Feb. 28, 1939. J. W. MacCLATCHIE 2,148,702

HEAT TRANSFERRING MEANS

Filed April 2, 1935 2 Sheets-Sheet 1

Fig. 1.

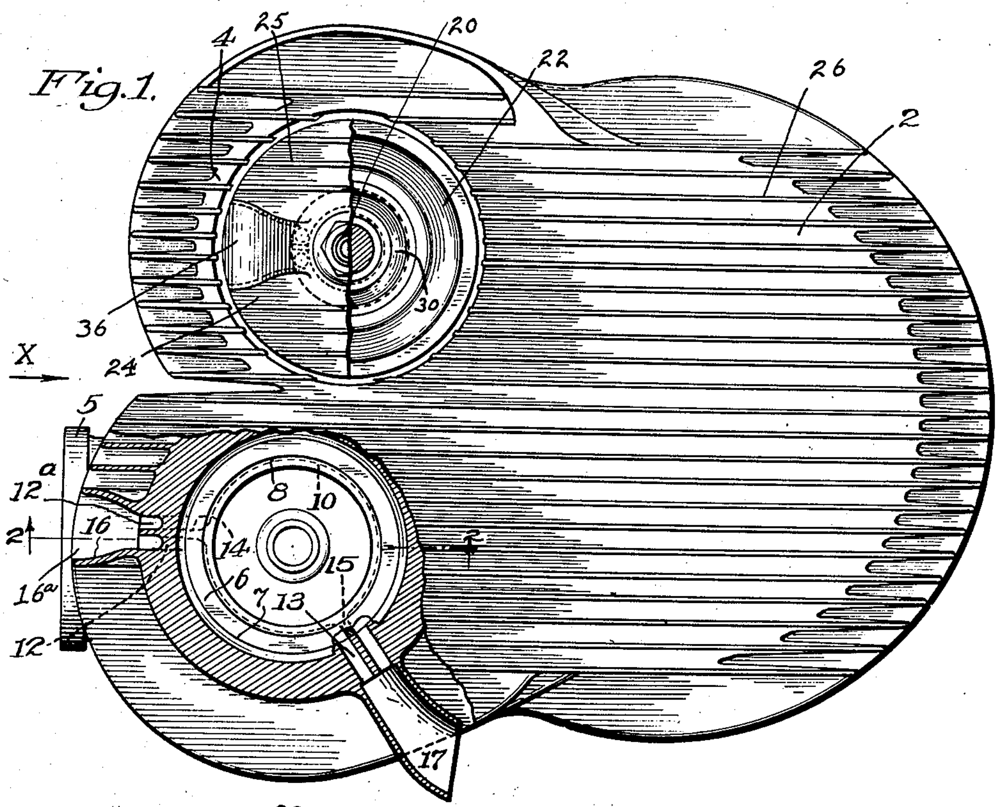

Fig. 2.

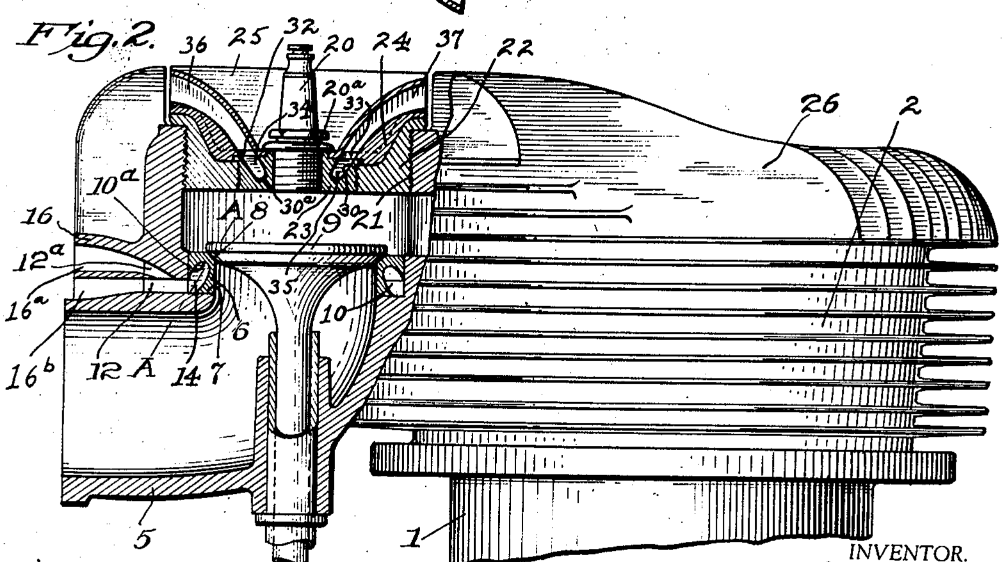

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Fig. 3.

