March 18, 1941. Z. A. BRUEGGER 2,235,475

PISTON

Filed Feb. 17, 1938

Fig. 1.

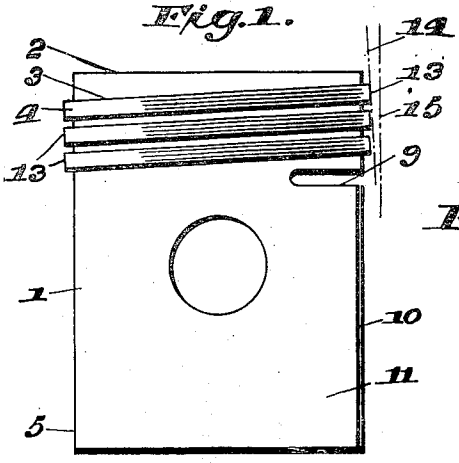


Fig. 2.

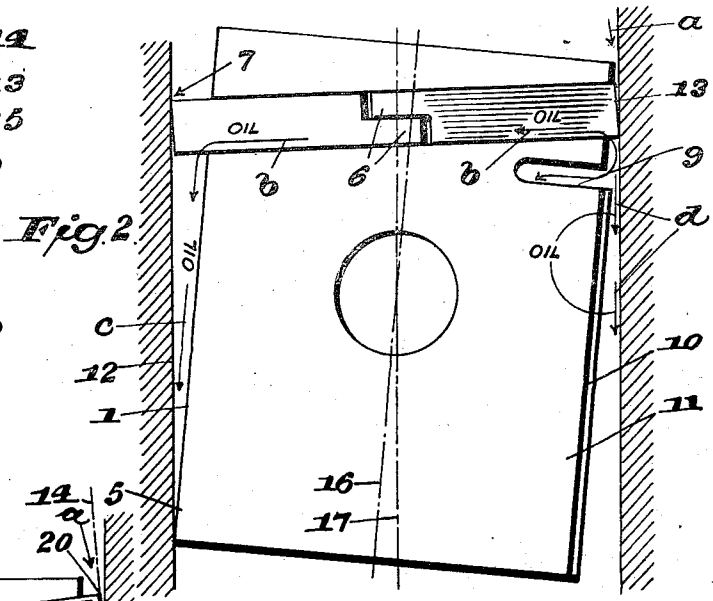


Fig. 3.

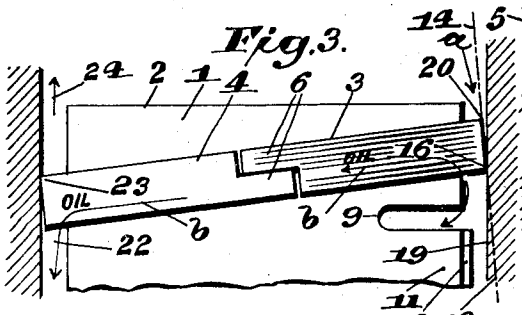


Fig. 4.

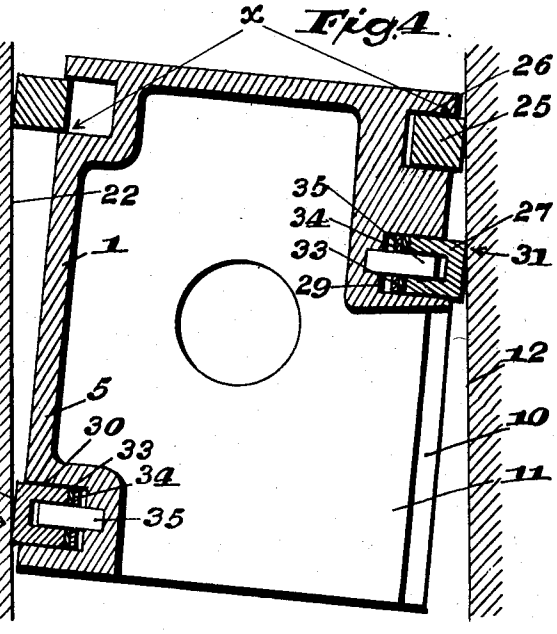


Fig. 8.

