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 [31] **M 73,169**

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[54] **LIGHT METAL PISTON WITH SKIRT DIAMETER**
CONTROLLING INSERTS AND CASTING
THEREOF
4 Claims, 16 Drawing Figs.

[52] U.S. Cl..... **92/228,**
249/95, 164/112
 [51] Int. Cl..... **F16j 1/04**
 [50] Field of Search..... **92/228, 229**

ABSTRACT: An aluminum piston has steel, diameter-controlling, inserts or struts embedded in the piston pin bosses and in the skirts. The inserts at the piston head end have radial members in the form of flanges or tongues extending to the outer surface of the piston, and at the other end have tabs extending below the skirts. The pistons are cast in molds supporting the inserts by the flange or tongue members and the tabs with the members at the mold parting plane normal to the main axis of the piston.

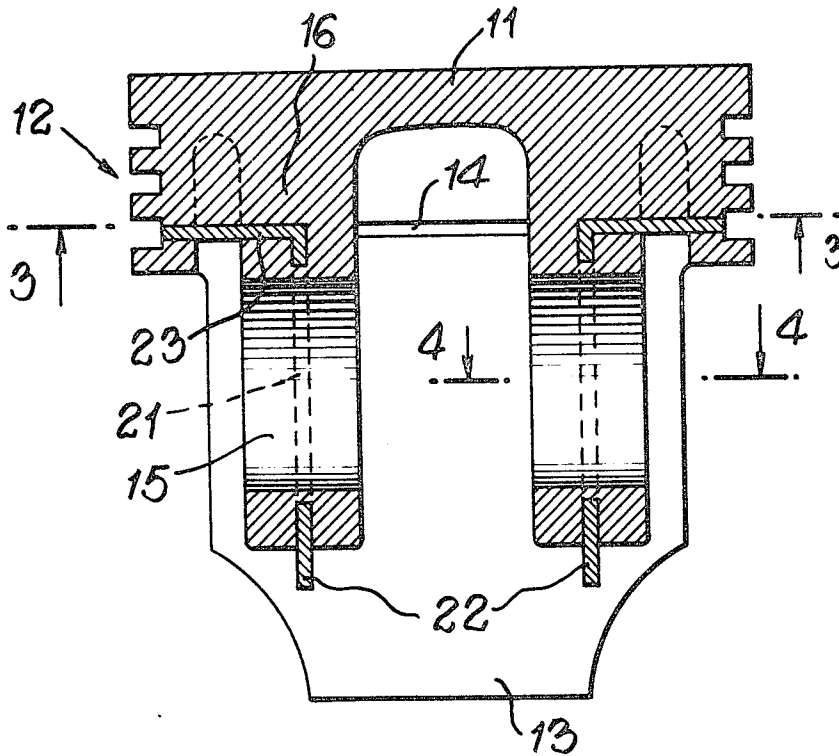


Fig. 1.

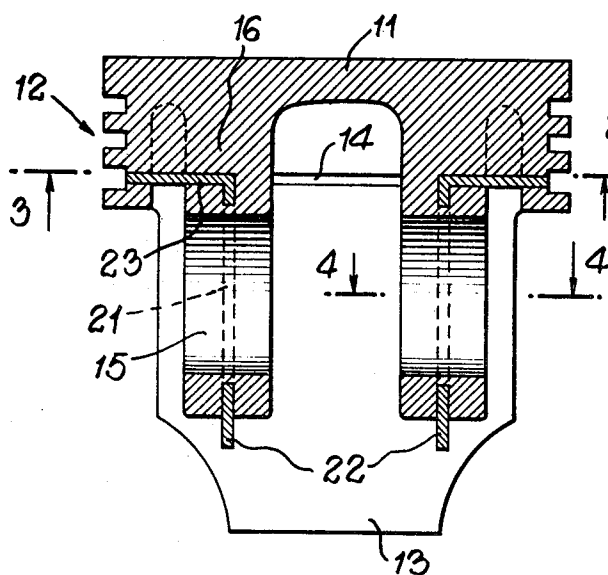


Fig. 2.

