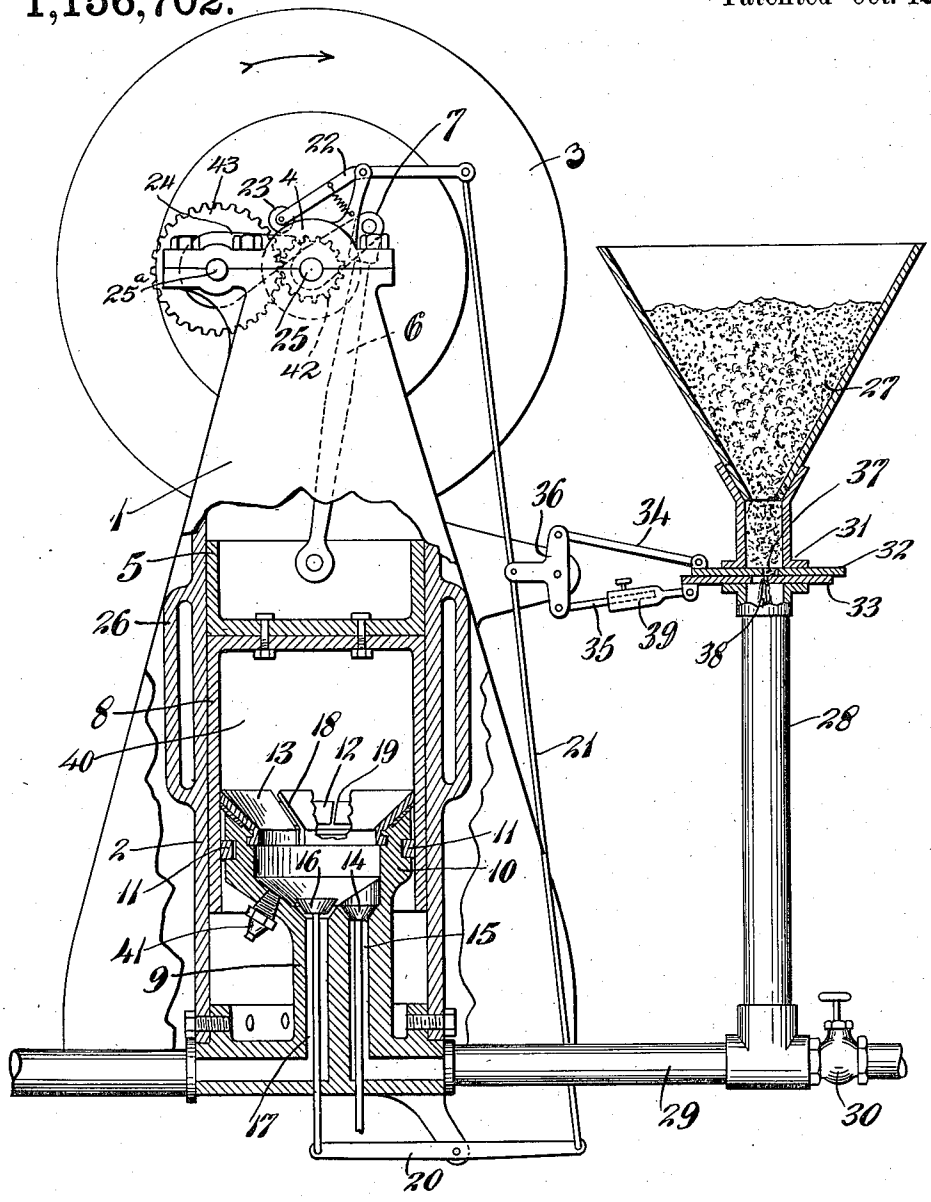
W. G. MINER.

ENGINE FOR UTILIZING POWDERED FUEL.

APPLICATION FILED JUNE 22, 1914.

1,156,702. Patented Oct. 12, 1915.




Witnesses

F. Thornton Bogert

A. D. Breese

Inventor

William G. Miner

By Walker & Murray

Attorneys

# UNITED STATES PATENT OFFICE.

WILLIAM G. MINER, OF CINCINNATI, OHIO.

## ENGINE FOR UTILIZING POWDERED FUEL.

1,156,702. Specification of Letters Patent. Patented Oct. 12, 1915.

Application filed June 22, 1914. Serial No. 846,436.

*To all whom it may concern:*

Be it known that I, WILLIAM G. MINER, a citizen of the United States of America, and resident of Cincinnati, county of Hamilton, and State of Ohio, have invented certain new and useful Improvements in Engines for Utilizing Powdered Fuel, of which the following is a specification.

This invention relates to improvements in internal combustion engines and has for an object to produce an internal combustion engine in which combustible powders are adapted to be used as fuel.

A further object is to produce an internal combustion engine in which powdered fuel is adapted to be used and in which means are employed for removing the ash resulting from the combustion of the fuel.

