CAST PISTON FOR HYDRAULIC TRANSLATING UNIT

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Filed: Jan. 8, 1975

Appl. No.: 539,408

Related U.S. Application Data
Continuation of Ser. No. 371,666, June 20, 1973, abandoned.

U.S. Cl. .................. 92/172; 91/488; 92/239; 92/248

Int. Cl. .......................... F16J 1/00

Field of Search ............... 91/172, 248, 249, 239, 91/488

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ABSTRACT
A piston such as used in axial and/or radial piston hydraulic translating units, comprising a hollow-skirt portion having inner surfaces defining a substantially conical cavity filled with a core of lightweight material, the material being retained in place against axial displacement by an annular wall integrally cast at the open end of the piston and against angular displacement by a plurality of integrally formed gussets joining the inner surfaces of the skirt wall and the annular wall.

2 Claims, 5 Drawing Figures
CAST PISTON FOR HYDRAULIC TRANSLATING UNIT

This is a continuation of Ser. No. 371,666, filed June 20, 1973.

BACKGROUND OF THE INVENTION

This invention relates to a reciprocating piston-type fluid translating device such as used for pumps or motors. More specifically, the invention relates to a lightweight core piston of the type used in these units having an improved means for retaining the core against axial and angular displacement during operation of the piston, and further having an improved core design to increase piston strength against the high stresses developed within the translating unit.

Conventionally, the weight of the pistons contained within these translating units is reduced by hollowing out the skirt portion of the pistons. This, however, increases the dead volume of fluid that must be moved within the translating unit, and can have the effect of decreasing the efficiency of these units. Consequently, it is usual to refill the hollowed-out portion with a material of lighter weight than that of the piston, and which possesses a sufficiently high bulk modulus to resist compression under the high pressures encountered during operation. Such filler material must be positively retained within the piston in some manner, so that it will not be displaced during operation of the translating units, thereby potentially causing severe damage to such units.

Prior attempts have been made to provide lightweight pistons for use in these hydraulic translating units. Such pistons are commonly made from solid bar stock material and expensive machining operations are required to shape the piston to the desired configuration. Further the means employed to retain the filler in position within the pistons are frequently inadequate leading to loosening or dislodging of the filler core during operation of the piston. Also, these retaining means frequently require additional machining operations, further adding to the cost of the piston. Additionally, although prior core designs have usually resulted in a lighter weight piston, the ensuing reduced piston strength has occasionally caused the piston to succumb to the high stresses developed during operation.

SUMMARY AND OBJECTS OF THE INVENTION

The core retaining means of this invention provide a relatively simple and economical method of retaining a lightweight core of filler material of substantially conical shape within a hollowed-out skirt portion of a piston, while at the same time the shape of the core provides a means of increasing the structural strength of the piston.

Accordingly, it is an object of this invention to provide an efficient and inexpensive means of retaining a core of filler material within the hollowed-out skirt portion of a piston used in piston-type hydraulic translating units.

It is a further object of this invention to provide a piston with core retaining means which can be formed by investment casting and requiring a minimum amount of machining to finish.

Another object of this invention is to provide an improved design for a piston with a core of filler material, resulting in a lightweight piston having improved capacity to withstand stress, because of having greater strength in the area where stress forces are concentrated.

BRIEF DESCRIPTION OF THE DRAWINGS

Other objects of this invention will become apparent from the following description of the drawings wherein:

FIG. 1 is a longitudinal cross-sectional view of a piston for a hydraulic pump or motor embodying means for retention of the core filler material and illustrating means of providing a maximum reduction in weight of the piston by providing a tapered piston bore;

FIG. 2 is a longitudinal cross-sectional view of the piston of FIG. 1, with the substantially conically-shaped core filler material in place;

FIG. 3 is an end view of the piston taken along the line III—III of FIG. 1, wherein the shaded area denotes the core filler material, and wherein a portion of the end wall is broken away to expose one of the reinforcements;

FIG. 4 is a longitudinal cross-sectional view of a piston for a pump or motor embodying alternate means for retention of the core filler material and illustrating means to provide a maximum reduction in weight of the piston by providing a tapered piston bore; and

FIG. 5 is an end view of the piston taken along the line V—V of FIG. 4.

