

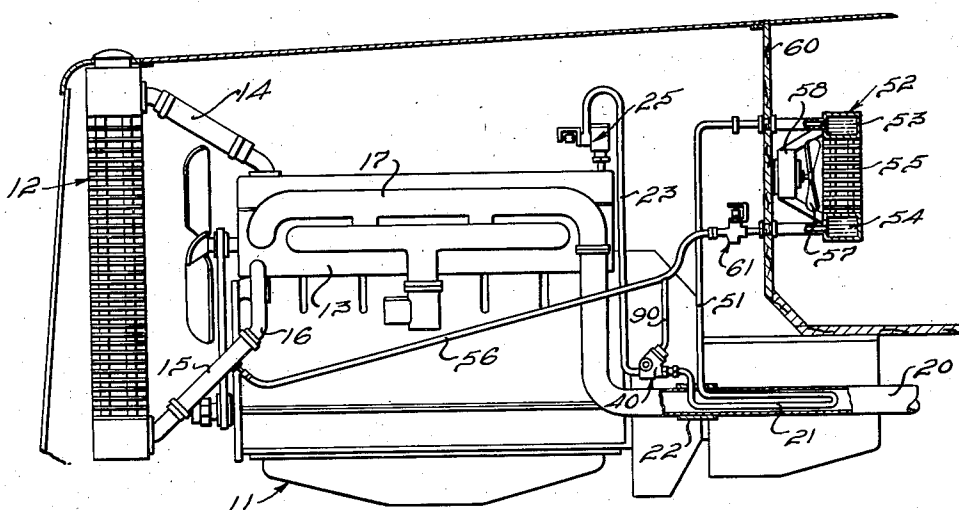
**Oct. 13, 1936.**

R. W. ANGSTMAN

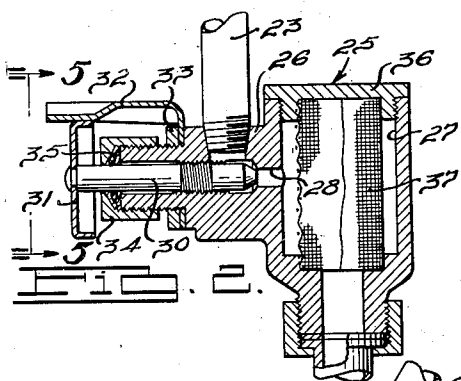
**2,057,128**

# STEAM HEATING SYSTEM FOR AUTOMOBILE BODIES

Original Filed June 6, 1934



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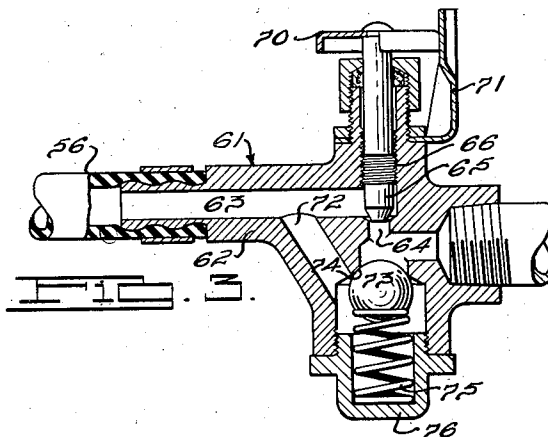
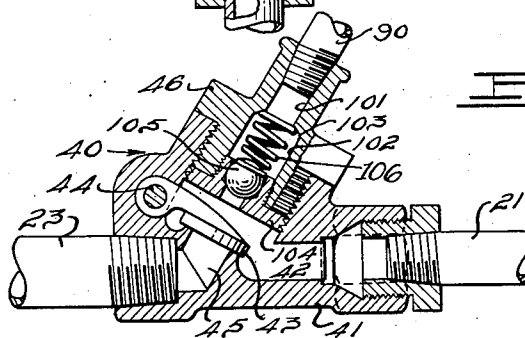
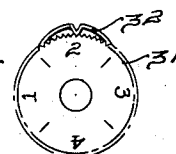


FIG. 3



III. 4.

FILE 5.



