

May 22, 1956

W. E. SWENSON

2,746,434

ENGINE COOLING AND FLYWHEEL MECHANISM

Filed April 28, 1952

3 Sheets-Sheet 1

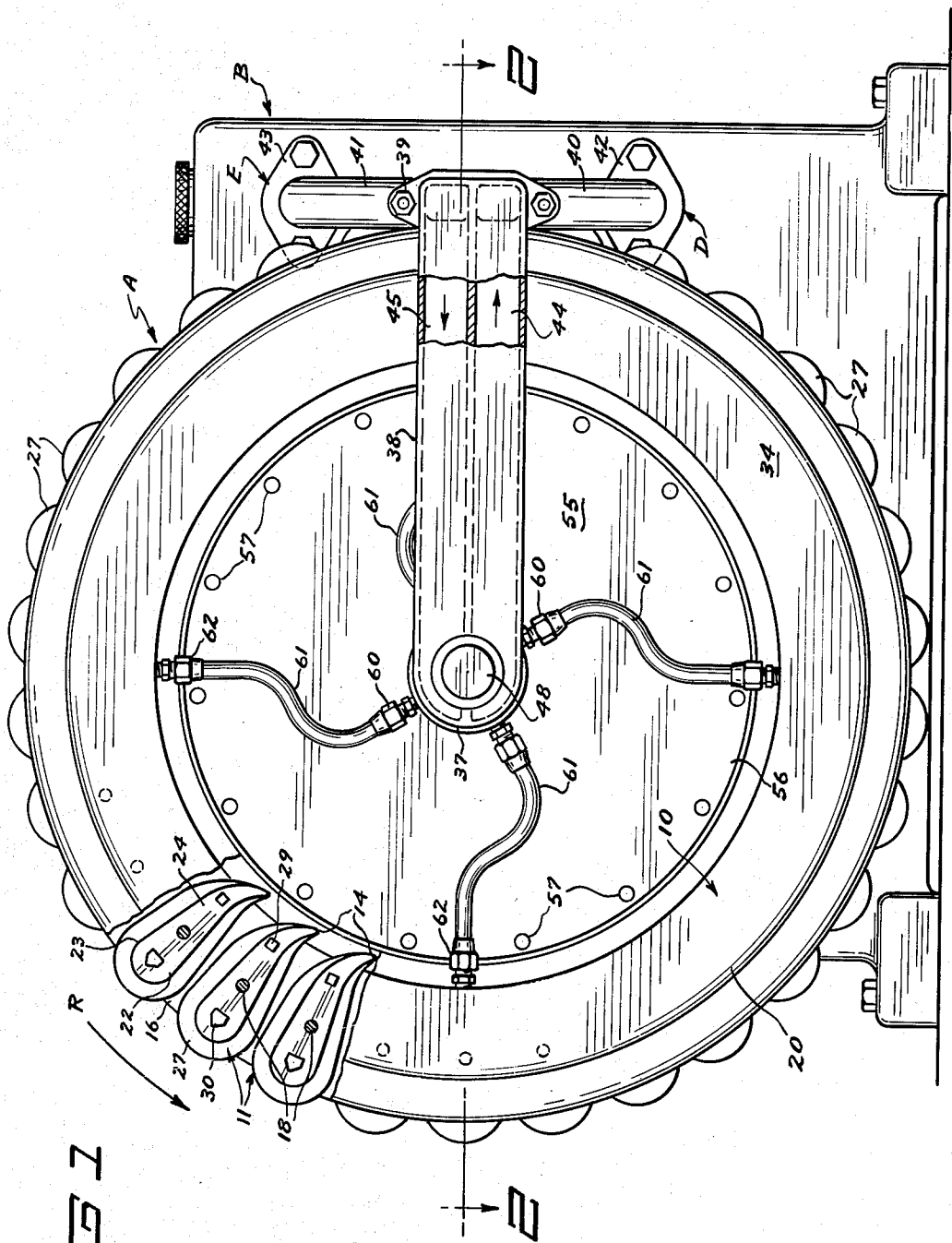


FIG 1