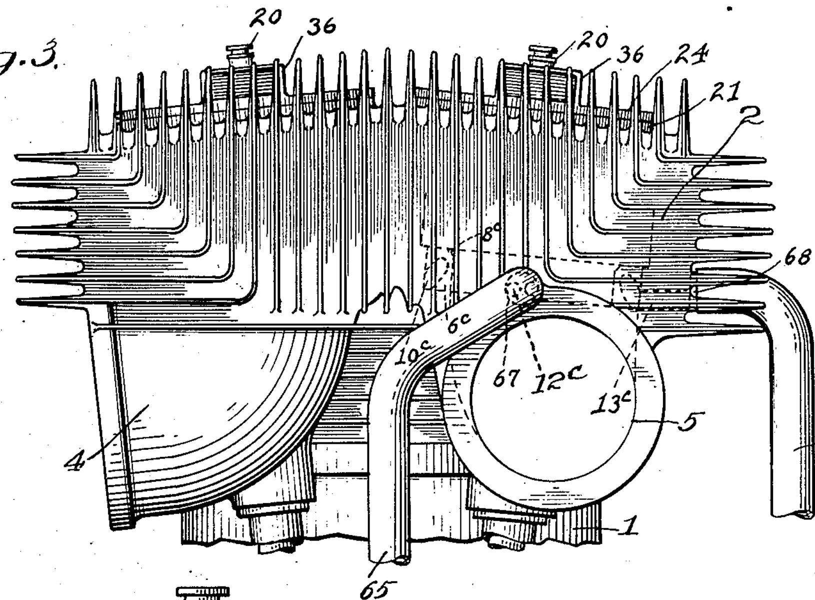
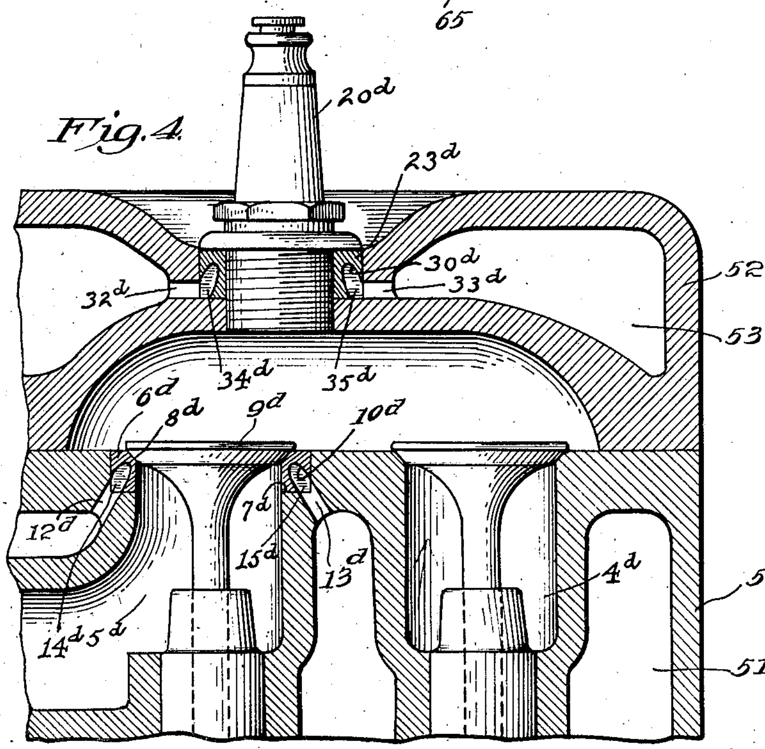


Fig. 4.