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## UNITED STATES PATENT OFFICE

2,057,128

## STEAM HEATING SYSTEM FOR AUTOMOBILE BODIES

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Original application June 6, 1934, Serial No.  
729,212. Divided and this application Decem-  
ber 21, 1934, Serial No. 758,594

## 9 Claims. (Cl. 237—12.3)

This invention relates to motor vehicle heating systems and more particularly to systems which utilize the waste heat from the exhaust gases of the internal combustion engine which drives the vehicle to generate steam or vapor from the water or other liquid in the cooling system of the engine, the steam or vapor then being passed through a radiator or radiators to heat the interior of the body of the vehicle, and is a division of my application for Letters Patent of the United States filed June 6, 1934 for improvements in Steam heating systems for automobiles, Serial No. 729,212, now Patent No. 1,990,159, issued February 5, 1935.

The principal object of the present invention is to provide means for automatically reducing the temperature of the steam being fed from the steam generator to the heater radiator under those conditions of operation during which the temperature of such steam may approach and/or exceed a value which may prove deleterious to the heater radiator.

Other objects of the invention includes the provision of an automobile steam heating system including a steam generator and a heater radiator in which means are provided for reducing the temperature of the steam being fed to the heater radiator during certain conditions of engine operation; the provision of means in connection with a device of the type described for discharging super-heated steam from the steam generator to the vehicle cooling system; the provision of an automobile body steam heating system including a steam generator heated by the exhaust gases of the engine, and a heater radiator to which steam from the generator is normally fed, together with means for discharging steam only under certain conditions of operation from the generator and returning it to the engine cooling system without passing it through the heater radiator; the provision of an automobile steam heating system including a steam generator and heater radiator connected in circuit with different portions of the liquid cooling system for the engine of the automobile, and a by-pass between the inlet side of the steam generator and the engine cooling system for returning a portion of the steam formed in the generator, independently of the heater radiator, to the engine cooling system during certain conditions of engine operation; the provision of means in a construction as above described for reducing the effect which super-heated steam formed in the steam generator would otherwise have on the heater radiator, comprising a duct connecting the inlet

side of the steam generator with the engine cooling system, and a spring pressed check valve in the duct so constructed and arranged as to by-pass fluid from the generator to the engine cooling system independently of the heater radiator under those conditions of engine operation conducive to the formation of super-heated steam in the steam generator.

Further objects of the invention include the provision of a method of operating an automobile body steam heating system so as to prevent the introduction of excessive volumes of steam at excessively high temperatures to the heater radiator; and the method of operating an automobile body steam heating system including a steam generator and a heater radiator connected in circuit with different portions of the cooling system for the automobile engine so as to prevent the introduction of excessive amounts of steam of excessively high temperatures to the heater radiator by returning a portion of such excessively high temperature steam from the steam generator to the engine cooling system so as to prevent such portion of such steam from being fed to the heater radiator.

The above being among the objects of the present invention the same consists in certain novel features of construction, combinations of parts and method of operation to be hereinafter described with reference to the accompanying drawing, and then claimed, having the above and other objects in view.

In the accompanying drawing which illustrates a suitable embodiment of the present invention and in which like numerals refer to like parts throughout the several different views,

Fig. 1 is a more or less diagrammatic side elevation, partly in section, of a portion of an automotive vehicle illustrating the application of a steam heating system to such vehicle.

Figs. 2, 3 and 4 are central, vertical and longitudinal sections of parts of the steam heating system shown in Fig. 1.

Fig. 5 is a detail of parts shown in Figs. 1, 2, and 3 as viewed, for instance on the line 5—5 of Fig. 2.

