May 9, 1933. L. G. HARTDORN 1,907,802

ENGINE COOLING SYSTEM

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Fig. 1,

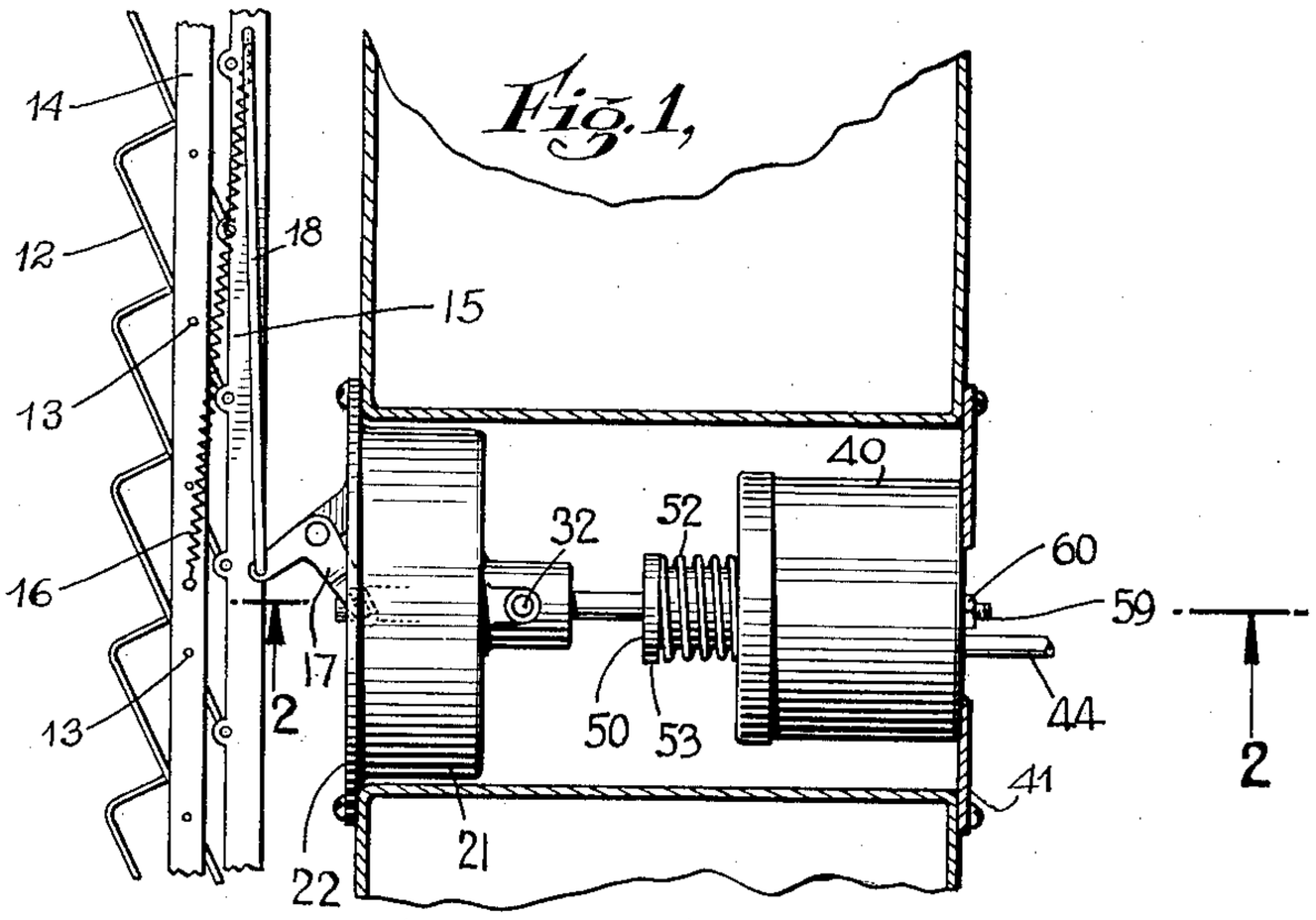


Fig. 2,

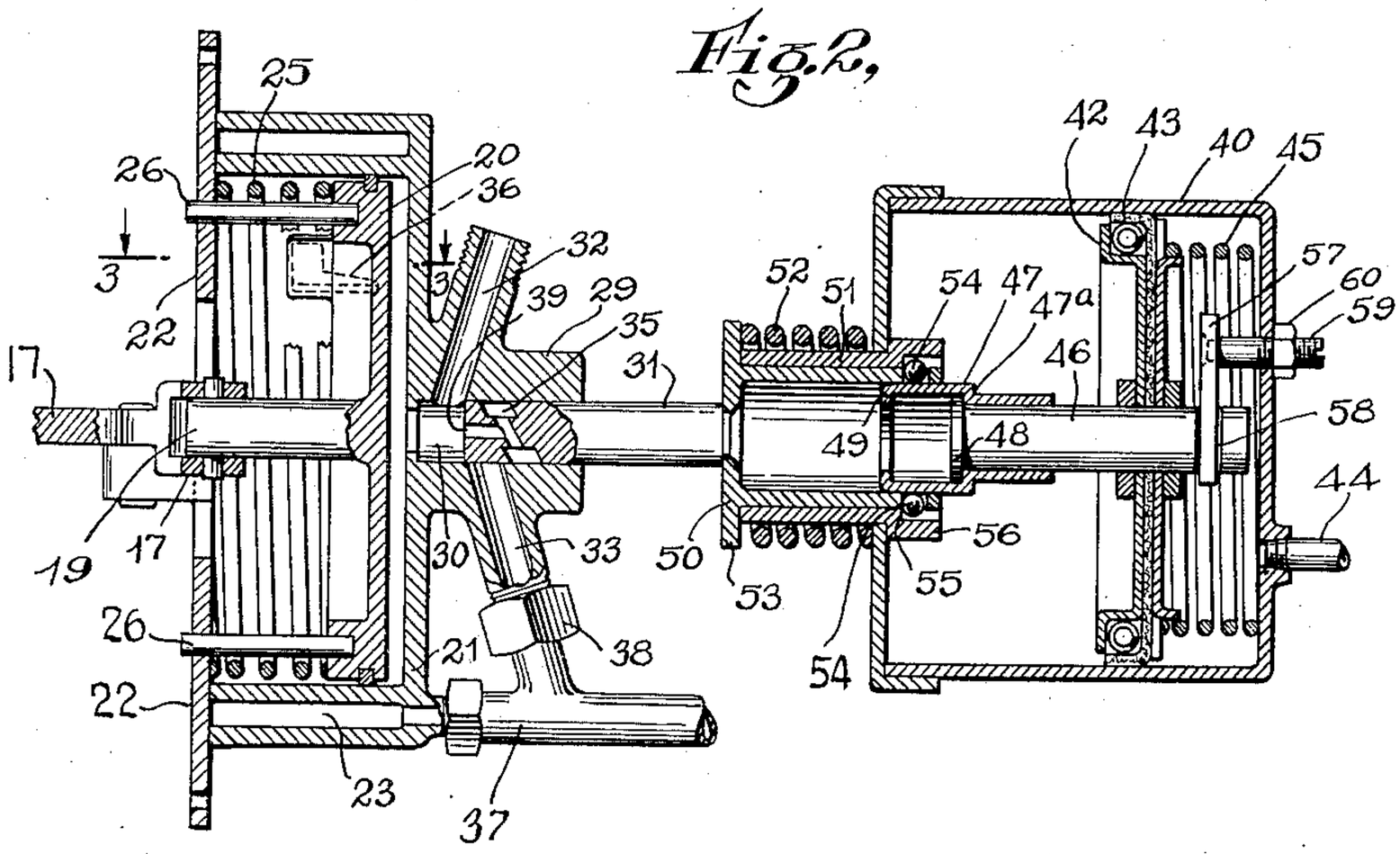
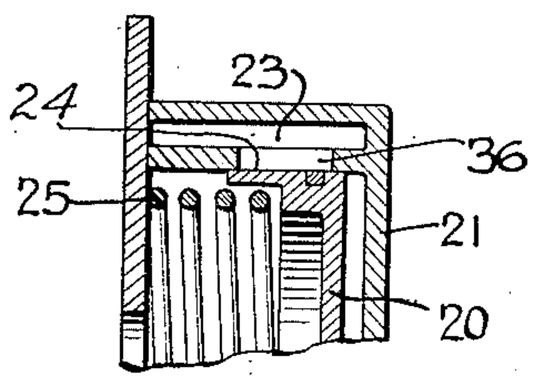


