H. H. BLACHE.

COOLING OF PISTONS AND PISTON RODS.

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1,412,833. Patented Apr. 18, 1922.

Fig. 1.

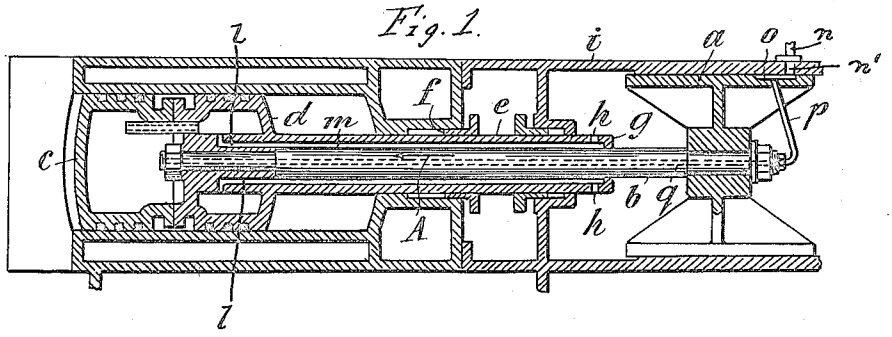


Fig 2.

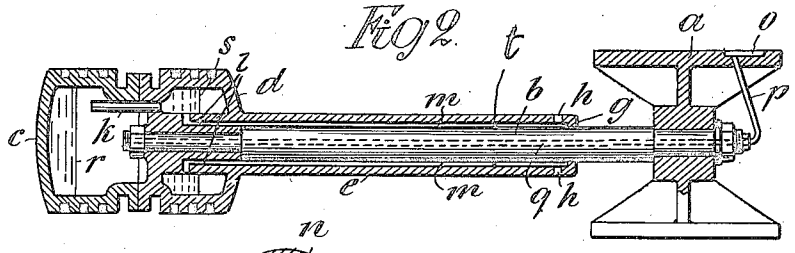


Fig 3.

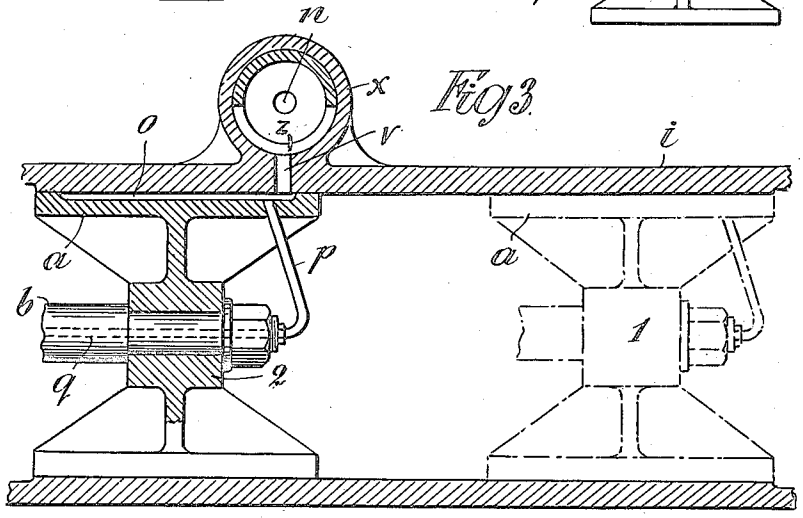
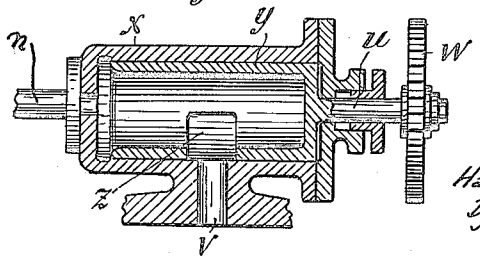


Fig 4.



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COOLING OF PISTONS AND PISTON RODS.

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To all whom it may concern:

Be it known that I, HANS HENRIK BLACHE, subject of the Kingdom of Denmark, and residing at Hellerup, near Copenhagen, Denmark, have invented certain new and useful Improvements Relating to the Cooling of Pistons and Piston Rods, of which the following is a specification.

This invention relates to internal combustion engines and more particularly to double-acting internal combustion engines of the type in which a hollow piston is cooled by the circulation of oil or other cooling medium through the piston rod and hollow piston, the oil being supplied to the piston rod through the crosshead from a port or ports in the crosshead guide.

