Sept. 10, 1940. J. M. GWINN, JR 2,214,053

HEAT EXCHANGER

Filed March 10, 1937

Fig. 1

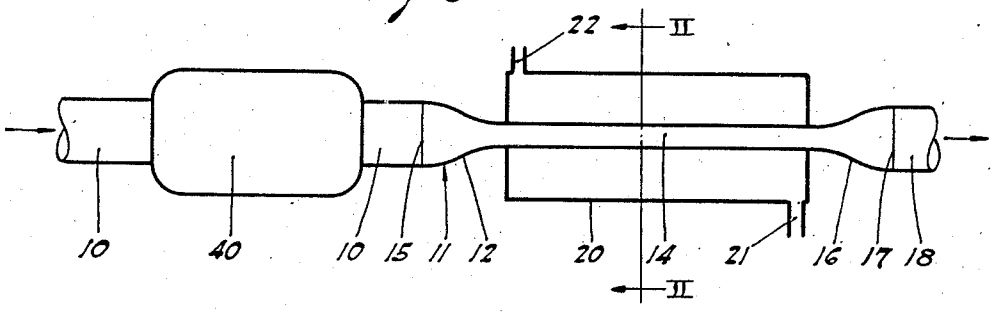


Fig. 3

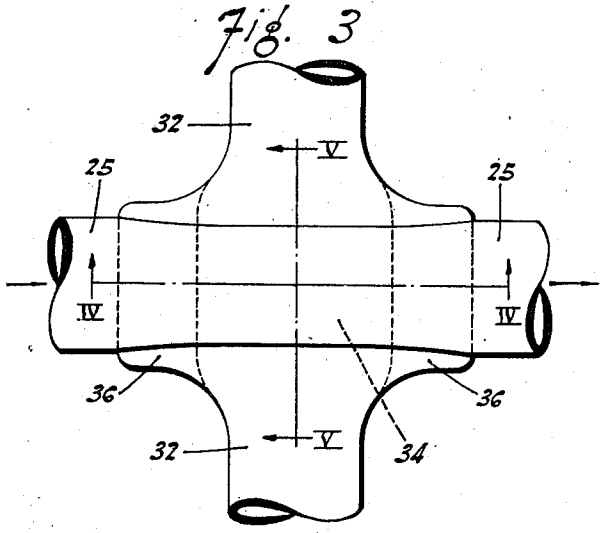


Fig. 2

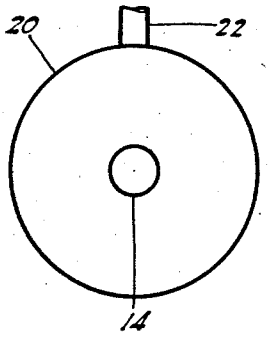


Fig. 4

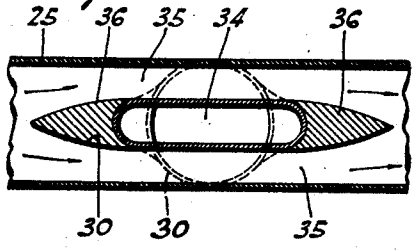
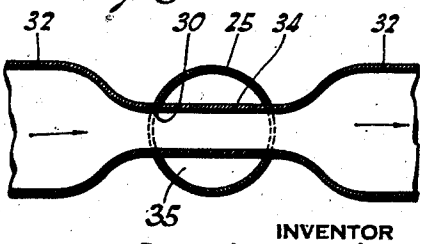


Fig. 5



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HEAT EXCHANGER

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4 Claims. (Cl. 257—241)

This invention relates to heat exchangers, and to a system and method for utilizing noxious types of heat dispensing or heat absorbing fluid mediums.

Many arrangements for this purpose have been devised and marketed, for example, in connection with exhaust gas heaters for automobiles and airplanes, but an ever-present danger from leakage of the exhaust gas into the heated air stream as a result of defects in partition members has heretofore attended their use; and an object of the present invention is to provide an efficient heat exchanger structure wherein it is inherently impossible for the heat dispensing or absorbing fluid to escape from its conduit into the fluid being treated, even though openings may be formed through the partitioning members separating the fluids as a result of deterioration, faulty workmanship, or any other cause.

The invention contemplates the provision of separate conduits for two fluid mediums, one of which is the fluid to be treated, and the other of which is to be utilized for its heat dispensing or heat absorbing capabilities, as the case may require. The two conduits are arranged at some point in heat exchange relation, and means are employed for providing a pressure differential between the fluids at the point of heat exchange contact in favor of the fluid to be treated, whereby the pressure differential will prevent entrance of the heat dispensing or absorbing fluid into the fluid being treated even though openings may occur in the members separating the two fluids.

