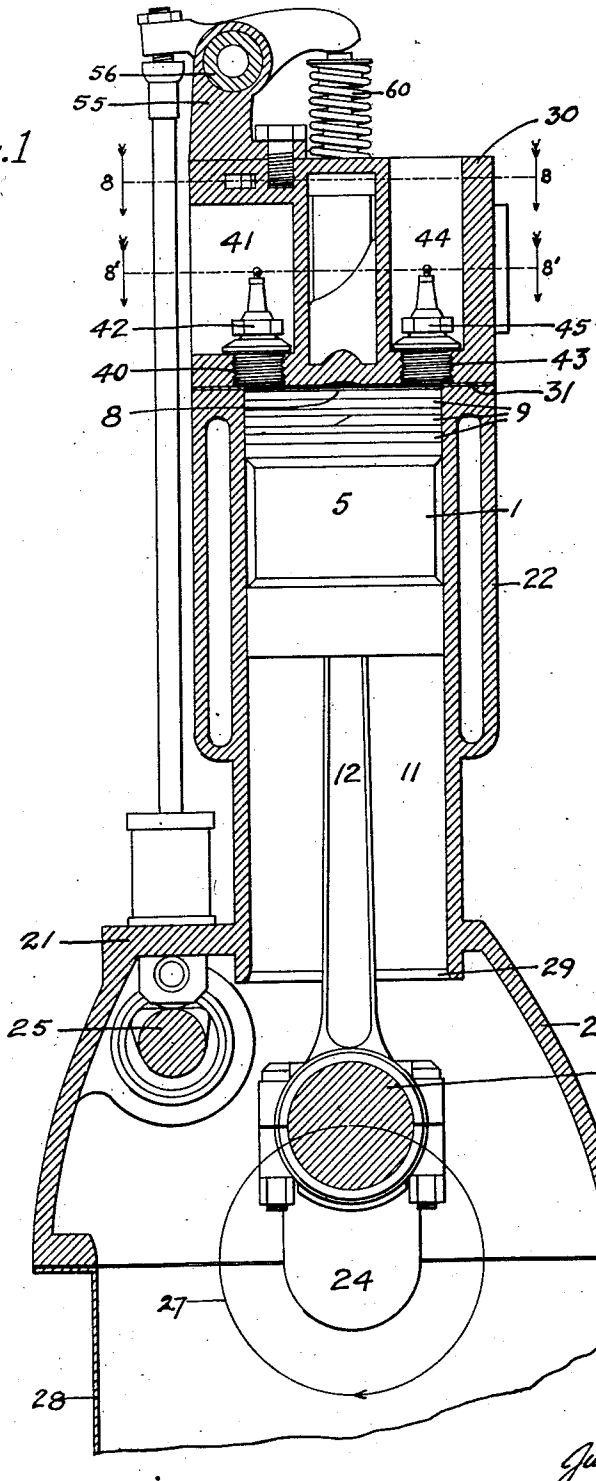
March 22, 1932. J. C. PETERSON 1,850,474