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HEAT TRANSFERRING MEANS

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Application April 2, 1935, Serial No. 14,265

8 Claims. (Cl. 123—171)

This invention is a heat transferring means, particularly applicable to those parts of an internal combustion engine which are difficult to properly cool, such as the valves and the spark plugs.

It is an object of the invention to circulate a cooling medium closely adjacent the part which it is desired to adequately cool, without thereby developing structural weakness. In the case of valves this result may be obtained by circulating a cooling medium in an annular passageway which is closely adjacent but out of communication with the valve contacting surface of the valve seat, and which is so arranged as to maintain the desired structural strength at the valve seat. In the case of spark plugs a similar annular passageway may be provided adjacent but closed to the bore which receives the spark plug, with the passageway so arranged as to not unduly weaken the structure proximate to said bore.

It is a further object of the invention to form the annular passageway by means of a groove in the surface of an annulus which is preferably a unitary structure separate from but mounted in the engine block, and this unit will be a valve seat annulus when the invention is applied to valves, and will be a bushing adapted to receive a spark plug when the invention is applied to spark plugs.

It is a still further object of the invention to arrange the groove so that in cross-section it extends to a point closely adjacent the valve seating surface at the inner periphery of a valve seat annulus or closely adjacent the threaded inner periphery of a bushing into which a spark plug is screwed, while maintaining such wall thickness for the groove adjacent said point of closest proximity as will avoid unduly weakening the valve seat or the threaded bore for the spark plug.

It is a still further object of the invention to provide communication with the annular groove via conduits in the engine block, whereby a cooling medium may be supplied to the annular groove for flow around the groove and discharge therefrom at a circumferentially spaced point; and these conduits may open to the atmosphere for circulating air as the cooling medium, or may be incorporated in a pressure system providing forced circulation for the cooling medium, which may be air, water, or other suitable fluid.

Further objects of the invention will be readily understood from the following description of the accompanying drawings, in which:

Fig. 1 is a plan view of a cylinder of a radial cylinder engine, partly in section to show the invention applied to the exhaust valve and to a bushing in which a spark plug is mounted.

Fig. 2 is a side elevation of the cylinder, partly in section on the line 2—2 of Fig. 1.

Fig. 3 is a front elevation of the cylinder, showing a modified means for circulating a cooling medium around the exhaust valve.

Fig. 4 is a fragmentary section through a cylinder-in-line engine, showing the invention applied to an exhaust valve and to the bushing in which a spark plug is mounted, and showing a further modification of the means for circulating a cooling medium around the exhaust valve and around the spark plug.

The invention contemplates circulation of any desired cooling medium around those parts of a structure such as an internal combustion engine which are liable to overheat. For example the cooling medium may be air, circulated by the draft created by propulsion of any land, water or air transport means which is propelled by an air-cooled internal combustion engine, or in such construction a fluid other than air may be circulated in a closed system which includes any suitable means for forcing circulation; or the invention may be embodied in a water-jacketed internal combustion engine, in which case the cooling medium may be water drawn from the water jacket.

At Figs. 1 and 2 I have shown a part of one of the cylinders of a radial-cylinder internal combustion engine of the type employed in aircraft, the direction of airflow resulting from propulsion of the aircraft in which the engine is mounted, being indicated by the arrow X. The cylinder is shown at **1** having a usual cylinder head **2**, from which depend intake and exhaust chambers **4—5** at the front of the cylinder head with relation to the direction of airflow as indicated by the arrow X.

The valve seat for the exhaust valve is an annulus **6** which may be a separate unit from the casting forming the cylinder head **2**, adapted for mounting in an annular recess **7** which is formed in the bore of the exhaust chamber **5**. The annulus **6** may be fixed in place in any suitable manner, as for example by shrinking the annulus **6** into its cooperating recess **7**; and the bore of the annulus **6** forms a usual seating surface **8** for an exhaust valve **9**, the seating surface **8** being preferably beveled as shown at Fig. 2.

Air may be circulated around the exhaust valve and also around the spark plugs for the cylinder, in order to adequately cool these parts which are liable to overheat.

