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T. O. THEOBALD
STEAM HEATING SYSTEM

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2 Sheets-Sheet 1

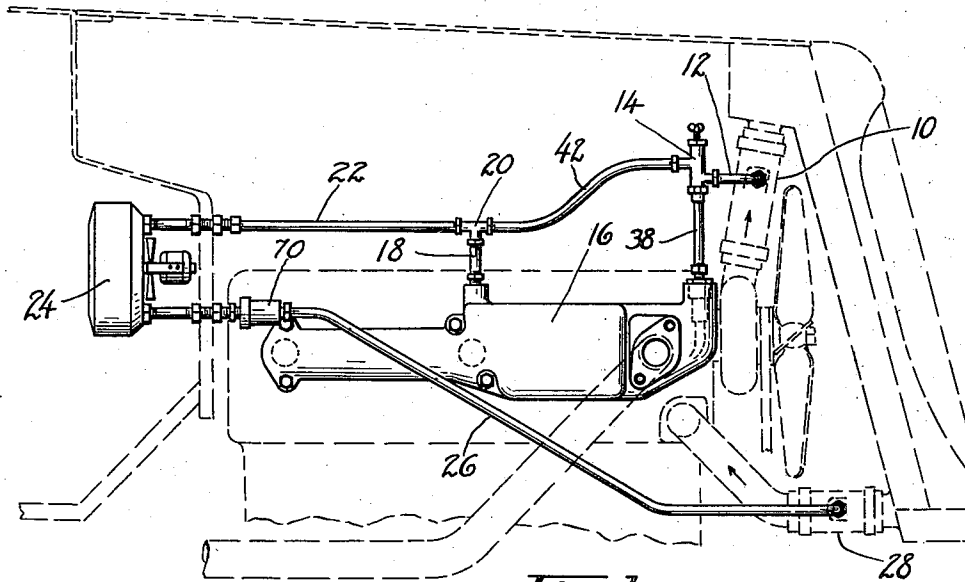


Fig. 1

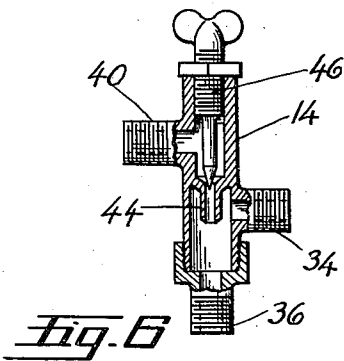


Fig. 6

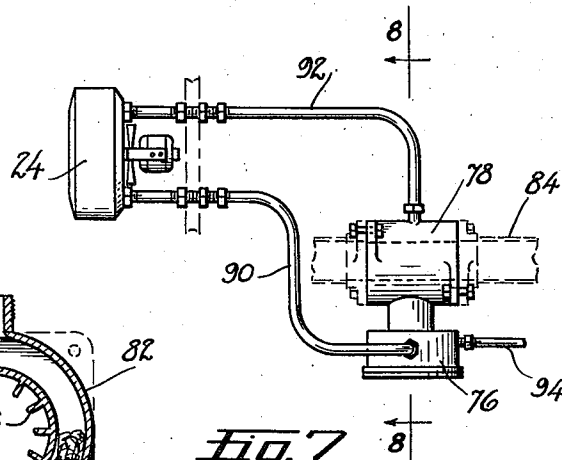
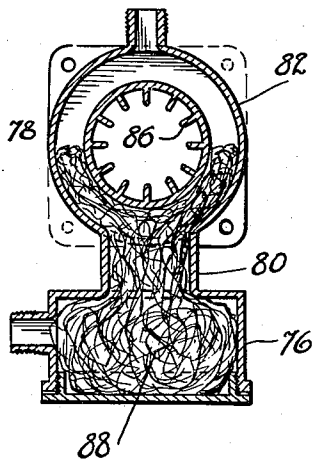


Fig. 7

Fig. 8

Fig. 5a



INVENTOR.
THOMAS O. THEOBALD
BY *R. L. Underwood*
ATTORNEY.

