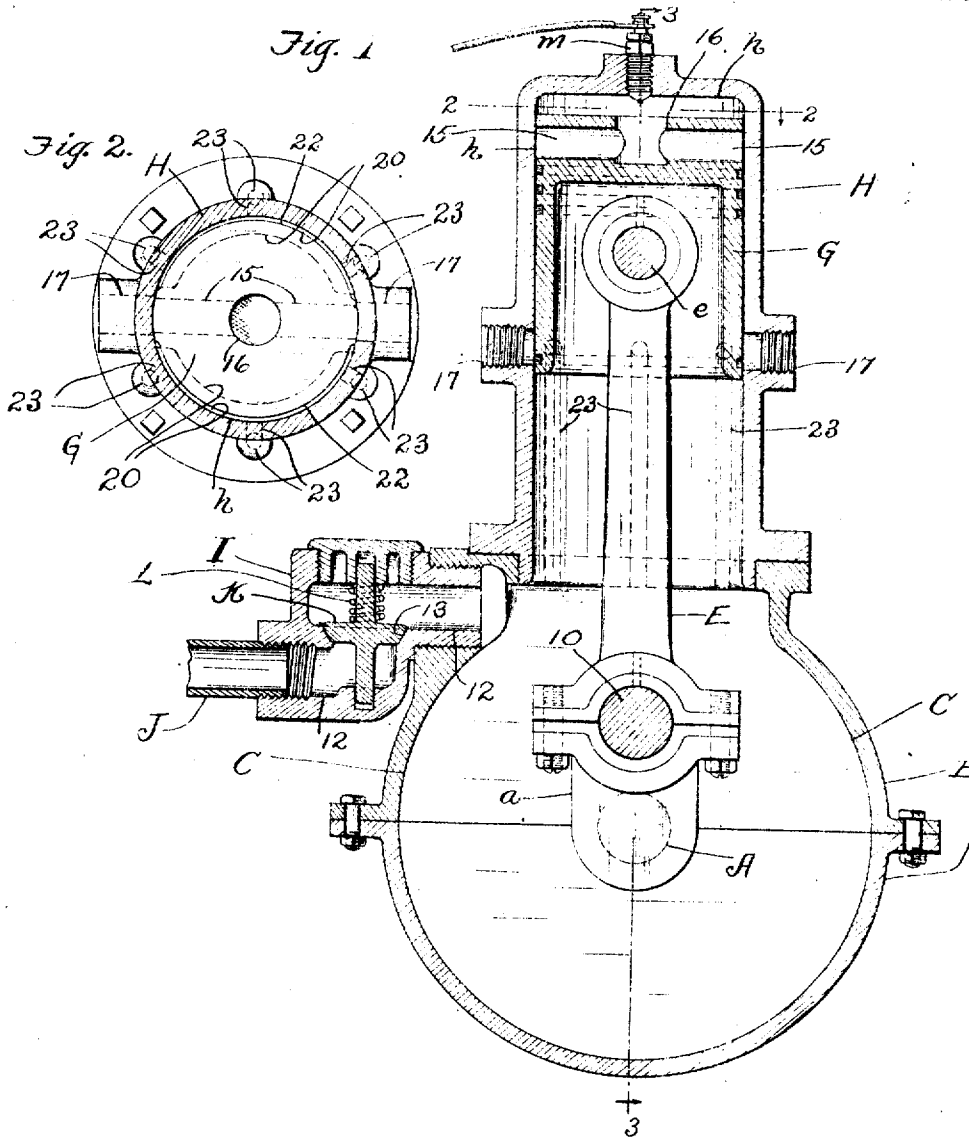


1,004,021.

