May 26, 1959 A. J. MORRIS 2,887,994

FUEL INJECTOR OF AIR-COOLED COMPRESSION IGNITION ENGINE

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Fig. 1.

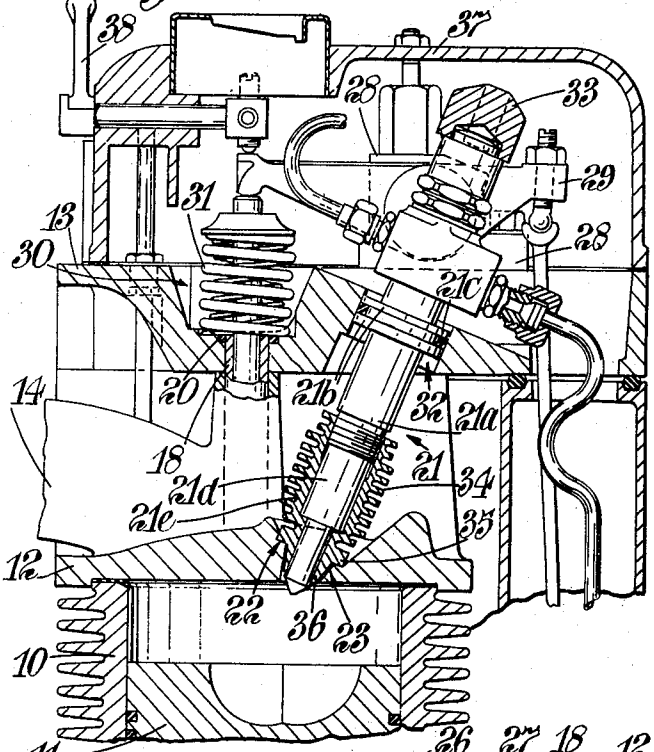
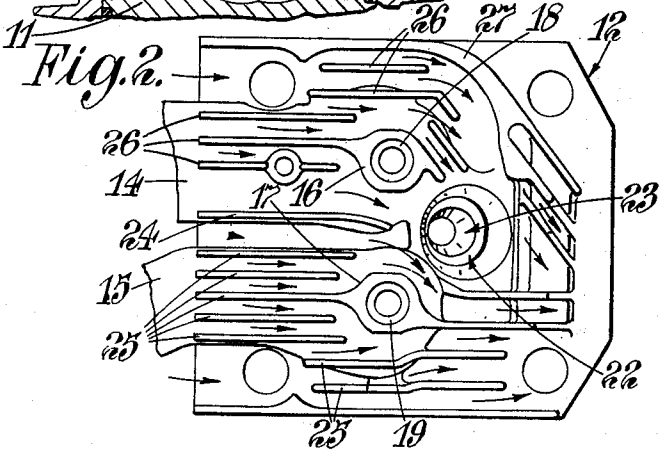


Fig. 2.



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Fig.3.

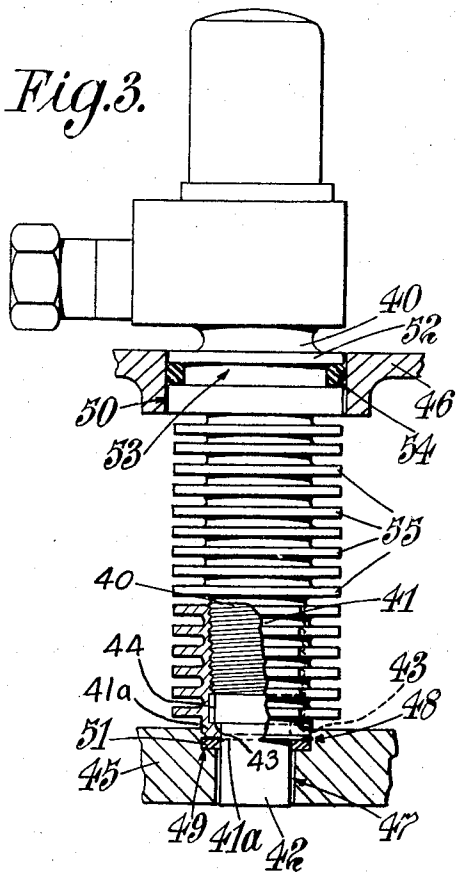
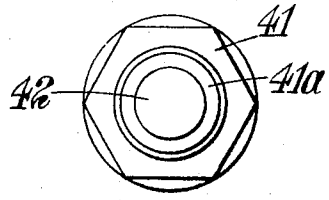


Fig.4.