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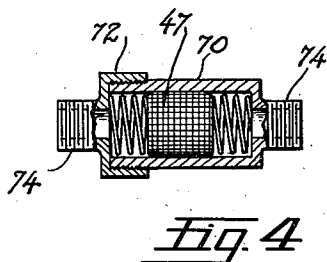
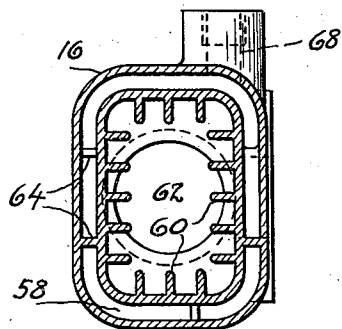
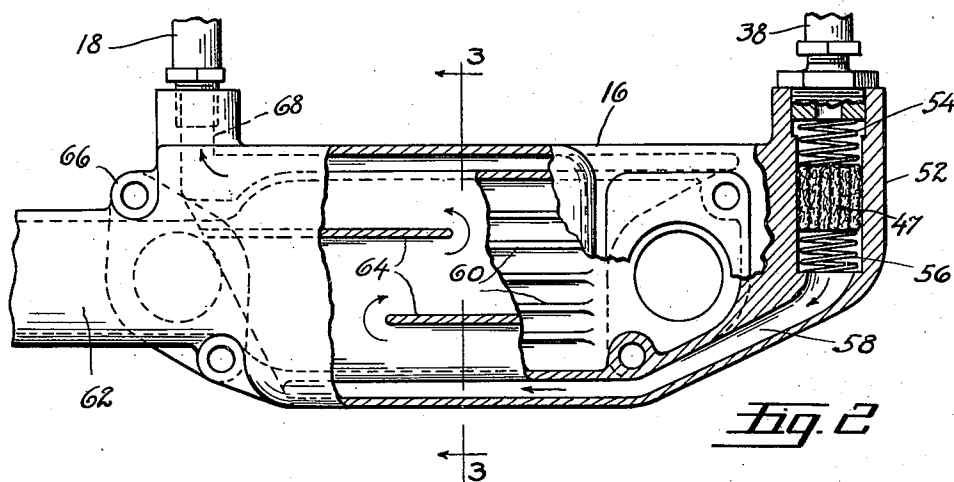
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INVENTOR.
THOMAS O. THEOBALD
BY *R. L. Underwood*
ATTORNEY.

UNITED STATES PATENT OFFICE

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STEAM HEATING SYSTEM

Thomas O. Theobald, Detroit, Mich.

Application January 2, 1935, Serial No. 148

4 Claims. (Cl. 237—12.3)

My invention relates to an improved steam heating system and has particular reference to controlling the direction and volume of steam and water flow within a steam heating system. Since certain problems involved are most pronounced and particularly difficult in designing steam heating systems adapted for automobiles, such a system has been disclosed by way of illustration.

The system includes broadly a source of vaporizable fluid, a boiler, and a condensing radiator or heater with appropriate passages connecting the units whereby the fluid is vaporized in the boiler, fed into the condensing radiator, condensed and returned to the source of vaporizable fluid. One of the most important problems involved resides in maintaining and controlling the direction of steam flow as the same is generated in the boiler. Particularly is this true with such a system as is disclosed herewith, since the irregular and sudden movements of the automotive vehicle create back pressures and surge effects within the system which do not occur in an ordinary stationary steam heating system.

Another important phase of the invention resides in controlling the volume of fluid feed to the boiler, such control likewise being particularly difficult to obtain in a system subject to the sudden movements explained above.

A further difficulty, encountered in steam heating systems wherein exhaust gases of the engine are relied upon as a source of heat, resides in the fact that the temperatures of the gases are tremendously varied due to the varying loads to which the engine is subjected. This fact renders it difficult to design a boiler of proper variable capacity for use in conjunction with such a heating source.

Hitherto it has been customary to use a mechanical control in the system, with the aid of check valves and perhaps a by-pass. Experiment has shown these to be unsatisfactory and I have devised a means of using natural laws of flow resistance as applied to fluids (gas and water) to obtain proper volume and directional control. This means is in the form of a plug positioned in the inlet conduit of the boiler, between the source of fluid supply and said boiler, such plug being so constructed and arranged that liquid can pass therethrough in both directions while at the same time constituting a substantial barrier to the flow of steam back to the source of fluid supply.

