Aug. 10, 1943. W. C. DEHN 2,326,335

AIR COOLING OF ENGINES

Filed July 26, 1940 2 Sheets-Sheet 1

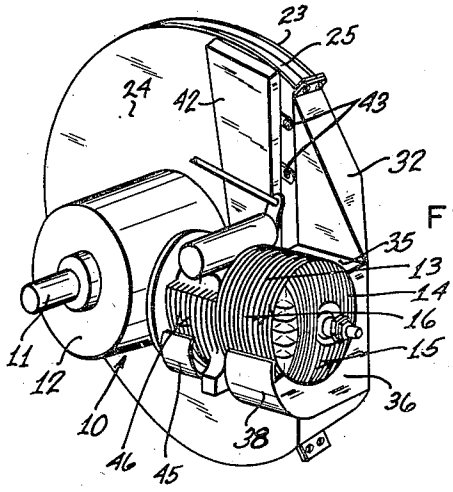


FIG. 1.

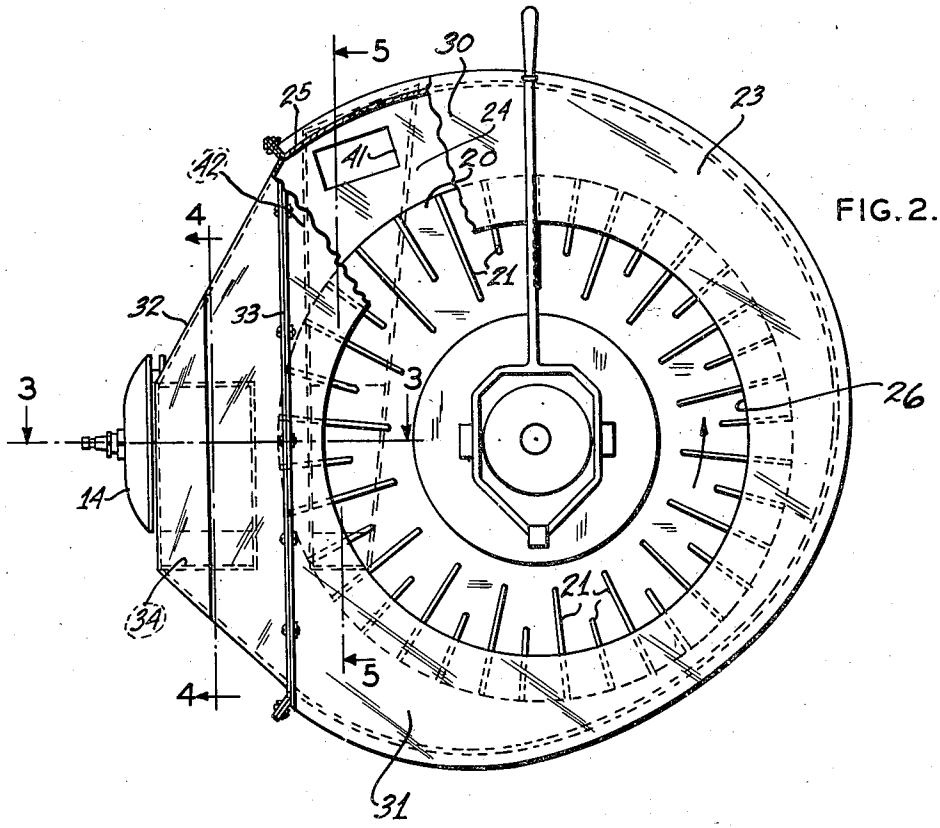


FIG. 2.

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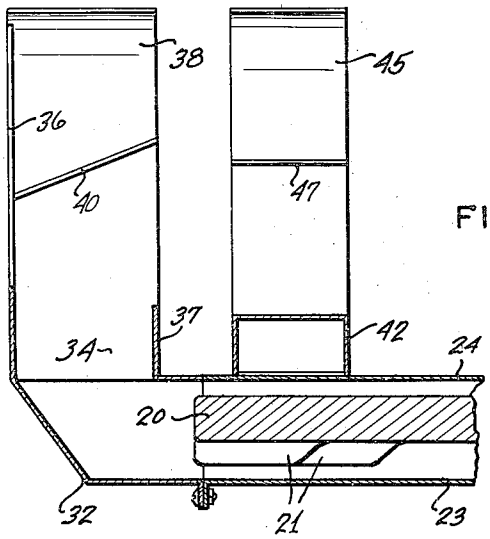


FIG. 3.