INTERNAL COMBUSTION ENGINE

Filed June 25, 1928 3 Sheets-Sheet 1

Fig.1



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INTERNAL COMBUSTION ENGINE

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Fig.3

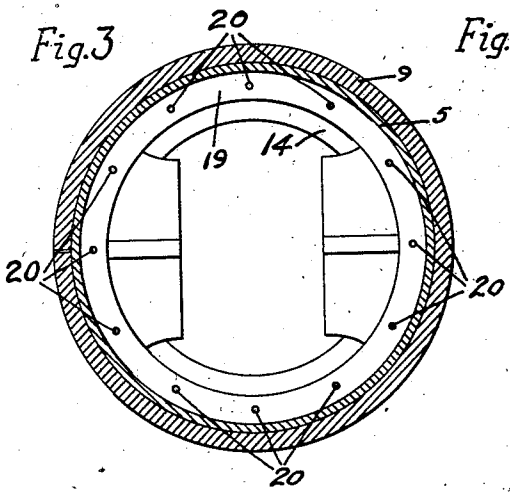


Fig.2

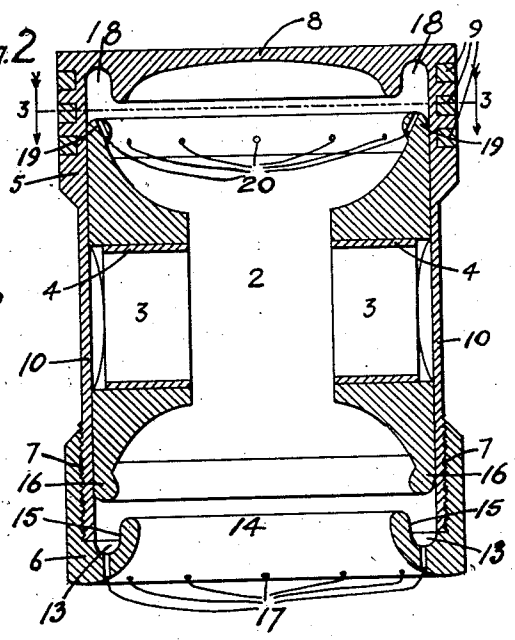
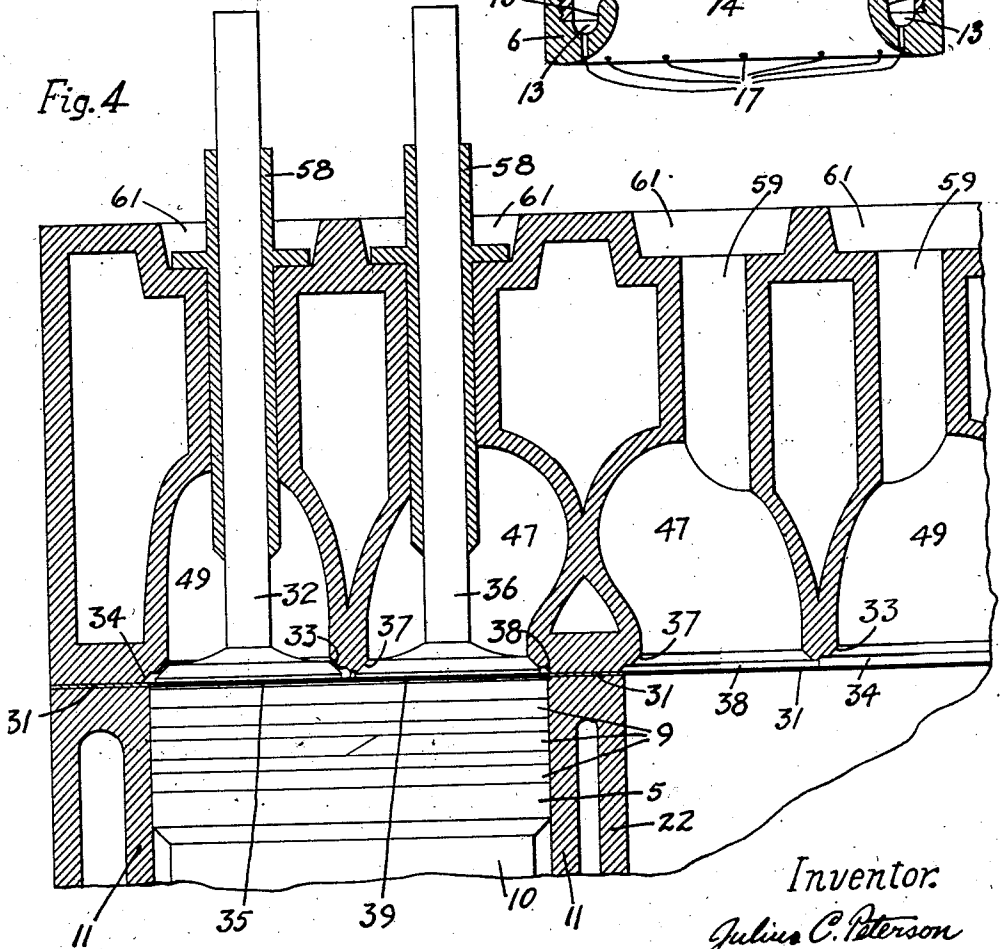


