Sept. 16, 1930. F. C. MATTHAEI 1,775,939

AUTOMOBILE HEATER

Filed Jan. 28, 1927

Fig. 1,

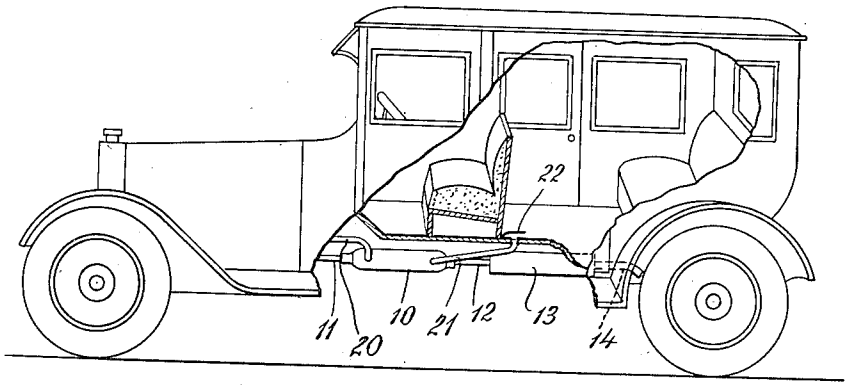


Fig. 2,

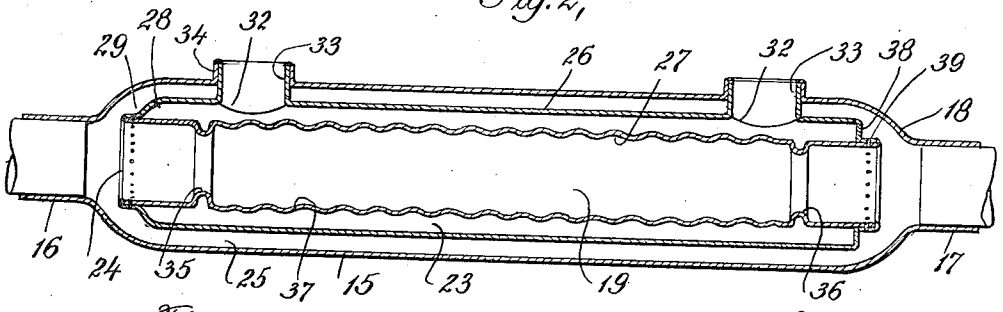


Fig. 3,

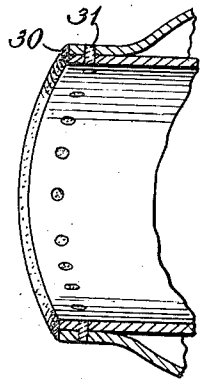


Fig. 4,

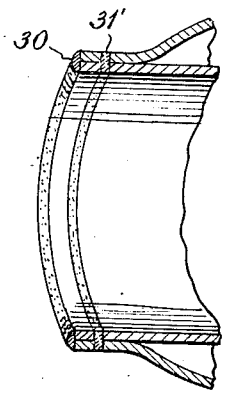
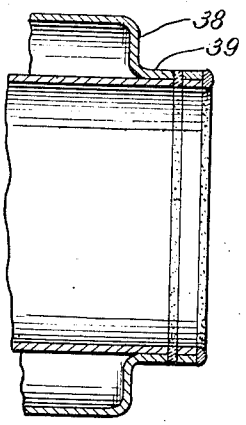


Fig. 5,



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UNITED STATES PATENT OFFICE

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AUTOMOBILE HEATER

Application filed January 28, 1927. Serial No. 164,182.

This invention relates to heating apparatus especially adapted for use in motor vehicles and is concerned more particularly with the provision of a heating device by which the heat carried off in the hot exhaust gases from the motor may be recovered and imparted to a heating fluid such as air which may be used for heating the interior of the vehicle.