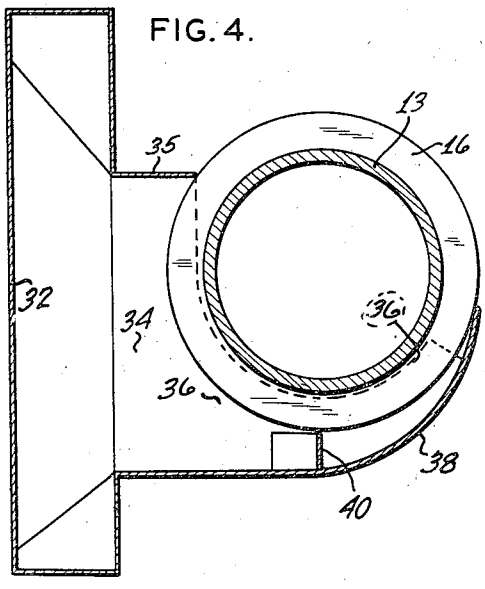


FIG. 4.

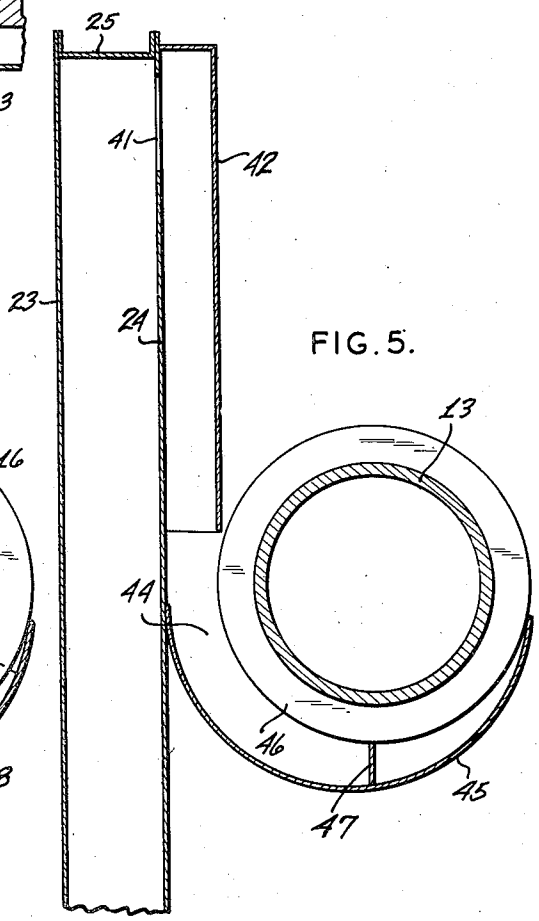


FIG. 5.

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2,326,335

AIR COOLING OF ENGINES

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Application July 26, 1940, Serial No. 347,621

2 Claims. (Cl. 123—171)

This invention relates to improvements in air cooling of engines, and more particularly to an improved air displacing and circulating assembly, particularly adapted for use in cooling the individual cylinders of internal combustion engines.

The present developments were evolved as a result of heretofore prevalent difficulties in cooling all parts of each individual cylinder of an air cooled engine, in such manner as to assure safe operating temperatures, even in warm climates, and under occasional overload operation; for example, under conditions wherein the engine is employed for vehicle propulsion as in the single cylinder engines utilized for the propulsion of railway inspection cars or the like. It is accordingly a major object of the invention to effect a better distribution of cooling air about the cylinder, and a better proportioning of a given volume of cooling air with respect to the relatively warmer and cooler portions of the cylinder.

An important object of the invention is attained in means conducing to a better and more complete envelopment of the cylinder by a cooling air stream, together with means for effecting a substantial turbulence of the air in the cooling air stream immediately adjacent and between the fins of an air cooled engine cylinder.

