E. A. TURNER.

PISTON FOR INTERNAL COMBUSTION ENGINES.

APPLICATION FILED DEC. 28, 1917.

**1,312,880.** Patented Aug. 12, 1919.

Fig. 1.

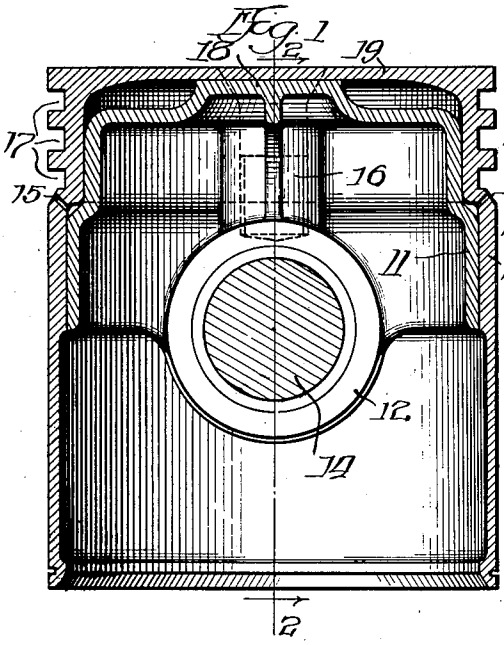



Fig. 2.

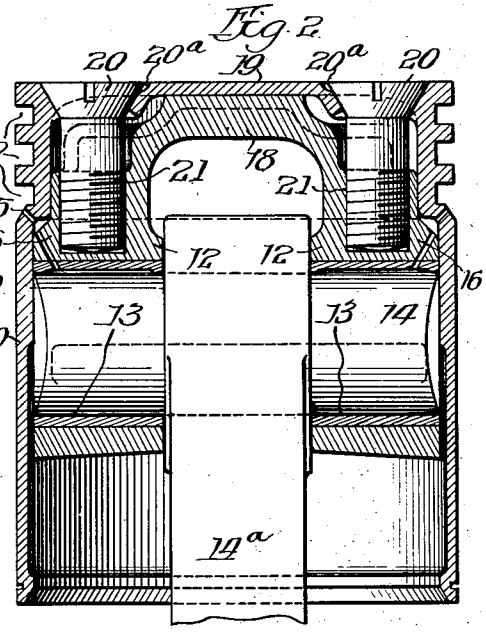



Fig. 3.

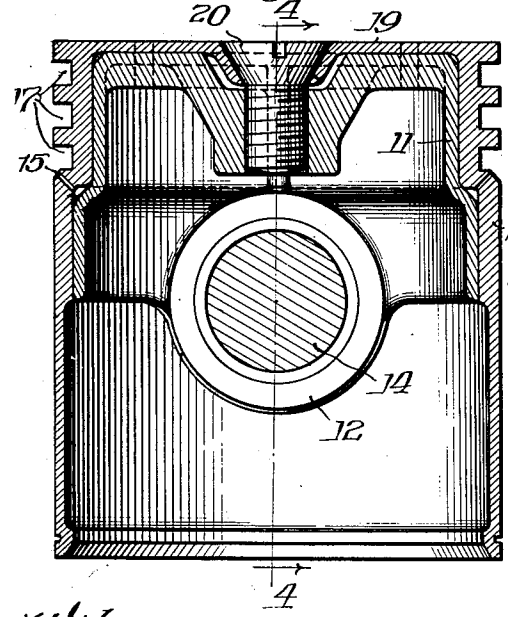
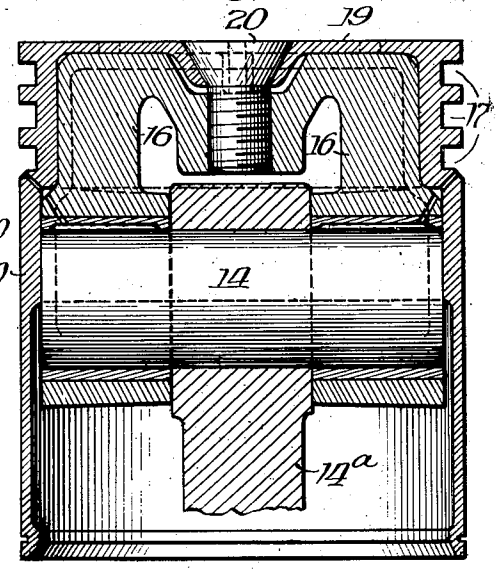



Fig. 4.