Fig.4



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INTERNAL COMBUSTION ENGINE

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Fig.5

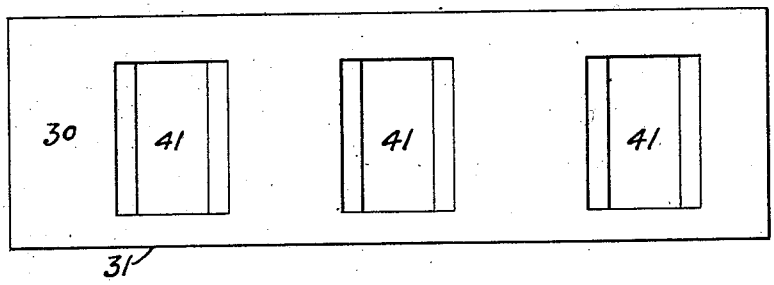


Fig.6

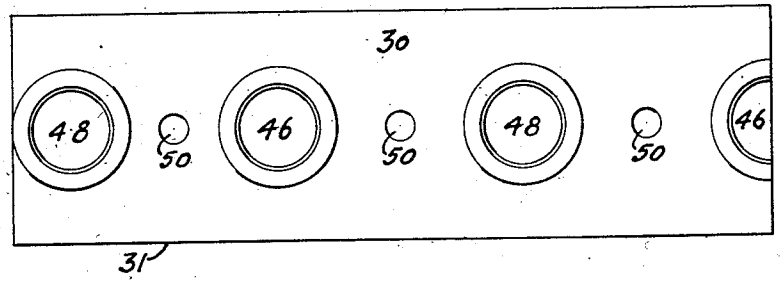


Fig.7

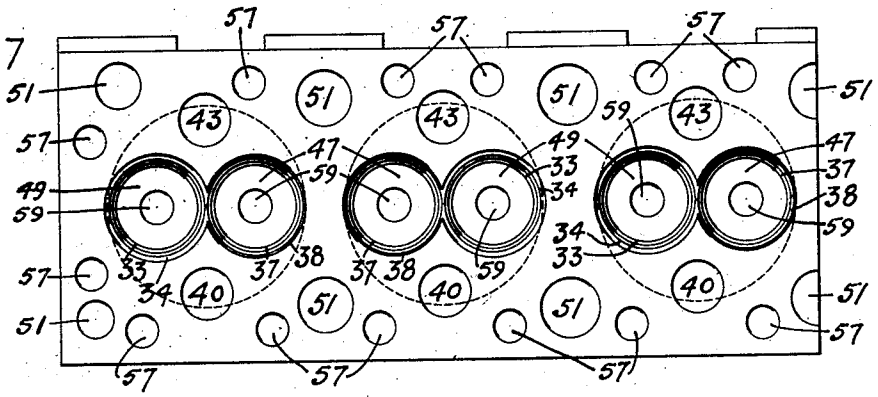
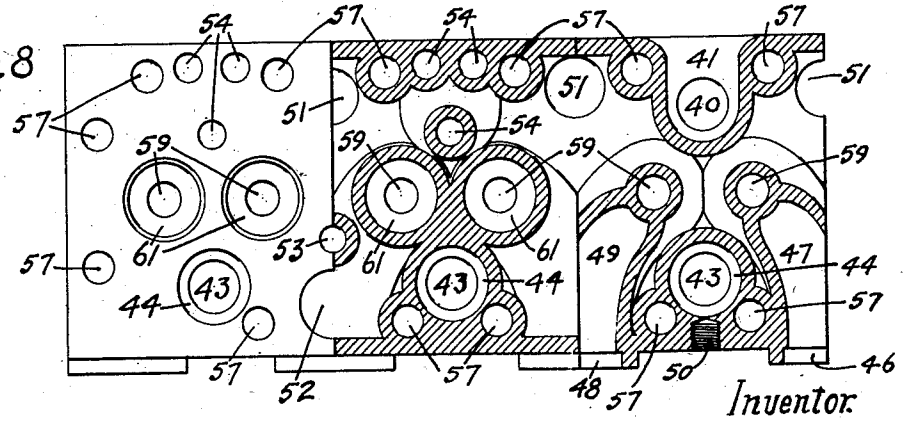


Fig.8



Inventor.

Julius C. Peterson.

Patented Mar. 22, 1932

1,850,474

UNITED STATES PATENT OFFICE

JULIUS C. PETERSON, OF CHICAGO, ILLINOIS

INTERNAL COMBUSTION ENGINE

Application filed June 25, 1928. Serial No. 288,150.

My invention relates to internal combustion engines of the four stroke cycle type and the principal objects of my invention are: first, to provide means for practically complete expulsion of the products of combustion from the cylinder on the exhaust stroke; and, second, to provide means for drawing into the cylinder, on the intake stroke, a charge of combustible mixture whose volume shall be practically equal to the full volume of the cylinder.

Further objects of my invention are to accomplish the foregoing objects in such a way that the usual construction of the engine will require very little modification, and no difficulties of manufacture shall be encountered, and that a minimum of power shall be absorbed.

Generally speaking, the ultimate object of my invention is to increase the efficiency of the engine, which is to say, to get more power from an engine having cylinders of given dimensions and to decrease the amount of fuel consumption per horsepower hour.

Heretofore in internal combustion engines of the four stroke cycle type, the piston has been connected to the crankshaft by a connecting rod in such a way that the distance from the head of the piston to the center of the upper connecting rod bearing has been constant.

In my invention the piston comprises two main parts which are so connected as to permit of a limited relative motion between them in the direction of the longitudinal axis of the cylinder. One of these parts includes the head of the piston, and the other part includes the piston pin bearings, so that the distance from the head of the piston to the center of the upper connecting rod bearing is variable within the limits of the relative motion of the two parts of the piston. As a consequence the path travelled by the piston head may be longer than the path travelled by the upper end of the connecting rod.

In an engine not equipped with my invention the piston head does not enter the compression chamber, and the products of combustion remaining therein, at the end of the exhaust stroke, are ordinarily termed the residual burned gas. The amount of residual burned gas varies with the compression ratio, the latter term being applied to the ratio of the volume of the entire cylinder to the volume of the compression chamber.

