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A. W. POPE, JR

1,750,429

PISTON

Filed Oct. 13, 1926

Fig. 1.

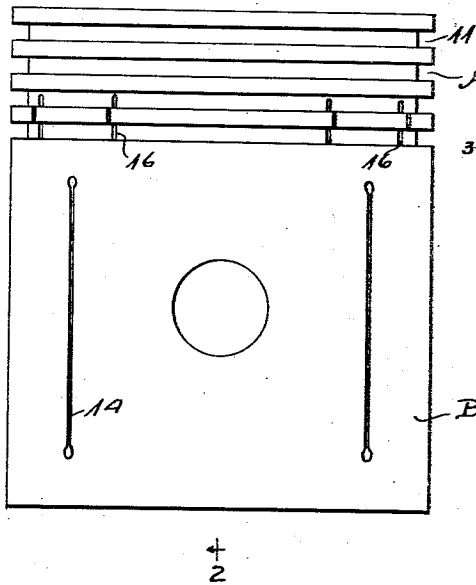


Fig. 2.

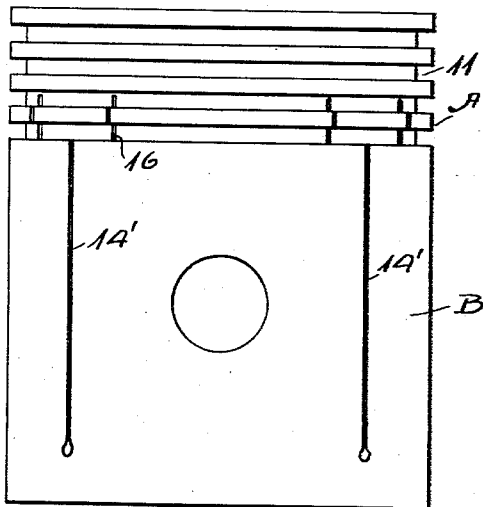
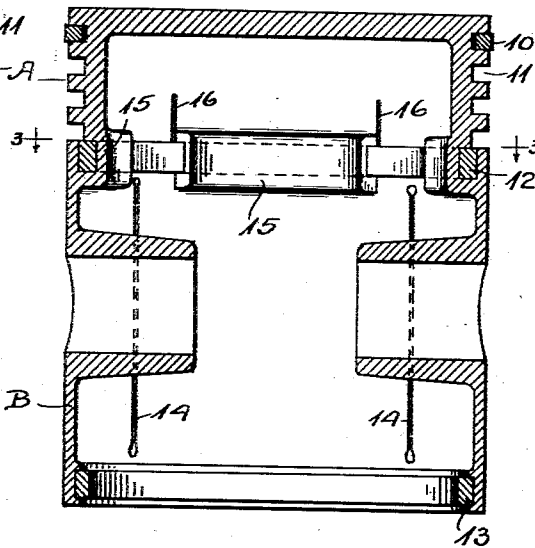


Fig. 3.

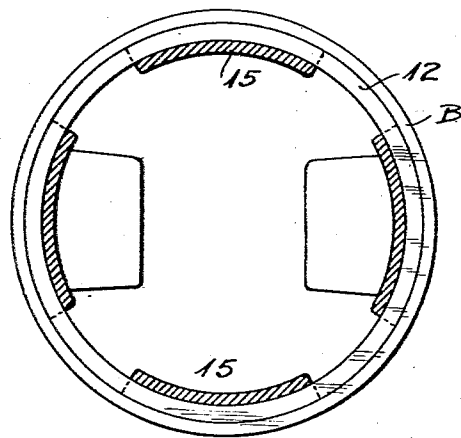


Fig. 4.

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UNITED STATES PATENT OFFICE

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PISTON

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My invention relates to pistons for internal combustion engines, particularly to a piston constructed of a light metal whose coefficient of expansion is much higher than that of the metal of the cylinder. The object of the invention is to provide such construction and arrangement, particularly in connection with the piston rings, that the diameter of the piston will expand to the same amount as that of the cylinder under the varying temperatures of operation, so that there will always be the same clearance between the cylinder and the piston under all operating conditions.