2 SHEETS-SHEET 1.



Witnesses:
N. J. Gettine
B. C. Brown

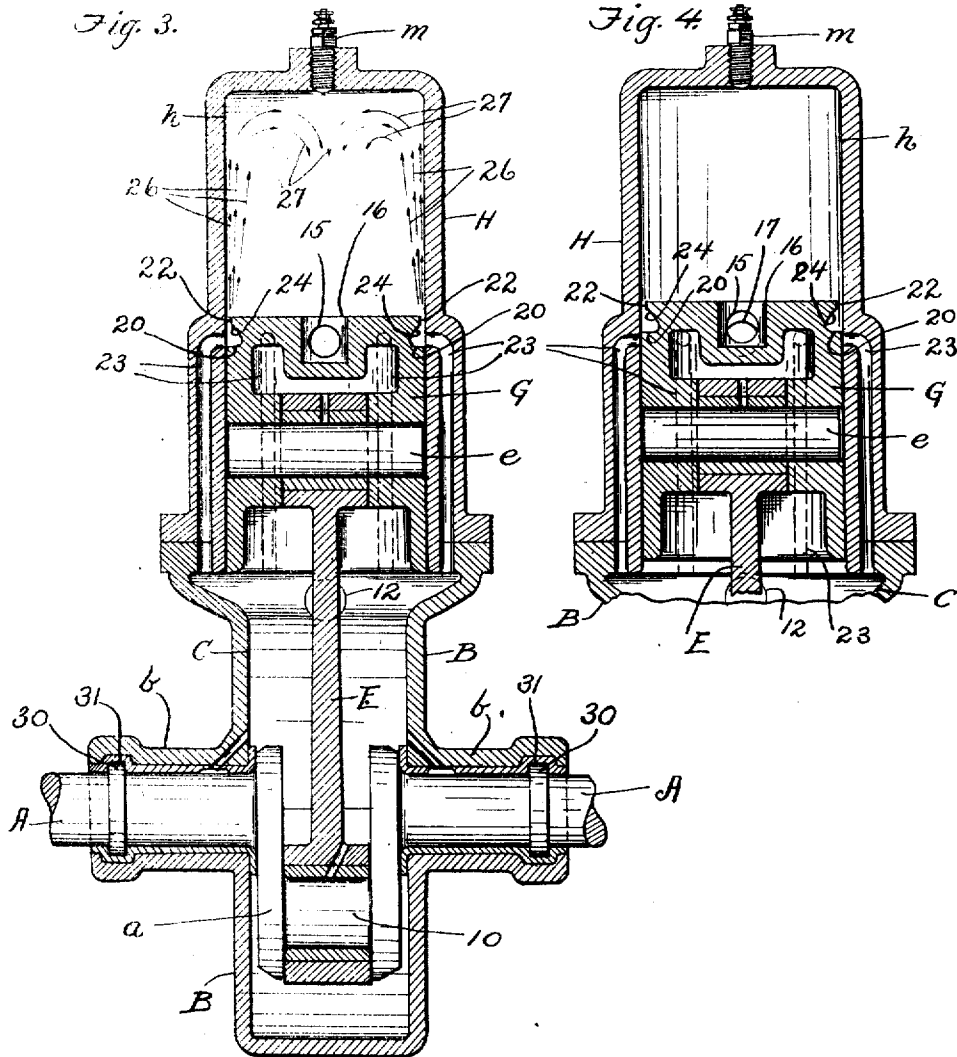
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T. H. HABERKORN.
TWO CYCLE INTERNAL COMBUSTION ENGINE.
APPLICATION FILED FEB. 19, 1909.

1,004,021.

Patented Sept. 26, 1911.

2 SHEETS-SHEET 2.



Witnesses:
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UNITED STATES PATENT OFFICE.

THEODORE H. HABERKORN, OF FORT WAYNE, INDIANA.

TWO-CYCLE INTERNAL-COMBUSTION ENGINE.

1,004,021.

Specification of Letters Patent. Patented Sept. 26, 1911.

Application filed February 19, 1909. Serial No. 478,930.

To all whom it may concern:

Be it known that I, THEODORE H. HABERKORN, a citizen of the United States of America, residing at Fort Wayne, in the county of Allen and State of Indiana, have invented certain new and useful Improvements in Two-Cycle Internal-Combustion Engines; and I hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it pertains to make and use the same.

This invention relates to improvements in two-cycle internal combustion engines wherein during the driving or working stroke of the piston of the engine, resulting from the expansive force or impact against the face of the piston by the explosion and consequent expansion of the combustible and explosive fluid or fuel compressed within the chamber of the cylinder in front of the face of the piston, the resulting burned or spent gases or products of combustion are to be exhausted from the said chamber near the end of but before the completion of the said piston-stroke.

