

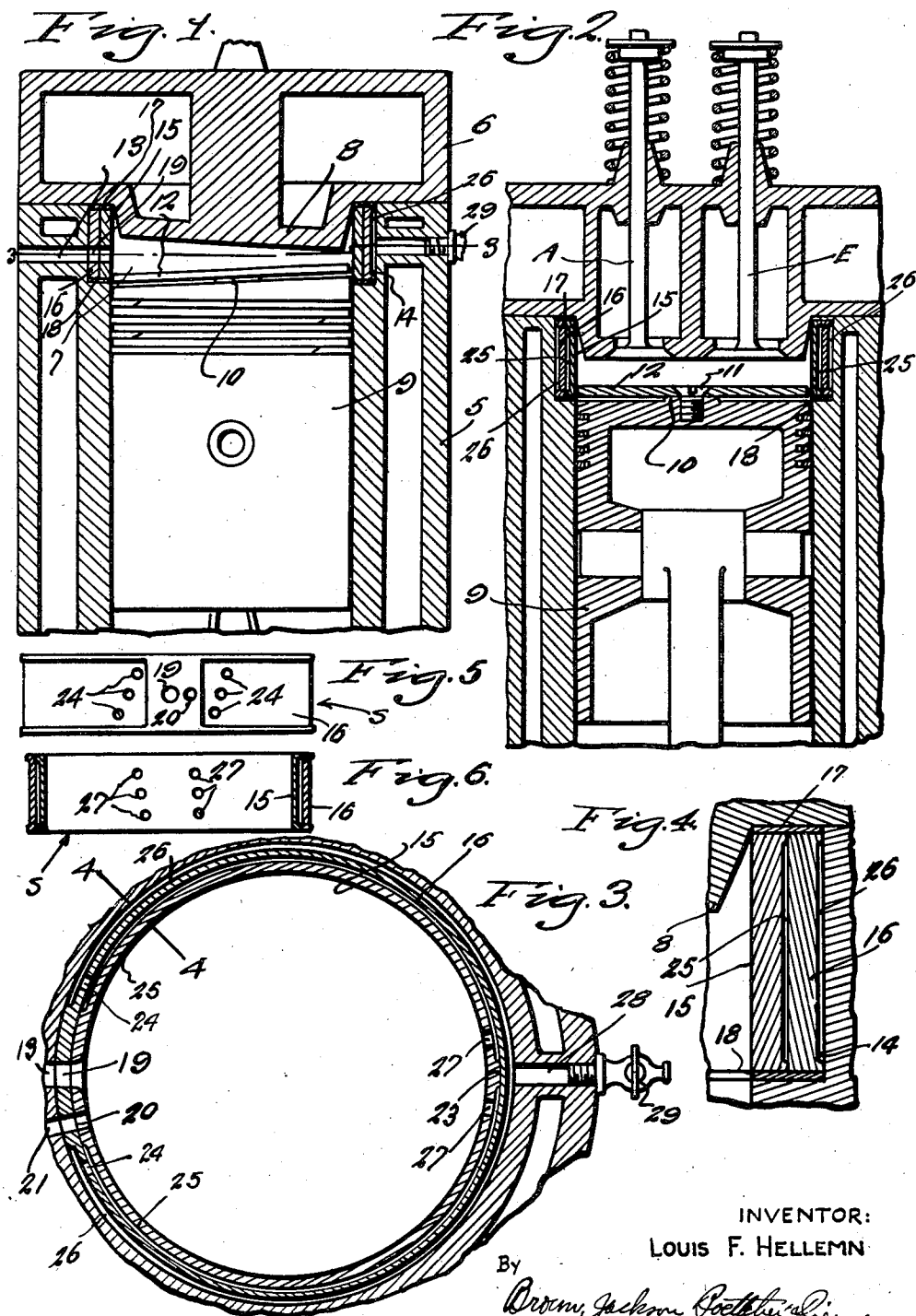
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L. F. HELLEMN

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INTERNAL COMBUSTION ENGINE

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INVENTOR:

LOUIS F. HELLEMN

By

Droom, Jackson, Grottel, & Pinner
ATTORNEYS

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INTERNAL COMBUSTION ENGINE

Louis F. Hellemn, Sherwood, Ohio

Continuation of application Serial No. 62,189,
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5 Claims. (Cl. 123—30)

This invention relates to internal combustion engines, and has to do with an injection engine of the compression ignition type.

