

May 8, 1923.

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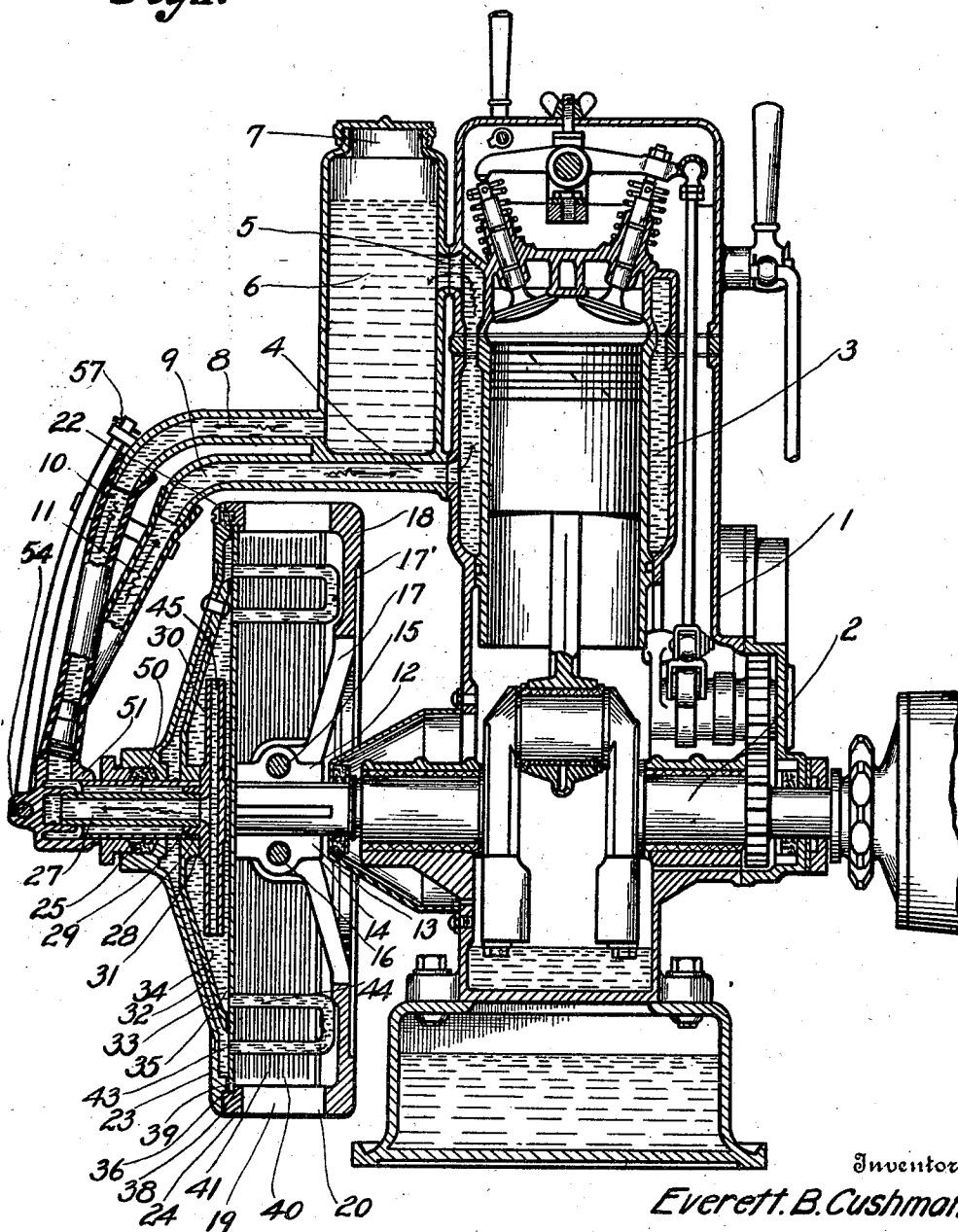
E. B. CUSHMAN

RADIATOR

Original Filed Nov. 25, 1919

4 Sheets-Sheet 1

Fig. I.



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May 8, 1923.

