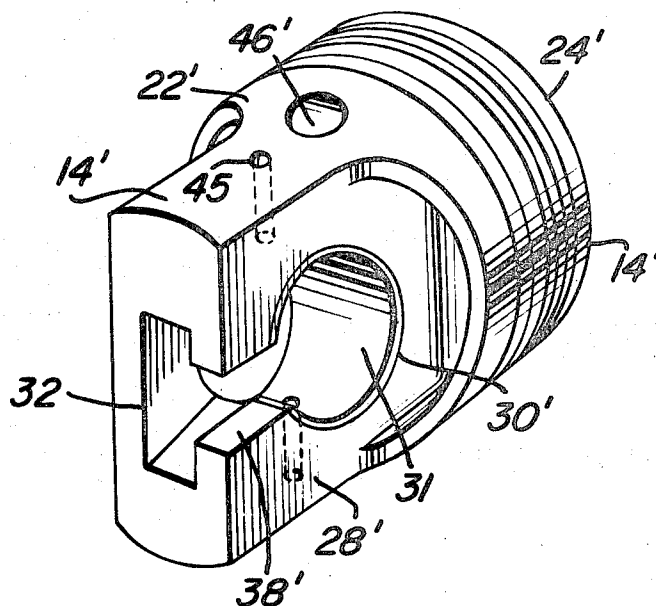
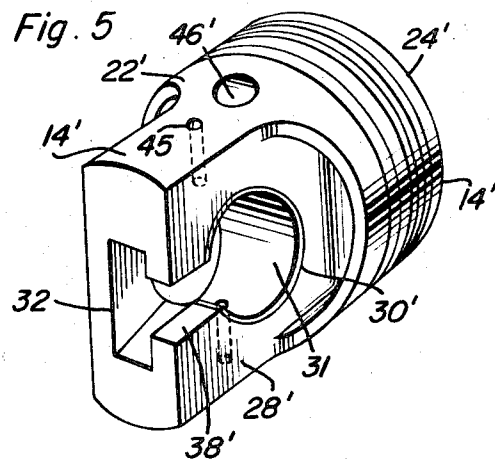
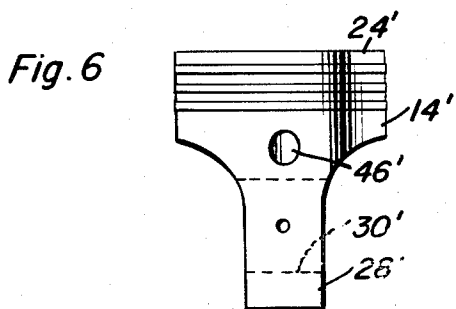
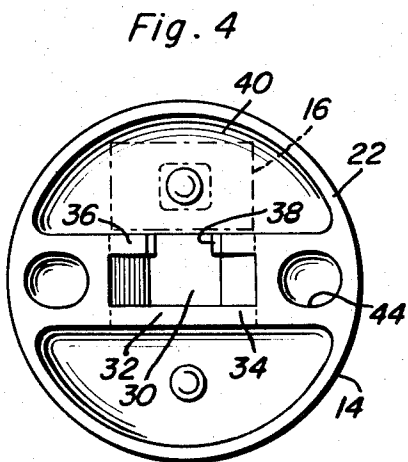
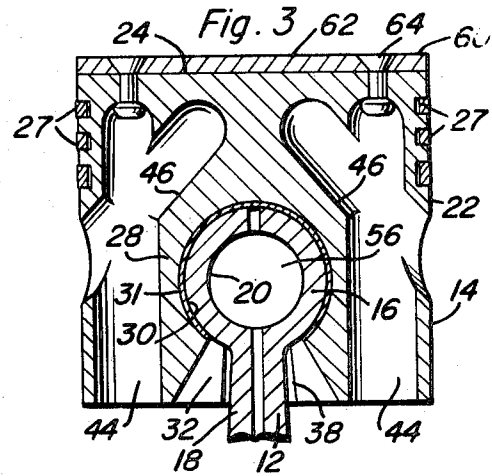
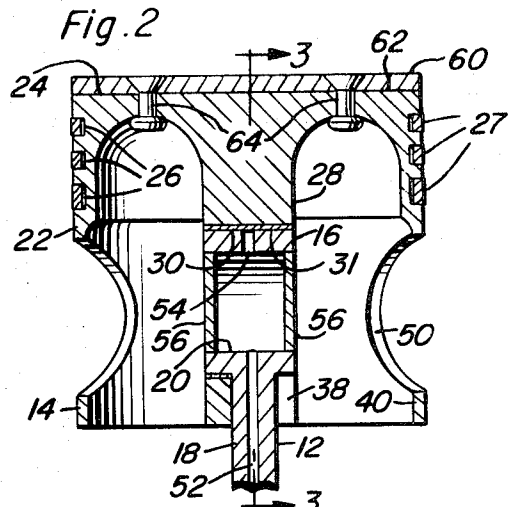
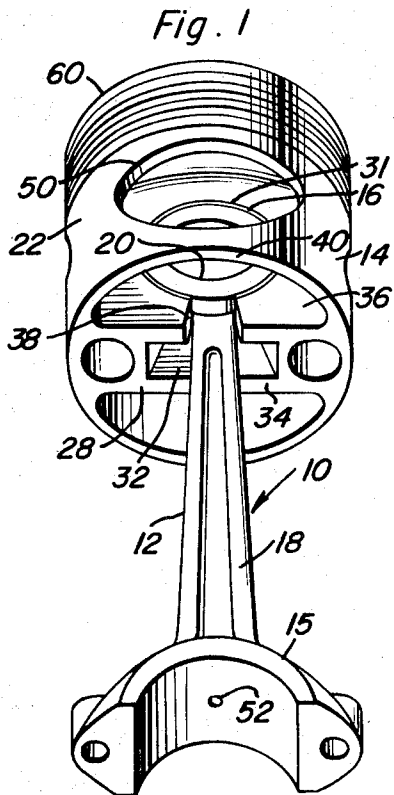






