Dec. 10, 1940. D. E. DASHER 2,224,219

REFRIGERATING APPARATUS

Filed July 31, 1937 4 Sheets-Sheet 1

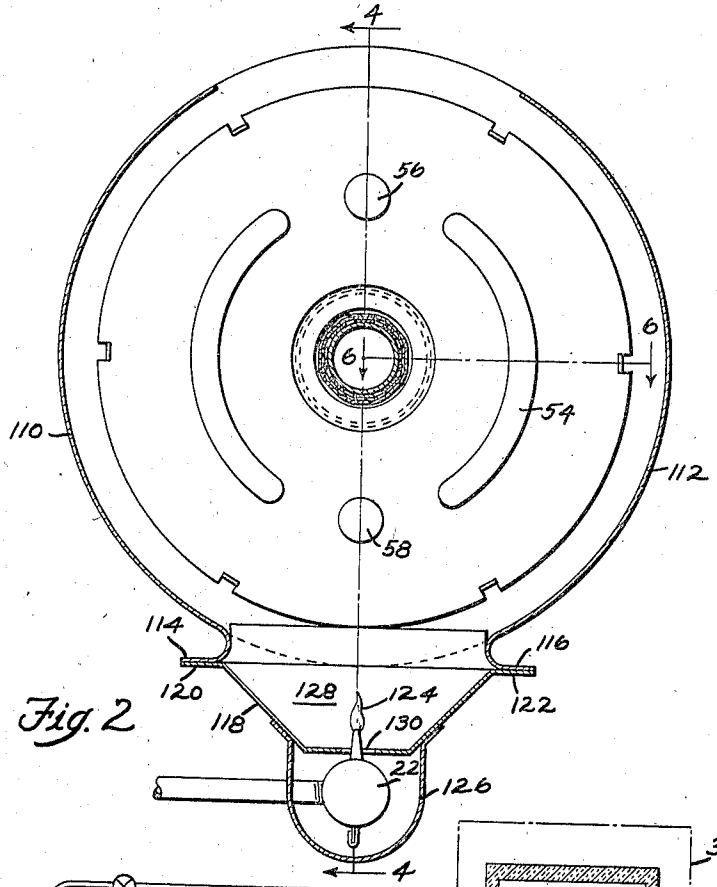


Fig. 2

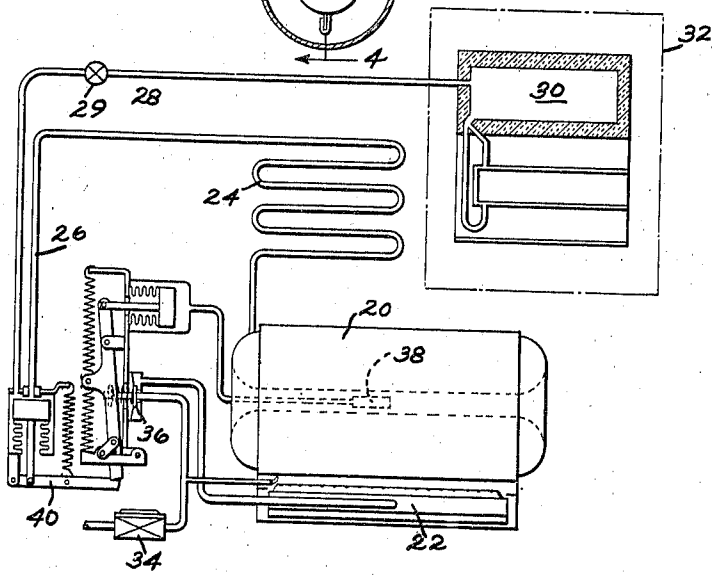


Fig. 1

