

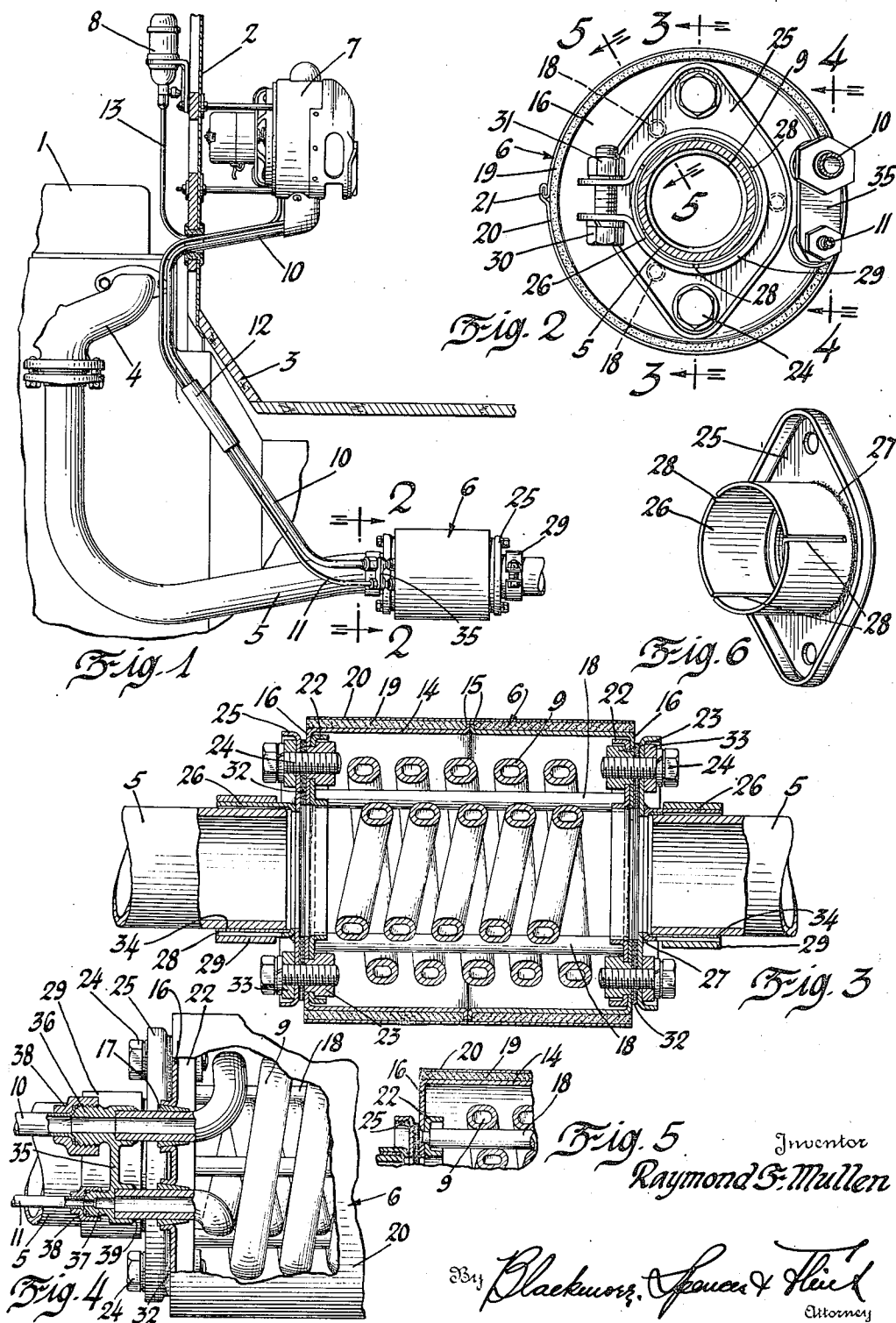
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STEAM BOILER FOR CAR HEATERS

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## UNITED STATES PATENT OFFICE

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## STEAM BOILER FOR CAR HEATERS

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8 Claims. (Cl. 257—241)

This invention relates generally to a steam generator or boiler which is particularly adapted for use in heating systems for motor vehicles in which the waste heat from the exhaust gases of the internal combustion engine is utilized to generate steam which is supplied to one or more heating units to heat the vehicle and in which the steam is condensed and the condensate returned to the steam generator or boiler.

One object of this invention is to provide a boiler which may be readily mounted in the engine exhaust pipe and function essentially as an integral part thereof for the passage of exhaust gases therethrough.

A further object is to provide a boiler which will withstand exhaust heat indefinitely and afford a rapid transfer of heat from the exhaust gases to the heating medium in the boiler without setting up any appreciable resistance to the passage of the exhaust gases.

