July 6, 1948. C. C. COONS 2,444,694

ABSORPTION TYPE PORTABLE AIR CONDITIONING UNIT

Filed Nov. 16, 1942 2 Sheets-Sheet 1

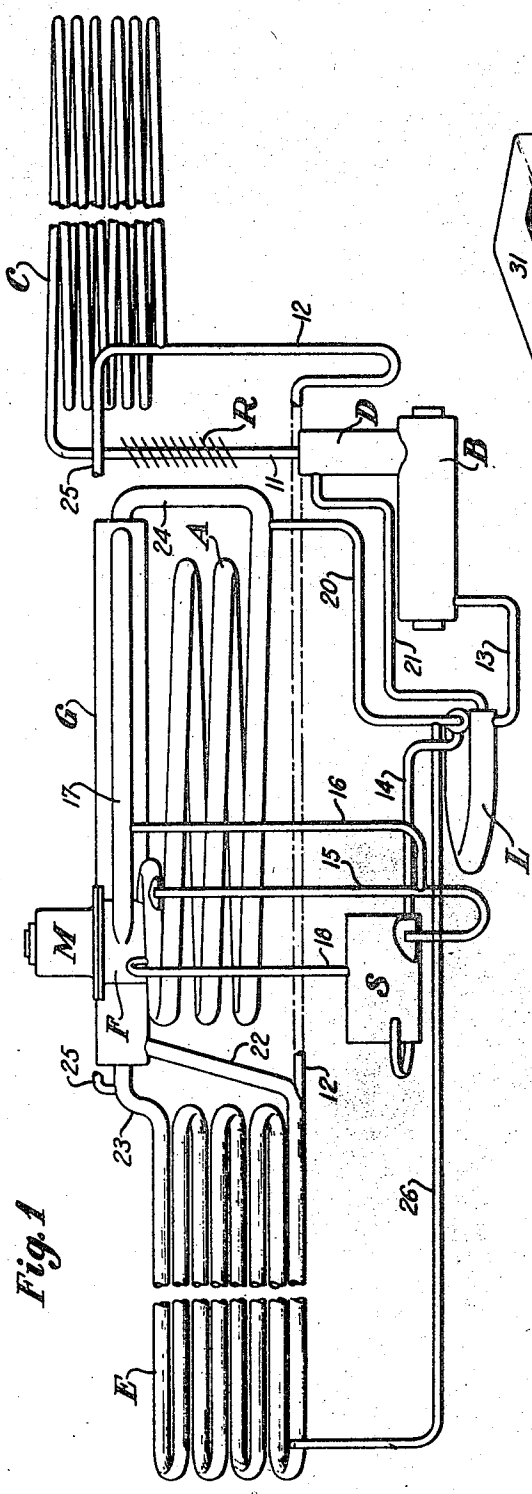

Fig. 1

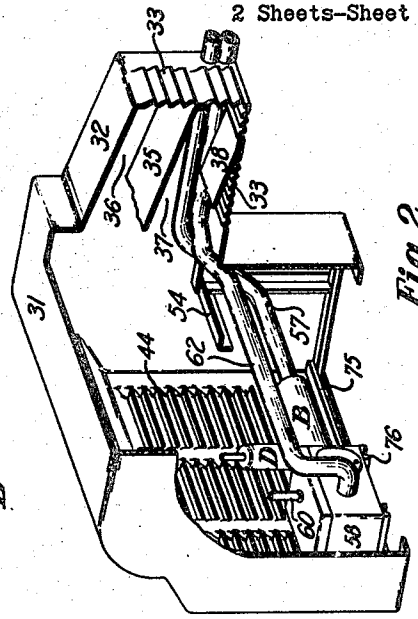

Fig. 2

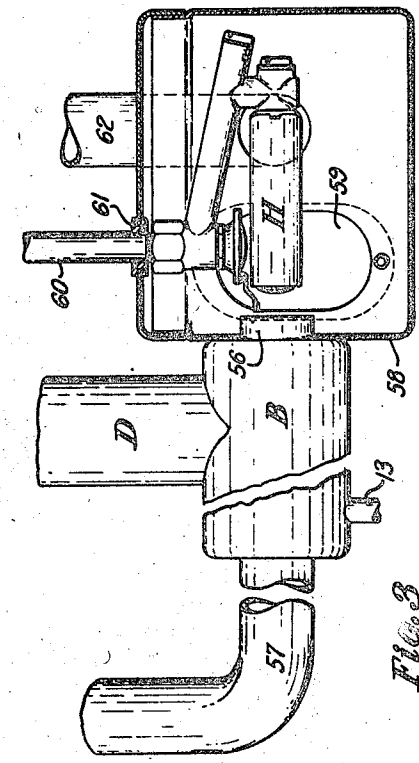

Fig. 3

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ABSORPTION TYPE PORTABLE AIR CONDITIONING UNIT

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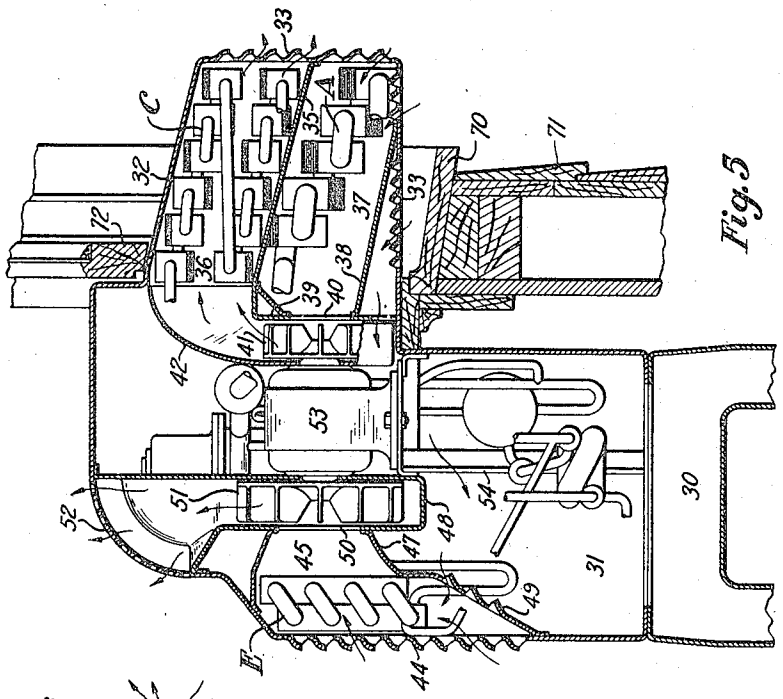

Fig. 5

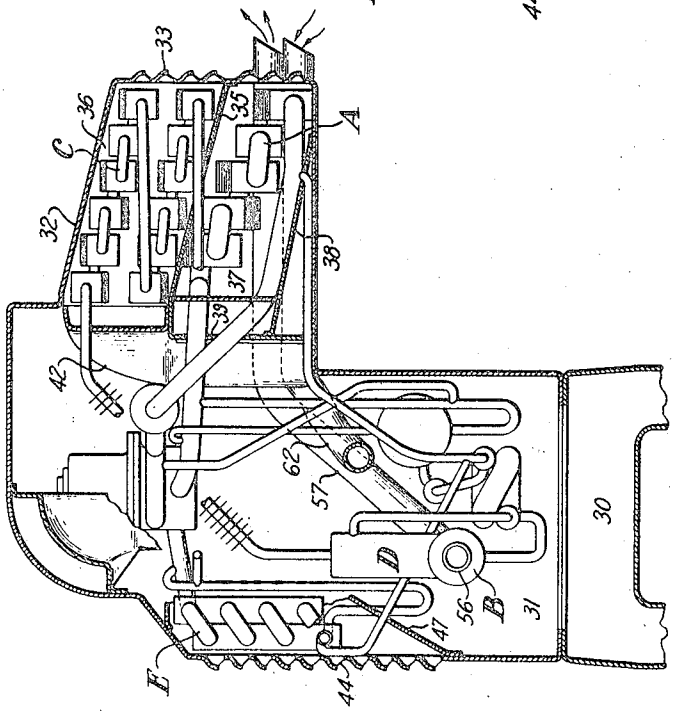

Fig. 4

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Patented July 6, 1948 2,444,694

UNITED STATES PATENT OFFICE

2,444,694

ABSORPTION TYPE PORTABLE AIR CONDITIONING UNIT

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Application November 16, 1942, Serial No. 465,685

7 Claims. (Cl. 62—129)

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This invention relates to the art of air conditioning and more particularly to an air conditioning apparatus which utilizes an absorption refrigerating apparatus of the heat operated type.

