

C. P. HOLLISTER.
 PISTON AND METHOD OF MAKING THE SAME.
 APPLICATION FILED DEC. 19, 1917.

1,362,313.

Patented Dec. 14, 1920.

2 SHEETS—SHEET 1.

Fig. 1.

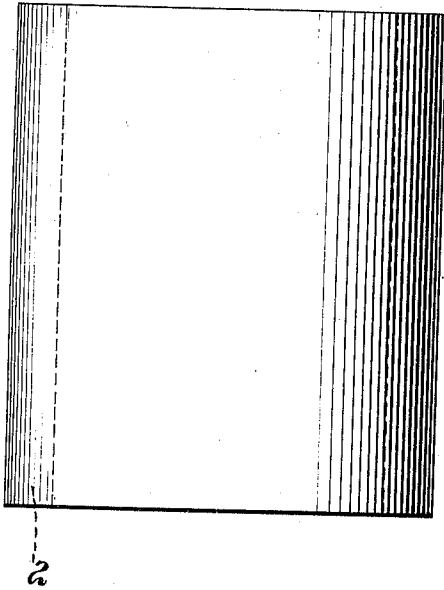


Fig. 2.

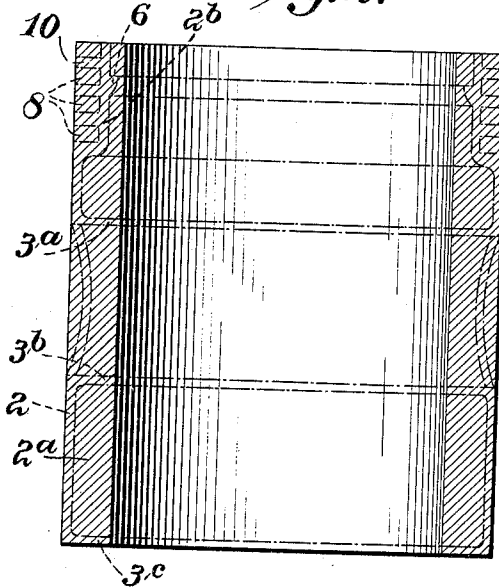
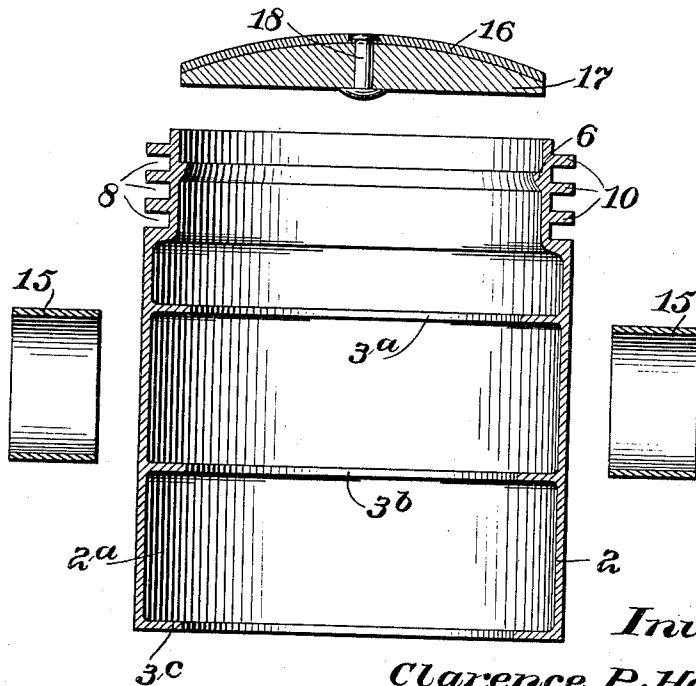


Fig. 3.



Inventor:

Clarence P. Hollister,

by Eugene C. Brown
 Atty.

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 2 SHEETS—SHEET 2.

Fig. 4.

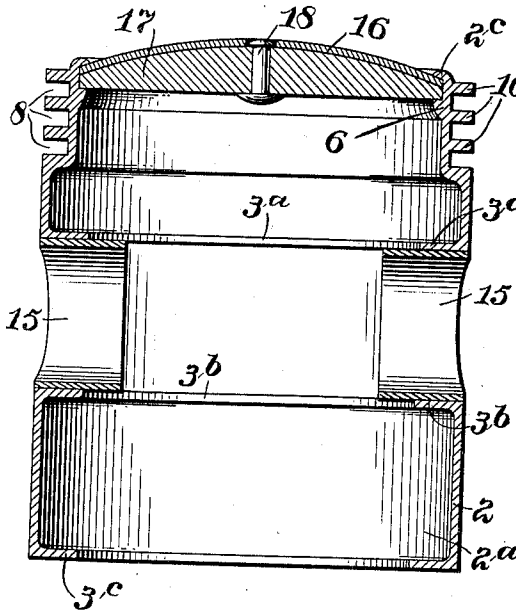


Fig. 5.