The present invention deals with that type of automobile body steam heating systems in which a steam generator, which may be conveniently formed of a length of tubing, is so positioned as to be heated by the exhaust gases of the engine which drives the automobile, and is adapted to deliver steam generated thereby to a radiator positioned within the automobile body for the purpose of heating the air in such body. The inlet

end of the steam generator is connected to the water jacket or other part of the cooling system for the engine, preferably with the inter-position of a check valve permitting the flow of water from the engine cooling system only in the direction of the generator. The discharge side of the body radiator is also connected with the engine cooling system so that the steam which is passed therethrough or which has condensed therein may be returned to the engine cooling system. Preferably the inlet and outlet ends of the body heating system are connected into the engine cooling system on opposite sides of the pump for such cooling system so that a pressure differential will be created at opposite ends of the body heating system tending to cause a circulation of fluid from the cooling system therethrough.

The parent patent application from which the present patent application was divided, as above identified, deals particularly with the introduction of means between the discharge side of the body radiator and the engine cooling system for normally restricting the flow of fluid from the body radiator so as to cause a positive pressure to be built up therein, thereby enhancing the heating effect of the body radiator as is desirable under certain conditions of operation as, for instance, when the engine is idling or the automobile is travelling at relatively low speed at which time the flow of exhaust gases are at a minimum, and providing means for rendering the restriction inoperative or at least to limit the restricting effects thereof so as to prevent an excessive pressure from being built up in the body radiator at such engine speeds that the flow of exhaust gases is in excess of that required to provide the necessary flow of steam for adequate body heating purposes. Such restricting feature, while it may be employed in connection with the present invention, is entirely independent thereof and the present invention is not to be limited thereby.

It has been found in connection with automobile body steam heating systems of the type described that under certain conditions of engine operation, particularly at high speeds and full load, that the amount of heat being transferred from the exhaust gases of the engine to the water or other liquid in the steam generator of the automobile body steam heating system is more than sufficient to turn such liquid into steam, and accordingly super-heats the steam thus formed. In extreme conditions at least the amount of super-heat thus imparted to the steam and which steam is consequently fed to the body radiator is of sufficiently high temperature to melt the solder holding and sealing the various parts of the radiator together, thus permitting the highly super-heated steam to escape into the interior of the automobile body where it may constitute a danger and menace to the occupants thereof. The present invention provides a means whereby the destructive effects of such super-heated steam on the heater radiator may be eliminated but without rendering the heater any less effective during normal operation at lower speeds.

The effect of such super-heated steam generated by the steam generator on the heater radiator is to all practical purposes eliminated or reduced by feeding a sufficient amount of such super-heated steam directly back to the engine cooling system without its having passed through the heater radiator. In other words, only a portion of the super-heated steam generated is permitted to pass through the heater radiator. In this manner the amount of super-heated steam fed to the

heater radiator is of such small volume that its excessive heat content is dissipated by the radiator before it has an opportunity to raise the temperature of the radiator to such an extent as to cause damage thereto. This is accomplished by providing a duct connected at one end to the steam generator as close as possible to the hottest point therein and preferably adjacent to the inlet end thereof and connected at its opposite end with the engine cooling system, and providing a spring pressed check valve in the duct so constructed and arranged to permit fluid to be by-passed through the duct from the steam generator to the engine cooling system only under those conditions of operation under which the formation of super-heated steam in the steam generator is liable to occur. Obviously the point of connection of this duct with the engine cooling system is more or less immaterial as long as it permits the discharge of super-heated fluid from the steam generator independently of the heater radiator, but ordinarily it will be found preferable to connect it with the engine cooling system on the suction side of the pump therefor and for this reason, as a matter of economy and simplicity in construction, it will ordinarily be found preferable to connect such duct with the discharge line from the heater radiator leading to the cooling system. Furthermore, while it is preferable for the proper operation of this device for the purpose described that it be connected with the inlet side of the steam generator, it will be understood that the actual point of connection with the steam generator may be varied within reasonable limits as long as it is subjected to the pressures simultaneously existing at the inlet end of the steam generator. It must, however, be connected on the down stream side of the check valve 40 and the check valve 40 should be placed as close as conveniently possible to the inlet end of the generator and as close as possible to the point where such end is in contact with the exhaust gases.