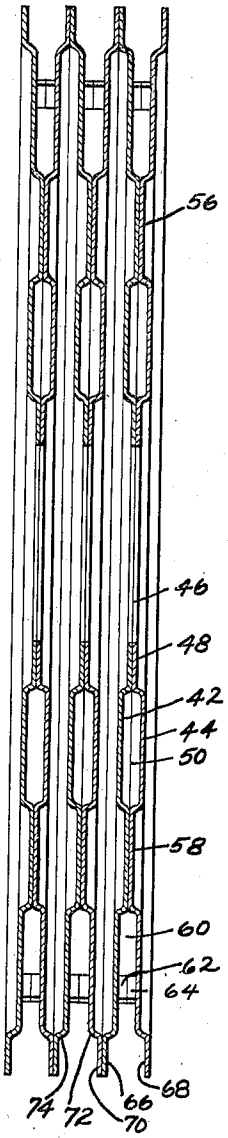


Fig. 3

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REFRIGERATING APPARATUS

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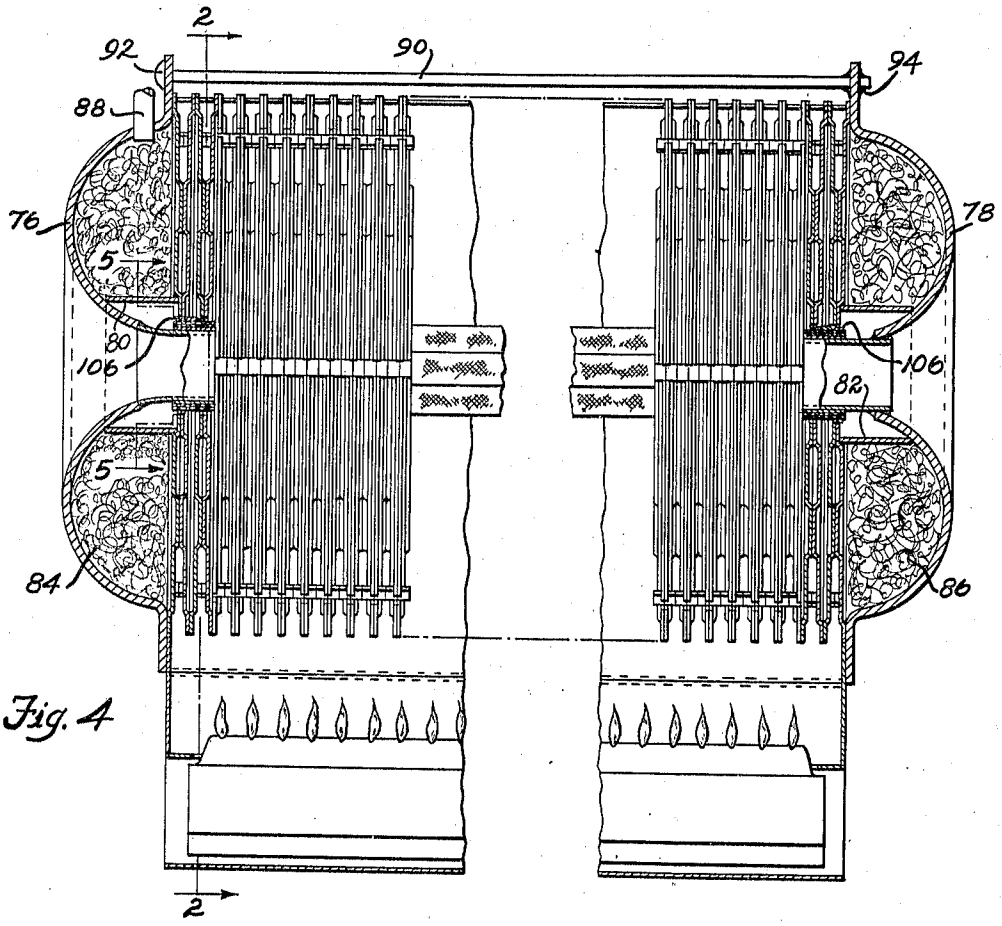


