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Clary et al.

[11] **3,805,677**

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[54] **TWO-PIECE OIL-COOLED PISTON WITH THERMAL EXPANSION CONTROL**

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[52] **U.S. Cl.** **92/186,** 92/216, 92/219, 92/228

[51] **Int. Cl.** **F01p 3/10,** F16j 1/00

[58] **Field of Search** 92/190, 215, 216, 219, 92/225, 228, 186, 41.35

[56] **References Cited**

UNITED STATES PATENTS

1,548,329	8/1925	Nelson	92/225 X
1,745,860	2/1930	Noble	92/190 X
1,929,831	10/1933	Teetor	92/190
2,110,346	3/1938	Teetor	92/228
2,180,521	11/1939	Harley	92/228
2,240,967	5/1941	Venner et al.	92/228

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Attorney, Agent, or Firm—Hill, Sherman, Meroni, Gross & Simpson

[57] **ABSTRACT**

A multi-piece piston assembly including a skirt defining portion and a head defining portion which interfit to provide wrist pin bores in registry for receiving a wrist pin, the skirt defining and head defining portions being composed of a metal having good thermal conductivity such as an aluminum alloy, together with a bridge member which is anchored in the skirt defining portion in the region of the thrust faces to provide thermal expansion control at the top of the skirt portion and to provide additional mechanical strength.