Witness:

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# UNITED STATES PATENT OFFICE.

EDGAR AMES TURNER, OF CHICAGO, ILLINOIS, ASSIGNOR TO NORTH-WESTERN EXPANDED METAL CO., OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

## PISTON FOR INTERNAL-COMBUSTION ENGINES.

1,312,880. Specification of Letters Patent. Patented Aug. 12, 1919.

Application filed December 28, 1917. Serial No. 209,274.

*To all whom it may concern:*

Be it known that I, EDGAR AMES TURNER, a citizen of the United States, and a resident of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Pistons for Internal-Combustion Engines, of which the following is a specification.

The present invention relates in general to pistons, and more particularly to that type of piston which employs a relatively elongated exterior side-wall, body or skirt having a large bearing surface against the wall of the cylinder within which it operates, such type of piston being utilized in lieu of construction utilizing a piston having a relatively short side-wall in combination with a cross head. More specifically the invention contemplates the provision of an improved piston structure peculiarly adapted to the conditions of modern internal combustion engine practice, though its utility is by no means limited to the explosion types of motors.

To the end that my present improvements may be best understood by those who are skilled in the art to which it pertains, I wish to point out that I desire to gain all the advantage of light weight, high heat conductivity, and detachability from the piston-head of the piston-wall and associated parts with little or no disturbance of such head, or of the connecting rod, and wrist pin where the latter is used, without sacrifice of any of the qualities of strength, support, wear resistance, rigidity, polishability, or of any of the other elements of efficiency in pistons of the best types known to me.

It is recognized in modern engineering practice relating to the construction of motors, especially multi-cylindered motors for automobiles, aeroplanes and the like, where the trend is toward higher compression small cylinder bore and longer piston stroke, that on the one hand greater efficiency is attained by the use of pistons formed of the lighter weight metals such as aluminum or its alloys, but that on the other hand the longevity in service to be attained by the uses of iron is sacrificed by the substitution of the lighter metals in piston construction.

It has been found as a result of experience, that pistons formed of metals of light weight or alloys thereof, heretofore employed, are of relatively short life, (or at best require early repairs or replacement as compared with iron pistons) owing to their lack of resistance to wear and mechanical strength, exhibited largely through their inability to afford a permanent tight seat for the piston rings, with ensuant "slap", loss of compression, and oil-leakage. Furthermore, they not only lack the inherent ability to take a high mirror-like polish as does cast iron, but on the other hand, having both a high co-efficient of heat expansion and a soft surface, they exhibit tendencies to enlarge in cross section, and grab or seize the cylinder walls at extra high engine speed and load. Again while light metal or alloy pistons exhibit excellent qualities of heat conduction, their use entails allowance for their high coefficient of heat expansion by providing for greater clearance than needed with iron pistons, with ensuant disadvantages at low motor temperatures of looseness of fit, "slap", loss of compression, and leakage of oil upward past the piston-head with resultant carbon deposits, which tend to interfere with the action of the piston-rings, and on becoming incandescent to cause pre-ignition of the explosive charge in the compression chamber. Likewise, such carbon particles, and road dust, especially when associated with soft metal and the alloys thereof which remain velvety and wear rapidly, tend to become embedded in the outer walls of the piston, which are in frictional contact with the inner walls of the cylinder, act as abrasive elements with slow but continuous lapping effect on such cylinder walls causing them, as well as the piston itself, to become out of round.