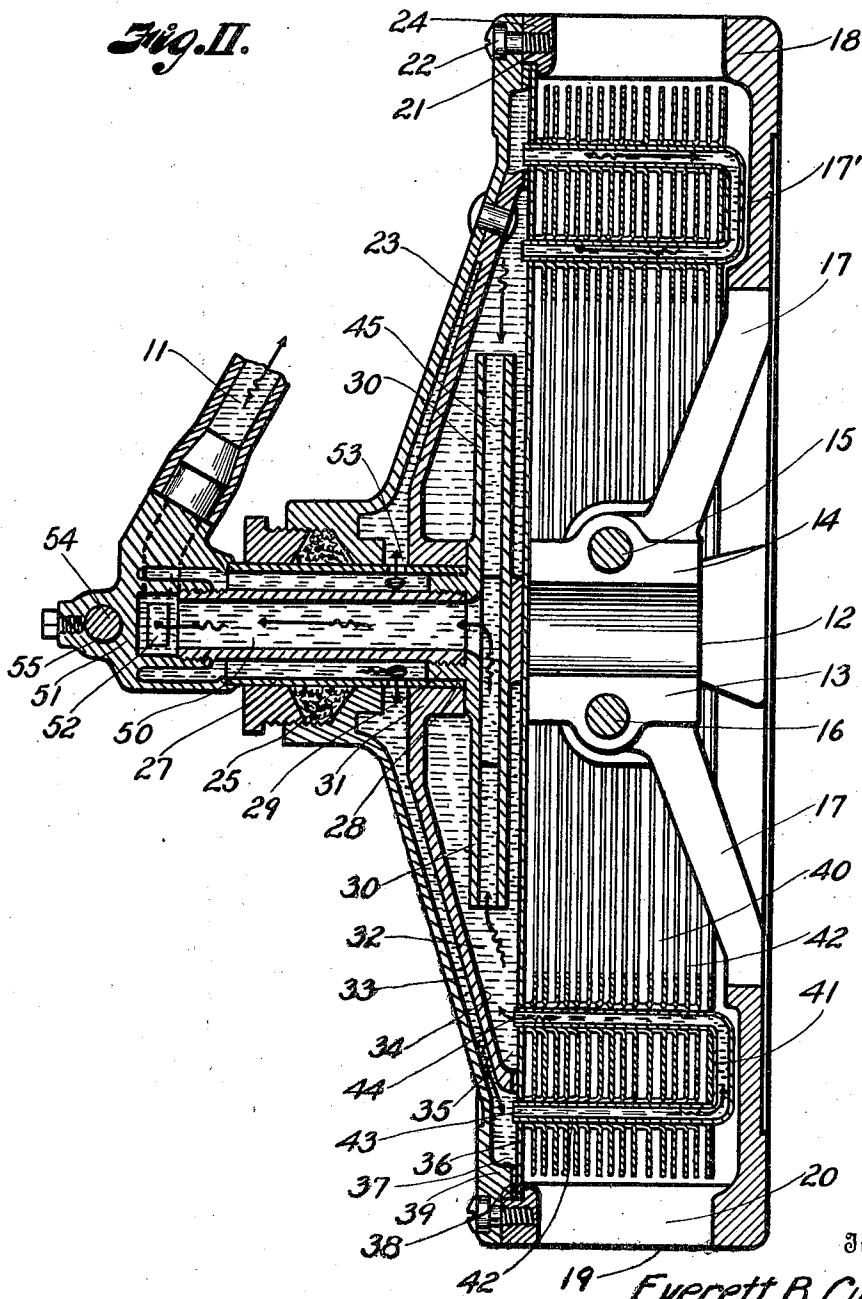
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4 Sheets-Sheet 2



