June 14, 1949. HSIN-YA TIEN 2,472,928

PISTON FOR USE IN INTERNAL-COMBUSTION ENGINES

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Fig. 1.

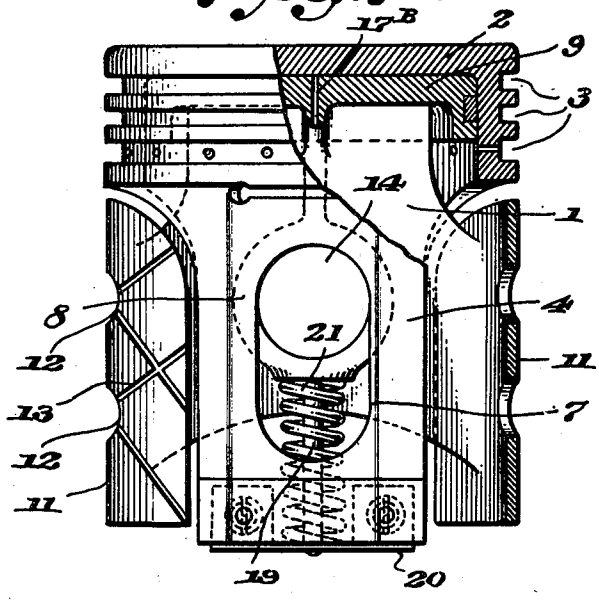
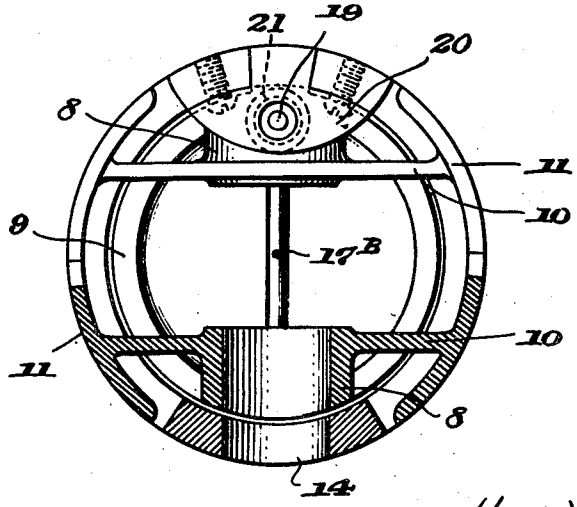


Fig. 2.



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Fig. 3.

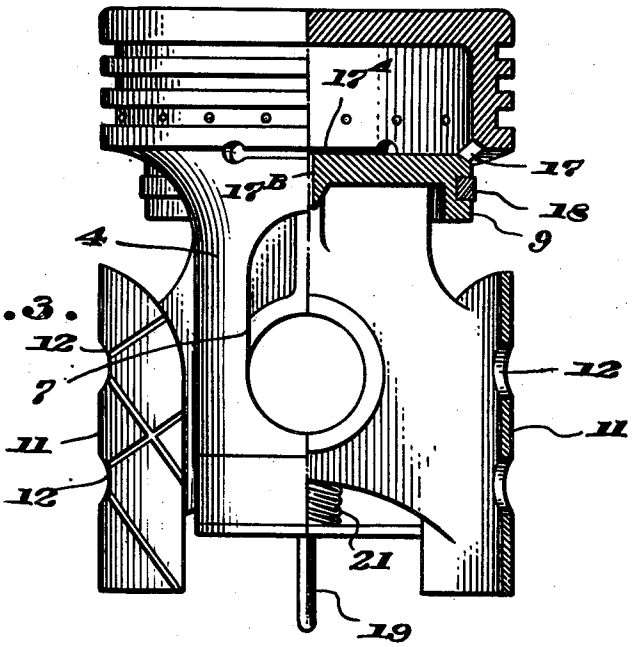
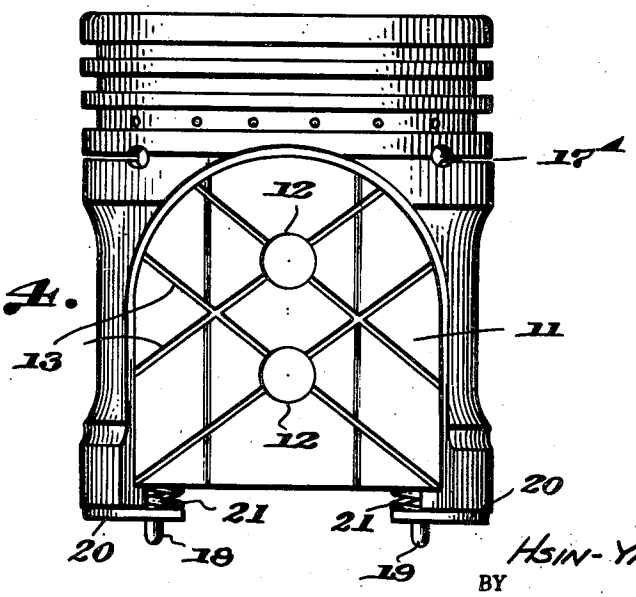