A still further object is to provide a universal boiler with adapters of varying sizes for installations in standard exhaust pipes of different diameters.

Other objects and the advantages of this invention will appear from the following description of the embodiment of the invention which is illustrated by way of example in the accompanying drawing, in which:

Figure 1 is a diagrammatic side elevation of a heating system as applied to an automotive vehicle.

Figure 2 is an enlarged vertical section taken on line 2—2 of Figure 1 showing one end of the boiler and its mounting in the engine exhaust pipe.

Figure 3 is a central vertical section of the boiler and its mounting taken on line 3—3 of Figure 2.

Figure 4 is a fragmentary side elevation of the boiler with parts broken away on line 4—4 of Figure 2.

Figure 5 is a fragmentary detail section on line 5—5 of Figure 2.

Figure 6 is a perspective view of one of the adapters for mounting the boiler.

The heating system in Figure 1 has been illustrated as merely an example of one system in which the steam generator or boiler which constitutes the present invention may be used for heating an automotive vehicle, and it will be obvious that the boiler not only is capable of use in other heating systems of this general character but may be variously applied in any system

wherein it is desired to utilize heat from the engine exhaust gases for heating purposes.

There has therefore been shown diagrammatically only those parts of the usual automotive vehicle and the heating system which are necessary for an understanding of one application of the steam generator or boiler. The internal combustion engine is indicated generally at 1 in the engine compartment which is separated from the body compartment in the usual manner by the dash 2 and floor boards 3. This engine includes the usual exhaust manifold 4 and exhaust pipe 5 and in this and other respects may be generally similar to standard practice.

The principal parts of the heating system which is more fully described and claimed in my copending application S. N. 714,365, filed March 7, 1934, consist of the steam generator or boiler unit indicated generally at 6, which is the subject of the present invention, a heater unit indicated generally at 7 within the body compartment, and a pressure control unit indicated generally at 8 within the engine compartment. The boiler unit 6 is provided with a steam forming chamber in the form of a tube 9 in which steam is generated by heat transfer from exhaust gases to the heating medium or liquid and this steam is supplied to a radiator condenser in the heater unit 7 through the steam supply conduit 10 and the condensate returned to the tube 9 through the condensate return conduit 11 which is of smaller diameter than conduit 10 with a connection 12 between these conduits intermediate the boiler unit and heater unit to facilitate the proper circulation of the heating medium as is fully set forth in the copending application referred to above. As is also more fully described in said copending application, the pressure control unit 8 includes a closed chamber which is connected to the radiator of the heater unit 7 by a conduit 13 and functions to automatically regulate the amount of heating medium in circulation between the boiler and radiator to prevent the development of excessive pressures in the heating system.

Referring now to the details of the boiler unit 6, the cylindrical metal case 14 for the tube 9 is adapted to be mounted in the manner hereinafter described between sections of the exhaust pipe 5 so as to constitute, in effect, an integral part of the exhaust pipe for the passage of exhaust gases and the contact thereof with the boiler tube 9. As shown in Figure 3, this case 14 may be conveniently constituted by two parts welded together at abutting flanges 15 and each of these

parts is provided with an end wall 16 having a central opening of substantially the same diameter as the exhaust pipe.

It should be noted that the diameter of the cylindrical boiler case 14 is somewhat greater than that of the exhaust pipe 5 so that the boiler tube 9, which is formed into a double coil to provide a large surface contact with the exhaust gases, does not cause excessive back pressure in the exhaust line. The ends of the tube 9 are extended through outwardly flared openings in one of the end walls 16 of the case 14 for the connection of the conduits 10 and 11, and the tube may be anchored in these openings by the tapered steel bushings 17 which are slotted for a portion of their length and adapted to be forcibly wedged between said openings and the tube 9 as shown in Figure 4, and then preferably welded within said openings.

It is not essential that the tapered steel bushings 17 be used and it is contemplated that the outwardly flared openings in the end wall may be made only large enough to receive the tube 9 which may then be secured directly to the end wall by silver soldering around said openings.

The boiler tube 9 is mounted in the case 14 by a plurality of support rods 18 riveted at their ends to the end walls 16 of the case. The rods 18 are preferably tapered slightly from one end to the other and are forced or wedged between the inner and outer coils of the boiler tube 9 to function both as a support and a spacer between the coils of the boiler tube, which may be initially formed with the space between the inner and outer coils slightly smaller than the diameter of rods 18.

To prevent heat radiation, the cylindrical wall of the boiler case 14 is surrounded by insulation 19, such as asbestos board, which is enclosed by a thin sheet metal jacket 20 secured thereon by a crimped joint 21.