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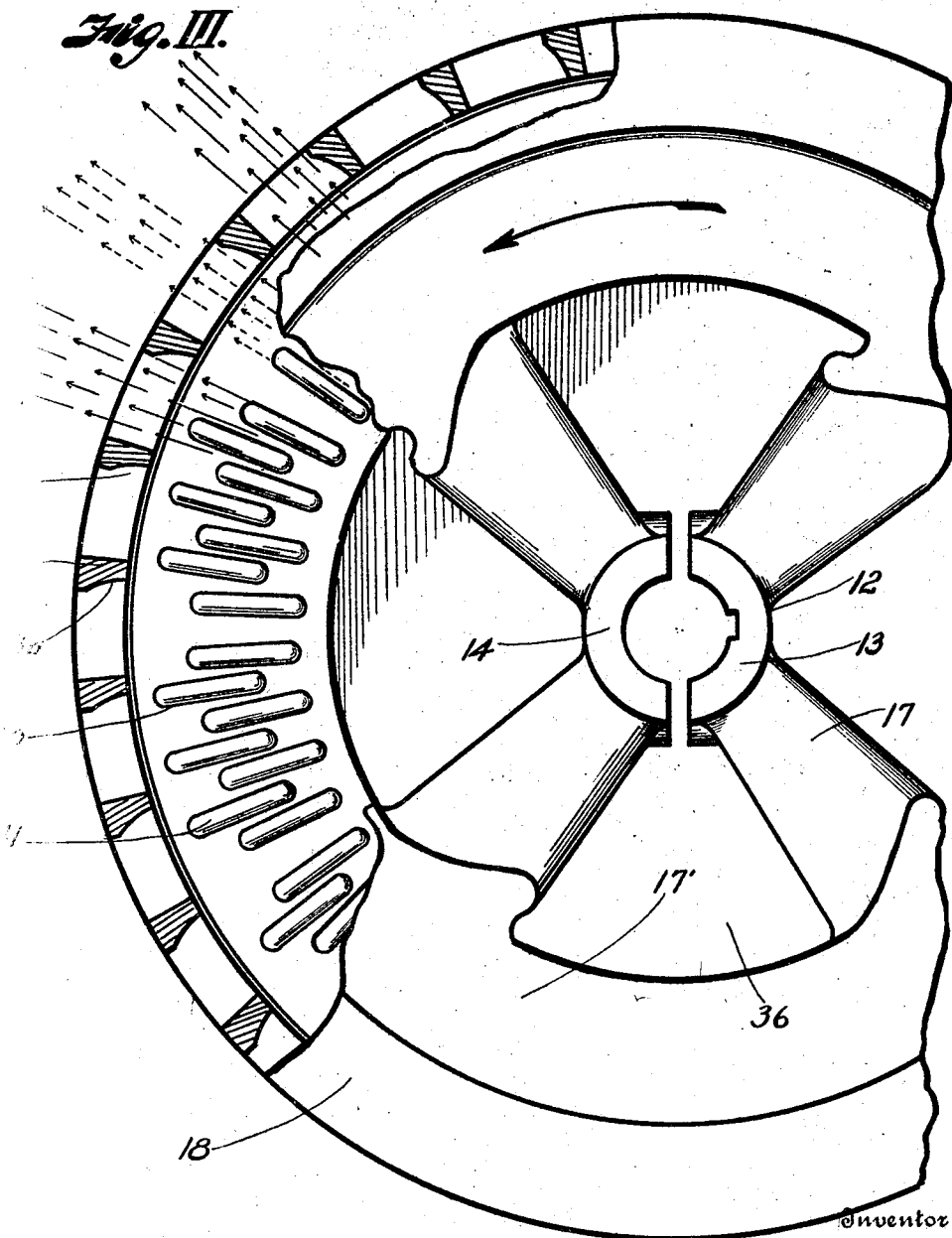
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RADIATOR