There are two general types of automotive steam heating systems in use today. They are:

(1) The auxiliary system in which the engine cooling liquid is diverted into a boiler (installed in the exhaust system), then fed through the car heater (condenser) and returned to the cooling system.

(2) The independent system in which a fixed amount of liquid is continually re-circulated in the car heating system, no connection existing with the engine cooling system.

The problems of controlling the auxiliary system are more difficult than those encountered with the independent system.

The auxiliary system necessitates control over the injection pressures developed by the engine water pump; it also requires directional control to prevent back pressures in the boiler from being transmitted through the injection system, and finally it requires careful flow metering to prevent "starving" of the boiler at high speeds.

The combination of these factors presents many difficulties. A system which uses mechanical check or feed valves to accomplish the desired result can be made to work providing the system is absolutely clean. However, after short periods of operation, scale and rust from the boiler and the engine cooling system tend to render these valves inoperative. In addition, it is extremely difficult to make a mechanical valve which will endure under the high temperatures encountered in a steam system of this type.

The improved arrangement devised by me for overcoming these difficulties is applicable to either of the two general types of systems above specified. It consists in substituting for the mechanical valve arrangements hitherto used a control plug which is composed of a substance which will retain a body or quantity of liquid to form a substantial barrier to the flow of gases or vapors and at the same time function as a metering device for the flow of liquid to the boiler. In other words, I propose to control the fluid flow within the system by blocking the boiler feed passage with a substance which will permit the passage of liquid therethrough but at the same time be substantially impervious to the passage of steam generated by the boiler.

Various other important phases of the invention will be apparent from the following description taken in conjunction with the drawings, wherein:

Figure 1 is a diagrammatical illustration of an auxiliary automobile steam heating system, Fig. 2 is a sectional view, partly broken away, of the boiler portion of my improved manifold, Fig. 3 is a section through line 3—3 of Fig. 2, Fig. 4 is a section through my control plug.

Fig. 5 illustrates another form of plug per se, Fig. 5a illustrates still another form of plug, Fig. 6 is a section through the injector feed control valve,

Fig. 7 is an elevation of an independent system, and

Fig. 8 is a section through line 8—8 of Fig. 7.

Referring first to Fig. 1 wherein my improved steam heating system is associated with a con-

ventional automobile engine cooling system, the boiler feed is taken from the hose connection 10 on the exhaust or pressure end of the engine cooling system. The water then passes through the conduit 12 and injector feed control valve 14 to the boiler 16. The steam generated therein passes up through conduit 18 to a T-fitting 20 and thence through conduit 22 to the intake side of the condenser radiator 24. It is there condensed and the water flows back through return line 26 to the intake hose connection 28 on the suction side of the engine cooling system.

I have described briefly above the broad operation of the system, these steps being common in all automobile steam heating systems wherein the source of vaporizable fluid is taken from the engine cooling system. As hitherto stated, an important phase of the invention is to maintain a proper volume feed to the boiler and maintain the proper directional flow of steam as the same is generated.

The injector flow control valve is illustrated clearly in Fig. 6. It is provided with intake passage 34 and outlet passage 36 to which the conduit 12 and the boiler feed conduit 38 respectively are connected. It is also provided with a passage 40 to which is connected conduit 42 extending from the T-fitting 20. The steam generated in the boiler 16, upon reaching the T-fitting 20, will have a tendency to split its flow, a portion going through conduit 22 to the condensing radiator and a portion going through conduit 42 which is connected with the valve 14. This valve is provided with an injector nozzle 44, the orifice of which is regulated by means of the needle valve 46. This orifice is adjusted in such a way that sufficient steam is permitted to pass therethrough, the major portion generated going through the conduit 22 to the condensing radiator 24. However, that portion which is permitted to pass through the orifice functions as a steam injector regulating the flow of water through the valve to the boiler via the feed conduit 38, thereby controlling the steam temperature.

To control the flow of fluid into the boiler and condense any steam which might tend to flow back through the boiler feed line, a so-called control plug is placed between the source of fluid supply and the boiler. As stated, this plug is so constructed and made of such material that it functions to permit some of the liquid in the feed line to pass through and feed water to the boiler as rapidly as the latter generates the steam, at the same time forming a substantial barrier to the passage of steam from the boiler side.