3 Claims, 2 Drawing Figures

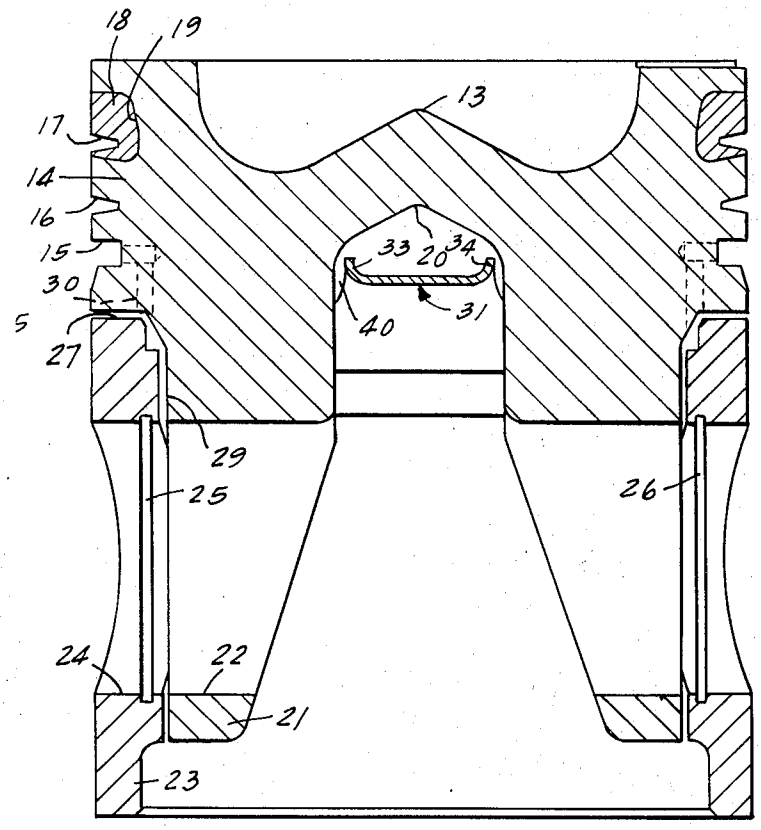

Fig. 2

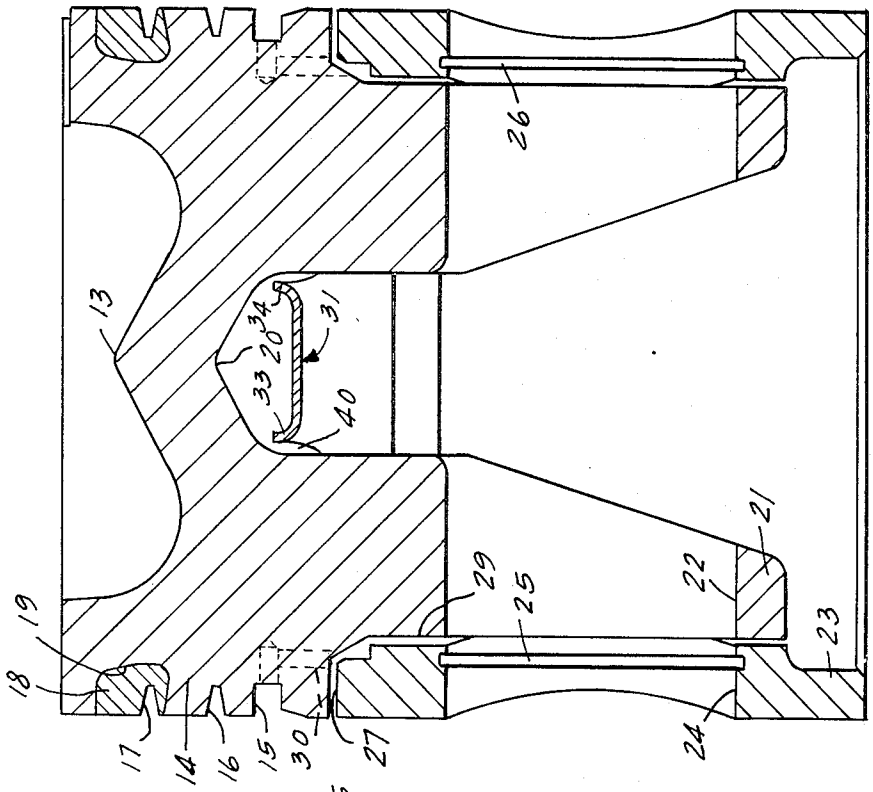
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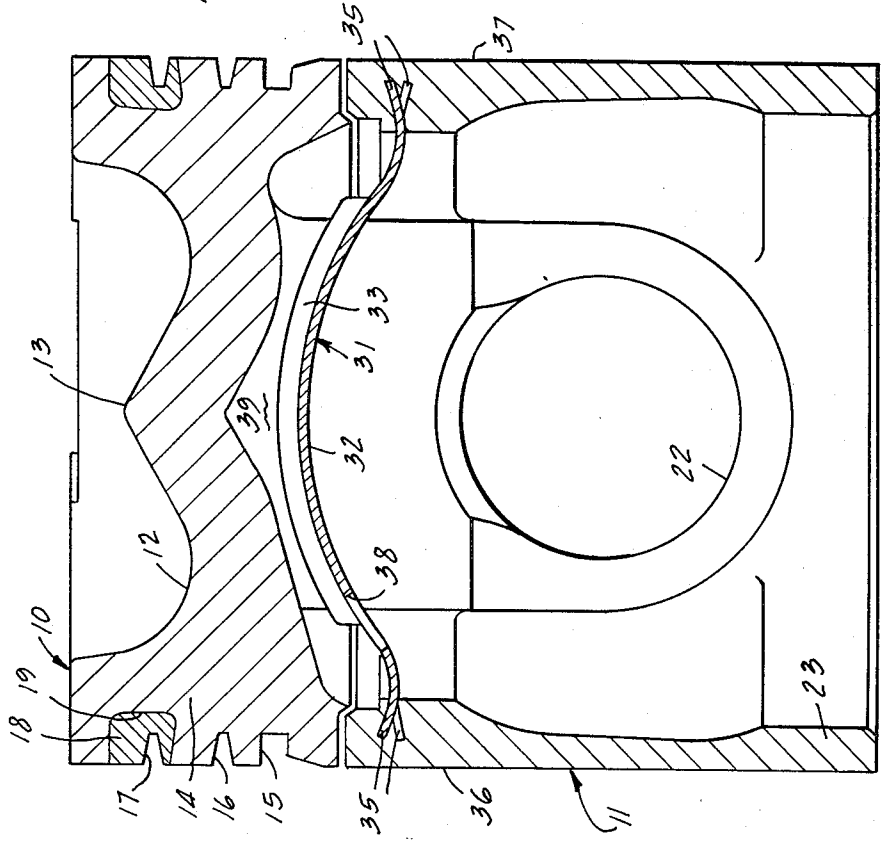
Fig. 1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TWO-PIECE OIL-COOLED PISTON WITH THERMAL EXPANSION CONTROL

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention is in the field of multi-piece pistons which are retained in proper working relation with respect to each other by means of the wrist pin and the cylinder bore, the skirt portion of the piston being provided with a bridge member composed of a metal having a lower rate of thermal expansion than the metal of the skirt portion.