PINLESS PISTON ASSEMBLY

The pinless piston and related connecting rod assembly of the instant invention relates a piston and connecting rod assembly wherein the wrist pin and wrist pin retainers normally utilized in conventional piston and rod assemblies are eliminated.

The assembly includes a piston having a central diametric web provided with a transverse bore and a connecting rod having a piston end including opposite side axially aligned stub shaft portions for journaling in the opposite ends of the web bore and the central area of the web is provided with a slot opening radially into the web bore. The slot divides the web into a pair of opposite side walls between which the slot is formed and one of the side walls also has a slot therein opening both into the web bore and the first mentioned slot whereby the piston end of the connecting rod may have its stub axle or shaft portions axially aligned with the web transverse bore and be disposed on the slotted side of the web for lateral advancement of the connecting rod through the web side wall slot and into operative position with the stub shaft portions journaled in the opposite ends of the transverse web bore and the adjacent end of the connecting rod oscillatable through the first mentioned central slot formed in the web.

The instant invention resides primarily in the manner in which the piston and rod are fabricated to establish the desired connection between the piston and the rod and therefore the piston itself may assume many different configurations. The piston may be domed, full-skirted, skirtless, stepped for use in ported engines, skirted on only one side for use in ported engines or have other special physical characteristics as desired as long as the basic piston to rod connecting structure is retained.

The main object of this invention is to provide a pinless piston and rod assembly of greatly reduced mass.

Another object of this invention is to provide a piston and connecting rod assembly devoid of a wrist pin and its attendant retainers.

A still further object of this invention is to provide a piston and connecting rod assembly better adapted for use in conjunction with a reciprocating piston combustion engine producing a relatively high torque at low engine speeds.

A further important object of this invention is to provide a piston and connecting rod assembly having physical properties enabling a large portion of conventional piston skirt area to be modified or eliminated while still retaining stability and strength of the piston.

Another object of this invention is to provide a pinless piston assembly including structural features which will inherently result in greater torque being developed by the associated engine.

