June 28, 1932. O. C. BERRY 1,865,299

PISTON FOR INTERNAL COMBUSTION ENGINES

Filed Nov. 1, 1929

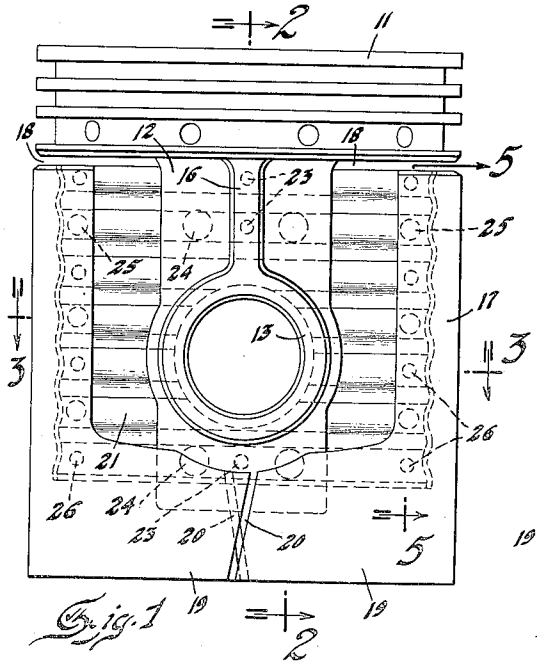


Fig. 1

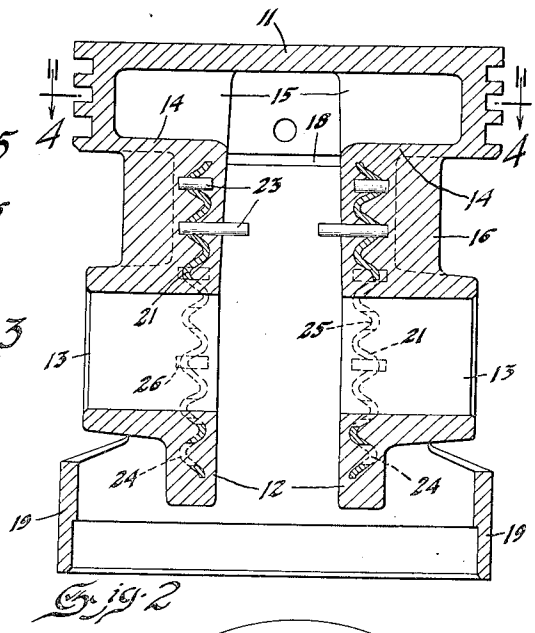


Fig. 2

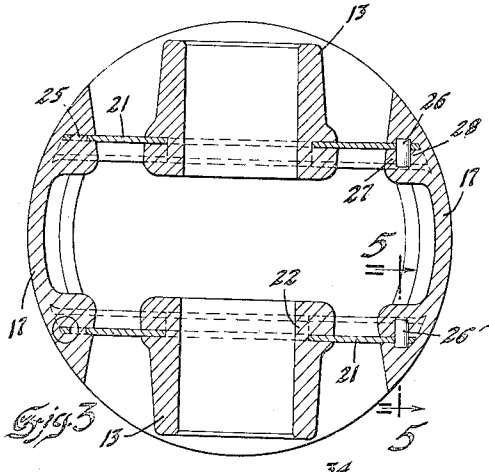


Fig. 3

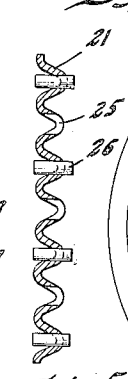


Fig. 5

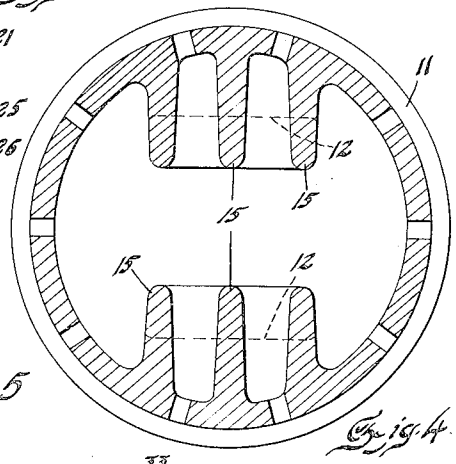


Fig. 4



Fig. 7

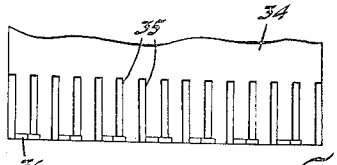


Fig. 8

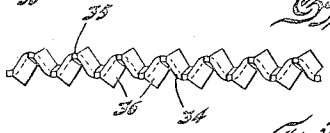


Fig. 9

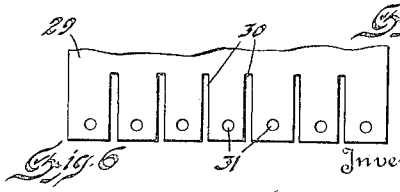


Fig. 6

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Patented June 28, 1932 1,865,299

UNITED STATES PATENT OFFICE

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PISTON FOR INTERNAL COMBUSTION ENGINES

Application filed November 1, 1929. Serial No. 404,035.

My invention relates to pistons for internal combustion engines, and particularly to pistons wherein there are two parallel steel or equivalent ferrous metal plates or struts extending transverse to the piston pin axis and spaced apart to receive the upper end of the piston rod between them; the middle parts of said members being embedded in piers depending from the piston head and having bosses at their lower ends which provide bearings for the two ends of the piston pin, and the ends thereof being embedded in the guiding portion or skirt of the piston which lies below the head and contacts with the interior of the cylinder in which the piston operates. The head, piers and skirt are commonly cast from aluminum or from an alloy the principal ingredient of which is aluminum, and the plates or struts are made of steel or nickel-iron alloy, the coefficient of expansion of which is much less than aluminum; so that as the piston becomes heated it will, because of the steel or ferrous metal struts, expand at a rate close to that of cast iron of which the cylinder is made, instead of at a greater rate as is the case if the piston is made entirely of aluminum