In automobile engines now being manufactured in this country, the compression ratio varies from four to one to six to one, with the trend toward the higher ratio, since experience shows that higher compression gives higher efficiency. As experience shows that a compression ratio of six to one is practicable, I will assume that ratio for the purpose of illustrating the approximate increase in power that results from the use of my invention. The residual burned gas will then amount to one-sixth of the total volume of the cylinder, or nearly 17%.

The pressure necessary to force the products of combustion out of the cylinder through the exhaust valve, varies from about one pound per square inch at low speeds up to several pounds per square inch at high speeds, with about three pounds per square inch for an average. The amount of suction necessary to draw the fresh fuel mixture into the cylinder through the intake valve varies similarly from low to high speeds, with about three pounds per square inch for an average. Assuming atmospheric pressure as fifteen pounds per square inch, the pressure on the exhaust stroke is then eighteen pounds per square inch, and on the intake stroke twelve pounds per square inch. According to the laws of expansion of gases, volume increasing for reduced pressure and decreasing for reduced temperature, the 33% decrease in pressure, modified by the decrease in temperature, will increase the volume of the residual burned gas from nearly 17% to about 20% of the volume of the cylinder during the intake stroke. At the end of the intake stroke, then, the contents of the cylinder will be 20% residual burned gas and 80% fresh fuel mixture.

With my invention the residual burned gas may be reduced so that it will not be over 2% of the entire volume of the cylinder. This will be increased to about 2.4% of the

volume of the cylinder during the intake stroke. At the end of the intake stroke, then, the contents of the cylinder will be 2.4% residual burned gas and 97.6% fresh fuel mixture. That is, 17.6% of the volume of the cylinder that was occupied by residual burned gas is now occupied by fresh fuel mixture. 88% of the residual burned gas has been expelled from the cylinder and 22% more fuel mixture has been drawn into the cylinder. The ratio of residual burned gas to fuel mixture has been reduced from one to four to one to forty.

The residual burned gas cannot be burned again, and on the intake stroke it is mixed with the fresh fuel mixture which is drawn into the cylinder. The presence of the residual burned gas in the mixture renders it less combustible and harder to ignite, and in order that ignition shall take place, more fuel must be present in the mixture than would have to be if the residual burned gas were absent from the mixture. Reducing the residual burned gas to one part in forty, through the use of my invention, makes it practicable to ignite and burn a very much leaner fuel mixture, so that while a greater volume of fuel mixture is drawn into the cylinder on each stroke, a smaller amount of fuel is contained therein.

While the accompanying drawings show one form that my invention may take, they are in the main illustrative, for other forms, coming within the scope of my invention, are practical and I do not limit my invention to what is shown in the drawings.

Figure 1 is a vertical section through the engine, on a plane containing the longitudinal axis of one of the cylinders and perpendicular to the axis of the crankshaft, the piston, connecting rod and spark plugs not being in section; Figure 2 is a vertical section through the center of the piston on a plane containing the longitudinal axis of the piston pin bearings; Figure 3 is a horizontal section of the piston on a plane 3 3 of Figure 2; Figure 4 is a vertical section through part of the engine on a plane containing the longitudinal axes of the cylinders, showing part of the cylinder head and the upper end of one of the cylinders, with two valves and the top of the piston not in section.

Figure 5 is a side view of one end of the cylinder head, showing the niches in which spark plugs are positioned; Figure 6 is a side view of one end of the cylinder head showing the openings of the exhaust and intake passages; Figure 7 is a bottom view of one end of the cylinder head showing the openings in the bottom of the head; Figure 8 is a top view of one end of the cylinder head, partly in section, showing in the center a horizontal section on the plane 8 8 of Figure 1, and at the right a horizontal section on a plane 8′ 8′ of Figure 1, the spark plugs being omitted.

The piston 1 is composed of two main parts, the piston slide 2 which contains the piston pin bearings 3 and the bushings 4, and the piston sleeve 5 which is itself composed of two parts, the piston sleeve proper and the retaining ring 6 attached to the sleeve by the male and female screw threads 7. This construction of the piston sleeve permits the piston slide to be inserted in the piston sleeve and there held securely. The piston sleeve 5 has the piston head 8, piston ring grooves in which are positioned the piston rings 9, and the skirt 10. The upper and lower portions of the piston sleeve are cylindrical and of a diameter to fit the bore of the cylinder 11 with proper clearance. In order to keep down the weight of the piston sleeve the skirt 10 has a smaller outer diameter than the upper and lower portions of the sleeve. The piston sleeve has a cylindrical inner surface of such diameter as to provide a sliding fit with the cylindrical outer surface of the piston slide 2. In assembling the piston, the upper end of the connecting rod 12 is passed through the retaining ring 6 and the piston slide is then connected to the connecting rod with a piston pin (not shown) in the same manner that ordinary pistons are connected.

Piston sleeve 5 is then slipped over piston slide 2 and retaining ring 6 screwed into position, completing the assembly. The parts of the piston in their assembled relation are best shown in Figure 2.