Fig. 4

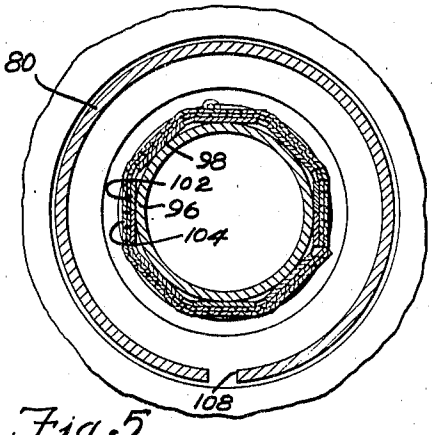


Fig. 5

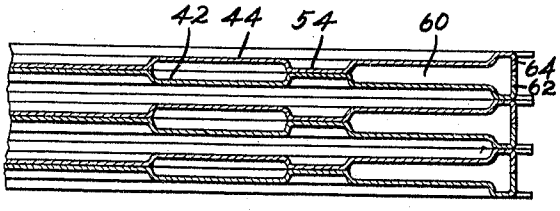


Fig. 6

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REFRIGERATING APPARATUS

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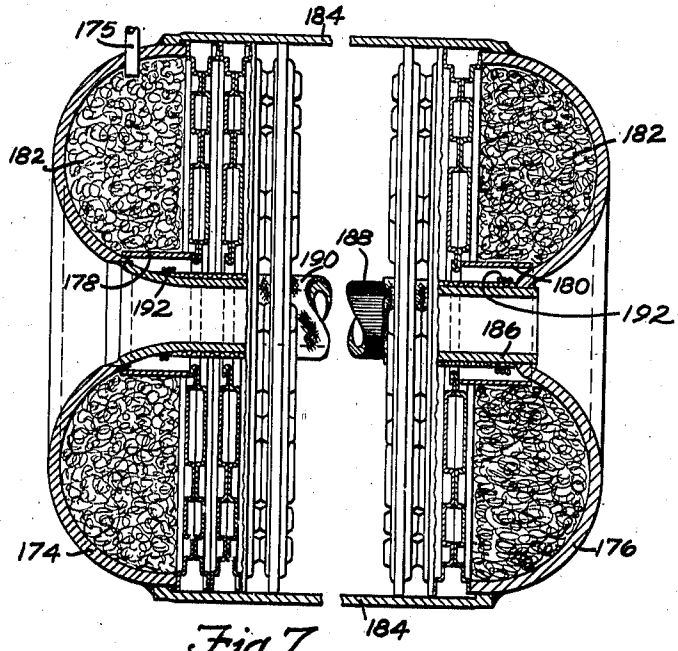


