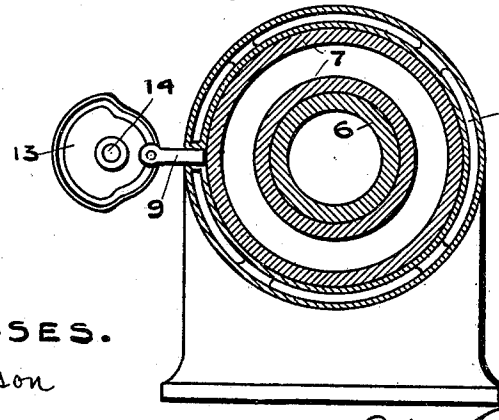


FIG. 3

WITNESSES.

A. G. Wilson

M. C. Brown

INVENTOR.

S. M. Zurawski

By Elliott & Hopkins

Attys.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

STANISLAUS M. ZURAWSKI, OF CHICAGO, ILLINOIS.

EXPLOSIVE-ENGINE.

SPECIFICATION forming part of Letters Patent No. 668,250, dated February 19, 1901.

Application filed December 21, 1899. Serial No. 741,091. (No model.)

To all whom it may concern:

Be it known that I, STANISLAUS M. ZURAWSKI, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Explosive-Engines, of which the following is a full, clear, and exact specification.

My invention relates to that class of explosive-engines or internal-combustion engines in which a piston or other abutment is exposed in an abutment-chamber or cylinder to the impulse of the suddenly-expanded fuel, usually gas or a mixture of combustible vapor with air ignited within the clearance-space or combustion-chamber of the engine; and the primary object of my invention is to increase the area of the piston or abutment exposed to the expansive force of the explosion over engines having a piston-stroke of the same length without thereby necessarily increasing the volume of the charge, or, in other words, without increasing the clearance-space in which the charge is compressed, thus exposing to the explosion the maximum piston area, while avoiding the objection of having to force such area against the new charge at the return stroke in the act of compressing it or having to draw in a fresh charge equal to the volume of the entire piston-stroke.

More specifically stated, the primary object of my invention is to provide a motor or engine with a plurality of abutments or pistons, all of which shall be directly subjected to and move under the same impulse or explosion, while but a portion of them shall act to either draw in the fresh charge or compress it, thereby multiplying the force of the explosion by the square of the piston-surfaces of the entire number of pistons, while the new charge will be only equal to the volume of the piston-stroke of less than the entire number of pistons.

Another object of my invention is to provide means for readily varying the capacity of the compression-chamber or clearance-space, whereby an engine will be adapted for use interchangeably with fixed gas, such as coal or city-illuminating gas, or with the mixture of air and the vapor of hydrocarbon.

In carrying out my invention I employ a plurality of pistons or other abutments against which the pressure acts and all of which are subjected or exposed to the direct action of the explosion or other impulse within the abutment-chamber and unite in driving the crank-shaft or other moving part from which the power is taken, while the drawing in of the new charge or its compression after admission is effected by less than the entire number of such abutments or pistons, the remainder being held at rest and substantially or partially filling the clearance-space or compression-chamber during the inspiration or the compression stroke. As a comprehensive and simple example of my invention I have shown but two of these abutments or pistons arranged for convenience and compactness one concentrically within the other and both located in the same cylinder or abutment-chamber of the engine, which in the particular example shown is of four-cycle type.

Referring now more particularly to the accompanying drawings, Figure 1 is a longitudinal sectional view of an explosive-engine constructed according to my invention. Fig. 2 is a similar view showing a different position of the pistons; and Fig. 3 is a transverse section taken on the line 3 3, Fig. 1.

1 represents the engine cylinder or abutment-chamber, of any suitable construction, which in the example shown is provided with an inlet-valve 2 and exhaust-valve 3, operated in any suitable manner to alternately open for respectively admitting the fuel and permitting the products of combustion to exhaust.

4 represents the crank-shaft, which is connected by pitman 5 with a piston or abutment 6, located in the cylinder 1, and which is accurately fitted and reciprocates within another abutment 7, which in the example shown in the drawings is of annular form and arranged concentrically with the abutment or piston 6, so that the two conjointly fill the cross-section of the cylinder, leaving a space 8 at one end, which is the clearance-space or explosion-chamber. The piston or abutment 6 reciprocates regularly at each revolution of the crank-shaft; but the abutment or piston 7 reciprocates only during each alternate revolution of the shaft and when at rest is held at the inner extremity of its stroke or at the end of its stroke nearest

the clearance-space 8 by means of a stop or catch 9, of any suitable construction, which is automatically withdrawn every other revolution of the shaft to permit the annular abutment 7 to make its advancing and return strokes. Both pistons or abutments have their areas exposed to the explosive force or impulse taking place in the chamber 8, and both contribute to the power of the engine by exerting their force upon the crank-shaft 4, the annular piston 7 being connected with the crank-shaft 4 for this purpose in any suitable manner. A simple method of effecting this connection consists in providing the inner piston 6 with a peripheral flange or lug 10, which projects outwardly into the path of the piston 7, so that when the piston 7 is driven by the impulse of the explosion it will communicate its pressure to the piston 6 and through the connecting-rod 5 to the crank-shaft 4, and when the piston 6 starts on its return stroke it will return the piston 7 to its normal position, (shown in Fig. 1,) occupying the inner end of the cylinder and in a position to be engaged by the stop or catch 9, thus causing the pistons 6 7 to unite in forcing out the exhaust or products of the explosion; but when the piston 6 makes its next advancing stroke or what might be termed its "inspiration" stroke for drawing in a new charge the piston 7 remains at rest, partially filling the compression-chamber 8, and as a consequence the charge drawn in will be equal only to the volume of the stroke of the smaller piston 6 and will be compressed by such smaller piston when the latter returns at the next inward or return stroke, thus providing a maximum piston-surface composed of the combined cross areas of the pistons 6 7, simultaneously exposed to the same impulse of the explosion taking place in the chamber 8, but avoiding the necessity of drawing in a charge of fluid equal to the volume of the stroke of the combined pistons 6 7 and also avoiding the necessity of forcing the combined areas of the two pistons against the charge in the act of compressing it.