or equivalent light metal alloy; whereby seizing of the piston in the cylinder and scoring thereof, and other evils due to expansion of the piston faster than the cylinder expands, are obviated. My piston herein described and claimed is an improvement upon the piston to which my application filed March 20, 1922, Serial Number 545,312 relates, the improvement having for its object to provide a more perfect connection between the piers and the central parts of the plates, and between the ends of the plates and the skirt.

My present invention is illustrated in the drawing accompanying this specification, and is hereinafter described and explained in detail and particularly claimed at the end hereof. It will be appreciated, however, that my invention includes such variations and modifications, within the scope of the claims, of the particular embodiment thereof illustrated and described as will be obvious to those skilled in the art to which it relates.

In the drawing:

Figure 1 is a view showing my improved piston in side elevation.

Figure 2 is a view showing a section upon vertical planes parallel to the axis of the piston pin indicated by the broken line 2—2, Figure 1.

Figure 3 is a view showing a section upon transverse planes indicated by the line 3—3, Figure 1, looking down.

Figure 4 is likewise a view showing a section upon a plane perpendicular to the axis of the piston, as indicated by the line 4—4, Figure 2.

Figure 5 is a view showing the construction of the end of a strut or plate which is embedded in the skirt. It is a section upon a plane indicated by the lines 5—5, Figures 1 and 3, although the pins are shown in elevation. The construction, however, is one and the same at all four ends of the struts in the form of my invention illustrated.

Figure 6 is a side elevation showing another form of strut end which is embedded in the piston skirt.

Figure 7 is a section showing another form of strut end.