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FUEL INJECTOR OF AIR-COOLED COMPRESSION IGNITION ENGINE

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Claims priority, application Great Britain May 23, 1957

15 Claims. (Cl. 123—32)

This invention relates to compression ignition engines and fuel injectors therefor.

According to the present invention, a fuel injector for a compression-ignition engine has an injector body and a nozzle element, the injector body comprising a main body part housing moving parts of the injector and a nut part threaded on the main body part to hold the nozzle element in abutment with one end of the main body part, said injector affording two external peripheral locating surfaces for the location of the injector in an engine, which locating surfaces are spaced apart lengthwise of the injector, one of said locating surfaces being provided on the injector nut adjacent the end thereof nearest the nozzle, and the other locating surface being provided on the main body part, at least part of the external surface of the injector between the two locating surfaces being provided with cooling fins.

According to one preferred arrangement of the present invention, the nut part has an annular portion projecting from the locating surface thereon, the internal surface of which portion closely surrounds the tip of the nozzle element and the external surface of which portion is frusto-conical so that the portion tapers in radial thickness in a direction away from the locating surface towards the tip of the nozzle element.

It is found that by providing such a projecting portion on the nut member, cooling of the injector is markedly improved, and the improvement in cooling is such that finning is needed only on the nut part.

Preferably, also the internal and external surfaces of the projecting portion of the nut part of the injector meet in an edge at their ends remote from the locating surface. The nut part may if desired be formed in two pieces, one piece being threaded on the main body part to hold the nozzle element in abutment with one end of the main body part, and the other piece affording the locating surface and said projecting annular portion, the two pieces of the nut being in abutment with each other lengthwise of the injector.

According to the invention, moreover, a compression ignition engine comprises one or more injectors as above set forth, and the engine has spaced walls which afford surfaces co-operating with said peripheral locating surfaces to locate the injector or injectors, and having provision for causing a flow of cooling air between said walls, whereby cooling air flows over the cooling fins of the injector or injectors.

According to a feature of the invention, where the injectors have a tapering projecting portion, the wall adjacent the engine combustion space which co-operates with the locating surface on the nut part, has a hole therein through which the nozzle element projects and the hole tapers to receive the annular projecting portion of the nut part with a small clearance.

According to a preferred feature of the present invention, the walls are afforded for each engine cylinder respectively by a finned cylinder head and by a heavy clamping plate carrying the valve rockers, resting on the

fins of the cylinder head and secured to the engine to restrain bending of the cylinder head, the air inlet duct and the exhaust duct project to one side of the head, and the fins on the head are shaped to maintain separate cooling air flows over the head in the region of the inlet duct and inlet port on the one hand and in the region of the exhaust duct and exhaust port on the other hand and to deflect the relatively cool air flowing in the region of the inlet port to flow around the fuel injector where it extends between the walls.

In one arrangement according to this feature of the invention, the cylinder head and clamping plate are located relatively by making the exhaust valve guide a press fit in each of these parts, and by making the inlet valve guide a press fit in the cylinder head and engaging the inlet valve guide in the clamping plate through a sealing ring.

Two constructions of fuel injector and air-cooled compression-ignition engine of this invention will now be described with reference to the accompanying drawings in which:

Figure 1 is a section through the engine on the axis of a cylinder,

Figure 2 is a plan view of the cylinder head,

Figure 3 is a view corresponding to Figure 1 of a second form of injector, and

Figure 4 is an end view of the injector shown in Figure 3.

Referring to the drawings, the engine comprises an externally finned cylinder **10** in which works a piston **11** of any convenient kind, a cylinder head **12**, and clamping plate **13**.

The cylinder head **12** has formed in one piece with it an air inlet duct **14** leading from the air manifold (not shown) to an air inlet port in the head, an exhaust duct **15** leading from an exhaust port to an exhaust manifold (not shown), a pair of bored upstanding pillars **16**, **17** for receiving the inlet and exhaust valve guides **18**, **19** respectively. The inlet valve guide **18** has an interference fit in the head **12** but has a clearance from the hole in the clamping plate **13** into which it projects and a circular-section ring **20** is provided around the guide **18** to prevent passage of lubricating oil through the hole to below the clamping plate **13**. The exhaust valve guide **19** is a press fit in both the head **12** and clamping plate **13**.

