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PISTON FOR INTERNAL COMBUSTION ENGINES,
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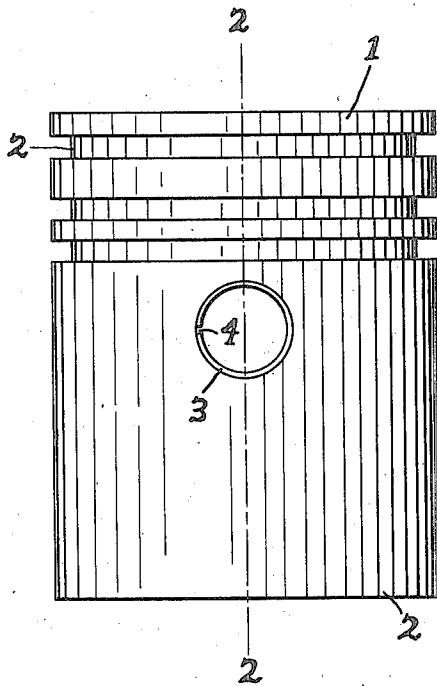


Fig. 1.

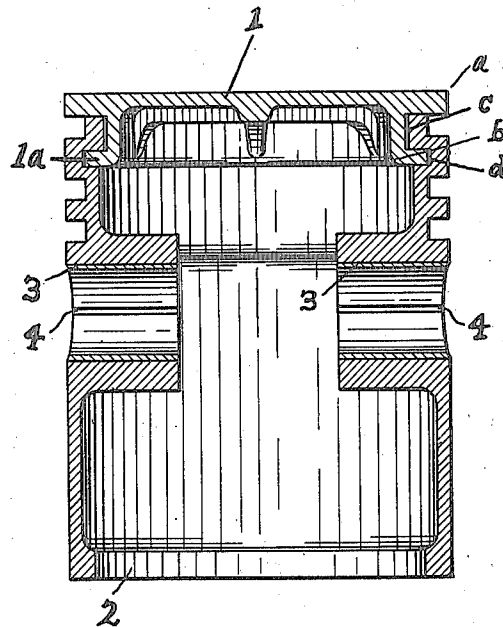


Fig. 2.

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PISTON FOR INTERNAL-COMBUSTION ENGINES.

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Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, DONALD JAMES CAMPBELL, a citizen of the United States of America, residing at Muskegon Heights, in the county of Muskegon and State of Michigan, have invented certain new and useful Improvements in Pistons for Internal-Combustion Engines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to improvements in so-called, trunk pistons for internal combustion engines, and more particularly in constructing such pistons from two metals, as will be hereinafter more fully described and particularly pointed out in the claims, reference being had to the accompanying drawing, in which:

Figure 1, shows a side elevation of my improved form of piston, and, Fig. 2, shows the same in vertical section on the line 2—2, of Fig. 1.

Like indices refer to like parts in both figures.

In present practice, in the construction of the so called, "high speed" and "high compression" internal combustion engines, it has been found very advantageous to construct the pistons of such engines just as light, in weight, as the various coefficients of strength of the metal, from which they may be made, will permit, having due regard as to the stress, strains and temperatures to which such pistons are to be subjected.

In conformity with the foregoing stated practice, there have been used, pistons made from various alloys of aluminum, which have attained varying degrees of success and failure. It has been found in practice, that such aluminum alloy pistons have given considerable trouble, in that, any available alloy of aluminum that has thus far been produced has not, under the conditions of the extremely high temperatures and the shock and strains of the blow of the explosions to which such pistons must, of necessity, be subjected under working conditions, proven capable of standing up as they should under

continuous heavy load, except when such pistons are made with comparatively very heavy walls, particularly in the heads, and even then, if such pistons are over three inches in diameter, the heads require deep, heavy bracing ribs. In the designing of pistons to be made from aluminum alloys, it has been found necessary to make the heads thereof very much thicker and to more thoroughly rib and brace the same to enable them to withstand the temperature and shock of the explosions. These conditions make it necessary to provide aluminum alloy pistons with comparatively very heavy heads and numerous deep ribs, and thus the single, desirable feature of aluminum alloy pistons, namely; lightness, is to a very material extent negatived by this thickness of wall and numerous ribs. Another very material point militating against the satisfactory performance of aluminum alloy pistons is the high thermal conductivity of such alloys, as compared with iron or steel. Thus, the head of an aluminum alloy piston, being subjected to the extremely high temperature of the explosions, possesses the capacity of absorbing and conveying to the skirt or barrel of such pistons, a much greater quantity of heat, than would a steel or iron piston, under like temperature and working conditions. This property of high thermal conductivity is most undesirable in a piston for internal combustion engines, because, so much more heat will be conveyed to the oil films on the piston and cylinder walls and the bearings of the piston pin that the proper and required lubrication of these parts is rendered much more than normally difficult to effect and maintain because of the much more rapid carbonization of the oil films. Another condition which is claimed to exist in internal combustion engines in which aluminum alloy pistons are used, and particularly in which the so called, "splash" system of lubrication is used, is: that because of the greater heat conductivity of aluminum alloy pistons, as compared with iron or steel pistons, the oil in the supply reservoir in the crank case is raised to a much higher temperature than it is when iron or steel pistons

are used, and thus such oil is rendered less efficient in lubricating power, and becomes more quickly burned or carbonized and its lubricating power lessened or destroyed.