INVENTOR.
WILLIAM E. SWENSON
BY
Carlson & Hayle
ATTORNEYS

May 22, 1956

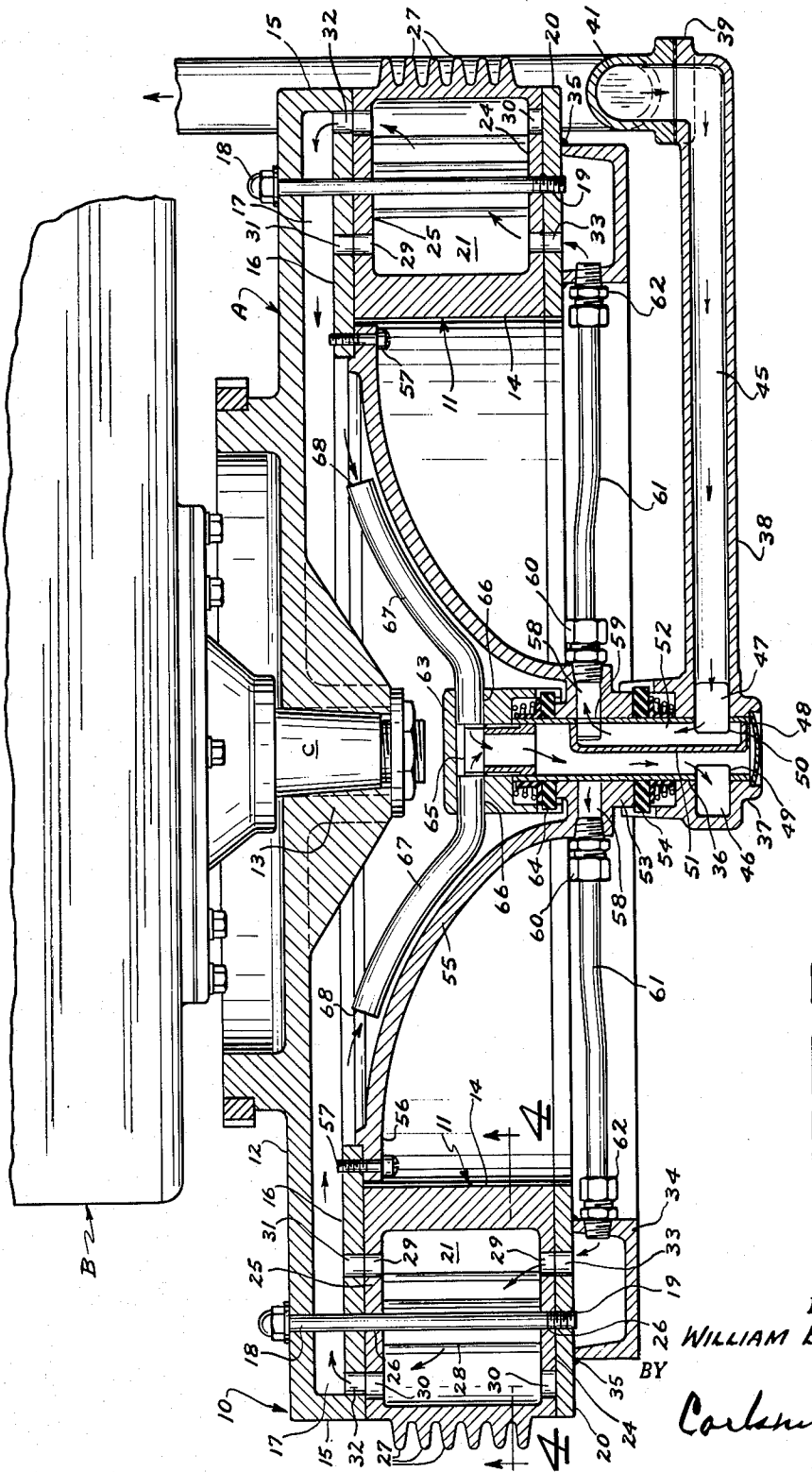
W. E. SWENSON

2,746,434

ENGINE COOLING AND FLYWHEEL MECHANISM

