June 14, 1927. 1,632,207

E. VAN TOFF

AIR COOLED ENGINE

Filed May 10, 1924 2 Sheets-Sheet 1

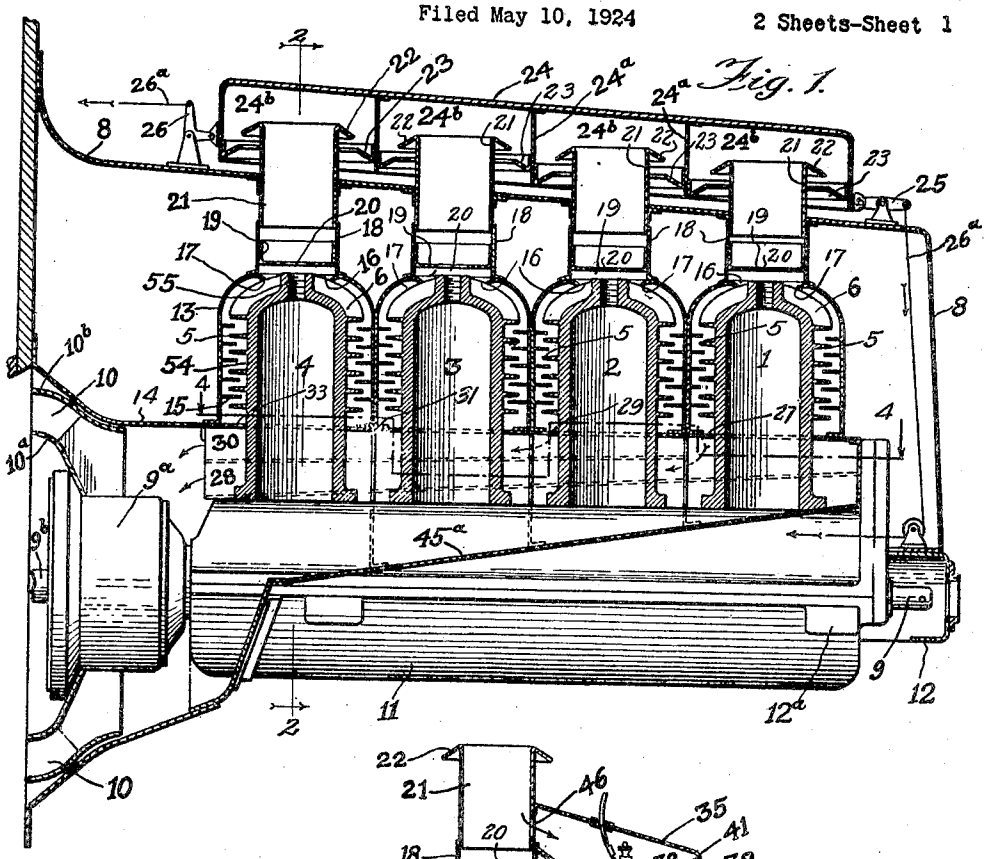


Fig. 1.

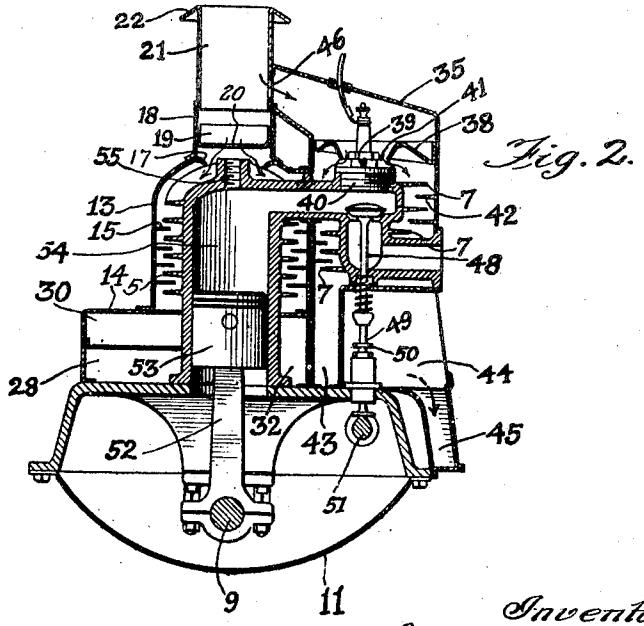


Fig. 2.