One object of this invention is to retain the advantages of a piston having a flat face arranged at a right angle to the cylinder-chamber endwise of which the piston reciprocates during the operation of the engine and yet permit the cylinder-chamber to exhaust through the piston centrally of the said face.

Another object is to provide the piston interiorly with an exhaust-port which communicates with the cylinder-chamber in front of the face of the piston at a point substantially centrally of the flat face of the piston and which is arranged to communicate with an exhaust-port with which the cylinder is provided, near the end but before the completion of the driving or working stroke of the piston so that the cylinder-chamber is reliably and satisfactorily exhausted with great facility during the said piston-stroke.

Another object is to supply the combustible and explosive fluid or fuel to the cylinder chamber at and circumferentially of the face of the piston and approximately wholly around the said face to cause the said fuel to materially participate in uniformly cooling the piston and cylinder circumferentially of the piston.

Another object is to provide the piston

next adjacent the face of the piston and in its periphery with one or more ports which extend circumferentially of the piston and open into the cylinder-chamber at and circumferentially of the face of the piston, and to provide the cylinder with ports which communicate at their receiving ends with the fuel-supply chamber in which the combustible and explosive fluid or fuel is compressed during the driving or working stroke of the piston and are arranged to communicate at their discharging ends with the said port or ports in the piston at and somewhat before the end of the said stroke of the piston but after the cylinder-chamber has begun to exhaust through the piston during the said piston-stroke, so that fresh fuel will near and at the end of the said piston-stroke be discharged through the said cylinder-ports and through the said piston-ports into the cylinder-chamber in front of the piston and circumferentially of the surrounding wall of the cylinder-chamber not unlike the flow of steam in operating a steam-whistle, and thereby operate to force the burned or spent gases or products of combustion still remaining in the said cylinder-chamber through the exhaust-ports in the piston and cylinder.

Another object is to allow the larger portion of the burned or spent gases or products of combustion to escape from the cylinder-chamber before the cylinder-chamber is supplied in front of the piston with a fresh charge of combustible or explosive fluid or fuel during the driving or working stroke of the piston.

Another object is to clean the walls of the cylinder-chamber by a proper discharge of a fresh charge of combustible and explosive fluid or fuel into the said chamber during each driving or working stroke of the piston and to carry oil or lubricant with the said charge into the said chamber to lubricate the said walls.

Another object is to avoid mixing of the fresh charge of combustible and explosive fluid or fuel with the burned or spent gases or products of combustion during the driving or working stroke of the piston.

Another object is to make an engine of the character indicated which is simple and durable in construction and reliable in its operation.

With these objects in view, and to the end of realizing other advantages hereinafter

appearing, this invention consists in certain features of construction, and combinations of parts, hereinafter described, pointed out in the claims and illustrated in the accompanying drawings.

In the said drawings, Figure 1 is a substantially central section of an engine embodying my invention. Fig. 2 is a transverse section on line 2—2, Fig. 1, looking in the direction indicated by the arrow. Fig. 3 is a section on line 3—3, Fig. 1, looking in the direction indicated by the arrow, but in Fig. 3 the piston of the engine is shown in position at the completion of its driving or working stroke, whereas in Fig. 1 the piston is shown in position for beginning its said stroke. Fig. 4 is a sectional view of a portion of the cylinder and the piston of the engine and illustrates the exhausting of the cylinder-chamber in advance of the discharge of a fresh charge of combustible and explosive fluid or fuel into the said chamber in front of the piston during the driving or working stroke of the piston.

Referring to the said drawings, A indicates the engine-shaft which is arranged horizontally and has bearing in two boxes *b* and *b* formed on or rigid with opposite side walls respectively of a case B which forms a chamber C whose lower portion is employed for holding oil or lubricant (not shown) for lubricating purposes. The engine illustrated is arranged upright, and the shaft A is provided within the chamber C with a crank *a* whose sweep is surrounded by the said chamber.

E indicates the piston-rod or pitman which establishes operative connection between the crank *a* and the piston G of the engine, which piston is arranged within and adapted to reciprocate endwise of the chamber *h* formed by and internally of the cylinder H of the engine, which cylinder is shown mounted on and secured to the upper end of the case B. It will be observed therefore that in the engine illustrated the cylinder H is arranged substantially vertically and extends upwardly from the case B, and that the engine-shaft is arranged a suitable distance below the piston. The pitman E has its lower end loosely embracing the wrist 10 of the crank of the shaft and has its upper end loosely embracing the pin *e* which pivots the piston-rod to the piston, which pin is arranged parallel with the shaft.