Within each end wall 16 of the boiler case 14 is secured, as by spot-welding, a flanged reinforcing bracket 22 through which the reduced ends of the support rods 18 may extend as shown in Figure 5. As will appear from Figure 3, each of the brackets 22 is formed with a central opening corresponding to the opening in the adjacent end wall 16 and opposite enlarged portions of each bracket are provided with openings for the reduced ends of screw-threaded nuts 23 which may be welded to the bracket and extend through similar openings in the adjacent end wall to receive the mounting bolts 24.

The mounting bolts 24 pass through openings in a separate mounting flange or adapter 25 at each end of the boiler case 14. Each mounting flange or adapter 25 is formed with a central opening and provided with a sleeve 26 which may be integral therewith or welded thereto at 27 as shown in Figures 3 and 6. The sleeve 26 is adapted to fit around the adjacent end of the exhaust pipe 5 and is provided with slots 28 whereby the same may be contracted into tight engagement with the exhaust pipe by the split band or clamp 29 which fits around the slotted sleeve 26 with the bolt 30 and nut 31 to draw the free ends of this clamp towards one another.

A copper covered asbestos gasket 32 is preferably interposed between each adapter 25 and the adjacent end wall of the case 14, and spacers 33 may be provided on the mounting bolts 24 to position the heads of these bolts outside the adapter flanges where they may be readily engaged by a wrench. To take care of minor variations in exhaust pipe diameters, a thin, slotted bushing 34

may be interposed between the adapter sleeve 26 and the exhaust pipe 5.

It was stated hereabove that the ends of the boiler tube 9 extend through one of the end walls 16 of the case 14 for the connection of the conduits 10 and 11. As is shown in Figure 4, the ends of the boiler tube terminate outside of the end wall 16 where they are connected together by the single fitting 35 which is provided with the screw-threaded terminals 36 and 37, respectively, for the connection of the conduits 10 and 11 by means of the nuts 38 adapted to draw flared ends on these conduits into leak-proof engagement between angular seats on the nuts and the terminals. The tube ends are preferably secured to the fitting by silver solder 39 and are placed in communication with the conduits 10 and 11 by passages through the fitting of which that leading to conduit 11 is reduced in cross section to correspond with the smaller diameter of this conduit.

It should be noted that the fitting 35 serves to distribute any strain between both ends of the boiler tube such as might be placed thereon during tightening of the conduit connections, and that the ends of the boiler tube are vertically spaced with the terminal connection to the steam supply conduit 10 above the terminal connection to the condensate return conduit 11 so as to facilitate the proper circulation of the heating medium through these conduits.

The boiler tube 9 is formed into the double coil from a single length of seamless tubing of oxygen-free or deoxidized copper having a soft temper. A copper tube with these characteristics may be readily coiled and has been found to withstand exhaust heat and the corrosive effect of exhaust gases indefinitely without leakage or any appreciable change in the amount of heat transfer from the exhaust gases to the heating medium.

It will be apparent that a single coil of tubing may be used but this would require a much greater overall length of the boiler unit to obtain the same surface area as is afforded by the double coil. It should be noted that the inner coil of the boiler tube in the illustrated form is of smaller diameter than the exhaust pipe so that it lies partly in the direct path of the exhaust gases which expand within the boiler case into contact with the outer coil. If desired, however, a baffle plate in the form of a disc or cone may be located within the inner coil to prevent the direct passage of exhaust gases therethrough and positively deflect gases outwardly through both coils of the boiler tube.

The boiler described above may be assembled and mounted in the exhaust pipe in the manner to be now described. The reinforcing brackets 22 with attached nuts 23 are first welded within the ends of the two parts of the case 14 and the support rods 18 riveted to the end wall 16 of that part of the case through which the ends of the tube 9 are to extend, after which this part of the case may be assembled with the tube 9 by forcing the rods 18 between the outer and inner coils of the tube until the ends of the tube extend through the end wall of the case and may be either anchored thereto by the tapered bushings 17 or welded directly thereto. The other part of the case may then be assembled, the abutting flanges 15 on the two case parts welded together and the rods 18 riveted to the end wall 16 of said other part. The fitting 35 is then silver soldered on the ends of the boiler tube 9, and the insulation 19 and jacket 20 placed around the boiler case 14.

To install the boiler, a horizontal section of the exhaust pipe of slightly greater length than the boiler case 14 is first removed by sawing at the proper points, and preferably as close as possible to the curved portion of the exhaust pipe leading to the exhaust manifold. The mounting flanges or adapters 25 with their split bands or clamps 29 are then placed over the adjacent ends of the cut-off exhaust pipe facing in opposite directions, after which the boiler case, etc., is placed between these ends with the larger terminal 36 on the fitting 35 at the top and the adapters 25 are moved towards the end walls of the boiler case and connected thereto (after inserting the gaskets 32) by the bolts 24, and the slotted sleeves 26 of the adapters clamped on the exhaust pipe by contracting the split bands or clamps 29. The boiler unit may then be connected to the heating system by securing the conduits 10 and 11 to the respective terminals 36 and 37.