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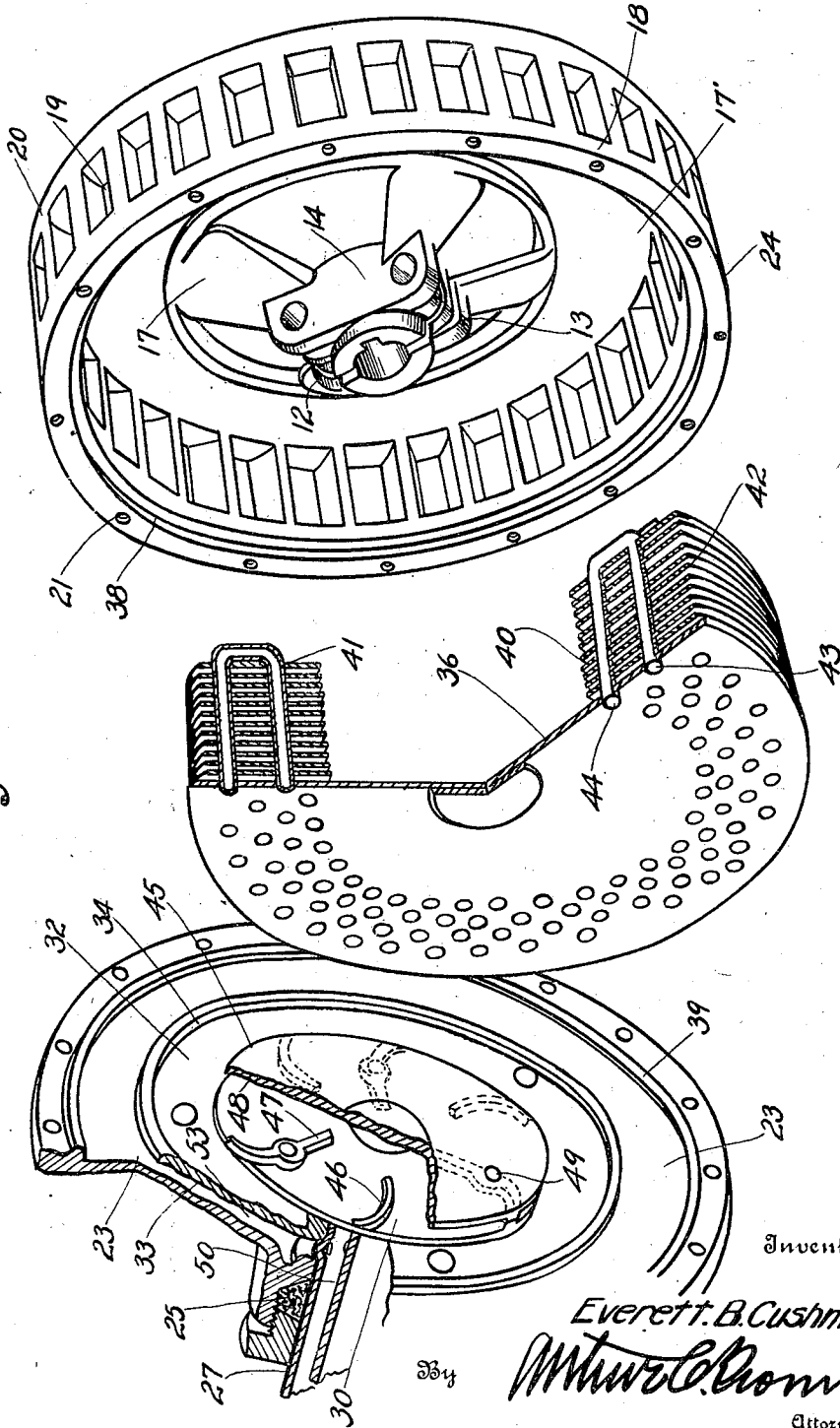
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RADIATOR

Original Filed Nov. 25, 1919

4 Sheets-Sheet 4

Fig. IV.



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UNITED STATES PATENT OFFICE.

EVERETT B. CUSHMAN, OF TOPEKA, KANSAS, ASSIGNOR, BY MESNE ASSIGNMENTS,
TO O. D. COLLIS, OF CLINTON, IOWA.

RADIATOR.

Continuation of application Serial No. 340,601, filed November 25, 1919. This application filed March 8, 1920. Serial No. 364,043.

To all whom it may concern:

Be it known that I, EVERETT B. CUSHMAN, a citizen of the United States, residing at Topeka, in the county of Shawnee and State of Kansas, have invented certain new and useful Improvements in Radiators; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the letters and figures of reference marked thereon, which form a part of this specification.

This invention relates to a radiator for internal combustion engines and one of the principal objects thereof is to provide a rotary radiator having movement in response to the operating cycles of the engine so that when the engine operates, the movement of the radiator will be insured, the present application being a continuation of my application filed November 25, 1919, Serial No. 340,601.

Another object of the invention is to provide an improved form of radiator for maintaining the temperature of the engine within practical limits and an important feature of the invention is to combine the radiator with a fly wheel so as to take advantage of the speed of the fly wheel for causing a circulation of the air around the liquid containing parts or tubes of the radiator.