DETAILED DESCRIPTION OF THE INVENTION

FIGS. 1, 2, 3, 4 and 5 illustrate pistons useful in piston-type hydraulic translating units. With particular reference to FIGS. 1 and 3, the piston 10 is made up of a tapered bore or cavity 14 and a spherical base portion 12, which cooperates with a conventional piston shoe (not shown). The base portion 12 is provided with a drilled passage 16 which communicates with cavity 14, thereby creating a channel for the introduction of lubricant between the ball section 12 and its cooperating piston shoe.

The skirt wall 13, defining cavity 14, is tapered so that the thickness of wall 13 is greater near the base portion 12, thereby providing greater strength in the area where the stress forces are concentrated. The actual thickness of the wall 13 and the degree of taper may be varied to obtain the appropriate degree of lightness and structural strength required.

Means for retaining filler material within cavity 14 are provided by annular wall 17 at the open end of piston 10, and gussets 19 disposed between annular wall 17 and skirt wall 13 within cavity 14. Wall 17 has an aperture 18 extending therethrough, communicating with cavity 14. The filler core material is prevented from axial displacement by annular wall 17. Gussets 19 perform the dual function of preventing angular displacement of the filler core material within the piston, and strengthening the annular wall 17. Preferably, annular wall 17 is investment cast with piston 10, thereby forming an integral part of the piston. Gussets 19 are also preferably integrally formed on skirt wall 13 and annular wall 17 at the time of casting.

FIG. 2 illustrates piston 10 with cavity 14 filled with a lightweight core filler material 21, positively mechanically interlocked with gussets 19 and annular wall 17. Any suitable lightweight filler material may be used to fill cavity 14, for example, a thermosetting phenolic resin such as Durex No. 22418, available from the Durez Plastics Division, Hooker Chemical Corp., 500 Walch Road, No. Tonawanda, New York. This material is of sufficient strength to resist compression under
the high pressure of the translating unit; however, any other lightweight material such as metal, epoxy, resin, etc., having a sufficiently high bulk modulus to resist compression under high pressure may be used. The phenolic resin is ordinarily compression molded into the cavity of the piston to eliminate any voids and to insure a positive mechanical interlock with the annular wall and gussets when the filler material hardens.

Also shown in FIGS. 2 and 3 is passage 22 through the core filler material 21 communicating with passage 16, to complete the channel for the flow of lubricant through piston unit 10, as previously discussed. Preferably, passage 22 is formed by placing a long rod extending the length of the piston unit into passage 16 prior to filling cavity 14, as disclosed in our copending application of Hein et al., Ser. No. 115,639, filed Feb. 16, 1971, having the same assignee as the present invention. The core filler material 21 is then molded around the rod in the cavity, leaving a passage when the rod is removed after the filler has hardened. Alternatively, the passage may be drilled through the filler material after it has hardened.

FIGS. 4 and 5 illustrate an alternate embodiment of the piston of this invention. Tapered bore or cavity 14 of piston 10 is filled with lightweight core filler material 21, which is provided with passage 22 communicating with passage 16 in spherical base portion 12. Cavity 14 is provided with a generous spherical radius R at the end proximate to base portion 12. Actual radius R will be determined in part by the degree of taper and actual thickness of skirt wall 13, which, as noted above, will vary according to the degree of lightness and structural strength required.

For optimum ease of casting, annular wall 17 illustrated in FIGS. 1 through 3 is preferably omitted, as shown in FIGS. 4 and 5; in this case core filler material is prevented from axial displacement by gussets 19. In some instances, however, it may be desirable to provide piston 10 illustrated in FIGS. 4 and 5 with annular wall 17.

What is claimed is:

1. In a piston of the type used in hydraulic translating units, wherein said piston has a base portion for engaging said piston to said unit and an attached skirt portion with a trailing end, said piston defining a hollowed-out cavity extending axially from a plane rearward of said base to an opening in the trailing end, and a core of molded filler material within the cavity, means for retaining the core of filler material within said cavity comprising annular wall means at the trailing end of said piston defining the opening therethrough, said annular wall means preventing axial displacement of the core of filler material relative to the piston, and a plurality of gussets embedded in said filler material, each gusset being integrally joined to the annular wall and the inner piston cavity surface, said gussets providing strengthening of the annular wall, meanwhile preventing angular displacement of the core of filler material within the piston.

2. The invention of claim 1 wherein the hollowed-out cavity is substantially conical in shape, wherein the cone increases in radius toward the trailing end of said piston.

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