Heretofore it has been proposed to provide the crosshead with inlet and outlet channels, communicating with corresponding ports in the crosshead guide. In such case the channels in the crosshead must be of such a length as to uncover the ports in the crosshead guide during the full stroke of the piston in order to ensure the uninterrupted supply and escape of the cooling medium, which is supplied to the engine under pressure.

The object of the present invention is to create the circulation of the cooling medium through the piston and piston rod by the accelerating and retarding action of the moving parts and without the necessity of supplying the cooling medium under pressure, which is ordinarily necessary in order to overcome the accelerating and retarding action on the cooling medium.

According to the present invention the crosshead only uncovers the port or ports in the crosshead guide during more or less of the outer part of its stroke, so that the said port or ports are only open for admission of the cooling medium to the piston during the outer part of the stroke of the piston, the outlet being open the whole stroke. By this means the acceleration and retardation of the parts creates a circulation of the oil through the piston and piston rod.

In order that the invention may be more clearly understood, reference is hereinafter made to the accompanying drawing showing one construction of the cooling means by way of example.

Fig. 1 is a longitudinal section showing a double-acting internal combustion engine and Fig. 2 is a corresponding view showing the piston, piston rod and crosshead removed from the engine. Figs. 3 and 4 show a modified form with a valve placed in the supply-pipe.

The crosshead *a* is connected to the piston rod *b* which carries a piston, the latter being preferably made in two parts, an outer hollow part *c* and an inner hollow part *d*. The inner part *d* of the piston is provided with a tubular extension or sleeve *e* which surrounds the piston rod *b* and extends from the piston beyond a stuffing box *f* into the crank-housing *i*. The sleeve *e* does not transmit the thrust of the piston to the crosshead *a*, but loosely surrounds the piston rod *b*, forming an annular chamber *m* around the piston rod. The sleeve *e* is of such a length that its inner end is situated within the enclosed crank housing *i* even when the piston is at the end of its out stroke, i. e. in the position shown in Fig. 1. The sleeve *e* is formed at its inner end with a flange *g* which forms a tight fit with the piston rod, and the sleeve *e* is also provided near the flange *g* with a plurality of holes *h* connecting the annular chamber *m* with the interior of the enclosed crank housing *i*. The inner half *d* of the piston is separated from the outer half by means of a transverse partition which is provided with a pipe *k* of suitable length extending into the outer part *c* of the piston and thereby forming a connection between the inner and outer chambers of the piston. An extension of the sleeve *e* within the hollow part *d* of the piston, provides a channel or channels *l* opening laterally into the inner chamber of the piston and thus connecting the latter with the interior of the enclosed crank casing.

The cooling medium is supplied through a pipe *n* which opens into a port *n'* in the crosshead guide, the crosshead *a* being provided with a recess or channel *o* adapted to register with the port *n'*. The channel *o* does not extend the whole length of the crosshead, but is only of such a length that the supply pipe *n'* is uncovered during more or less of the outer part of the stroke of the piston i. e. from the position of the piston shown in Fig. 1 half the way or less than half the way of the stroke before and after this position. The channel *o* communicates by way of a pipe *p* with a central bore *q* in the piston rod *b* in such a manner that the cooling medium is supplied by the channel *o* to the outer chamber *c* of the piston.

The arrangement is such that when the crosshead a is in the position nearest the engine cylinder, it uncovers the supply pipe n', thereby admitting cooling medium through the channel o and pipe p into the piston rod b. The channel o is of such a length that the supply of cooling medium will be cut off as or shortly before the piston reaches the middle of its stroke.

When the piston is reciprocating between its middle position and top dead centre, the direction of the retarding and accelerating forces, which act on the cooling medium within the piston and piston rod, will be that indicated by the arrow A in Fig. 1, and in consequence thereof the cooling-oil will collect as shown at r and s (Fig. 2) within the piston and extend along the annular chamber m to such a level as that indicated by the letter t in Fig. 2.

During this period the cooling medium will flow through the pipe k from the inner chamber d to the outer chamber c of the piston. As soon as the piston has passed the middle of its stroke and is reciprocating between its middle position and the bottom dead centre, the accelerating and retarding forces on the cooling-oil will act in the opposite direction to the arrow A. During this period the supply pipe n' for the cooling-oil is cut off from the channel o in the crosshead, thereby preventing the back flow of the cooling medium into the supply pipe n. The cooling medium may, however, flow from the outer chamber c of the piston into the inner chamber d through the pipe k, and from the chamber d through the ducts l into the annular chamber m, and from thence through the openings h into the enclosed crank housing. The warm cooling medium will therefore be ejected from the annular chamber m, but a sufficient quantity will be left in the piston owing to the length of the pipe k and owing to the fact that the ducts l are disposed at a distance from the transverse partition separating the chambers c and d. Every time the piston reciprocates through the outer part of its stroke, fresh cooling medium will be supplied through the pipe n, and when the piston is reciprocating through the inner part of its stroke, a proportional quantity of warm cooling medium will be ejected through the annular chamber m into the enclosed crank housing. A suitable quantity of cooling liquid will always be retained in the two chambers of the piston, and on account of the reciprocatory motion, this cooling medium will always be in violent motion and will thus be splashed upon the hot walls of the piston.