Fig. 3,



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ENGINE COOLING SYSTEM

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Fig. 4.

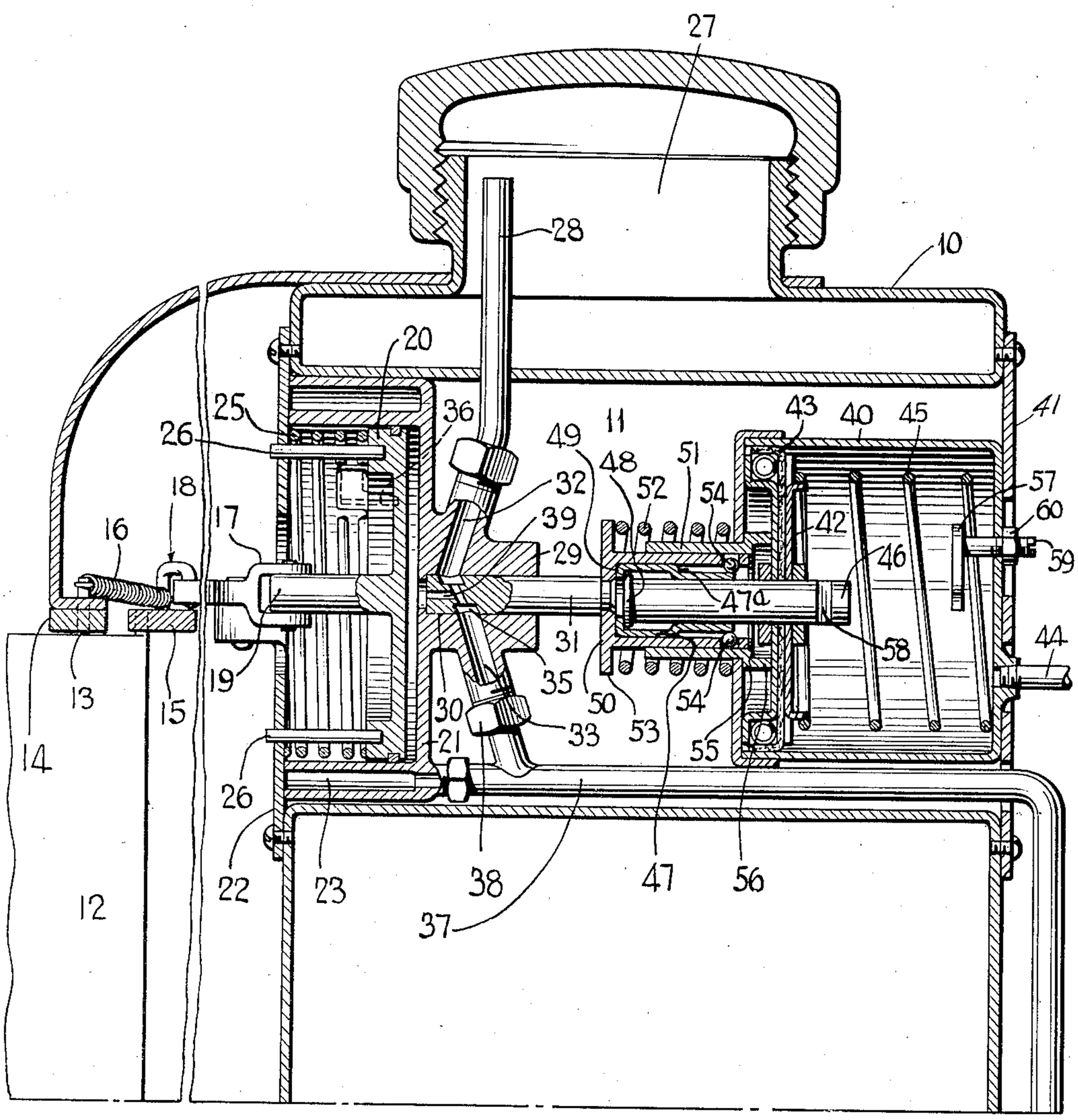
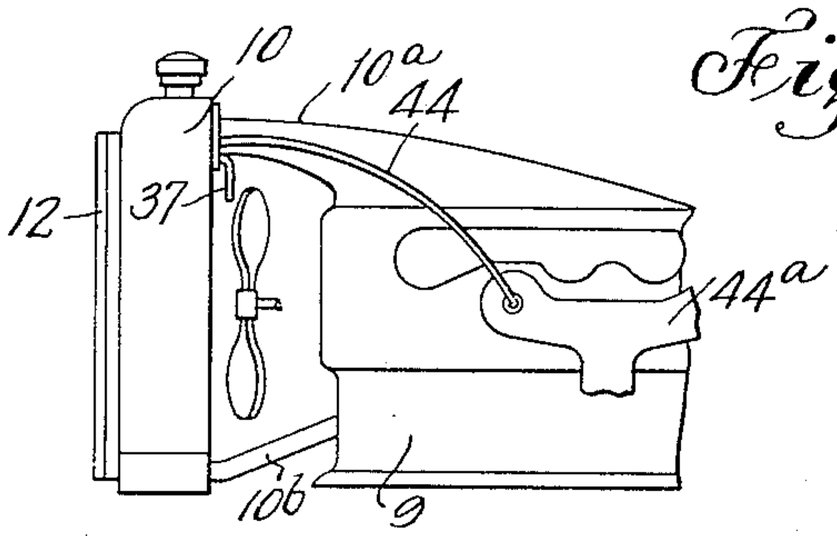