The case B is provided at its upper end and at one side of the adjacent end of the cylinder H (see Fig. 1) with a valve-casing I which is attached to the case B in any approved manner and has an internal passageway 12 which communicates at its discharging end with the chamber C, and at its opposite and receiving end communicates with a pipe J for supplying combustible and

explosive gas, vapor or other aeriform fuel through the passageway 12 to the chamber C which constitutes the fuel-supply chamber for the cylinder-chamber *h* and whence fuel is supplied to the cylinder-chamber in front of the piston and there exploded at the proper time to produce the required expansive force or impact against the said face and result in the driving of the piston.

The valve-casing I is provided centrally between the ends of its passageway 12 with an upwardly flaring valve-seat 13 which forms the central portion of the surrounding wall of the passageway and is arranged to be engaged by a suction-valve K, and a suitably applied spiral spring L is confined over and engages the upper end of the valve and acts to retain the latter in its closed position.

Obviously during the movement of the piston farther from the shaft to compress a charge of fresh combustible and explosive fluid or fuel supplied to the cylinder-chamber in front of the face of the piston suction is created within the fuel-supply chamber C, resulting in the creation of suction within the passageway 12 in the valve-casing and in the opening of the valve K against the action of the spring L, and the body of combustible and explosive fluid or fuel in the said fuel-supply chamber is compressed during the driving or working movement of the piston toward the shaft by the impact against the face of the piston upon the ignition and explosion of a compressed charge of fresh fuel within the cylinder-chamber in front of the said face.

The cylinder H is provided at its upper extremity and centrally,—that is, at its extremity in front of the face of the piston,—with an ignition device, such, for instance, as a spark-plug *m*, whereby a charge of fresh fuel supplied to the cylinder-chamber in front of the piston is, upon being compressed during the forward stroke of the piston, ignited and exploded at the proper time. Suitable ignition devices for internal combustion engines are however too well known in the art to require illustration and description in this specification. I would also remark that the piston G has a flat face arranged in the usual manner at a right angle to the cylinder.

A highly meritorious feature of my invention consists in the provision of means whereby the burned or spent gases or products of combustion resulting from the explosion of a fresh charge of fuel compressed in the cylinder-chamber by and in front of the face of the piston are exhausted from the said chamber to the exterior of the cylinder through the piston during the driving or working stroke of the piston, said means comprising an opening 16 which is formed in the front of the piston at and centrally of the face of the piston and communicates

with the cylinder-chamber at the said face. The opening 16 is in communication with the inner ends of two exhaust-ports 15 which are formed in the front of the piston between the ends of the piston and in suitable proximity to the face of the piston. The exhaust-ports 15 are substantially parallel with the flat face of the piston and extend transversely of the piston from the opening 16 to diametrically opposite points respectively on the periphery or exterior of the piston. The exhaust-ports are arranged in line endwise and a suitable distance from the face of the piston and communicate through the opening 16 with the cylinder-chamber in front of the said face. The exhaust-ports 15 are arranged to begin to communicate with the exhaust-ports 17 formed in the cylinder as shown in Fig. 4, when the piston during its driving or working stroke nears the end of the said stroke, and the piston-ports 15 are in full communication with the cylinder-ports 17 when the piston is at the end of the said stroke as shown in Fig. 3. That is, the cylinder is provided between the face of the piston and the case B and a suitable distance from the said face with two exhaust-ports 17 and 15 which are formed in opposite sides respectively of the cylinder and communicate at their outer ends with the external atmosphere or with pipes (not shown) for conducting fluid discharged through the exhaust-ports to any desired place, and the said ports are arranged to communicate at their inner ends with piston-ports 15 and at the periphery of the piston-ports as soon as the piston during its driving or working stroke nears the end of the stroke. Obviously therefore the burned or spent gases or products of combustion resulting from the explosion of a fresh charge of compressed fuel in the cylinder-chamber in front of the piston when the piston is in position at or substantially at the beginning of its driving or working stroke escape during the said stroke of the piston at a point centrally of the face of and through the piston as soon as the piston-ports 15 during the said piston-stroke come into communication with the exhaust-ports 17 of the cylinder.

