March 8, 1927. 1,620,124

G. P. NIELSEN

INTERNAL COMBUSTION ENGINE

Filed May 17, 1923

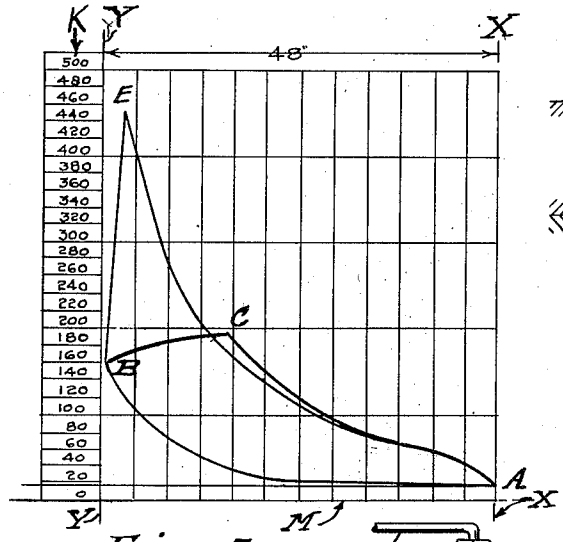


Fig. 3.

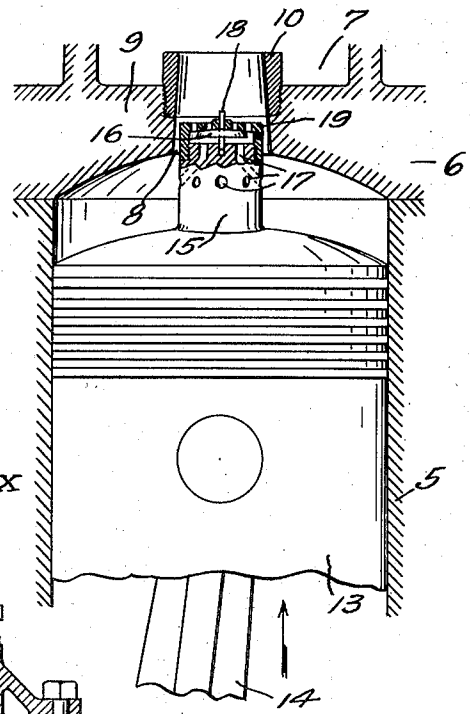


Fig. 2.

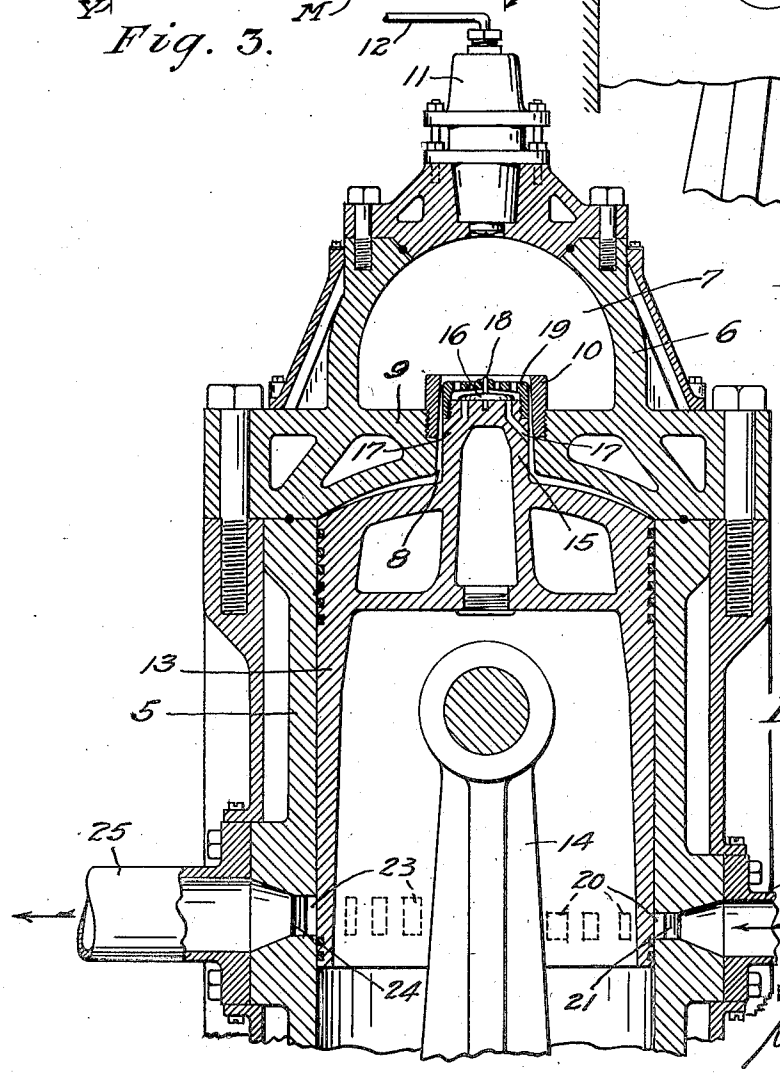


Fig. 1.