A further object of this invention is to provide an assembly in accordance with the preceding objects and constructed in a manner enabling faster acceleration and higher engine operating speeds at least partly because of the reduction in weight and thus the reciprocating mass represented by the assembly.

Another important object of this invention is to provide a pinless piston assembly wherein a piston rod and associated piston are supported from each other for relative oscillation by means of simplified construction eliminating the necessity for separate wrist pins and pin retainers.

A further object of this invention is to provide a rod and piston assembly including structure enabling the utilization of larger bearing surfaces between the piston and its associated rod resulting in increased stability and bearing life so as to support decreased fuel consumption and thus less air pollution and greater strength while maintaining the overall weight of the piston and rod assembly at a minimum.

Another object of this invention is to provide a connecting rod-to-piston connection of reduced size and weight and utilizing a connecting rod which may be of less mass at the piston end thereof.

Yet another object of this invention is to provide a piston-to-connecting rod connection that does not utilize a conventional piston pin and yet which provides means for maintaining proper alignment of the piston in the associated cylinder bore relative to the associated crankshaft so that the proper bearing surfaces of the piston are kept in proper sliding relationship with the associated cylinder wall.

Another object of this invention is to provide a piston-to-connecting rod connection constructed in a manner whereby the tendency for the connecting rod or piston, adjacent the connection between the two, will have less tendency to break, particularly at high engine speeds.

A further object of this invention is to provide a connecting rod-to-piston connection which may also be utilized effectively in high efficiency pumps of the reciprocating piston type.

A still further object of this invention is to provide a connecting rod-to-piston connection of the pinless type embodying an integral central diametric web in the piston immediately inwardly of the head thereof whereby the strength of the associated piston is increased.

A further important object of this invention is to provide a piston-to-connecting rod connection in accordance with the immediately preceding object embodying low mass of materials resulting in an engine producing less vibration and exhaust pollutants while idling due to less fuel consumption.

Yet another important object of this invention is to provide a connecting rod-to-piston connection that may be advantageously utilized in aircraft engines as well as automotive engines with the result that aircraft engines may develop greater power and enjoy all of the benefits dependent upon greater power such as increased safety factor during take-offs, greater cruising speeds and higher surface ceilings.

A further object of this invention is to provide a connecting rod-to-piston connection which, because of its reduced mass, will support greater connecting rod and crankshaft bearing life and therefore may better withstand supercharging of the associated engine.

Still another object of this invention is to provide a connecting rod-to-piston connection including structural features affording for forced lubrication of the bearing surfaces between the connecting rod and the piston and also forced lubrication of the cylinder walls and outer surfaces of the pistons of the associated engine.

Another important object of this invention is to provide a piston head of modified construction which will withstand greater combustion temperatures and therefore resist pitting or burning as a result of pre-ignition.

Yet another object of this invention is to provide a novel connecting rod-to-piston connection which may

be adapted to existing pistons by removal of existing piston heads and reattachment of those removed heads to piston lower portions constructed in accordance with the present invention.

Another very important object of this invention is to provide a connecting rod-to-piston connection embodying structural features enabling an associated piston to be constructed with a removable head portion secured to the remainder of the piston by means of a threaded connection.

A further object of this invention is to provide a connecting rod-to-piston connection which will enable the associated pistons to be provided with skirts abbreviated in such a manner to allow the pistons to approach the associated crankshaft more closely and therefore promote a reduction in overall size of the associated engine.

A further important object of this invention is to provide a piston construction with an extremely reduced width skirt portion below the connection between the piston and the associated piston rod whereby not only the piston rod but also the lower end of the piston may pass between the counterweights of the associated crankshaft.

Another important object of this invention is to provide a piston and rod assembly of the pinless type and including a large single central bearing surface between the piston and the associated piston end of the rod in order to provide a greater stability by reducing the tendency of the piston to slap.

Still another important object of this invention is to provide a piston and rod assembly utilizing an integral diametric web portion of the piston to define journal surfaces for journaling a transverse cylindrical end on the piston end of the rod whereby the overall strength of the piston and rod assembly is increased.