Cast iron on the other hand is, in modern practice in this art, open to the very great objection of excess weight though it presents the advantages of great strength, rigidity, wear resistance, low co-efficient of heat expansion, freedom from distortion under heat and a high ability to take and retain a mirror-like polish on frictional surfaces such as marks its contact with the interior walls of a cylinder when used in piston construction.

Furthermore, in the use of low gravity fuels, employed largely at this day for driving internal combustion engines, (the trend being even toward heavier oils such as naphtha and kerosene) the pre-ignition point is much lower than was the case a few

years ago, this fact requiring when iron is used in constructing the piston, a material thickening of the piston head (with consequent further increase in the undesirable factor of weight) in order to provide a sufficient mass of metal to attain the desired degree of heat conductance with resultant lowering of temperature on top of the piston.

The principal objects of my present invention therefore are: the provision of a piston characterized by the employment of a built-up construction wherein some metal, even if relatively heavy but having a relatively hard and polishable wearing surface and preferably a low co-efficient of expansion with ensuant freedom from distortion, is employed for the piston head and external piston body, wall or skirt, in combination with some metal having a high conductivity of heat, and preferably one of light specific gravity employed for the interior core; the provision of a built-up piston structure wherein the piston core is extended up to and abuts against the top of the piston so as to transmit heat from the central portion of the piston head against which the explosive force of the burning gases act, and where the heat is most intense; the provision of an improved form of built-up piston structure comprising separate core or skeleton and head with wall or skirt wherein the parts are readily detachable; the provision of improved means for conducting heat away from the piston head and wall and for facilitating the dissipation of such heat; the provision of an improved form of piston which is characterized not only by light weight but also by an improved degree of ability to conduct the heat from the piston head and wall to the connecting rod or pitman whereby the dissipation of heat is facilitated, together with such other objects as may hereinafter appear. In attaining the objects outlined above, and certain additional benefits and advantages to be pointed out below, I have provided constructions illustrated in the accompanying drawings wherein—

Figure 1 is a vertical sectional elevation of a piston embodying my present improvements;

Fig. 2 is a central vertical sectional view of the structure of Fig. 1 taken on the line 2—2 therein; and

Figs. 3 and 4 are views similar to those of Figs. 1 and 2, Fig. 4 being a view taken on line 4—4 of Fig. 3, illustrative of a modified form of construction.

Referring now more particularly to the structure of Figs. 1 and 2, it will be observed that I have here shown my present improvements applied to a form of piston employed in internal combustion engines, wherein, the piston body, wall, or skirt 10 is mounted on a core 11 provided with means, such as the bosses 12 apertured as at 13 for the reception of a wrist pin 14, and thus attachment to a connecting rod or pitman 14a. Where a wrist pin, or ball and socket joint, or other flexible connection is used, I prefer to provide lubrication grooves, as indicated at 15, which may be conveniently disposed in complementary passages in the piston wall 10, and in the ribs 16 that form part of the body of the carrier 11, and give it a skeleton form such as is desirable for the sake of lightness. The piston wall 10 is also provided with such circumferential annular recesses or grooves (indicated at 17) as may be desired for the reception of the piston rings.

Now it will be apparent on examination of the drawing that in each case the core or skeleton 11 has a solid top 18 contacting with the central portion of the piston head 19, which provides means for transmitting heat from the piston head 19 to the core 11.

In some modern multi-cylindered gas-engines having removable cylinder heads, especially where crank-shafts having large connecting rod bearings and counter-balance weights and crank throws disposed in a plurality of planes are employed, it is desirable that the pistons and any associated parts such as piston rings may be installed from the tops of the cylinders in assembling the engine, or even from time to time withdrawn therefrom for inspection, cleaning, repair or replacement. In such cases, I preferably detachably secure the piston wall or skirt 10 to the carrier 11 by means of flat head counter-sunk screws 20 having threaded engagement with apertures 21 in one of the ribs 16. The apertures 21 are preferably arranged immediately over the bosses 12 in order that all tension strains—on outward strokes of the piston in compressing the charge of gas and in scavenging the burnt gases, where the centrifugal force of the piston is greater than the resistance of the contents of the firing chamber, as well as on the compression strains of explosion strokes—may be transmitted in a straight line between the screws 20 and bosses 21 through their connecting rib 16 and directly to the wrist pin 14, instead of transversely thereto with consequent tendency to distortion. The screws 20 may be restrained from accidental rotation by driving a small portion of the outer edge of the screw into a notch 20a.

