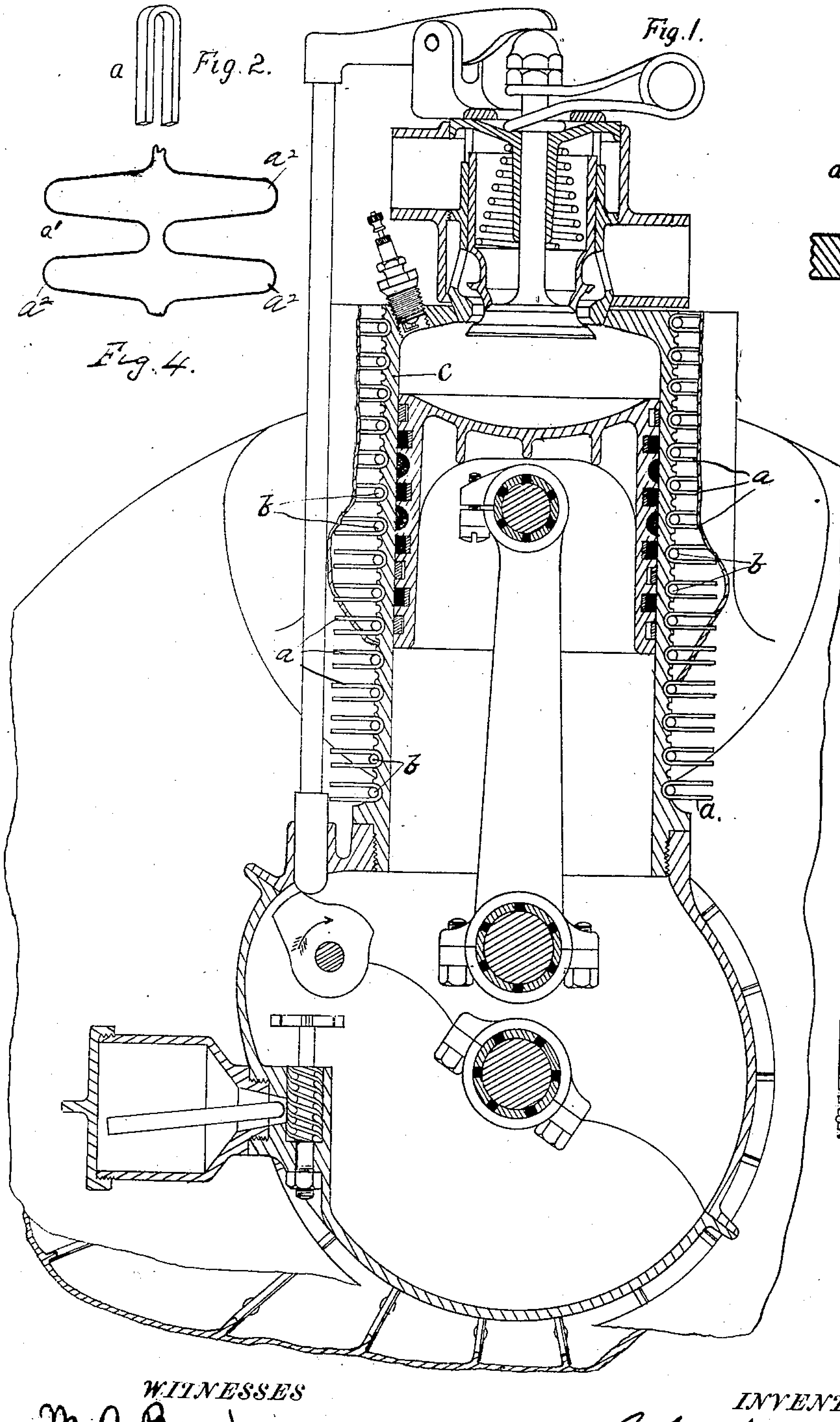
C. E. DURYEA.

INTERNAL COMBUSTION ENGINE.

APPLICATION FILED OCT. 2, 1905.

912,546.

Patented Feb. 16, 1909.



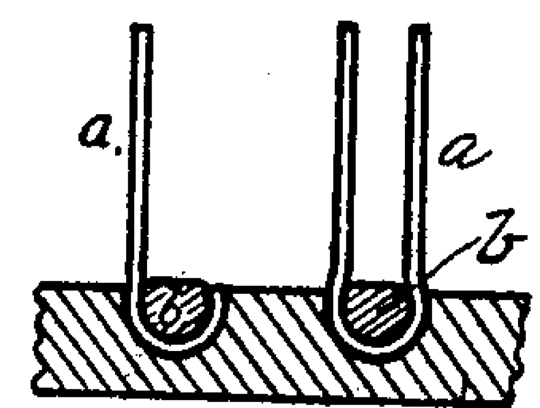




Fig. 3.

Fig. 5.