Figure 8 is a side elevation and Figure 9 a view showing it as seen from below looking up, of still another form of strut end.

Referring now to the drawing, the reference numeral 11 designates the head of my improved piston, the same having the usual ring grooves as shown; and 12, 12 piers depending from the head and having bosses 13 at their lower ends which provide bearings for the two ends of the piston pin, not shown. These piers and bosses are spaced apart to receive the upper end of the usual piston rod between them, and their upper ends merge with the head through horizontally disposed webs 14, vertical internal webs 15 and outer webs 16, to thereby impart sufficient strength to the head structure. All the parts here referred to are cast as a single integral structure of aluminum or equivalent light weight metal or alloy, as will be appreciated.

The skirt in the form of my improved piston illustrated is made up of two oppositely disposed sections or slippers 17, 17 cast of the same metal as the head and piers, they be-

ing shaped to fit the cylinder whereby the skirt guides the piston in its movement. These parts are separated from the periphery of the piston head 11 by slots 18, and their lower ends are formed with circumferential extensions 19 located below the pin bosses on each side of the piston, and which extensions extend toward one another and are separated by slots 20 beneath the ends of the pin bosses. The upper parts of the guides or slippers 17 are shown as extending each throughout approximately one-quarter of the circumference of the piston, although the circumferential extent of the slippers which form the guiding skirt is largely a matter of choice and may be varied.

In this as in my earlier application hereinbefore mentioned, the skirt sections or slippers are supported from the depending piers 12 by two parallel struts or plates 21, 21 the middle portions of which are embedded, during the casting of the piston, in the said piers, and the ends of which are embedded in the slipper sections during the casting process. The struts have central holes larger than the piston pin so that there will be aluminum at 22, Figure 3, in the bearing surface for the pin; and said struts are longitudinally corrugated, as shown, so that they may yield slightly to accommodate differences in up and down expansion of the struts and the aluminum in which they are embedded, due to the different coefficients of expansion of the aluminum and the steel of which the struts are made. The struts preferably but not necessarily extend throughout the vertical dimension or height of the piers, as best shown in Figure 2; and they are vertically arranged in the piston structure, and their planes extend transverse and at right angles to the axis of the piston pin, as will be understood.

If it be desired to eliminate, substantially, changes in diameter of the piston measured across the slippers, as the temperature of the piston varies, then the struts should be made of the nickel-iron alloy known as invar, which has a nil or substantially nil coefficient of expansion with changes in temperature. Inasmuch, however, as the cast iron cylinder in which the piston operates expands as it becomes heated a piston having struts of invar may be looser in its cylinder than is desirable, after the engine has operated for a time and both have attained their normal operating temperatures. I therefore prefer to use for the struts a ferrous material having a coefficient of expansion somewhat greater than that of invar, but not so great as that of ordinary steel; as by so doing I produce a piston which will have a substantially uniform clearance at such temperatures as are ordinarily met with in internal combustion engine practice. The struts being made from a material like steel I refer to them as of steel having in mind, however, the generic properties of the material rather than any particular ferrous metal composition, or distinguishing characteristic, other than that its coefficient of expansion shall be such as to control the expansion of the piston as herein explained.

The central portions of the struts or plates 21 where they are embedded in the piers are provided with holes in which transversely extending iron pins 23 are placed; certain of them being longer than others to provide a convenient method for supporting of the struts inside the mould and from a sand core used in casting the piston, during the casting operation; which pins may be upset to secure them the more firmly in the holes or the holes may be slightly smaller than the pins so that the pins when driven in the holes will stay in place. These long pins are shown in Figure 2, but as a matter of course their ends projecting inward from the piers will be cut off in finishing the piston casting. My invention, however, is not particularly concerned with the method of casting the piston, and the steel struts may be held in place during the casting operation in any suitable way. This central part of the struts is also preferably provided with other holes 24 in which there are no transverse pins, so that the molten aluminum runs through them during the casting of the piston; to thereby form ties between portions of aluminum upon opposite sides of the struts and provide more firm joints between the parts, as shown at the lower end of Figure 2.