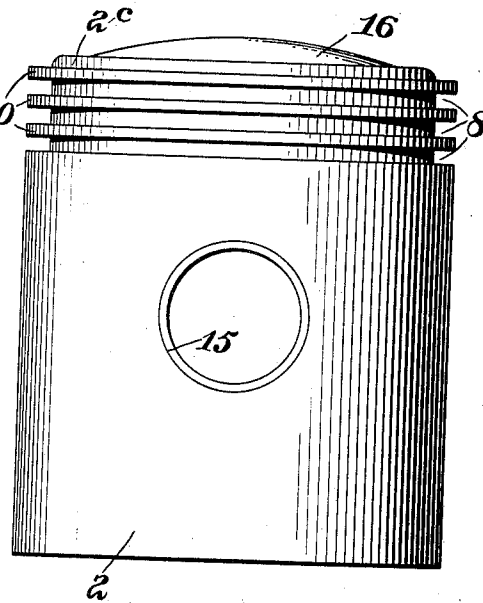


Fig. 6.

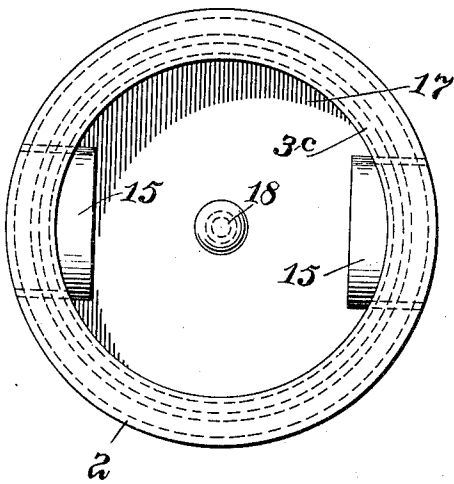
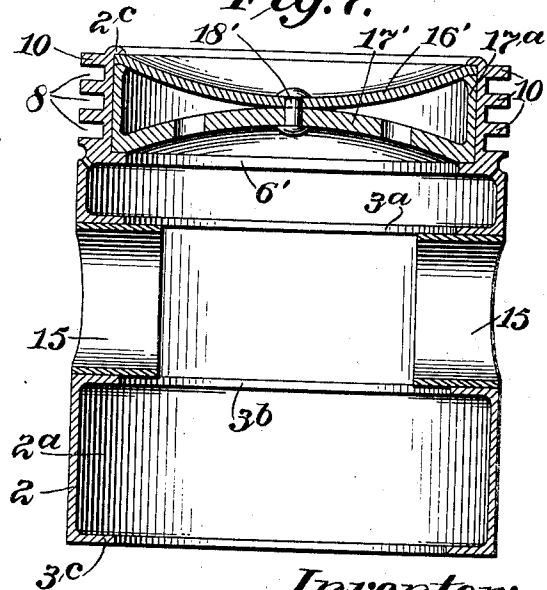


Fig. 7.



Inventor:

Clarence P. Hollister,
by Eugene C. Brown
Atty.

UNITED STATES PATENT OFFICE.

CLARENCE P. HOLLISTER, OF NEW YORK, N. Y.

PISTON AND METHOD OF MAKING THE SAME.

1,362,313.

Specification of Letters Patent.

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Application filed December 19, 1917. Serial No. 207,840.

To all whom it may concern:

Be it known that I, CLARENCE P. HOLLISTER, a citizen of the United States, residing at New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Pistons and Methods of Making the Same, of which the following is a specification.

This invention relates to pistons especially adapted for internal combustion engines and to the method of making the same.

The main objects of my invention are to provide a very light steel piston having a high degree of rigidity, and to provide for the rapid transfer of heat from the piston head to the side walls to thereby preserve the integrity of the piston and reduce the danger of pre-ignition or pre-expansion of the charge of combustible mixture.