It is necessary that the crosshead shoe, if the engine is to be used for a long stroke, should be of considerable length, as the crosshead shoe in all its positions must cover the supply-opening n' for the cooling medium. Such an elongated crosshead shoe necessitates increased first cost in the manufacturing, besides which the engines will be of increased length and weight. The modified form shown in Figs. 3 and 4 does away with the above mentioned drawback by the use of a cross-head shoe of normal length, whereas there is arranged in the supply pipe for the cooling medium a cut-off device, for instance a rotating valve, which is driven from the shaft of the engine by means of a chain or the like.

In Figs. 3 and 4 is shown a constructional form. Fig. 3 shows a longitudinal section through the crosshead and the guide planes for same. Fig. 4 shows a section through the valve placed in the supply pipe.

In the drawing 1 designates the cross head shown in the position nearest to the crank shaft, 2 shows the crosshead in the "dead point" position nearest the cylinder. o designates the recess in the crosshead shoe a and n is the supply pipe for the cooling medium. In the position 2 for the crosshead, the supply port v communicates with the recess o which through the pipe p is connected to the boring q in the piston-rod b in the manner set forth. The crosshead shoe a has, as shown in the drawing, such a length that the cross-head shoe covers the port v, when the crosshead moves away from the cylinder, somewhat over the middle part of the stroke.

Between the supply pipe n and the part v is placed a cylindrical casing x containing the rotating valve y and said valve is provided with an opening z which is adapted to register with the port v. The valve is actuated by means of its stem u, which extends through the valve-casing x and is provided with a sprocket wheel w, to be driven by means of a chain from the engine shaft, in such a manner that the valve makes the same number of revolutions as said shaft. The opening z in the valve is made of a suitable length to enable it to be open to supply the oil during that part of the stroke where the crosshead shoe with its oil-channel o covers the supply port v, while the rotating valve shuts off the port v before the crosshead shoe uncovers said port.

I claim:

1. An internal combustion engine, comprising a hollow piston having inner and outer internal chambers, and a transverse partition therebetween, a cylinder wherein the piston works; a hollow piston rod connected to said piston and opening at one end of its bore into the outer piston chamber; and means for supplying a cooling liquid to the other end of the piston rod bore for passage therethrough and through said outer chamber, said partition having means for enabling the passage of the cooling liquid therethrough from one chamber

to the other alternately in opposite directions, and said communicating means into the inner piston chamber, said inner chamber also having an outlet for the liquid.

2. An internal combustion engine, comprising a hollow piston having inner and outer internal chambers, and a transverse partition between them; a hollow piston rod connected to the piston and opening at one end of its bore into the outer chamber; a cylinder wherein the piston works; means for supplying a cooling liquid to the other end of the piston bore for passage therethrough into the outer chamber, the inner chamber having an outlet for the liquid; and a tube extending from the outer chamber through the partition into the inner chamber to deliver the liquid from one chamber to the other alternately in opposite directions, said tube having a length such that a quantity of the liquid is always retained in the outer chamber.

3. An internal combustion engine, comprising a hollow piston having inner and outer internal chambers, and a transverse partition between them; a hollow piston rod connected to the piston and opening at one end of its bore into the outer chamber; a cylinder wherein the piston works; means for supplying a cooling liquid to the other end of the piston bore for passage therethrough into the outer chamber; and a tube extending from the outer chamber through the partition into the inner chamber to deliver the liquid from one chamber to the other alternately in opposite directions, the inner chamber having a plurality of outlet ports for the liquid which are spaced from said partition to insure a quantity of said liquid always being retained in that chamber.

4. An internal combustion engine, comprising a hollow piston; a cylinder wherein the piston works; a crosshead connected to the piston; a crosshead guide provided with an inlet port; a delivery pipe communicating at one end with the interior of the hollow piston and opening at the other end through the crosshead to be brought into and out of communication with said port; a supply pipe leading to said port for supplying a cooling medium thereto; and a rotary cut-off valve associated with the supply pipe and adapted to automatically shut off the flow of the cooling medium when the port is uncovered by the crosshead.

In testimony whereof I affix my signature.

HANS HENRIK BLACHE.