In heaters for motor cars, it is essential to provide apparatus which is of simple, rugged construction, so that it will withstand the shocks and jars to which the vehicle is exposed in ordinary use, and when the heat to be supplied to the car is derived from the hot exhaust gases, it is particularly important that the heat transfer elements shall be gas-tight since these gases contain ingredients which are dangerously poisonous. In such an exhaust gas heater, the heating elements are exposed to hot gases under pressure and therefore the gases will immediately mix with the heating fluid if any leakage occurs through the heat transfer walls. Also, unless the heater is properly constructed, the presence of the heating elements in the stream of hot gases will result in the generation of back pressure which greatly reduces the motor efficiency and sometimes results in overheating.

The object of the present invention is to provide heating apparatus of an improved construction suitable for use in motor vehicles and intended to be mounted as an integral part of the exhaust line from the motor. This apparatus is arranged for the free passage of the gases therethrough so that the generation of back pressure is avoided and in addition the parts which confine the air to be delivered into the car body are of particularly rugged construction with gas-tight joints so that no mixing of the air and gases can take place.

The heater of the present invention includes a shell preferably of tubular construction which may be mounted to form a part of the exhaust line, this shell having a neck at one end which is connected to a part of the exhaust pipe leading to the motor and a neck at the other end connected to the usual muffler. The shell is of a larger diameter than the necks and within it is a heater chamber of annular construction having a length not substantially less than that of the shell. For simplicity in construction this chamber is made of a pair of tubes of different diameters, the outer tube having its ends contracted so that they contact with the ends of the inner tube and are secured thereto. The heater chamber has integral necks which pass through the wall of the shell and provide conduits for cold air which enters the chamber at one end and hot air which leaves at the other, and these necks are secured to the shell to provide a support for the chamber, holding it concentrically within the shell. The heating of the air is brought about by the transfer of heat through the chamber walls and the hot gases entering the shell flow through the center of the air chamber and also around the outer tube between that tube and the shell wall.

In order to insure that the two tubes forming the air chamber will be firmly secured together to prevent leakage, the outer tube is contracted at its ends to form straight end portions of reduced diameter which lie in contact with the outer walls of the inner tube and the end edges of the tubes are secured together by welding. In addition, these straight contacting portions of the two tubes are secured together by welding at a distance from the extreme end edges, this second welding being either a circumferential line weld or a spot welding operation with the welded spots at a relatively short spacing circumferentially of the tubes.

I have found that when a car equipped with a heater of this type is started in operation with the parts relatively cold, the initial flow of the hot exhaust gases is primarily through the inner tube of the annular air chamber with the result that heating of the metal of this inner tube takes place at a rate substantially in excess of the rate of heating of the metal of the outer tube. Because of this, expansion of these two parts of the air chamber takes place unequally and unless provision is made for guarding against the effects of such unequal expansion, strains will be set up which may lead to opening of seams

or other cracks and consequent admission of the exhaust gases to the air passage. I therefore give to the inner tube of the air chamber a special construction whereby these ill-effects of unequal expansion are eliminated. The inner tube is provided with a circumferential bead near each end and each bead extends inwardly of the tube to restrict somewhat the freedom of flow of the hot gases through the inner tube and thus cause a larger proportion of the gases to flow through the space between the outer tube and the shell. These beads form take-up or compensating devices for any expansion or contraction of one of the two tubes which is unaccompanied by equivalent expansion or contraction of the other.

In addition, the inner tube is circumferentially corrugated or otherwise provided with expansion bends preferably throughout its length so that expansion and contraction of the inner tube relative to the outer one is absorbed in the bends.

As a further safe-guard, at one end and preferably the end through which the exhaust gases leave the heater shell, the tubes are connected to permit their relative expansion and preferably the outer tube has a portion which is turned inwardly toward the inner tube substantially at right angles thereto and then this inwardly extending portion is turned parallel to the inner tube to form a flange which lies in contact with the inner tube and is secured thereto by the double line of welding above mentioned. This manner of forming the tubes at this end provides additional means for counteracting the effect of unequal expansion which might otherwise tend to cause a separation of the tubes with resultant leakage.