Fig. 7

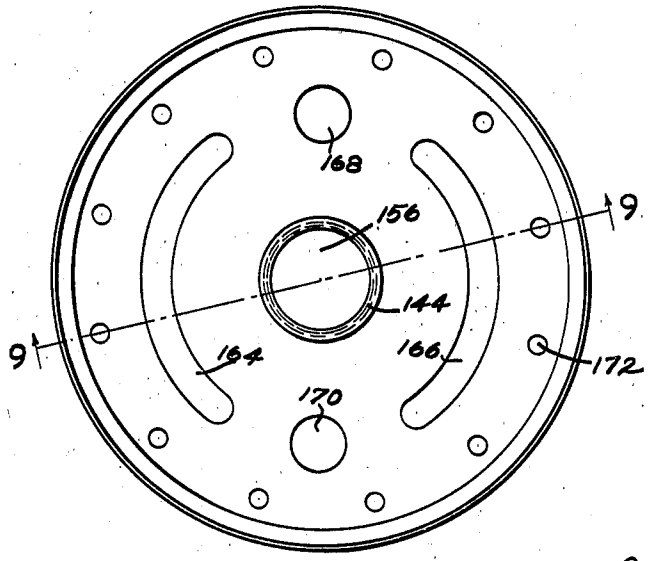


Fig. 8

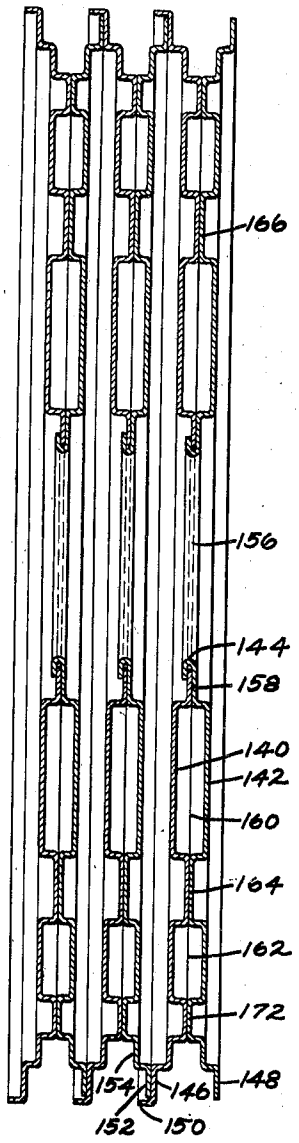


Fig. 9

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REFRIGERATING APPARATUS

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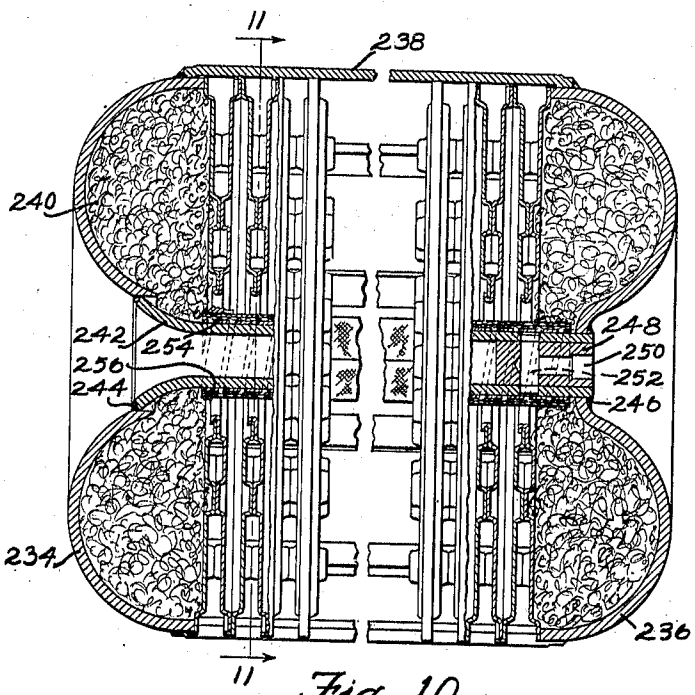


Fig. 10

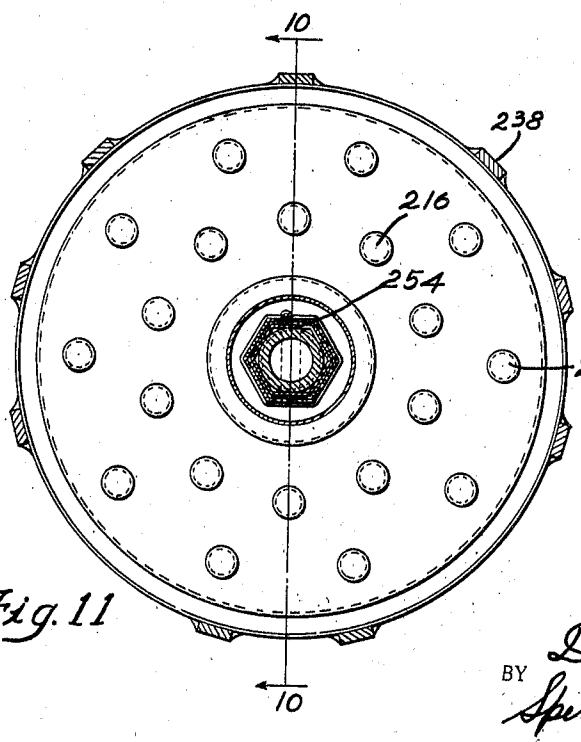


Fig. 11

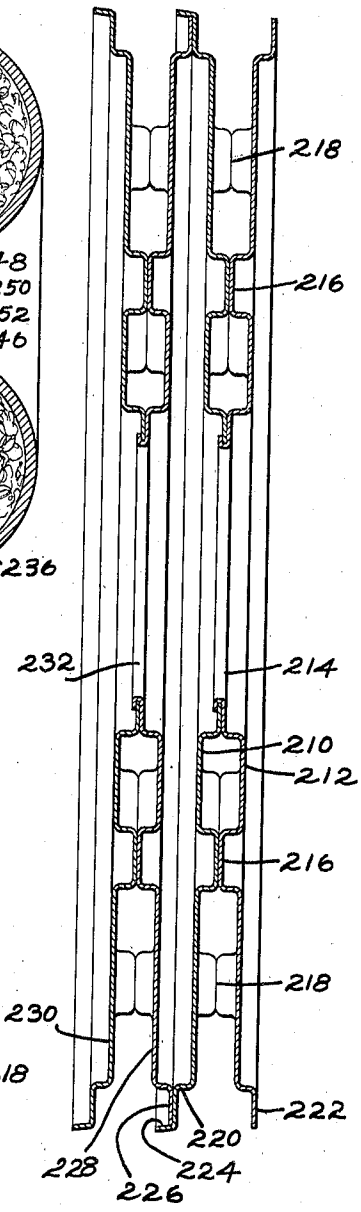


Fig. 12

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Patented Dec. 10, 1940

2,224,219

UNITED STATES PATENT OFFICE

2,224,219

REFRIGERATING APPARATUS

Don E. Dasher, Dayton, Ohio, assignor to General Motors Corporation, Dayton, Ohio, a corporation of Delaware

Application July 31, 1937, Serial No. 156,770

10 Claims. (Cl. 62—118)

This invention relates to refrigerating apparatus and more particularly to generator-absorbers particularly of the solid absorbent type.