2. Description of the Prior Art

There have been some two-piece piston designs utilizing mating skirt portions and head portions which have certain advantages over one-piece pistons. Each element, for example, is free to rotate about the wrist pin to the extent that the clearance between the cylinder bore and the outside diameters of each of the elements will permit. This feature significantly reduces the misalignment of the ring belt section of the piston head which is encountered with a conventional one-piece piston when side thrust loads are imposed by the angularity of the connecting rod. In two-piece piston constructions, the piston rings are permitted to maintain a more effective seal and thereby reduce blow-by and oil consumption. Furthermore, the clearance between the skirt section of the two-piece piston and the cylinder bore can be less than that which is required with a conventional one-piece piston since heat is not transmitted directly from the piston crown to the skirt to cause gross thermal expansion of the piston skirt.

The difficulty with two-piece piston structures in the past, however, has been a lack of strength which is required to withstand the thermal and mechanical loads encountered in high output engines. Furthermore, such pistons normally do not provide any adequate means for cooling the crown in the ring belt areas. The provision of an improved two-piece piston which overcomes the difficulties of the prior art structures is the principal object of the present invention.

SUMMARY OF THE INVENTION

The present invention relates to a piston assembly composed of a skirt defining portion which has opposed thrust faces and a separate head defining portion including a crown, a ring belt and grooves therein for receiving piston rings, the skirt defining portion and the head defining portion being disposed in interfitting relationship to define a wrist pin bore extending through both the skirt defining and the head defining portions. A bridge or strut member has its ends anchored in the opposed thrust faces and has a medial portion in confronting relation to the under side of the crown, the bridge member having a coefficient of thermal expansion less than that of the skirt defining portion. The marginal edges of the medial portion of the bridge member are spaced from the interior of the crown portion, and one or more apertures are provided in the bridge member to permit oil to come into contact with the underside of the crown portion during operation of the piston, and to flow back around the bridge member during further movement of the piston.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a vertical cross sectional view of an improved piston according to the present invention, the view being taken looking through the wrist pin bore; and

FIG. 2 is a cross sectional view taken in a plane 90° from the view of FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In the improved piston assembly of the present invention there are two main piston defining elements, these being a head defining portion generally indicated at reference numeral **10** and a skirt defining portion generally indicated at reference numeral **11**. Both the head defining portion **10** and the skirt defining portion **11** are preferably composed of a lightweight, heat transmitting metal such as an aluminum alloy. The head defining portion **10** includes a recessed crown portion **12** having a conical portion **13** centrally thereof as is common with some types of heavy duty pistons. The head defining portion **10** includes a ring belt area **14** into which piston ring receiving grooves **15** and **16** are provided in the usual manner. The uppermost piston ring may be received in a groove **17** provided in a ring groove reinforcement **18** composed of cast iron or the like. As explained in Clary U.S. Pat. No. 3,430,969 such piston ring groove reinforcements may be received within a circumferential groove **19** in tight mechanical engagement, with the junction between the reinforcement **18** and the groove being substantially devoid of metallurgical bonding. The reinforcement ring **18** may also include non-planar opposed faces including raised portions thereon and having an area to weight ratio of at least 60 square inches of ring in contact with the piston per pound of ring, thereby reducing the temperature differential between the reinforcement **18** and the piston in service.

The crown portion of the piston head has an upwardly bowed underside indicated at reference numeral **20** in the drawings. It also has a depending portion **21** through which a partial wrist pin bore **22** is formed.