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Fig. 3.

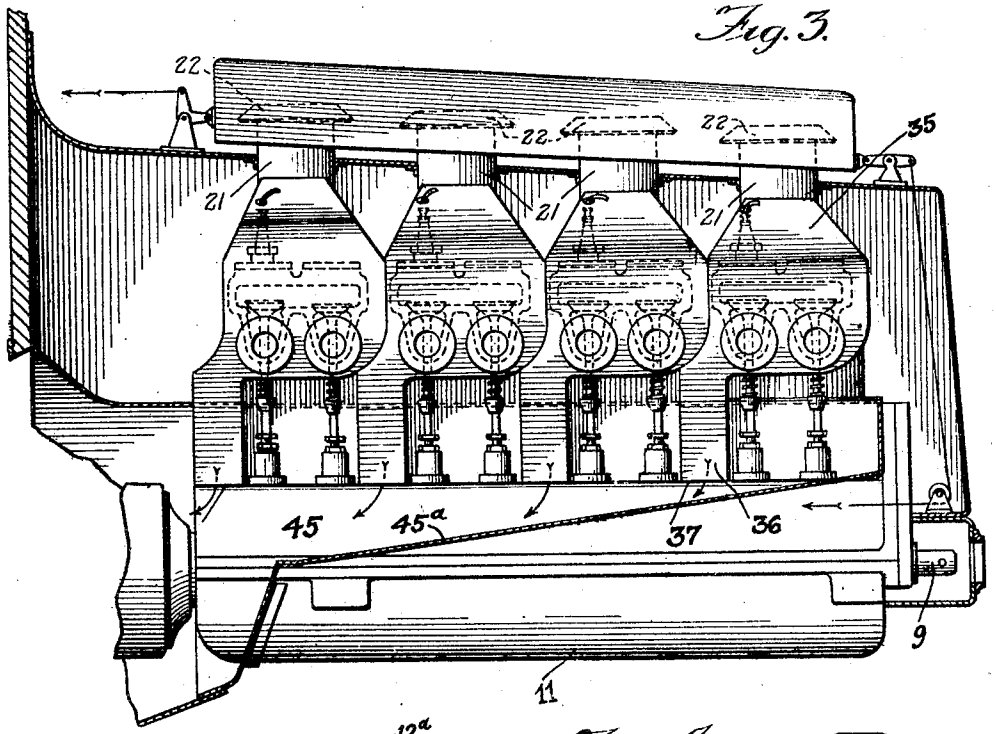
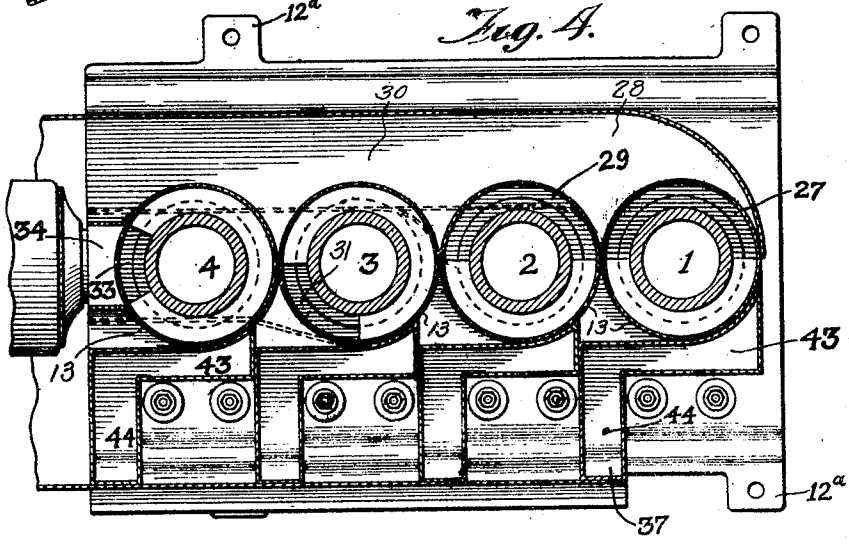


Fig. 4.