Another object of the invention is attained in an improved arrangement for directing cooling air substantially over the full length of a cylinder of a type provided with a series of parallel fins of a trend transverse to the cylinder axis.

Yet another object is attained, in a reversible vehicle-propelling engine, in an improved provision of an engine-driven fan, together with means for supplying a stream of air from the fan to the cylinder or cylinders, in the same manner in either forward or reverse operation of the engine.

A still further object of the invention is attained in an improved housing and volute structure which is particularly adapted to a reversibly operable, engine-driven fan, but which is of somewhat general adaptation for use with centrifugal air-impelling agencies of different types.

The foregoing and numerous other objects will more clearly appear from the following detailed description of a preferred embodiment of the invention, considered in connection with the accompanying drawings, in which:

Fig. 1 is an elevation in perspective of an engine of air-cooled type to which the present improvements are applied; Fig. 2 is a side elevation of the engine, somewhat enlarged, certain portions being broken away to illustrate features internally of the assembly; Fig. 3 is a fragmentary horizontal section as viewed along line 3—3 of Fig. 2; Fig. 4 is a section in a vertical plane, as viewed along line 4—4 of Fig. 2, and Fig. 5 is a fragmentary sectional view in a vertical plane, as taken along line 5—5 of Fig. 2.

Referring now by characters of reference to the drawings of the embodiment selected for description, a single cylinder engine designated generally at 10 is provided with a crankshaft 11, crankcase 12 and a single air-cooled cylinder 13. The engine shown is of a two-cycle type, which, as is well known in the art, is readily and inherently reversible in operation, and in the present example, reversal of the engine is utilized to effect reverse operation of a railway inspection car or the like (not shown). The preferred mounting of the engine on the car is such that the cylinder, particularly the head portion 14 thereof, is presented toward the air stream so as better to realize on the motion of the vehicle for cooling purposes.

The cooling fin arrangement as appears on the head 14, consists of a series of parallel head fins 15 while the ribs or fins 16 on the cylinder are preferably cast integrally therewith and arranged in spaced parallel relation, being of annular form with their centers coincident with the axis of the cylinder.

The engine 10 is provided with a flywheel 20, on which are a plurality of spaced, radially arranged air displacing blades 21. It will be obvious that the rotation of the flywheel results in a centrifugal displacement of air thereby, so that the flywheel per se, functions as the air displacing agency for cooling the engine.

Surrounding the flywheel and substantially enclosing same, is a volute and housing structure consisting of what may be termed a side element 23 seen at the front of the assembly, and a companion side element 24, arranged rearwardly of the flywheel. The housing and volute structure is conveniently formed at a low cost of fabricated sheet steel or the like, and is of irregular curvature in outline, or in any event shaped eccentrically with respect to the engine shaft axis. Enclosure of the housing and volute structure is completed peripherally by a marginal band 25. An air inlet port or fan eye is indicated at 26.

It will be noted from the drawings, particu-

larly Fig. 2, that the volute and housing structure is formed to provide a volute portion 30 which functions, as such, as an air reservoir or build-up space during normal or forward direction of operation of the engine, and hence of the flywheel fan. A second volute portion 31 is similarly provided to function for this purpose during periods in which the engine is operated in reverse direction, the normal or forward direction of engine operation being as indicated by the arrow (Fig. 2).

An outlet duct 32 is provided, which is characterized, for economy of production, by a rectangular section, which diminishes from the plane of connection 33 between the discharge fitting and the volute-housing structure. It will be noted that discharge fitting 32 connects with both the volute portions 30 and 31 so as to function for the delivery of discharge air, in either direction of engine rotation.

Extending at a right angle from, and communicating with the fitting 32, is a discharge nozzle 34, the form and structure of which best appears in Fig. 4. The member 34 is provided with a partial closure plate 35 at its upper portion, and is of a generally trough-like form and of arcuate trend. The outer portion of the nozzle 34 is comprised of a pair of side members 36 and 37 which, together with the bottom, partly cylindrical portion 38, constitute the arcuate trough-like structure. In assembly, the nozzle is so applied to the cylinder that each of its side elements 36 and 37 extends between a pair of the cooling fins 16, so as to provide a partial seal between the sides of the trough and the cylinder portion about which it is wrapped. This relation is best shown by the relation of the lines indicating the fin outline and edge of member 36 in Fig. 4.