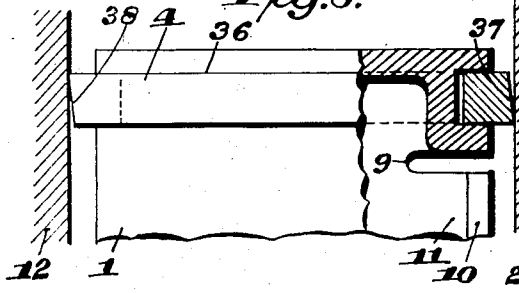


Fig. 9.

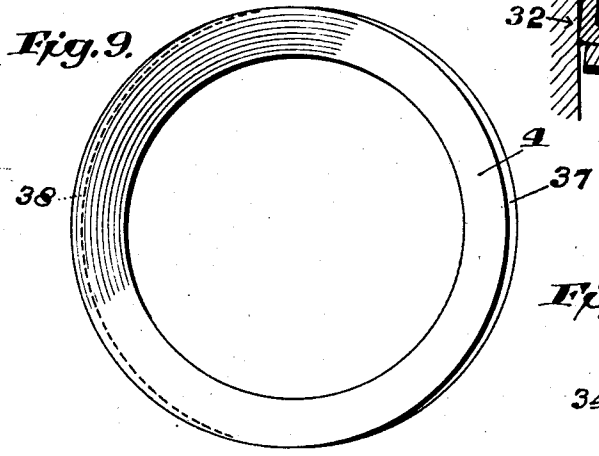


Fig. 5.



Fig. 6.

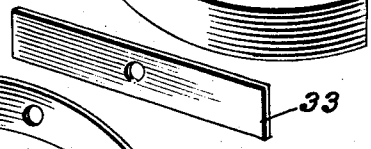


Fig. 7.



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PISTON

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Application February 17, 1938, Serial No. 191,078

2 Claims. (Cl. 309—7)

This invention relates to improvements in pistons, and its objects are as follows:

First, to provide an improved piston, principally for internal combustion engines, wherein there is attained a more perfect ring alinement with the cylinder wall after all piston canting has been accounted for, than in existing piston and ring combinations.

Second, to provide a piston, or an equivalent annulus, so constructed that when its peripherical face is square with its cylinder wall a pressure-sealing ring embodied therein or carried by it will assume such position as will provide the maximum efficiency.

Third, to provide a piston which carries adjustable shoes which serve the purpose of regulating the wear upon the diagonally opposite pressure areas of the piston.

Fourth, to provide a special form of ring which will make a maximum efficient contact with the cylinder wall when the piston is canted, even though the groove by which said ring is carried is normal to the axis of the piston.

Other objects and advantages will appear in the following specification, reference being had to the accompanying drawing, in which:

Figure 1 is a side elevation of a piston, illustrating the biased grooves and slanting position which the rings assume when the piston is at rest, by being contained by said groove.

Figure 2 is a diagrammatic side elevational view showing how maximum contact is made by a ring with the wall of the cylinder when a piston is canted under extreme impulse pressure.

Figure 3 is a detail side elevational diagrammatic view illustrating the position of the piston and ring under high speed.

Figure 4 is a diagrammatic sectional view illustrating a modified piston construction wherein shoes are employed at the diagonally opposite wear points.

Figures 5, 6 and 7 are perspective views of the shoe and shim assemblage illustrated in Fig. 4.

Figure 8 is a partially sectional and elevational diagrammatic view illustrating a modified form of piston ring.

Figure 9 is a plan view of the type of ring illustrated in Fig. 8.

It is not the purpose of this description to go into detail as to the cause of carbon formation upon piston heads, excessive ring and ring land wear, dilution of crank case oil by a seepage of gasoline, nor piston-slap which is especially prevalent in cold motors. That these disorders exist in internal combustion engines can be accepted without dispute. The instant invention is a contribution toward an alleviation and prevention of the engine troubles named.