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UNITED STATES PATENT OFFICE.

ERNEST VAN TOFF, OF CHICAGO, ILLINOIS.

AIR-COOLED ENGINE.

Application filed May 10, 1924. Serial No. 712,195.

This invention relates to improvements in air-cooled internal combustion engines, in which the cylinders are in longitudinal alinement, with the valves and valve housings mounted on their top walls, and which for cooling purposes rely upon the deflection of currents of air individual to each cylinder from a single column of cooling air directed in a plane above the several cylinders and in alinement therewith.

Other than the tandem arrangement of the several cylinders, the structure above described is subject to a number of objections, among which may be mentioned that the temperature of the air column, in its passage from the first to the last cylinder, is gradually increased and its density reduced through expansion, with the result that it is impossible to reduce any of the cylinders or to air-cool the upper and hottest portion of any two or more of them to the same or substantially the same degree of coolness, and that the valves not infrequently become too overheated for the successful closing of the cylinders.

From the foregoing, it will now be apparent that any means by which it is possible and practicable to uniformly air-cool every cylinder and at the same time maintain the valves against the possibility of their being overheated, will be a substantial and material improvement in the art of air-cooled internal combustion engines.

The prime object of my invention broadly stated, is to provide a means by which the several cylinders of an air-cooled engine may be uniformly cooled, and to a degree below that heretofore possible.

More specifically stated, the object of my invention is an air-cooled engine in which cooling air currents uniform in pressure and quantity are simultaneously directed to initial contact with each of its several cylinders and valve chambers, and discharged there from.

Another object of my invention is to have the valves for the several cylinders so located that they may be exposed to currents of air, reducing and maintaining their temperature below any degree of heat capable of injuring any of the valves, but not so low as to condensate the gas charge in the intake.

A further object of my invention is not only to have the several cylinders of an engine air-cooled with uniformity, but to have the valves therefor so located that they may be uniformly cooled independently of the cooling air currents for any of the cylinders.

More specifically stated, the object of my invention is an air-cooled internal combustion engine in which set-in valve heads or housings are dispensed with and a separate column of cooling air is projected to direct contact with the valve chamber, and means are provided for regulating the amount of air in each column and for so distributing the cooling air for the cylinders and valves that the amount of cool air applied to the hottest part of the cylinders is greater than that applied to the cooler parts.

With these ends in view, my invention finds embodiment in certain features of novelty in the construction, combination and arrangement of parts by which the said objects and certain other objects are attained, all as hereinafter fully described with reference to the accompanying drawings and more fully pointed out in the claims.

In said drawing,—

Fig. 1 illustrates, partly in vertical longitudinal section, an engine and housing therefor in which my invention finds embodiment.

Fig. 2 is a vertical cross-section partly on the line 2—2 of Fig. 1.

Fig. 3 is a side elevation, with parts of the housing and hood broken away for better illustrating the invention, and

Fig. 4 is a horizontal section taken on the line 4—4 of Fig. 1.

Similar characters of reference indicate the same parts in the several figures of the drawing.

The cylinders 1, 2, 3 and 4, in the order in which they are usually designated, are shown in tandem relation, each of which cylinders is provided with annular ribs or flanges 5, for the purposes of increasing the surfaces exposed to cooling air for facilitating the cooling of the cylinders, which cylinders are also provided on top with radial flanges 6, directing the cooling air to the side flanges, the valve caps being also provided with radial flanges for distributing and directing air to the valve chambers, as will be hereinafter more fully described.

The hood 8 for covering and enclosing the automobile engine is otherwise of the usual type for that purpose.

Centered on a crankshaft 9 is a fly-wheel 9^a, connected with a drive shaft 9^b by means of the usual spring-actuated friction clutch (not shown).

Secured to and projecting from the rim of the fly-wheel 9^a is an inner ring 10^a and an outer ring 10^b, carrying vanes 10 for a rotary suction fan, which vanes are located between an inner ring 10^a and an outer ring 10^b, to which the edges of the vanes are secured. The vanes 10 are also located at frequent intervals of each other and at such an angle with reference to the periphery of the rings that they operate to suck the air from the engine and discharge it through the continuous circular opening between the rings, the outer ring of which curves inwardly and the inner ring outwardly.