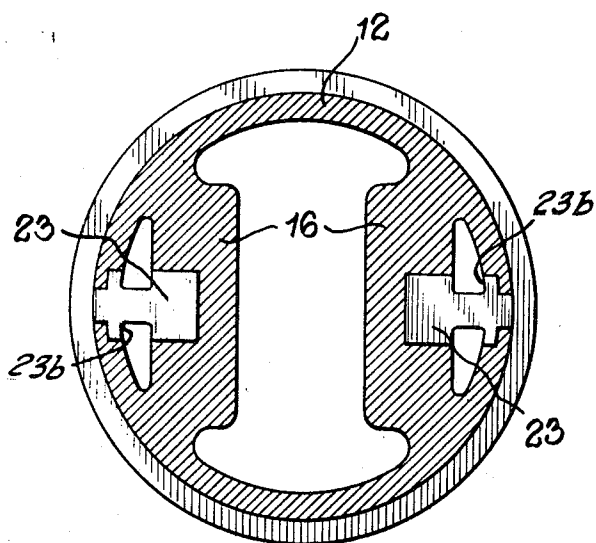
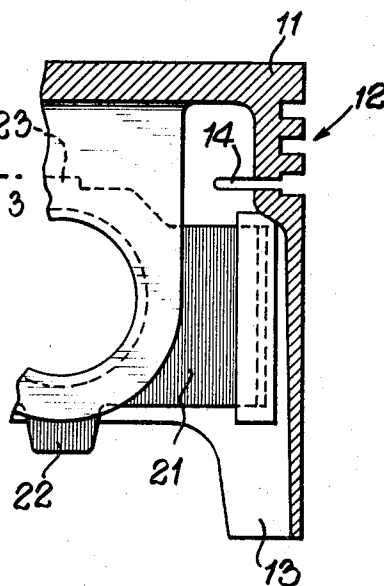


Fig. 3.