A final object of this invention is to be specifically enumerated herein is to provide a piston and connecting rod assembly which will conform to conventional forms of manufacture, be of simple construction and easy to assemble so as to provide a device that will be economically feasible, long lasting and relatively trouble free.

These together with other objects and advantages which will become subsequently apparent reside in the details of construction and operation as more fully hereinafter described and claimed, reference being had to the accompanying drawings forming a part hereof, wherein like numerals refer to like parts throughout, and in which:

FIG. 1 is a view of the piston and connecting rod assembly of the instant invention in assembled condition;

FIG. 2 is a fragmentary enlarged sectional view taken substantially upon a diameter of the piston coinciding with its axis of oscillation relative to the connecting rod;

FIG. 3 is a fragmentary sectional view taken substantially upon a plane indicated by the section line 3—3 of FIG. 2;

FIG. 4 is a bottom plan view of the piston with the outline of the piston end of the connecting rod illustrated in phantom lines as positioned immediately prior to assembly of the connecting rod with the piston;

FIG. 5 is a perspective view of a modified form of piston constructed in accordance with the present invention; and

FIG. 6 is a side elevational view of the piston illustrated in FIG. 5.

Referring now more specifically to the drawings the numeral 10 generally designates the piston and connecting rod assembly of the instant invention. The assembly 10 includes a piston rod 12 and a piston 14. The rod 12 includes a substantially conventional crankshaft end 15 and an opposite piston end 16.

The piston ends of conventional connecting rods are provided with transverse bores which are sleeved to a specific diameter for the reception of a wrist pin there-through with the opposite ends of the wrist pin projecting outwardly of the ends of the transverse bore and received in diametrically opposite radial piston pin bores formed in an associated piston.

However, the piston end 16 of the rod 12 is somewhat different in that it defines a cylindrical enlargement on the corresponding end of the shank 18 of the rod 12. The cylindrical enlargement is disposed with its center axis normal to the center axis of the shank 18 and the opposite ends of the enlargement 16 project endwise outwardly from the corresponding sides of the shank 18. If it is desired, for lightness, the enlargement or enlarged end 16 may be provided with a concentric bore such as the bore 20 illustrated in FIGS. 1 through 3. However, the bore 20 performs functions other than lightening the enlarged end 16 such as aiding in heat dissipation.

The piston 14 is somewhat conventional in design in that it comprises a cylindrical body 22 defining a closed piston head end 24 at one end. The piston head end includes a plurality of circumferential ring grooves 26 in which any suitable piston rings 27 may be disposed and the piston 14 further includes a diametric web 28 having a transverse bore 30 formed therethrough including a thin coating 31 of any suitable bearing material. Of course, if the web 28 is of a material that will serve as a bearing material itself, then no additional bearing 31 is needed. The web 28 extends between diametrically opposite side walls of the body 22 and projects from the head end 24 to the open end of the body 22.

The end of the web 28 remote from the head end 24 is provided with a central longitudinal slot 32 which opens outwardly through the web 28 at the open end of the piston and generally radially inwardly of the bore 30 at the other end of the slot 32.

By the formation of the slot 32 in the web 28, the web 28 defines a pair of opposite side walls 34 and 36 between which the slot 32 is formed and the side wall 36 has an entrance slot 38 formed therethrough communicating not only with the slot 32 but also with the bore 30. The width of the slot 38 is slightly greater than the width of the shank 18 measured in a direction normal to the center axis of the bore 20. In addition, the external diameter of the cylindrical enlargement 16 is only slightly less than the internal diameter of the bore 30 and accordingly, with sufficient space being provided between the side wall 36 and the opposing skirt wall 40 of the piston 14, the enlargement 16 may be positioned between the side wall 36 and the skirt wall 40 with the cylindrical enlargement 16 aligned with the bore 30 and the shank 18 aligned with the slot 38 in order to enable the rod 12 to be assembled to the piston 14 by laterally advancing the rod 12 through the slot 38 to the position illustrated in FIGS. 1 and 2 of the drawings, the thickness of the end of the shank 18 adjacent the enlargement 16 being slightly less than the width of the slot 32 in order to provide at least minimum clearance

between the opposite sides of the shank 18 and the confronting surfaces of the side walls 34 and 36.