Fig. 4.



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Fig. 5.

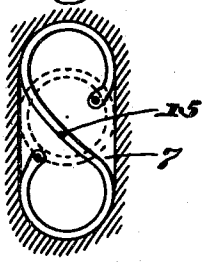


Fig. 9.

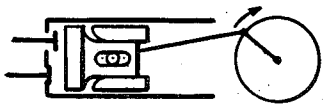


Fig. 10.



Fig. 11.

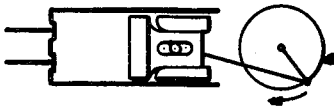


Fig. 12.

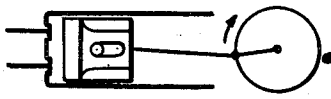


Fig. 6.

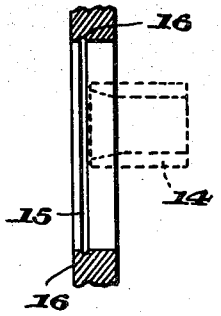


Fig. 13.

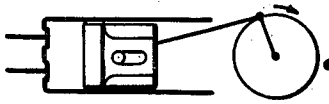


Fig. 14.

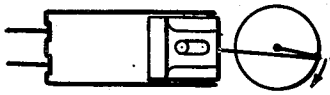


Fig. 15.



Fig. 16.

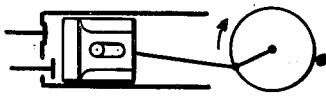


Fig. 7.

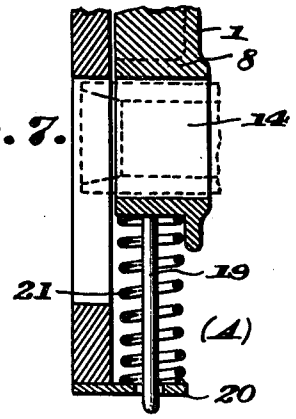
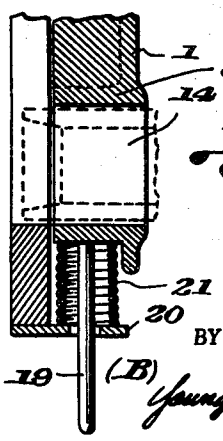


Fig. 8.



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UNITED STATES PATENT OFFICE

2,472,928

PISTON FOR USE IN INTERNAL-COMBUSTION ENGINES

Hsin-Ya Tien, Singapore, Straits Settlements

Application January 4, 1947, Serial No. 720,139

4 Claims. (Cl. 123—78)

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This invention relates to an improved piston for use in internal combustion engines of the kind described and claimed in the specification of my earlier Patent No. 2,404,467.

According to my earlier invention the piston head is provided with a variable air cushion whereby the power or expansion stroke and the exhaust stroke are made longer than the effective suction stroke, thereby increasing the efficiency of the engine.

The present invention relates more particularly to the construction of an improved piston which obviates the necessity of boring the cylinder walls and presents many advantages which are noted hereafter.

A principal object of the invention is to provide a combined piston in which the power or expansion stroke and the exhaust stroke are made longer than the suction stroke.