For a better understanding of the invention, reference may be had to the accompanying drawings, in which

Fig. 1 shows a view of the apparatus in place on a motor vehicle,

Fig. 2 is a longitudinal cross-section through the device, and

Figs. 3, 4, and 5 are enlarged sectional views showing the manner in which the ends of the tubes forming the heater chamber are secured together.

Referring now to the drawings, the apparatus generally designated 10 is shown in a form suitable for utilizing hot exhaust gases from the motor to heat air which is passed through the heater and delivered into the interior of the closed car body. The apparatus is mounted beneath the floor of the motor vehicle and connected in the exhaust line. The portion 11 of this exhaust line leads from the motor to the heater, while another portion 12 of the line leads from the outlet end of the heater to the usual muffler 13 through which the gases flow to a tail pipe 14 whence they are discharged to the atmosphere. The heater, instead of being placed in the line in front of the muffler, may be placed to the rear of the muffler, if conditions so require.

The new heater which is constructed so that it may be produced at a low cost and at a high output rate, includes a tubular shell of metal 15 formed of two similar parts secured together longitudinally in the usual way. The shell 15 has a neck 16 at one end by which it is connected to the portion 11 of the exhaust line and another neck 17 at the opposite end, to which the portion 12 of the line is connected. These necks are formed as integral parts of the shell, and the main body of the shell merges smoothly with the necks, as indicated at 18. Within the shell is the heater element 19 through which flows the heating fluid led to the interior of the car. In the heater illustrated, the heating fluid employed is air and the air is led into the heater element 19 through a line 20 which may lead from any convenient point on the vehicle; preferably its forward end is funnel-shaped and is mounted behind the fan. Air entering the pipe 20 enters the heater element 19, flows from one end to the other thereof, and passes out through the line 21 to the register 22 disposed at any convenient part of the vehicle and discharging the air into the interior thereof.

The heater element is in the form of an elongated double-walled chamber providing an annular space 23 through which the air flows. The element is mounted concentrically within the shell to provide a central passage 24 through the interior of the element and an outer annular pasage 25 between the outer wall of the element and the inner shell wall. Through these two passages the hot gases entering the neck 16 flow through the shell to the outlet neck 17 and the cross-sectional area of the passage is somewhat greater than the cross-sectional area of the necks so that the gases may expand slightly within the shell. The heater element must be made air- and gas-tight in order that there may be no mingling of the hot gases with the air which is to be introduced into the interior of the car. This is a matter of particular importance in heaters to be used with automobiles where the gases contain poisonous ingredients such as carbon monoxide. Furthermore, the gases are introduced into the heater at a pressure considerably greater than the air, and consequently any leaks would result in flow of the gases into the air passages. To prevent difficulties from this source, the heater element is made of a pair of tubes 26 and 27 of different diameters, the outer tube 26 having its ends contracted to contact with the ends of the inner tube 27. Forwardly toward the end of the shell at which the gases are admitted, the end 28 of the outer tube 26 is contracted with a smooth curve generally following the curvature of the shell wall.

Then the extreme end of the tube 26 has a straight portion 29 which lies directly in contact with the outer wall of the inner tube. The tubes terminate with their ends in alignment, and their extreme ends are welded together, as indicated at 30, to form a strong autogenous union which is absolutely airtight. In addition the contacting parallel straight portions of the two tubes are further secured together by a line of welding 31 spaced inwardly from the welded edge 30 and the line of welding 31 may either be a continuous line, as indicated in Fig. 4 at 31', or may be a row of welded spots, as shown in Fig. 3. In either case, the combination of the two lines of welding, one at the extreme end of the tubes and one spaced a short distance from the ends, insures that the tubes will be so rigidly secured together that they will not be separated by the incessant shocks and jars occurring during the operation of the vehicle, or by unequal expansion and contraction of the tubes.

The outer tube 26 is provided with openings 32 near its ends and the metal of the tube around these openings is struck up to form integral flanges or necks 33 which pass through the wall of the shell 15 and are secured in position therein in any convenient manner. These necks thus provide a means of mounting the heater element concentrically within the shell and also form conduits for the intake and outlet of the heating fluid. In the construction illustrated, the shell itself has openings defined by outwardly projecting circumferential flanges 34 to which the ends of the necks 33 are suitably secured and to the flanges 34 are secured the ends of the conduits 20 and 21.

