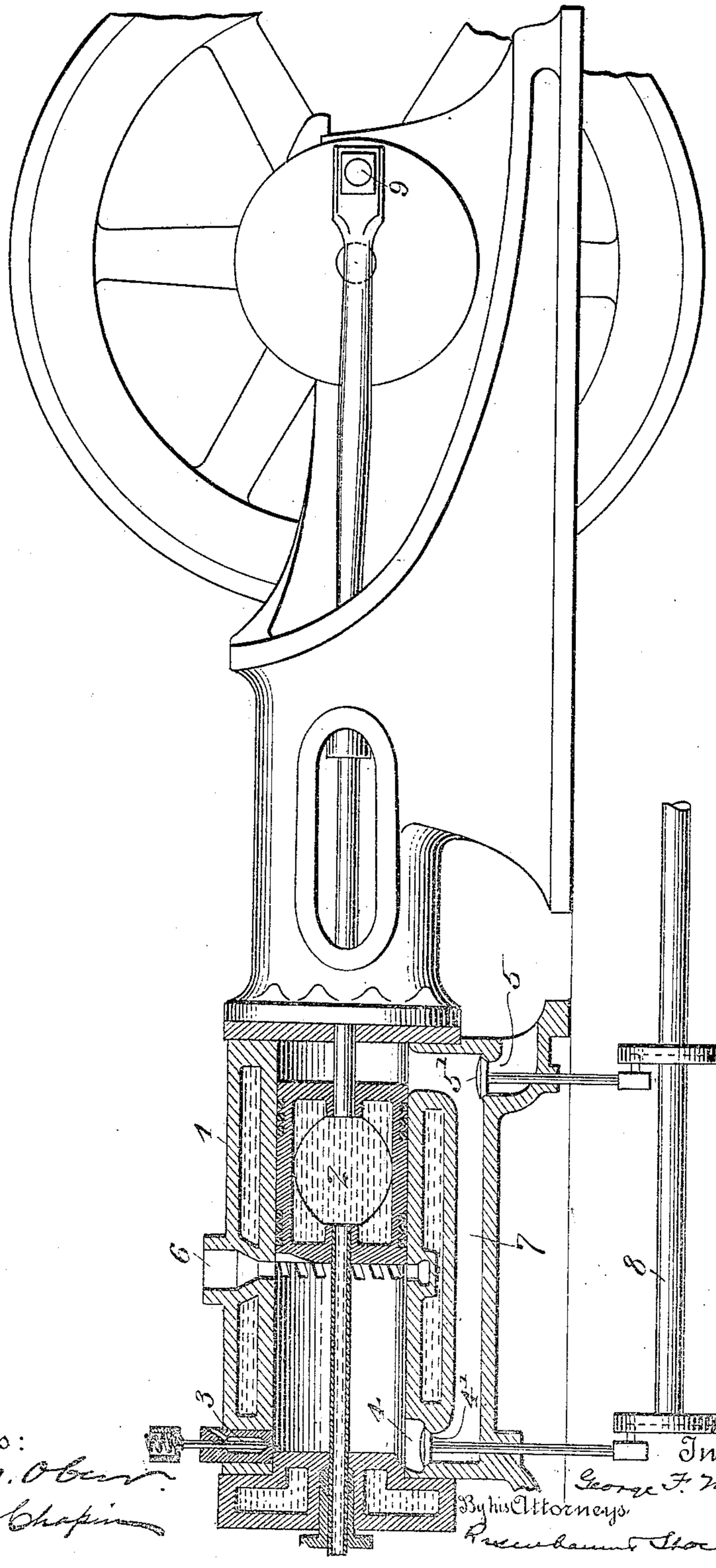
G. F. MURPHY.

TWO CYCLE DIESEL ENGINE.

APPLICATION FILED JULY 2, 1907.

898,768.

Patented Sept. 15, 1908.



Witnesses:
Francis. Obrien
Waldo M. Chapin

Inventor
George F. Murphy
By his Attorneys.
Pressbaum & Stockbridge

THE NORRIS PETERS CO., WASHINGTON, D. C.

123. INTERNAL COMBUSTION ENGINES.
Burning by highly compressed air.
UNITED STATES

UNITED STATES PATENT OFFICE.