Still another object of the invention is to provide improved means for circulating water through the radiator which consists of a stationary member located in one of the rotary chambers of the wheel and tapping the chamber at a point where the centrifugal pressure accumulates to take advantage of the difference in pressures between the two chambers of the wheel to move the water through the system.

While the invention is not necessarily limited to a portable stationary engine, it is particularly applicable thereto because the radiator is mechanically driven through the air in such a manner as to cause effective heat radiation and heat dissipation from the cooling liquid, even when the engine is standing still.

In those types of engine used for motor vehicles driven at relatively high speeds and

having air circulation superinduced by a fan driven from the engine, the passage of air about and through the grid or tubes of the radiator can be more or less successfully accomplished but as is well known, such devices become wholly inadequate when the motor car is standing still and the engine is running. Such devices as just described are also impractical for tractors or slow moving vehicles unless the radiating surface is very large and the fan can move excessive volumes of air about the radiator.

The invention is so constructed that it may be installed with an ordinary explosion motor without materially changing the construction of the motor and without the necessity for supplying the tube connections and the excessive space for installations required by existing types of devices for accomplishing the desired result.

Another advantage is that the entire device, including the engine and radiator can be supported from a single base so that a unitary structure is provided, this being of prime importance in portable stationary engines since the installation may readily be transported from place to place or set upon a movable base if necessary, without disturbing any of the connections.

In the drawings,

Fig. I is a vertical, longitudinal, sectional view of an engine and circulating system constructed in accordance with my invention.

Fig. II is an enlarged, vertical, longitudinal, sectional view through the cooling liquid collector, radiator and fly wheel.

Fig. III is a rear elevation of the fly wheel, a portion being broken away to show the radiating device and air vanes, and

Fig. IV is a disassociated view of the several principal parts of the device shown in Fig. II, parts being broken away to illustrate the cross sectional view of certain elements.

Referring now to the drawings showing the preferred embodiment of my invention:

1 designates an explosion engine of preferred construction provided with a crank shaft 2 upon which the rotary element, embodied in the illustrated form of the invention, is mounted. The usual water jacket 3 for the cylinder has an inlet port 4 and an outlet port 5, the outlet port 5 being illus-

trated as discharging into a water reservoir 6 at a point above the inlet port 4. The reservoir consists of a receptacle of appropriate proportions, and provided with a removable cap 7, whereby the water may initially be introduced into the reservoir. For convenience, I may cast elongated nipples 8 and 9 integral with the reservoir 6, the nipple 8 carrying discharge from the reservoir and the nipple 9 carrying supply to the port 4 in the water jacket 3. The nipples 8 and 9 may communicate with the remainder of the system through the pipes 10 and 11, which, in actual practice, preferably consist of rubber hose.

Rigidly mounted on the extended end of the crank shaft 2 is a rotatable element consisting of a split hub 12, comprising the members 13 and 14 which are adapted to be fastened to the shaft by bolts 15 and 16, there being a keyway provided to assist in preventing rotative movement of the hub with respect to the shaft. Extending radially from the hub is a plurality of vanes or fan blades 17, which connect to a disk or web 17' carrying about its perimeter a circumferential flange 18, here shown as provided with a circular series of rectangular slots 19, the partitions 20 between the slots serving as blades for directing air away from the rotary element at an increased velocity, as will be presently explained. The outer edge of the flange 18 is provided with threaded openings 21 to receive the screws 22 which fasten the cone-shaped cover member 23 to the member 24, consisting of the hub, the blades 17, the web 17' and the flange 18, the members 23 and 24 forming a housing rotatable about the axis of the shaft and cooperating to form a fly wheel. Since the members 23 and 24 are rigidly connected together, it will be apparent that they will rotate together.

The cover member 23 is tongued into the groove 39 of the rim 24 and extends therefrom conically outward to a stuffing box or gland 25. Rigidly mounted on the inner face of the cone shaped portion of the cover and spaced uniformly therefrom, to form a water passage 33, is a plate or disk 32 having a central bearing 31 which registers with the stuffing box 25 of the cover plate 23 so as to form a bearing for the tubular member 27 of the stationary collector 30. The inner face 34 of the member 32 serves as one wall of a water passage or chamber 35, which co-operates with a disk 36 to enclose the chamber 35. The disk 36 extends past the discharge point of the chamber 33 and is fastened in a convenient manner between the shoulder 38 on the flange 18 and the member 23, as will be clearly seen by reference to Fig. II.