Referring to the drawing, the numeral 11 indicates an internal combustion engine of the type usually employed in motor vehicles and having a radiator 12 in front of the same as a part of the cooling system of the engine, the radiator having its upper and lower portions connected with the corresponding portions of the water jacket 13 of the engine by means of conduits 14 and 15 respectively. A pump 16 is interposed, in circuit, between the conduit 15 and the lower portion of the water jacket 13 to cause a forced circulation in the cooling system of the engine during operation of the latter. The engine is provided with an exhaust manifold 17 and an exhaust pipe 20 for conducting the exhaust gases from the engine to a suitable point of discharge.

A steam generator 21 is associated with the exhaust pipe 20 and, as illustrated in Fig. 1, for the purpose of illustration, is shown as consisting of a single re-entrant tube, the end portions of which may be supported by the saddle clamp 22 or other suitable means, the tube extending a substantial distance longitudinally of the exhaust pipe 20. Liquid is supplied to the steam generator 21 by means of a feed conduit 23 connected to the upper portion of the water jacket 13 through a throttling or metering valve means 25 connected into the water jacket 13 at this point. The valve means 25 is provided for the purpose of controlling the rate of flow of feed water from the cooling system of the engine to the steam generator.

Reference may now be had to Fig. 2 which illus-

trates the construction of the valve 25 more in detail. The supply valve 25 comprises a body casting 26 provided with a strainer chamber 27 communicating at one end with the conduit portion leading from the top of the water jacket 13, or other points in the cooling system on the high pressure side of the circulating pump, and communicating through an orifice 28 leading into the side of the chamber 27 and communicating with the conduit 23 leading to the steam generator 21. A needle valve stem 30 is threaded into the supply valve body 26 and arranged to regulate the flow through the restricted orifice 28. A needle valve adjustment knob 31 is secured to the end of the needle valve stem 30 for rotating the latter so as to regulate the effective opening of the orifice 28 and thus restrict, throttle and/or meter the amount of water flowing through the valve 25 so that the desired amount of water will be fed to the steam generator. The needle valve adjusting spring 32 is secured to the supply valve body 26 by means of a lock nut 33 and cooperates with the periphery of the adjustment knob so as to retain the needle valve in the desired adjusted position. A packing nut 34 and packing 35 are employed to effect a seal about the valve stem 30. One end of the strainer chamber 27 may be closed by a plug 36 threaded to the supply valve body 26 to hold the strainer 37 in position, and removable therefrom for the purpose of cleaning or replacing the strainer 37 which is employed to separate out scale, dirt or other foreign matter from cooling liquid passed through the valve so that such foreign matter will not be conveyed by the liquid into the heating system.

Referring now to Figs. 1 and 4 it will be noted that a check valve 40 is interposed between the feed water conduit 23 and the steam generator 21 and that the location of the valve 40 is in close proximity to the point where the inlet end of the generator 21 extends through the exhaust pipe 20. The valve 40 comprises a body 41 provided with a chamber 42 in which is disposed a gravity operated check valve flapper 43 pivoted to the valve body 41 as indicated at 44, and adapted to close a valve port 45 against the flow from right to left as viewed in Fig. 4 but to permit flow from left to right through the valve port 45. The valve body 41 is provided with a removable plug 46 which upon removal will permit cleaning, inspection, or replacement of the check valve flapper 43. For the purpose of simplicity in construction and economy in manufacture the plug is additionally formed to provide a part of the present invention, but this will be described later and for the present stage of description may be considered simply as a plug.