GEORGE F. MURPHY, OF JERSEY CITY, NEW JERSEY.

TWO-CYCLE DIESEL ENGINE.

No. 898,768. Specification of Letters Patent. Patented Sept. 15, 1908.

Application filed July 2, 1907. Serial No. 381,920.

To all whom it may concern:

Be it known that I, GEORGE F. MURPHY, a citizen of the United States, residing at Jersey City, in the county of Hudson and State of New Jersey, have invented certain new and useful Improvements in Two-Cycle Diesel Engines, of which the following is a full, clear, and exact description.

This invention consists in an improvement in Diesel engines, by which a firing or working stroke is obtained in each cylinder at every revolution of the fly wheel.

More particularly stated, the invention consists in a form of engine, which secures all the features of the Diesel engine of the ordinary type, as set forth in Patent No. 542,846, dated July 16, 1895, and which works on the two-cycle principle.

The ordinary Diesel engine compresses pure air to a very high degree, about thirty-five atmospheres, at which its temperature becomes so elevated that oil or liquid fuel injected therein becomes ignited and burns, adding its energy to the compressed air.

Referring to the drawings, in which a practical engine embodying my invention is shown, 1 denotes the cylinder, and 2 the piston thereof; 3, 4, 5 and 6 are ports, of which 3 is for the forcible injection of oil or hydrocarbon fuel.

4′ and 5′ are valves opening into the cylinder and into passage 7 respectively, and 6 is a multiple exhaust port in the cylinder wall. The passage 7 is water cooled by the adjacent jacket of the cylinder. The valves 4′ and 5′ are positively actuated and controlled by a cam shaft 8 rotating synchronously with the crank 9, to secure certain important cushioning functions hereinafter stated. The valve 4′ opens after the exhaust port is uncovered by the piston, and the valve 5′ opens just after the piston has completed its forward stroke and has passed the dead center. By reason of this particular arrangement and operation of the valves, air is compressed at the crank end of the cylinder at each revolution and this compression is retained until the crank is passing the dead center, thereby having an important cushioning effect on the movement of the piston, and balancing the inertia of the reciprocating parts. The inertia in the opposite direction is balanced at every stroke by the compression of the air prior to the injection of the fuel. From a mechanical standpoint, the engine is therefore well balanced, since every stroke of the piston in both directions is cushioned, and the inertia thereof balanced. This is a most important consideration. The retaining of the compression at the crank end until the engine is actually passing or has passed the dead center at the crank end, I find in practice to substantially overcome a most serious objection to the ordinary two-cycle engine, which is the great mechanical inefficiency due to lack of balance at this point of the cycle. I therefore regard this as a very important feature of my invention. I will now consider the operation of the engine from a thermo-dynamic standpoint.

The ordinary two-cycle engine has a limited field of utility because carbureted air is injected directly into the cylinder at the moment when the hot gases of the firing stroke are escaping, so that premature ignition is extremely liable to occur in all two-cycle engines at high speeds, and in large engines at all speeds. This has also greatly limited the application of the two-cycle principle. In accordance with my invention, this limitation is also removed, because pure air can be used with the present engine, which is not susceptible to premature ignitions, either in large engines, or at the highest speeds. The waste of carbureted air through the exhaust port which unavoidably occurs in a two-cycle engine is also not of any importance in an engine according to the present invention since there is only mere uncarbureted air to be wasted when the exhaust is open. On the other hand, all of the advantages of the ordinary four-cycle Diesel engine are retained.

An additional feature of the present invention lies in the fact that a larger body of air is compressed at the crank end of the cylinder than the effective displacement at the head end during the compression stroke. This occurs on account of the exhaust openings 6 which effectively diminish the stroke at the head end by the amount of their longitudinal extent in the cylinder wall. In other words the effective piston displacement at the combustion end is less than the total displacement by an amount corresponding to the piston displacement while it is passing the open exhaust port. As these ports are not present at the crank end of the cylinder, the full stroke of the piston at this end is effective. The above result by which a larger body of air is compressed than is required to fill the cylinder at the moment of

commencement of its effective compression stroke is very important in practice since it secures the ample expulsion of the spent gases and the thorough scavenging of the cylinder. By virtue of the hydrocarbon fuel injection principle employed, the waste of the charge which results from this action is of no importance, because the charge consists of mere air which does not carry any hydrocarbon, the loss of which would be an item of expense. I therefore regard the arrangement by which an excessive body of air is compressed prior to its admission into the firing end of the cylinder as of peculiar and special importance in the particular cycle of the present invention.

