Jan. 26, 1926.

1,570,837

J. E. HOY ET AL

PISTON

Original Filed March 18, 1924

Fig. 2.

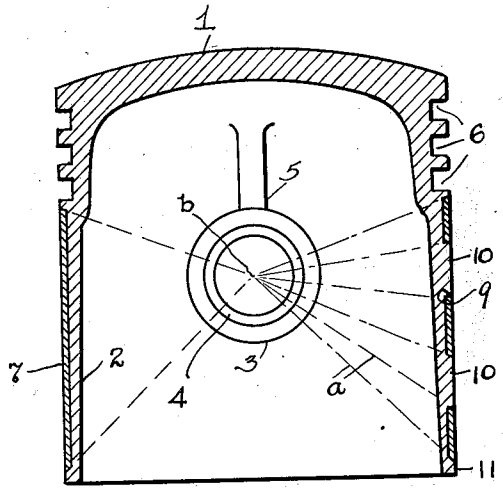
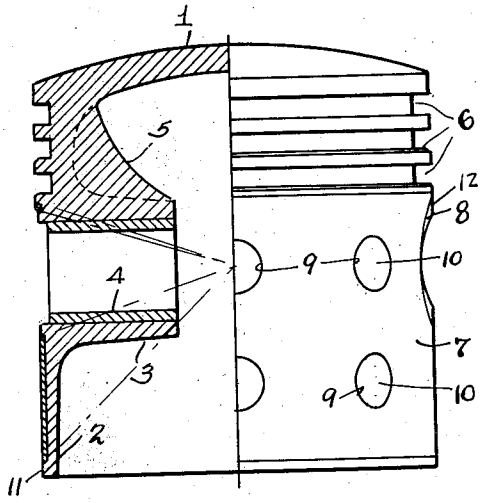


Fig. 1.



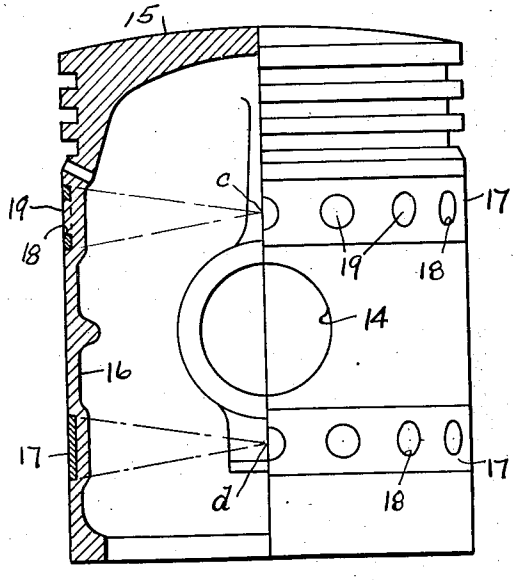


Fig. 3

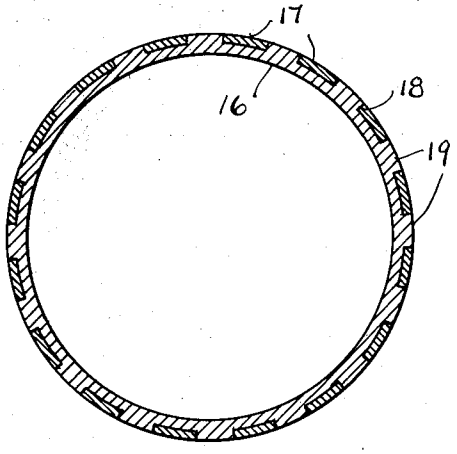


Fig. 4

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Patented Jan. 26, 1926. 1,570,837

UNITED STATES PATENT OFFICE.

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PISTON.

Application filed March 18, 1924, Serial No. 699,978. Renewed January 22, 1925.

To all whom it may concern:

Be it known that we, JOHN E. HOY and NORMAN A. BEST, citizens of the United States, and residents of Midland, county of Midland, State of Michigan, have jointly invented a new and useful Improvement in Pistons, of which the following is a specification, the principle of the invention being herein explained and the best mode in which we have contemplated applying that principle, so as to distinguish it from other inventions.

In order to overcome the undue expansion of internal combustion engine pistons formed of light metal alloys, as well as for the sake of the better bearing contact that is obtained between the cast iron cylinder bore and a piston having a skirt likewise of cast iron or of steel, a number of pistons have been designed of composite structure. That is, the bodies of such pistons have been made of a light metal alloy, for example, one of the numerous magnesium base alloys available for the purpose, and the skirt of the piston has been surrounded by, or encased in, a shell of cast iron or steel, or one or more iron bands, as distinguished from the loosely fitting piston ring, have been attached to the piston skirt. A serious difficulty, however, is encountered whenever it is thus attempted to firmly attach to a light metal piston, with its relatively high coefficient of expansion, a band of metal having a lower coefficient of expansion. In other words, when such a composite piston is subjected to the changes of temperature encountered in the operation of an internal combustion motor the band will either work loose or the piston skirt be so distorted as to detract seriously from the utility of the device.