In this manner, the rod 12 is assembled to the piston 14 for relative oscillation therebetween.

In order to lighten the piston 14, the web 28 may be provided with upstanding bores 44, see FIG. 3, which taper upwardly toward their closed ends. In addition, the opposite sides of the body 22 are provided with inclined upwardly convergent bores 46. However, these bores 44 and 46 may be omitted for any good reason or additional voids may be provided, if desired.

With attention now invited more specifically to FIGS. 5 and 6 of the drawings, there will be seen a modified form of piston which may be utilized in conjunction with the rod 12 and which is generally designated by the reference numeral 14'. The piston 14' is very similar to the piston 14 and accordingly components of the piston 14' corresponding to similar components of the piston 14 have been designated by corresponding prime reference numerals.

The only difference between the piston 14' and the piston 14 is that the skirt walls of the piston 14' disposed below the level of the bore 30' and on opposite sides of the web 28' have been eliminated. Otherwise, the piston 14' is identical to the piston 14, except for the omission of bores corresponding to the bores 44 and the inclusion of bores 45 to be hereinafter more fully set forth.

If it is desired, in order to further decrease the weight of the pistons 14 and 14', the various skirt portions thereof may taper downwardly away from the closed ends of the pistons. Further, it may be seen from FIGS. 1 and 2 of the drawings that the piston 14 may have the skirt wall portions thereof opposing the web 28 provided with large oval openings 50 in order to further decrease the weight of the piston 14.

The pistons 14 and 14' are constructed so as to dissipate heat evenly throughout enabling closer running clearances and reduction of oil consumption and blow-by. Further, reinforcing vanes or webs can be provided beneath the piston head anchored to the latter and the adjacent side walls of the piston body.

With attention invited now more specifically to FIG. 2 of the drawings it may be seen that the rod 12 has a longitudinal bore 52 formed therethrough which opens through the crankshaft end 15 and also into the bore 20. In addition, the enlarged end 16 is also provided with a radial bore 54 diametrically opposite the adjacent end of the bore 52 and the opposite ends of the bore 20 are closed by means of end plates 56 secured in position in any convenient manner. Thus, lubricating oil may be ducted through the bore 52 from the associated crankshaft (not shown) and into the bore 20 between the end walls or enclosures 56 and thereafter through the radial bore 54 to the inner face between the outer surfaces the cylindrical enlargement 16 and the inner surfaces of the coating 31 of bearing material.

With attention now invited more specifically to FIGS. 2 and 3 it may be seen that the upper end wall of the piston 14 is provided with a fire cap 60 of heat resistant metal of any suitable type. Fire cap 60 is secured to the upper end face 62 of the piston 14 by means of suitable fasteners 64 secured through the fire cap 60 and those portions of the head of the piston 14 defining the upper extremities of the bores 44.

Also, with attention invited to FIG. 5 of the drawings, it may be seen that the bores 44 may be omitted and

that the transverse bores 45 which open through the piston skirt walls at their outer ends and open through the bearing material 31 at their inner ends may serve to pressure lubricate the outer surfaces of the piston skirt and the associated cylinder bore.

Also, with attention now invited to FIG. 2, the end walls 56 could be removed or omitted and have their function accomplished by a substantially solid piston end of the rod with the bore 52 extending on through such a solid end and the bore 54 forming a part of the bore 52. In this construction, the piston end of the rod may be lightened by forming aligned opposite side transverse blind bores in the piston end 16 terminating just short of the midportion of the piston end 16 with only enough material remaining to provide the desired strength and to enable the extended bore 52 to extend therethrough.