Filed April 28, 1952

3 Sheets-Sheet 2



May 22, 1956

W. E. SWENSON

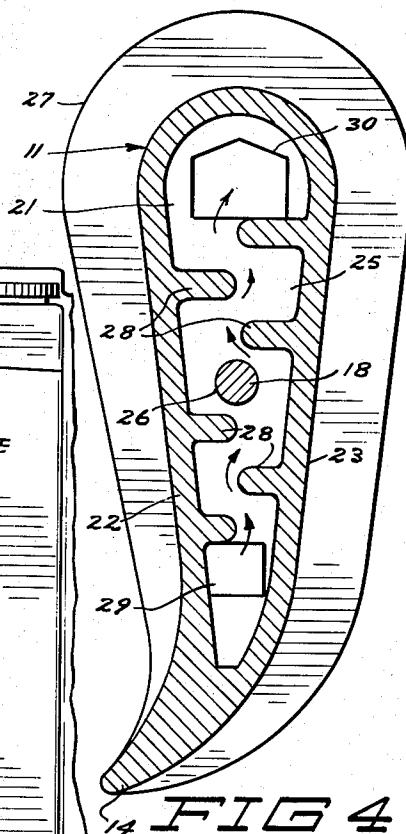
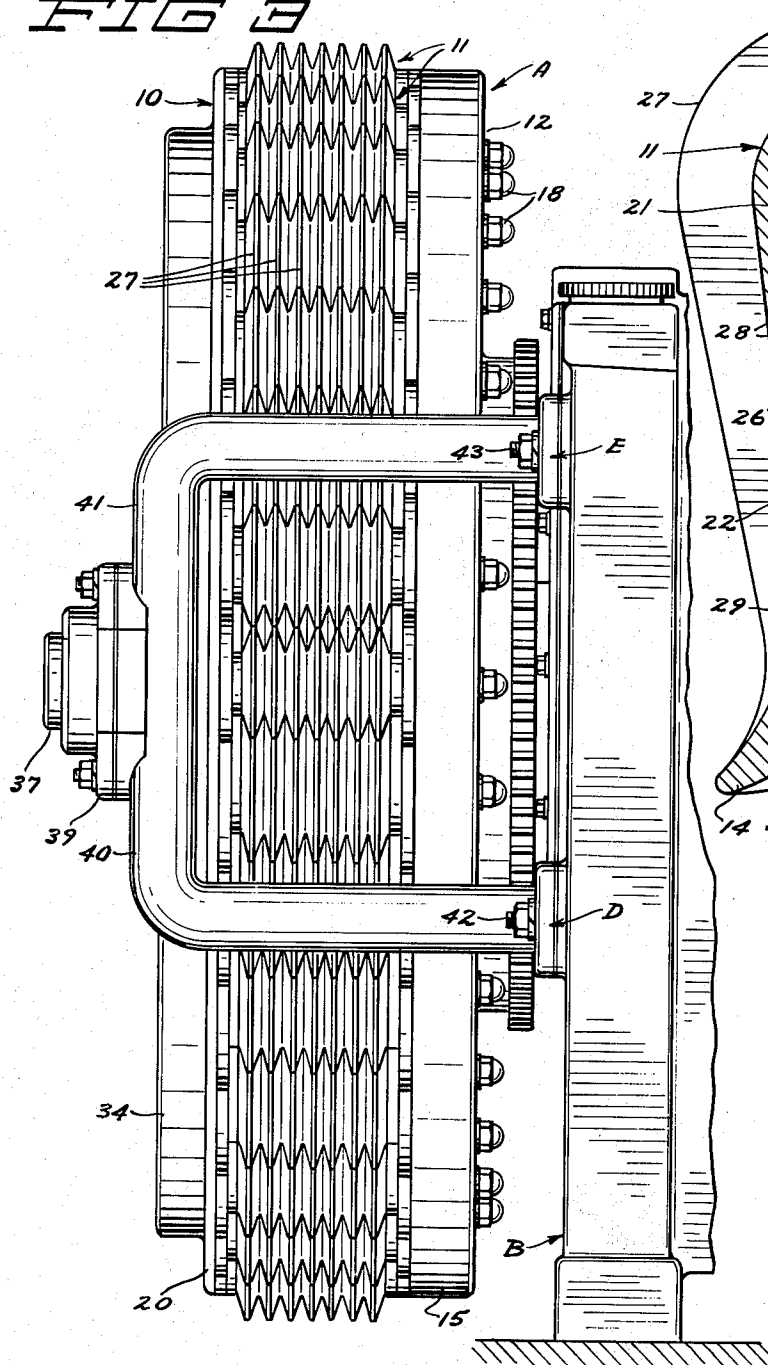
2,746,434