In Figs. 3 and 4, I have shown a construction similar in certain respects to that of Figs. 1 and 2, save mainly that but a single central screw is employed for attaching the head 19 to the core 11.

This is desirable since any inequalities serve as foci for the deposit and retention of carbon particles, tending on accumulation and subsequent incandescence to become live

points of fire and thereby to cause pre-ignition of the compressed charge in the explosion chamber.

On the other hand, the construction of Figs. 1 and 2 presents advantages to be pointed out, especially in that all strains are transmitted in direct alinement.

In constructing the form of piston above described I preferably form the outer wall or elongated skirt 10 of some form of iron or other hard metal, and the inner core or skeleton of aluminum or of an alloy thereof, a ground or other gas-tight joint being formed at some point of contact therebetween, such as the seat between the head 19 and that portion of the top 18 of the core lying immediately thereunder. The parallel portions of the members 10 and 11 should fit closely so as to give, as far as possible, a tight telescopic joint therebetween at all points under normal operating temperatures, owing to the difference in the relative co-efficients of heat expansion between the two dissimilar metals when proper predetermined clearances are used between such dissimilar metals. Aluminum alloys are very light in weight compared with any hard durable metal such as cast iron or steel, and in this construction would constitute the core or skeleton, and thus the bulk of the mass of the piston. The outer piston sleeve or wall, fitted closely into the core, could be machined both inside and outside and be very thin and light in weight even if made of iron. Aluminum alloy is furthermore an excellent conductor of heat, and it would in the present construction be a solid integral mass with its upper face in contact with the central portion of the piston head which has its principal surface exposed to the spot where most of the heat in the piston is generated. Being also in intimate contact with the outer piston sleeve on the side walls and having a large area exposed to the cooling splash of the lubricating oil and comparatively cooler air of the crank case, as well as being situated to transmit heat directly down the connecting rod to which it is attached, it provides means of constructing a piston of lighter weight than is possible with the lightest feasible cast iron piston without in the least, however, sacrificing the admirable wearing qualities, low co-efficient of heat expansion, and freedom from distortion of the solid cast iron type of piston. At the same time it provides far better cooling of the piston head than is possible with cast iron. The perfect cylindrical form of the outer piston sleeve or wall, the complete absence of inequalities of thickness in the wall, and of wrist pin bosses, ribs under the piston head, etc., would further tend to give uniform heat expansion and freedom from distortion, thereby preventing the piston itself from becoming out of round and causing uneven wear or possible scoring to the cylinder walls under heat, and the piston wall losing its close and even contact with the cylinder walls.

It will also be seen that in my present construction there is no possible way for the wrist pin to become misplaced and cause scoring of the cylinder wall, nor does the wrist pin have to be held in place by such means as are commonly employed in ordinary piston construction; in fact the wrist pin can be allowed to float both in the piston core bosses and in the connecting rod.

Having thus described my invention and illustrated its use, what I claim as new and desire to secure by Letters Patent is:

1. A built up bi-metallic piston construction comprising, in combination, an outer iron wall and head, and an inner supporting core of aluminum alloy contacting with said head, adjacent the center thereof for transmitting heat therefrom.

2. A built up bi-metallic piston construction comprising, in combination, an outer wall and head, and an inner supporting core contacting therewith adjacent the center of the head for transmitting heat therefrom, the said core being formed of metal of relatively high heat conductivity as compared with that of the head.