For the system illustrated I have designed a boiler which is particularly efficient for the desired purpose and have positioned adjacent the intake thereof such a control plug 47. While this plug may be inserted at any point in the boiler feed line it is believed that the form illustrated is desirable. The plug may be composed of loosely packed cotton or asbestos, or such material may be encased in a wire screen to retain the packing in proper shape. In the preferred form illustrated in Fig. 5 the plug has been made by rolling a layer of relatively fine copper mesh screen 48 and a layer of asbestos 50 into cylindrical form. This plug constitutes a filter or strainer as well as a control plug. It may be composed of all fine mesh screen, either in flat face-to-face layers, as illustrated in Fig.

5a, or rolled, or alternate layers of screen and asbestos material. The form is not of the essence, but rather the function of the plug in blocking the boiler feed passage and controlling the boiler feed, as well as the back surge of steam generated in the boiler. It is important to note that such a plug is tantamount to a control valve in which the feed liquid is trapped by the phenomenon commonly termed surface tension. Due to well known physical laws governing the resistance offered by it to the flow of liquid and gas or vapor, respectively, it will permit liquid to pass in both directions, but provides a barrier or check valve preventing the passage of steam therethrough.

This plug may be positioned in the boiler intake 52 (see Fig. 2) and is seated between two coil springs 54 and 56 to permit a pulsating movement of the plug within the passage. The springs tend to maintain the plug in a balanced floating position and permit the pulsating vibratory movement which is caused by the uneven or surging flow of water through the boiler feed line 38 into the boiler. This pulsating movement has a tendency to maintain the plug clean and eliminate any sediment or foreign matter which may tend to clog the same, thereby impeding the flow of water therethrough. Satisfactory operation is obtained, however, when the plug is fixedly positioned in the feed line.

Referring now more particularly to the improved boiler 16 disclosed in detail in Fig. 2, a portion of a conventional exhaust manifold has been jacketed and finned to provide the proper heat transfer surfaces for the water flowing in through the plug into the boiler intake passage 58. Heat transfer fins 60 extend along the interior of the boiler at regular spaced intervals and are located in the exhaust passage 62. The water passes into and around the jacketed portion of the boiler, two longitudinally extending baffles 64 being provided to stagger the direction of flow and secure the greatest efficiency of the heat transfer surfaces provided. As illustrated this boiler has been constructed integrally with the exhaust manifold and the entire unit is bolted to the engine block through ears 66 in the customary manner.

Steam generated in the jackets passes out the steam exhaust opening 68 into the conduit 18 which leads to the T-fitting 20.

As already explained, the steam passes through the conduit 22 into condensing coils of radiator 24. In the return line 26, and preferably closely adjacent the outlet passage of condenser 24 I may insert a second plug 70. While no particular form of plug is essential to its operation in this position, I have illustrated in Fig. 4 a cylinder open at one end and provided with a threaded cap 72. The closed end of the cylinder and the cap 72 are provided with externally threaded nipples 74 by which the plug assembly may be readily inserted between the return conduit 26 and the condenser 24. Within the casing formed by cylinder 70 I have positioned a plug 47, constructed as already described. The insertion of this plug in the return conduit insures complete condensation of the steam passing through the coils of condenser 24 and prevents any steam getting in the cooling system to evaporate any anti-freeze or liquid therein.

The use of plug 70 in the return line is not essential to the successful operation of the system. The control plug 47 functions as a pressure

reducer and flow metering device, as well as a back check valve. The water flow to the boiler is impeded by passing through the control plug, so that the desired flow may be obtained. When the water contacts the boiler, and steam is generated, the plug resists the back passage of steam in such a manner that the steam tends to exhaust itself from the free end of the boiler. Any steam which tends to flow back is condensed by contact with the relatively cool surface of the plug, the plug being maintained at a relatively low temperature by reason of the engine cooling liquid with which it is saturated.

It will be apparent that this plug is superior to any type of mechanical or thermostatic back check valve because there is no mechanical or hysteresis lag in its operation. This is especially important in considering the effect of sudden acceleration or deceleration of the car, under which conditions a mechanical or thermostatic valve permits a quantity of water to flood the boiler, or escape from the boiler due to the hysteresis lag. This, of course, results in terrific boiler stresses due to the sudden change in boiler temperature. With the plug, however, the checking action is practically instantaneous, thus assuring uniform operation whether the car is in constant motion or is suddenly accelerated or decelerated.