The object of the present invention is the production of a light metal alloy piston, primarily one designed for use in internal combustion engines, to which piston is permanently attached one or more bands of cast iron or steel in such a manner as always to remain firmly in contact with the piston body proper, irrespective of changes in temperature. At the same time any tendency towards distortion of the body of the piston is avoided.

To the accomplishment of the foregoing and related ends, the invention then consists of the means hereinafter fully described and particularly pointed out in the claims; the annexed drawing and the following description setting forth in detail certain mechanism embodying the invention, such disclosed means constituting, however, but one of various mechanical forms in which the principle of the invention may be used.

In said annexed drawing:—

Fig. 1 is partly a side elevation and partly a central vertical section of a piston embodying our present improvements; Fig. 2 is a central vertical section of such piston, the plane thereof being at right angles to the plane of the sectioned portion of Fig. 1; Fig. 3 is partly a side elevation and partly a central vertical section of a modified construction of such piston; and Fig. 4 is a horizontal transverse section of such modified construction.

In its general features of construction, our present improved piston is similar to those of cast iron or light metal alloys heretofore used in internal combustion engines. In other words, such piston comprises a more or less cylindrical head portion 1, from which depends a sleeve or skirt portion 2. Such sleeve or skirt portion is formed with oppositely placed inwardly directed bosses 3, which are apertured to receive the wrist pin (not shown) whereby the piston is attached to the connecting rod. Bushings 4 of bronze or equivalent bearing metal are preferably fitted to the apertures in such bosses, as best shown in Fig. 1, and an integral rib 5 between each boss and the head 1 contributes to the strength of the structure. In order effectually to seal the piston within the walls of the cylinder in which it works, resilient piston rings (not shown) of familiar construction are seated in annular recesses 6 in the head portion 1, as need not be here explained.

Referring to the specific form of our improved piston, illustrated in Figs. 1 and 2, it will be seen that the skirt portion 2 is substantially surrounded by a shell or band 7. In contradistinction to the light metal alloy whereof the piston proper is composed, as stated above, this shell or band 7 will be made of either cast iron or steel, or other metal of relatively low coefficient of expansion that will correspond more nearly to the coefficient of expansion of the metal whereof the engine cylinder is composed. Where such shell, as in the construction illustrated

in Figs. 1 and 2, extends above the wrist pin openings in bosses 3 it will be formed with corresponding openings 8, preferably of somewhat larger diameter, and the lower edge of such shell will furthermore terminate somewhat short of the lower edge of the piston skirt 2. Intermediate of its upper and lower edges, and suitably spaced between openings 8, a number of other smaller openings 9 are formed in the shell, which are filled in casting with integral projecting portions 10 of the piston skirt.

It will be understood that the metal composing the piston proper (head 1 and skirt 2) is cast in a suitable mold, in which such shell or band 7 has been previously placed, the walls of the mold being formed to give the proper contour to the exposed portions of the body and skirt. Such exposed portions as just indicated will include the projections 10 on the skirt, as also the lower edge of the latter which projects in the form of a flange 11 lying flush with the lower edge of the shell and a similar circular flange 12 that lies within each wrist pin opening 8 in the shell. After casting the cylindrical surface of the composite piston may be machined down and ground or otherwise finished in any approved manner.

The feature of the foregoing construction to which particular attention is directed is the inclination of the laterally contacting surfaces of the lower edge of the shell and of the edges of openings 8 and 9 therein with the opposed surfaces of flanges 11 and 12 and projections 10 on the skirt of the piston. The lines *a* of contact, as shown in Fig. 2, in every case meet at a point on a central axial line within the piston. Such point, in the particular case illustrated, lies at the center *b* of the wrist pin. This point, or other corresponding point, thus selected within the piston will be hereinafter referred to as the neutral expansion point of the structure and, as signified by this term, the result of having the lateral engaging surfaces or the parts in question thus all diverge from such common central point within the piston will be to maintain such surfaces in contact, irrespective of any changes in such parts due to their contraction or expansion, this despite the differences in the rate of such contraction or expansion occasioned by the difference in the coefficients of expansion of the metals whereof the parts are respectively formed. Accordingly the band 7 will at all times remain firmly attached to the piston skirt 2.