The disk 36 also serves as a carrier for the radiator unit comprising the lamina-

tions or radiator rings 40, of which there are a number arranged in parallel about and spaced from the hub 12 and connected to the disk 36 by the U-shaped tubes 41, to which they are secured, preferably by flanging the openings 42 in the rings 40, drive fitting the tubes in the disks and in the disk 36 and finally soldering the ends of the tubes to the outer face of the disk 36, preferably in staggered alternate relation, as clearly seen in Fig. III, and have the inlet ports 43 communicating with the chamber 33, and discharge ports 44 communicating with the chamber 35 so that chambers 33 and 35 may communicate one with the other only through the tubes 41. In order to effect the greatest possible radiation from the tubes I preferably coat the tubes with aluminium paint before placing them in the rings, to create a bond between the tubes and rings.

The collector 30 heretofore mentioned comprises the disk 30', and a disk 45 parallel with the disk 30', and curved vanes or directional blades 46 and 47 between the disks, the vanes 47 being provided with threaded enlargements 48 to receive the fastening devices 49 whereby the disks 30' and 45 may be secured together with the curved blades between them, to form a chamber 45' capable of holding a body of water not subject to centrifugal force and to direct the flow of cooling liquid into a pipe 50, which is screwed to the hub or flange 29 of the disk 30', and opens to the center of the collector, as will be apparent by reference to the drawings. The opposite end of the pipe 50 is threaded into the boss 51' of the water connection 51 and communicates with the pipe 11 through a port 52. The pipe 50 acts as a nipple between the disk 30' and the connection 51 so that when the parts are screwed together, the pipe 27 which fits over the outer face of hub 29 and within the shoulder 50'' of the water connection, is drawn snugly thereagainst to form a rigid water tight unit whereby the disk 30' is controlled positively from the connection 51 for the purpose presently described. This construction permits of an annular passage 50' being formed between the pipes 27 and 50 which communicates with the chamber 33 through the openings 53 and with the pipe 10 through the port 27', so that communication may be had between the reservoir 6 and the space or chamber 33 through the port 8, pipe 10, port 27', passage 50' and openings 53 and liquid from chamber 33, may circulate through the U-shaped passageways or tubes 41 into the chamber 35, thence through the collector formed by the disks 30 and 45 and blades 46 and 47 and into the pipe 50, thence through port 52 pipe 11 and port 9 to the chamber 3, it being understood, of course, that the pipe 27, pipe 50 and disks 30 and

45 are stationary and that the housing and the appurtenances which it carries rotate about said pipes, so that the radiator elements, the housing members and the water in the passages carried thereby are all rotated by means of the crank shaft. However, the collector unit including the water connection 51, disk 30 and 45 and pipes 27 and 50 are held against rotation by the anchor rod 54 one end of which engages the opening 55 in the water connection 51 to which it is fastened by the device 56 and the other end of which is secured to the port 8 by the fastening device 57 of approved construction.

In the illustrated embodiment of the invention, the air vanes or partitions 20 of the fly wheel are provided with curved faces 18^a so that when the fly wheel rapidly revolves, air which issues through the spaces or ports 19 at the perimeter of the wheel is thrown out some distance from the periphery of the fly wheel, thereby permitting a free circulation of the air between the radiator rings and around the U-tubes 41, through which the water in the circulating system passes. When the fly wheel is rotating rapidly, the air is drawn into the center of the fly wheel and thrown outwardly by centrifugal force but as it leaves the periphery of the fly wheel it meets an inert body of the air which might substantially check the velocity of the air issuing from the fly wheel unless some means is provided for throwing the air outwardly at some distance. Extensive experiments have demonstrated that the herein described construction is such that the air issuing from the fly wheel impinges against the curved, forward surfaces of the partitions 20 so that air is thrown a considerable distance and, therefore, is not choked as it issues through the ports 19. Thus, free unimpeded circulation of air is provided and on account of the relatively large volume of air allowed to pass between the rings 40 and around the tubes 41, heat from the water is quickly dissipated so that relatively cold water is returned to the cylinder.