The gases entering the shell through the inlet 16 divide and one portion thereof flows through the central passage through the heater element. The other portion of the gases is diverted and flows outwardly and around the heater element between the outer tube thereof and the inner wall of the shell. When the motor is started with the heater cold, the inner tube is raised in temperature more rapidly than the outer tube and consequently expansion takes place in the two tubes unequally. Such unequal expansion of the two tubes is likely to subject the means uniting the tubes to undue strains, and to obviate difficulties which might arise from this source, the inner tube is provided with inwardly extending beads 35 and 36 near the opposite ends thereof. These beads compensate for any excess of expansion of the inner tube without subjecting the connections between that tube and the outer tube to strains. In addition, the beads partially restrict the passage through the inner tube, causing a more equal distribution of the gas flow through the inner tube and the annular passage between the heater element and the shell. As a further safe-guard, the inner tube is circumferentially folded upon itself or corrugated, as indicated at 37, providing additional expansion bends which relieve the tube connections from strains and provide additional heating surface.

In some instances it may be desirable to secure the ends of the tubes together in a manner such that the relatively greater expansion of one tube than the other is further compensated. For this purpose the outer tube at one end, preferably that at which the gases leave the heater, has an inwardly turned flange 38 which merges into a tubular portion 39, which portion lies in contact with the end of the inner tube and is secured thereto by the double lines of welding previously mentioned. With this arrangement, any expansion of the inner tube with reference to the outer tube would result in a slight flexing at the inner and outer edges of the flange 38 and this may take place without causing damage. Giving the heater element the shape indicated at the outlet end of the heater does not result in eddy currents which interfere with the flow of gases to any substantial extent, and by the combination of beads, corrugations, and this manner of forming the end of the heater element, the strains to which the lines of welding securing the parts of the heater element would otherwise be subjected are so thoroughly compensated as to eliminate all danger of injury when raised to operating temperature from a cold state.

It will be seen that in the new heating apparatus the heater element consists only of two parts, namely the inner and outer tubes which are secured rigidly together to prevent gas leakage, and in addition this heater element is rigidly and securely mounted in position within the tubular shell. This mounting does not require additional parts because the metal of the outer tube is used for the purpose, being struck outwardly to form the integral flanges or necks. These necks further provide conduits for the intake and outlet of the heating fluid and avoid the necessity of using bushings or other conduit means to connect the air lines to the heater chamber. The chamber itself is arranged so that its parts are relieved from strain due to unequal expansion and in addition a more even distribution of gas flow through the central and outer passages through the shell is secured. Furthermore, by having the central passage in alignment with the intake neck for the exhaust gases, and having a diameter not substantially less than the intake neck, the development of back pressure is largely avoided. This result is further secured by streamlining the ends of the shell and the forward end of the heater element, thus avoiding eddy currents which would cut down the effective area of the passages for gas flow.

I claim:

1. A heater for use in a motor vehicle, comprising the combination of a shell connected to receive exhaust gases from the motor, an open-center chamber disposed within the shell spaced from the walls thereof to permit the hot gases to flow through and around the chamber, the said chamber being formed of a pair of tubes of different diameters and of the same overall length disposed one within the other, the outer tube being curved smoothly inwardly at one end and rigidly connected to the inner tube, and the outer tube being formed at the other end with a portion extending at an angle to the wall of the inner tube and a terminal portion lying in contact with the wall of the inner tube and secured thereto, and conduits for leading air to and from the space between the tubes through the shell wall.

2. A heater for use in a motor vehicle, comprising the combination of a shell disposed in the exhaust line from the motor to receive exhaust gases, a double-walled tubular chamber disposed within the shell spaced from the walls thereof, one of the walls of the chamber being formed with expansion bends substantially throughout its length to permit relative expansion of the walls, said walls being rigidly connected at one end of the chamber and secured together at the other end by a connection permitting relative expansion of said walls, and air conduits for leading air into and out of the chamber through the shell wall.