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UNITED STATES PATENT OFFICE.

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INTERNAL-COMBUSTION ENGINE.

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This invention relates to internal combustion engines and more especially to engines of the Diesel or semi-Diesel type and its object, generally, is the perfecting of engines of this character to render the same more efficient, durable, and economical in the consumption of fuel.

More specific objects and advantages of the invention will appear in the following description.

The invention consists in the novel construction, adaptation and combination of parts hereinafter described and claimed.

In the accompanying drawing,—

Figure 1 is a transverse vertical section of an internal combustion engine of the Diesel type embodying my improvements. Fig. 2 is a similar view, somewhat diagrammatic, the piston being shown in elevation and in a different position from that in which it is represented in Fig. 1. Fig. 3 is a view of an indicator card illustrating the pressures acting against the piston at various positions of the same.

In said drawing, the numeral 5 designates the cylinder of an internal combustion engine having a head 6 containing an explosion chamber 7. The chamber 7 is connected with the cylinder bore by means of a duct 8 in the partition 9 and in a tubular extension 10 which protrudes upwardly into said chamber. The duct 8 is disposed axially of the cylinder bore and is of a conoidal shape tapering from said bore to its extremity within the chamber 7.

11 represents a fuel injection device of any known or suitable type whereby fuel supplied under pressure through a pipe 12 is delivered into a charge of air within said combustion chamber to produce an explosive mixture. 13 represents the engine piston having a connecting rod 14 as usual. Said piston is formed or provided with a projection 15, preferably cylindrical, which is adapted to enter the duct 8 and of a diameter substantially equal to the diameter of the smaller end of said duct.

The extremity of the piston projection 15 is formed to provide a seat for a disk valve 16 which serves as a closure for air ports 17 extending to said seat from inlets provided in the periphery of the projection at about the midlength of the latter.

The valve 16, as shown, is provided with a stem 18 acting in guide apertures provided respectively in the piston projection and in a perforated cap element 19 which is secured to said projection.

Located in the peripheral wall of the cylinder bore at a distance from the top end thereof equal to or slightly less than the length of the piston stroke is a plurality of air-intake ports 20 which are disposed in spaced relations circumferentially of the cylinder bore and communicating with a distributing passage 21 provided in the cylinder wall.

22 represents a pipe leading from a pump or compressor (not shown) whereby air at a pressure of approximately four pounds per inch above that of the atmosphere is supplied to said passage for delivery into the cylinder bore. Disposed opposite to the air intake ports 20, the cylinder is provided with a plurality of exhaust ports 23 which communicate through the medium of a passage 24 with the pipe 25 for the discharge of spent gases from the cylinder.

To facilitate an understanding of the operation of the present invention I illustrate in Fig. 3 indicator diagrams showing fluid pressures per square inch estimated for the effective piston area of the usual type of engine and for the effective piston area, including the projection 15, of my improved construction. Said indicator diagrams being taken for a cylinder bore of 40 inches, a piston stroke of 48 inches, and the diameter of the smaller end of the duct 8 and the diameter of the piston projection ten inches or one-fourth the diameter of the piston.

The column K of numbers at the left hand side of the diagram, Fig. 3, denote average pressure in pounds per square inch throughout the entire area of piston upon ordinates taken from a base line M. The abscissæ of the indicating diagram represent the strokes, the positions of points on the indicating lines are taken from the axes X—X and Y—Y, respectively, for the compression and explosion strokes of the piston.

The operation of the engine above described is as follows:

A charge of air admitted through the intake ports 20 into the cylinder bore is during the following upward stroke of the piston 13 thereby compressed and forced through the partition duct 8 into the chamber 7 to afford therein a pressure, for instance, equivalent to 160 pounds per square inch if distributed over the entire piston area. The progressive pressures thus pro-

duced by the compression stroke of the piston is represented by the curve A—B in Fig. 3.

With such a compression of air in the combustion chamber 7 a charge of fuel oil is delivered from the injecting device 11 into said combustion chamber and forms with the air a combustible power medium which is ignited by the heat obtaining in such chamber.