These and other objects are attained in the apparatus described in the following specification and illustrated in the accompanying drawing.

In the drawing I have illustrated an engine of the inverted vertical type, as an embodiment of my invention. This engine consists of a frame 1, in which a cylinder 2, is mounted. At the upper end of the frame a fly wheel 3 is journaled in bearings 4. The fly wheel is adapted to be rotated by means of a reciprocating piston 5, connected to a rod 6 and a crank 7, as in ordinary reciprocating engine practice. Secured to the head of piston 5 is an inverted cup shaped member 8, forming an extension of the piston 5 and which in effect forms a sleeve reciprocating within the cylinder. The cylinder is secured at its bottom end to a cylinder head casting 9, which is formed with a substantially conical cup portion 10 having piston rings 11, 12 and 13 bearing against the inner surface of the sleeve 8. This cone shaped cylinder head is provided with an inlet valve 14 adapted to open and close an inlet passage 15, and an exhaust valve 16 adapted to close an exhaust passage 17.

The arrangement and form of the piston rings is such that the ash resulting from the combustion of the powdered fuel, will be removed from the inner walls of the sleeve 8 as it reciprocates. Ring 13 is particularly intended to perform this function of removing the resultant ash since it is formed with inwardly and downwardly projecting walls, the upper edge of which is adapted to cut away the ash from the walls of the sleeve and to direct it toward the center of the cylinder head chamber, in position to be exhausted when the valve 16 is open. The ring 12 is located beneath ring 13 to aid the latter in cleaning the walls of the sleeve at the point 18 where ring 13 is of necessity cut in order to provide for its removal and to enable it to expand against the sleeve walls. The cut 19 in ring 12 is located in staggered relation with cut 18 in order that the ash may not sift between the rings into the spaces adjacent to and below ring 11. The purpose of providing the reciprocating sleeve 8 between the cylinder walls and the rings is to prevent the abrasive ash from detrimentally affecting the inner surface of the cylinder and the outer surfaces of the reciprocating sleeve and piston.

Any suitable valve operating mechanism may be provided, as for example the exhaust valve operating mechanism shown in the drawing. This mechanism consists of a pivot lever 20 connected at one of its ends to the exhaust valve stem and at its other end to an upwardly extending rod 21 which is connected at its upper end to a lever 22, which carries a roller 23, adapted to ride upon the surface of the valve operating cam 24, secured to a rotating shaft $25^a$ which is driven by 2 to 1 reduction gears 42 and 43 mounted upon the respective shafts 25 and $25^a$. A similar valve operating mechanism may be provided for the inlet valve 14.

In order to prevent the heat of the engine becoming too great some cooling means such as the water jacket 26 is provided.

I have shown in connection with the more or less diagrammatic view of my improved engine, a similar view of a powdered fuel receptacle 27, together with a valve device for controlling the delivery of fuel to the engine during its operation. This receptacle is shown mounted upon a stand pipe 28 which is connected at its lower end to a pipe 29 having an air valve 30 secured at one end and connected at its other end to the head casting of the engine. Located in the stand pipe is a valve 31 which is adapted to control the amount of fuel delivered just previous to the opening of the inlet valve of the engine. This fuel control valve is shown as two reciprocating plates 32, 33 which are connected by means of rods 34, 35 to a rocking T shaped lever 36, which in turn is connected to the valve operating rod 21. Each time the valve rod is moved downwardly to open the exhaust valve, the T

shaped lever 26 is also moved to cause the plates 32, 33 to move in a direction which will bring aperture 37 in plate 32 and aperture 38 in plate 33, opposite one another to permit a charge of powdered fuel to pass therethrough and downwardly through pipe 28. Rod 35 connected to plate 33, is provided with a slip joint 39, so that relative adjustment to plate 33 and 32 is permitted in order that the amount of opening between apertures 37 and 38, when the plates 32 and 33 are moved, may be regulated to permit the desired amount of fuel for each charge, to pass therethrough. In operation the engine may be given its initial motion in any suitable manner, and upon the movement of the rod 21 downwardly, the correct quantity of fuel is permitted to fall through pipe 28 because of the opening of valve 31. As the engine continues to rotate, exhaust valve 16 closes and valve 14 is opened. The piston now moves upwardly drawing in air through valve 30 and past the lower end of pipe 28 just in time to catch the descending fuel powder and to cause it to mix with the air in such a manner that it is held suspended therein in a cloud-like condition. As the piston moves upwardly, this mixture of suspended dust and air, fills the combustion chamber 40 of the engine. The inlet valve now closes and the piston and sleeve move downwardly to compress the charge in the chamber. The charge is now exploded by means of a spark from the spark plug 41 and the force of the explosion drives the piston upwardly. As the engine shaft rotates, cam 24 causes roller 23 on the end of lever 22, to rise, thereby lifting exhaust valve 16, to release the exploded charge of fuel. The piston, carrying sleeve 8, now moves downwardly while the exhaust valve is being held open and the ash resulting from the combustion of the powdered fuel, falls into the conical cylinder head and passes out through the exhaust passage 17. In its downward movement sleeve 8 is thoroughly cleaned of any ash which may have accumulated upon its walls, by means of the rings 12 and 13. It will be seen that the inner wall of the cylinder and the outer walls of the piston and sleeve, are at all times kept free of any accumulation of carbon or ash, due to the combustion of the fuel.