My invention is directed to the provision of means facilitating starting, when cold, an engine of the type referred to. More specifically, I provide heat absorbing and radiating means of a character to be heated by air friction, when the engine is turned over, such means being effective for heating the combustion chamber and appurtenant parts sufficiently to assure heating of the fuel mixture charge to combustion temperature, upon the compression stroke of the piston. I also provide, in conjunction with the heating means, a wedge-shaped chamber so related to the heating means and to the fuel injector port, as to assure that the fuel is injected into the zone of the combustion chamber of highest temperature, for facilitating combustion and starting of the engine. Further advantages and objects of my invention will appear from the detailed description.

In the drawing:

Figure 1 is an axial sectional view through the cylinder and cylinder head of an engine embodying my invention, certain parts being shown in elevation, and the lower portion of the cylinder being broken away;

Figure 2 is an axial sectional view through the cylinder head and the cylinder taken in a plane perpendicular to the plane in which Figure 1 is taken, certain parts being shown in elevation and certain other parts being broken away;

Figure 3 is a sectional view taken substantially on the line 3—3 of Figure 1, with certain parts broken away and certain other parts shown in elevation;

Figure 4 is a detail sectional view taken substantially on line 4—4 of Figure 3, on an enlarged scale;

Figure 5 is an elevational view of the heating ring structure, as viewed from the injector port side thereof; and

Figure 6 is an axial sectional view through the ring structure of Figure 5.

This application is a continuation of my co-pending application, Serial No. 62,189, filed February 3, 1936.

I have illustrated my invention, by way of example, as embodied in an engine comprising a cylinder 5, a cylinder head 6 and a substantially inverted frusto-conical portion extending downward into the cylinder and provided with a flat inclined bottom wall 8, defining the roof of combustion chamber 7 above piston 9, operating in

cylinder 5, when the piston is in its inner dead center position, that is, its position of maximum compression. Cylinder head 6 is secured upon cylinder 5 in any suitable known manner.

The upper end of piston 9 is inclined oppositely to wall 8 and is provided with a central boss 10, the upper face of which is inclined correspondingly to the upper end of the piston. Boss 10 is suitably bored and threaded for reception of a screw 11 which secures a flat plate or disc 12 to the boss, in spaced relation to the top face of the piston providing, in effect, a dead air space between disc 12 and the top of the piston. Cylinder 5 is provided with an injector port 13 extending through the side wall thereof, this port being disposed for injecting fuel into the combustion chamber substantially normal to the cylinder axis and at the side of the combustion chamber of greatest height. When piston 9 is at or about its inner dead center position, shown in Figure 1, wall 8 and plate 12 define between them a wedge-shaped combustion space which converges in a direction away from port 13, into the base portion of which space the fuel is injected, as noted.

Cylinder head 6 is provided with air inlet and burned gas exhaust passages, in a known manner, and wall 8 is provided with inlet and exhaust ports opening therethrough from the passages and controlled by inlet and exhaust valves A and E, respectively. Air is drawn into the cylinder through the intake passage and the port controlled by valve A, during the suction stroke of piston 9, and is compressed during the compression stroke of the piston, as is known. Since the combustion chamber, circular in plan, is of lesser depth on the side thereof remote from the injector port 13 than on the side adjacent such port, the volume-to-volume ratio, for a given movement of the piston, is greater at the former than at the latter. The ensuing movement of air, to equalize the pressure throughout the combustion chamber, as the piston approaches the end of its compression stroke, is toward the injector port 13, i. e., against the injected fuel, causing intimate commingling of the fuel and the air particles.

Cylinder 5 is provided at the upper end thereof with an interior circumferential groove 14 extending about the combustion chamber 7. Groove 14 receives a heat absorbing and radiating structure comprising inner and outer rings 15 and 16, respectively, disposed concentrically with the circumferential wall of the combustion chamber. The upper and lower ends of rings 15 and 16 are enlarged or of increased width, as shown more

clearly in Figure 4, preferably are permanently united in any suitable manner, and the flanges thus provided serve to space the intermediate portions of the rings apart and to space the intermediate portion of the outer ring 16 from the circumferential wall of the combustion chamber. Flat rings 17 and 18 are disposed between the upper and lower ends of rings 15 and 16 and head 6 and the shoulder at the lower end of groove 14, respectively. The heat absorbing and radiating structure is thus disposed so as to extend about the combustion chamber interiorly thereof and is closed, at its top and bottom, to the combustion chamber. The inverted frusto-conical shape of the portion of head 6 extending into the combustion chamber assures but slight area of contact between such portion and ring 15, which is desirable as reducing transfer of heat from this ring to the head 6, by conduction.