Referring to the drawing,

Figure 1 is a side elevational view of the piston;

Fig. 2 is a sectional view on plane 2—2 of Fig. 1;

Fig. 3 is a sectional view on plane 3—3 of Fig. 1; and

Fig. 4 is a side elevational view showing a modified arrangement.

The piston comprises two parts, the head part A and the skirt part B. The head part serves merely as the carrier for the packing rings 10, for which the grooves 11 are provided. The diameter of this head part is therefore made small enough so that it will not be necessary to control its expansion under any temperature. The skirt part, however, bears against the cylinder wall to guide the piston in its travel and consequently it is necessary to keep the clearance between the skirt and the cylinder constant in order to assure smooth and efficient operation.

The cylinders are usually made of cast-iron and the pistons, in order to obtain light structures, are made of lighter material, as for example, aluminum alloy. Such lighter material has, however, a coefficient of expansion considerably greater than that of cast-iron and the problem has been to efficiently control the diametral expansion of such piston structures so that under varying temperature conditions, the diametral expansion of the piston structure will be restrained and to be in accord with the expansion of the cylinder so that efficient operating clearance will be maintained under all conditions between the piston and the cylinder wall. In accordance

with my invention, I provide two rings 12 and 13 which may be of steel which has a coefficient of expansion less than that of the aluminum alloy, the ring 12 being at the upper edge of the skirt and the ring 13 at the lower edge thereof. The rings are placed in the mold before the piston is cast and the metal is poured into the mold and around the rings so that the rings will be at the inside of the skirt structure. As the piston metal cools, it will attempt to contract more than the rings, due to the difference in coefficient of expansion, the steel rings resisting the contraction with the result that when the aluminum alloy has cooled it will actually be stretched around the steel rings. The amount of such contraction is dependent upon the relative strength of the rings and the piston and the elastic limit of the aluminum. To relieve the skirt section of stresses and give it greater flexibility, longitudinally extending slits 14 are cut in the skirt part between the rings, four such slits being shown. In the arrangement of Figs. 1 and 2, these slits terminate short of the upper and lower edges of the skirt part so that at such edges, the skirt part will be continuous and controlled by the rings. That is, the effective diameter of the skirt will be determined by the diameter at its upper and lower edges.

The head and skirt section are connected together by means of the bands or struts 15 which extend around and receive the ring 12 and are cast integral with the piston body structure. These bands or struts extend between the slits 16 which are cut in the head part A for a distance upwardly from the upper edge of the skirt part. These slits permit the struts to spring or give so that the expansion and contraction of the head part can have no effect on the diameter of the skirt part, the struts giving sufficiently so that they will not distort or interfere with the proper operation of the ring 12.

Describing now the operation, as the temperature of the piston structure increases, any expansion at the upper and lower edges of the skirt will be controlled entirely by the rings 12 and 13. This is on account of the stretched and tensed condition of the alumi-

num surrounding the rings and until all such strain has been eliminated, the aluminum will merely follow the expansion of the rings, whose coefficient of expansion is substantially that of the cylinder metal.

The expansion of the rings will not be exactly the same as it would if the rings were not in a slightly compressed state due to the pressure of the aluminum upon them. They will have a slightly higher coefficient than the same metal in an unstrained condition. This difference can be made negligible by proportioning the size of the rings or by using a metal of lower coefficient of expansion. Therefore, for a certain range in diameter, the coefficient of diametrical expansion of the skirt is approximately the same as that of the rings. Some allowance will, however, have to be made where the rings are subjected to any degree of compression by the shrinkage or stretch of the aluminum surrounding them. Under such compression, the coefficient of expansion will be slightly higher than if the rings were not subjected to such strain. However, this difference in expansion can be made negligible by proportioning the size of the rings or by using a grade of metal of sufficiently lower coefficient of expansion to allow and compensate for the increase which will be caused by the compression of the rings, and with such compensation the expansion in the piston structure will accurately follow that of the cylinder and the proper clearance will be maintained.