Referring again to Fig. 1, it will be noted that the discharge side of the steam generator 21 is extended as at 51 to form a conduit connecting the steam generator with the upper end of a heater radiator 52 adapted to be arranged within the body of the automobile. The radiator 52 comprises upper and lower headers 53 and 54 respectively and tubes 55 or other suitable heat transfer means interconnecting the headers. A return conduit 56 leads from the bottom header 54 and communicates with the conduit 15 at a point adjacent the inlet of the pump 16. A fan 57 operable by a suitable electric motor 58 is mounted in back of the tubes 55 or equivalent heat transfer means of the radiator 52 in order to cause a forced circulation of air therethrough. The radiator 52 and motor and fan assembly may

be connected to the dash 60 of the automobile in any suitable manner for supporting the same, a convenient method being to support it by means of the pipes or conduits leading into and out of the upper and lower header thereof.

Reference may now be had to Figs. 1 and 3 which illustrate the arrangement and construction of an exhaust throttling and safety valve 61 interposed in the return conduit 56 leading back to the engine cooling system. This valve comprises a body portion 62 provided with a longitudinal passage 63 communicating at the left hand end, as viewed in Fig. 3, with the portion of the return conduit 56 and communicating at the right end with the portion of the return conduit leading to the radiator 52. The passage 63 is provided with an orifice 64 which cooperates with a needle valve stem 65 threaded to the valve body 62, as indicated at 66, for regulating the effective area of the orifice 64. The valve stem 65 is of the same construction as the valve stem 30 illustrated in Fig. 2 and is provided with a similar adjusting knob 70 adapted to be locked in fixed position by means of the needle valve adjusting spring 71. A by-pass 72 is provided in the valve body 62 and communicates with the passage 63 on both sides of the restricted orifice 64. A ball valve 73 is adapted to cooperate with a valve port 74 provided in the by-pass 72 and is yieldably urged into position closing such port by means of a spring 75. A spring retainer nut 76 is threaded to the valve body 62 to retain the spring 75 in compressed condition to urge the ball valve 73 toward its closed position.

The valve 61 is adjusted to impede the flow of water or steam through the return conduit 56 so as to cause a positive pressure to be built up within the radiator 52 and thereby increase the heating effect of such radiator, especially for low operating speed of the engine 11. If excessive pressures develop within the radiator 52, these pressures will depress the ball valve 73 against the force of the spring 75 and by-pass steam or water, or both, through the by-pass passage 72 into the return conduit 56 to prevent damage to the radiator. The compressive stress of spring 75 determines the pressure at which the valve 73 will be depressed and consequently the maximum pressure that may be built up in the radiator 52.

In the operation of the apparatus thus far described, when the engine 11 is operating, water from the water jacket 13 and which is under the discharge pressure of the pump 16 will be forced through the valve 25 at a rate determined by the setting thereof, through the check valve 40 to the steam generator 21 where the exhaust gases passing through the exhaust pipe 20 will cause such water to be turned to steam which will flow through the duct 51 to the radiator 52 and after passing through the radiator 52 will be returned to the engine cooling system on the suction side of the pump 16 through the duct 56, the valve 61 normally retarding the flow from the radiator 52 so as to maintain a positive pressure on the steam within the radiator and which pressure may, for instance, be from five to seven pounds per square inch gauge. The steam in passing through the radiator 52 will give up heat to the surrounding air and this transfer of heat will be accelerated or increased by operation of the fan 57 and motor 58. Should the pressure of the steam in the radiator 52 exceed a desirable maximum value the ball valve 73 will be moved away from its seat 74 to permit steam to

be by-passed around the stem 65 until the pressure of the steam in the radiator 52 has been reduced to the desired value. Now it will be readily understood that the capacity of the steam generator 21 for a given diameter of tubing, and it may be noted that five-sixteenths inch tubing may be advantageously employed for the steam generator in the majority of installations, will be approximately proportional to the length of the steam generator. Considering that the greatest mileage put on the average automobile is at a speed of 30 miles per hour or less, when the engine is running at only part speed and under part load conditions, it will be understood that the generator 21 should be made of such length as to permit an ample supply of steam at such speed to maintain the desired high degree of temperature in the automobile body. I have found, however, that when the generator is so proportioned and the automobile is driven at relatively high speed and particularly at high speeds and under full loads, the amount of heat transferred to the fluid in the generator is in excess of that required to turn the water within it into steam, and consequently the steam formed becomes super-heated, in some cases to such a degree that its temperature is sufficient to melt the solder employed in the construction of the radiator 52, and when this occurs the radiator 52 leaks and allows such super-heated steam to escape into the interior of the automobile body, creating a dangerous condition.