ENGINE COOLING AND FLYWHEEL MECHANISM

Filed April 28, 1952

3 Sheets-Sheet 3

FIG 3



INVENTOR,
WILLIAM E. SWENSON
BY
Carlson & Hays
ATTORNEYS

1

2,746,434

ENGINE COOLING AND FLYWHEEL MECHANISM

William E. Swenson, St. Paul, Minn., assignor to Minneapolis-Moline Company, Hopkins, Minn., a corporation of Minnesota

Application April 28, 1952, Serial No. 284,682

5 Claims. (Cl. 123—41.43)

This invention relates generally to improvements in engines such as the internal combustion type now so widely used both in mobile and stationary installations, and more particularly relates to improvements in what may be referred to as the auxiliary equipment of such engines, by which the engine is cooled and its torque output smoothed by a flywheel effect.

The ordinary engine of the so-called water cooled type embodies a radiator through which the liquid coolant is circulated by an engine driven pump, and with a fan arranged to force air through the radiator in heat exchanging relation with the coolant circulating therethrough. It is the primary object of my invention to improve this cooling system in such fashion as to combine the actions of the radiator, pump and fan in a single rotary element, and additionally to so circulate the coolant through this element that its weight may be utilized for a flywheel effect, thus combining also the function of a flywheel with the cooling system. There are numerous advantages to be found in this combination of functions, among which is increased effective cooling efficiency as well as a pronounced simplification of construction, resulting in a saving in manufacturing cost and upkeep. It is also a prime object of the invention to provide an improved method of cooling the engine, combining the actions of a fan, pump and radiator.

Another object of my invention is to provide a rotary fan of the sirocco-type connected to and driven by the engine and with the component blades, by which the air is scooped up and centrifugally expelled, made up in hollow formation or chambered so that the coolant may be circulated therethrough in intimate, heat exchanging relation with the air being moved by the blades. Further in accordance with this object of my invention I not only fin these blades externally but provide them internally with baffles, in order to increase the surface area over which the air and coolant respectively travel with a scrubbing effect, with a resulting increase in cooling efficiency.

A further object of my invention is to provide, in conjunction with the structure just recited, means whereby the coolant, as it is taken from the engine, is brought to the axis of rotation of the fan from which the fluid travels radially outward to and through the hollow or chambered blades, so that a centrifugal pumping effect is set up to positively circulate the liquid without the necessity of a separate pump for the purpose. The coolant return to the engine is also taken from the center of rotation and the coolant is scooped up as it emerges from the hollow sirocco fan blades through stationary scoop or pick-up tubes to complete the circulating system. In addition to its simplicity and the facility with which the centrifugal pumping effect fits into the use of the rotary fan or heat exchanger, it is also my belief that the centrifugal pumping of the coolant liquid will counteract the tendency of air and steam to collect in the cooling system, with the result that the coolant will be of greater and more consistent density. As is well known the coolant, whether it be water, anti-freeze or a combination of the two, will

2

have a better cooling effect upon the engine if its density can be maintained and entrainment of air or steam prevented.