Heretofore, generator-absorbers of the solid absorbent type have been largely made up of finned structures which depended upon carrying the heat of conduction longitudinally through metal from the heating fluid to the absorber. In such a structure, however, the heat transfer both in heating and cooling the absorber is relatively slower.

It is an object of my invention to provide a generator absorbing means wherein a more direct heat flow may be obtained between all the absorbent and the heating and cooling fluid.

It is another object of my invention to provide a generator-absorber in which the path for heat transfer between all the solid absorbent and the heating and cooling fluid is very short.

It is still another object of my invention to provide a generator-absorber means in which the absorbent is cased within thin members, the greater part of which may be surrounded by a heat transfer fluid.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings, wherein a preferred form of the present invention is clearly shown.

In the drawings:

Fig. 1 is a diagrammatic representation of a refrigerating system including a generator-absorber unit embodying my invention;

Fig. 2 is a vertical sectional view through the generator-absorber taken along the lines 2—2 of Fig. 4;

Fig. 3 is an enlarged sectional view of a portion of the generator-absorber taken along the lines 4—4 of Fig. 2;

Fig. 4 is a view partly in section taken along the lines 4—4 of Fig. 2;

Fig. 5 is a sectional view taken along the lines 5—5 of Fig. 4;

Fig. 6 is a sectional view of a portion of the generator-absorber taken along the lines 6—6 of Fig. 2;

Fig. 7 is a sectional view of a modified form of generator-absorber;

Fig. 8 is an end view of an intermediate section of the generator-absorber shown in Fig. 7;

Fig. 9 is a sectional view taken along the lines 9—9 of Fig. 8;

Fig. 10 is a sectional view of another improved generator-absorber construction taken along the lines 10—10 of Fig. 11;

Fig. 11 is a sectional view taken along the lines 11—11 of Fig. 10; and

Fig. 12 is a sectional view of several plates taken along the lines 10—10 of Fig. 11.

Briefly, I have shown a refrigerating system of the solid absorption type in which the absorber is made up of a plurality of metal plates having central apertures, the plates being alternately joined together at the edges of their apertures and at their outer peripheries. These plates are slightly spaced to provide a space for holding the absorbent and another space through which the heat transfer fluid may pass.

Referring now to the drawings and more particularly to Fig. 1, there is shown a simple absorption refrigerating system of the solid adsorbent type including an absorber 20 containing a solid absorbent which is heated by a gas burner 22 to cause ammonia or other volatile liquid in the form of a gas to be driven from the solid absorbent and condensed within a condenser 24 shown diagrammatically where the compressed refrigerant is condensed and supplied through conduit means 26 and 28 under the control of a suitable valve 29 to an evaporating means 30 located within a compartment 32 to be cooled.

The gas is supplied under the control of a pressure regulating valve 34 and a gas valve 36 to the burner 22. The gas valve 36 is operated by a thermostat bulb 38 located within the interior of the generator-absorber. When the generator-absorber reaches a predetermined temperature, th gas valve is closed by reason of the high pressure created within the thermostat bulb 38. The generator-absorber 20 then cools and absorbs refrigerant in vapor form which returns from the evaporator 30 through the same conduits 28 and 26 as well as the condenser 24. The gas valve is prevented from closing by an interlock mechanism 40 which is responsive to the refrigerant pressure within the conduit means 26. When a predetermined pressure is reached within the conduit means 26, the interlock mechanism releases the gas valve 36 and allows it to close in order to start a new generating cycle.

Referring now more particularly to Figs. 2 to 6, inclusive, one form of the generator-absorber 20 is shown mainly made up of a plurality of stacked metal plates best shown in Figs. 3 and 6. In this form, identical plates are turned toward each other in pairs such as the plates 42 and 44. These plates are each provided with an aperture 46 in their central portions, and surrounding this aperture 46 these plates are each deformed to provide a flanged portion 48, the two

flanges 48 fitting together around the aperture. Around this flanged portion the plates are spaced to provide a space 50 through which the gases from the fuel burner 22 may pass. Surrounding this space 50, the plates are deformed to provide two long arc-shaped projections 52 and 54 as well as two small round projections 56 and 58, all of which fit together as shown in Figs. 3 and 6.

The plates 42 and 44 are also spaced surrounding the projections 52 to 58 to provide a gas space 60 at their edges. The plates 42 and 44 are deformed to provide flanges 66 and 68 which extend away from each other. At the extreme edge of these plates, cuts are made about half way in the flanges to provide tongues of metal which are bent toward each other to provide the spacing projections 62 and 64 which fit together to preserve the spacing between the edge portions of the plates 42 and 44.