This construction of the piston permits the piston sleeve and the piston slide to have a limited sliding motion relative to each other, in addition to the sliding motion of the piston in the cylinder. As will be shown later, the piston sleeve and the piston slide will periodically have widely varying velocities, the velocity of the piston sleeve being very high when the velocity of the piston slide is very low. In a high speed engine the difference in velocity may range as high as three to four thousand feet per minute. Consequently means is provided to prevent the shock which would occur when the parts reach their limits of relative motion. This means consists of two dashpots, one to absorb the energy of the parts for each limit of relative motion. In the retaining ring 6 is formed the annular groove 13, of substantially semicircular section at the bottom. The outer wall of the groove is formed by the inner surface of the piston sleeve, the lip 14 of the retaining ring 6 forming the inner wall 15, which is slightly inclined so that the top of the groove is wider than the bottom, which is just wide enough to permit the ring 16, on the lower end of piston slide 2, to enter. Oil is splashed on all the interior parts of the piston from the spray formed by the lubrication system of the engine, and some of it collects in the groove 13. As the ring 16 and the groove 13 come together, more oil is pushed along the inner surface of the piston sleeve into the

groove by the ring. As the two parts of the piston come together their energy is absorbed by the work done in the dashpot.

As the ring 16 enters groove 13 the oil is forced out of the groove through the clearances between the walls of the groove and the ring, and through the small holes 17, equally spaced around the bottom of groove 13, so that the parts come together gently without shock.

The surface of ring 16 is slightly flattened at the bottom, otherwise the ring fits the bottom of the groove 13 so as to give an adequate area of contact to support the pressure applied. When forces act that cause the parts of the piston to move in such a manner that ring 16 and groove 13 tend to separate, the cohesion of the ring and groove might hold them together were it not for the fact that the flattening of the bottom of the ring 16 and the holes 17 permit oil and air to enter the bottom of the groove and reduce the amount of the cohesion.

The annular groove 18 formed in the lower side of piston head 8, and the ring 19 on the upper end of piston slide 2, with the holes 20, equally spaced in the ring 19, are similarly formed to form the other dashpot, which operates in a similar manner. The clearances in the upper dashpot are somewhat smaller than those in the lower, and the holes 20 are a little smaller than the holes 17, as the energy to be absorbed by the upper dashpot is somewhat greater than that to be absorbed by the lower, due to the force of gravity acting downward and accelerating the downward motion of the piston sleeve 5, while it retards its upward motion.

The amount of the relative motion between the piston slide and the piston sleeve is dependent on two factors, the compression ratio of the engine and the permissible maximum possible movement, which will be explained later.

The cylinder block 21 has the cylinder 11 with the usual cylinder jacket 22, upper crank case 23 and bearings for the crankshaft 24 and crankshaft 25. The center of the crank pin 26 travels in the crank pin circle 27. The oil pan 28 is shown in part. The cylinder 11 is of uniform bore throughout its length except for the conical surface 29 at the bottom, to facilitate the insertion of the piston with its piston rings, as is usual.

The cylinder head 30 is of usual construction except for the novel features of the valve seats and of the provision for placing both the spark plugs and the valves in the head. The cylinder head is substantially in the shape of a rectangular block, with all its parts cast integral. Its lower surface 31 is a plane except for the circular depressions in which the valve seats are formed. The exhaust valve 32 has the valve seat 33 formed in the circular depression 34, which is of such depth that the lower surface 35 of the valve head will lie substantially in the plane of the lower surface 31 of the cylinder head when the valve is still slightly open, as the head of the piston reaches its highest point on the exhaust stroke. The intake valve 36 has the valve seat 37 formed in the circular depression 38, which is of such depth that when the intake valve is closed, the lower surface 39 of the valve head will lie substantially in the plane of the lower surface 31 of the cylinder head. This construction is best shown in Figure 4. This construction of the cylinder and cylinder head permits the piston head to approach the cylinder head with a minimum clearance, so that the volume occupied by the products of combustion at the end of the exhaust stroke, will be a minimum.

The circular depressions in which the valve seats are positioned are of sufficient diameter so as not to interfere with the passage of the gases, and so as to permit the use of valves the sum of whose maximum diameters is only slightly less than the diameter of the cylinder.

Threaded holes 40 are positioned in the bottom of the niches 41 formed in one side of the cylinder head, to receive spark plugs 42. Similar threaded holes 43 are positioned in the bottom of the wells 44, formed in the top of the cylinder head, to receive spark plugs 45. This construction permits of the use of either one or two spark plugs for each cylinder. As experience shows that greater power for the same amount of fuel is obtained when two spark plugs for each cylinder are used, I have made provision for them in the novel manner described. The bottom of the spark plugs is substantially flush with the lower surface of the cylinder head, so that there will be sufficient clearance to prevent the piston head from striking them.