Another object of my invention, and flowing from the fact that the cooling liquid is circulated through the blades of the fan, is to utilize the weight of the coolant for the W R ratio by which flywheel effect is determined. The blades are, of course, arranged in an annular series around the outside portion of the fan and the coolant being circulated through these hollow blades will thus add its weight to the rotating assembly to achieve the desired flywheel action upon the engine.

These and other more detailed and specific objects will be disclosed in the course of the following specification, reference being had to the accompanying drawings, in which—

Fig. 1 is a front end view or elevation, partially broken away and in section, of an engine cooling and flywheel mechanism according to my invention, as operatively connected to an engine shown only in barest outline.

Fig. 2 is a horizontal and substantially diametrical sectional view taken along the line 2—2 in Fig. 1, and also showing in outline an adjacent part of an engine.

Fig. 3 is a side elevation of the structure as shown in Fig. 1 and viewing the same from the righthand side thereof, this view being substantially to the scale of Fig. 2.

Fig. 4 is a still further enlarged sectional detail view through one of the hollow or chambered fan blades as viewed substantially along the line 4—4 in Fig. 2.

Referring now more particularly and by reference characters to the drawing, the cooling and flywheel mechanism constituting my invention is designated generally at A and the same is here shown for purposes of disclosure as associated with a stationary internal combustion engine, designated generally at B. It will, of course, be understood that the engine, per se, is not a part of my present invention and only such elements thereof as necessary to an understanding of this disclosure are shown, the same being the shaft C which is driven by the engine and the inlet and outlet D and E, respectively, through which the fluid coolant is to be circulated through the engine and cooling system. For convenience in this description it will be assumed that the shaft C and inlet and outlet D and E are all arranged at the front of the engine.

Turning now to a complete description of the mechanism making up my invention, the same consists fundamentally of a rotating fan element including a rotor, indicated generally at 10, which carries a plurality of sirocco-type fan blades, denoted collectively at 11, around its outer peripheral portion. The circular back plate 12 of the rotor 10 is centrally provided with a hub 13 by which it is secured to the shaft C for rotation thereby, and as customary in this sirocco-type of fan or blower the blades 11 are characterized in that they have inner ends 14 which curve inward and forward with reference to the direction of rotation, designated by the arrow R in Fig. 1, so that the blades will scoop up air from the center of the rotor and will centrifugally expel the air as the fan rotates. The precise details of the manner in which the rotor 10 and blades 11 are fabricated and assembled are not particularly important and while they are here shown as separate elements it is quite conceivable that they may be integrally cast, or otherwise best fabricated from a production standpoint. The rotor-blade assembly does, however, have a number of important characteristics which will now be set out in conjunction with a complete description of the construction chosen for this disclosure.

As stated, the rotor 100 consists of a circular back plate 12 provided with the hub 13 by which drive connection is established to the engine and this back plate has a peripheral, forwardly turned rim 15 from which

there extends inwardly a comparatively narrow annular flange 16 spaced forwardly from the adjacent portion of the back plate to form an intervening outlet chamber 17. The blades 11 are positioned in circumferentially spaced and generally radial positions against the forward face of the aforesaid flange 16 and are held in place by a series of elongated cap screws 18 projecting forwardly through the blades and threaded at 19 into an annular retainer ring 20, which is pulled up tight to hold the blades in assembly when the cap screws 18 are set up. It will be apparent from an inspection of Fig. 2 that this assembly locates the blades 11 forward of the back plate and exposes the inner ends 14 of the blades so that they may scoop up air at the center of the fan assembly and discharge the air centrifugally as mentioned above, the back plate 12 and ring 20 constituting spaced rotor members for carrying the fan blades.