The flange 66 rests against the flange 70 of the adjacent plate 72 which is formed similarly to the plates 66 and 68 and occupies a position corresponding to the plate 44. The plate 72 fits against the inner flange and the projections of another similar plate 74 which is positioned similarly to the plate 42. These plates are further built up in this manner and stacked together until a sufficient number is obtained to provide adequate capacity for the amount of solid absorbent required for the apparatus.

For a household refrigerator, enough of these plates are stacked together to make an assembly about 16 or 18 inches long. Upon the ends of these stacked members, there is provided end members 76 and 78 which are formed of heavy sheet metal and contain split collars 80 and 82 surrounding which steel wool designated by the reference characters 84 and 86 is provided. This entire assembly is then copper hydrogen brazed to cause the inner and outer flanges as well as the projections to be thermally joined together by a metallic bond.

One of the headers is provided with an inlet 88, and the entire assembly is tested with a fluid under pressure to detect any leaks which might arise due to faulty brazing. At the same time the assembly is expanded by a pressure within the assembly which tends to spread the plates; and when the assembly is at its proper length bars 90 having heads 92 at one end are slipped through apertures at the flanges of the end members 76 and 78, and the opposite end is welded as shown at 94 in order to prevent the plates from spreading under pressure.

After this, the assembly is placed in a vertical position and rotated while the solid absorbent is poured into the central apertures 46. This causes the absorbent to be thrown out by centrifugal force into the spaces between the plates such as between the plate 42 and the plate 72. Preferably, the absorbent used is strontium bromide, strontium chloride, or magnesium chloride with lithium nitrate.

After this, the absorbent is cleared out of the space along the apertures in the metal plates, and an inner tube 96 is welded at its ends to the headers. This tube is surrounded by eight flat staves 98 which are held within two asbestos socks or tubes 102 and 104. The ends of these socks are wrapped with wire designated by the reference character 106. The purpose of the staves and asbestos socks is to provide a passage through which the refrigerant in vapor form may readily flow from all the absorbent to the space within the split collar 80 and through the split opening 108 to the space containing the steel wool 84 from which the gas passes through the outlet 88. The asbestos sock and the steel wool both act as filters. The sock prevents the absorbent from leaving its place in the absorber, while the steel wool prevents any foreign matter from entering the absorbent space of the absorber.

Surrounding the absorber is a shroud which has metal members 110 and 112 slightly spaced away from the edges of the metal plates. An opening is left at the top between the two metal members of the shroud for the escape of the products of combustion. The bottoms of the shroud members 110 and 112 are curled outwardly to form the flanges 114 and 116. Another sheet metal member 118 is provided with flanges 120 and 122 which may be spot welded or otherwise fastened by these flanges to the flanges 114 and 116. This member 118 provides a combustion space for the flame 124 which issues from the gas burner 22. The lower portion of the gas burner is supported by another metal member 126 which is fastened to the member 118. The secondary air supply enters through this member 126 and passes into the combustion chamber 128 through an aperture 130 in the member 118 which aperture also receives the tip of the burner 22.

In Figs. 7, 8 and 9 I have shown an improved form of generator-absorber unit. In this form there is provided metal plates 140 and 142 which are first deformed in a press. These plates 140 and 142 are slightly different from each other. The plate 142 is provided with a flange 144 which fits into the aperture provided in the central portion of the plate 140. This flange 144 is turned or spun over to lock the inner flanges of the plates 140 and 142 together. The outer edges of the plates 140 and 142 are provided with flanges 146 and 148 which are similar to the flanges in the first modification excepting that the flange 146 has an additional laterally turned flange 150 which is adapted to receive the flange 152 of the adjacent metal plate 154 which is similar to the plate 142. Otherwise, the plates are similar to the plates in the first modification and have a central aperture 156 surrounded by flanges 158 which fit together, which in turn are surrounded by a space 160 through which the products of combustion may pass.

There is also another space 162 upon the outside of the plates through which the products of combustion may pass. Similar projections 164, 166, 168, and 170 are provided for the interior of the metal plates; but, in addition thereto, small projections 172 are distributed uniformly around the outer edges of the plates in order to serve as the spacing means and to provide an increased bonding surface to hold the plates together.