The cylinder head **12** is also provided with a hole through which a fuel injector **21** extends. The hole is shaped to afford a seat **22** for one end of the injector and has a frusto-conical portion **23** beyond the seat extending to the cylinder space.

The cylinder head is also provided with finning which is designed to provide efficient cooling of the injector **21**. The finning comprises a central fin **24** which separates the air flows over the duct **14** from that over duct **15** and is curved at its downstream end to deflect air flowing between it and the duct **15** towards the airstream flowing over fins **25** on the duct **15** and pillar **17**, thus to prevent this air stream which is relatively hot from contacting the injector **21**. The duct **14** and adjacent parts of the head **12** are provided with fins **26** and a continuous wall **27** which are shaped to deflect the relatively cool air stream flowing over the duct **14** and pillar **16** to flow over the injector **21** to cool it. The provision of a separate clamping plate **13** and the design of the finning enables the cylinder head to be produced by a simple casting method avoiding the use of complicated coring as would be required if the top wall of the cooling air space is made in one with the head **12**. The finning is also designed to permit a high velocity air flow of substantially constant speed through the air spaces between the head **12** and clamping plate **13**.

The clamping plate **13** rests on the finning and is de-

signed to prevent bending of the head. The clamping plate has mounted on it a pair of pedestals 28 carrying the valve rockers 29 and is formed with wells 30 receiving the valve springs 31. Between the pedestals 28, the clamping plate is provided with a cylindrical-walled hole 32 through which the injector 21 projects, and the injector is retained in position by a cross bar 33 bearing on the upper end of the injector 12 and secured to the rocker pedestals 28.

In order to ensure efficient cooling of the injector 21, an improved injector is employed. This comprises a main injector body part 21*a* containing any moving parts of the injector and formed with a pair of flanges 21*b*. The flanges 21*b* occupy the hole and receive between them a sealing ring 21*c*; the flanges 21*b*, ring 21*c* and the hole 32 afford a first location for the injector. The injector further comprises a nozzle element 21*d* which is held in abutment with the end of the main body part 21*a* by a nut part 21*e* threaded on the main body part.

The nut part 21*e* is provided with finning 34 over the portion thereof which lies in the air space, with a flange 35 which bears on the seat 22 and provides a second location for the injector, and with an annular portion 36 which projects from the flange 35, surrounds the tip of the nozzle element 21*d* with a small clearance, say .005 inch, and has an external surface of frusto-conical form so as to have a clearance, of say .015 inch, from the frusto-conical bore portion 23 and so that the portion 36 tapers in thickness away from flange 35 towards the cylinder space. The conical surface of the portion 36 and its bore meet adjacent the end of the nozzle element substantially in an edge. It is found that the provision of the frusto-conical portion 36 and the finning 34 markedly improves the cooling of the injector.

If desired, the nut part 21*e* just described may incorporate parts made from material having a high heat conductivity. In one such arrangement the nut 21*e* comprises a cylindrical threaded part made of a metal having high tensile strength, which part serves to secure the nozzle element 21*d* in abutment with the main body part 21*a*, and an outer sleeve part which abuts and is a close sliding fit over the cylindrical part and which affords the cooling finning 34, the flange 35 and annular portion 36. The outer sleeve part is made from a metal having high heat conductivity so that heat is conducted more rapidly away from the tip of the nozzle element.

In an alternative arrangement, the part affording the flange 35 and annular portion 36 is made separately from the threaded nut part 21*e*, the two parts abutting one another axially of the injector. In this case the part affording the flange 35 and portion 36 is made a close sliding fit over the tip of the nozzle element 21*d*, and is made from a highly conductive metal with the result that the rate of conduction of heat away from the nozzle tip is increased considerably. The threaded nut part is of course made from material, such as steel, having a high tensile strength. Finning 34 is provided on the threaded nut part, and in addition the part affording flange 35 may have a sufficient axial length to be provided with one or more radial cooling fins at its end abutting the nut part.