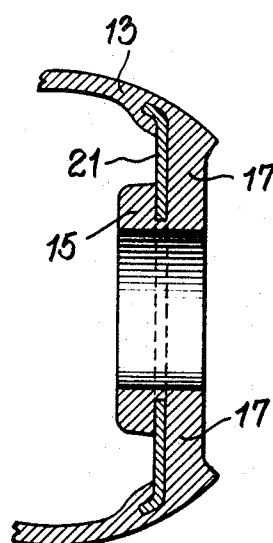
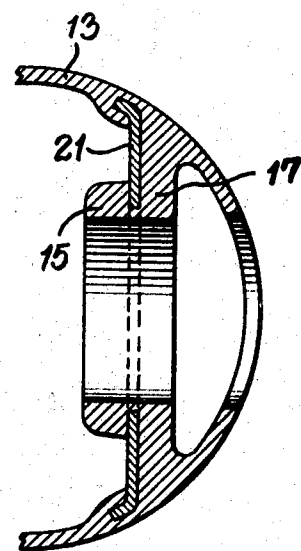
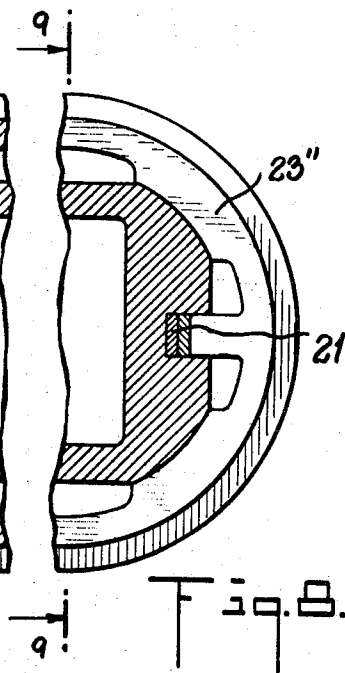
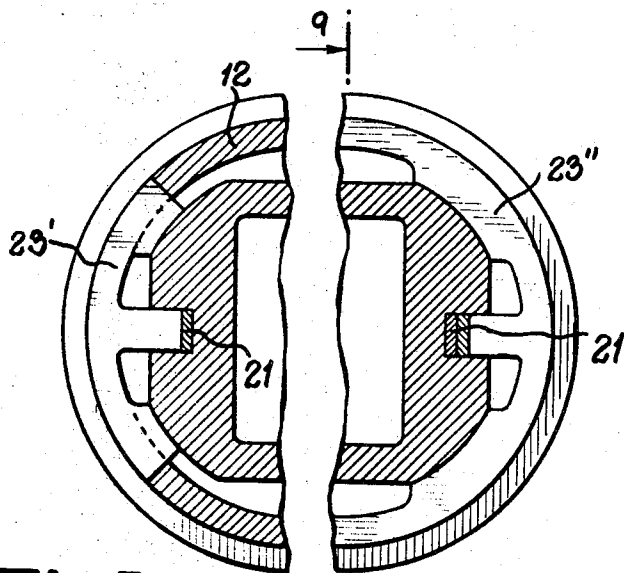
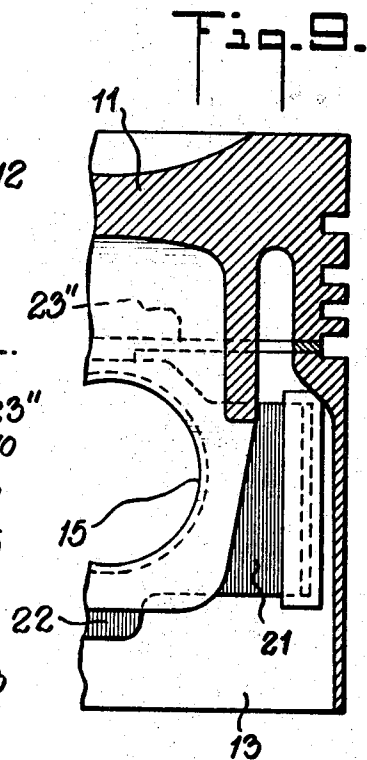