Fig. 4a



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ENGINE COOLING SYSTEM

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Fig. 5.

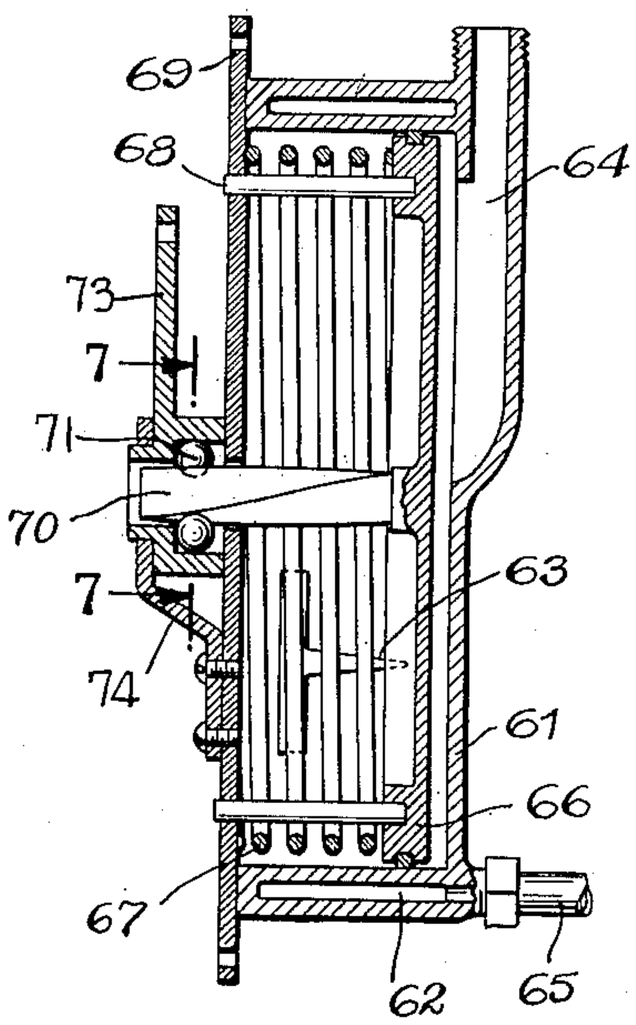


Fig. 6.