The engine is also provided with a rocker cover 37 and the normal decompression lever 38.

The cooling air supply may be effected in any convenient manner; for instance a cowling may be provided at the left hand side of the engine (as viewed in Figure 1) to convey the cooling air to this side of the cylinder 10 and the adjacent end of the cooling air space between the head 12 and clamping plate, the air flowing from the engine at the right hand side.

Referring now to Figures 3 and 4, the body member of the injector comprises a substantially tubular main body part 40, in which are mounted the moving parts of the injector, and a nut part 41 which is threaded on the main body part 40 and secures an injector nozzle member 42 thereto. For this purpose the nut 41 is provided with an internal annular shoulder 43 which co-operates with a corresponding external annular flange 44 on the injector nozzle member 42, the flange 44 being so located that the lower portion of the injector nozzle member 42 protrudes below the lower end of the nut 41. The external surface of the nut 41 is accurately machined at its lower end to afford a spigot location 41*a* in the cylinder head for the lower end of the injector, the lower edge of the spigot location 41*a* being slightly chamfered.

The cylinder head of the engine comprises an inner wall 45 and an outer wall 46 with an air space between the walls, the lower side of the inner wall 45 being adjacent the working cylinders. A supply of cooling air is circulated between the two walls.

The inner wall 45 has a drilling 47 at the location of each injector opening into a cylinder of the engine, and the drilling has an enlarged diameter portion 48 at its end remote from the cylinder affording a locating diameter and an annular abutment 49 at the change of diameter. The outer wall 46 of the cylinder head has a corresponding aligned hole 50 bored to allow the insertion of the injector. When the injector is inserted the nozzle and body portions pass through the hole 50 in the outer wall 46 of the cylinder head and the nozzle member 42 fits into the hole 47 in the inner wall so that the end of the nozzle member 42 is level with the adjacent portions of the bounding surface of the cylinder. The spigot portion 41*a* machined on the nut 41 engages in the corresponding enlarged diameter portion 48 of the drilling 47 and a gas sealing ring 51 is interposed between the end of the nut 41 and the annular abutment 49. The injector is held down securely on to the abutment.

The injector body is provided with a locating flange 52 to engage the outer wall 46 of the cylinder at the location of the hole 50. A groove 53 is machined on the periphery of the flange 52 and contains a rubber ring 54 to prevent leakage of lubricating oil into the space between the inner and outer walls of the cylinder head. Alternative types of oil-sealing gland may be used.

In this embodiment, peripheral cooling fins 55 are provided on the external surfaces of the main body part 40 and nut 51 of the injector body between the spigot location 51*a* and the locating flange 52. The flow of cooling air between the inner and outer walls 45, 46 of the engine cylinder head thus passes over the finned portions of the injector body to ensure effective cooling of the injector.

The nut is normally made on an automatic lathe and thus the additional cost of machining the cooling fins on it is very small. In addition where the nut is made from hexagonal bar, the necessary flats for the spanner are already provided and the cooling fins 55 are formed by cutting into the flats.

I claim:

1. A fuel injector for a compression ignition engine having an injector body and a nozzle element, the injector body comprising a main body part housing moving parts of the injector and a nut part threaded on the main body part to hold the nozzle element in abutment with one end of the main body part, said injector affording two external peripheral locating surfaces for the location of the injector in an engine, which locating surfaces are spaced apart lengthwise of the injector, one of said locating surfaces being provided on the injector nut adjacent the end thereof nearest the nozzle, and the other locating surface being provided on the main body part, at least the external surface of the nut part between the two locating surfaces being provided with cooling fins.

2. A fuel injector according to claim 1, wherein the nut part has an annular portion projecting from the locating surface thereon, the internal surface of which portion closely surrounds the tip of the nozzle element

and the external surface of which portion is frusto-conical so that the portion tapers in radial thickness in a direction away from the locating surface towards the tip of the nozzle element.

3. An injector according to claim 2, wherein the internal and external surfaces of the projecting portion of the nut part of the injector meet in an edge at their ends remote from the locating surfaces.

4. An injector according to claim 2 wherein said nut part is formed in two pieces, one piece being threaded on the main body part to hold the nozzle element in abutment with one end of the main body part, and the other piece affording the locating surface and said projecting annular portion, the two pieces of the nut being in abutment with each other lengthwise of the injector.