It is a further object of the present invention to provide an air conditioning apparatus utilizing an absorption refrigerating apparatus of the three-fluid type so constructed and arranged that the refrigerating apparatus may be positioned within a cabinet having a low vertical height so that the same may conveniently be placed adjacent or beneath the window opening of a residence or office.

It is a further object of the present invention to provide an air conditioner utilizing a heat operated refrigerating apparatus of the absorption type characterized by the provision of distinct air ducts for the conditioned air and for the cooling air which serves to dissipate the heat rejected by the condenser and absorber and utilizing a single power operated element for circulating the various air streams.

It is a further object of the present invention to provide an air conditioning apparatus utilizing a heat operated refrigerating system to which energy is applied by the combustion of a combustible fuel and in which the apparatus is so constructed and arranged that the combustible fuel burning element is shielded from pressure fluctuations occurring between the space housing the air conditioning apparatus and the discharge of the products of combustion flue.

It is a more specific object of the present invention to provide an air conditioning apparatus of the portable type utilizing a heat operated refrigerating system which includes a combustible fuel burner, a products of combustion discharge element which is arranged to convey waste products of combustion to the exterior of the space housing the portable air conditioner and with an air supply duct which supplies combustion air to the heating element from the area immediately adjoining the discharge of the waste products of combustion flue.

Other objects and advantages of the invention will become apparent as the description proceeds when taken in connection with the accompanying drawings, in which—

Figure 1 is a diagrammatic view of the refrigerating system per se;

Figure 2 is a cut-away view of the air conditioning unit illustrating the arrangement of certain parts thereof;

Figure 3 is a sectional detail on an enlarged scale of a burner and its associated housing;

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Figure 4 is a sectional side elevational view of the apparatus showing the placement of the various parts thereof in detail, and

Figure 5 is a sectional side elevational view of the apparatus illustrating further detail as to the placement of parts and the arrangement of a particular form of the apparatus in conjunction with the window opening of a space to be conditioned.

Referring now to the drawing in detail and first to Figure 1 thereof, there is illustrated a three-fluid absorption refrigerating apparatus embodying a generator B, an analyzer D, an air cooled rectifier R, a tubular air cooled condenser C, a tubular air cooled absorber A, an evaporator E, a gas heat exchanger G, a solution reservoir S, a solution heat exchanger L, and a gas circulating pump or fan F which is driven by an electrical motor M. These elements are connected by suitable conduits to form a plurality of gas and liquid circuits to be described more fully hereinafter.

The above described refrigerating apparatus will be charged with a suitable refrigerant, such as ammonia, an absorbent therefor, such as water, and an inert pressure equalizing medium, preferably a dense gas such as nitrogen.

The boiler is heated by a means to be described more fully hereinafter. The application of heat to the boiler liberates vapor from the strong solution therein contained. Vapor is then conveyed through the analyzer and conduit 11 containing the rectifier to the upper portion of the condenser C wherein it is liquefied by atmospheric air and condensed to the liquid phase. The liquid collecting in the condenser then flows through the deep U-shaped trap conduit 12 to the bottom portion of the evaporator E.

The lean solution formed in the boiler by the evolution of refrigerant vapor is conveyed therefrom to the solution reservoir S by way of conduit 13, liquid heat exchanger L, and conduit 14. The solution is then elevated from the reservoir S to the upper portion of the absorber A by the gas lift pump conduit 15. Pumping gas is conducted to conduit 15 by conduit 16 which is connected to the discharge conduit 17 of the circulating fan F. The upper gas space of the reservoir S is vented by conduit 18 to the upper portion of the absorber.