To overcome this defect and still permit ample amounts of heat to be provided at lower engine speeds and loads, means are provided as previously mentioned for discharging part of the steam formed at higher engine speeds and loads from the system in the immediate vicinity of the steam generator 13 back to the engine cooling system, thus reducing volume of super-heated steam fed under such conditions to the radiator to such an extent that the heat thereof may be dissipated by the radiator before it has an opportunity to damage it. Also as previously mentioned, the portion of the super-heated steam which is expelled from the generator does not need to be removed exactly at the inlet of the generator, but preferably should be removed from a point adjacent such inlet, and as also previously explained this portion of the super-heated steam which is removed from the generator may, in the broader aspects of the invention, be returned to the engine cooling system at any suitable location but preferably to the cooling system on the suction side of the pump 16 so that the suction of the pump, where present, will aid it in being withdrawn from the steam generator. The particular method of doing this as illustrated in the drawing, by way of illustration, is to provide a tube 90 between the check valve 40 and the conduit 56 connecting the discharge side of the heater radiator 52 with the connection 15 between the cooling radiator 12 and the pump 16. To connect the by-pass tube or conduit 90 to the check valve 40 the plug 46 is provided with a central bore 101 into which the corresponding end of the tube 90 may be connected as by threading. The bore 101 which leads into the hollow interior 42 of the valve body 41 on the down stream side of the flapper valve 43, is enlarged as at 102 to provide a shoulder 103. The lower end of the bore 101 is closed by an apertured plug 104 which provides a seat for the ball valve 105 which in turn, is constantly urged toward seated position by means of a coil spring

106 maintained under compression between the ball 105 and the shoulder 103. Steam from the generator 21 may thus pass from the discharge end of the generator past the ball valve 105 and through the duct 90 to the return line 56 and thence back to the cooling system of the engine without having passed through the heater radiator 53. In this manner, under those conditions of engine operation at which steam formed in the generator 21 is liable to be of a super-heated nature, a sufficient volume of such steam may be discharged directly from the steam generator to the engine cooling system without having passed through the heater radiator 52, and where the mechanism is properly proportioned and adjusted the amounts of super-heated steam thus left to be fed to the heater radiator 52 will be of such small quantities that the temperature thereof will be immediately reduced to such an extent as not to offer possibility of serious damage to the heater radiator.

It will be understood, of course, that the force of the spring 106 must be such as to prevent the ball valve 105 from lifting from its seat during normal running conditions at which no super-heat occurs and during which the valve 73 on the discharge side of the radiator 52 functions to maintain a positive pressure in the system. Preferably the force of the spring 106 is such as to require a pressure in the system of two or three pounds per square inch greater than that required to lift the valve 73 from its seat, in order for it to operate and by-pass superheated steam directly back to the cooling system for the engine without passing through the radiator 52.