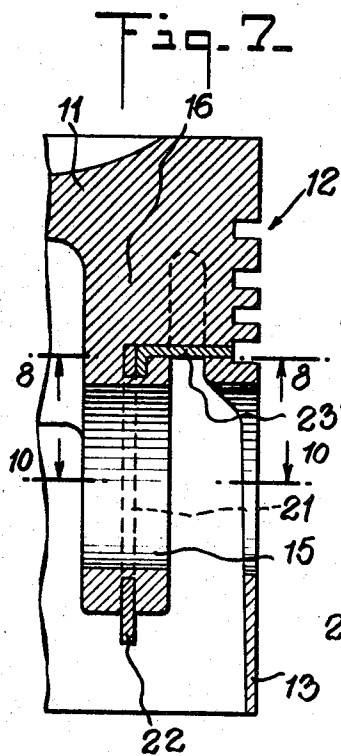
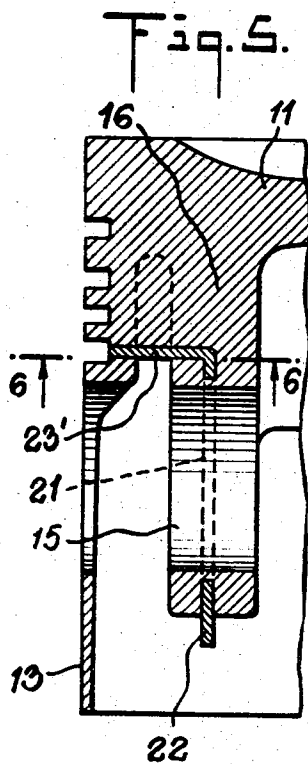
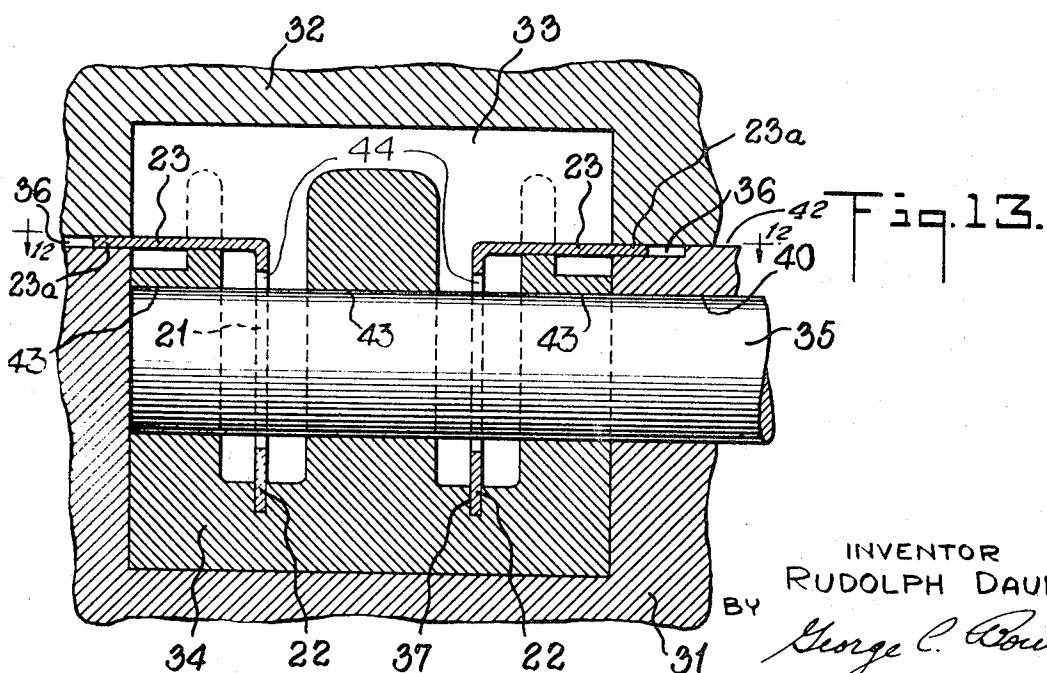
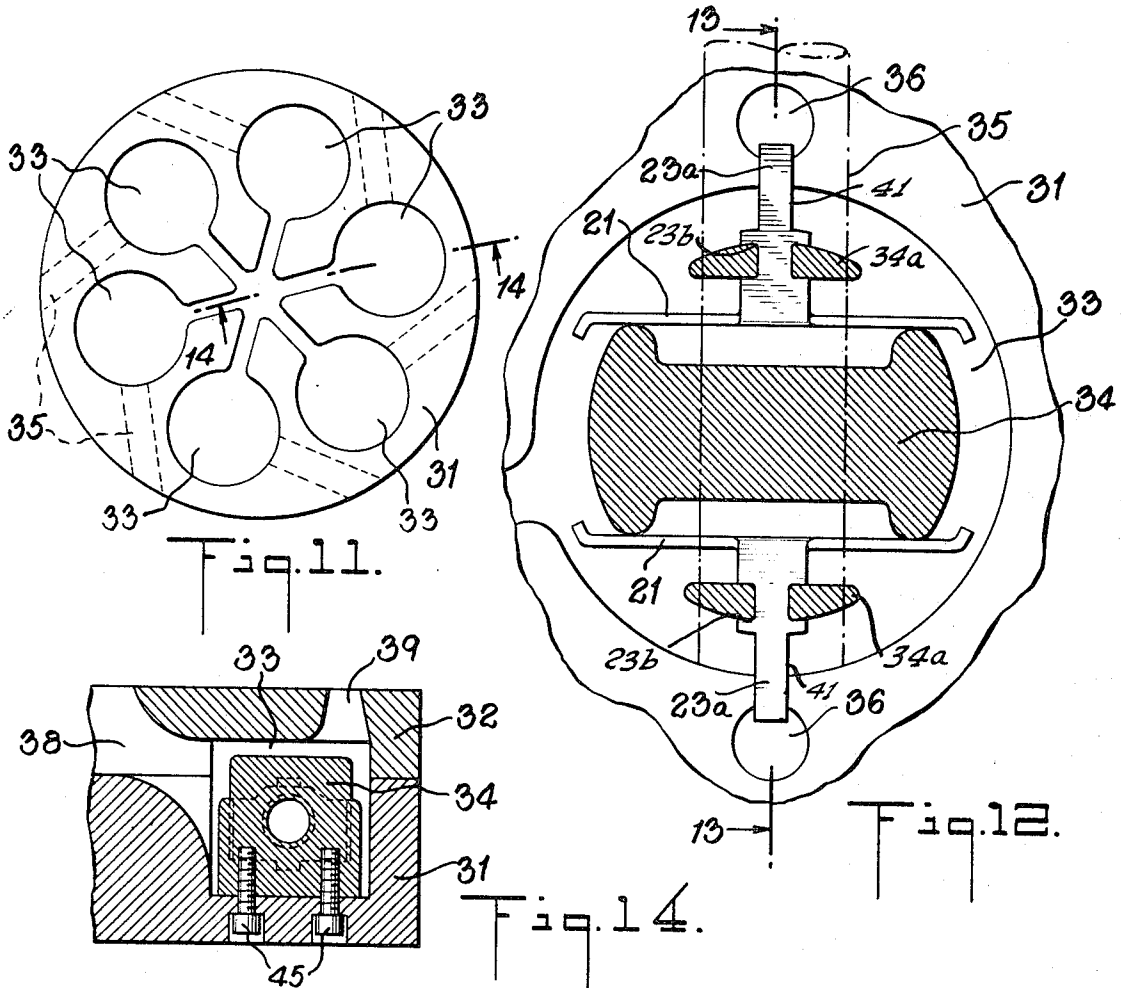


