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O. E. BARTHEL

PISTON

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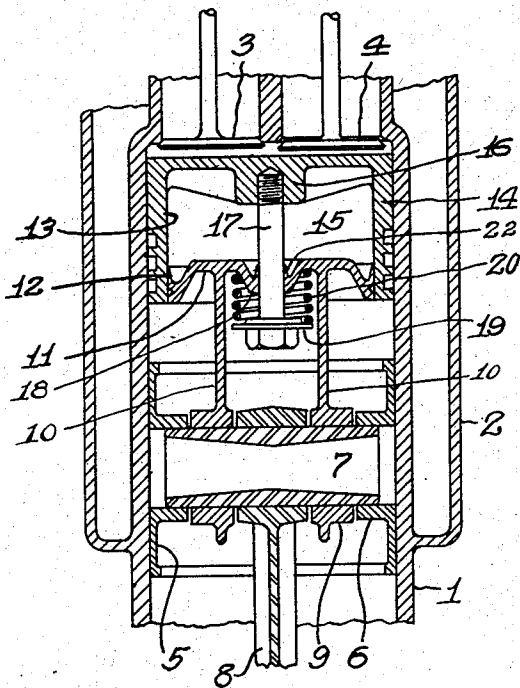


Fig. 1.

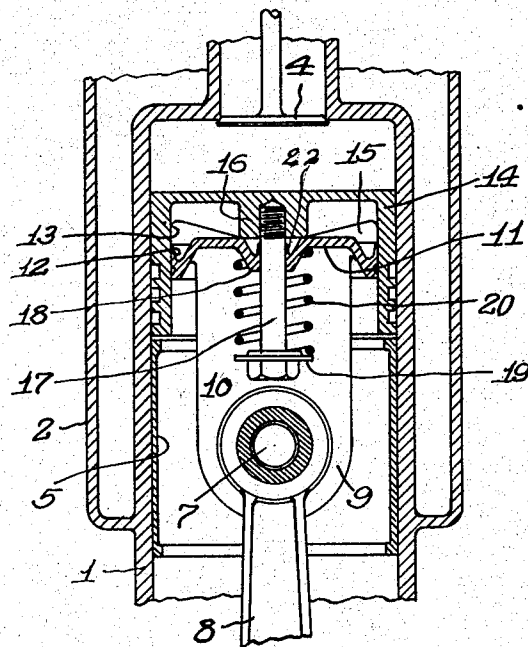


Fig. 2.

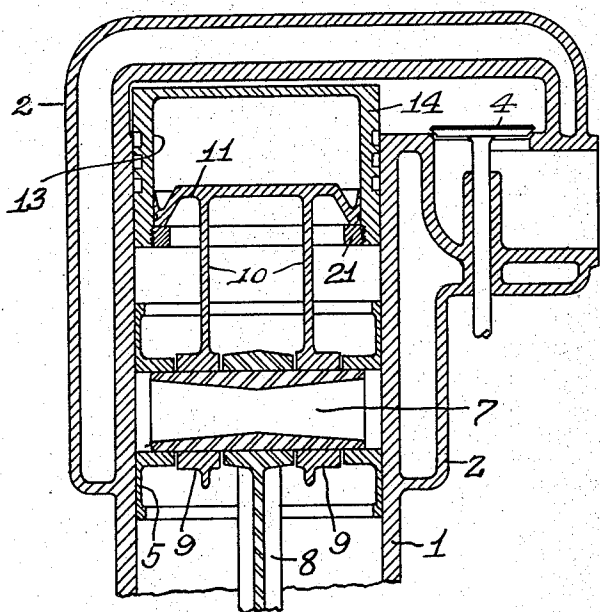


Fig. 3.

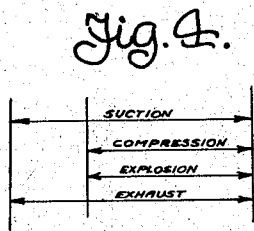


Fig. 4.

