

Dec. 5, 1933.

M. TIBBETTS
INTERNAL COMBUSTION ENGINE

1,937,801

Filed Oct. 31, 1929

2 Sheets-Sheet 2

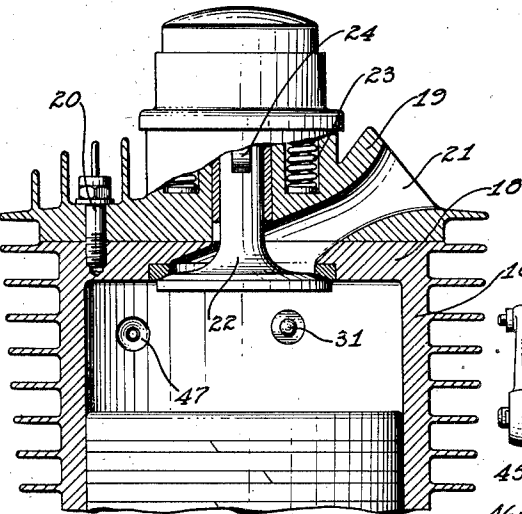


FIG. 3

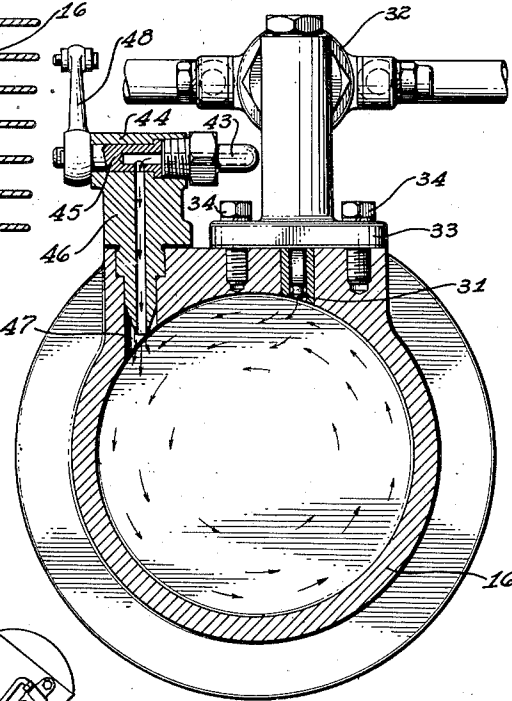


FIG. 4

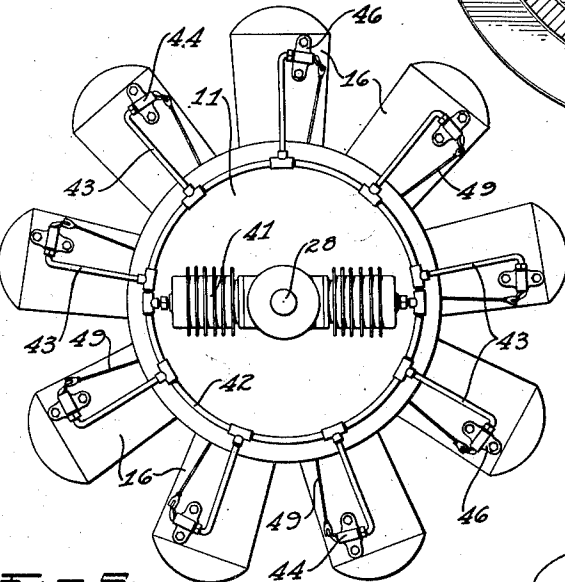


FIG. 5

Inventor

Milton Tibbets

UNITED STATES PATENT OFFICE

1,937,801

INTERNAL COMBUSTION ENGINE

Milton Tibbetts, Detroit, Mich., assignor to.
Packard Motor Car Company, Detroit, Mich., a
corporation of Michigan

Application October 31, 1929. Serial No. 403,863

3 Claims. (Cl. 123—32)

This invention relates to internal combustion engines, and more particularly to engines of the Diesel type.