Another feature involved in my invention and not of less importance than my improved means for exhausting the cylinder-chamber through the piston consists in the improved means employed for conducting a fresh charge of combustible and explosive fluid or fuel to the cylinder-chamber in front of the piston from the fuel-supply chamber C which, as already indicated, is kept supplied with fresh fuel during the operation of the engine. My improved means for conducting a fresh charge of fuel from the fuel-supply chamber C to the cylinder-chamber in front of the piston prefer-

ably comprise two ports 20 and 20 formed in and circumferentially of the piston at the face of the piston and arranged at opposite sides respectively of the piston, which ports open into and therefore continuously communicate with the cylinder-chamber in front of the piston and are arranged to communicate at and just before the end of the driving or working stroke of the piston with fuel-conducting ports 23 which are formed in and longitudinally of the cylinder and extend at their discharging ends to the interior of the cylinder and communicate at their opposite ends with the fuel-supply chamber C. The fuel-conducting cylinder-ports 23 are spaced equidistantly circumferentially of the cylinder and discharge into the fuel-conducting piston-ports 20 as the latter during but near the end of the driving or working stroke of the piston come into communication with the said cylinder-ports, and obviously during the compression of the body of fresh fuel in the fuel-supply chamber C by the piston during the said piston-stroke a charge of fresh fuel, as soon as the piston-ports 20 communicate with the cylinder-ports 23 during the said piston-stroke, is forced from within the said chamber through the said cylinder-ports and through the said piston-ports into the cylinder-chamber in front of the piston, and the fuel thus discharged forward of the piston by the said piston-ports is by the latter distributed circumferentially of the face of the piston next the surrounding wall of the cylinder-chamber. It will be observed that the spacing of the fuel-conducting cylinder-ports 23 equidistantly circumferentially of the cylinder insures a proper distribution of fuel by the said ports to the piston-ports 20. The forward portion of each piston-port 20 has a laterally and outwardly facing side wall 22 which is arranged substantially parallel with the line of movement of the piston so that the fuel discharged from the said ports passes along the surrounding wall of the cylinder-chamber in front of the piston to or toward the piston-facing end wall of the said chamber as indicated by the arrows 26 in Fig. 3 and thence inwardly toward the center of the cylinder-chamber as indicated by the arrows 27 in the said figure and behind and forces burned or spent gases or products of combustion still remaining in the cylinder-chamber out through the exhaust-ports of the piston and cylinder and keeps the said walls of the said chamber in a clean condition. Preferably each piston-port 20 is enlarged inwardly at the inner end of its wall 22 toward the center of the piston, and the said enlarged portion of the said port has an outwardly facing side wall 24 sloping laterally outwardly and toward the wall 22 of the port.

By the construction hereinbefore de-

scribed it will be observed that the piston has a front of hollow character; that each piston-port 20 extends circumferentially of the piston at the face of the piston; that the portion of the piston between the inner end of the cylinder and the piston-ports 20 forms an inner circular flange fitting closely in the cylinder and operatively connected with the pitman E; that the said piston-ports form fluid-conducting passageways extending and spaced circumferentially of the piston and discharging into the cylinder along the surrounding wall of the cylinder-chamber; that the walls 22 and 24 of each piston-port or passageway 20 form an outer flange on the piston, which flange is spaced from the adjacent portion of the surrounding wall of the cylinder-chamber and extends circumferentially of the piston and is also spaced from the aforesaid pitman-connecting inner flange of the piston by the enlarged portion of the port or passageway 20 between the said flanges so that the said flanges are separated by an interval which extends circumferentially of the piston; that the opening 16 formed in the piston at and centrally of the top or face of the piston communicates with the exhaust-ports 15 which are arranged below the said face and register with the exhaust-ports or passageways 17 leading from the cylinder when the piston is at the lower end of its stroke, and that the fuel-conducting cylinder-ports 23 constitute inlet passages which are formed in the cylinder and communicate with the interval formed by the enlarged portion of the adjacent port or passageway 20 when the piston is at the lower end of its stroke.