To this end the invention contemplates a method of making pistons, which consists in boring or cutting from drawn seamless steel tubing or from bar stock, the entire skirt portion of the piston, with exterior annular grooves to receive the piston rings and interior annular flanges or ribs adapted to stiffen the piston and strengthen it against lateral stresses, the central flanges serving also as fastening means for the wrist-pin bushings or bearings, which are welded thereto; then fashioning the piston head from sheet metal by stamping or spinning; reinforcing the head by means of a metal insert of high heat conductivity, such as aluminum, which will rapidly transfer the heat from the head to the skirt portion and then uniting the head and skirt preferably by means of a bead rolled from the upper margin of the skirt portion.

The method of manufacture and the structural features of pistons embodying my invention will be understood from the following description in connection with the accompanying drawings, in which—

Figure 1 is a side elevation of a drawn steel tube from which the skirt portion of the piston may be constructed; Fig. 2 is a vertical cross section of the same, showing in dotted lines the manner of boring or cutting away the metal to form the skirt; Fig. 3 is a sectional view of the parts of the piston before they are united to form the complete piston; Fig. 4 is a vertical section of the completed

piston; Fig. 5 is a side elevation and Fig. 6, a bottom plan view of the same; and Fig. 7 is a vertical section of a modified form of my piston.

In modern high speed internal combustion engines for use in automobiles and especially for use in aeroplanes, it is particularly advantageous to have the pistons very light. For this reason it has been proposed to make them of aluminum, but this metal has the serious disadvantage of large expansion and contraction when subjected to wide ranges of temperature. Steel has the advantage of being much less susceptible to expansion and contraction and also provides long wearing non-frictional surfaces. Pistons made of steel can, therefore, be machined to fit the cylinder very snugly.

It has been proposed to make the skirt or body portion of the piston of thin steel tubing and to strengthen it by forming the head of a drop forging which is welded to the thin steel shell. This construction, however, does not afford sufficient rigidity in the skirt portion, while the drop forged head unduly increases the weight and retains too much of the heat imparted by the exploding gases.

I have overcome the difficulties heretofore encountered by devising a method of constructing pistons of drawn steel tubing in which the greater portion may have very thin walls to insure lightness, while a high degree of rigidity and strength is secured by means of a plurality of integral annular ribs.

While the skirt portion of the piston may be bored from bar stock steel, I prefer to construct it from drawn steel tubing, such as illustrated in Figs. 1 and 2 having walls 2^a, the thickness of the wall 2 of the finished piston, plus the width of the annular strengthening ribs 3^a, 3^b, 3^c. The walls are then cut or machined upon the interior until the metal has been cut away as indicated by the dotted lines in Fig. 2, leaving a bottom rib or flange 3^c, two intermediate ribs 3^a, 3^b and a contracted upper wall portion 2^b having an inwardly extending annular ledge 6, near the top upon which the piston head may seat. Grooves 8, cut in the outer side for the packing rings provide exterior flanges 10, which reinforce and strengthen the upper portion of the piston wall. These internal and external ribs or annular flanges

shaped from the solid steel tube afford such strength and rigidity to the thin walls of the piston as to prevent any lateral distortion as cannot be obtained with the same weight of metal when separate ribs are welded thereto. Moreover, by this method of construction I am enabled to obtain absolute homogeneity in the thermal qualities of the walls and ribs as is not the case when separate metal parts are united.

The ribs 3^a and 3^b are placed at the proper distance apart so that they will serve as supporting flanges for the wrist-pin bushings 15. Holes are first bored in the piston walls of the proper diameter and the bushings are then inserted and welded or brazed to the flanges so that they become an integral part of the piston.

The piston head, in the form shown in Figs. 3, 4 and 5 is constructed by stamping or spinning from sheet steel a concavo-convex disk 16 of a proper diameter to fit into the upper end of the bore of the piston. A disk of aluminum is then constructed in any suitable manner to form a plano-convex disk 17, which is rigidly secured to the disk 16 as by means of a rivet 18, which may be welded or brazed to the plate 16 and be upset at its lower end against the bottom wall of the disk 17, in the manner illustrated in Figs. 3 and 4. This duplex head is then inserted in the upper end of the piston and the upper margin of the piston wall is rolled over the perimeter of the head into a bead 2^c to thereby rigidly secure the head upon the inner annular ledge 6. This construction is exceedingly rigid and strong and is compact and easy to manufacture.