One side of the cylinder head has the openings 46 for the intake passages 47, and similar openings 48 for the exhaust passages 49. Bolt holes 50 are provided for bolts to hold the intake and exhaust manifolds (not shown) in position. The cooling water passes from the cylinder block to the cylinder head through passages 51, and from the cylinder head to the water manifold (not shown) through passage 52. 53 is a bolt hole for a bolt to hold the water manifold in position. 54 are bolt holes for bolts to hold the supports 55 for the rocker arm shaft 56 in position, and 57 are bolt holes for bolts to hold the cylinder head in position on the cylinder block. The valve guides 58 are positioned in the holes 59, and the valve springs 60 are received in the depressions 61.

As will be seen from the drawings, adequate space for the cooling water has been left in the cylinder head, and the gas passages and valve seats are adequately surrounded by water. As the cylinder head is symmetrical

with respect to a vertical plane through its center and perpendicular to its longer axis, the complete head for a four cylinder engine would require simply the addition of an end on the right for the fourth cylinder, symmetrical with the end shown on the left for the first cylinder. For a six cylinder engine a right portion symmetrical to the left portion shown would be required, and for an eight cylinder engine, the same as for a six, with an additional portion in the center similar to that shown for two interior cylinders.

As any suitable valve gear, ignition system, lubrication system, and so on may be used in the engine, the presence of such parts is assumed.

In such a system as that described, where a cylinder contains a piston comprising two parts capable of limited relative sliding motion, connected by a connecting rod to the crank pin of a revolving crankshaft, the motion of the piston slide, being connected to the upper end of the connecting rod, is in a straight line, with a velocity varying from zero at the moments when the crank pin is at the top and bottom of the crank pin circle, to a maximum slightly in excess of the linear speed of the crank pin at the two moments when the axis of the connecting rod is tangent to the crank pin circle. For a connecting rod whose length is twice the diameter of the crank pin circle, these two points are each approximately seventy-six degrees from the top of the crank pin circle. For longer connecting rods the angle will be greater.

For convenience I will divide each stroke of the piston slide into two parts, calling the part during which the crank pin travels between the bottom of the crank pin circle and a point of tangency of the axis of the connecting rod, the lower part; and the remaining part, during which the crank pin travels between a point of tangency and the top of the crank pin circle, the upper part. In designating the relative positions of the piston slide and piston sleeve with reference to each other, I will call the position when the piston head is nearest the piston pin, with the upper dashpot closed, the lower position of the piston sleeve; and the position when the piston head is farthest from the piston pin, and the lower dashpot closed, the upper position of the piston sleeve.

During the lower part of an upward stroke and the upper part of a downward stroke, then, the piston slide and the piston sleeve are accelerated together, and at the end of that part of the stroke, both parts of the piston have attained the same maximum velocity. During the upper part of an upward stroke and the lower part of a downward stroke, the piston slide is retarded by the connecting rod, but the piston sleeve, being capable of motion relative to the piston slide, has a motion which will be considered separately for each stroke of the cycle.

At the start of the exhaust stroke the piston sleeve is assumed to be in its lower position, then. At the end of the lower part of the stroke the piston sleeve has attained its maximum velocity and has stored in it energy proportional to its weight and to the square of its velocity. If it were not retarded, it would continue upward at this velocity, but it is retarded by gravity, friction and the pressure of the burned gas in the cylinder, its energy being expended in overcoming these resistances.

If the speed of the engine is very low, the energy of the piston sleeve will not be sufficient to overcome entirely the resistances and permit the sleeve to get up to its upper position at the end of the exhaust stroke, but as the speed of the engine increases, the energy of the piston sleeve increases much faster and soon is sufficient not only to overcome the resistances and cause the sleeve to rise to its upper position at the end of the stroke, but to require that the lower dashpot absorb the excess energy and bring the piston sleeve to rest. With the piston sleeve in its upper position at the end of the stroke, the piston head is as close to the cylinder head as the necessities of good mechanical clearance permit, and practically all the products of combustion are forced out of the cylinder, reducing the volume of residual burned gas to a minimum.

At the start of the intake stroke, then, the piston sleeve is in its upper position. The piston slide pulls it down until its maximum velocity is attained at the end of the upper part of the stroke. As in the case of the exhaust stroke, it has acquired energy and this energy is used in the lower part of the stroke in overcoming the resistance of friction and the difference in pressure between the air in the crank case and the fuel mixture entering through the intake valve. Gravity acts to accelerate the motion of the piston sleeve instead of to retard it. The piston sleeve moves to its lower position at the end of the stroke, the energy still remaining being absorbed by the upper dashpot and the sleeve being brought to rest. Substantially the entire volume of the cylinder is thus filled with fresh fuel mixture.