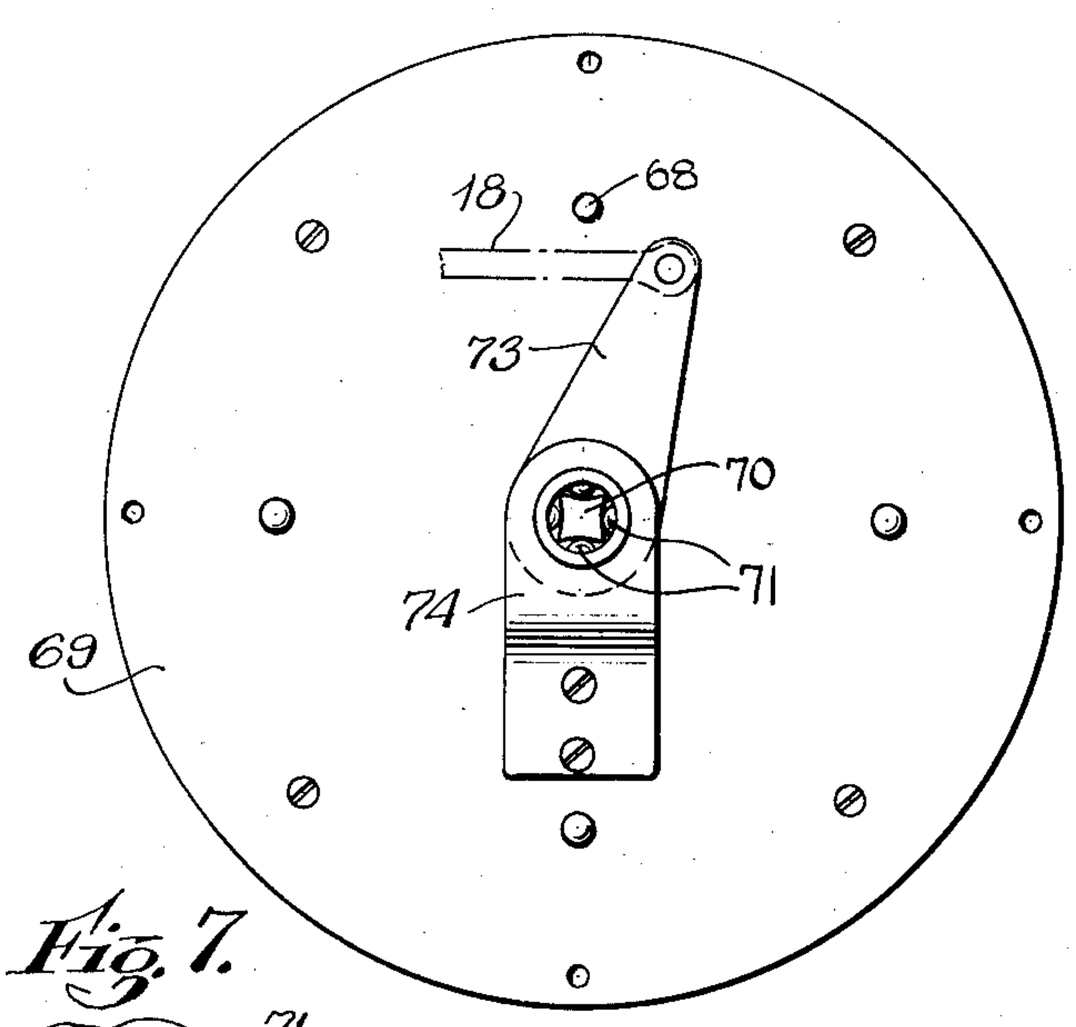


Fig. 7.

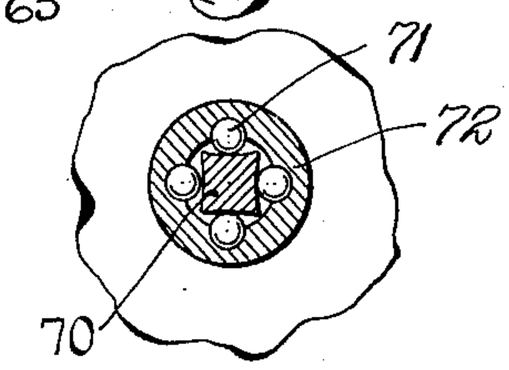
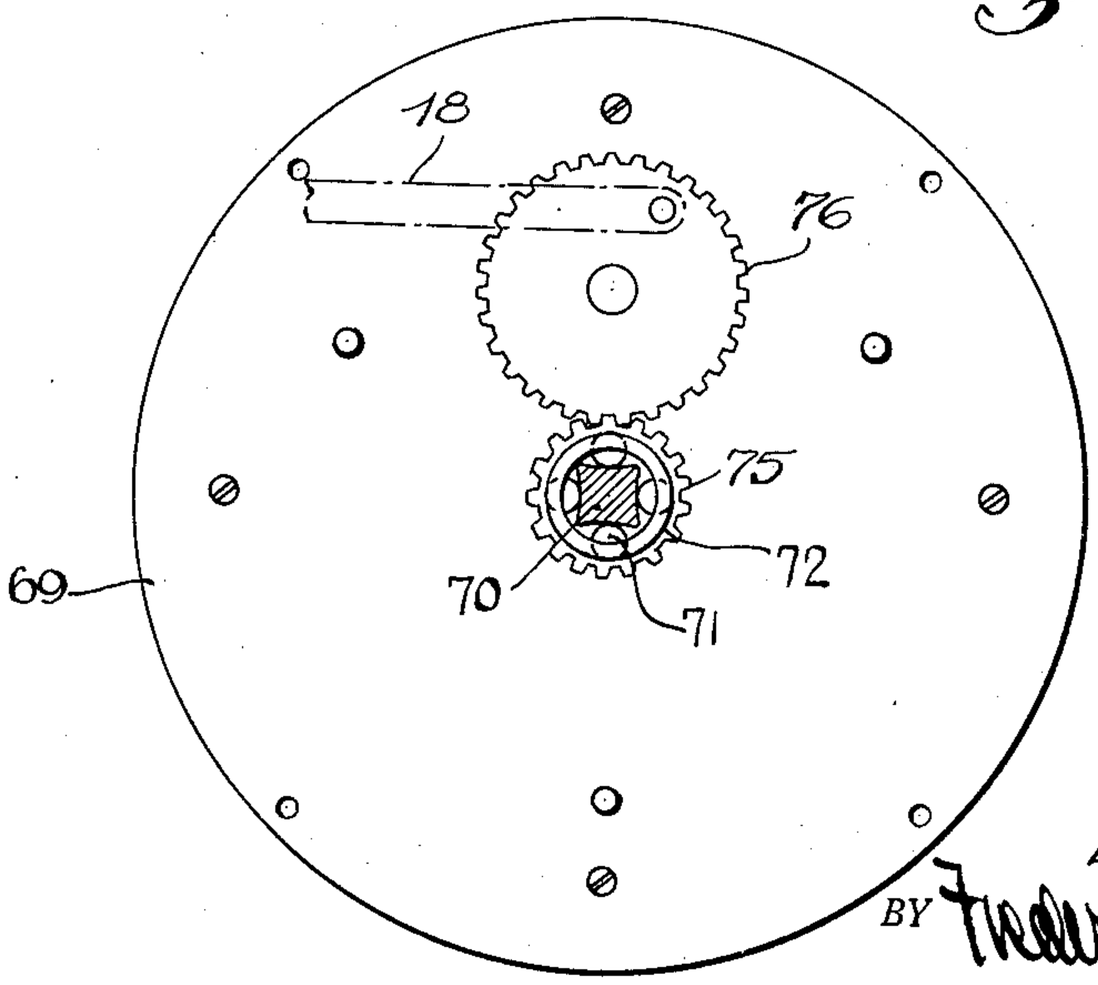


Fig. 8.