In engines of the Diesel type in which solid fuel injection, sometimes called airless fuel injection, is employed, it is necessary that a high degree of turbulence be produced in the combustion chamber in order to obtain the necessary intermingling with air and vaporization in a short period of time. This is particularly true when the engine is designed for high speed operation, and I have found that difficulty is experienced in obtaining the desired turbulence for the best conditioning of the fuel charges.

It is an object of this invention to provide a Diesel type of internal combustion engine with auxiliary means for assisting the turbulence of the fuel charges.

Another object of the invention is to provide an engine of the Diesel type with means for accelerating the rotation of a fuel charge within the cylinder shortly in advance of combustion.

Another object of my invention is to provide a Diesel type of internal combustion engine in which compressed air is utilized to accelerate the turbulence of the air and fuel charges within the combustion chamber so that improved intermingling and vaporization will result.

A further object of my invention is to provide a Diesel type of internal combustion engine with automatically actuated means for admitting a compressed air charge into the cylinder at a predetermined period during the air compression cycle.

These and other objects of the invention will appear from the following description taken in connection with the drawings, which form a part of this specification, and in which:

Fig. 1 is a rear elevation of an internal combustion engine partially broken away to show valve actuating mechanism with which my invention is incorporated,

Fig. 2 is a sectional view taken on line 2—2 of Fig. 1,

Fig. 3 is a fragmentary vertical sectional view of one of the cylinders of the engine,

Fig. 4 is a horizontal sectional view taken on line 4—4 of Fig. 1, and

Fig. 5 is a diagrammatic view of the engine showing the compressed air mechanism and its association with the cylinders.

Referring now to the drawings by characters of reference, 10 designates generally a radial internal combustion engine of the Diesel type which includes the annular crank case 11 hav-

ing two compartments 12 and 13 formed therein by a diaphragm 14 and the end wall 15. A plurality of cylinders 16 extend radially from the annular crank case and are preferably nine in number, a pair of endless compression bands 17 serve to clamp portions of the cylinders against the crank case so that explosive loads are transferred thereby annularly to the crank case.

As shown in Fig. 3, the cylinders 16 are provided with an integral head portion 18 and an auxiliary head 19 which is secured in position by cap screws 20. The cylinder heads are formed with a Venturi passage 21 which extends tangentially of the cylinder wall, and at an angle to the axis thereof, the valve 22 controlling the inner end of the passage. Such valve is normally closed by the springs 23 and is opened by a lever 24 which is actuated by mechanism extending through the sleeve 25 and into the chamber 13 where it is seated upon the slipper 27 mounted to be actuated by the cam 27'. Cam 27' is mounted to rotate about the crank shaft 28 which extends axially through the crank case, and is rotated in an anti-clockwise direction by the gear 29 meshing with the internal teeth 30 formed thereon, such gear 29 being driven from the crank shaft 28 by gearing (not shown) so that the cam will operate at one eighth crank shaft speed.

The engine illustrated is of the four cycle type and the cam 27' is formed so that the valves 22 will be held in open position during the exhaust stroke and the air intake stroke, and will be closed during the compression and explosion strokes of the pistons. Air charges are drawn into the cylinders, which in this instance are the combustion chambers, through the passages 21 and due to the form and arrangement of such passages, air will strike the wall of the cylinders and will be caused to rotate in a spiral direction toward the pistons, which rotation continues after the valves 22 have closed and during the compression strokes of the pistons.

The liquid fuel is sprayed into the cylinders in desired quantities through unit mechanisms which are associated one with each of the cylinders and operated from a common actuating member. Such mechanism includes a combined nozzle and pump member, the nozzle portion of which is indicated at 31 and the pump portion of which is indicated at 32. Such integral units are secured to the side walls of the cylinders through means of brackets 33 and cap screws 34, the nozzles extending through apertures in

the wall of the cylinders and being adapted to be opened by pressure so that liquid fuel charges can be sprayed in the path of the rotating air. Within the pump sections of each of the fuel injecting devices, I provide a plunger 33' which is connected with a link 34' which engage a rocker 35 pivotally mounted upon a shaft 36, such shafts also pivotally carry the slippers 27 and extend transversely across the compartment 13 being carried by the walls 14 and 15. The rods 34' are pivotally connected with an adjustable ring member 37 by means of links 38 and movement of the ring 37 will cause adjustment of the rods 34' longitudinally upon the curved face of the slippers 35 so that in this manner the stroke of the pumps can be varied and thereby control the timing and the quantity of fuel injected into the cylinders. The rockers 35 are actuated by cam 39 which is secured to the cam 27' by the bolts 40.