The air for cooling the exhaust valve may be circulated around the annulus 6 which forms the valve seat, and for this purpose the annulus 6, prior to insertion in recess 7, may be provided with an annular groove 10, preferably in its outer peripheral surface. The cross-sectional area of the groove 10 preferably has a major axis and a minor axis, i. e., measured along its major axis it has a greater dimension than measured along its minor axis, and the major axis, indicated at A—A, is preferably substantially perpendicular to the inclined seating surface 8 as shown at Fig. 2. The groove may thus be of maximum cross-sectional area without unduly weakening the annulus 6, and the base of the groove is preferably curved as shown at 10*a*, so that the minimum wall thickness between the groove 10 and the seating surface 8 is approximately medial of the width of said seating surface, with the wall thickness then increasing at each side of the major axis A—A and thus providing an arched structure insuring adequate strength at the seating surface 8, and the side wall of the groove 10 which is adjacent the bore of the annulus 6 is preferably a curved continuation of the curved base of the groove, with these curvatures defining a wall thickness between the groove 10 and the bore of the annulus 6 whereby the fluid in the groove 10 is brought into close proximity to the seating surface 8, and the groove extends closest to the bore of the annulus 6 at a portion of the length of said bore which is adjacent said seating surface.

Supply and discharge conduits 12—13 provide for circulating air around the groove 10, and these conduits are formed in the valve chamber 5 and communicate with the annular recess 7 at circumferentially spaced points, so that when the annulus 6 is in place the conduits 12—13 communicate with the groove 10. To insure a part of the air circulating around each side of the annular groove 10 the conduits 12—13 may each consist of a pair of laterally spaced parallel conduits as shown at Fig. 1, and baffles 14—15 may extend across the groove 10 between the pair of supply conduits 12 and between the pair of discharge conduits 13. Air supplied at the conduits 12 is thus directed around the respective sides of annular groove 10 for discharge at the respective conduits 13.

An air intake 16 communicates with the pair of conduits 12, and is shown as a funnel projecting forwardly from the exhaust chamber 5 and open to the atmosphere at its forward end whereby airflow in the direction of the arrow X will be directed into the conduits 12 and thence around the groove 10. A jet action may be provided for increasing the velocity of the airflow in conduits 12, and for this purpose conduits 12*a* may communicate with the inner restricted end of funnel 16 and gradually taper toward their inner ends as shown at Fig. 2 so as to form restricted nozzles which open into the respective conduits 12 at points spaced inwardly from the outer ends of said conduits so that the air flow discharged from the restricted nozzles 12*a* into the conduits 12 creates a jet action for increasing the air flow through the grooves 10, and a transverse partition may divide the funnel 16 into upper and lower chambers 16*a*—16*b*, which respectively communicate with the conduits 12—12*a*. The pair of discharge conduits 13 preferably open into an air outlet 17 which projects laterally and rearwardly from the exhaust chamber 5 and which opens to the atmosphere at its outer flaring end, whereby airflow past the cylinder creates suction at the outlet 17 for increasing the flow of air around the groove 10.

A pair of spark plugs 20 are preferably mounted in the cylinder head 2; and for this purpose a threaded opening 21 is formed in the cylinder head above each of the intake and exhaust chambers 4—5, and a closure plug 22 is threaded into each of these openings with a bushing 23 threaded into each of the closure plugs and adapted for threaded reception of a spark plug. A cap 24 is preferably mounted on each closure plug 22 with vertical heat radiating fins 25 projecting from the cap; and the cap 24 is preferably rotatably adjustable on the closure plug 22 so that irrespective of the position to which the closure plug is turned when it is screwed into the opening 21, the cap 24 may be turned so that its fins 25 aline with heat radiating fins 26 which project vertically from the cylinder head 2 and which extend in the direction of airflow indicated by the arrow X. A flange 20*a* of the spark plug may overlie and engage the edge of cap 24 when the spark plug is screwed into place, in order to secure the cap in its rotatably adjusted position.

Air is circulated around the spark plugs, and for this purpose each bushing 23 is provided with an annular groove 30, which in cross-section extends toward the bore of the bushing so as to leave a minimum wall thickness at some point along the length of the bore whereby air in the groove 30 is brought into close proximity to the spark plug, and the base of the groove is preferably curved as shown at 30*a* so that the wall thickness gradually increases from this point of minimum thickness, in order to provide an arched structure insuring adequate strength at the mounting for the spark plug.