The form of the vanes, as shown in Fig. 1, is approximately that of the truncated sector of a circle, but they may be of other form wherein rectangular vanes are confined between flat portions of the rings. When the front and rear rings extend at an angle, the forms of the vanes will be polygonal.

11 is the crank-case of the engine and 12 is a frame upon which the engine is supported by means of lugs 12^a (see Figs. 1 and 4).

Surrounding each cylinder is a housing 13 resting at its lower end upon a flat portion 14 of a duct 30, fastened thereto in any suitable manner.

On the inside of the housing 13 are annular flanges 15, which differ in width (see Figs. 1 and 2) for speeding the air as it is pulled downwardly by the fan 10; that is to say, so that the speed of air applied to the sides of the cylinder increases with the decrease of the heat of the cylinder, as it invariably does, from the top to the bottom of the latter.

The housing 13 has an opening 16 in its top, the edges of which are slightly crimped downwardly, as shown at 17, so that the lower edge of said crimping may rest upon and project between the radial flanges 6.

Resting on top of the housing 13 and secured thereto, is a short pipe 18, flanged at its bottom to provide an air-tight joint.

Inside of the pipe 18 is fastened slidably a cup 19 in which is a hole 20 placed directly over the center of the cylinder so that a certain amount of strong blast of cooling air, due to the fan 10, will be directed against the cylinder at this point and spread to all sides of the cylinders by the flanges 6.

Inside of this pipe 18, and projecting downwardly only far enough to secure an air-tight joint is a pipe 21, provided at its upper and outer end with a beveled flange 22, which, together with the beveled flange 23, will adjust and determine the total amount of air necessary for cooling the different parts of each cylinder and its valve chambers to the desired degree.

The pipes 21 provide a means for conducting a single and separate column of air to direct contact with the hottest surface of each cylinder, namely, their tops, the amount of air for each cylinder being regulated and controlled by the raising and lowering of cover 24, divided by partitions 24^a forming a separate air-supply chamber for each pipe 21, the amount of air supplied from the cover 24 to the pipes 21 being regulated and controlled by the raising and lowering of the cover through the medium of a lever 25, and bell-crank 26, adapted to raise and lower the cover 24 by means of a hand-operated cable 26^a, or some thermostatic regulator.

In other words, it will now be seen, by reference to Fig. 1, that my invention provides for separately directing to contact with each cylinder, cooling air at the same temperature; that the amount of air is uniformly controllable for every cylinder; and that, as the air is drawn down by means of the suction fan 10, the cooling air passes under the cover 24 up through and between the flanges 22 and 23, down through the pipes 21, the holes 20 in cups 19, and through the openings 16 in the housing 13 to direct contact with the top of the cylinders, and whence the air is distributed around all parts of the cylinders and thence descends through and between the baffle plates 15 and flanges 5.

From the flanges 5 the air is directed from each cylinder by differing suction passages, as, for instance (see Figs. 1 and 4), the opening 27 partially surrounding cylinder 1, allows the air to pass downward into a passage 28, the opening 29 permitting the air surrounding the cylinder 2 to pass down into a suction chamber 30; the opening 31 allowing the air around the cylinder 3 to pass down into a suction passage 32, and the opening 33 allowing the air around cylinder 4 to pass down into and out through the suction passage 34, and by which arrangement there can be regulated the amount of air pulled through the duct and around each cylinder.

Surrounding the valve chambers of each cylinder (see Fig. 3) is the housing 35, which does not extend all the way down to cover the valve stems, tappet adjustments, etc., and it projects down to the top of the upper crank case only between the valve sets, as shown at 36, and these projecting parts are open at their lower ends as indicated at 37.

Referring to Fig. 2, there is mounted in the upper portion of the housing unit 35, a ring 38, the inner edge of which rests upon radial flanges 39 on the valve cap 40, but permits the passage of air between said radial flanges, as indicated by the arrows, through the opening 41, which air, on account of the flanges 39, is distributed in all

directions around the valve chamber and thence it is drawn down between the flanges 7 and baffle plates 42, into the suction passage 43, from which the air passes through the air duct down through the opening 37 and into the suction passage 45.