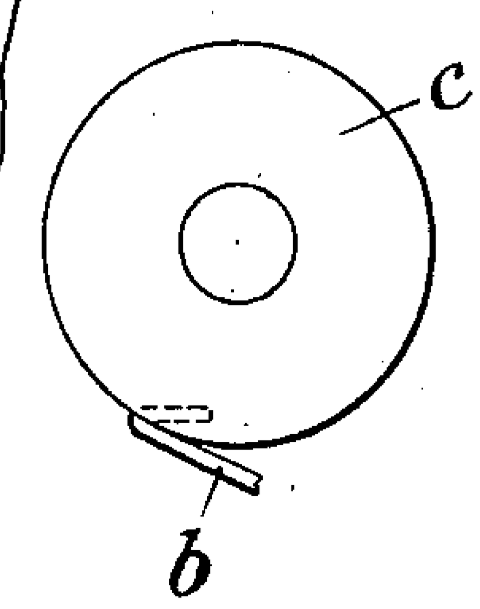
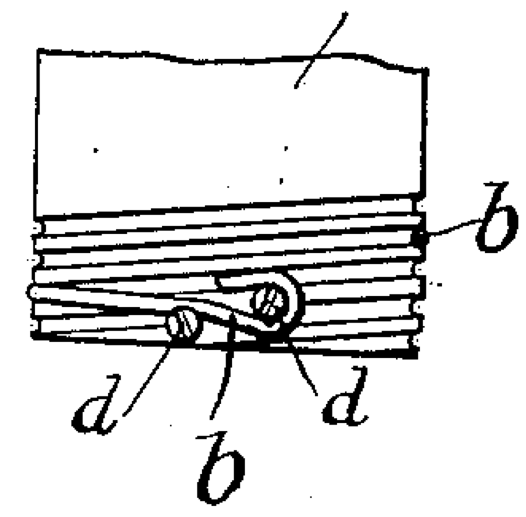



Fig. 6.




WITNESSES

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## INTERNAL-COMBUSTION ENGINE.

No. 912,546. Specification of Letters Patent. Patented Feb. 16, 1909.

Application filed October 2, 1905. Serial No. 280,974.

*To all whom it may concern:*

Be it known that I, CHARLES E. DURYEA, citizen of the United States, residing at Reading, in the county of Berks and State of Pennsylvania, have invented certain new and useful Improvements in Internal-Combustion Engines, and 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 internal combustion engines, particularly to the class used for auto or aeronautic work, wherein a high efficiency is needed, coupled with light weight, few parts and cheap construction.

To secure a high efficiency in a heat engine, it is necessary to avoid needless loss of heat and therefore I have designed an engine, which I preferably operate without the use of oil as a lubricant, capable of operation at extremely high temperatures.

The object of my invention is to provide sufficient cooling of the cylinder walls in a novel manner, as will appear hereafter. I accomplish this result by the mechanism shown in the accompanying drawings in which—

Figure 1 is a section through the axis of the cylinder parallel to the plane of the fly wheel. Fig. 2 shows one of the copper radiating staples. Fig. 3 is a detail section of cylinder wall showing single and double prong staples. Fig. 4 shows a modified form of the staples. Fig. 5 is a detail showing the attachment of one end of the binding wire, and Fig. 6 is a view showing the attachment of the other end thereof.

Similar letters refer to similar parts throughout the several views.

The usual internal combustion engine is water jacketed to carry off the excess heat. By so doing the parts remain cool enough not to ignite the new charge prematurely and the piston remains cool enough to properly be lubricated by oils of low fire test and no parts deteriorate because of excessive heat. In order to save weight of water, piping, tanks, circulating pump and similar parts, many engines are fitted with flanges or pins or similar devices calculated to convey the heat from the cylinder wall outward and permit it to be carried away by a current of air, caused either by the motion of the vehicle or by an exhaust fan or blower. These devices are fairly efficient but with them, as with the water cooling device, there exists the necessity for keeping everything so cool that the oil is not destroyed nor any parts permitted to become hot enough for premature ignition. Further, many of these devices must be attached to the cylinder in a more or less unsatisfactory and costly manner.