Inventor
Oliver E. Barthel

By *Richard W. Barthel*

Attorneys

UNITED STATES PATENT OFFICE.

OLIVER E. BARTHEL, OF DETROIT, MICHIGAN.

PISTON.

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To all whom it may concern:

Be it known that I, OLIVER E. BARTHEL, a citizen of the United States of America, residing at Detroit, in the county of Wayne and State of Michigan, have invented certain new and useful Improvements in Pistons, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention relates to a variable length piston, one which, during the reciprocation in an engine cylinder, may automatically have its longitudinal dimension increased and decreased to produce beneficial results in the operation of an internal combustion engine.

Briefly described, the piston includes a skirt, somewhat self adjusting relative to cylinder walls, articulated with a connecting rod. Movable with the piston skirt is an inner piston head reciprocable in an outer piston head, which is adapted to operate with the skirt in an engine cylinder. The outer piston head affords a normally closed air chamber cooperating, due to the compression and expansion of air therein, with the inner piston head in performing work or a function which materially contributes to an efficient and economical operation of an engine. A yieldable spring or defined loose connection is established between the inner or outer piston heads, and the piston as a whole may be used in any type of internal combustion engine having cylinders for reciprocable pistons.

By means of this variable length piston, the exhaust gases are driven entirely out of the working cycle during the exhaust stroke. Only a minute part of the exhaust gases remains to dilute and weaken the charge, instead of the entire compression space full, as in the commonly known "Otto" cycle. With my mechanism the piston head has three strokes of varying length. Starting with the beginning of the suction stroke, the piston is at the extreme head end of the cylinder, due to the partial vacuum, because of the inertia of the exhaust gas, the inertia of the piston and the expansion of the air compressed under the piston head. The spring is compressed and the piston automatically lengthens. At the end of the suction stroke advantage is again taken of the inertia of the piston and incoming gas which tends to release the tension of the spring and cause the piston head to descend,

thus shortening the piston and increasing the volume of the suction stroke, thereby increasing the volumetric efficiency considerably over that possible with the "Otto" cycle. During the compression stroke, the compression pressure causes the piston to shorten by compressing the air trapped under the piston head and also distending the spring to a predetermined length governed by the volume of the compression space above the piston head and by the tension of the spring in conjunction with the volume of the compression space under the piston head. On completing the compression stroke, the piston has moved a distance equal to about two-thirds of the suction stroke, compressing the charge into about one-third of its original volume. The charge is then ignited, the explosion drives the piston forward, in its shortest form, which position is maintained until, as stated in the beginning, the piston returns to the extreme end of the cylinder and lengthens on the way up due to the inertia of the piston, the inertia of the exhaust gas column and the compressed air under the piston head overcoming the spring and the frictional resistance of the cylinder walls, which permits the piston head to travel at a greater rate than the piston skirt.

By this arrangement the incoming charge is materially increased which increases the volumetric efficiency of the engine and the compression space is entirely cleared of exhaust gases during the exhaust stroke.

My invention will be hereinafter considered and then claimed, and reference will now be had to the drawing, wherein—

Figure 1 is a vertical sectional view of a portion of an engine cylinder provided with a piston in accordance with my invention, showing the piston as completing an exhaust stroke;

Fig. 2 is a similar view showing a piston as completing a compression stroke;

Fig. 3 is a similar view illustrating a slight modification in the piston and applied to an L head type of engine, and

Fig. 4 is a diagrammatic view showing the comparative length of piston strokes.

In the drawing the reference numeral 1 denotes a portion of an engine cylinder having a water jacket 2, an intake valve 3 and an exhaust valve 4, and these elements are of a conventional form common to a horizontal or vertical type of internal combustion engine.