While the arched form of the steel disk 16 possesses a large amount of inherent strength, owing to its thinness, it would be liable to collapse when subjected to the exceedingly high temperatures of the exploding gases which are concentrated upon the piston head. To increase the thickness of the steel plate would defeat the purposes of my invention, not only by largely increasing weight, but also because the greater mass of steel would retain the heat and thereby cause pre-ignition of the explosive gases and also, to a large extent, increase the pre-expansion of the charge before explosion. To obviate these difficulties and to very greatly increase the efficiency of the engines I have devised the duplex piston head above described, by reducing the steel in the head to a minimum and then reinforcing this comparatively thin steel disk 16 with a thick disk of aluminum 17, which serves the double purpose of reinforcing the thin steel disk and also of conducting the heat away from the steel disk 16 and transferring it with great rapidity to the side walls of the piston, thereby distributing the heat over large

metal surfaces and preventing the undue heating of the piston head. The exceedingly great importance of this feature of my invention will be appreciated by engineers and especially by those who have had experience in the operation of high-speed internal combustion engines.

Instead of forming the head with an upwardly extending convexity, as in the form above described, I may make the end of the head concave, by stamping the steel plate as shown at 16' in Fig. 7. For the purpose of forming an exceedingly rigid head, I may construct the aluminum reinforcement with a reversely formed convex disk portion 17', having an upwardly extending annular flange or skirt portion 17^a, upon which the periphery of the steel disk rests, the aluminum reinforcement being supported upon the inner annular ledge 6'. In this construction, in which the convexities of the steel plate 16' and aluminum disk 17' brace each other, the parts form, in effect, a truss, which is able to resist enormous pressures. The steel and aluminum parts are rigidly secured together by means of the rivet 18' as in the previous form. In this modification, it is evident, that the heat will be rapidly conducted away from the steel disk 16' both at the center and around the entire peripheral margin by the contact of the aluminum reinforcement, and the heat will be quickly and effectively transferred to the side walls of the piston.

The peculiar advantages possessed by the pistons constructed in accordance with my invention will now be appreciated.

By reason of its lightness, this piston is especially adapted to high-speed engines. The drawn steel body provides long wearing non-frictional surfaces and being formed of steel which is homogeneous throughout, by reason of the integral construction of the skirt and reinforcing ribs, it is less susceptible to the expansion and contraction than cast iron or steel provided with separate reinforcing parts which are welded or otherwise secured thereto and the piston can, therefore, be machined to fit the cylinder very snugly and can be made with very thin walls. The duplex construction of the head, having a minimum amount of steel and a large amount of aluminum, which has the property of absorbing and transferring heat with great rapidity, provides a piston head having the very desirable qualities of great strength and rigidity and at the same time, of remaining comparatively cool even when subjected to the very high temperatures in high-speed explosion engines.

I have described the different forms of construction illustrated in the accompanying drawings for the purpose of definitely disclosing embodiments of my invention, but

it will be apparent to engineers that various changes and modifications may be made within the scope of my claims and without in any manner departing from the spirit of my invention.

I claim:—

1. The method of making pistons, which comprises forming the skirt-portion from an integral steel tube having a thickness equal to that of the finished wall plus reinforcing flanges, cutting the metal upon the interior until it is reduced to the desired thickness of the piston wall but leaving a plurality of uncut portions to form interior annular flanges, and a thickened portion adjacent the head end thereof, boring alined openings upon opposite sides of the wall between adjacent flanges, inserting wrist-pin bushings and securing them to said flanges, cutting a series of grooves in said thickened part to receive the piston rings, forming a disk-like head and securing it to said head end of the tube.

2. In the method of making pistons, as specified in claim 1, forming said head of an outer thin steel disk and an inner reinforcing aluminum disk secured to each other.

3. In the method of making pistons, as specified in claim 1, forming said head of an outer thin steel disk and an inner thicker aluminum disk secured in contact therewith, inserting the head in the bore of the skirt portion and rolling the edge thereof

over the margin of the head to form a retaining head.

4. The method of making pistons, which comprises forming the skirt-portion from an integral steel tube having a thickness equal to that of the finished wall plus reinforcing flanges, cutting the metal upon the interior until it is reduced to the desired thickness of the piston wall but leaving a plurality of uncut portions to form interior annular flanges, and a thickened portion adjacent the head end thereof, and cutting a series of grooves in said thickened part to receive the piston rings.

5. A piston comprising a skirt portion formed from an integral drawn steel tube and provided with exterior ring-receiving grooves and interior annular flanges cut from the metal of the tube, and a head secured to the end of the tube.

6. A piston as specified in claim 5, in which the head is formed of an outer steel disk and an inner disk of aluminum adapted to reinforce the steel disk and to conduct the heat therefrom.

7. A piston as specified in claim 5, and wrist-pin bushings inserted into opposite alining apertures in the wall of the skirt portion and secured upon opposite sides to adjacent interior flanges which serve as supporting bosses for the bushings.

In testimony whereof I affix my signature.

CLARENCE P. HOLLISTER.