When the piston is in use forces are set up, due to the angularity of the piston rod, which tend to move the piston pin and the lower parts of the piers transverse to the path of movement of the piston and along the struts, such movement being opposed by the slippers in contact with the cylinder and acting as abutments; and without the pins 23 or holes 24 these forces, disregarding the aluminum walls at 22, are of necessity resisted only by the gripping action upon opposite sides of the struts which results when the aluminum solidifies in the mould. The pins and holes, however, greatly augment the strength of the joint between the piers and the struts as the aluminum which surrounds the pins, because of its position relative to them, forms a solid wall acting to prevent relative sidewise movement between the parts; because the surfaces of contact between the aluminum and the pins are at right angles to the planes of the struts. As regards the holes, the aluminum which extends through them likewise provides abutments which oppose sidewise movement by surfaces which are disposed at right angles to the direction of such movement; and provides also a tie between oppositely disposed sides of the piers whereby enhanced gripping action between the surfaces of the aluminum and the struts is

secured as the molten metal cools and contracts.

The extremities of the plates or struts 21 are shown as bevelled to conform in a general way with a circle concentric with the circumference of the piston, and their ends are provided with holes 25 without pins, and with holes having transverse pins 26 in them, the same as hereinbefore explained in describing the construction at the central parts of the struts at the piers. All holes or all pins may, however, be employed at both places instead of part holes and part pins if desired, with enhanced holding or anchoring action in both cases.

During the casting operation the molten aluminum runs through the holes 25, as indicated at the left-hand side of Figure 3, and provides areas of aluminum and of steel which are disposed at right angles to the forces, due to angularity of the piston rod, acting longitudinally of the struts, the same as at the piers 12. At the ends of the struts, however, this construction provides a gripping action which is greatly increased over what it would be without the holes; because the aluminum in the holes and at the sides of the struts, and across the extremities thereof, provides in effect a continuous short ring of aluminum, as indicated by the circle at the lower left-hand side of Figure 3, which contracts as the metal sets and cools thereby providing a gripping action of large magnitude at the ends of the struts. In the form of my invention illustrated there are, as will be seen, three such gripping rings at each end of each strut or plate 21.

As regards the pins 26 which like the pins 23 are in effect parts of the struts, it will be seen that they are embedded in and surrounded by the metal of the skirt sections whereby there are provided portions of aluminum at 27, 28 in contact with the sides of each pin which, in connection with the pins, provide engaging parts arranged at right angles to the plane of the struts, and in which forces acting longitudinally of the struts are resisted by portions of the strut and of the metal of the slippers which are subjected to compression; whereby a much stronger joint and greater holding action are secured than is the case when the ends of the struts are held in the slippers merely by gripping action upon the sides of the struts acting at right angles to the planes of the struts, as is the case when the pins are not used. Also, the aluminum as it contracts after setting grips the sides of the pins, thereby further increasing the strength of the joint between the slipper sections and the ends of the struts.

Figure 6 shows a construction wherein the strut end 29, which is corrugated as in the forms hereinbefore described, is provided with slits 30, and with holes 31, through both of which the molten aluminum runs during the casting process; and Figure 7 shows a construction wherein portions of the strut 32 at the crests of the corrugations are punched from the metal of the strut, thereby forming projections or burrs 33 which combine in a single feature of construction the functions of both the pins and the holes; while in Figures 8 and 9 the end of the strut 34 is slotted, as at 35, and the ends 36 of the fingers thus formed are bent at right angles to the plane of the strut. The slots thus corresponding in function, approximately, with the holes in the form of strut structure first herein described; and the bent over extremities provide parts disposed at right angles to the plane of the strut and function substantially the same as the pins hereinbefore described. As regards the form shown in Figure 7 the punched out burrs may obviously be provided at the central parts of the struts where they are embedded in the piers, as well as at the ends of the struts as shown.