Most engine cylinders are cast iron, which has a low heat conductivity or else are of some form of steel equally low in conductivity. If radiating devices are attached, there is difficulty to make them remain tightly in place if of a different metal than the cylinder wall because of the constant expansion and contraction which soon causes metal of high heat conductivity like copper to become loose. Further, if the flanges are a part of the cylinder, they must be heavy in order to be readily formed, and being frequently irregular, they warp irregularly and distort the cylinder walls with consequent leakage of gases past the piston. I overcome these objections by machining the cylinder inside and out, thus securing cylinder walls having concentric surfaces of equal thickness and free from possible chills or blow holes, such as frequently exist in castings not machined all over. I machine the outer surface of the cylinder *c* into grooves, preferably spiral. These grooves are preferably semi-circular in cross section, although they may be otherwise shaped. I provide strips of copper, bent into such shape as will fit these grooves with one or both ends projecting more or less directly outward in radial lines to the cylinder and I hold these copper strips or staples *a* which may be either J or U shaped, in place by winding a steel wire *b* into the bent portion, thus binding them down into the grooves. (See *a* Figs. 1 and 3). This wire *b* is fastened at each end as seen in Figs. 5 and 6, *d* in the latter view being clamping screws for holding one end of the wire, the other end being engaged in a hole in the cylinder. This, however, is but one way of fastening the ends of the wire, and if put in place under great tension it will bind the radiating strips into place with great firmness. The wire never gets so hot as the cylinder wall underneath and may be of less expansion coefficient, such as nickel steel, so that when the cylinder is hot, the radiating strips are gripped very firmly. If the grooves are shaped, as shown in Fig. 3, it is necesssary that the undercut be very slight in order that the wire may be admitted and after admission, it is necessary to calk the wire to make it fill the groove tightly. This calking causes the wire to become somewhat U-shaped as shown in Fig. 3. If the wire is calked sufficiently, it is not so important that it be fastened at the ends although fastening at the ends is the proper and sure method. These radiating strips being made of copper, aluminum or even silver, have high heat conductivity and carry the heat out from the walls very rapidly, so that a large amount of heat can be carried away by the air, on which account less air than usual is able to perform the necessary service.

The radiating staples may be spaced wider apart on the cooler portions of the cylinder by varying the pitch of the grooves in which they are placed but this is not so convenient as to space wider apart along the grooves in a self evident manner. While I prefer the staples separate, because they may be made cheaply, and spaced to suit, I can cut them out of sheet stock in such a manner that they are joined together at the curved portion $a^2$, or at least, in such a manner that they may be handled as a strip, although after applying, they will give the desired projecting points as do the separate staples. Fig. 4 shows such a construction of sheet-stock staples.

I claim,

1. In combination with the cylinder of an internal combustion engine having its wall grooved, a binding wire of less coefficient of expansion than said cylinder having its ends held to said cylinder, a radiating means consisting of strips of metal having points and seated to fit and seated in the groove in the cylinder wall and bound in such groove with said points projecting outward, by said binding wire.

2. In an internal combustion engine, a cylinder machined inside and out with its outer surface provided with a spirally disposed groove, and radiating metallic strips held in said groove, and a metallic fastening in said groove with its ends held to said cylinder for holding said radiating metallic strips in place, said fastening being of less coefficient of expansion than the cylinder.

3. In an internal combustion engine, a cylinder machined inside and out with its outer surface provided with a spirally disposed groove, and radiating metallic strips held in said groove, and a metallic fastening of less coefficient of expansion than the cylinder seated in said groove for holding said radiating metallic strips in place and means for fastening said fastening means at the ends.

4. In an internal combustion engine, a cylinder of low heat conductivity machined inside and out with its outer surface provided with a spirally disposed groove, separated radiating metallic strips of high seat conductivity each having a curved portion fitting a groove, with its point free and projecting outwardly from the cylinder, and a fastening wire engaging the curved parts of said strips and seated in and holding the same in said groove, said fastening wire having its ends fastened to said cylinder, said wire having a co-efficient of expansion less than that of the material of the cylinder and held in place.

5. In an internal combustion engine, a cylinder of cast iron of low heat conductivity, having its outer surface spirally grooved, sheet metal fins, flexible, light and of high heat conductivity disposed in said groove, and binding means of expansion coefficient less than that of the cylinder engaging the portions of said fins which are disposed in said groove, said fins being disposed on the outer face of the cylinder and held to place by said binding means, the latter being secured to said cylinder.

6. In an internal combustion engine, a cylinder of cast iron of low heat conductivity having its outer surface spirally grooved, sheet metal fins, flexible, light and of high heat conductivity, having rounded portions fitting in said groove, a binding wire of expansion coefficient less than that of the cylinder wound into the bent portions of said fins and binding them firmly into said grooves, said wire being fastened to said cylinder and being substantially D-shaped in cross section with its flat face substantially flush with the outer wall of the cylinder.

7. In an internal combustion engine, a cylinder of cast iron of low heat conductivity having its outer surface spirally grooved, sheet metal fins, flexible, light and of high heat conductivity, having rounded portions fitting in said groove, a binding wire of expansion coefficient less than that of the cylinder wound into the bent portions of said fins and binding them firmly into said grooves, said wire being substantially D-shaped in cross section with its flat face substantially flush with the outer wall of the cylinder, said wire being fastened at each end and put in place under great tension.

8. In an internal combustion engine, a cylinder of cast iron of low heat conductivity having its outer surface provided with a groove, curved sheet metal fins joined to-

gether at their curved portions with the curved portions seated in said groove, and a fastening wire of less coefficient of expansion than the cylinder secured to the latter and seated in said groove over the curved portions of the fins and holding them in place therein.

In testimony whereof I affix my signature, in presence of two witnesses.

CHARLES E. DURYEA.

Witnesses:
E. A. Ruth,
B. E. Bates.