After the plates are stamped upon a punch press, they are assembled in pairs and the flange 144 is turned over to lock the pairs at their apertures. These pairs of plates are then stacked together with the flanges of one set of plates fitting into the turned flanges of the adjacent pair of plates. Enough of these pairs of plates are stacked together to form an absorber of suitable size; and, thereafter, the end plates 174 and 176 are assembled onto the ends of the stacked pairs of metal plates. These end plates are of a rounded annular shape in order to withstand high internal pressure.

These end plates 174 and 176 are provided with split collars 178 and 180 as well as the steel wool

182. The end plate 174 is provided with an outlet 175. This assembly is then copper hydrogen brazed; and, thereafter, the assembly is tested by pressure. When expanded to the proper size, the bars 184 are welded at their opposite ends to the end members 174 and 176 in order to prevent the plates from spreading. The assembly is then centrifugally charged with a suitable absorbent such as the absorbents mentioned in connection with the first modification. After this the inner tube 186 is inserted in place and welded at its ends to the end plate. This inner tube 186 has a knurled or grooved outer surface 188 through which the refrigerant vapor may pass. This tube 188 is surrounded by an asbestos sock 190 or a sock of glass wool fabric which is wrapped at its ends with copper wire designated by reference character 192. Instead of employing a sock, the inner tube 186 may be wrapped spirally with glass wool or asbestos fabric and bound with wire.

In Figs. 10, 11, and 12 I have shown another form of generator-absorber 20. In this form the pairs of apertured plates such as the plates 210 and 212 are each deformed to provide abutting inner flanges which are locked together by turning the inner flange of the plate 212 over the inner flange of the plate 210 as shown at 214. Surrounding these inner flanges are a circle of ten projections 216 which are formed in each member of every pair of plates and which are sufficiently long so that when the plates are assembled and locked as shown at 214 the projections 216 will fit together. Surrounding the circle of projections 216 is another circle of ten projections 218 which will also fit together to form spacing and bonding portions for the pairs of metal plates. These pairs of metal plates are provided with outwardly turned flanges 220 and 222. The flange 222 of the plate 212 has no laterally turned portion but the flange 220 has a laterally turned portion 224 which receives the plain flange 226 of the adjacent metal plate 228, which is like the plate 212, and with the plate 230 forms a pair of metal plates which are locked together as shown at 232 in a manner similar to the locking shown at 214.

Pairs or sets of plates are first assembled by locking the one plate to its mate as shown at 214 and 232 and then the pairs or sets are stacked upon one another as shown in Figs. 10 and 12 in sufficient number to provide an absorber of suitable size. In each case the plain flange of one set fits into the laterally turned flange of the adjacent set. After these sets of plates are stacked together they are provided with end plates 234 and 236 formed of sheet metal in the shape of a split hollow ring. This assembly is copper hydrogen brazed and then tested for leaks under pressure.

At this time the assembly is brought to the correct length and the longitudinal bars 238 are welded to the end members 234 and 236 at their opposite ends to prevent the assembly from spreading. After this, the end members 234 and 236 are filled with steel wool designated by the reference character 240, after which the spaces between the locked sets of plates are filled with the absorbent material by a centrifugal process. After the spaces between the pairs or sets of plates are filled with absorbent a hole is made in the center of the absorbent in the assembly and an inner tube 242 including its assembly is inserted and welded in place at both ends of the wells 244 and 246.

This inner tube 242 differs from the other inner tubes in that it serves as the inlet and therefore is provided with a plug 248 at its smaller end which is provided with a longitudinal inlet passage 250 and a transverse inlet passage 252 which extends through the walls of the inner tube. The inner tube 242 is wrapped spirally with flat wire or strip 254 which previously to the wrapping has been bent at intervals so that when it is wrapped upon the inner tube it will form itself into a hexagonal shape thereon. This provides the free longitudinal passage for the refrigerant gases so that they may distribute themselves evenly into the absorbent. Surrounding this wrapping of flat wire or strip are two asbestos or glass wool socks 256 which serve as a filter to prevent the absorbent from entering the longitudinal passage formed by the flat wire strip member 254. The ends of these socks are fastened by wire wrapped around them. With this assembly, it will be noted that the absorber proper is completed. After that the shroud for the combustion system is applied.

In this form, as well as the other forms, the absorbent is held between closely spaced metal plates such as the metal plates 210 and 228 which form parts of adjacent pairs of such a plate. The air for cooling the absorbent or other fluid which may be used, has access to substantially the entire surface of the outer side of each of these plates, while on the inner side substantially the entire surface of the plate is in direct contact with the absorbent. This makes excellent heat transfer conditions, since practically all the absorbent is located less than the distance of one-half the spacing of the metal plates from the nearest cooling air or cooling fluid. Likewise, during the heating period, the products of combustion may pass upon substantially all of the outer surface of the metal plates so that efficient heating also results. In this way, the cooling of the absorber is much more rapid and efficient; and the heating is also more rapid and efficient. This overcomes the major obstacle in the manufacture of generator-absorbers for solid absorbents since it makes it possible to obtain relatively good heat transfer conditions when a solid absorbent is employed.