In actual practice I prefer to substantially fill the reservoir 6 so that the entire system, including the fly wheel, tubes and water jacket, is completely full of water. For the best practice, the water level in the reservoir 6 should at least be above the port 8.

When the parts are arranged and assembled as shown in Fig. 1 and the engine is started so that the fly wheel revolves rapidly, water contained in the radiating unit and the water chambers 33 and 35 will be carried around at a relatively high rate of speed. The collector, consisting of the disks 30 and 45 and the vanes or blades 46 and 47, however, remains stationary due to its

connection through the cap 51, which is tied by the rod 54. It will be seen that the fly-wheel is made up primarily of two water chambers, namely 33 and 35, which are connected at their outer peripheries by the U-tubes 41 of the radiator unit while the central portions of each chamber communicate with the water jacket of the engine through the collector 30 and associated pipe connections. As each of the water chambers 33 and 35 is a narrow circular chamber of comparatively large diameter, it will be apparent that when the flywheel is revolving, each will be subject to a centrifugal force whereby pressure will accumulate in each in proportion to the speed at which the fly-wheel is revolved. As pressure is greater on large diameters than on small diameters when the speed of revolution remains the same, it follows that by inserting the collector 30 in the chamber 35, we have placed a part which is not subject to centrifugal pressure at a point in the chamber 35 that is subject to considerable pressure. That this is a proven fact is apparent when it is considered that all the fluid in the chamber 35, except that contained within the collector 30, is subject to centrifugal force and inasmuch as this body of water is stationary, it is apparent that the water in chamber 35, which is subject to centrifugal force, will be caused to flow into the collector 30 under a pressure equal to the head of water of the same diameter as the collector 30 which is contained in the chamber 33 because the latter body of water is subject to centrifugal force and will cause an unbalanced condition in the two chambers. The remaining water in the chambers 33 and 35 which extends outwardly of the periphery of the collector 30 will, of course, be balanced according to the laws of hydrostatic pressure and if it were not for the collector 30 there would be no circulation whatever, but owing to the balanced condition it is apparent that the collector will meet no undue resistance from centrifugal force of the surplus water in the radiator because it acts under a perfectly balanced condition regardless of the volume in the two chambers.

In tracing the circulation of water through the system it will be noted that water in the jacket 3 of the engine will be heated from the explosions of gas and flow out of port 5 into the reservoir 6, passing downwardly through the port 8, hose connection 10, through the port 27, passage 50, and openings 53 into the water chamber 33 of the flywheel where it is revolved rapidly with the flywheel and is subject to centrifugal force. The action of the collector in the chamber 35 then causes the water to be drawn from the chamber 33 through the U-tubes 41 where the heat is radiated from the

plates 40 and carried away through the ports 19 in the flywheel by the current of air which is drawn in between the spokes 17. After entering the chamber 25 the water passes into the collector, which is stationary, and which therefore remains substantially at atmospheric pressure and passes through the pipe 50, port 52, hose connection 11, nipple 9 and port 4 back to the water jacket of the engine.

It will be observed that the circulation is entirely due to differences in centrifugal pressures in the flywheel and that the thermo-siphon action is practically negligible. It is also apparent that the connection between the cylinder and the radiating element is very short and that only sufficient water is necessary to absorb the heat of the engine and carry it to the radiating surfaces, thereby eliminating the necessity of carrying a large volume of absorbing fluid and consequently reducing the size of the radiator.

It is further apparent that by locating the radiating element in the flywheel, the cooling efficiency is somewhat under the control of the engine itself, that is, when the engine is running full speed it is apparent that a greater volume of air will pass through the radiating element than when the engine is running slowly, thereby tending to compensate for the increased number of explosions in the motor. This condition, of course, does not hold good between heavy and light loads on the engine under the same speed. It is therefore necessary to construct the radiator of sufficient size to cool the engine under full load, but it is apparent that considerable advantage is gained by compensating for speed.

It will be observed by reference to the drawings that the U-tubes are so disposed with respect to the radiator that the flow of the circulating fluid is at right angles to the stream lines of the cooling air so that the air may readily pass across and around them, absorbing the heat and thereby efficiently reducing the temperature of the circulating fluid before it returns to the jacket 3.