Fig. 4.

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Fig. 15.

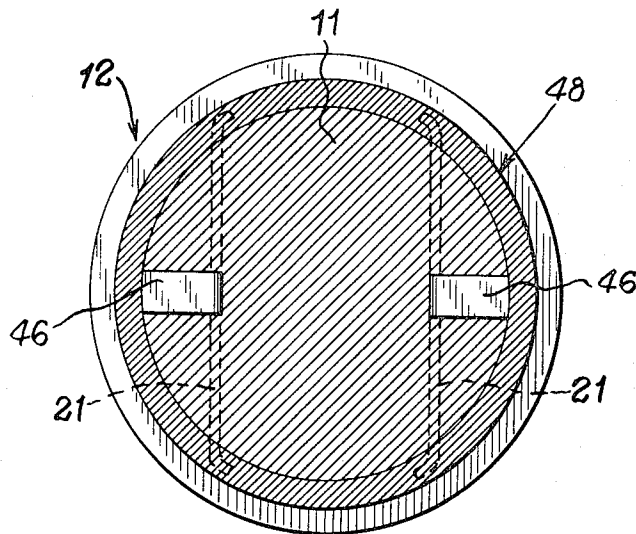
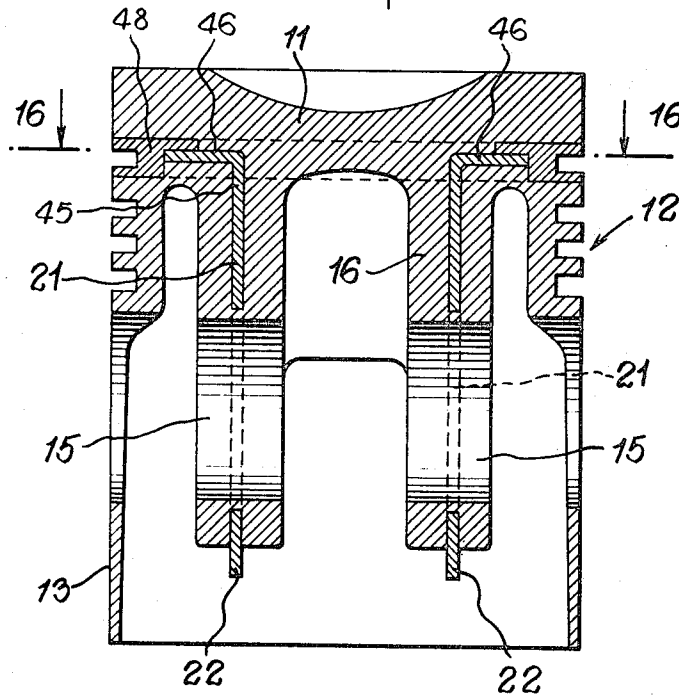