In the modified construction illustrated in Figs. 3 and 4, aside from the fact that the piston is relatively longer and that the wrist pin bosses 14 are located further down, i. e., at a greater distance from the head 15 of the piston, the general construction is the same as before. However, instead of employing a single shell of cast iron or steel on the skirt 16 we here utilize two such bands 17, one located above and the other below the openings in the wrist pin bosses. These bands, just as in the case of shell 7, are formed with a series of circumferentially spaced openings 18 and are set substantially flush with the outer surface of the piston skirt, the openings 18 being filled by projections 19 on the latter. As before, the lateral edges of the bands 17 and of the openings 18 therein, together with the complementary edges on the skirt 16 of the piston and the projections 19 of the latter, diverge from a common point on an axial line within the piston. However, we here show separate points *c* and *d* for such contacting edges in the case of such upper and lower bands 17, respectively. It is not necessary, in other words, in this case that the lines for both bands should diverge from a single point in order to obtain the advantageous results pointed out in describing the first form, i. e., that of Figs. 1 and 2. As shown in Fig. 4, the vertical sides of the projections 19 and the corresponding edges of the openings 18 where intersected on a horizontal plane will lie on strictly radial lines. As a matter of fact, such contacting surfaces in the case of the projections and openings in question will be in the form of conical frustra, either normal or oblique, depending upon whether the corresponding neutral expansion point lies in a plane central with respect to such projections and openings or not. Similarly, the contacting surfaces that bound the edges of the bands will form conical frustra unless, as is permissible, the corresponding neutral expansion point should lie in the same transverse plane with one edge of the band, in which event, of course, that edge will be normal to the cylindrical surface of the piston. In such case, of course, the other edge of the band will be that much more sharply inclined.

The term, light metal alloy, as used herein should be understood to refer not only to aluminum base alloys but also to those in which magnesium is the predominant ingredient. The shell or band that forms part of the composite piston may be referred to in general terms as composed of ferrous metal, cast iron and steel being examples. Any metal part, however, having a different coefficient of expansion than that of the body of the piston, whether attached thereto for the purpose hereinbefore stated or for some other, different purpose will be desirably attached in the improved manner characterizing our invention.

It will be understood of course, that the body of the piston or corresponding article may be either cast or forged and that the particular manner of fabrication of the surrounding shell, whether, in other words, it

be a casting, stamping or forging, does not affect the principle involved in our invention.

It will be understood also that the term "common point" as employed herein does not necessarily imply a strictly geometrical point, since the advantages of our improved construction may be secured to a substantial degree by having the contacting edges in question conform to surfaces described by lines that approximate passing through a neutral expansion point situated within the piston as hereinbefore set forth. Finally, it is not essential that all the edges in question thus conform, but the principle of our invention may be incorporated in part or whole in any composite piston structure, as may be desired.

Other modes of applying the principle of the invention may be employed instead of the one explained, change being made as regards the mechanism herein disclosed, provided the means stated by any of the following claims or the equivalent of such stated means be employed.

We therefore particularly point out and distinctly claim as our invention:—

1. In a piston, or like article, the combination of a body and a part surrounding the same, said body and part being composed of metals having different co-efficients of expansion and laterally contacting edges of said body and part inclining with respect to the cylindrical face of said body, substantially as described.

2. In a piston, or like article, the combination with a body composed of a metal having a relatively high co-efficient of expansion, of a part surrounding said body and composed of a metal having a relatively low co-efficient of expansion, laterally contacting edges of said body and part converging in a general inward direction.

3. In a piston, or like article, the combination with a body composed of a metal having a relatively high co-efficient of expansion, of a part surrounding said body and composed of a metal having a relatively low co-efficient of expansion, laterally contacting edges of said body and part conforming to surfaces described by lines passing through an approximately common point lying within said body.

4. In a piston, or like article, the combination with a body composed of a metal having a relatively high co-efficient of expansion; of a part surrounding said body and composed of a metal having a relatively low co-efficient of expansion, laterally contacting edges of said body and part conforming to surfaces described by lines passing through a common point in the axis of said body.

5. In a piston, or like article, the combination with a body composed of a light metal alloy; of a part surrounding said body and composed of a ferrous metal, laterally contacting edges of said body and part conforming to surfaces described by lines passing through a common point in the axis of said body.

6. In a piston, or like article, the combination with a body composed of a metal having a relatively high co-efficient of expansion; of a part surrounding said body and composed of a metal having a relatively low co-efficient of expansion, said part being formed with openings wherein projections from said body extend, and laterally contacting edges of said body and part conforming to surfaces described by lines passing through a common point in the axis of said body.

7. In a piston, or like article, the combination with a body composed of a light metal alloy; of a part surrounding said body and composed of a ferrous metal, said part being formed with openings wherein projections from said body extend, and laterally contacting edges of said body and part conforming to surfaces described by lines passing through a common point in the axis of said body.

8. In a piston, the combination with a cylindrical body of a light metal alloy; of a shell of ferrous metal surrounding said body and terminating short of the lower edge thereof, said shell being formed with a series of circumferentially spaced openings wherein projections from said body extend, and laterally contacting edges of said body and shell, including the lower edge of said body and such projections thereon, conforming to surfaces described by lines passing through a common point in the axis of said body.

Signed by us this 13th day of March, 1924.

JOHN E. HOY.
NORMAN A. BEST.