Bridging the sides 36 and 37 of the nozzle structure, preferably in about the position shown, is a baffle member 40 formed of an element of sheet metal, preferably aluminum sheet, even though the nozzle and duct structures be formed of sheet steel. The member 18 serves a multiple purpose as will hereinafter appear, and in keeping with its function is preferably disposed in a somewhat biased position in bridging relation to the sides 36 and 37 of the nozzle structure. The arrangement of the baffle is by preference at an angle of 30° to a plane normal to the axis of the nozzle trough in this zone. The depthwise extent of the baffle or bridge piece 40 is substantially as indicated in Fig. 4, namely such that the baffle extends from the bottom element 38 of the nozzle, inwardly or upwardly to proximity with the adjacent cylinder fins 16. Only a minor clearance is desirable between the end of the baffle and the adjacent fins.

Although the air distribution and nozzle arrangement thus far described, is a distinct improvement when utilized without further cylinder provisions, it is preferred to provide a specific agency for air-cooling the inner or barrel portion of the cylinder, as distinguished from the head portion of the cylinder, and by distinctly directing air streams over these zones, the assembly is arranged so as substantially to cover the full length of the cylinder with a highly efficient stream or streams of cooling air. Provision for cooling the barrel part of the cylinder consists, first, of a port 41 in the side volute-housing plate 24. This port opens into and serves as an air supply for an elongate, vertically disposed, laterally mounted second air duct 42. This duct portion is formed of an open side sheet steel element preferably of a gradually reduced section from its inlet to its discharge end, and which is assembled to the volute-housing member by a plurality of securely bolted or riveted straps 43.

The duct 42 terminates at its lower or outermost end in a nozzle structure 44, which is generally similar to the nozzle assembly 34, heretofore described, except that for use in certain engines, the side members of the duct may be eliminated or foreshortened in comparison with those of nozzle 34. The nozzle structure 44 is, however, preferably characterized by the arcuate trend, and particularly the arcuate bottom portion 45, which is partly wrapped about the cylinder closely adjacent to the concentric ribs 46 on the barrel portion thereof.

It is desirable and preferred that the nozzle 44 be provided with a baffle element 47, which is or may be similar in purpose, extent and location, to the nozzle member 40 heretofore described, except that it is desirably located more nearly exactly transverse to the air stream through the nozzle 44. A slight angularity of the baffle 47 may be desirable in engines characterized by a long stroke and hence a longer cylinder.

The operation of the cooling system heretofore described by reference to its parts and assembly, is thought to have been apparent from the foregoing discussion, but may be briefly reviewed as follows: The rotation of the engine flywheel, which for present purposes may be considered as a blower or fan, results during forward running of the engine, in building up an appreciable head of air in the volute portion 30, and the propulsion of a rapidly moving stream of air therefrom into the discharge fitting 32, thence into the nozzle 34. The air stream is at this point brought against the baffle element 40 which it impinges at a substantial velocity, and by which a portion of the air, doubtless the major portion, is given a backflow effect. The result of impact of this larger portion of the air stream against the baffle, has been found to give rise to a substantial turbulence, so that there results through the coaction between the baffle and the ribs or fins on the cylinder, a plurality of divided, highly turbulent air streams, which move outwardly to atmosphere between the ribs or fins of the cylinder, the linear velocity of these streams being substantially reduced by reason of the turbulence induced therein by baffle 40. These streams of air thus advance relatively slowly along and past the fins or ribs of the cylinder, thus providing for a maximum heat pickup by the given volume of air, due to the stated turbulent effect. A considerable part of the stream of cooling air will be impelled between the baffle 40 and the adjacent fins, and instead of being given a reversal of flow by the baffle, will continue outwardly through and along the fins on the opposite side of the cylinder. It results from the provision of the baffle and the shape of the nozzle, that the divided streams, being diverted as they are to the opposite sides of the cylinder, result in a highly turbulent series of streams which practically envelop, with a highly efficient cooling action, the hotter or head portion of the cylinder.