Supply and discharge openings provide for circulating air around the groove 30, and may consist of a pair of supply ports 32 and a pair of discharge ports 33 formed in the cap 24 so as to communicate with the groove 30 at diametrically opposite points; and baffles 34—35 preferably depend from the cap 24 between the pair of supply ports and between the pair of discharge ports so that the baffles extend into the groove 30 when the cap 24 is in place. The air which is supplied at the ports 32 is thus directed by the baffles around the respective sides of the annular groove 30 for discharge at the respective ports 33.

An air intake 36 communicates with the supply ports 32, and is shown as a funnel integral with the cap 24 and projecting upwardly and forwardly from the ports 32 and open at its forward end whereby airflow in the direction of the arrow X is directed into the funnel 36 and thence around the groove 30. A similar air outlet funnel 37 communicates with the discharge ports 33, and projects upwardly and rearwardly from the ports 33 with its outer end opening rearwardly whereby the airflow creates suction at the outlet for increasing airflow around the groove 30. The funnels 36—37 are preferably diametrically opposite one another and extend in the direction of fins 25, so that when the cap 24 is turned so as to aline the fins 25—26 the funnels 36—37 are alined with the direction of airflow as indicated by the arrow X; and by projecting the baffles 34—35 from the rotatably adjustable cap 24, the baffles direct the airflow equally around the respective sides of the annular groove 30, irrespective of the position to which the cap 24 is turned with relation to the bushing 23 and the plug 22.

In the modification of the invention shown at Fig. 3, the construction is the same as that previously described except that a closed fluid circulating system is provided for directing fluid around the exhaust valve. This fluid may be water or other suitable heat absorbing medium, and is supplied via conduit 65 and returned via conduit 66, these conduits being connected to any suitable circulating system which may include a usual pump and radiator (not shown). The valve seat for the exhaust valve is of the same construction as shown at Fig. 2, including an annular 6c forming the valve seat 8c and grooved as shown at 10c; and a pair of supply conduits 12c extend through the exhaust chamber 5c and open into the groove 10c with the outer ends of said conduits forming a nipple 67 to which the pipe 65 is connected. A pair of discharge conduits 13c also extend through the exhaust chamber 5c and open into the groove 10c in circumferentially spaced relation from the supply conduits 12c as explained in connection with Figs. 1 and 2, and the outer ends of the discharge conduits form a nipple 68 to which the pipe 66 is connected. The circulating system to which pipes 65—66 are connected thus provides for circulating a suitable fluid around the groove 10c for cooling the exhaust valve, and the fluid may be directed around both sides of the annular groove by providing baffles (not shown) in the groove between the pair of supply ports 12c and between the pair of discharge ports 13c, in the manner described in connection with Figs. 1 and 2.

A cooling medium is preferably also circulated around the spark plugs 20; but circulation via a closed circulating system similar to that which includes the supply conduit 65 and the return conduit 66 is not shown for the spark plugs, the illustrated embodiment having simply the same type of draft circulation for the spark plugs as previously explained in connection with Figs. 1 and 2. Of this construction only the intake funnels 36, the caps 24 and the closure plugs 21 are visible in Fig. 3.

At Fig. 4 I have shown the invention embodied in a cylinder-in-line internal combustion engine. A part of the engine is shown, including cylinder block 50 water-jacketed in usual manner as shown at 51, and having a cylinder head 52 which is water-jacketed as shown at 53. The intake and exhaust chambers for one of the cylinders are shown at 4d—5d.

A cooling medium may be circulated around the exhaust valve and around the spark plug for the cylinder.