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Patented May 9, 1933 1,907,802

UNITED STATES PATENT OFFICE

LOUIS G. HARTDORN, OF FOREST HILLS, NEW YORK

ENGINE COOLING SYSTEM

Application filed June 28, 1929. Serial No. 374,372.

My invention relates to methods of and means for controlling radiator shutters and particularly the shutters of automobile engines.

The common method of controlling such shutters heretofore has been to employ a thermostat which would open the shutters when the radiator was heated above a predetermined temperature. In my copending applications Serial No. 59,253, filed September 29, 1925, and Serial No. 361,562, filed May 9, 1929, I show mechanism of this general type in which means are provided for establishing an operative connection between the thermostat and the shutters only when the engine is running; the shutters, if open, automatically closing as soon as the engine stops, so as to retain heat in the radiator as long as possible.

An object of the present invention is to provide a shutter control in which the thermostat is dispensed with, the shutters being operated directly by the heat energy in the radiator. Automobile radiators are customarily provided with a vent pipe through which any overflow may be carried off. When the radiator is heated the air in the top of the radiator is expanded and the excess thereof escapes through the vent pipe. This air is accompanied, or followed by vapor or steam as the temperature of the water in the radiator rises still higher. It is an object of my invention to utilize the fluid thus discharged from the radiator to control the operation of the shutters.

Another object of the invention is to provide such a shutter control in which the extent to which the shutters are opened depends upon the temperature in the radiator.

Another object is to provide means operative as soon as the engine stops running, for closing the shutters regardless of the temperature in the radiator.

Another object is to provide means controlled by power of the engine for maintaining operative relation between the radiator and the shutters, such relation, once established, being independent of variations of said power and being broken only when the engine stops running.

Further objects will appear in the following description of a preferred embodiment of my invention, and thereafter the novelty and scope of the invention will be pointed out in the claims.

In the accompanying drawings;

Figure 1 is a plan view of my control mechanism as applied to the shutters of a radiator, only a part of the shutter and radiator being shown, and such portion of the radiator being in section;

Fig. 2 is a view in longitudinal section of my control mechanism, showing the position of the certain clutch mechanism while the engine is running, the section being taken on the line 2—2 of Fig. 1;

Fig. 3 is a fragmentary view in section taken on the line 3—3 of Fig. 2;

Fig. 4 is a view in vertical section through a portion of the radiator and shutter and showing the control mechanism also in section, as in Fig. 2, but with the clutch mechanism released;

Fig. 4*a* is a fragmental view in side elevation of an automobile engine and radiator equipped with my improved shutter control;

Fig. 5 is a view in section of another form of shutter control device adapted for use without control by the engine;

Fig. 6 is a front elevation of the device, as viewed from the left hand side of Fig. 5;

Fig. 7 is a detail view in section taken on the line 7—7 of Fig. 5; and

Fig. 8 is a front elevation of still another form of shutter control.

Referring particularly to Fig. 4, I have shown an automobile radiator 10 provided with a transverse opening 11 which extends therethrough and provides a chamber for the control mechanism. The radiator is connected in the usual manner by pipes 10*a* and 10*b* (Fig. 4*a*) to the water jacket of the automobile engine 9. In front of the radiator is a shutter comprising vanes 12 pivotally secured at 13 in frame members 14 of the usual shutter shell. The vanes are pivotally connected at their inner edges to an operating bar 15. Normally, the shutters are held in closed position, as shown in Fig. 1, by a spring 16 which is connected at

one end to the frame member 14 and at the other to the bar 15. Mounted on a suitable support adjacent the chamber 11 is a bell crank 17, one arm of which is pivotally connected by a push rod 18 to the operating bar 15, while the other arm of the bell crank is connected to the stem 19 of a piston 20. The latter operates in a cylinder 21.

The cylinder 21 is cup shaped with the open end thereof toward the front of the radiator and is carried by a plate 22 which fits over the front of the chamber 11 and is secured to the radiator. The cylinder 21 is provided with double cylindrical walls to form an annular chamber 23 surrounding the working chamber of the cylinder. A spring 25 is compressed between the piston and the plate 22 and normally tends to force the piston inward or toward the right, as viewed in Fig. 2. The piston is provided with guide rods 26 which pass through the front plate 22 and serve to prevent rotation and tilting of the piston as it operates in the cylinder.

As shown in Fig. 4, the radiator 10 is provided with an expansion chamber 27 from which leads a vent pipe 28. The latter, under control of a valve presently to be described, may communicate with the working chamber of the cylinder 21, so that fluid discharged from the radiator by thermal expansion, may enter the cylinder and force the piston 20 outward against the pressure of the spring 25. As the piston moves outward it rocks the bell crank 17, causing the shutter vanes to open.

The cylinder 21 is formed with a valve casing 29 extending rearwardly therefrom, and this casing has a bore 30 therethrough which opens into the working chamber. A valve 31 slides in the bore 30. Communicating with the bore 30 is an inlet passage 32 and an outlet passage 33. These passages are relatively offset so that slide valve 31 may close the passage 33 without interrupting the passage 32. The valve 31 is in the form of a rod provided with an inclined passage 35 which, when the valve is moved to the position shown in Fig. 4, will establish direct communication between the passage 32 and the passage 33. The vent pipe 28 communicates with the inlet 32 and when the valve 31 is in the position shown in Fig. 2, fluid discharged from the radiator will enter the working chamber of the cylinder and force the piston 20 outward.