Further, it is to be noted that the pistons corresponding to the pistons 14 could be constructed with the webs 28 thereof separate from the remainder of the pistons and removably secured thereto in any convenient manner such as by rivets or other fasteners and that in such cases the webs 28 would be provided with transverse mounting flanges secured to the underside of the associated piston heads by such suitable fasteners which may also be secured through the heat resistant fire cap 60. Further, such removable webs could be threadedly engaged with the associated piston heads.

It is again pointed out that the bearing material 31 may or may not be used as desired. Further, the end plates 56 may be moved closer together, if desired, to reduce the volume of the space disposed therebetween. Further, any suitable means may be utilized to secure the plates 56 in place. Also, if the plates 56 removed and the entire bore 20 was filled with a removable plug, such a removable plug could be provided with a diametric bore communicating the bores 52 and 54.

The foregoing is considered as illustrative only of the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly, all suitable modifications and equivalents may be resorted to, falling within the scope of the invention.

What is claimed as new is as follows:

1. A hollow piston assembly having an integral closed head end and an open skirt end, a diametric connecting rod mounting web formed integrally with said integral head and skirt ends and extending across the interior of said piston assembly and provided with a transverse cylindrical bore opening through the opposite sides of the web for providing the sole support for a piston and of a connecting rod, said web having a central slot formed therein opening into said transverse bore at one end and outwardly of the web axially of the skirt end of the piston, said slot being formed in the web centrally intermediate its opposite sides and dividing the adjacent portions of the web into opposite side walls between which said slot is defined and through which said opposite ends of said bore open, one of said side walls including an access slot formed therethrough opening into the corresponding end of said bore at one end through the portion of the web facing outwardly of the skirt end of the piston at its other end, said access slot opening into the first mentioned slot throughout its entire length, said access slot being adapted to pass the

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piston end of a connecting rod laterally therethrough.

2. The combination of claim 1 including a piston connecting rod having a piston end and a crankshaft end, said piston end of said connecting rod including a cylindrical terminal end projecting outwardly from opposite sides of said rod and whose center axis is disposed normal to the center line of said connecting rod, said piston end of said connecting rod being positionable alongside the outer surface of said one side wall with said terminal end aligned with said bore and the end of said connecting rod adjacent said terminal end being laterally receivable through said access slot, the outer diameter of said terminal end being slightly smaller than the diameter of the transverse bore.

3. The combination of claim 2 wherein the ends of said web adjacent the skirt portions of said piston between which said web extends and disposed on opposite sides of said central slot being provided with blind bores generally paralleling the center line of said piston and terminating in the head end of the latter adjacent the terminal end thereof.

4. The combination of claim 3 wherein the opposite sides of said piston between which said web extends are provided with blind bores converging toward each other and inclined toward the head end of said piston, said inclined bores being disposed in substantially the same plane as the first mentioned pair of bores.

5. The combination of claim 1 wherein the walls of the skirt portion of said piston on opposite sides of said web taper in thickness away from the head of said piston.

6. The combination of claim 1 wherein the first men-

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tioned slot opening radially into said transverse bore is generally truncated cone shaped in side elevation with its minor dimension end opening into said transverse bore.

7. The combination of claim 6 including a piston rod having a piston end and a crankshaft end, said piston end of said connecting rod including an enlarged cylindrical terminal end projecting outwardly from opposite sides of said rod and whose center axis is disposed normal to the center line of said connecting rod, said piston end of said connecting rod being positionable alongside the outer surface of said one side wall with said terminal end aligned with said bore and the end of said connecting rod adjacent said terminal end being laterally receivable through said access slot, the outer diameter of said terminal end being slightly smaller than the diameter of said transverse bore.

8. The combination of claim 7 wherein the ends of said web adjacent the skirt portions of said piston between which said web extends and disposed on opposite sides of said central slot being provided with blind bores generally paralleling the center line of said piston and terminating in the head end of the latter adjacent the terminal end thereof.

9. The combination of claim 8 wherein the opposite sides of said piston between which said web extends are provided with blind bores converging toward each other and inclined toward the head end of said piston, said inclined bores being disposed in substantially the same plane as the first mentioned pair of bores.

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