Slidable in the cylinder 1 is a two-part piston with one of the parts thereof constituting a self-adjusting skirt, and the other part thereof composed of inner and outer piston heads, the latter telescoping the former and constructively arranged so as to always have connection therewith.

The skirt is designated 5 and has diametrically opposed bearings or bosses 6 for a tubular piston pin 7 to which a connecting rod 8 is suitably connected.

On the piston pin 7, between the connecting rod 8 and the bosses 6 are the inner bearing ends 9 of parallel arms 10, said arms supporting the inner piston head previously mentioned and now designated 11. This inner piston head has side walls or an annular flange 12 terminating in a feather or knife edge which engages the annular interior wall 13 of the outer piston head, designated 14, said outer piston head telescoping the inner piston head 11 and providing an air chamber 15 therebetween. The air chamber 15 contains a body of air or fluid that may be compressed and allowed to expand in the chamber by the outer piston head 14 moving to and from the inner piston head, the air being compressed in the chamber when the inner and outer piston heads are in the position shown in Fig. 2. With the heads in proximity to each other, as shown in this view, the telescoping movement of the outer piston head is limited by a central boss 16 of said head engaging the inner piston head 11, and said central boss has a stem or post 17 extending through a central guide portion 18 of the inner piston head 11. On the end of the stem 17 is an abutment 19 and encircling said stem, between the abutment and the central guide portion 18 of the inner piston head 11, is a coiled expansion spring 20 which is held under compression, as shown in Fig. 1, by the body of air within the chamber 15. The central guide portion 18 of the inner piston head 11 has feather edges 22 snugly embracing the stem 17, so that the chamber 15 may be positively closed by the inner piston head 11. The compression of air in the chamber tends to more securely hold the feather edges of the guide 18 and the flange 12 against the piston wall 13 and thus seal the chamber 15. The stem 17 and the abutment 19 may be conveniently in the form of a bolt and washer or head thereon, and the outer walls of the inner and outer piston heads may be provided with packing rings of a conventional form.

It is apparent that the abutment 19 of the outer piston head constitutes means for limiting the movement of the outer piston head, in one direction, relative to the inner piston head, but instead of attaching this abutment to the central portion of the outer piston head I may dispense with the stem

17 and its appurtenant parts and attach an abutment 21 to the inner open end of the outer piston head, as shown in Fig. 3, the abutment 21 being in the form of a nut or retaining ring screwed or otherwise mounted in the inner end of the outer piston head.

Considering the operation of the piston, the inner and outer piston heads have a self-adjustment relative to the skirt 5, which serves as a cross head, and this adjustment is one of the important features of my invention, as the piston heads are relieved from any side thrust by the connecting rod 8 or a pitman and can readily accommodate themselves to the walls of the cylinder. The gap between the inner and outer piston heads and the skirt is also essential, as heat from the piston heads can pass into the skirt and be transferred to and absorbed by the cooling agent of the cylinder 1. These features alone permit of the piston being advantageously used in connection with an air compressor.

Considering the inner and outer piston heads, the normal relative position of these heads is indicated in Fig. 1, and with the exhaust valve 4 open and the piston on its exhaust stroke the outer piston head 14 will completely scavenge the cylinder. On the exhaust stroke the piston lengthens or the outer head 14 assumes an extended position relative to the inner head 11 due to the inertia of the piston, the inertia of the exhausting gases, and the expansion of air between said piston heads; these three forces cooperating to overcome the expansive force of the spring 20 and the frictional resistance of the cylinder walls. It is therefore possible for the outer piston head to travel at a greater rate of speed than the inner piston head 11 which is connected to the skirt 5 and the latter held by the connecting rod 8.