3. A built up bi-metallic piston construction comprising, in combination, an outer iron wall and head, an inner supporting core of alluminum alloy detachably contacting with said head for transmitting heat therefrom.

4. A built up bi-metallic piston construction comprising, in combination, an outer wall and head, and an inner supporting core having a portion extending toward and contacting with said head at some point for transmitting heat therefrom, said core being formed of metal of relatively high heat conductivity as compared with that of the head.

5. A built up bi-metallic piston construction comprising, in combination, an outer wall and head, and a skeleton inner supporting core contacting with said head adjacent the center thereof for transmitting heat therefrom.

6. A built up bi-metallic piston construction, in combination, an outer wall and head and an inner core having a portion extending toward and contacting with said head at some point for transmitting heat therefrom, the said core detachably supporting said head and wall, and being formed of metal of relatively high conductivity as compared with that of the head.

7. A built up bi-metallic piston construction comprising, in combination, an outer wall and head, and an inner core having a portion extending toward and contacting with said head at some point for trans-

mitting heat therefrom, the said core being formed of metal of relatively high heat conductivity as compared with that of the head and having a relatively great coefficient of expansion and detachably supporting said head and wall.

8. A built up bi-metallic piston construction comprising, in combination, an outer iron wall and head, and an inner core of aluminum alloy contacting at said head adjacent the center thereof for transmitting heat therefrom, the said core and head being detachably secured together and provided with means for fixing them in predetermined relation.

9. A built up bi-metallic piston construction comprising, in combination, an outer iron wall and head, and an inner supporting core of aluminum alloy contacting with said head adjacent the center thereof for transmitting heat therefrom, the said core and head being detachably secured together and provided with means for fixing them in predetermined relation, said last mentioned means being operable from the head end of the piston.

10. A built up bi-metallic piston construction comprising, in combination, an outer wall and head, and an inner core contacting with the head at some point and provided with means for supporting a wrist pin and connecting rod carried thereby, and means for detachably connecting said core and head, two of said last mentioned elements being arranged in alinement whereby strains may be transmitted in a direct line.

11. A built up bi-metallic piston construction comprising, in combination, an outer wall and head, and an inner core provided with means for supporting a wrist pin and connecting rod carried thereby, and means for detachably connecting said core and head, two of said last mentioned elements being arranged in alinement whereby strains may be transmitted in a direct line, and said core being formed of metal of a relatively high heat conductivity as compared with that of the head.

12. A built up bi-metallic piston construction comprising, in combination, an outer wall and head, and an inner core provided with means for supporting a wrist pin and connecting rod carried thereby and being in contact with said head adjacent the center thereof, said core being formed of metal of a relatively high heat conductivity as compared with that of the head and thereby adapted to transmit heat from said head to said wrist pin and the connecting rod.

13. A built up bi-metallic piston construction comprising, in combination, an outer wall and head, and an inner core detachably supporting said outer wall and head and being in contact with said head adjacent the center thereof and provided with means for supporting a wrist pin and connecting rod carried thereby, said core being formed of metal of a relatively high heat conductivity as compared with that of the head and thereby adapted to transmit heat from said head to the wrist pin and connecting rod.

14. A built up bi-metallic piston construction comprising, in combination, an outer wall and head, an inner core detachably supporting said outer wall and head and being in contact with said head adjacent the center thereof, and provided with means for supporting a wrist pin and connecting rod carried thereby, and means for connecting said core and head, the said core being formed of metal of a relatively high heat conductivity as compared with that of the head and thereby adapted to transmit heat from the head to the wrist pin and connecting rod.

15. A built up bi-metallic piston construction comprising, in combination, an outer iron shell forming the piston head, an inner supporting core of aluminum alloy having a portion projecting toward and contacting with said head at some point for transmitting heat therefrom, and means for preventing relative movement therebetween.

16. A built up bi-metallic piston construction comprising, in combination, an outer shell forming the piston head, and an inner core adapted to engage a wrist pin and connecting rod carried thereby, provided with a portion projecting toward and connecting with said head at some point for transmitting heat from said head to the wrist pin and connecting rod.