If the speed of the engine is too slow to cause the piston sleeve to move entirely up to its upper position on the exhaust stroke, it is evident that all the products of combustion will not be forced out of the cylinder, and that at the start of the intake stroke the piston sleeve will descend due to gravity until the piston slide catches up to it and begins to pull it down. The upper dashpot, in such a case, has far more than sufficient capacity to prevent any shock to the parts of the piston when they come together. The piston sleeve will descend nearly to its lower posi-

tion, however, but the upper dashpot may not be entirely closed.

At the start of the compression stroke, then, the piston sleeve is in its lower position. As on the exhaust stroke, it attains its maximum velocity at the end of the lower part of the stroke, and acquires energy. But whereas on the exhaust stroke the pressure of the burned gas varies from almost nothing up to a few pounds per square inch, on the compression stroke, with both valves closed, the pressure of the compressed fuel mixture is much higher. In an engine having a compression ratio of six to one, at average speed, the pressure at the beginning of the upper part of the stroke is from twenty to twenty-five pounds per square inch, and at the end of the stroke is from one hundred to one hundred and twenty-five pounds per square inch. With a lower compression ratio the pressures will be somewhat less, and with the throttle nearly closed the pressures will be much less. But with a nearly closed throttle the speed of the engine will ordinarily be low. Consequently the energy of the piston sleeve will not be sufficient to entirely overcome this pressure and the piston sleeve will remain in its lower position, leaving, at the end of the stroke, the required space for the compression chamber.

At the start of the power stroke, then, the piston sleeve is in its lower position. The pressure of the gas keeps it there throughout the entire stroke, and at the end of the stroke it is in the position assumed for it at the start of the exhaust stroke, and the cycle is completed.

It will be seen that on the compression and power strokes the piston sleeve remains in its lower position, there being no relative motion of the piston sleeve and the piston slide. The action of the piston on these strokes is the same as that of an ordinary piston.

There is an exception to the above statement. In the case when the throttle is closed, or nearly closed, while the engine is running at high speed, there will be but little fuel mixture in the cylinder on the compression stroke and the energy in the piston sleeve will be sufficient to compress the fuel mixture into a volume less than that of the normal compression chamber, the piston sleeve leaving its lower position but not rising as high as its upper position. The upper dashpot is opened. As the amount of fuel mixture was small, the force of the explosion on the power stroke will not be great and by the time that the piston sleeve starts to descend the piston slide will also have started downward. As the two parts of the piston come together they will be travelling in the same direction and the upper dashpot will be required to absorb sufficient energy to prevent any shock. The dashpot must have sufficient capacity to do this.

The distance that the piston sleeve can travel during the upper part of the exhaust stroke cannot safely exceed a certain definite limit. The sleeve must be brought to rest before the piston slide starts downward on the following intake stroke and sufficient time must be allowed for this to take place.

A simple calculation shows that while the piston slide moves approximately .4 of the diameter of the crank pin circle during the upper part of the exhaust stroke, the piston sleeve, if unretarded, would in the same time move approximately .7 of the diameter of the crank pin circle, or .3 of the diameter farther. Allowing for retardation due to gravity, gas pressure, and friction, and for time in which to bring the piston sleeve to rest, the maximum distance the sleeve should move may be put at .25 of the diameter of the crank pin circle, which is the length of the compression chamber for a compression ratio of five to one. Thus for compression ratios of five to one or greater, the piston sleeve may have sufficient motion relative to the piston slide for the practically complete expulsion of the products of combustion. For compression ratios less than five to one, while the amount of the products of combustion expelled will be less, it will still be sufficient to greatly improve engine performance.

The relative motion of the piston parts is further limited by the fact that the piston head must not strike the cylinder head. In an engine having a compression ratio of six to ene, the length of the compression chamber, in an engine such as I have described, would be .2 of the diameter of the crank pin circle. Allowing .02 of the diameter for mechanical clearance, the relative motion of the piston parts would be .18 of the diameter, which is only about three-fourths of the permissible maximum and should give excellent results over a wide range of engine speed.

I claim:

1. A piston for an internal combustion engine comprising in combination a piston sleeve, a piston slide mounted within the sleeve for limited free movement relative thereto, and means for cushioning the piston slide and sleeve against shock upon reaching the limiting ranges of relative movement.

2. A piston for an internal combusition engine comprising in combination a piston sleeve, a piston slide mounted within the sleeve for limited movement relative thereto, means for cushioning the said limited relative movement of the slide and sleeve, and means for lubricating the bearing surfaces including an interior annular groove at the base of the piston sleeve.

3. A piston for an internal combustion engine comprising in combination a piston sleeve, a piston slide mounted within the sleeve for limited free movement relative thereto, and means for cushioning the said

limited relative movement of the slide and sleeve including a dash-pot arrangement.

4. A piston for an internal combustion engine comprising in combination a piston sleeve, a piston slide mounted within the sleeve for limited movement relative thereto, and a retaining cap fitted to the base of the piston sleeve and having an upwardly extending annular lip cooperating with the base of the piston slide to form a dash-pot.