To proportion the extent of opening of the shutters to the temperature developed in the radiator, I provide a port 36 in the inner side wall of the working chamber of the cylinder which opens into the space 23. Normally, this port is closed by the piston 20. As the port extends beyond the normal width of the piston, the latter is provided with an extension 24 to cover the port (see Fig. 3). As the piston is moved outward the port is gradually opened, permitting the fluid in the cylinder to escape into the annular space 23, and thence into an exhaust pipe 37. The extension 24 prevents fluid from by-passing around the piston when the latter is moved part way out. The port 36 is of such form as to provide a progressively wider opening as the piston is moved outward. Thus, the extent to which the piston moves will be determined by the pressure, or, in other words, by the temperature developed in the radiator.

As long as the valve 31 is retained in the position shown in Fig. 2, the shutters will be under direct control of the radiator and the shutter vanes will open more or less depending upon the temperature developed in the radiator. However, when the valve 31 is moved inward to the position shown in Fig. 4 the excess fluid from the radiator will be by-passed through passage 35 to the exhaust passage 33 and the radiator will no longer control the shutters. The shutters will then close and the piston will move inward under the combined action of springs 16 and 25. To prevent banking of fluid in the working chamber of the cylinder after the piston has closed the port 36, a passage 39 is provided in the end of the valve 31 which establishes connection between the cylinder chamber and the by-pass 35. Thereupon such fluid as may be trapped in the cylinder 21 will escape through the passages 39 and 35 into the passage 33. The latter passage leads into the exhaust pipe 37.

The valve 31 is adapted to be controlled by the power of the engine, being held in the position shown in Fig. 2, only while the engine is operating, and being moved inward to establish a by-pass between the passages 32 and 33 as soon as the engine stops running. In the present embodiment of my invention, I employ suction produced by the engine to move the valve 31 to the position shown in Fig. 2, in which position it is maintained by a clutch. The latter will not release the piston until the suction is reduced to practically zero.

Within the radiator chamber 11 a cylinder 40 is mounted being secured to the rear face of the radiator by means of a plate 41 bolted or otherwise fastened to the cylinder and to the radiator. Fitted to slide within the cylinder 40 is a plunger 42 provided with an inwardly turned cup leather 43. Communicating with the working chamber of cylinder 40 is a pipe 44 which is connected to the intake manifold 44*a* of the automobile. Thus, when the engine 9 is operated and suction is produced in the cylinder 40, the plunger 42 will be drawn toward the right as viewed in Fig. 2 against the resistance of a coil spring 45.

The plunger 42 is provided with a cen-

tral stem 46 which carries a clutch sleeve 47. The sleeve 47 comprises a reduced portion which has a sliding engagement with the stem 46 and an enlarged portion which clears a head 48 formed on the free end of the stem. The enlarged portion is provided with an inwardly turned lip 49. Thus, the sleeve is allowed a certain amount of lost motion on the stem being stopped in one direction by engagement of the head 48 with the lip 49 and in the other by engagement of the head with a shoulder formed by the annular wall 47*a* connecting the two sleeve portions. The sleeve 47 is arranged to slide within a thimble 50 secured to the end of the valve 31. The thimble 50, in turn, is adapted to slide in a fixed bearing 51, carried by the cylinder 40. A spring 52 is compressed between the inner end wall of the cylinder 40 and a flange 53 on the thimble 50. The spring, therefore, tends to force the valve 31 from the position shown in Fig. 2, to that shown in Fig. 4.

Movable radially in apertures formed in the thimble 50 are a number of balls 54. With the parts in normal position, as shown in Fig. 4, the balls engage the reduced portion of the clutch sleeve 47, but when the parts are in the position shown in Fig. 2, they are forced outward and engage a shoulder 55 formed in a ball cup 56 at the inner end of the bearing 51, thereby locking the valve in retracted position against the pressure of the spring 52.

The operation of the apparatus is as follows: Normally, when the engine is not running the balls 54 will be retracted and the thimble 50 will occupy the position shown in Fig. 4. In this position, the passages 32 and 33 will be connected by the by-pass 35 and the shutters will remain in closed position. When the engine is started, producing suction in the working chamber of the cylinder 40, the piston 42 will be drawn toward the right and the thimble 50 and valve 31 will be withdrawn by engagement of the wall 47*a* with the balls 54. As soon as the thimble has been withdrawn to the position shown in Fig. 2, the balls will be forced outward into engagement with the shoulder 55, and in this position they will be maintained by the enlarged portion of sleeve 47. When the valve 31 is thus withdrawn communication between passages 32 and 33 will be interrupted and communication between passage 32 and the working chamber of cylinder 21 will be established, thereby placing the shutters under direct control of the radiator. As the radiator heats, excess fluid discharged therefrom will enter the cylinder 21 through the passage 30 and will force the piston 20 outward, opening the shutter vanes. The extent to which the shutter vanes are opened will depend upon the pressure developed in the cylinder 21, which pressure is modified by the extent to which the port 36 is uncovered. In the meantime, as the suction produced by the engine varies, the piston 42 will move in and out of the cylinder 40 without declutching the thimble, because of the lost motion between the clutch sleeve and the piston stem, and because the clutch sleeve may move to a considerable extent before the enlarged portion thereof clears the balls 54. Only when the suction is reduced practically to zero, or, in other words, when the engine stops, will the sleeve 47 be moved in far enough to clear the balls 54 and permit them to move inward upon the reduced portion of the sleeve. Thereupon the spring 52 will move the valve 31 to the by-pass position shown in Fig. 4. The shutters will then close immediately, due to venting of the cylinder 21, by way of the port 36 and also by way of the port 39 and such heat as there is in the radiator will be conserved.