17. A built up bi-metallic piston construction comprising, in combination, an outer shell forming the piston head, and an inner supporting core having telescopic relation with said shell and contacting with said head adjacent the center thereof, for transmitting heat therefrom.

18. A built up bi-metallic piston construction comprising, in combination, an outer shell forming the piston head, and an inner supporting core having telescopic relation with said shell and contacting with the head adjacent the center thereof, the said core being formed of metal having a relatively high heat conductivity and a relatively high co-efficient of heat expansion as compared with that of the head whereby it is brought into intimate contact with said shell under normal operating temperatures and thereby adapted more effectively to transmit heat from said head.

19. A built up piston construction comprising, in combination, an outer shell of iron and an inner supporting core of aluminum alloy contacting with the head portion

of said shell adjacent the center thereof for conducting heat therefrom.

20. A built up bi-metallic piston construction comprising, in combination, an integral outer shell and head, an inner supporting core contacting therewith at some point adjacent the center of the head for transmitting heat from the said head, and means for detachably connecting head and core.

21. A built up bi-metallic piston construction, comprising, in combination, an integral outer shell and head, an inner supporting core contacting therewith at some point adjacent the center of the head for transmitting heat from the said head, and threaded means for detachably connecting said head and core.

22. A built up bi-metallic piston construction, comprising, in combination, an integral shell and head, an inner core contacting therewith at some point adjacent the center of the head for transmitting heat from said head and threaded means operable from the head end of the piston for detachably connecting said head and core.

23. A built up bi-metallic piston construction, comprising, in combination, an integral outer shell and head, an inner core contacting therewith at some point adjacent the center of the head for transmitting heat from said head, and means operable from the head end of said piston for detachably connecting said head and core.

24. A built up bi-metallic piston construction, comprising, in combination, an integral outer shell and head, and an inner core for supporting said shell and head, said core being in contact with the head at some point for transmitting heat therefrom and said shell being of substantially cylindrical form internally, throughout substantially its entire length.

25. A built up bi-metallic piston construction comprising, in combination, an integral outer shell and head, an inner core for supporting said shell and head, said core being in contact with the head at some point for transmitting heat therefrom, and said shell being of substantially cylindrical form internally, such internal surface being substantially free from internal projections.

26. A built up bi-metallic piston construction comprising, in combination, a connecting rod or pitman, an iron outer wall and head forming a shell, an inner core of aluminum alloy contacting with said head adjacent to the center thereof for transmitting heat therefrom, the said core being constructed and arranged for the attachment of the shell to the connecting rod or pitman.

27. A built up bi-metallic piston construction comprising, in combination, an outer wall and head, and an inner supporting core of aluminum alloy contacting with said head and wall for transmitting heat therefrom.

28. In a fluid pressure engine including a cylinder, a piston reciprocable therein, and a connecting rod or pitman operable by said piston, the said piston having an iron outer wall and head forming a shell, and an inner core of aluminum alloy supporting said shell and connecting it to said connecting rod or pitman and adapted to conduct heat away from said shell and cylinder wall and to said pitman or connecting rod.

29. In a fluid pressure engine including a cylinder, and a piston reciprocable therein, a connecting rod or pitman operable by said piston, the said piston construction comprising an inner core of relatively high conductivity and light weight, and an outer sleeve fitted thereupon supported thereby and contacting with the walls of the cylinder, said core being adapted to transmit heat from the piston and cylinder walls to the connecting rod or pitman.

30. A built up bi-metallic piston construction comprising, in combination, an outer wall and head of relatively low heat conductivity, and an inner supporting core of relatively high conductivity for transmitting heat from said wall and head.

31. A built up bi-metallic piston construction comprising, in combination, an outer shell forming the piston head and skirt, and an inner supporting core having a telescopic relation with said skirt for transmitting heat therefrom.

In testimony whereof I have hereunto signed my name.

EDGAR AMES TURNER.