Fig. 16.

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LIGHT METAL PISTON WITH SKIRT DIAMETER CONTROLLING INSERTS AND CASTING THEREOF

RELATED APPLICATION

This is in part based on my German Pat. application Ser. No. M 73 169 XII/47f filed on March 14, 1967 and entitled "Light Metal Piston with Expansion Controlling Inserts and the Mold to Cast It".

BACKGROUND OF THE INVENTION

In previous pistons made of light metal such as aluminum, aluminum alloy or the like, the skirts of the pistons have steel or iron inserts extending parallel to the piston axis to control the thermal expansion of the skirts. The inserts control the piston skirt diameter. In molding these pistons the inserts are fitted on dowel pins extending from the sides of the inner mold casings generally in a plane normal to the main axis of the piston in order to receive the inserts. The outer molds also must separate in a direction away from the axis of the piston. The parting line or plane of the molds is parallel to the axis of the piston thus limiting the mold to two cavities for each sprue. This limits molding techniques and rate of output.

SUMMARY OF THE INVENTION

The ferrous, diameter-controlling inserts in the skirts of the pistons have members in the form of flanges or tongues extending outwardly generally normal to the piston axis to support the inserts in depressions at the mold parting plane, i.e., in slots facing the parting plane, and have axially extending tabs at the other end of the inserts or struts fitting in axially extending slots. The molds separate axially along a parting plane normal to the main axis. This has distinct advantages in permitting a large number of pistons to be cast from a single sprue and the utilization of all conventional molding techniques, including die casting. The molding operations may be performed by automatic equipment at a high rate of output per molding operation.

The radial flange or tongue member may be about one-quarter of an inch wide to provide sufficient supporting strength. In addition the narrow flange or tongue member may have a circumferential ringlike means either completely circumferential or in segmental form. This assists in isolating the skirts from the piston head and improving the control of the diameter of the skirt by the ferrous inserts or struts. It also provides a simple means for armoring the piston ring groove.

An object of this invention is to improve the rate of molding of light metal pistons having ferrous inserts controlling the diameter of the skirts of the pistons.

Another object of the invention is to provide an improved light metal piston having ferrous inserts controlling the diameter of the piston skirt in its entire length, that further isolates the piston skirts from the piston head to improve the control of the diameter of the piston skirts by the ferrous inserts.

Another object of the invention is to provide a piston with the combination of armor-plated piston ring groove and diameter control of the skirts by ferrous inserts by an improved and faster method of casting light metal pistons.

Other and further objects and advantages will be apparent from the following description taken in connection with the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 illustrates a longitudinal sectional view through the main axis of the piston and the axis of the piston pin.

FIG. 2 illustrates a fragmentary sectional view of the piston shown in FIG. 1 taken along the axis of the piston and perpendicular to the axis of the piston pin.

FIG. 3 illustrates a sectional view of the piston shown in FIG. 1 taken along lines 3-3.

FIG. 4 illustrates a fragmentary sectional view of the piston along lines 4-4 of FIG. 1.

FIG. 5 illustrates a longitudinal sectional view of the piston taken through the main axis of the piston and the axis of the piston pin with the horizontal portions of the ferrous inserts including a continuous radially extending ring.

FIG. 6 is a sectional view of the piston of FIG. 5 taken along the lines 6-6 of FIG. 5.