It is to be noted that in any two-cycle engine a clearance space is necessarily left at the combustion end, the proportion of which to the total effective piston displacement determines the pressure and the temperature of the initial compression. In an ordinary two-cycle engine this clearance is necessarily quite large in order to avoid premature ignition, but in a Diesel engine it is necessarily very small in order to secure ignition by compression. It will be noted that with the proportion of the parts shown in the drawing and corresponding to the requirements of ignition by compression, that the clearance space at the combustion end of the cylinder is less than the loss in the effective displacement of the piston at this end due to the exhaust ports 6. In other words, the total space to be filled prior to compression at the combustion end, including the clearance, is less than the piston displacement at the crank end so that a larger amount of scavenging air is blown into the combustion end of the cylinder than is necessary to completely fill it at the instant the compression commences.

It will be noted that the piston 2 is made hollow and connected with a source of water supply so as to be effectively water cooled. The importance of this is two-fold: first, it is necessary to have very efficient cooling means in an engine of the present type on account of the high temperature of the gases during the combustion. The cooling of the piston prevents this part from unduly expanding and binding in the cylinder walls under the high temperatures to which it is subjected. The cooling is also important on account of the fact that the crank end of the cylinder is utilized for compressing the charge previous to its admission into the working end of the cylinder. The air compressed for this purpose should not become very greatly heated during the stroke on account of the larger amount of power which would be uselessly expended in the compression under such circumstances. By having the piston water cooled in the manner shown, this latter effect is prevented and the power used in the preliminary compressing of the charge greatly economized.

What I claim, is:—

1. In a two cycle engine, the combination of a cylinder and piston, the space on one side of the piston being for combustion and having a clearance space so proportioned to the effective piston displacement at this end of the cylinder as to produce a compression and resulting temperature high enough to ignite the fuel to be consumed, the space on the other side of the piston being for initial compression, a valve controlled passage between the two spaces and coöperating with the movement of the piston to cause an initial compression simultaneously with the working or power stroke, and an exhaust port communicating with the said combustion and space at the conclusion of the combustion stroke and producing a diminution of effective piston displacement at this end of the cylinder greater than said clearance space thereat, whereby a scavenging charge in excess of the charge to be compressed for the working stroke is supplied.

2. In a two cycle engine, the combination of a cylinder and piston, the space on one side of the piston being for combustion and having a clearance space so proportioned to the effective piston displacement at this end of the cylinder as to produce a compression and resulting temperature high enough to ignite the fuel to be consumed, said cylinder having an exhaust port near its middle portion uncovered by the piston at the end of the piston stroke, said clearance space being of less volume than the displacement of the piston in passing said exhaust port, the space on the other side of said piston being for initial compression, and a valve controlled passage between the two spaces and coöperating with the movement of the piston to cause an initial compression simultaneously with the working or power stroke, whereby a scavenging charge in excess of the charge to be compressed for the working stroke is supplied.

3. In a two cycle engine, the combination of a cylinder and piston, the space on one side of the piston being for combustion and having a clearance space so proportioned to the effective piston displacement at this end of the cylinder as to produce a compression and resulting temperature high enough to ignite the fuel to be consumed, said cylinder having an exhaust port opened to the atmosphere during a distance of the piston movement corresponding to a displacement greater than said clearance space, the space on the other side of said piston being for initial compression, and a valve controlled passage between the two spaces and coöperating with the movement of the piston to cause an initial compression simultaneously with the working or power stroke, whereby a scaveng-

ing charge in excess of the charge to be compressed for the working stroke is supplied.

4. In an internal combustion engine, means for compressing a charge at one end of the engine cylinder, means whereby the compression is maintained at such end of the cylinder while the crank is passing the dead center, and means for thereupon admitting the charge so compressed to the combustion end of the cylinder.

In witness whereof, I subscribe my signature, in the presence of two witnesses.

GEORGE F. MURPHY.

Witnesses:

WALDO M. CHAPIN,

REUBEN GREENE.