Suction passage 45 (see Figs. 1 and 3) has an inclined bottom 45^a and is open to suction from the fan 10 at the end nearest the fan, so that the amount of air drawn through the housing unit 35 and around the valve chambers is controlled entirely by the opening 46 in the pipe 21.

The construction of the engine shown in the drawings is of what is commonly known as the "L-head" type, in which the cylinders are provided with intake and exhaust valves 48, the stems 49 of each of which have thereon tappet adjustment nuts 50 and are actuated by a cam-shaft 51. 52 indicates connecting rods on the crankshaft 9; 53, the pistons for the cylinders 54; and 55, screw-threads in the upper ends of the cylinders for removable plugs (not shown).

It will, however, be no departure from this invention to apply the above principles to an engine having T-head cylinders.

In operation, the exhaust produced by the fan 10 induces atmospheric air to simultaneously ascend between the pipes 21 and rings 23 into the compartments 24^b for each cylinder, whence the air simultaneously descends through the pipes 21, the opening 20 in the cup 19, between the radial flanges 6 to direct contact with substantially the entire top of each cylinder, so that the air supplied for each cylinder has exactly the same temperature and density, and is directed by the top flanges 6 uniformly around the sides of each cylinder, and likewise thence against the flanges 5 projecting from each of the cylinders, deflected, as the air is, by the flanges 15 projecting inwardly from the housing 13, in stepped relation with reference to the flanges 5.

With the flanges 15 successively increasing in width from top to bottom, the speed of the air is gradually increased to correspond with the decrease in heat of the surface of the cylinders from top to bottom, and this regardless of the amount and velocity of the air initially contacting with the top of the cylinders, with the result that the contact of the cooling air with the hottest portion of the cylinders is not prolonged beyond a time sufficient for reducing the temperature of the hottest portion of the cylinders before the cooler portion of the cylinders is exposed thereto, and whereby the cylinders are uniformly cooled throughout their length, as nearly as may be.

With the descent of the air to a plane below the staggered flanges, it passes into the suction passage or duct 32, and (see Fig. 1) thence through between the fan vanes and out between the inner and outer rings 10^a and 10^b, respectively.

In this connection, it is now to be observed that each cylinder is supplied with cooling air at the same pressure and therefore in equal amounts that such air is afterwards confined within the passages surrounding the cylinders, and the comparatively small ducts leading from the cylinders to the fan, and the inner and outer rings, whence it is discharged, and that by so confining the cooling air for the cylinders, the size of the fan and the power of the engine may be and are thereby reduced to a minimum, in the absence of any possibility for any air in the whole system to lag.

For the cooling of the valve structures which includes the intake and exhaust valves and surrounding ports it is now to be observed that a portion of the air descending through each pipe 21 is diverted through the opening 46 therein into the housing unit 35 to direct contact with the valve cap 40, whence it is deflected by the radial flanges 39 to a plane below the ring 38, and, following the contact of the air with the staggered flanges 7 and 42, respectively projecting from the walls of the valve chamber, also the valve seat and the valve housing, descends thence through the suction passage 43, whence it passes into the air duct 44, and is drawn therefrom into the fan 10 and out between the rings 10^a and 10^b.

In other words, my invention provides a means by which each of the several cylinders of an internal combustion engine is exposed to the initial contact of the cooling air at the same atmospheric temperature, the contact of which air is prolonged of the upper part on account of the restriction that the cooling effect of the descending air is decreased with the decrease in the temperature of the cylinders exposed thereto, whereby the surface temperature of each cylinder is uniformly maintained, as nearly as may be, throughout the process of their cooling.

My invention furthermore provides a means by which the housing for each set of valves, comprising an intake and an exhaust valve for the several cylinders of an internal combustion engine, and the adjacent end of the intake and exhaust pipes therefor are exposed to the direct contact of cooling air, at substantially atmospheric temperature, both concurrently and independently with the cooling air contacting with the cylinders.