Also important to my invention is the fact that the blades 11 are each hollowed or formed with an interior chamber 21, following in general outline the outside shape of the blades themselves, and as here shown the blades are made up of suitably cored castings having the aforesaid curved inner ends 14, the side walls 22—23 and end walls 24—25 enclosing said chamber 21. Said end walls 24 and 25 will, of course, each be provided with a properly located opening, as designated at 26, to pass the aforesaid cap screws 18 by which the parts are held in assembly. Exteriorly the blades 11 are then provided with a plurality of fins, designated collectively at 27, to increase the effective area over which air will scrub as the fan rotates, these fins being as shown located parallel with the plane of rotation. Internally the blades 11 are also provided with opposed, staggered baffles, indicated throughout at 28, running from end to end of the blades in order to increase the inside area over which the coolant will pass in scrubbing relation as will be presently described. To permit the ingress and egress of the coolant, each end 24—25 of each blade is provided with an inner opening 29 and outer opening 30 and while all of said openings will not necessarily be used the formation is the same at each end in the interest of uniformity and in order to facilitate casting. Also as shown in Fig. 2 to best advantage, the back flange 16 is provided with corresponding inner and outer openings 31 and 32, respectively, to register with the openings 29—30 of each blade, whereas the retainer ring 20 is provided with but a single inner opening 33 for registering with the adjacent inner opening 29 of each blade. It will thus be observed that the interior of each blade will communicate with the openings 29, 30, 31 and 32 with the aforesaid outlet chamber 17, while at the forward side of the fan assembly the chambers in the blades will also communicate through the openings 29 and 33, with a hollow annular intake manifold 34 secured in a water-tight fashion to the retainer ring 20 and forming part of the rotating assembly. Said manifold 34 is U-shaped in cross section with the open side welded at 35, or otherwise suitably secured to the ring 20, so that its annular interior, inlet chamber communicates with all of said openings 33.

Forwardly of, and axially aligned with, the shaft C and hub 13 is a stationary assembly the core of which is a tubular element or sleeve 36 on the forward end of which is a cap 37 forming a part of a radially extending dual conduit or duct 38. The latter extends outward beyond the peripheral edge of the rotary assembly and at the outer end is secured at 39 to vertically diverging pipes 40—41 which then turn rearwardly and are secured at 42—43 to the inlet and outlet connections D and E, respectively. The interior of the pipes 40—41 communicate with bores 44—45 in the duct 38 and these bores in turn communicate with recesses 46—47 within said cap 37. The forward end of the sleeve 36 is closed by a disk 48 and has openings 49—50 communicating with the recesses 46—47 but the sleeve is divided length-

wise and centrally by a suitably shaped divider 51 so that it has a separate chamber 52 communicating only with recess 47.

Immediately behind the cap 37 a journal or hub 53 rotatably embraces the sleeve 36 and between this hub and the cap there is a liquid tight seal 54. The hub is formed on a forwardly and inwardly curving center shell or disk 55, the periphery 56 of which is secured tightly by cap screws 57 around the inner edge of the flange 16. Thus this shell and hub rotate with the fan as a whole and interiorly the hub has a plurality of recesses 58 which communicate successively with the interior of the aforesaid chamber 52 as the hub rotates, the sleeve 36 having an opening 59 in its wall for this purpose. Said recesses 58 open outward radially and are tapped to receive fittings 60 for tubes 61 which radiate outward and are connected at outer ends by similar fittings 62 to the manifold 34. It will be readily understood then that the outlet E is now connected through the bore 45, chamber 52 and these tubes 61 to the interior of manifold 34 and thence to the chambers 21 in the fan blades 11. As seen in Fig. 1 the tubes 61 are reversely curved between their inner and outer ends to permit the necessary expansion and contraction.