Another important function of the baffle 40, due to its angular position, consists in its deflection of an appreciable part of the air which comes into engagement with the baffle, downwardly of the head portion and toward the barrel portion. While it will be understood that a single nozzle of single width may care for all of the cylinder

length requiring cooling in engines of certain types, nevertheless in case the nozzle, as is illustrated, is of lesser width than the axial length of the cylinder the angularity of the baffle assumes a considerable importance in directing a portion of the air to those fins inwardly or downwardly of that cylinder portion which is enveloped by the nozzle **34**.

In the present structure a separate yet cooperating agency consisting of port **41**, duct **42** and associated nozzle, serves to cool the barrel part of the cylinder in much the same manner as that described above in connection with nozzle **34** and the head cylinder portion. The course of the air being impelled from port **41** through duct **42** and nozzle **44** is substantially as above described, and the effect of the baffle in nozzle **44** is the same as that of baffle **40**, except that because of its different angularity, specifically its lesser bias, it does not so definitely serve to direct a portion of the air stream axially of the cylinder.

Referring now more particularly to the arrangement whereby specific provision is made for effective cooling in reverse operation of the engine, as well as forward running, it will be noted that the radial disposition of ribs on the flywheel renders it equally effective as an air displacement agency in either direction of engine rotation. However, were only a single volute portion provided in the fan housing, the blower assembly would be considerably reduced in efficiency when running in reverse. Accordingly, there is provided the separate volute portion **31** which functions primarily for reverse running. Since, by railroad order, a reverse running of inspection cars and the like is usually limited to an extent of two miles, and usually at reduced speeds, the provision for cooling air in reverse operation need not be as great as that for forward running. For this reason the proportion of volume in the forward running volute **30** to the volume in volute **31** is substantially in a ratio of the order of two-thirds and one-third respectively, of the total of the two. It will have appeared from the description of the volute and fan assembly that this arrangement is of considerable value in reversible blowers generally, whether or not utilized for the cooling of internal combustion engines.

Although the invention has been described by making particular reference to a preferred embodiment of the cooling system as utilized for a specific purpose, the detail of description herein is to be understood solely in an illustrative, and not in a limiting sense, it being possible with or without minor changes to depart from the exemplary structure without exceeding the spirit and scope of the claims hereunto appended.

The following is claimed:

1. In an air cooling system for internal combustion engines, a reversible engine driven fan, a volute and housing structure about the fan, characterized by two substantially opposite volute portions, an end fitting or connection to said housing structure connecting with both volute portions, a duct communicating with said connections, a side connection laterally secured to and communicating with the volute-housing structure, a duct communicating with said side connection, a nozzle for each of said ducts, a turbulence-inducing baffle in each of said nozzles, the nozzles being of partly circular trend, and in partly wrapped relation, respectively to the head portion and barrel portion of the cylinder, the baffle in the nozzle adjacent the head portion of the cylinder, being arranged in biased relation to the associated nozzle whereby to direct a portion of the air entering said nozzle in a direction axially of the cylinder and toward the barrel portion thereof, the cylinder being provided with a plurality of cooling fins respectively on the head and on the barrel portion thereof, and coacting with the said baffles to produce a divided highly turbulent air stream, and to direct such stream circumferentially of the cylinder.

2. In an air cooling system for internal combustion engines, a reversible engine driven fan, a volute and housing structure about the fan, characterized by two substantially opposite volute portions, a duct, a connection between said housing structure and the duct, a nozzle at the outer terminus of the duct, a baffle disposed in the nozzle and arranged substantially across the normal flow of air into the nozzle, the nozzle being of partly circular trend, and in partly wrapped relation, to at least a portion of the cylinder, and the baffle being so arranged in the nozzle as to be face-wise impinged by the air stream, whereby to reverse the direction of and induce a distinct turbulence in a said portion of the air stream, the baffle being further arranged to permit passage between itself and the adjacent cylinder, of a portion of the air stream without markedly affecting the direction of the last said portion, the cylinder being provided with a plurality of circumferential cooling fins coacting with the nozzle and with the baffle therein, to direct the several portions of the air stream emanating from the nozzle, in directions circumferentially of the cylinder.

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