5 These conditions result in a less efficient lubrication of the several moving parts of an engine, besides, materially increasing the oil consumption.

Further, the very material difference of
10 coefficient of linear expansion of aluminum alloys as compared with iron or steel (being substantially three to one, respectively), makes it necessary to machine aluminum alloy pistons with a much greater allowance
15 for expansion than is required for steel or iron pistons, and thus it is much more difficult, if not quite impossible, to produce a quiet, efficient working piston, under the varying conditions of speed and load required, from an aluminum alloy, than to
20 produce such a piston from iron or steel.

Finally, the melting point of aluminum is practically only one half that of cast iron or steel. (Aluminum 625° C., cast iron
25 1220° C., and steel 1400° C., Roberts-Austen, authority.)

Having thus pointed out the comparatively well known advantages and disadvantages of pistons as now constructed, I
30 will now proceed to describe and explain my present invention.

By the utilization of my present invention I am able to retain all of the advantages of strength, resistance to overheating
35 and low coefficient of expansion and high melting point inherent in the full cast iron or steel piston, while by the same structure I gain the advantage of reduction of weight of aluminum alloy pistons; while at the
40 same time I avoid the very fragile nature, high thermal conductivity and high coefficient of expansion and low melting point of the same. By using cast iron or an equivalent metal for the head portion the same
45 can be made with a very thin wall and few strengthening ribs, and such a head portion in combination with a thin walled aluminum alloy skirt or barrel portion, produces a piston which possesses all the requisite
50 factors of strength, resistance to distortion, low coefficients of thermal conductivity and expansion and high melting point of the part which is directly exposed to the extreme heat and the shock of the explosion, while at the same time such a piston
55 is substantially, if not fully, as light in weight as a full aluminum alloy piston can be made which would withstand the strains and heat to which it would be subjected
60 under working conditions.

Referring to the accompanying drawing, Fig. 1, it will be noted, that the external appearance of my improved form of piston is the same as the ordinary usual construction

of trunk piston; referring to Fig. 2, 1, 65 is the head of the piston, which is to be produced, preferably, from cast iron, the surfaces of which, from the point (a), continuously, longitudinally and circumferentially, down to the point (b), are to be thoroughly
70 cleaned, preferably by machining, before the barrel or skirt portion 2, (which is to be produced, preferably, from a light weight aluminum alloy), is joined to the head portion 1. I prefer to accomplish the joining
75 of the two said parts by casting the skirt or barrel portion onto the head portion. This may be easily done by fixing the head 1, on a formed casting core, then placing the said core together with the part 1, attached
80 thereto, into a suitably prepared mold and casting the skirt or barrel portion 2, onto the head 1. This method is entirely practicable, since the temperature of the melted aluminum alloy is far below the melting point
85 of the material from which the head portion 1 is to be made. It will be noted that the projecting flange 1^a, of the head 1, will, at the time of casting, form a groove in the skirt or barrel portion 2, and by the inter-
90 locking of this groove and flange the head and skirt will be held inseparably and securely together.

In the construction as shown in the drawing, to make special provision against rupture
95 of the skirt 2, where it, in cooling, shrinks onto the head 1, I have provided at the points (c) and (d), a compressible packing or gasket, preferably of asbestos tape, but this provision is not absolutely necessary, for I have found in practice that by
100 heating the head 1, to as high a temperature as the core to which it is attached will stand, without crumbling or breaking up, the normal shrinkage of the skirt 2, and the
105 head 1, in cooling, will be just right to form a firm stable joint between these two parts, without putting undue strain on the skirt or barrel portion 2. I have also thought it expedient to provide, in the piston pin
110 bosses, a lining or bushing 3, of steel or any suitable bearing metal. Said linings may be formed from tubes, with a portion as at 4, removed throughout their entire length. This opening permits of compression of the
115 linings 3, as the metal of the bosses shrink in cooling. These linings 3, are also to be fixed onto the casting core, and thus, when the skirt or barrel 2, is cast, become rigidly
120 fixed into the bosses of the same.