Rings 15 and 16 are provided, at the side thereof adjacent injector port 13, with thick portions having registering ports 19 therein, the outer one of such ports being also in register with the injector port 13. The thick portions of the rings are also provided with registering ports 20, the outer one of which is in register with an idling jet port 21 extending through the cylinder wall adjacent port 13.

The rings 15 and 16 and the circumferential wall of the groove 14 together define an inner thin annular space 25 and a thin outer annular space 26, such spaces extending substantially the full height of the rings and being closed at their top and bottom, by the flanges provided by thickening of the ends of the rings, as previously noted. The thickened portions of the rings, provided with the ports 19 and 20, extend the full width or height thereof and close the spaces 25 and 26 at one side of the combustion chamber. At the opposite side of the combustion chamber, the inner ring 15 is provided with a thickened portion 23 extending the full width thereof and closing the space 25. At opposite sides of thickened portion 23, ring 15 is provided with ports 27 opening from the combustion chamber into space 25, and ring 16 is provided, at opposite sides of its enlarged or thickened portion, with ports 24 opening from the inner space 25 into the outer space 26.

The spaces 25 and 26 are of such radial width as to offer considerable resistance to flow of air about the rings through such spaces, the resistance to air flow thus offered being sufficient to cause heating of the rings by friction of the air flowing in contact therewith. The width of the spaces may vary within limits, depending upon the compression ratio, cylinder bore, piston stroke and related factors. I will give, by way of example, the pertinent dimensions and compression ratio of an injection engine embodying my invention, which has actually been constructed and operated. In that engine the cylinder bore is 3.792 inches, the piston stroke is 5 1/2 inches, the compression ratio is approximately 1 to 14, the radial thickness of the inner ring is .114 inch, the radial thickness of the inner space 25 is .011 inch, the radial thickness of the outer ring is .110 inch, and the radial width of the outer space 26 is .008 inch. The diameter of the ports 24, 27 in the rings 15, 16 is approximately .125 inch. In general, the radial width or thickness of the spaces defined by the rings and the circumferential wall of the combustion chamber should be approximately .01 inch, some variation being permissible, within limits, depending

upon the compression ratio, piston displacement volume, and related factors of the particular engine under consideration.

In starting the engine cold, it is turned over in the usual manner. In the compression stroke of the piston, the air is forced through ports 27 into space 25, flows circumferentially of ring 15 through this space in opposite directions from the thickened element 23, then passes through ports 24 into space 26, and flows through the latter space in opposite directions circumferentially of ring 16. This air flows through the ports and between the rings and the circumferential wall of the combustion chamber under high pressure and high velocity, and is effective for quickly heating the rings to high temperature, by friction of the air flowing in contact with the rings and through the ports thereof. The heat thus generated and absorbed by the rings is radiated into the combustion chamber and assures that the fuel air mixture within that chamber will be raised, by the heat of compression plus the heat radiated from the rings, to combustion temperature. In that manner, starting of the engine in cold weather is greatly facilitated. The engine above referred to was readily started outdoors in sub-zero weather and without any pre-heating, with only a few turns of the crank shaft. That was rendered possible by the additional heat provided by the heating of the rings due to air friction, in the manner stated.

It will be understood that the injector port 13 receives a fuel injection nozzle of known type, by means of which the fuel is injected into the combustion chamber 7 as the piston 9 approaches its inner dead center position, which is its position of maximum compression. The fuel is thus injected into the zone of the combustion chamber which is most remote from heat conducting surfaces and, therefore, is the zone of maximum temperature within such chamber. That, in conjunction with the thorough commingling of the air and the injected fuel, previously referred to, further assists starting of the engine cold. It will also be noted that the ports 13 and 19 are diametrically opposite to the thickened element or portion 23 of ring 15, so that the tip of the injected fuel spray is directed toward the portion of ring 15 adjacent the ports 27. The air passing through these ports, under high pressure and high velocity and abruptly changing its direction of flow as it enters the passage 25, heats the portion of ring 15 adjacent ports 27 to a somewhat higher temperature than the remainder of this ring. Accordingly, the tip portion of the fuel spray, which is in a finely subdivided condition or mist, enters a zone of the combustion chamber which is at relatively high temperature and in which abundant combustion supporting air is present, which further assures ignition of the fuel air mixture. In that manner, the combustion chamber and appurtenant parts cooperate with the heat absorbing and radiating ring structure to facilitate starting of the engine cold. Once started, the engine operates in a known manner, which need not be described in greater detail, it being noted that the slight area of contact of the ring structure with the cylinder and cylinder head is sufficient to prevent heating of the rings to objectionably high temperatures while avoiding transfer of heat, to an objectionable extent, from the rings in the starting of the engine.