5. An injector according to claim 4, wherein said internal surface is a close sliding fit around the tip of the nozzle.

6. An injector according to claim 4, wherein the threaded piece of the nut is cylindrical, and said other piece of the nut affords a sleeve closely surrounding the threaded portion and is formed internally with the cooling fins.

7. An injector according to claim 4, wherein said other piece of the nut is formed from a material having a high heat conductivity.

8. A fuel injector according to claim 1, wherein the nut part is hexagonal and the cooling fins are formed by cutting into the flats.

9. A fuel injector according to claim 8, wherein the main body part is also provided with cooling fins.

10. A compression-ignition engine having at least one fuel injector as claimed in claim 1, wherein the engine has spaced walls which afford surfaces co-operating with said peripheral locating surfaces to locate the injector, and having provision for causing a flow of cooling air between said walls, whereby cooling air flows over the cooling fins of the injector.

11. An air-cooled compression-ignition engine as claimed in claim 10, wherein the wall adjacent the engine combustion space which co-operates with the locating surface on the nut part, has a hole therein through which the nozzle element projects and the hole tapers to receive the annular projecting portion of the nut part with a small clearance.

12. An air-cooled compression-ignition engine as claimed in claim 11, wherein the walls are afforded for each engine cylinder respectively by a finned cylinder head and by a heavy clamping plate carrying the valve rockers, resting on the fins of the cylinder head and secured to the engine to restrain bending of the cylinder head, the air inlet duct and the exhaust duct project to one side of the head, and the fins on the head are shaped to maintain separate cooling air flows over the head in the region of the inlet duct and inlet port on the one hand and in the region of the exhaust duct and exhaust port on the other hand and to deflect the relatively cool air flowing in the region of the inlet port to flow around the fuel injector where it extends between the walls.

13. An air-cooled compression-ignition engine as claimed in claim 12, wherein the cylinder head and clamping plate are located relatively by making the exhaust valve guide a press fit in each of these parts, and by making the inlet valve guide a press fit in the cylinder head and engaging the inlet valve guide in the clamping plate through a sealing ring.

14. A fuel injector for a compression ignition engine having an injector body and a nozzle element, the injector body comprising a main body part housing moving parts of the injector and a nut part threaded on the main body part to hold the nozzle element in abutment with one end of the main body part, said injector affording two external peripheral locating surfaces for the location of the injector in an engine, which locating surfaces are spaced apart lengthwise of the injector, one of said locating surfaces being provided on the injector nut adjacent the end thereof nearest the nozzle, and the other locating surface being provided on the main body part, at least the external surface of the nut part between the two locating surfaces being provided with cooling fins, said nut part also having an annular portion projecting from the locating surface thereon towards the tip of the nozzle element, which annular portion closely surrounds the tip of the nozzle element and tapers in radial thickness in a direction from the locating surface towards the tip and terminates adjacent the tip in a sharp edge.

15. A compression ignition engine having a combustion space and at least one fuel injector for delivering fuel to said combustion space, said fuel injector comprising an injector body and a nozzle element, the injector body comprising a main body part housing moving parts of the injector and a nut part threaded on the main body part to hold the nozzle element in abutment with one end of the main body part, said injector affording two external peripheral locating surfaces for the location of the injector in an engine, which locating surfaces are spaced apart lengthwise of the injector, one of said locating surfaces being provided on the injector nut adjacent the end thereof nearest the nozzle, and the other locating surface being provided on the main body part, at least the external surface of the nut part between the two locating surfaces being provided with cooling fins, said nut part also having an annular portion projecting from the locating surface thereon towards the tip of the nozzle element, which annular portion closely surrounds the tip of the nozzle element and tapers in radial thickness in a direction from the locating surface towards the tip and terminates adjacent the tip in a sharp edge, said engine having also spaced walls which afford surfaces co-operating with said peripheral locating surfaces to locate the injector, and having means causing a flow of cooling air between said walls, whereby cooling air flows over the cooling fins of the injector, and the one of said walls adjacent the engine combustion space which co-operates with the locating surface on the nut part, having a hole therein through which the nozzle element projects, the hole tapering to receive the annular projecting portion of the nut part with a small clearance.

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