These linings 3, as well as the packings or gaskets (c) and (d), may be dispensed with, without departing from the essential features or spirit of my invention.

The required machining of my improved
125 construction of piston may be performed in the same manner as that of the standard form of trunk pistons. I desire to call at-

tention to the fact, that in my improved construction of piston, only so much heat can be transmitted to the skirt or barrel portion 2, as would normally be transmitted to the skirt or barrel of a full steel or iron piston, since the absorption of heat from the explosions is limited to the amount of heat which can be absorbed and transmitted by the steel or iron head, and even this transmission will be abnormally retarded on account of the fact, that in operation oil will work into the joint between the head 1, and skirt 2, and act as a partial heat insulation, the result being that, the aluminum alloy skirt or barrel 2, of my improved form of piston, will under working conditions, remain at a much lower temperature than it would be possible for the skirt or barrel of a full aluminum alloy piston to work at, and as accurately as it has been possible for me to determine, the aluminum alloy skirt or barrel of my improved form of piston remains at substantially the same temperature, or a trifle lower, than would the skirt or barrel of a full steel or cast iron piston, working under like conditions.

It will be further noted, that because of the reduction of the quantity of heat transmitted to and the lower temperature of skirt 2, the expansion of this aluminum alloy skirt will be very materially reduced, as compared with the expansion of the skirt of a full aluminum alloy piston, and thus, at least a material part, of one of the great disadvantages of an aluminum alloy piston will be quite materially reduced.

Another point to be observed is: that by my improved construction I have so arranged the parts, so that, the metal of the highest coefficient of expansion is subjected to the least influence of the extreme heat of the combustion chamber, and at the same time, should any abnormal condition arise by which this aluminum alloy skirt 2, should be caused to unduly expand from the effect of heat, either frictionally generated or transmitted, said skirt 2, is free to expand away from the iron or steel head 1, at their point of engagement, and thus neither the skirt nor head would be distorted or broken by such excessive expansion.

I do not wish to be understood as limiting my invention to the exact specific details of construction which I have herein shown and described, since, variations in the details of construction may be had without departing from the essential purpose or spirit of my invention. Nor do I limit my invention to the use of a cast iron head, or any particular alloy of aluminum from which the skirt is to be made, since, the heads may be made from cast iron, steel or nickel, or alloys of any two or more of such metals, and formed by stamping, forging or casting, and the

skirt may be made from any one of a variety of aluminum alloys, and cast, forged, stamped, spun, and fixed onto the heads by a number of different methods.

The basic principle upon which my invention rests, is: the utilization of a head portion, which is to be subjected to the destructive influence of the high temperature and disruptive force of the blow and shock of the explosions, to be made from a metal which possesses the physical properties and characteristics of high melting point, high resistance to deflecting strains, fire erosion and mechanical abrasion, with a low coefficient of expansion and thermal conductivity, and to have fixed thereto, a skirt or barrel portion to be made from a metal possessing one essential physical property, namely, relative lightness, as compared with the metal from which the head is made.

I claim:

1. A piston comprising a head portion and a skirt portion inseparably joined together in operative relation by a groove and flange connection.

2. A piston of the class described consisting of, a head portion made from a metal, the physical properties and characteristics of which are, high melting point, high resistance to deflecting stresses and relatively low thermal conductivity and expansion, and a skirt or barrel portion made from a metal, the principal physical property of which is lightness as compared with the metal of the said head, said parts being inseparably joined together in operative relation.

3. A piston of the class described consisting of, a head portion made from a metal, the physical properties and characteristics of which are, high melting point, high resistance to deflecting stresses and relatively low thermal conductivity and expansion, and a skirt or barrel portion made from a metal, the principal physical property of which is lightness as compared with the metal of the said head, said parts being inseparably joined together in operative relation by casting the said skirt portion onto the head portion.

4. In a piston of the class described consisting of, a head portion and a skirt portion, said portions being made from two different metals of very materially different physical properties and characteristics, namely, of tensile strength, resistance to deflecting strains, coefficients of thermal conductivity, expansion, melting point and relative weight, said parts being inseparably joined by casting the part made from the metal of the lower melting point onto the other part.

5. A piston of the class described comprising a head portion of cast iron, and a skirt

portion of aluminum alloy, said two portions being inseparably joined by means of interlocking portions of one member engaging corresponding interlocking portions on
5 the other member.

6. A piston of the class described comprising, a cast iron head portion having an external circumferential groove, an aluminum alloy skirt portion inseparably joined

to said head portion by being cast onto the 10 same so that an internal projecting flange of said skirt portion engages the said groove of said head portion.

In testimony whereof I hereunto affix my signature to the foregoing specifications and 15 claims.

DONALD JAMES CAMPBELL.