In the engine so far described, the cylinders are fired alternately so that all the cylinders will be fired upon two revolutions of the crank shaft. For a more complete understanding of an engine of the character above described, reference may be had to Patent 1,896,387 of February 7, 1933 to Lionel M. Woolson. With an engine of the character described, it is sometimes desirable to accelerate the turbulence of the mixture within the combustion chamber, and also to augment the air charge, and to these ends this invention is directed.

In carrying out my improvement, I prefer to utilize air which is compressed by the engine. At one end of the crank case is mounted an air compressor 41 which is arranged to be driven from the crank shaft 28 and from which a compressed air manifold 42 extends around the end of the crank case. Conduits 43 extend adjacent each of the cylinders and communicate with fittings 44 in which a valve member 45 is rotated to control the passage of compressed air through the connection 46 which is fixed to each cylinder. One end of the connection 46 extends through an aperture 47 in the cylinder wall and is arranged substantially tangential with the inner wall of the cylinders, and the openings 47 are arranged substantially in the same horizontal plane as that in which the fuel injection nozzle of the associated cylinder is located. A lever 48 is secured to each of the rotary valve members 45, and such levers are actuated through rods 49 which extend through the crank case into the compartment 13, springs 50 being associated with the rods 49 and the crank case to normally move the valves 45 into closed position. Such rods are provided with rollers 51 which are arranged in a plane to be actuated by lobes 52 on the cam 39, the lobes

52 extending adjacent the lobes 53 which operate the fuel valves. The lobes 52 are arranged with respect to the lobes 53 so that the valves 45 will be opened substantially at the same time that the fuel device in the same cylinder starts its injection period, and in this manner an additional supply of air is provided within the cylinder under a compression such that it will accelerate the rotary movement of the fuel charge within the cylinder.

It will be seen that turbulence is materially increased during the period of fuel injection into the compressed air charge in each cylinder so that the liquid fuel will be more uniformly distributed with the air and will be better vaporized.

While a specific embodiment of the invention has been herein described, which is deemed to be new and advantageous and may be specifically claimed, it is not to be understood that the invention is limited to the exact details of the construction, as it will be apparent that changes may be made therein without departing from the spirit or scope of the invention.

What I claim is:

1. In an internal combustion engine, a cylinder having an inlet port arranged to cause air entering the cylinder to rotate, a piston in the cylinder for drawing charges of air into the cylinder and compressing the same, an injection device for spraying liquid fuel into the rotating compressed air charges, and means for introducing compressed air into the cylinder at a time and in a direction causing accelerated rotation of the mixture.
2. In an internal combustion engine, the method of charging a cylinder with an explosive mixture comprising introducing air charges into the cylinder in a manner to cause rotation thereof, compressing the rotating air charges, introducing liquid fuel by pressure into the compressed rotating air charges, and introducing compressed air into the cylinder in a direction to cause accelerated rotation of the contents.
3. In an internal combustion engine, a plurality of radially extending cylinders, pistons in the cylinders, air charges being drawn into the cylinders upon the suction strokes of the pistons and compressed during the compression strokes of the pistons, devices for injecting liquid fuel into the cylinders, a source of compressed air, conduits leading from said source of compressed air to each cylinder, valve mechanisms for controlling the passage of air from the conduits into the cylinders, and a single engine driven cam for actuating all of the fuel injection devices and all of the valve mechanisms to cause injections therefrom.

MILTON TIBBETTS.