FIG. 7 illustrates a longitudinal sectional view of the piston taken through the main axis of the piston and the axis of the piston pin with the horizontal portions of the ferrous inserts including a continuous radially extending ring.

FIG. 8 is a sectional view of the piston of FIG. 7 taken along the lines 8-8 of FIG. 7.

FIG. 9 is a fragmentary longitudinal sectional view taken along lines 9-9 of FIG. 8.

FIG. 10 is a fragmentary sectional view taken along lines 10-10 of FIG. 7.

FIG. 11 schematically shows the top of the lower part of the mold containing six cavities which can be filled through a centrally located single inlet opening with molten alloy.

FIG. 12 is an enlarged view of the piston mold taken along lines 12-12 of FIG. 13.

FIG. 13 is a longitudinal sectional view taken along lines 13-13 of FIG. 12.

FIG. 14 is a reduced FIG. of an assembled mold prepared for die casting taken along line 14-14 of FIG. 11.

FIG. 15 is a fragmentary sectional view illustrating the combination of a ferrous insert and an armoring of the piston ring groove.

FIG. 16 is a sectional view taken along lines 16-16 of FIG. 15.

DETAILED DESCRIPTION

Referring to FIGS. 1 to 4 a light metal piston is made of aluminum, aluminum alloy or the like and has a piston head 11 with a ring bearing portion 12 and skirt means 13 in the form of slipper skirts on opposite sides of the piston. The slipper skirts are severed from the ring portion 12 by slots 14 and secured to the piston pin bosses 15 by the longitudinal ribs 17 (FIG. 4). The two piston pin bosses 15 on opposite sides of the main piston axis are connected to the piston head by columns 16. The skirts 13, since they are only attached to the piston by the ribs 17, readily change in diameter on expansion and contraction of the piston. Inserts or struts 21 extend radially from opposite sides of the piston pin bosses 15 to control the radial expansion of the piston skirt 13 due to a change in piston temperature. The struts 21 are made of a ferrous metal, such as sheet steel, and are arranged in a well-known manner. This forms a so-called bimetallic structure. The struts are anchored in the piston bosses 15, as illustrated in FIGS. 4 and 10, and in the piston ring skirts 13. The edge of the strut in the piston skirt may be bent at an angle to form an anchoring portion. As illustrated the struts 21 extend along the ribs 17.

The steel struts or inserts 21 compel the aluminum piston skirt to expand in a direction normal to the piston pin in unison with the ferrous insert, assuring equal running clearance between the piston skirt and the cylinder over the range of operating temperatures. The steel struts 21 have tabs 22 extending from the lower edge thereof and exteriorly to the bottom of the piston pin bosses 15. These tabs set and hold inserts at the bottom of the mold and on the finished piston may be machined or cut in length to impart the correct weight to the piston. If too light, a slug can be added by welding. At the piston head end the horizontal flanges 23 extend radially outwardly terminating at the axial wall of the lower ring groove in the ring portion 12.

In the embodiments illustrated in FIGS. 5 to 9 the flange or tongue member 23 has circumferential means extending around the piston between the skirts and ring portions in a radial plane normal to the main axis of the piston. In the embodiment illustrated in FIGS. 5 and 6 the ferrous inserts or struts 21 are the same as shown in FIGS. 4 and 10 and are embedded in the piston pin bosses 15 and the ribs 17. The flange

or tongue members 23 extending perpendicular to the outer piston groove, as illustrated, have ringlike segments 23' which extend circumferentially to axially overlap with the skirts 13 partially filling the slot 14. This partially forms a partition between piston head and skirt means.

In the embodiments shown in FIGS. 7, 8 and 9 the flange or tongue members 23 on the skirts 13 have a continuous circumferential ring 23" extending in a radial plane normal to the piston axis. This ring forms a partition between the ring portion 12 and the skirts 13, as illustrated in FIG. 9, filling the slot 14. The circumferential means 23" prevents the distortion of the piston head from being transmitted to the skirts. This physical separation of the lightly constructed skirt from the hot massive piston head improves the control of the skirts by the ferrous inserts.