Not unimportant is the size and arrangement of the exhaust-ports of the piston and cylinder relative to the arrangement of the fuel-conducting ports of the cylinder and piston, whereby each exhaust-port of the piston during the driving or working stroke of the piston communicates with the exhaust-ports of the cylinder in advance of the communication of the fuel-conducting piston-ports with the fuel-conducting cylinder-ports during the said piston-stroke, so that the burned or spent gases or products of combustion resulting from the explosion of a charge of fresh fuel supplied to and under compression in the cylinder-chamber in front of the piston when the piston is substantially at the commencement of its said stroke shall have been largely exhausted from the cylinder before a new supply of fresh fuel is discharged into the cylinder-chamber at the face of the piston and so that preferably about seventy-five per cent. of the said products of combustion are exhausted before the supply of the next charge of fresh fuel in front of the piston.

The discharge of fresh fuel circumferentially and forward of the face of the piston

is not unlike the flow of steam in the operation of a steam-whistle, and it will be observed that the surrounding wall of the cylinder-chamber forward of the face of the piston is not only cleaned by every fresh charge of fuel delivered forward of the said face but the said wall is also lubricated by the oil or lubricant which is carried with the said fuel from the oil-receiving fuel-supply chamber. It will also be observed that the fresh fuel passing into the cylinder-chamber forward of the piston and behind the escaping burned or spent gases or products of combustion and operating to drive the said products of combustion from the said chamber does not mix with the said gases or products of combustion as is the case in two-cycle internal combustion engines having an exhaust-port on one side of the cylinder and a fuel-inlet directly opposite the exhaust-port.

To prevent the escape of fuel from the oil-receiving fuel-supply chamber C along the shaft during the driving or working stroke of the piston the shaft is provided centrally between the ends of each box b with an external collar 30 which is turned on the shaft, and the boxes b are provided internally with annular recesses 31 to accommodate the location of the collars 30.

It will also be observed that by admitting the fuel into the cylinder-chamber in front of the piston through the circumferentially extending piston-ports 20 which are comparatively narrow where they discharge into the cylinder there is no liability of any communication of fire from the explosion of fuel within the cylinder to the fuel-supply chamber C when the latter is in communication with the aforesaid piston-ports. I would also remark that by the construction hereinbefore described fuel from within the fuel-supply chamber C, being mostly cool air and evenly distributed circumferentially of the cylinder during each rotation of the engine-shaft, materially participates in the uniformly cooling of the cylinder. It is obvious also that by the provision of the fuel-conducting piston-ports 20 the fresh fuel is supplied to the cylinder-chamber at the face of the piston substantially wholly around the said face and materially participates in cooling both piston and cylinder uniformly circumferentially of the piston.

What I claim is:—

1. In a two-cycle internal combustion engine, an internally chambered cylinder; a reciprocating piston arranged within the cylinder-chamber and having a flat face arranged transversely of and at a right angle to the cylinder; an exhaust-port formed in the piston and extending transversely of the piston a suitable distance from the said face and opening into the cylinder-chamber centrally of the said face; an exhaust-port

formed in the cylinder and arranged to communicate with the exhaust-port in the piston during but near the end of each driving or working stroke of the piston, and means whereby a charge of fresh fuel is begun to be supplied, near the end of the piston-stroke, to the cylinder-chamber at the face and circumferentially of opposite sides of the piston.

10 2. In a two-cycle internal combustion engine, an internally chambered cylinder; a reciprocatory piston arranged within the cylinder and having a flat face arranged transversely of and at a right angle to the cylinder; an exhaust-port formed in the piston
15 and extending transversely of the piston between diametrically opposite points on the exterior of the piston, said exhaust-port being arranged substantially parallel with the said face and opening into the cylinder-chamber centrally of the said face; means whereby the said exhaust-port communicates with the external atmosphere during but
20 near the end of each driving or working stroke of the piston, and means whereby a charge of fresh fuel during but near the end of the said piston-stroke is begun to be supplied to the cylinder-chamber at the face of the piston.