It is a well-known fact that the ordinary gas-engine or explosive-engine is not adapted for use interchangeably with fixed gases, such as coal-gas or city-illuminating gas, and the mixture of air and hydrocarbon, such as gasolene, owing to the fact that with one form of fuel a higher degree of compression is required than with the other. In order that the engine may be adapted for this interchangeable use, I provide means for readily varying the capacity of the clearance-space or compression-chamber. This may be simply effected by providing the under side of the piston 7 with a number of spacing-plates or shims 11, interposed between it and the upper or inner side of the flange 10, so that the position of the piston 7 may be altered with reference to the stroke of the piston 6, thus projecting it at one time farther into the chamber 8 and reducing the latter's capacity, and when one or more shims are removed permitting it to recede from the chamber 8 and increase its capacity. These shims or plates 11, if desired, may be secured by screws 12 or other devices to the piston 7.

The stop or catch 9 is shown as passing through the wall of the cylinder 1, and it is pushed in and drawn out at every other revolution of the shaft 4 by means of a cam 13, secured to a shaft 14 and operated from the shaft 4 in any suitable manner.

Although I have shown the means for varying the capacity of the compression-chamber only in connection with an engine having a plurality of abutments, it will nevertheless be understood that the same may be employed with a single-abutment engine also without departing from the spirit of my invention.

Having thus described my invention, what I claim as new therein, and desire to secure by Letters Patent, is—

1. An explosive-engine having in combination two abutments both of which are exposed to and move under the same impulse and one of which is movable independently of the other and means for holding one of said abutments stationary while the other moves, substantially as set forth.

2. An explosive-engine having in combination a shaft, two abutments one of which is operatively connected with said shaft and makes two strokes during each revolution and the other of which makes two strokes during one revolution and remains at rest during every other revolution, substantially as set forth.

3. An explosive-engine having in combination two abutments one of which is independent of the other, means for holding one of said abutments at rest while the other moves in one direction and means for causing the former abutment to move with the latter in the opposite direction, substantially as set forth.

4. An explosive-engine having in combination an abutment-chamber, a crank-shaft, two abutments arranged in the same said chamber and in direct contact with the same charge, one of said abutments being connected to said crank-shaft and the other being independent of both said crank-shaft and the other abutment, means for imparting the force of the explosion-stroke of said independent abutment to said crank-shaft and means for causing it to make its return stroke, substantially as set forth.

5. An explosive-engine having in combination two concentric abutments both exposed to the same impulse and one of which is movable independently of the other, a crank-shaft with which one of said abutments is operatively connected and means for imparting the explosive stroke of the other abutment to said crank-shaft, substantially as set forth.

6. An explosive-engine having in combination a shaft, two abutments one of which is operatively connected with said shaft and

both exposed to the same impulse and one of which is movable independently of the other, and a catch for holding the latter against movement during every alternate revolution, substantially as set forth.

7. An explosive-engine having in combination a shaft, an abutment operatively connected with said shaft, an annular abutment in which said first abutment is located and movable independently thereof, both of said abutments being exposed to the same impulse, a projection on one of said abutments engaging the other to cause them to move together in one direction and to impart the explosive stroke of the annular abutment to the other abutment, a catch for holding said annular abutment while the other abutment moves and means for disengaging said catch at every other revolution of the engine, substantially as set forth.

8. An explosive-engine having in combination a shaft, two abutments one of which is operatively connected with said shaft and both subject to the same impulse and one reciprocating at every revolution of the engine and the other reciprocating during but every other revolution, and means for varying the position of the latter abutment with relation to the travel of the other one, substantially as set forth.

9. An explosive-engine having in combination a shaft, two abutments, one operatively connected with said shaft and both exposed to the same impulse and one of which is movable independently of the other, a projection on one of said abutments with which the other abutment engages, a series of removable blocks or spacing-plates located between said projection and the other abutment for varying the position of one abutment with relation to the stroke of the other, and means for holding one of said abutments at rest while the other moves, substantially as set forth.

10. An explosive-engine having in combination a shaft, two abutments, one operatively connected with said shaft and both exposed to the same impulse and one of which is movable independently of the other, a catch or stop for holding one of said abutments while the other moves and a cam operatively connected with the moving parts of the engine and also with said catch or stop for withdrawing the latter at every other revolution of the engine, substantially as set forth.

11. An explosive-engine having in combination a shaft, two abutments, one operatively connected with the shaft and both exposed to the same charge and one reciprocating at every revolution of the engine and the other reciprocating during but every other revolution and means for varying the length of travel of the latter abutment with relation to the length of travel of the other one, substantially as set forth.

STANISLAUS M. ZURAWSKI.

Witnesses:
F. A. HOPKINS,
E. NUNITT.