While the form of embodiment of the invention as herein disclosed, constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. An absorber comprising a plurality of metal plates having substantially centrally located apertures therein, the plates being alternately joined directly together at the edges of their apertures and adjacent their outer peripheries, said plates being slightly spaced in between the joined portions, the interior of the plate construction being filled with a solid absorbent material located between the plates.

2. An absorber comprising a plurality of metal plates having substantially centrally located apertures therein, the plates being alternately joined together at the edges of their apertures and adjacent their outer peripheries, said plates being slightly spaced in between the joined portions, the interior of the plate construction being filled with an absorbent material located between the plates, said plates being provided with projections, said projections being joined together for preventing the spreading of the plates.

3. An absorber comprising a plurality of metal plates having substantially centrally located apertures therein, the plates being alternately joined together at the edges of their apertures and adjacent their outer peripheries, said plates being slightly spaced in between the joined portions, the interior of the plate construction being filled with an absorbent material located between the plates, end members at the opposite ends of said metal plates, and bars joining said end members.

4. An absorber comprising a plurality of metal plates having substantially centrally located apertures therein, the plates being alternately joined together at the edges of their apertures and adjacent their outer peripheries, said plates being slightly spaced in between the joined portions, a tubular member extending through said centrally located apertures, and an absorbent located between said tubular member and the metal plates.

5. An absorber comprising a plurality of metal plates having substantially centrally located apertures therein, the plates being alternately joined together at the edges of their apertures and adjacent their outer peripheries, said plates being slightly spaced in between the joined portions, a tubular member extending through said centrally located apertures, an absorbent located between said tubular member and the metal plates, and means providing passages along the tubular member.

6. An absorber comprising a plurality of metal plates having substantially centrally located apertures therein, the plates being alternately joined together at the edges of their apertures and adjacent their outer peripheries, said plates being slightly spaced in between the joined portions, the interior of the plate construction being filled with an absorbent material located between the plates, end members at the opposite ends of said metal plates, bars joining said end members on the outside of said plates, and a tubular member extending through the centrally located apertures in said plates to join the end members.

7. An absorber comprising a plurality of metal plates having apertures therein, the plates being alternately joined together at the edges of their apertures and adjacent their outer peripheries, said plates being slightly spaced in between the joined portions, the interior of the plate construction being filled with an absorbent material located between the plates, end members at the opposite ends of said metal plates, bars joining said end members on the outside of said plates, a tubular member extending through the apertures in said plates to join the end members, and means providing passages along the tubular member including a fabric member of an inorganic material.

8. An absorber comprising a plurality of metal plates having apertures therein, the plates being alternately joined together at the edges of their apertures and adjacent their outer peripheries, said plates being slightly spaced in between the joined portions, the interior of the plate construction being filled with an absorbent material located between the plates, a tubular member extending through said apertures, said tubular member being smaller than said apertures to provide for communication between the interior of the plate construction.

9. An absorber comprising a plurality of metal plates having substantially centrally located apertures therein, the plates being alternately joined together at the edges of their apertures and adjacent their outer peripheries, said plates being slightly spaced in between the joined portions, the interior of the plate construction being filled with an absorbent material located between the plates, said absorber having end plates at its opposite ends, said end plates being joined to said metal plates adjacent their outer peripheries, said end plates each being provided with a substantially centrally located aperture, a tubular member connecting the aperture located in the end plates and extending through the centrally located apertures in said metal plates, the apertures in said metal plates being larger than the outside of said tube to permit the passage of gases along the tube.

10. A heat transfer means comprising a plurality of metal plates having apertures therein, the plates being alternately joined together at the edges of their apertures and adjacent their outer peripheries, said plates being spaced close together but separated slightly, a member extending through said apertures, said member being smaller than said apertures to provide communication between the various spaces enclosed between the plates, said plates being also provided with distributed projections near their edge portions, means for joining the projections of those adjacent plates which are unconnected at their outer peripheries to prevent spreading of the plates, and means cooperating with the outside plates of the plurality of plates and with said member to seal the space between said member and said plurality of plates.

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