30 3. In a two-cycle internal combustion engine, an internally chambered cylinder, a piston arranged within and adapted to reciprocate endwise of the cylinder-chamber, a shaft operatively connected with the piston, means whereby the cylinder-chamber in
35 front of the piston exhausts through the piston during but near the end of the driving or working stroke of the piston, two fuel-conducting ports formed in the periphery and extending circumferentially of the piston at opposite sides respectively of the piston, which ports open into and are arranged to discharge into the cylinder-chamber at and circumferentially of the face of
45 the piston; ports formed in and longitudinally of the cylinder at points spaced circumferentially of the cylinder and having their discharging ends arranged to communicate with the fuel-conducting ports in the piston at the end of the aforesaid stroke of the piston, said cylinder-ports having their said ends closed by the piston during the said piston-stroke until the piston nears the end of the said stroke, and a suitably
55 charged fuel-supply chamber communicating with the said cylinder-ports and arranged to have the fuel therein compressed by the piston during the aforesaid stroke of the piston.

60 4. In a two-cycle internal combustion engine, an internally chambered cylinder; a piston arranged within and adapted to reciprocate endwise of the cylinder-chamber; a shaft operatively connected with the piston; means whereby the cylinder-chamber in

front of the piston exhausts through the piston during but near the end of the driving or working stroke of the piston; fuel-conducting ports formed in the periphery and extending circumferentially of the piston, which ports open and are arranged to discharge into the cylinder-chamber at and circumferentially of the face of the piston; substantially parallel ports formed in and longitudinally of the cylinder at points spaced substantially equidistantly circumferentially of the cylinder and having the discharging ends arranged to communicate with the fuel-conducting ports in the piston at the end of the aforesaid stroke of the piston, said cylinder-ports having their said ends closed by the piston during the said piston-stroke until the piston nears the end of the said stroke, and a suitably charged fuel-supply chamber communicating with the said cylinder-ports and arranged to have the fuel therein compressed by the piston during the aforesaid stroke of the piston.

5. In a two-cycle internal combustion engine, an internally chambered cylinder; a piston arranged within and adapted to reciprocate endwise of the cylinder-chamber; a shaft operatively connected with the piston; fuel-conducting ports formed in the periphery and extending circumferentially of the piston and opening into the cylinder-chamber at and circumferentially of the face of the piston, the forward portions of the said ports having laterally and outwardly facing side walls which are substantially parallel with the line of movement of the piston; fuel-conducting ports formed in the cylinder and arranged to discharge into the aforesaid piston-ports at the end of the driving or working stroke of the piston, said cylinder-ports having their discharging ends closed by the piston during the said piston-stroke until the piston nears the end of its said stroke; a suitably charged fuel-supply chamber communicating with the said cylinder-ports and arranged to have the fuel therein compressed by the piston during the said stroke of the piston, and means whereby expanded products of combustion resulting from the explosion of a charge of fuel compressed by and in front of the face of the piston during the opposite stroke of the piston are exhausted through the piston during the next driving or working stroke of the piston.

6. In a two-cycle internal combustion engine, an internally chambered cylinder; a piston arranged within and adapted to reciprocate endwise of the cylinder-chamber; a shaft operatively connected with the piston; fuel-conducting ports formed in the periphery and extending circumferentially of the piston, and opening into the cylinder-chamber at and circumferentially of the face of the piston, the forward portions of the

5 said ports having laterally and outwardly facing side walls which are substantially parallel with the line of movement of the piston, said ports being enlarged at the inner ends of the said walls inwardly toward the center of the piston and the enlarged portions of the ports having laterally and outwardly facing side walls which slope laterally outwardly and toward the face of the piston and connect with the first-mentioned walls; fuel-conducting ports formed in the cylinder and arranged to discharge into the aforesaid piston-ports at the end of the driving or working stroke of the piston, said cylinder-ports having their discharging ends closed by the piston during the said piston-stroke until the piston nears the end of its

said stroke; a suitably charged fuel-supply chamber communicating with the said cylinder-ports and arranged to have the fuel therein compressed by the piston during the said piston-stroke, and exhaust-ports arranged to exhaust the cylinder-chamber during the said piston-stroke but in advance of the discharge of fresh fuel through the aforesaid piston-ports during the said piston-stroke.

In testimony whereof, I sign the foregoing specification, in the presence of two witnesses.

THEODORE H. HABERKORN.

Witnesses:

ALLEN J. VESEY,
LUCY UPSON.