With the above described construction it will be obvious that particularly where the valve 61 maintains a positive pressure on the steam in the generator 21 and heater radiator 52, the interior of the check valve 40 will be subjected to a higher pressure than the pressure existing in the return line 56 which is connected to the suction side of the pump 16. This normal operating pressure differential increases with increased speed of operation of the engine 11 because of increased speed of operation of the pump 16 and consequently the force of the spring 103 may be so arranged that the ball valve 105 will be lifted from its seat to pass steam through the duct 90 only during those speeds of engine operation at which the flow of exhaust gases through the exhaust pipe 20 is of such extent as to cause the steam generated thereby to be super-heated to an undesirable degree. It has been discovered, however, that during those phases of engine operation at which the steam generated in the generator 21 becomes of a highly super-heated nature, relatively violent surges of pressure occur within the steam generator and these surges of pressure are found to be of maximum value between the points where the inlet to the generator 21 extends into the exhaust pipe 20 and the check valve 40. Experiments have shown maximum pressures built up by these surges as high as fifteen pounds per square inch gauge and probably the reason they are greatest on the inlet side of the generator is that the check valve 43 does not permit relief of pressure in its direction as in the case of the by-pass valve 73. It is, therefore, found preferable to employ these surges of pressure which are materially greater than the normal pressure differential existing between the high pressure and low pressure sides of the heating system to actuate the ball valve 105 under such conditions. Ac-

cordingly when these surges occur the ball valve 105 is lifted and a portion of the super-heated steam in the generator 21 is discharged past the ball valve 105 through the duct 90 to the return line 56 where it is drawn by the pump 16 into the cooling system of the engine and is suitably condensed by the lower temperature thereof. The amount of super-heated steam thus fed past the ball valve 105 will depend to some extent upon the force of the spring 103 and accordingly by varying the force of such spring the amounts of super-heated steam thus fed back to the engine cooling system may be governed to a greater or lesser extent. In this manner the amount of steam fed from the generator 21 to the heater radiator 52 during such phases of engine operation may be reduced in volume to such an extent that the high heat content thereof may be dissipated in the radiator at such a rate as to prevent the radiator or parts thereof from becoming equally highly heated. At the same time this smaller amount of heat being fed to the heater radiator 52, because of its relatively high heat content, will still be found to be ample for the purpose of heating the interior of the automobile body to the desired degree. The super-heated steam fed back to the duct 90 and return line 56 to the engine cooling system will, of course, have a tendency to increase the temperature of the cooling fluid in such cooling system, but it will be found that this effect is so small as to be negligible and offers no material problem in this regard.

While but one embodiment of the present invention has been shown in the accompanying drawing various modifications thereof will be apparent to those skilled in the art once the teachings herein are disclosed to them and, accordingly, it will be understood that formal changes may be made in the specific embodiment of the invention described without departing from the spirit and substance of the broad invention, the scope of which is commensurate with the appended claims.

What I claim is:

1. In combination with a water cooling system of an internal combustion engine, a heater radiator, a feed pipe connecting said cooling system and said heater radiator, a steam generator in said feed pipe, a check valve in said feed pipe between said cooling system and said generator for preventing return flow of fluid from the generator to the cooling system through said feed pipe, a return pipe connecting said heater radiator and said cooling system, a conduit communicating at one end with the portion of said feed pipe extending between said check valve and said steam generator and at a point therein closely adjacent said generator and at the other end with said water cooling system independently of said heater radiator, and pressure responsive means in said conduit operable in response to a predetermined pressure differential between the ends of said conduit to pass fluid from said steam generator to said cooling system through said conduit without passing it through said heater radiator.

2. In combination with a water cooling system of an internal combustion engine, a heater radiator, a feed pipe connecting said cooling system and said heater radiator, a steam generator in said feed pipe, a check valve in said feed pipe between said cooling system and said generator, a return pipe connecting said heater radiator and said cooling system, a conduit communicating at

one end with that portion of said feed pipe between said check valve and said steam generator and at a point therein closely adjacent said generator and at the other end with said return pipe, said conduit being subjected to a varying pressure differential between the ends thereof, and pressure responsive means associated with said conduit operable in response to a predetermined pressure differential to pass fluid from said generator to said return pipe through said conduit without said fluid passing through said heater radiator.

3. In an automobile body steam heating system including a steam generator and a body radiator connected in circuit with different portions of the automobile engine cooling system and having a metering device and a check valve in the connection for conducting fluid from the cooling system to the generator, the combination of means responsive to a condition in the system which accompanies excess heating in said radiator for discharging steam from the inlet end of said generator to said cooling system independently of said radiator and without reversing the flow of fluid from said cooling system to said generator.