Inwardly of the hub 53 an inside cap 63 is secured on and closes the rear end of sleeve 36, with a seal 64 between the hub and cap, and this inside cap has a recess 65 communicating with the interior of the sleeve, from which recess there opens radial openings 66 wherein are tightly fitted the inner ends of scoop or pick-up tubes 67. These tubes 67 extend outward and are curved to closely follow the contour of the shell 55, the outer ends 68 of the tubes lying just within the aforesaid outlet chamber 17. These scoop tubes 67 communicate through the sleeve 36 with the bore 44 and return or inlet connection D of the engine.

Operation

It will, of course, be understood now that as the engine runs the shaft C will rotate the fan assembly and that the blades 11 will pick up and centrifugally expel air in continuous scrubbing engagement with the fins 27, the air being drawn in at the center of the fan over the dished center shell 55. The rotation of this fan assembly will also cause the coolant, taken from the engine at E and brought in through the bore 45 and chamber 52 to the axis of rotation, to be centrifugally pumped outward through the tubes 61 into the manifold 34 from which the coolant will enter the chambers 21 in the fan blades 11 through the openings 33—29. Naturally then the coolant will flow through said chambers, aided by the fact that the inlets 33—29 are near the inside of the chambers and the major outlets 30—32 are at the outside to secure the benefit of centrifugal force in moving the liquid. The entire coolant system being full, of course, the chamber 17 will be filled and as this body of coolant spins with the fan the stationary tubes 67 will scoop up the liquid and return it through the sleeve 36 and bore 44 to the return or inlet D of the engine, setting up a continuous circulation through the entire system. No separate pump is required for such circulation, the centrifugal effect being more than sufficient for the purpose. Not only then is expense reduced but this centrifugal pumping, as mentioned supra, has the very desirable added effect of driving out entrained air bubbles or steam from the coolant to maintain its density and cooling efficiency.

As the liquid is driven through the fan blade chambers 21 it passes in scrubbing relation over and around the baffles 28 and in heat exchanging relation with the air being blown by the fan past the exterior fins 27. Thus these blades serve the dual functions of a fan and radiator with a resulting saving and with increased efficiency as compared to the usual fan-radiator units now so generally used.

Finally, since the chambers 21 are constantly filled

with coolant as it circulates through the system the weight of this liquid adds a flywheel effect and the combination fan and radiator thus serves the third function of a flywheel for the engine.

My invention also embraces a new method of engine cooling including the centrifugal pumping of the liquid coolant through the chambered fan blades, by bringing the coolant from the engine to the axis of rotation so that it may be driven centrifugally outward through the fan blades in heat exchanging relation with the air being moved by the fan and then scooping up the cooled liquid with stationary scoops for return to the engine. Thus the actions of a fan, pump and radiator are all combined as described in detail supra.

It is understood that suitable modifications may be made in the structure as disclosed, provided such modifications come within the spirit and scope of the appended claims. Having now therefore fully illustrated and described my invention, what I claim to be new and desire to protect by Letters Patent is:

1. For an engine having inlet and outlet means for circulation of a fluid coolant, cooling mechanism of the character described, comprising in combination a rotary fan having an annular series of generally radially arranged blades, each blade having a chamber with an inlet and an outlet, a central hub forming a rotary part of the fan and having at least one radially extending hollow member connecting the said outlet means to the chamber inlets for centrifugally pumping the coolant into and through the chambers in heat exchanging relation with air blown past the blades, and means for returning the coolant from the chamber outlets to the said inlet means, the said chamber inlets being closer to the axis of rotation than the outlets to cause centrifugal force also to urge the coolant through the chambers.