For the purpose of cooling the exhaust valve its valve seat may be constructed as explained in connection with Figs. 1 and 2, i. e. an annulus 6d is seated in an annular recess 7d and forms a valve seat 8d, and the annulus 6d is grooved as shown at 10d for circulation of a cooling medium. The cooling medium may be any suitable fluid supplied in any suitable manner, and for purpose of illustration is shown as the water which circulates in water-jacket 51. As an instance of this arrangement a pair of parallel laterally spaced conduits 12d (only one of which is shown) may communicate with the water jacket 51 and extend through the cylinder block so as to open into the groove 10d, and a similar pair of laterally spaced conduits 13d (only one of which is shown) communicate with the water jacket 51 and extend through the cylinder block so as to open into the groove 10d at a point which is preferably diametrically opposite the conduits 12d. Baffles 14d—15d such as described in connection with Figs. 1 and 2 preferably extend across the groove 10d between the pair of conduits 12d and between the pair of conduits 13d, for directing a part of the cooling medium around each side of the annular groove 10d.

The spark plug 20d for the cylinder is preferably threaded into a bushing 23d which is seated in the cylinder head 52 in any usual manner; and for the purpose of cooling the spark plug the bushing 23d may be grooved as shown at 30d, the groove 30d being preferably similar to the groove 10d in the annulus 6d. A cooling medium is circulated around the groove 30d, and the cooling medium may be water from the water jacket 53. For this purpose pairs of laterally spaced conduits 32d—33d, diametrically opposite one another, may open through the cylinder head from the water jacket 53 into the groove 30d, with baffles 34d—35d preferably extending across the groove 30d between the pair of conduits 32d and between the pair of conduits 33d, so as to direct a part of the cooling medium around each side of the annular groove 30d.

I claim:

1. In combination, a structure having a surface liable to become heated when the structure is in use and having an annular passageway in said structure proximate to said surface and open at one side to the exterior, a cap for said structure, and an air intake on the cap, the cap being mounted on the said structure for adjustment relative thereto concentrically with the annular passageway to position the air intake in a desired direction, and the cap having a port opening therethrough from the air intake, the cap overlying and forming a closure for the open side of the annular passageway, and the port providing communication with the annular passageway throughout said adjustment of the cap.

2. In combination, a structure having a surface liable to become heated when the structure is in use and having a passageway in said structure proximate to said surface and open to the exterior of said structure at one side of said passageway, and directing means for a fluid mounted on the said structure for adjustment relative thereto to position the directing means in a desired direction, the directing means having a port opening therethrough the directing means overlying and forming a closure for the open side of the passageway, and the port providing communication with the passageway throughout said adjustment of the directing means.

3. In an internal combustion engine, a spark plug for the engine, and means for directing a fluid toward the spark plug radially thereof and thence past the spark plug, said means being mounted on the engine for adjustment relative thereto to position said directing means in a desired direction radially of the spark plug.

4. In an internal combustion engine, a member having a bore, an annular passageway in said member proximate to and surrounding said bore, a cap for said member having a bore alining with the first mentioned bore and rotatably adjustable relative to the said member, an air intake and a diametrically opposite air outlet on the cap, the cap having ports opening from the air intake and the air outlet and communicating with the annular passageway throughout rotat-

able adjustment of the cap, and a spark plug received in said alined bores and having a flange engaging the cap to hold it in rotatably adjusted position.

5. In a structure having a fin at its outer surface, a spark plug in an opening in the said structure, a closure for said opening, a fin on said closure, and means for adjusting the last mentioned fin for alining it with the first mentioned fin.

6. In an internal combustion engine having parallel heat radiating fins at its outer surface, a spark plug in an opening in the wall of the engine, a closure for said opening, a cap for said closure having parallel heat radiating fins at its outer surface, and means for adjusting the cap relative to the closure for alining the fins of the cap with the fins of the engine.

7. In combination, an element having a bore for a spark plug and a passageway in said element proximate to said bore, and an element cooperating with the first mentioned element and including air directing means open to the atmosphere at the exterior of the first mentioned element, one of said cooperating elements including means providing restricted communication between the passageway and the air directing means, and one of said cooperating elements including means for closing the passageway to the atmosphere except via said restricted communication.

8. In an internal combustion engine, a member having a bore, an annular passageway in said member proximate to said bore, a cap for said member having a bore alining with the first mentioned bore and rotatably adjustable relative to the said member, an air intake and an air outlet on the cap, the cap having ports opening from the air intake and the air outlet and communicating with the annular passageway throughout rotatable adjustment of the cap, and a spark plug received in said alined bores.

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