In the drawing:

Fig. 1 is a fragmentary diagrammatic view of a motor exhaust conduit and a heater illustrating one embodiment of the invention;

Fig. 2 is a diagrammatic transverse section, on a larger scale, taken along line II—II of Fig. 1;

Fig. 3 is a fragmentary plan of another form of structure in which the invention is incorporated;

Fig. 4 is a longitudinal section taken substantially along line IV—IV of Fig. 3;

Fig. 5 is a transverse section taken substantially along line V—V of Fig. 3.

The drawing illustrates as one adaptation of the invention a construction comprising a conduit for motor exhaust gases and a separate air conduit which is connected in circuit with the passenger compartment of an automobile, airplane or other motor driven vehicle. These conduits are arranged in juxtaposed relation and in heat exchange contact. In accordance with the present invention means are employed to provide a pressure differential between the two fluids in favor of the fluid to be treated. According to one form of the invention this pressure differential providing means is in the form of a non-mechanical arrangement of parts such as for example having the portion of the exhaust conduit which is immediately adjacent the air conduit constricted in form and dimension to automatically cause the exhaust gases therein to flow through the zone of juxtaposition at an increased velocity. This arrangement is for the purpose of reducing pressure of the exhaust gases in the zone where heat exchange is to take place, whereby, under normal conditions, the pressure in the air chamber is greater than the pressure in the exhaust gas conduit. Thus, if openings develop in the structure which separates the exhaust gases from the heated air, there will nevertheless be no leakage of gases from the exhaust gas conduit into the circulating air system.

Referring particularly to Fig. 1, a conventional motor exhaust conduit 10 is provided with a deformed section 11 which comprises a reducing section 12, a constricted central portion 14, and an expanding portion 16. The deformed conduit member 11 may be formed as an integral part of the conduit 10, or as a separate unit adapted for connection at 15, by welding or in any other suitable manner, to the end portion of the conduit 10. The relationship of the constricted portion 14 to the expanding portion 16 will, upon movement of gases through the conduit in the direction indicated by the arrows, produce in the exhaust gas occupying the constricted portion 14 a pressure that is less than the pressure in the gas at the end portion 17 of the expanding portion 16 and the portion 10 of the conduit. The deformed portion 11 functions substantially in the manner of a Venturi tube for purposes of reducing the pressure of the gas while passing through the constricted conduit portion 14. The expanding portion 16 is in open communication with the atmosphere, and hence the exhaust gas passing through the constricted conduit portion 14 is under less than atmospheric pressure.

A casing 20 is provided about the constricted conduit portion 14 and is provided with inlet and outlet connections 21 and 22, respectively, for communication with the closed compartment which is to be heated. Thus air can be admitted into the casing 20 through the inlet connection 21 and carried from the outlet connection 22 to the compartment.

The air is circulated through the casing 20 at substantially atmospheric pressure, and encompasses the outer wall of the constricted portion 14 at a pressure which is higher than that of the exhaust gas passing through the interior of the constricted portion 14. Thus if any openings occur in the wall of the constricted portion 14 the difference in pressure upon the opposite sides thereof will prevent movement of exhaust gases through such openings into the interior of the casing 20 and possible contamination of the air circulating in connection with the compartment is prevented.

If it is desired to convey the exhaust gases to a more remote point of discharge, an enlarged conduit 18 may be connected to the expanding portion, as at 17, by welding or some other suitable method.

Figs. 3, 4 and 5 illustrate another form of the invention, wherein motor exhaust conduit 25 of uniform tubular shape is provided with a pair of diametrically opposed openings 30 through its side walls.

An air conduit 32, connected in open communication with the compartment to be heated, is provided with a partially flattened portion 34 disposed within the openings 30 and extending through the exhaust gas conduit 25 in transverse relation therewith. There is thus provided a pair of constricted passages 35 for the exhaust gas between the flattened portion 34 and the wall of the conduit 10. The flattened portion 34 is provided with V-shaped gas deflecting members 36 at the front and rear edges thereof for guiding the exhaust gas toward and away from the constricted passages 35 and for cooperation with opposite portions of the wall of the conduit 25 to provide a pair of tapering sections which are similar to the reducing and expanding portions 12 and 16 of the exhaust conduit of the form of construction illustrated in Fig. 1. The pair of constricted passages 35 function in a manner similar to the constricted opening 14 in the form of construction illustrated in Fig. 1, because the combined cross sectional areas of the pair of passages 35 is substantially less than the unobstructed cross sectional area of the conduit 25. Thus, the pressure in the exhaust gas as it is passing through the constricted passageways 35 is less than the pressure in the air within the conduit portion 34, and movement of exhaust gas through any openings that may occur in the wall of the air conduit member 34 and into the air stream therein will be prevented by the pressure differential upon the opposite sides of the conduit wall.