A further object of the invention is to use the air in the crank case to cool the piston head and for this purpose means are provided to circulate the air against the piston head at every effective stroke which is done by the movement of the piston itself.

According to the invention there is provided a combined piston made up of an inner piston body adapted to reciprocate in a piston head and in which provision is made to rapidly pass air intermittently between the inner piston body and the piston head whereby the heat absorbed by the piston is rapidly removed during the movement of the combined piston in the cylinder so that the power stroke and the exhaust stroke are made longer than the suction stroke.

The combined piston is made up of an inner piston body adapted to reciprocate in a piston head in which the lower part of the piston head is cut away leaving two segmental openings occupied by corresponding segmental plates connected to the inner piston body so that a substantially cylindrical shape is imparted to the combined piston, and wherein the inner piston body is moved relative to the piston head against the action of resilient means during the working of the combined piston in the engine cylinder.

The piston head has on its outer periphery near its end several annular grooves in which the piston rings are mounted and the lower part of the piston head is cut away leaving two segmental wings which surround the inner piston body on two sides leaving a segmental gap on either side by which air can enter the space between the end of the inner piston body and the

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piston head, which air is admitted and driven out at each effective stroke of the piston.

The invention is more particularly described with reference to the accompanying drawings in which:

Fig. 1 is a part sectional elevation of the improved piston,

Fig. 2 is a part sectional plan of Fig. 1 viewed from the underside,

Fig. 3 is a similar sectional elevation as in Fig. 1 but showing the piston in the expanded position.

Fig. 4 is an elevation,

Figs. 5 and 6 are sections of details showing the method of retaining the gudgeon pin in position,

Figs. 7 and 8 are sectional views of the spindles attached to the underside of the hub receiving the gudgeon pin in its two positions, and

Figs. 9 to 16 are diagrammatic views showing the relative positions of the combined piston head in its various positions in the engine cylinder.

Referring to the drawings:

The combined piston is composed of an inner piston body 1 adapted to reciprocate in piston head 2. The outer end of the piston head 2 has several annular grooves 3 in which the piston rings (not shown) are mounted.

The piston head 2 is cut away on each side leaving two segmental wings 4. The outer surface 5 of these wings 4 are slightly cut away leaving only the lower ends 6 of the same external diameter as the piston head. This cutting away reduces friction with the cylinder wall. The shape of both the piston head and the inner piston body will vary to suit the configuration of the combustion chamber. It will be seen that the length of the piston head 2 is made slightly longer than the length of the inner body 1 for reasons hereinafter explained.

A slot 7 is provided on each of the wings 4 to allow limited movement of the gudgeon pin fitted across the piston body 1 through the hubs 8. This slot may be varied in length dependent on the length of the piston head 2 so that the relative amount of movement between the inner piston body and the piston head can be varied to suit different types of engine.

The head 9 of the inner piston body which is similar to the configuration of the main piston head and which may be flat is supported by two longitudinal plates 10 located along the piston body 1 and these two plates 10 carry outer seg-

mental plates 11 substantially corresponding to the wings 4 so that a substantial cylinndrical shape is imparted to the combined piston. These two plates 10 also carry the gudgeon pin hubs 8.

The outer surface of the segmental plates 11 have small countersunk holes 12 from which a series of grooves 13 are spread across the surface and lubricating oil is led from these holes 12 to the grooves 13 whereby the cylinder walls are kept well lubricated.

The ends of the gudgeon pin 14 which passes through the hubs 8 of the piston body extend into the slots 7 cut in the opposite wings 4 of the piston head 2 so that by the movement of the inner piston body the piston head is drawn to and fro in the cylinder of the engine.

A spring attachment such as 15 fitting into grooves 16 in the sides of the slots 7 may be used to keep the gudgeon pin 14 in its proper position as shown in Figs. 5 and 6.

When the inner piston body 1 is moved outwards relative to the piston head 2 the segmental plates 4 are also drawn back until the end of the gudgeon pin 14 reaches the bottom end of the slot 7.