The mounting flanges 25 have also been called adapters because they may be provided in several sizes for installation in exhaust pipes of different diameters without requiring any change in other elements of the boiler unit, in which the aligned central openings in the reinforcing brackets 22, end walls 16 of the case 14, and gaskets 32 should be substantially the same diameter as the largest exhaust pipe in which the unit may be installed. The adapters 25 for installation in different exhaust pipes would be identical with that shown in Figure 6 of the drawing except for the diameter of the sleeves 26 which are adapted to be clamped about the exhaust pipe, and to reduce the number of adapter sizes that might be necessary for all installations, the relatively thin bushings 34 may be used for minor variations in diameter.

The present boiler unit has been particularly designed for ready installation in the manner set forth above with separate adapters of different sizes for the majority of present cars which have exhaust pipes varying in diameters from  $1\frac{3}{4}$  to  $2\frac{1}{4}$  inches. With larger exhaust pipe sizes, such as the standard  $2\frac{1}{2}$  inch diameter, it has been found that the increased size of the sleeves 26 on the adapters 25 with the clamps 29 around these sleeves makes it practically impossible to use the mounting bolts 24, so instead of providing separate adapters and installing the boiler unit as heretofore described, the mounting flanges may be secured to the end walls of the boiler case, as by welding, prior to installation. Then to insert the boiler unit in a cut-out portion of the exhaust pipe, it is necessary to disconnect one of the exhaust pipe sections from either the exhaust manifold or the usual muffler and separate these sections sufficiently to place the boiler in position and then move the sections towards one another to slide the adjacent cut ends into the sleeves 26 on the mounting flanges and then contract these sleeves by the clamps 29.

The above described mounting detail has not been specifically shown in the drawing, but it should be understood that in this detail and other details, the structure and mounting shown and described may be variously changed and modified without departing from the spirit and scope of my invention as set forth in the following claims.

I claim:

1. The combination with an exhaust pipe, of a

boiler adapted to be interposed therein having a casing for the passage of exhaust gases there-through, and a boiler tube in said casing extending in a double coil around the longitudinal axis of said casing with the inner coil of said boiler tube of smaller diameter than the exhaust pipe in which said boiler is interposed.

2. The combination with an exhaust pipe, of a boiler adapted to be interposed therein having a casing for the passage of exhaust gases there-through, a boiler tube in said casing with its ends extending through flared openings in said casing to provide for external connections thereto, and tapered friction bushings between said tube and the openings in said casings.

3. The combination with an exhaust pipe, of a boiler adapted to be mounted therein including a casing with end walls having openings for the passage of exhaust gases therethrough, a boiler tube in said casing, and reinforcing means on said end walls to receive detachable means for mounting the boiler.

4. The combination with an exhaust pipe section, of a boiler including a casing and a boiler tube in said casing, and means to secure said boiler to the end of said exhaust pipe section to provide for the passage of exhaust gases through said casing including an adapter which may be detachably secured to said boiler casing and is provided with a clamping sleeve of the proper diameter to fit closely around said exhaust pipe section.

5. The elements set forth in claim 4, in which said boiler casing is so formed as to provide for the connection thereto of any one of a plurality of adapters having clamping sleeves of different diameters to be secured to exhaust pipe sections of different diameters.

6. The combination of an exhaust pipe, of a boiler adapted to be interposed therein having a casing for the passing of exhaust gases there-through and a steam generating chamber in said casing comprising a reentrant coiled tube having both of its ends extending outside of the casing adjacent each other at one end thereof and reinforcing means connecting the said two ends outside of the end wall to space and reinforce the ends and to support the coil within the chamber.

7. The combination of an exhaust pipe, of a boiler adapted to be interposed therein having a casing for the passing of exhaust gases there-through and a steam generating chamber in said casing comprising a reentrant coiled tube having both of its ends extending outside of the casing adjacent each other at one end thereof and means on the end of the tube for connecting conduits thereto of different diameters.

8. The combination of an exhaust pipe, of a boiler adapted to be interposed therein having a casing for the passing of exhaust gases there-through and a steam generating chamber in said casing comprising a reentrant coiled tube having both of its ends extending outside of the casing adjacent each other at one end thereof and means connecting the ends of said tube outside the end wall, said means providing terminals for the connection of conduits thereto and with passages placing said conduits in communication with the tube.

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