In constructing a device in accordance with this invention it is important that no restriction is offered to the flow of air through the zone of juxtaposition with the gas conduit whereby a reduction in the pressure in the air at that point would result to offset in some degree the pressure differential produced by the constriction of the exhaust gas conduit. Therefore, that portion of the air conduit member which is exposed to exhaust gases about the wall thereof should be so formed and dimensioned that its cross sectional area is slightly greater than the cross sectional area of the other portions of the air conduit.

In the form shown in Fig. 1, the relatively constricted portion 14 of the gas conduit may constitute a part of a motor exhaust conduit which is similarly shaped and dimensioned, because the ratio of gas velocity and pressure within the constricted portion 14 to the velocity and pressure of the gas while passing through the expanded discharge member 16 depends only upon the ratio of the cross sectional areas of these two portions.

It is preferable, in order to obtain maximum operating efficiency in a device of this invention, that the exhaust gases pass through the constricted portion in the form of a smooth flowing stream. In some types of motor installations the exhaust gases are delivered in a pulsating manner, and to counteract this condition and to provide a smooth flow of gas to the heat exchanger it may be desirable to incorporate a gas storage reservoir 40 in the exhaust conduit between the motor and the constricted portion or heater. To insure positive circulation of the air through the heater, any conventional means may be employed in connection with the device, such as a thermosyphon closed circuit arrangement or mechanical air-propelling means, (not shown). Such mechanical air propelling means, such as a fan or pump, when used in conjunction with the constricted portion will increase the pressure differential in favor of the air stream flowing into the passenger compartment. This will provide for further safety in avoiding contamination of the preferred fluid stream, which in the case of an automobile heater is the supply of fresh warm air being provided for passenger consumption. Such means may, however, be used solely and independently of the constricted portion for insuring the higher pressure being placed on the fresh air stream.

Thus, the means for creating the pressure differential in favor of the preferred fluid stream may be arranged to act upon either fluid stream, and may be either mechanical or non-mechanical. When mechanical means are used in conjunction with the fluid being treated, the fan or the like would preferably be so positioned as to cause a build up of pressure in the fluid at the point of heat exchange relation; and if mechanical means are employed in connection with the other fluid, the fan or the like would be arranged at the discharge end of the fluid conduit so as to urge the withdrawal of the fluid to provide a reduction of the pressure in the fluid at the point of heat exchange relation.

Although only a limited number of forms of the invention have been shown and described in detail, it will be apparent to those skilled in the art that the invention is not so limited but that various changes may be made therein without departing from the spirit of the invention or from the scope of the appended claims.

What is claimed is:

1. In a heat exchange device for transferring heat from one fluid to another, a conduit for the treating fluid having a portion in the form of a Venturi tube, a chamber for the treated fluid arranged in heat exchange relation with said conduit solely in the region of the constricted portion of said Venturi-like portion of said conduit, the outlet end of said conduit being expanded and extended, whereby the pressure of the fluid in said constricted portion of said conduit is normally reduced so that danger of leakage from the treating fluid to the treated fluid is minimized.

2. In a heat exchange device for transferring heat from one fluid to another, a conduit for the treating fluid, means in said conduit providing a constriction therein for producing a Venturi-like effect, said means including a portion of a

second conduit for treated fluid, said portion of said second conduit having its wall exposed to the treating fluid at said constriction only, whereby the pressure of the fluid in said constricted portion of said conduit is normally reduced so that danger of leakage from the treating fluid to the treated fluid is minimized.

3. In a heat exchange device for transferring heat from one fluid to another, a conduit for the treating fluid, means extending through said conduit and dividing the latter into a pair of fluid passages of Venturi-like form, said means including a conduit for treated fluid, the second mentioned conduit constituting wall portions of said passages solely at the constricted portions thereof, the inlet and outlet ends of said passages expanding from said constricted portions thereof.

4. In a heat exchange device for transferring heat from one fluid to another, a conduit for the treating fluid, a chamber for the treated fluid arranged in heat exchange relation thereto, the outlet end of said conduit being gradually expanded and extended whereby the pressure of the fluid in the portion of the conduit in advance of the expanded and extended portion is normally reduced, and said chamber being arranged on said conduit solely at the reduced pressure region thereof in advance of the expanded and extended portion.

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