Persons acquainted with the operation of an internal combustion engine know that the piston (making reference to only one) of an internal combustion engine will cant out of its true axial position when cold and also when under a heavy load. In the first instance the canting, which causes the previously mentioned piston-slap is relieved to a great extent when the engine heats up, although there will always be some canting to correct. In the second instance there is a strong tendency toward the crushing of the skirt. When the piston is canted, as in the first instance, the ring, making mention of only one, is also canted. This distorted position of the ring enables oil to seep up past the ring on the down stroke of the piston, on the over-oiled side, opposite to the pressure side, and simultaneously causes the ring to scrape gasoline from the cylinder wall and make it drain downwardly toward the crank case on the pressure, or dry side.

Furthermore, the opening between the ring and cylinder wall on said pressure side affords a convenient place through which the pressure gas of the exploded charge can blow. This blow-by blows the oil off the cylinder wall, causing a dry side at the very place which should be lubricated. The possibility of a blow-by is to be anticipated in an internal combustion engine, but according to the improved piston it is put to a good use, being transferred to the over-oiled side, opposite to the pressure side where it is made to aid in the driving the excess oil back down into the crank case.

Another disorder to be noted in prevailing types of pistons and rings is that the canting of the piston and ring forces the ends of the heat expanded ring together. This can be understood by reference to Fig. 4 which illustrates the condition, but here the bad effect is compensated for by inserted shoes which are presently described.

Considering the ends of the rings pried or forced together it is easy to understand that the flexibility of the ring is temporarily suspended. The ends will abut so tightly that the ring virtually becomes a solid, unyielding circle upon which the piston hangs and pries when under the powerful impulse strokes. Instead of the

ring then performing only its intended purpose it acts as a virtually solid, sharp-edged knife or cutting tool, doing severe damage to the rings, ring lands and cylinder wall, especially while the power impulses are heaviest as under severe loads.

This is the exact situation in the majority of internal combustion engines, and it is directly contrary to what it should be. The oil should be blown back, and scraped from the over-oiled side, opposite to the pressure side. The gasoline, if scraped from the cylinder wall, especially in a cold motor, should be directed upwardly and back into the combustion space, and not scraped and blown downwardly into the crankcase by each explosion.

The ideal ring condition is depicted in Fig. 2 to which detailed reference is made later. It is to be noted that there is no opening between the ring and cylinder wall on either side, the now uncanted position of the ring making an efficient pressure seal, and any excess oil is scraped back into the crank case or gravitates down the biased ring groove to the pressure side.

Another important result of the arrangement in Fig. 2 is that when the ring is canted, as shown, it is permitted to operate without diminution of its resiliency. The ring ends do not abut, but remain open at the joint, thus preserving its flexibility and maintaining its customary seven-pound tension intact. Instead of being converted into a solid cutting tool, as pointed out above, the ring is now left free to shape itself to the contour of the cylinder wall, eliminating excess ring and ring land wear, and no blow-by or ring flutter is apparent. In order that it may be understood how the invention is responsible for the improvement, reference is made to the drawing.

In all instances the piston is generally designated 1. This, as is commonly known, comprises the head 2, one or more ring grooves 3, one or more rings 4, and a skirt 5. In practice the piston is internally reinforced but neither the reinforcement nor the bosses in which the wrist pins are fitted are shown in the drawing.

Some pistons are solid-skirted, and others, as illustrated in Figs. 1, 2, 3, and 8 are horizontally slotted at 9 at a place immediately below the head 2, said slot being communicated with by an upright kerf 10 in the skirt 5. This arrangement of slotting and kerfing produces more or less flexible skirt leaves 11. Either piston is operable however in a working cylinder which is designated 12.

Attention is first directed to Fig. 1, which illustrates the main improvement. The groove 3, and all others like it, is situated on a bias so that the ring 4 occupies a slanting position when fitted therein. With the ring 4 in this position it is easy to see that its external periphery 13 (Fig. 1) will stand harmlessly at the inclination 14 with respect to the cylinder wall 12 when motor is at rest, the position and spacing of which is greatly exaggerated at 15 in Fig. 1, in order that the reader may understand the comparison.