In this position there is a gap 17 through which air can freely pass to the space between the two piston heads. When the inner piston body is moved in the reverse direction a part of this air is rapidly driven out and as this passage of air takes place during each effective stroke of the piston the piston is always kept cool. In line with gap 17 and at right angles thereto horizontal slots 17A are also provided in the piston head 2 to ensure an adequate flow of air in the combined piston.

The inner piston body may have one or more piston rings 18 on its periphery.

The lower sides of the hubs 8 are adapted to carry spindles 19 the free ends of which pass through buckles 20 secured to the ends of the wings 4 and round each spindle is a spiral spring 21 which tends to push the hubs 8 and the inner piston body towards the piston head in the position shown in Fig. 1. These springs 21 are compressed when the body of the piston is driven back in the position occupied by the piston body shown in Fig. 3. This resilient connection between the piston body and the piston head also serves to avoid rattle and noise in working.

The strength of the springs is important as the strength must be sufficient to balance the friction between the piston head and the cylinder wall and the deformation of the springs will directly affect the length of the effective suction stroke. As the springs are under compression the shorter the length of the springs the shorter will be the effective suction stroke and the effective suction stroke will vary according to this friction. Therefore an engine running at high speed, when the friction is greater, will have its effective suction stroke shorter than when running at a lower speed. It will be obvious that when the engine is running at high speed the side apertures or gaps 17, which allow air to be admitted and expelled between the two piston heads will be bigger so that a better cooling effect is obtained.

A small hole or slot 17B is provided in the head of the inner piston head 9 to allow the air trapped in the space between the respective heads to escape from said space. This hole 17B also allows air to be sucked into this space between the pistons when the inner piston body is drawn downwards.

Referring more particularly to the diagrams shown in Figs. 9 to 16 where the operation of the piston is shown:

Figs. 9 and 10, suction stroke.—At the beginning of the suction stroke the piston head and piston body are close together, Fig. 9. When the piston body is drawn back by the connecting rod, the piston head remains stationary until the gudgeon pin engages the end of the slot 7 after which both the piston head and the piston are drawn back, Fig. 10.

Figs. 11 and 12, compression stroke.—When the crank returns the piston body is first moved towards the piston head, Fig. 11, and drives out the air between the piston head and the piston body and the piston body and head remain close together right up to the end of the stroke, Fig. 12.

Figs. 13 and 14, power stroke.—When the explosion occurs both the piston head and the piston body are pushed back, Fig. 13 and Fig. 14, and making comparison with it will be seen that the power or expansion stroke is greater than the suction stroke.

Figs. 15 and 16, exhaust stroke.—As in the last position both the piston head and the piston body are close together, Figs. 15 and 16, it will be apparent that the exhaust stroke is equal to the power stroke and is therefore also greater than the suction stroke.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:

1. A combined piston for an engine cylinder comprising a piston head having the lower part thereof cut away to form two segmental openings, an inner piston body adapted to reciprocate in said piston head and having segmental plates connected thereto and corresponding to the segmental openings, said piston head and segmental plates forming a substantially cylindrical shape to the combined piston, and resilient means between the inner piston body and the piston head thereby permitting movement of the piston head and piston body against the action of the resilient means during the working of the combined piston in the engine cylinder.

2. A combined piston comprising a piston head having segmental openings at the sides, an inner piston body adapted to reciprocate in the piston head and forming a space between the body and head during relative movements thereof so that air may rapidly pass into and be removed from the space between the body and head, said inner piston body being provided with hubs connected thereto and the piston head having slots in the sides thereof, and a gudgeon pin mounted in the hubs with the ends extending into the slots whereby movement of the inner piston body relative to the piston head is limited to the length of the said slots which are determined by the relative lengths of the piston head and the inner piston body.

3. A combined piston comprising a piston head having two segmental wings in the lower part, and an inner piston body adapted to reciprocate in the piston head, the segmental wings surrounding the piston body on two sides to form a gap on either side of the piston whereby air can enter the space between the end of the inner piston body and the piston head.

4. A combined piston according to claim 3, in which outer segmental plates and two longitudinal plates are provided, the two longitudinal

plates being in the inner piston body and the outer segmental plates being supported by the longitudinal plates to substantially fill the gap between the segmental wings so that a substantially cylindrical shape is imparted to the combined piston.

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