4. In an automobile body steam heating system including a steam generator and a heater radiator connected in circuit with different portions of the automobile engine cooling system and having a metering device and a check valve in the connection for conducting fluid from the cooling system to the generator, the combination of a duct connecting the inlet end of the generator at a point closely adjacent thereto with the cooling system independently of the heater radiator and a pressure release valve in said conduit operable in response to a condition in the system which accompanies excess heating in said heater radiator for discharging steam from the inlet end of said steam generator to said cooling system through said duct without necessitating its passage through said heater radiator.

5. In an automobile body steam heating system including a steam generator and a body radiator connected in circuit with different portions of the automobile engine cooling system and having a metering device and a check valve in the connection for conducting the fluid from the cooling system to the generator, the combination of means responsive to an increase in pressure in said generator which accompanies excess heating in said heater radiator for discharging a portion of the steam generated by said generator to said engine cooling system without the necessity of passing through said heater radiator, comprising a conduit interposed between the inlet end of said generator and connected thereto at a point closely adjacent to it and said check valve and leading to said engine cooling system independently of said radiator.

6. In an automobile body steam heating system including a steam generator and a body radiator connected in circuit with different portions of the automobile engine cooling system and having a metering device in the connection for conducting fluid from the cooling system to said generator, of means responsive to an increase in pressure in said generator which accompanies excess heating in said radiator for feeding a portion of the steam formed in said generator to said engine cooling system independently of said radiator, including, in combination, a check valve interposed between the inlet end of said steam generator and the feed pipe conducting fluid

thereto from said engine cooling system and permitting feed of fluid through said feed pipe from said engine cooling system toward said generator only, a conduit communicating with the inlet side of said generator between said generator and said check valve and closely adjacent to said generator and communicating at its opposite end with said engine cooling system, and a spring pressed check valve in said conduit permitting flow of fluid therethrough only in the direction from said generator to said cooling system.

7. In an automobile body steam heating system including a steam generator positioned in the path of flow of exhaust gases from the internal combustion engine of the automobile, a heater radiator, a duct for feeding fluid from the engine cooling system to the inlet end of the steam generator, a duct connecting the outlet end of the steam generator with the inlet end of the heater radiator and a duct connecting the discharge side of the heater radiator with the engine cooling system, the combination of a check valve for preventing reversal of flow of fluid from the steam generator to the engine cooling system through the first mentioned duct and positioned in said first mentioned duct in close proximity to point at which the inlet end of the steam generator is first subjected to the effects of the exhaust gases of the engine, a duct communicating at one end with the steam generator on the down stream side of said check valve and connected at its opposite end with said engine cooling system, and a spring pressed check valve in said duct permitting flow of fluid therethrough only in the direction from said generator toward said cooling system.

8. The method of operating an automobile body steam heating system including a steam generator adapted to be subjected to the flow of exhaust gases from an internal combustion engine and a heater radiator connected in circuit between different portions of the cooling system for said engine, comprising preventing the reversal of flow of fluid in the heater system at a point in close proximity to the inlet end of the steam generator and discharging steam from the steam generator directly to the engine cooling system independently of the heater radiator under those conditions of engine operation conducive to the formation of super-heated steam in said steam generator.

9. In an automobile body steam heating system including a steam generator exposed to the flow of exhaust gases from the internal combustion engine of the automobile and a heater radiator connected in circuit with different portions of the engine cooling system, the method of eliminating the deleterious effects of super-heated steam formed in the steam generator upon the heater radiator comprising preventing the reversal of flow of fluid through the heater system at a point in close proximity to the point at which the inlet end of the steam generator is first subjected to the effects of said exhaust gases, and automatically by-passing steam from the steam generator to the engine cooling system around the heater radiator during substantially only those periods of engine operation conducive to the formation of super-heated steam in said steam generator.

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