By so forming the rings 12 and 13 of the cylinder head, all possibility of destroying the usefulness of ring 11, is eliminated since it is manifestly impossible for the ash and other products of combustion to escape from the combustion chamber and into the spaces surrounding the cylinder head. The compression in the combustion chamber is therefore rendered perfect at each succeeding cycle of the engine operation. By the use of powdered fuel such as coal dust, flour or other explosive powder, I have eliminated the necessity of converting this material into gas in order to make it suitable for use in an internal combustion engine. In addition to this, the amount of energy involved in converting the solid fuel into a gas, is saved and utilized within the engine itself, thereby making this energy which would otherwise be lost in converting the fuel to a gas, do useful work by helping to propel the engine.

Having thus described my invention what I claim is:

1. In combination in an internal combustion engine, a cylinder, a cylinder head spaced away from said cylinder and provided with an inlet and an exhaust passage, a piston mounted within said cylinder and provided with a sleeve adapted to reciprocate within the space between the cylinder and the cylinder head, and means mounted on said cylinder head adapted to remove and divert the products of combustion from said sleeve, toward said exhaust passage.

2. In an internal combustion engine, the combination of a cylinder, a cup-shaped cylinder head spaced away from said cylinder, and having an inwardly inclined top edge, a piston mounted in said cylinder and provided with a sleeve, said sleeve being adapted to reciprocate in the space between the cylinder head and the cylinder, a packing ring rectangular in cross section mounted on the cylinder head and adapted to engage the interior of the sleeve, a second ring adapted to engage the interior of the sleeve mounted on the inwardly inclined top edge of the cup-shaped cylinder head and adapted to remove and divert the products of combustion from the inner walls of the sleeve to the interior of the cylinder head.

3. In combination in an internal combustion engine, a cylinder, a cup-shaped cylinder head spaced away from said cylinder and having an inwardly inclined top edge, a piston mounted in said cylinder and provided with a sleeve, said sleeve being adapted to reciprocate in the space between the cylinder head and the cylinder, a packing ring rectangular in cross section mounted on the cylinder head and adapted to engage the interior of the sleeve, a second ring adapted to engage the interior of the sleeve mounted on the inwardly inclined top edge of the cup-shaped cylinder head and adapted to remove and divert the products of combustion from the inner walls of the sleeve to the interior of the cylinder head, and a third ring located between the second mentioned ring and the first mentioned ring and adapted to engage the interior of the sleeve.

4. An internal combustion engine adapted to the use of powdered fuel comprising a cylinder, a cup-shaped cylinder head spaced away from the cylinder and having an inwardly inclined top edge, a piston mounted

in said cylinder and provided with a sleeve, said sleeve being adapted to reciprocate in the space between the cylinder head and the cylinder, a packing ring rectangular in cross section mounted on the cylinder head and adapted to engage the interior of the sleeve, a second ring adapted to engage the interior of the sleeve mounted on the inwardly inclined top edge of the cup-shaped cylinder head, and adapted to remove and divert the products of combustion from the inner walls of the sleeve to the interior of the cylinder head, and an exhaust valve located in the cylinder head adapted to permit the discharge of the products of combustion from the cylinder.

5. In combination in an internal combustion engine adapted to the use of powdered fuel, a cylinder, a cup-shaped cylinder head spaced away from the cylinder and having an inwardly inclined top edge, a piston mounted in the cylinder and provided with a sleeve, said sleeve being adapted to reciprocate in the space between the cylinder head and the cylinder, a packing ring rectangular in cross section mounted on the cylinder head and adapted to engage the interior of the sleeve, a second ring mounted on the inwardly inclined top edge of the cup-shaped cylinder head and adapted to remove and divert the products of combustion from the inner walls of the sleeve to the interior of the cylinder head, a third ring located between the first and second mentioned rings in engagement with the interior wall of the sleeve and adapted to assist the second mentioned ring in removing and diverting the products of combustion from said wall to the interior of the cylinder head, and an exhaust valve located in the cylinder head adapted to permit the discharge of the products of combustion.

In testimony whereof, I have hereunto subscribed my name this 20th day of June, 1914.

WILLIAM G. MINER.

Witnesses:
WALTER F. MURRAY,
W. THORNTON BOGERT.