At the end of the suction stroke, as stated in the beginning, advantage is again taken of the inertia of the piston and the incoming charge of gas, which tends to release the tension of the spring and cause the outer piston head to approach the inner piston head, thus shortening the piston and increasing the volumetric efficiency of the piston or the capacity of the cylinder for gas or an explosive charge. When the piston starts on its compression stroke the outer piston head may tend to move in advance of the inner head, due to the expansion of the body of air within the chamber 15, but as the piston advances, on its compression stroke and the explosive charge is compressed, the body of air between the inner and outer pistons is compressed, assisted by the expansive force of the spring 20. The compression stroke relative to the suction and exhaust strokes has been comparatively indicated in Fig. 4 and on the completion of the compression stroke the piston has moved a distance equal

to approximately two-thirds of the suction stroke, compressing the explosive charge into approximately one-third its original volume. Assuming that the charge is then ignited, the explosion drives the piston, in its shortest form and such form is maintained until, as heretofore stated, the piston returns to the extreme end of the cylinder and lengthens for the exhaust stroke.

During the above operations the abutments cooperate with the outer piston head in limiting its movement relative to the inner piston head, and the body of air between said piston heads provides a pneumatic cushion effect to absorb shocks or vibrations during the operation of the engine. It is also apparent that my construction contributes to the dissipation of heat, precludes excessive expansion and distortion, carbon deposits, and undue wear on the piston due to inequalities between the piston rod and the piston. All of this contributes to a higher degree of perfection in connection with an internal combustion engine.

While in the drawings there are illustrated the preferred embodiments of my invention, it is to be understood that the structural elements are susceptible to such variations and modifications as fall within the scope of the appended claims.

What I claim is:—

1. A piston for a cylinder comprising two parts constructively arranged and articulated so that one part has a self adjusting lateral movement and the other part a reciprocable movement at an angle thereto, the parts being in constant spaced relation and affording a heat dissipating exit from walls of the cylinder exposed between the piston parts.

2. In an internal combustion engine having a cylinder, a piston reciprocable in the engine cylinder, said piston being composed of a skirt and a head in spaced relation, the skirt being open from end to end and permitting of heat being dissipated from the cylinder walls exposed between said skirt and head, and means supporting the head relative to the skirt so that said head may move to and from said skirt.

3. A piston comprising parts adjustable relative to each other and providing a constantly open gap between said parts, one of which is open from end to end, and means axially of the piston parts yieldably connecting said parts.

4. A piston comprising heads one within the other with a body of air therebetween

adapted to be compressed by one head moving towards the other head, and guiding means for the last mentioned head in spaced relation to the first mentioned head and providing a heat disseminating space.

5. A piston as characterized in claim 4, wherein said means is in the form of a skirt open from end to end and adjustable relative to the first mentioned head.

6. A piston comprising a skirt, an outer piston head, an inner piston head slidable in said outer piston head and having an annular feather edge flange against the walls of said outer piston head and co-operating therewith in providing a sealed air chamber in which air is compressed by said outer piston head telescoping said inner piston head, means connecting said inner piston head to said skirt, and means carried by said outer piston head and extending between the connecting means of said skirt and said inner piston head to limit the outward movement of said outer piston head relative to said inner piston head.

7. A piston as characterized in claim 6, wherein said inner piston head has an annular feather edge flange against the walls of said outer piston head.

8. A piston comprising a skirt, an inner piston head connected thereto and held in spaced relation to said skirt, said inner piston head having a closed end, an outer piston head slidable on said inner piston head and means carried by said outer piston head and extending through said inner piston head to limit the sliding of said outer piston head in one direction on said inner piston head, said means including a spring against the outer face of the closed end of said inner piston head.

9. A piston comprising a skirt having open ends, a connecting rod extending into one end of said skirt, arms extending into the other end of said skirt, means connecting said arms and said connecting rod to said skirt, an inner head carried by said arms, and an outer head movable on said inner head.

10. A piston as in claim 9, and means between said arms connected to the outer head and affording a yieldable connection between said heads.

In testimony whereof I affix my signature in the presence of two witnesses.

OLIVER E. BARTHEL.

Witnesses:

KARL H. BUTLER,
ANNA M. DORR.