It should, therefore, be understood, in view of the foregoing, that my invention is not to be limited to the details of construction and arrangement of the devices shown in the drawings, for securing the above desired results, and for regulating, controlling and directing cooling air to contact with the cylinders and the valve chambers and that my invention includes any means for simultane-

ously delivering to initial contact with each cylinder of an air-cooled engine cooling air at atmospheric temperature and at the same or substantially the same pressure, and likewise to contact with the walls of the valve chambers of such engine.

In short, while I have illustrated and described the preferred form and construction of devices for carrying my invention into effect, it is nevertheless capable of variations and modifications, without departing from the spirit of my invention, and I therefore do not wish to be limited to the precise details of construction shown and described, but desire to avail myself of such variations and modifications as come within the scope of the appended claims.

Having described my invention, what I claim and desire to secure by Letters Patent is:

1. In an air cooled engine, a series of cylinders, a jacket surrounding each cylinder and having an upwardly extending neck, an adjustable hood over said necks adapted for admitting air to the jackets, an exhaust fan, and a separate air conduit extending from each cylinder to said fan.

2. In an air cooled engine, a series of cylinders, a jacket around each cylinder and having an upwardly extending neck with a downwardly deflected flange, an adjustable hood extending over said necks, said hood having separate compartments, one for each neck, and a baffle plate in each compartment below said downwardly deflected flange, said baffle plate having an inlet part.

3. In an air cooled engine, a series of cylinders, a jacket surrounding each cylinder, means providing a circuitous passage for simultaneously and separately admitting air to each jacket, an exhaust fan and separate air conduit leading from said cylinders to said fan.

4. In an air cooled engine, a series of cylinders, a jacket around each cylinder, and having an upwardly extending neck, a hood having a series of compartmen, one for receiving each neck, and means providing an upwardly directed circuitous path in each compartment for admitting air to each jacket.

5. In an air cooled engine, a series of cylinders, a jacket surrounding each cylinder, an air inlet compartment over each jacket and so constructed as to provide an upwardly directed circuitous path for the admission of air to the jacket.

6. In an air cooled engine, a series of cylinders, a jacket surrounding each cylinder, means providing a separate air inlet compartment over each jacket, each compartment providing an upwardly directed circuitous air passage, an exhaust fan, and separate air conduits extending from said jackets to said fan.

7. In an air cooled engine, a series of cylinders, a jacket surrounding each cylinder and having an upwardly extending neck, an adjustable air inlet hood providing circuitous air inlet passages over said necks, an exhaust fan and separate air conduits extending from said jackets to said fan.

8. In an air cooled engine, a series of cylinders, a jacket around each cylinder, a separate air inlet structure for each jacket, an exhaust fan, and a separate air outlet passage for each jacket extending to said fan.

9. In an air cooled engine, a plurality of cylinders, an exhaust fan, separate air circulating means for each cylinder, and a separate suction passage extending from each means to said fan.

10. In an air cooled engine, a series of valve structures, an air cooling jacket around each valve structure, means providing circuitous passages for simultaneously and separately admitting air to each jacket, and a separate exhaust duct for each jacket.

11. In an air cooled engine, a series of valve structures, a separate jacket surrounding each structure, an upwardly extending intake conduit connected to each jacket, an adjustable hood over said conduits providing a separate compartment for each intake conduit, a separate exhaust duct for each jacket, said ducts exhausting into a common passage, and a fan at the end of said passage.

12. In an air cooled engine, a series of valve structures, a jacket surrounding each valve structure, a separate air intake conduit connected to each jacket, a hood providing separate inlet compartments over said conduits, and a separate exhaust conduit extending from each jacket.

13. In an air cooled engine, a plurality of valve structures including adjusting means therefor, a jacket surrounding each valve structure, an air inlet conduit for each jacket, and exhaust conduits extending from said jackets, each exhaust conduit being offset or to one side of the valve adjusting means to allow access thereto.

14. In an air cooled engine, a series of valve structures, a separate jacket around each valve structure, a separate air inlet conduit for each jacket, an adjustable hood having a separate compartment for each conduit, and positioned over said conduits, means between said hood and conduits for providing a circuitous air inlet passage, and a separate exhaust duct extending from each jacket.

In witness whereof, I have hereunto set my hand this 3rd day of May, 1924.

ERNEST VAN TOFF.