This disposition of the groove 3 and ring 4 is adopted out of consideration of the canted position which the piston 1 takes when subjected to severe pressure. The canted position is illustrated in Fig. 2. Instead of the axis 16 of the piston being parallel to the axis 17 of the cylinder, it has become tilted out of position to the approximate extent indicated so that the initially slanted ring 4 is now substantially perpendicular to the axis 17, its external periphery 13 making a maximum contact with the wall of the cylinder 12. In other words, virtually the entire area of the external face of the ring is brought into contact with the cylinder wall preventing any ring and ring land wear at x Fig. 4, fluttering of the ring or any undesirable blowing by of the fluid under pressure above the piston. The rings' ends 6 are now apart allowing free resilience for flex action.

The high pressure under which the piston in Fig. 2 is supposed to be virtually closes the kerf 10 because of the right side of the piston having been crushed over against the right wall of the cylinder 12 at the top. The consequent yielding of the skirt 5 to the full extent of the width of the kerf 10 is an aid to the ring 4 taking the practically square position across the cylinder 12 with the ring ends free for perfect resilience. It is easy to see that when the ring takes this position during the entire period that the piston is working under severest impulse pressure and load resistance, the rings will assume their maximum face contact thus preventing all power blow by and ring flutter. The tendency of the ring to dig the cylinder wall and excessive wearing of the ring and ring lands is reduced to a minimum because it can now flex instead of being held rigidly together at the ring ends. Special note is to be made of the advantageous situation of the ring. The upper left surface and side of the ring makes a pressure seal at 7, preventing any blow-by at this point. Any blow-by that may occur at the right (arrow a) because of any slight fissure between the ring and cylinder wall serves the good purpose of driving any excess oil into the ring groove (arrows b) whence it drains down to the dry side (arrow c). The rest of the oil is driven back to the crank case through kerf 9 where it belongs, little if any ever getting to the top of the piston.

It is the canting and contacting ends of known rings with known pistons when the latter are driven under high pressure and under extreme load resistance that the wearing of rings, ring lands and of the cylinder wall into a cross sectional oval form occurs. The initial canting of the ring with respect to the piston, as in Fig. 1, and the eventual straightening of the ring with respect to the cylinder wall when the piston is canted is what prevents said cutting of the cylinder wall and the excessive ring and ring land wear, and constitutes the first improvement.

Fig. 3 illustrates the piston in Fig. 1 when operated under high speed but not under especially heavy load resistance, at which time most oil pumping occurs with ordinary portions. The canting of the piston is scarcely noticeable. In fact it is shown as being in alinement with the cylinder axis. The ring 4 remains partly in its original biased position, as can be seen by reference to the inclination line 14 which is repeated in Fig. 3.

The slight opening between the ring and cylinder wall on the right is an unavoidable consequence of the ring being canted. But this situation now serves a good purpose because any blow-by which occurs and which has to be tolerated returns the excess oil to the crank case when the motor is performing at high speed, and some of it is also directed into adjacent ring groove where it is diverted to the high pressure and commonly dry side.

The advantages of the positioning of the ring are repeated. The edge 16 of the ring 4 scrapes

oil at 9 and 19, sending it back to the crank case, the upper edge which is slightly held away from the cylinder wall at 20 allowing the blow-by to additionally direct the excess oil downward. The main distinction between the two views is that Fig. 2 illustrates the position of the piston when operating under heavy impulse pressure, whereas Fig. 3 illustrates the position of the piston when operating under high speed, but not necessarily high pressure.

If the reader will pause for a moment and consider the illustration Fig. 4 of the known piston and the ring given at the beginning of this description, he will understand that any slight canting of said piston and ring will allow some blow-by and cause the ring to scrape oil from the cylinder at the left side, in other words at the place to which the numeral 22 is applied. This is the pressure side, and it is with this side that the lower ends of the skirt of the piston makes contact whenever there is any tendency toward canting.