It is to be understood, of course, that packing boxes, glands, etc., are to be sufficiently tight to prevent leakage and that the U-tubes may be brazed, soldered or otherwise secured, as the best practice may dictate and I do not wish to be limited to the specific details of construction shown, since, obviously, variations in the minor details of construction may be resorted to without in any way affecting the generic principles involved.

What I claim and desire to secure by Letters-Patent is:

1. In combination with a flywheel, comprising a rim member, a radiator, located

interiorly of the rim member and attached to the wheel to rotate therewith, both the rim member and radiator having radial openings, whereby air may enter the radiator and pass therethrough and through the rim member.

2. In combination with a wheel, having a laterally extended rim, an annular radiator located within said rim, both the rim and radiator having radial openings for the flow of air therethrough.

3. In combination with a wheel, having an apertured rim forming an interior chamber, an annular radiator located within the rim, attached to the wheel and having passages communicating with said chamber and with the rim openings.

4. In combination with a wheel, a radiator carried by said wheel and comprising tubes and spaced laminae connecting them, and means on the wheel for directing a flow of air from the center of the wheel in radial stream lines over the tubes.

5. In combination with a wheel, a radiator carried by said wheel and comprising tubes and spaced laminae connecting them, and means on the wheel for directing a flow of air from the center of the wheel in radial stream lines over the tubes and past the periphery of the wheel.

6. In combination with a wheel having a recessed central portion, a radiator in the recessed central portion, said radiator comprising lateral tubes, laminae connecting said lateral tubes, and means for directing a flow of air between the laminae and over the walls of the tubes.

7. In combination with a wheel having a recessed central portion, a removable radiator carried by the wheel, said radiator comprising transverse tubes, spaced rings connecting said tubes, the central portions of the rings being open to admit air between the rings, and means for directing air radially between the disks.

8. In combination with a wheel having a recessed central portion, a removable radiator carried by the wheel, said radiator comprising transverse tubes, spaced rings connecting said tubes, the central portions of the rings being open to admit air between the rings, and means for directing air radially between the rings, said means increasing the velocity of the air at the periphery of the radiator.

9. A radiator comprising annular plates spaced apart to provide air passages, said plates having central openings to provide inlets for the air, water circulating tubes extending transversely through said plates, a water chamber, and means in the water chamber for directing water through the circulating tubes.

10. A radiator comprising annular plates spaced apart to provide air passages, said

plates having central openings to provide inlets for the air, water circulating tubes extending transversely through said plates, a water chamber, and an impeller in the chamber for directing the flow of water through the water tubes.

11. In combination with a wheel having a water supply chamber and a return chamber discharging into the supply chamber, tubes connecting the two chambers, and means carried by the rim of the wheel for inducing a flow of air over the tubes.

12. In combination with a wheel having a water supply chamber and a return chamber discharging into the supply chamber, tubes connecting the two chambers, and disks at right angles to and carried by said tubes.

13. In combination with a wheel comprising a closed side forming one wall of a water chamber and an opposite side having an air intake opening, a radiator attached to the wheel comprising a closed side forming the other wall of the water chamber, a partition dividing said chamber into separate compartments, and water circulating and air directing members assembled with the radiator wall, whereby the separate compartments are connected and air directed in cooling relation to the water in circulation.

14. In combination with a wheel comprising a closed side forming one wall of a water chamber and an opposite side having an air intake opening, a radiator attached to the wheel and comprising a closed side forming the other wall of the radiator chamber, an annular series of spaced disks assembled with said side wall, a partition dividing the water chamber into separate compartments, and conduits extending through said disks and communicating with said separate compartments.

15. In combination with a wheel comprising a closed side forming one wall of a water chamber and an opposite side having an air intake opening, a radiator attached to the wheel comprising a closed side forming the other wall of the water chamber, a partition dividing said chamber into separate compartments, water circulating and air directing members assembled with the radiator wall, whereby the separate compartments are connected and air directed in cooling relation to the water in circulation, an impeller in one of the compartments, and supply and return conduits communicating with the impeller and the other compartment respectively.

In testimony whereof I affix my signature.
EVERETT B. CUSHMAN.