Under abnormal or extreme temperature conditions, the upper portion of the skirt will become so hot that the aluminum metal will be relieved of all strain and it will then begin to expand with the same coefficient as the metal in its normal unstrained state. For pistons which are to operate at such high temperatures, the longitudinal slits or slots 14' will be extended to the upper edge of the skirt so as to circumferentially sub-divide this part of the skirt. When the aluminum surrounding the upper ring at the outside then tends to expand at its normal rate, which is greater than that of the ring metal, it will be restrained from so doing by the struts 15, which extend around the inside of the ring. In other words, the ring 12 being secured to the outer wall of the skirt by the struts 15 will restrain the expansion of the skirt at a greater rate than that of the ring, and the expansion force inherent in the aluminum will be relieved and taken care of by the slots 14', the sections between these slots being able to expand to the extent of the slots and thus keeping the skirt wall outside of the ring 12 in intimate contact with the ring.

The slit 16 cut in the head part A and between which the struts 15 extend will permit the natural expansion and contraction of the aluminum of the head independently of

the skirt part and without interfering with the expansion and contraction of the skirt part to maintain cylinder clearance.

By providing the skirt section between the rings with the slits 14, the metal may expand circumferentially without increasing the diameter beyond the skirt diameter adjacent to the rings 12 and 13.

The lower end of the skirt around the ring 13 is not subjected to the same high temperature as the upper edge of the skirt just below the head part A and consequently the slits 14 or 14' will terminate short of the lower edge of the skirt so that the skirt will remain continuous around the ring 13 and be controlled by the expansion of the ring.

I thus produce a simple and efficient piston structure of light material whose effective skirt diameter is controlled by rings on the inside of the skirt whose effective expansion and contraction is in accurate accord with the expansion and contraction of the cylinder so that the proper operating clearance will be accurately maintained at all times between the piston and cylinder walls.

I claim:

1. A piston structure comprising a head section and a skirt section, a closed ring seated against the inner side of the skirt section at the upper edge thereof, a closed ring seated against the inner side of the skirt section near the bottom thereof, said rings having a coefficient of expansion less than that of the skirt section and the skirt section being continuous in the planes of the respective rings and means connecting the head section to the skirt section and adapting said head section for expansion and contraction independently of the skirt section, the skirt section being normally under stress over the rings and the rings being normally under compression due to such stress.

2. A piston structure for internal combustion engines comprising a head section and a skirt section, said sections being of metal having a comparatively high coefficient of expansion, rings received and compressed by the skirt section at the upper and lower edges thereof and of a metal having a coefficient of expansion considerably less than that of the skirt section, and struts connecting said head section to the skirt section and extending around the inner side of the adjacent ring.

3. In a piston structure for internal combustion engines, the combination of a head part and a skirt part, a ring on the inside of said skirt part at the upper end thereof for controlling the radial expansion of said skirt part and having a coefficient of expansion materially less than that of the skirt part, said head part having longitudinally extending slits above the skirt part, and struts extending between said slits and around said ring for securing said head part to the skirt part.

4. In a piston structure for internal com-

bustion engines comprising a metallic skirt part and radial expansion controlling rings of a metal having a coefficient of expansion materially less than that of the metal of the skirt part, the method of changing the effective coefficient of expansion of the skirt part which consists of casting the metal of the skirt part around the outside of said rings whereby upon cooling, the skirt metal diametrically outside of the rings will be stretched around and against the rings and its coefficient of expansion reduced considerably below normal.

5. In a piston structure for internal combustion engines comprising a metallic skirt part and expansion controlling rings of a metal having a coefficient of expansion materially less than that of the skirt part, the method of changing the effective coefficient of expansion of the skirt part which consists in heating the skirt metal and cooling and shrinking it around the rings to thereby reduce the effective coefficient of expansion of the skirt metal materially below that of the metal when normal.

6. In a piston structure for internal combustion engines, the combination of a skirt in the form of a cylindrical shell, a ring on the inside of said shell at the upper end thereof for controlling the radial expansion of said skirt and having a coefficient of expansion materially less than that of the skirt, a head above the skirt, and struts extending from said skirt and engaging against the inner side of said ring and with said head to secure the head to the skirt, said head being free from the upper end of said skirt whereby said head and skirt may expand and contract independently during temperature changes.

7. A piston structure comprising a head section and a skirt section, and a ring seated against the inner side of the skirt section, said ring having a coefficient of expansion less than that of the skirt section and the skirt section being continuous in the plane of the ring, said skirt sections being normally under stress over the ring and the ring being normally under compression due to such stress.

In witness whereof, I hereunto subscribe my name this 8th day of October, 1926.

ARTHUR W. POPE, JR.

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