It is not desirable to use the engine control mechanism in summer time and, for this reason, I provide means for locking the parts in the position shown in Fig. 2. This means consists of a latch 57 adapted to engage a groove 58 in the stem 46. The latch 57 has a stem 59 which is threaded through the outer wall of the cylinder 40. In warm weather, the stem 59 may be turned by a screw driver or other means so that the latch will engage the groove 58 and hold the stem 46 in retracted position, and a lock nut 60 on the stem may be screwed against the cylinder 40 to lock the latch in such position. In cold weather, the latch 57 is moved clear of the groove 58 and is locked in such position by the nut 60.

In Figs. 5 to 7, I show a somewhat different form of control device. As illustrated this control device has no connection with the engine and hence the shutters are at all times under the control of the heat condition in the radiator, regardless of whether the engine is running or not. It will be obvious, however, that this same control means can be employed in connection with a suction operated clutch mechanism of the type illustrated in Fig. 2. The device shown in Fig. 5 comprises a cylinder 61, similar in form to the cylinder 21, being provided with an annular peripheral chamber 62 and a port 63 to provide communication between the chamber 62 and the working chamber of the cylinder 61. At the rear of the cylinder 61 there is an inlet 64 which may be connected to the vent pipe 28 of the radiator. An exhaust pipe 65 is connected to the annular chamber 62.

Within the cylinder 61 operates a plunger 66 which is normally pressed by a spring 67 to the retracted position shown in Fig. 5. The plunger 66 is provided with guide rods 68 which pass through openings in a front plate 69. The plunger 66 is formed with a

central stem 70 which projects through an opening in plate 69. The stem 70 is formed with spiral grooves adapted to be engaged by a set of balls 71 retained in pockets in the hub 72 of an operating arm 73. The hub 72 is seated against the plate 69 and is journaled in a bracket 74 secured to the plate 69. The free end of the arm 73 is pivotally connected to the push rod 18, so that as the arm swings in its bearing it will push the rod 18 and cause the shutters to open. Angular movement of the arm 73 is effected by outward movement of the piston 66, because as the stem 70 moves outward, the hub will be compelled to rotate by engagement of the balls therein with the spiral grooves in said stem. It will be understood that the piston 66 is kept from rotating by the guide rods 68. The inclination of the spiral grooves in the stem 70 is so chosen as to control the extent of opening of the shutter vanes in proportion to the extent to which the plunger 66 is moved outward and the extent of movement of the plunger in turn is controlled by the temperature and consequent pressure developed in the radiator, this pressure being modified by the port 63.

Instead of employing an operating arm 73 integral with the hub a reducing gear may be used between the hub 72 and the connecting rod 18. Thus, in Fig. 8, I show a hub 72 with a pinion 75 integral therewith. The pinion meshes with a gear 76 of greater diameter. The rod 18 is pivotally connected to the gear 76. When the piston 66 moves outward, the pinion 75 is partially rotated, turning the gear 76, and thereby opening the shutters. Obviously, the pitch of the grooves in stem 70 will be steeper in the construction shown in Fig. 8 than in that shown in Fig. 5.

While I have illustrated and described a preferred embodiment of my invention and several alternative forms, I wish it to be understood that these are to be considered merely as illustrative and not limitative of the invention and that my invention embraces such changes in form, construction and arrangements of parts as fall within the spirit and scope of the following claims.

I claim:

1. In combination with an internal combustion engine, and its cooling system including a radiator, means for controlling the flow of air through the radiator, mechanism operable by pressure generated in the radiator for operating said controlling means, and means effective only when the engine is running for operatively connecting said mechanism to the radiator.

2. In combination with an internal combustion engine and its cooling system including a radiator, means for controlling the flow of air through the radiator, mechanism actuated by pressure generated in the radiator for operating said means, said mechanism being normally operatively disconnected from the radiator, and means responsive to suction in the engine for operatively connecting said mechanism to the radiator.

3. In combination with an internal combustion engine and its cooling system including a radiator, means for controlling the flow of air through the radiator, means actuated by pressure generated in the radiator for operating the control means, a valve normally closing communication between the radiator and the actuating means, and means actuated by the engine for opening the valve.

4. In combination with an internal combustion engine and its cooling system including a radiator, means for controlling the flow of air through the radiator, means actuated by pressure generated in the radiator for operating the controlling means, a valve normally closing communication between the radiator and the actuating means, means actuated by the engine for opening the valve, and means for holding said valve open as long as the engine is running.

5. In combination with an internal combustion engine and its cooling system including a radiator, means for controlling the flow of air through the radiator, means actuated by pressure generated in the radiator for operating the controlling means, a valve normally closing communication between the radiator and the actuating means, and means controlled by suction of the engine for opening the valve.

6. In combination with an internal combustion engine and its cooling system including a radiator, means for controlling the flow of air through the radiator, means actuated by pressure generated in the radiator for operating the controlling means, a valve normally closing communication between the radiator and the actuating means, means controlled by suction of the engine for opening the valve, and a clutch for holding the valve open until said suction is reduced practically to zero.

7. In combination with an internal combustion engine and its cooling system including a radiator, a shutter for the radiator, means actuated by pressure generated in the radiator for opening the shutter, a valve normally closing communication between the radiator and the actuating means, and means actuated by the engine for opening the valve.

8. In combination with an internal combustion engine and its cooling system including a radiator, a shutter for the radiator, means actuated by pressure generated in the radiator for opening the shutter, a valve normally closing communication between the radiator and the actuating means, means actuated by the engine for opening the valve,

and a clutch for holding the valve open as long as the engine is running.

9. In combination with an internal combustion engine and its cooling system including a radiator, a shutter for the radiator, means actuated by pressure generated in the radiator for opening the shutter, a valve normally closing communication between the radiator and the actuating means, means controlled by suction of the engine for opening the valve, and the clutch for holding the valve open until the suction is reduced to practically zero.