From the foregoing it will be apparent that, when such an automobile heating system as has been described and illustrated herein is started and the boiler is flooded, water can be discharged back to the source of supply whereas no such flow will be permitted if an ordinary check valve is used.

In Figs. 7 and 8 I have illustrated a somewhat modified form of steam generating system which differs as to structure but is essentially the same in so far as the most important phases of the invention are concerned. Here, instead of using the cooling fluid of the engine cooling system as a source of vaporizable liquid, I provide a separate and independent source. In this arrangement, already specified generally as the independent type of system, the plug material also functions as a wick to feed the boiler by capillary action, dependent on surface tension, in accordance with its needs. A small cylindrical reservoir 76, of sufficient fluid capacity, is positioned closely adjacent a boiler 78 and connected thereto by a passage 80. While the form of boiler used is not of paramount importance, a jacket 82 surrounding the exhaust pipe 84 and provided with internal heat transfer fins 86 has been found satisfactory. The reservoir 76 containing the vaporizable fluid has sufficient plug material 88 to function as a capillary feed to boiler 82. This material extends up through the passage 80 and partially into the boiler, here illustrated as diverging somewhat into the jacketed steam chamber surrounding the exhaust pipe. The reservoir 76 is connected by means of conduit 90 with the outlet end of condensing radiator 24. The upper or steam dome portion of the boiler 78 is connected through conduit 92 to the upper leg or intake of the condensing radiator.

It will be apparent that, with this arrangement, material 88 will function precisely the same as does the wick of an oil lamp in drawing up moisture from the reservoir 76 into the boiler 78, the steam being there generated to pass on to and through the condensing radiator. The

boiler feed will be automatically controlled in accordance with the temperature of the boiler and as the fluid is vaporized more rapidly the feed to the boiler will become more rapid. The control is automatic. Any steam passing down through the return conduit 90 will be condensed in the reservoir 76 on contact with the moist or saturated material 88. The conduit 94, extending from reservoir 76, can be used as an air vent or plugged to form a closed system. It can also be connected to a water supply, thereby forming an automatic water feed.

I have described preferred forms of the invention, and other modifications thereof will be apparent. However, I wish to limit myself only within the scope of the appended claims.

What I claim is:

1. In combination with a heating system including a source of liquid supply, a boiler, and a feed line from said source to said boiler, a fluid control plug inserted in said line so constructed and arranged as to substantially bar the passage of gases or vapors therethrough while permitting liquid to pass.

2. In an automobile having a forced feed liquid engine cooling system, a steam heating system including in combination a boiler arranged to receive heat from the exhaust gases of the engine, a radiator condenser, a liquid feed conduit extending from said engine cooling system to said boiler, a plug inserted in said feed line so constructed and arranged as to substantially bar the passage of gases or vapors therethrough while permitting liquid to pass, a conduit between said boiler and said condensing radiator, and a return conduit from said radiator to said engine cooling system.

3. In an automobile having a forced feed liquid engine cooling system, a steam heating system including in combination a boiler arranged to receive heat from the exhaust gases of the engine, a radiator condenser, a liquid feed conduit extending from said engine cooling system to said boiler, a plug inserted in said feed line so constructed and arranged as to substantially bar the passage of gases or vapors therethrough while permitting liquid to pass, a conduit between said boiler and said condensing radiator, a return conduit from said radiator to said engine cooling system, and a second plug similarly constructed and arranged inserted in the return line between the radiator condenser and the engine cooling system.

4. In an automobile having a forced feed liquid engine cooling system, a steam heating system including in combination a boiler arranged to receive heat from the exhaust gases of the engine, a radiator condenser, a liquid feed conduit extending from said engine cooling system to the boiler, a return conduit from said radiator to said engine cooling system, a conduit from said boiler to said radiator, a steam injector chamber having a nozzle opening into said feed conduit, a branch conduit extending from said boiler-radiator conduit to said steam injector chamber, means for varying the orifice of said nozzle, and a plug inserted in said feed line between the injector nozzle and the boiler so constructed and arranged as to substantially bar the passage of gases and vapors therethrough while permitting the passage of liquid.

THOMAS O. THEOBALD.