2. For an engine having inlet and outlet means for circulation of a fluid coolant, cooling mechanism of the character described, comprising in combination, a rotary fan having an annular series of generally radially arranged blades, each blade having a chamber with an inlet and an outlet, a central hub forming a rotary part of the fan and having at least one radially extending hollow member connecting the said outlet means to the chamber inlets for centrifugally pumping the coolant into and through the chambers in heat exchanging relation with air blown past the blades, the fan also having means forming an annular chamber communicating with the outlets of the blade chambers, and non-rotating scoop means entering said annular chamber to scoop up and return coolant therefrom to the inlet means of the engine.

3. For an engine having inlet and outlet means for circulation of a fluid coolant, cooling mechanism of the character described, comprising in combination, a rotary fan having an annular series of generally radially arranged blades, each blade having a chamber with an inlet and an outlet, a central hub forming a rotary part of the fan and having at least one radially extending hollow member connecting the said outlet means to the chamber inlets for centrifugally pumping the coolant into and through the chambers in heat exchanging relation with air blown past the blades, the fan also including means forming a centrally opening annular chamber communicating with the outlets of the blade chambers, a stationary member in said central hub, stationary radially extending scoop tubes carried by said stationary member and extending at outer ends into said annular chamber to pick up coolant emerging from the blade chambers, and

means for returning coolant from the tubes to said inlet means of the engine.

4. A combination fan, radiator, pump and flywheel, for use with an engine having a shaft and inlet and outlet means for circulation of a liquid coolant through the engine, comprising a fan rotor connected for rotation by said shaft, a series of generally radially arranged fan blades on the rotor and each of said blades having a chamber with an inlet at one side and outlet at the other, an annular manifold connecting all of said inlets, the rotor including also means forming an annular chamber communicating with all of said outlets, and the rotor also having a centrally located rotary hub, a partitioned sleeve stationarily supported in the hub and having separate passages connected respectively to the inlet and outlet means on the engine, generally radially arranged tubes connecting the hub and manifold and communicating with the passage leading to the outlet means to thereby centrifugally pump coolant into the blade chambers, and stationary pick-up means connected to the passage leading to the said inlet means and extending outward into the said annular chamber to scoop up and return coolant to the engine.

5. A combination fan, radiator, pump and flywheel, for use with an engine having a shaft and inlet and outlet means for circulation of a liquid coolant through the engine, comprising a fan rotor connected for rotation by said shaft, a series of generally radially arranged fan blades on the rotor and each of said blades having a chamber with an inlet at one side and outlet at the other, an annular manifold connecting all of said inlets, the rotor including also means forming an annular chamber communicating with all of said outlets, and the rotor also having a centrally located rotary hub, a partitioned sleeve stationarily supported in the hub and having separate passages connected respectively to the inlet and outlet means on the engine, stationary caps on the sleeve at opposite sides of the hub, one cap having means for connecting the passages in the sleeve to the engine and the other cap having stationary radially extending scoop tubes extending out into the said annular chamber and communicating at inner ends with the passage leading to the engine inlet means, seals between the caps and the hub, radially extending tubes connecting the hub and manifold and communicating with the passage leading to the engine outlet means whereby rotation of the tubes with the fan rotor will centrifugally pump the coolant from the engine through the blade chambers and the stationary scoop tubes will pick up and return the coolant to the engine.

References Cited in the file of this patent

UNITED STATES PATENTS

584,920	Capitaine	June 22, 1897
942,493	Fesler	Dec. 7, 1909
947,424	Weber	Jan. 25, 1910
1,417,037	Cushman	May 23, 1922
1,454,315	Cushman	May 8, 1923
1,458,321	Bowman	June 12, 1923
1,858,226	Hlavaty	May 10, 1932
1,980,811	Ljungstrom	Nov. 13, 1934
2,151,791	Muren	Mar. 28, 1939

FOREIGN PATENTS

35,421	Switzerland	Jan. 25, 1906
372,143	France	Mar. 26, 1907
322,812	Germany	July 9, 1920
386,165	Great Britain	Jan. 12, 1933