10. In combination with an internal combustion engine and its cooling system including a radiator, a shutter for the radiator, means actuated by pressure generated in the radiator for operating the shutter, a valve normally closing communication between the radiator and the actuating means, means actuated by the engine for opening the valve, a clutch for holding the valve open as long as the engine is running, and a by-pass for relieving pressure in the radiator when the valve is closed.

11. In combination with an internal combustion engine and its cooling system including a radiator, a shutter for the radiator, means actuated by pressure generated in the radiator for operating the shutter, a valve normally closing communication between the radiator and the actuating means, means actuated by the engine for opening the valve, a clutch for holding the valve open as long as the engine is running, a by-pass for relieving pressure in the radiator when the valve is closed, and a latch operable to hold the valve open.

12. In combination with an internal combustion engine and its cooling system including a radiator, a shutter for controlling the flow of air through the radiator, a spring normally holding the shutter closed, means actuated by pressure generated in the radiator for opening the shutter, a valve normally closing communication between the radiator and the actuating means, and means actuated by the engine for opening the valve.

13. In combination with an internal combustion engine and its cooling system including a radiator, a shutter for controlling the flow of air through the radiator, a spring normally holding the shutter closed, means actuated by pressure generated in the radiator for opening the shutter, a valve normally closing communication between the radiator and the actuating means, means actuated by the engine for opening the valve, and a clutch for holding the valve open as long as the engine is running.

14. In combination with an internal combustion engine and its cooling system including a radiator, a shutter for controlling the flow of air through the radiator, a spring normally holding the shutter closed, means actuated by pressure generated in the radiator for opening the shutter, a valve normally closing communication between the radiator and the actuating means, means actuated by the engine for opening the valve, said valve being formed with a by-pass adapted to relieve the pressure in the radiator when the valve is closed.

15. In combination with an internal combustion engine and its cooling system including a radiator, a shutter for controlling the flow of air through the radiator, a spring normally holding the shutter closed, means actuated by pressure generated in the radiator for opening the shutter, a valve normally closing communication between the radiator and the actuating means, means actuated by suction of the engine for opening the valve, and a clutch adapted to hold the valve open until the suction is reduced practically to zero.

16. In combination with an internal combustion engine and its cooling system including a radiator, a shutter for controlling the flow of air through the radiator, a spring normally holding the shutter closed, means actuated by pressure generated in the radiator for opening the shutter, a valve normally closing communication between the radiator and the actuating means, means actuated by suction of the engine for opening the valve, and a clutch for holding the valve open until the suction is reduced practically to zero, the valve being formed with a by-pass to relieve the pressure in the radiator when the valve is closed.

17. Means for controlling the shutter of the radiator of a water cooling system, said means comprising a cylinder, a piston operable therein and connected with the shutter, and means for leading vapor under pressure from the radiator into the cylinder to displace the piston and open the shutter, the cylinder being formed with an outlet port adapted to be controlled by displacement of the piston to relieve the vapor pressure in the radiator.

18. The combination with the radiator of a water cooling system and a shutter for the radiator, of a spring normally holding the shutter closed, a cylinder, a piston connected to the shutter and operable in the cylinder, means for leading vapor under pressure from the radiator into the cylinder to move the piston outward and open the shutter, the cylinder being formed with an outlet port adapted to be uncovered by the piston to relieve the vapor pressure, the port being of such form as to regulate the opening of the shutter in proportion to the temperature of the radiator.

19. The combination with the radiator of a water cooling system and a shutter for the radiator, of a spring normally holding the shutter closed, a cylinder, a piston connected

to the shutter and operable in the cylinder, means for leading vapor generated by heat in the radiator to the cylinder to move the piston outward and open the shutter, the cylinder being formed with an outlet port adapted to be uncovered by the piston and relieve the vapor pressure, the port being of such form as to regulate the opening of the shutter in proportion to the temperature of the radiator, and a valve for closing communication between the radiator and the cylinder, said valve being formed with a by-pass to relieve pressure in the radiator when the valve is closed.

20. In combination with a radiator and a shutter therefor, a spring normally holding the shutter closed, a cylinder, a piston connected to the shutter and operable in the cylinder, means for leading vapor generated in the radiator to the cylinder to move the piston outward and open the shutter, the cylinder being formed with an outlet port adapted to be uncovered by the piston and relieve the vapor pressure, the port being of such form as to regulate the opening of the shutter in proportion to the heat in the radiator, a valve for closing communication between the radiator and the cylinder, and means for opening the valve.

21. In combination with a radiator and a shutter therefor, a spring normally holding the shutter closed, a cylinder, a piston connected to the shutter and operable in the cylinder, means for leading vapor generated in the radiator to the cylinder to move the piston outward and open the shutter, the cylinder being formed with an outlet port adapted to be uncovered by the piston and relieve the vapor pressure, the port being of such form as to regulate the opening of the shutter in proportion to the heat in the radiator, a valve for closing communication between the radiator and the cylinder, and means for locking the valve in open position, the valve being formed with a by-pass to relieve the pressure in the radiator when the valve is closed.

22. In combination with the radiator of an internal combustion engine, means for controlling the flow of air through the radiator, means actuated by pressure generated in the radiator for operating the controlling means, and means for relieving said pressure in predetermined relation to the opening of said shutter.

23. The method of controlling the opening of the shutter of a radiator, which consists in utilizing pressure in the radiator generated by heat to operate the shutter and relieving said pressure in a predetermined relation to the opening of the shutter.

24. The method of controlling the opening of the shutter of an engine radiator, which consists in utilizing pressure in the radiator generated by heat to open the shutter, and utilizing suction power of the engine to control said utilization of pressure, whereby the shutter will open only when the engine is running.

25. The method of controlling the opening of the shutter of an engine radiator, said shutter being spring-biased to closed position, which comprises the steps of utilizing pressure in the radiator generated by heat to open the shutter and utilizing power of the engine to control said utilization of pressure, whereby the shutter will open only when the engine is running and will close as soon as the engine stops running.

In testimony whereof, I have signed this specification.

LOUIS G. HARTDORN.