Inasmuch as the ring scrapes the oil from the cylinder on this side, it follows that there is a lack of lubrication in the very area where it is mostly needed. The biased ring 4 (Fig. 3) prevents a dry condition on the pressure side of the cylinder, and although the piston becomes canted, there will be ample lubrication for the skirt. Inasmuch as the ring 4 functions as a scraper on the right side, it follows that no oil will be pumped to the top of the piston to become carbonized.

Again referring to Fig. 3, the edge 23 of the ring diagonally opposite the edge 16, automatically acts as a reverse gasoline scraper. Instead of the gasoline being scraped downward, as occurs in known types of pistons and rings, the gasoline is scraped from the cylinder wall in the direction of the arrow 24. The gasoline is thus directed back up into the combustion chamber where it is burned, and not into the crank case where it would dilute the oil, thus decreasing the gasoline wastage of the motor.

Reference is now made to Fig. 4. The main purpose of the construction shown here is to properly adjust the skirt 5 in relationship to the cylinder wall 12 so as to hold the ring 25 within the limits intended by the bias grooves in Figs. 1, 2 and 3. It will be noticed in Fig. 4 that the groove 26 of the ring 25 is perpendicular to the axis of the piston 1, and not on a bias as in the first form. Upper and lower shoes 27, 28 are loosely fitted in recesses 29, 30 in the piston head and skirt in the region of the main and diagonally opposite positioned wearing points 31, 32. It has been found that these two points evidence the most wear of the piston structure due to the canting of the piston while on duty. It is the purpose of the shoes 27, 28 to allow a readjustment of the skirt in case the clearance between the skirt and cylinder wall has been increased to an undesirable extent because of wear and skirt crushing.

It is readily seen that the shoes 27, 28 could be made to hold the piston 1 perfectly erect in the working cylinder. This result is accomplished by adding shims, of which two kinds are employed. The first kind 33 (Fig. 6) is a perfectly straight metal slip. The second, 34 (Fig. 7), is bowed and preferably is of resilient metal. The addition or subtraction of shims increases or decreases the straightening of the piston, and correspondingly prevents or allows canting. It is obvious that as the shims 33 are added, backward canting is produced and the ring 25 will make a more and more efficient contact with the cylinder wall 12. Although the resiliency of the shim 34 is a desirable quality yet it is one of choice, the principle underlying the shims of the disclosed combination of shims being that of a substantially inert backing for the shoes 27, 28. The setting of the piston can, therefore, be regulated with virtual precision, this being an advantage not readily obtainable in any other way, especially not when abutment springs are solely relied upon. The result will serve to approach and maintain that of the bias groove 3.

Dowel pins 35 are shown in use in Fig. 4, but these are not essential. Fig. 8 illustrates an extension of the principle in Figs. 1, 2 and 3. Instead of the ring groove 36 being made on a bias with respect to the axis of the piston 1 it is left square across according to custom, but the external periphery of the ring 4 is made on a bias as at 37 (Figs. 8 and 9). This ring is intended to have all of the advantages of the ring Fig. 1, and the further advantage of being able to convert known types of pistons with straight across grooves so that when canting occurs there will be a complete annular oil and pressure seal between the ring and cylinder wall.

It is easy to understand that when the piston in Fig. 8 is canted enough as shown in Fig. 2, the biased surface 37 will line up straight with the erect cylinder wall. The external periphery of the ring will then lie square against the wall surface or substantially so with the advantages already named. Fig. 9 shows the configuration of this ring very plainly. Because of its peculiar shape it is necessarily pinned in place in the ring groove so that the bias faces 37, 38 will maintain the intended relationship of the cylinder wall.

I claim:

1. A piston and a ring, the piston having a right-cylindrical groove disposed on a bias to the axis of the piston, the ring occupying the groove and having a right-cylindrical external surface and approximately right-cylindrical internal surface, said ring having its flat top and bottom sides perpendicular to the axis thereof.

2. An internal combustion engine piston having a head with a cylindrical groove situated on a bias to the axis of the piston, and a right-cylindrical, lap-jointed ring undistortedly occupying the groove for free flexure in a plane perpendicular to the axis of the groove.

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