In the embodiment illustrated in FIGS. 15 and 16 the ferrous inserts or struts 21 have L-shaped members 45 extending into the piston head 11 with a radially extending flange or tongue portion 46 extending in a plane normal to the axis of the piston. The piston ring groove armoring means 48 extend circumferentially around the piston head. The tongue portions 46 are attached to the armoring means for easy insertion and positioning in the mold.

The main feature of this invention is the adaptation of the piston to rapid multiple casting processes, *i.e.*, permanent mold or die casting. In FIGS. 11 to 14 a mold used for casting the pistons is illustrated and comprises a lower mold casing 31 and an upper mold casing 32 forming six cavities 33 for molding six pistons. Each cavity has a core 34 and a core pin 35 inserted into the cavity and core 34 through passages 40 in the lower mold casing 31. The ferrous inserts 21 have the tabs extending from the lower edge thereof fitting in slots 37 in the core 34 as illustrated in FIG. 13. The flange or tongue members 23 have mounting portions 23a extending beyond the cavity 33 to fit in slots 41 and extend into circular chambers 36. The tongue members have stepped means or notches 23b for fitting and interlocking with the core portions 34a. The slots 41 and the chambers 36 are formed below the mating surface 42 of the lower mold 31 so that the flange or tongue members 23 are at the parting plane between the upper and lower mold casings 32 and 31. Thus the ferrous inserts 21 with the flange or tongue members 23 are radially fitted in place either by hand or by mechanical methods in the direction of the mating and parting of the mold casings 31 and 32. The pins 35 are inserted after the ferrous inserts are positioned in the lower mold casing and fit through the openings 43 in the core 34 and the openings 44 in the ferrous inserts 21. The molten metal is introduced through the sprue 38 communicating with each of the cavities 33 and fills the rises 39, as illustrated in

FIGS. 11 and 14. The core 34 is firmly fastened to the lower casing 31 by the bolts 45, as illustrated in FIG. 14. The ferrous inserts 21 with the flange or tongue members 23 are firmly held between the upper and lower mold casings 32 and 31 and in the slots 37 to withstand the pressures of the molten metal. The upper and lower casings 32 and 31 are separated in accordance with conventional casting techniques and the pins automatically removed. The cast pistons may then be lifted from the cavity 33 and machined to size removing the projections of the flange or tongue members 23 beyond the piston.

In the embodiments in FIGS. 15 and 16 the parting plane of the upper and lower mold casings is at the upper piston ring groove and a circumferential slot is provided in the lower mold casing to receive the armoring means 48 to hold the support the ferrous insert 21 and the L-shaped member 46 in a similar manner to the holding of the ferrous insert 21 and flange or tongue members 23.

It is thus seen from the foregoing description that an improved light metal piston with steel inserts for controlling diameter of the skirts of the piston has been developed which is adaptable to various casting techniques for a more rapid production of pistons. The improved piston not only may be produced at a high output rate, but also has improved structural arrangements in providing for an isolation of the skirts from the piston head and tabs to permit adjusting the weight of the pistons. Also, a simple means is provided for armoring the upper piston ring groove surfaces by mounting the reinforcing ring on the skirt-diameter-controlling inserts.

Other modifications and embodiments may be made in the invention without departing from the definition set forth in the appended claims.

I claim:

1. A cast piston of light metal comprising a piston head, skirt means, piston pin bosses and ribs between said skirt means, said piston pin bosses having openings for wrist pins, inserts mounted in said piston pin bosses and extending to and embedded in said skirt means for controlling the thermal expansion of said skirt means characterized by said inserts having members substantially narrower than said openings in said piston pin bosses and extending radially to the exterior side of said piston.

2. A cast piston of light metal as set forth in claim 1 wherein said members have stepped means for radially locking said inserts in a piston mold core.

3. A cast piston of light metal as set forth in claim 2 wherein said stepped means are notches in said members.

4. A cast piston of light metal as set forth in claim 2 wherein said inserts have tabs extending from the bottom of said bosses.

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