3. A heater for use in a motor vehicle, comprising the combination of a tubular shell having necks at either end to be connected in the exhaust line of the motor to lead hot exhaust gases through the shell, a tubular, double-walled chamber mounted within the shell free of the walls thereof to permit the gases to flow through and around the chamber in contact with its walls, the inner wall of the chamber being formed with expansion bends substantially throughout its length, said walls being rigidly connected at one end of the chamber and secured together at the other end by a connection permitting relative expansion of said walls, and air conduits for leading air into and out of the chamber through the shell wall.

4. A heater for use in a motor vehicle, comprising the combination of a tubular shell connected in the exhaust line of the motor to receive hot exhaust gases, a tubular double-walled chamber disposed within the shell concentrically therewith and free of the shell walls, this chamber being formed of a pair of tubes of different diameters and the same overall length, the inner tube having an inner diameter substantially the same as that of the exhaust line in which the shell is connected, and the outer tube being curved smoothly inwardly to meet the end of the inner tube adjacent the end of the shell to which the gases are admitted, the outer tube having a flanged portion at the other end thereof extending at an angle to the axis of the inner tube and a terminal portion connected to said first portion and contacting with and secured to the wall of the inner tube, and air conduits for leading air to and from the space between the tubes through the shell wall.

5. A heater for use in a motor vehicle, comprising the combination of a tubular shell adapted to be connected in the exhaust line of the motor to receive hot gases therefrom, a tubular double-walled chamber disposed within the shell free of the walls thereof, this chamber being made up of inner and outer tubes of different diameters with the inner tube folded upon itself circumferentially to provide expansion bends, the ends of the tubes being connected together by double lines of welding, one of said connections being rigid, the other permitting relative expansion of the tubes, and conduits for leading air into and out of the chamber through the shell wall.

6. A heater for use in a motor vehicle, comprising the combination of a tubular shell having a cylindrical body portion merging into necks of reduced diameter at either end adapted to be connected to the exhaust line for the flow of hot exhaust gases therethrough, a tubular double-walled chamber within the shell free of the walls thereof and having a central passage in alignment with the intake neck, this chamber being made up of an inner and an outer tube of different diameters, with the ends of the outer tube contracted and secured to the ends of the inner tube, the inner tube being formed with circumferential expansion bends substantially throughout its length, and air conduits for leading air into and out of the chamber to be heated by the exhaust gases.

7. A heater for use in a motor vehicle, comprising the combination of a tubular shell for receiving hot gases from the motor, and a double-walled air chamber disposed within the shell free of the walls thereof, this chamber being made up of inner and outer tubes of different diameters with the ends of the outer tube contracted and secured to the ends of the inner tube by double connecting means, one of these connections being rigid, the other permitting relative expansion of the tubes, the inner tube being provided with circumferential bends to absorb the expansion thereof.

8. A heater for use in a motor vehicle, comprising the combination of a tubular shell adapted to be connected to the exhaust line from the motor to receive hot exhaust gases and an air chamber within this shell, this chamber being made up of an inner and an outer tube of different diameters, the

outer tube being contracted at one end and secured to the end of the inner tube, the other end of the outer tube having a flanged portion extending at an angle to the axis of the inner tube and another flanged portion lying parallel to the axis, the second flanged portion being secured to the end of the inner tube.

9. A heater element for use in a motor vehicle heater, comprising a pair of tubes of different diameters placed one within the other, one end of the outer tube being curved smoothly inwardly to meet the outer wall of the inner tube and being secured thereto, the outer tube at its other end having a portion extending inwardly at an angle to the axis of the inner tube and a terminal portion connected to said first portion and extending along the outer wall of the inner tube and connected thereto, the inner tube having circumferential expansion bends, and integral tubular extensions from said outer tube, one near each end thereof.

In testimony whereof I affix my signature.

FREDERICK CARL MATTHAEI.