The skirt forming portion **11** includes a skirt **23** and a wrist pin bore **24** which is coaxial with the wrist bore **22** of the head forming portion when the head forming portion and the wrist forming portion are placed in interfitting engagement as shown in FIGS. **1** and **2**. Grooves **25** and **26** are provided in the wrist pin bore **24** for receiving the locking rings (not shown) of the wrist pin assembly itself.

A circumferential groove **27** is provided between the head forming portion **10** and the skirt forming portion **11**, together with a space **29** to accommodate relative movement between the two parts. A port **30** is provided to provide escape for oil wiped off the cylinder wall by the piston rings, the oil finding its way to the engine oil sump through the clearance provided between the two parts of the piston.

In accordance with the present invention, there is provided a bridge or strut member **31** having an upwardly bowed medial portion **32** along which are formed a pair of upwardly extending flange portions **33** and **34** as best seen in FIG. **2**. The bridge member **31** is composed of steel or other material having a coefficient of thermal expansion lower than the aluminum alloy of which the head and skirt forming portions are formed. The extreme ends of the bridge member **31** may be provided with fingers or tabs **35** to facilitate anchoring the ends of the bridge member **31** in the metal

of the skirt forming portion **11**, in the vicinity of the thrust faces **36** and **37**. Preferably, the fingers **35** are held in position by having the front of the skirt cast around them. The bridge member **31** is also provided with one or more apertures **38** so that upon each downstroke of the piston, oil enters a cooling chamber **39** provided between the top of the bridge member **31** and the underside **20** of the crown portion of the piston. On each downstroke of the piston, oil enters the chamber **39** and is thrown against the underside **20** of the piston head. On each upstroke of the piston, the oil, which has absorbed heat from the piston crown escapes through the spaces **40** existing between the upturned medial flange portions **33** and **34** and the confronting side wall of the piston head.

The bridge member **31** with its lower rate of thermal expansion than the aluminum piston body restricts the amount of thermal expansion of the aluminum piston skirt. The reduced skirt clearance thus provided reduces the noise generated when the top of the skirt contacts alternate sides of the cylinder bore when the side thrust loads reverse direction. The reduced skirt clearance also reduces the rate of cavitation erosion which occurs on the outer diameter of wet cylinder liners of the type used in heavy duty engines.

The bridge member **31** also provides additional strength at the top of the skirt to enable it to carry the side thrust loads encountered in mounted engines without excessive deflection or failure.

It will be seen that with the piston of the present invention, the head forming portion and the skirt forming portion are retained in their proper working positions with respect to each other by the wrist pin and the cylinder bore, but each element is free to rotate about the wrist pin to the extent permitted by the clearance between the cylinder bore and the outside diameters of each of the elements. This significantly reduces the axial misalignment of the ring belt section that is encountered with a conventional one-piece piston and

permits the piston rings to maintain a more effective seal and thereby reduce blow-by and oil consumption. The presence of the bridge member further provides the strength required to resist the side thrust loads and provides thermal expansion control at the top of the skirt while also providing additional strength.

It should be evident that various modifications can be made to the described embodiments without departing from the scope of the present invention.

We claim as our invention:

1. A two-piece metal piston assembly comprising a skirt defining portion having opposed thrust faces thereon, a separate head defining portion having a crown and depending wrist pin bosses and having grooves for receiving piston rings, said skirt defining portion and said head defining portion being aligned to provide a wrist pin bore extending through said portions, and a metal bridge member having its ends anchored in said opposed thrust faces, said bridge member having a coefficient of thermal expansion less than that of said skirt defining portion, said bridge member having a large surface area and having oil-retaining upturned marginal edges facing said crown and being in closely spaced relation to the crown and to the inner, opposing faces of the wrist pin bosses, the space between the bridge member and the underside of the crown defining a cooling chamber, said bridge member having an aperture therein permitting entry of oil into said cooling chamber upon the downward stroke of said piston.

2. The two-piece metal piston assembly of claim **1** in which said skirt defining portion is composed of an aluminum alloy and said bridge member is composed of steel.

3. The two-piece metal piston assembly of claim **1** in which the ends of said bridge member have finger portions embedded in the metal of said thrust faces.

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