5. A piston for an internal combustion engine comprising in combination a piston sleeve, a piston slide mounted within the sleeve for limited movement relative thereto, a retaining cap fitted to the base of the piston sleeve and having an upwardly extending annular lip cooperating with the base of the piston slide to form a dash-pot, and a second dash-pot comprising an annular groove in the top of the piston sleeve cooperating with the top of the piston slide.

6. A piston for an internal combustion engine comprising in combination a piston sleeve, a piston slide mounted within the sleeve for limited movement relative thereto, a retaining cap fitted to the base of the piston sleeve and having an upwardly extending annular lip cooperating with the base of the piston slide to form a dash pot, and a second dash pot comprising an annular groove in the top of the piston sleeve cooperating with the top of the piston slide, said dash pots being provided with relief vents.

7. An internal combustion engine comprising a cylinder, a piston within the cylinder, a cylinder head for closing said cylinder, valves within the cylinder head located above the cylinder and arranged so that their heads lie in a plane with the base of the cylinder head, when the valves are in a substantially closed position, said piston comprising a piston sleeve having a slide mounted therein for limited free movement relative thereto and being adapted to travel the full length of the cylinder for completely scavenging the cylinder of residual burnt gases.

8. In an internal combustion engine comprising in combination a cylinder, a piston within the cylinder, said piston comprising components freely movable for a limited distance relative to each other to vary the effective length of the piston stroke, a cylinder head closing the top of the cylinder, intake and exhaust passages within the cylinder head, and valves for controlling the opening and closing of said passages, the heads of said valves being arranged within the cylinder head so as to lie in the plane of the lower face of the cylinder head when the valves are in a closed position.

9. A piston for an internal combustion engine comprising in combination a piston sleeve, a piston slide mounted within the sleeve for limited movement relative thereto, means for cushioning the said limited relative movement of the slide and sleeve, said means comprising an annular groove cooperating with the base of the piston slide.

10. A piston for an internal combustion engine comprising in combination a piston sleeve, a piston slide mounted within the sleeve for limited movement relative thereto, and dash pots adjacent the top and bottom of the piston sleeve for cushioning the said limited relative movement of the slide and sleeve.

11. A piston for an internal combustion engine comprising in combination a piston sleeve, a piston slide mounted within the sleeve for limited movement relative thereto, and means for cushioning the said limited relative movement of the piston sleeve and slide including annular grooves adjacent the top and bottom of the piston sleeve and cooperating with the top and bottom respectively of the piston slide for forming dash pots.

12. An internal combustion engine comprising in combination a cylinder, a piston within said cylinder, a cylinder head for closing the top of said cylinder, said piston comprising a piston sleeve having a piston slide mounted therein for limited free movement relative thereto, and means for causing said sleeve to travel a maximum distance during the exhaust and intake strokes, and a somewhat smaller distance during the compression and power strokes.

13. An internal combustion engine comprising in combination a cylinder, a piston within said cylinder, a cylinder head for closing the top of said cylinder, said piston comprising a piston sleeve having a piston slide mounted therein for limited free movement relative thereto, a dash pot for cushioning the limited relative movement of the piston sleeve and slide, and means for causing said sleeve to travel a maximum distance during the exhaust and intake strokes, and a somewhat smaller distance during the compression and power strokes.

14. An internal combustion engine comprising in combination a cylinder, a cylinder head for closing the top of said cylinder, a piston within the cylinder, said piston comprising components freely movable for a limited distance relative to each other to vary the effective length of the piston stroke and limited at each end of their relative movement by a dash pot, valves for controlling the gaseous content of the cylinder, and ignition means for producing an explosion within the cylinder, said piston having a maximum travel under certain conditions to a point adjacent the lower face of the piston head, said valves and ignition means being so positioned with respect to the cylinder as to permit a substantially complete expulsion of the gaseous content of the cylinder when the piston travels its maximum distance.

15. An internal combustion engine comprising in combination a cylinder, a cylinder head, a piston within the cylinder, a crank shaft, a connecting rod connecting the piston to the crank shaft, said piston comprising outer and inner members freely movable for a limited distance relative to each other to vary the length of the piston stroke during different conditions of engine operation and a dash pot for cushioning the limited movement of the outer and inner piston members.

16. A piston for an internal combustion engine comprising in combination an outer cylindrical member closed at one end by a head, an inner cylindrical member slidably mounted within the outer member for limited movement relative thereto, means provided on said inner member for connection with a connecting rod, a retaining cap fitted to the base of the outer member and having an inwardly and upwardly extending annular lip forming an interior groove at the base of said outer member, an annular groove formed in the lower face of the outer cylinder member, beads provided on the upper and lower edges of the inner cylinder for cooperating with the annular grooves at the top and bottom of the outer cylinder member for forming dash pots to cushion the relative movement of the two members.

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