It will therefore be seen that my invention provides stronger joints at the places where the plates or struts are embedded in the aluminum of the piers and in the aluminum of the guiding skirt or slippers of the piston by providing portions of aluminum and of steel in engagement with one another and which are disposed at right angles to the forces due to the angularity of the piston rod, which forces tend to loosen the joints between the aluminum and the struts, there being many such pairs of metal so disposed throughout the piston. This feature prevents looseness from developing at the several joints even if it be assumed that the gripping action acting perpendicular to the planes of the struts due to the contraction of the aluminum as it cools, may in time be lessened, due to repeated heating and cooling of the piston and to such other forces as may tend to loosen the joints between the several parts. In addition to the restraining action due to surfaces perpendicular to the planes of the struts in engagement as above, which is inherent in both the hole and the pin construction, the hole form provides as hereinbefore explained increased gripping action between aluminum parts upon opposite sides of the strut, such action being particularly pronounced at the ends of the struts where they are embedded in the slippers or skirt sections of the piston.

As a matter of course the diameter of the head 11 of the piston is made considerably less than that of the piston across the skirt sections 17, tightness being accomplished by the rings, so that even though the head expands with the larger coefficient of expansion inherent in aluminum its periphery will never actually engage the interior of the cylinder; and although I have referred to the piston as cast from aluminum or aluminum alloy

the same may be made from other light metals or their alloys such, for example, as magnesium, which have a coefficient of expansion which is high as compared with the steel material of which the struts are made; and which unless prevented from doing so expand and seize in the cylinder, as the parts become heated to the temperatures commonly met with in internal combustion engine practice, unless excessive clearance is provided for between the piston and the interior of the cylinder.

Having thus described and explained my invention I claim and desire to secure by Letters Patent:

1. A piston of the class described having a head and depending piers cast integrally therewith, and having piston pin bosses at their lower ends; a cast metal skirt located beneath said head for guiding the piston; and two parallel vertically arranged corrugated steel struts spaced apart from one another and the central portions of which are embedded in said piers during the casting of the piston, and the ends of which are likewise embedded in said skirt, said struts having parts which extend therefrom at right angles to the planes of the struts and are embedded in the metal of the piston.

2. A piston of the class described cast from an alloy of which aluminum is the principal ingredient and having a head, skirt sections free from said head at the periphery thereof and located beneath said head, and piers depending from said head and having piston pin bosses at their lower ends; and two parallel vertically arranged corrugated steel struts spaced apart from one another and the central and end portions of which are embedded, respectively, in said piers and in said skirt sections during the casting of the piston; said struts having holes through them through which molten metal runs during the casting of the piston.

3. A piston of the class described cast from aluminum or an alloy of which aluminum is the principal ingredient and having a head, skirt sections free from said head at the periphery thereof and located beneath said head, and piers integral with and depending from said head and having piston pin bosses at their lower ends; and two parallel vertically arranged corrugated steel struts spaced apart from one another and the central and end portions of which are embedded, respectively, in said piers and in said skirt sections during the casting of the piston; said struts having projections embedded in the aluminum of the piston, and which extend transverse to the planes of the struts.

4. In a cast aluminum or aluminum alloy piston of the class described, a head portion; piers integral with said head and depending therefrom, and having piston pin bosses at their lower ends; oppositely arranged skirt sections located beneath said head and separated therefrom at the periphery of the head; two vertically arranged and longitudinally corrugated steel struts connecting said skirt sections and piers together, the middle parts of said struts being embedded in said piers and the ends in said skirt sections during the casting of the piston, said struts having holes through them where they are embedded in aluminum as aforesaid; and transversely extending pins in some of said holes and which pins are embedded in the aluminum of which the piston is made during the casting thereof.

In testimony whereof I affix my signature.

OTTO CARTER BERRY.