The resultant explosion produces a relatively high pressure within the combustion chamber which if distributed over the area of the piston would be equivalent to about 450 pounds per square inch, see line B—E on the indicator diagram.

By reason, however, of the relatively small portion of the piston, that is to say—a transverse area of the piston projection 15—being primarily exposed to the force of the explosion, the resultant force acting against the piston in the early part of its power stroke produces a comparatively small increase (about 30 pounds) of pressure per square inch with respect to the entire area of the piston.

Such pressure increase is represented upon the indicator by line B—C and occurs, say, in the first third of the power stroke and during the remaining two-thirds of the power stroke, the diminishing pressure acting against the piston as a whole is approximately as represented by the indicator line C—A.

It is to be noted that the conical shape of the duct 8 affords a gradually increasing annular passage about the piston projection 15 in the withdrawal of the latter from the duct 8 so that as the pressure of the combustion products in the chamber 7 lessens the effective area for the flow of gases into the cylinder bore increases.

By such devices the power pressure resulting from the explosion at first acts against the projection only and later is applied throughout the end area of the piston. When the force of the power medium has been practically expended the exhaust ports 23 are uncovered by the piston for the escape of the spent gases from the cylinder.

In the cycle of operation comprising a compression stroke and a power stroke as described above, the valve 16 responds to the pressures acting thereagainst as follows: During the upward, or compression, stroke the valve remains seated until the projection 15 (see Fig. 2) enters the duct 8 to partially throttle the duct, whereupon the valve is elevated by the flow of air through the by-pass ports 17 from the cylinder bore.

The valve is open with respect to said ports only while the projection 15 is travelling upwardly within the duct 8.

The operation of the invention will, it is thought, be understood from the foregoing description. The advantages of the invention reside principally in the provision of means which control the force produced by the explosion of fuel with respect to the piston, its connecting rod and the torsional stresses of the associated crank shaft, and cause such forces and stresses to be transmitted more uniformly than with other constructions known to me.

The invention also eliminates the effects of the excessive shocks or impulses due to explosions as represented in Fig. 3 by indicator lines B—E and E—A which is a fair illustration of other systems for comparison with the indicator lines B—C and C—A as attained by the present invention.

What I claim, is,—

1. An internal combustion engine cylinder having a combustion chamber and piston bore formed therein in spaced relation, a spacing member interposed between the combustion chamber and the cylinder bore, said spacing member having a tapered duct therethrough and in communication with the combustion chamber and the piston bore and a piston having a projection thereon of a uniform diameter throughout its length and of approximately the same diameter as the smallest diameter of the duct.

2. The combination of an internal combustion engine cylinder having an explosion chamber and piston bore formed therein and spaced apart by a wall having a truncated cone shaped duct therethrough and in communication with the combustion chamber and the cylinder bore with a piston having a projection thereon of a diameter of approximately the smallest diameter of the duct and adapted to have reciprocal movement therein.

3. The combination of an internal combustion engine cylinder having an explosion chamber and piston bore formed therein and spaced apart by a wall having a longitudinally and uniformly tapered duct connecting the combustion chamber and the cylinder bore, with a piston having a projection thereon of a diameter approximately equal to the smallest diameter of the duct and adapted to close and open the duct at the juncture of the duct and explosion chamber.

4. An internal combustion engine cylinder having a combustion chamber and a piston bore formed therein and spaced apart by a wall having a duct therethrough connecting the combustion chamber and the piston bore and a piston having a projection thereon of such diameter as to close the duct at the limit of its movement toward the explosion chamber, the duct being so tapered as to expose a gradually increasing area of the explosive force to the piston head throughout the entire outward movement of the projection from the duct.

5. An internal combustion engine cylinder

having a combustion chamber and piston bore formed therein in spaced relation with a duct therebetween, a piston having a projection of a uniform diameter thereon for closing the duct when at its limit of movement toward the explosion chamber, the duct being so tapered as to gradually and uniformly deliver an increasing force of the explosion of a fuel charge in the combustion chamber to the head of the piston during the outward movement of the projection from the duct.

6. An internal combustion engine cylinder provided with a combustion chamber and a piston bore disposed in spaced relation, with a longitudinally tapered duct connecting them and a reciprocal piston within said bore, said piston having a projection positioned to enter said duct and to close the same when the piston is in the extreme position of its movement toward said combustion chamber and to gradually and uniformly open the duct when the piston moves away from said chamber whereby as the force of the gas explosion in the combustion chamber diminishes, the field of said force is increasingly exerted against piston.

Signed at Seattle, Washington, this 7th day of May, 1923.

GEORGE P. NIELSEN.