Preferably, cylinder 5 is provided with a drain passage 28 into which is threaded a drain cock 29, whereby condensate may be drained from

space 26 and, if desired, the spaces 25 and 26 may be blown out, in the operation of the engine, by opening of the drain cock.

I claim:

1. In an internal combustion engine, a power cylinder having in the upper portion of the wall thereof an internal groove, and a fuel injection port disposed in said groove, a sleeve fitted within said groove and comprising a pair of inner and outer concentric rings, diametrically opposed portions of which are laterally enlarged and contiguous each to the other, said rings having the portions thereof between the enlargements spaced from one another and from the wall of the groove to provide air spaces, said rings having in the enlargements at one side thereof a fuel injection port registering with said fuel injection port in the wall of the power cylinder, the inner of said rings at opposite sides of the second enlarged portion thereof being provided with ports through which air enters into the spaces between the rings from the combustion chamber of the power cylinder, the outer of said rings at opposite sides of the first mentioned enlarged portion thereof being provided with ports through which air from the spaces between said rings pass into the space between the innermost ring and the wall of the groove, said air ports being restricted to an extent effective for causing frictional heat to be generated in said rings by air forced through said air ports, and a drain cock tapped into the wall of the cylinder opposite the second named enlarged contiguous portions of said rings.
2. In an internal combustion engine of the class described, a power cylinder having a combustion chamber and a piston movable therein, said cylinder having an enlarged upper portion, a pair of rings disposed concentrically one within another in said enlarged portion and spaced radially from each other and from the wall of said cylinder to provide a pair of annular concentric passages, said rings having restricted apertures connecting said passages with each other and with the combustion chamber, the apertures in one of said rings being spaced peripherally from the apertures in the other of said rings, whereby sufficient resistance to the flow of air compressed in said chamber is provided by said restricted apertures and passages to cause frictional heat to be generated in said rings, thereby raising the temperature thereof during starting of the engine to expedite combustion.
3. In an injection engine, a cylinder and a

piston operating therein, a combustion chamber circular in plan opening into said cylinder, and a heat absorbing and radiating ring structure extending about said combustion chamber interiorly thereof comprising inner and outer rings concentric with the combustion chamber wall, said rings and wall together defining relatively thin inner and outer annular spaces closed at their top and bottom to said combustion chamber, said rings being provided at one side thereof with thickened portions closing said spaces, said inner ring being provided at its opposite side with a thickened portion closing said inner space and with ports at opposite sides of said thickened portion opening from said inner space into said combustion chamber, said outer ring being provided at opposite sides of its thickened portion with ports opening from said inner space into said outer space, said spaces being so thin as to present resistance to flow of air there-through, during the compression stroke of the piston, sufficient to cause heating of said structure by friction of the air therewith.

4. In an injection engine, a cylinder and a piston operating therein, a combustion chamber opening into said cylinder, and a heat absorbing and radiating structure exposed to the interior of said combustion chamber and having passages receiving air displaced from the cylinder by the piston during the compression stroke thereof, said passages being sufficiently restricted to assure heating of said structure by friction of air flowing at high velocity therethrough to a sufficiently high temperature to insure ignition of the fuel charge incident to the compression stroke of the piston, and means for directing to said structure, as the piston approaches the limit of its compression stroke, a fuel-air mixture conditioned to be ignited.

5. In an injection engine, a cylinder and a piston operating therein, a combustion chamber opening into said cylinder, a heat accumulator in the combustion chamber comprising means defining a restricted passageway through which air is forced at high velocity on the compression stroke of said piston, said passageway being sufficiently restricted to assure heating of said accumulator by friction of the air flowing there-through to a temperature sufficiently high to assure ignition of the fuel charge on the compression stroke of the piston, and means for directing to said accumulator, as the piston approaches the limit of its compression stroke, a fuel-air mixture conditioned to be ignited.

LOUIS F. HELLEMN.