The lean solution supplied to the upper portion of the absorber flows downwardly therethrough by gravity in counterflow relationship with a mixture of inert gas and refrigerant vapor which is supplied to the bottom portion of the absorber in a manner to be described hereinafter. The solution absorbs refrigerant vapor from the

mixture and the resulting heat of absorption is dissipated through cooling fins on the exterior of the absorber to the atmospheric air. Strong solution formed in the absorber gravitates to the bottom portion thereof from which point it is conveyed to the upper portion of the analyzer D by way of the conduit 20, liquid heat exchanger L, and conduit 21.

The upper portion of the absorber A connects directly to the suction inlet of the circulating fan F wherein the lean inert gas is placed under pressure and is then conveyed to the bottom portion of the evaporator E by way of conduit 17, gas heat exchanger G, and conduit 22 to which the liquid supply conduit 12 connects. The evaporator conduit is of rather small diameter and the inert gas flows upwardly therethrough with sufficient pressure and velocity to sweep or drag the liquid refrigerant upwardly through the evaporator as it is evaporating to produce a refrigerating effect. After traversing the evaporator the resulting rich mixture of inert gas and refrigerant vapor is conveyed therefrom to the bottom portion of the absorber A by means of the conduit 23, gas heat exchanger G and conduit 24.

The condenser side of the trap in the conduit 12 is vented by means of conduit 25 to the gas discharge conduit 23 of the evaporator.

The lowermost conduit of the evaporator is provided with an overflow drain 26 which is connected to the strong solution return conduit 20.

The type of evaporator disclosed above is disclosed and claimed in application Serial No. 386,395, filed April 2, 1941, now Patent No. 2,328,196, dated August 31, 1943. However, other types of evaporators may be used if desired without departing from this invention.

In the refrigerating system just described the evaporator is positioned beneath the condenser and absorber, and the liquid refrigerant flows by gravity into the bottom portion of the evaporator and is elevated therethrough by the inert gas as it is evaporating. Foreign material and nonvolatile material which is conveyed through the evaporator by the inert gas flows through the inert gas circuit to the bottom portion of the absorber where the same is discharged into the solution circuit.

The above described refrigerating system is assembled with the cabinet of a portable air conditioning unit in a manner illustrated in Figures 2, 4 and 5.

Though a particular refrigerating system has been described in detail herein, it is to be understood that other types of heat operated refrigerating systems may be utilized in conjunction with this apparatus and in particular in conjunction with the combustion regulating apparatus to be described hereinafter.

The conditioning cabinet comprises a base structure 30 which will normally rest upon the floor in the room to be air conditioned. The conditioning cabinet proper includes a front machinery chamber 31 which is provided with a rearwardly extending casing 32.

The rear and bottom walls of the extending portion 32 are provided with louvres as is indicated at 33. Interiorly a partition 35 divides the chamber 32 into an upper condenser receiving air pass portion 36 and into a lower absorber receiving air pass portion 37. A partition 38 cuts off a portion of the louvres 33 and serves also as one of the defining walls of the chamber 37. The partitions 35 and 38 are joined by a vertical panel 39 which is provided with an opening 40

adjacent the eye of a centrifugal fan 41. A partition 42 forms the back wall of the fan housing and also forms an air passageway leading from the fan 41 into the inner end of the passage 36. In operation the fan draws cooling air in through the louvres 33 across the absorber into the eye of the fan which then discharges the air into the passageway 36 across the condenser after which it exits through other of the louvres 33.

The front portion of the cabinet 31 is provided with louvres 44 which open into an evaporator encasing chamber 45 defined by the partition 47 and a fan receiving housing 48. The panel 47 is provided with louvres 49 whereby fresh air admitted through the louvres 33 forwardly of and beneath the partition 38 may pass through the housing 31 and louvres 49 into the chamber 45. The evaporator E is positioned in the forward portion of the chamber 45. The fan housing 48 has a central eye 50 opening into the chamber 45. Within the housing 48 there is a fan 51 which discharges conditioned air through a grill 52 positioned in the upper forward portion of the chamber 31.

A suitable electrical motor 53 is arranged to drive the fans 41 and 51. The motor is mounted upon an angle iron pedestal 54 which is secured to the casing 31.

The boiler B and analyzer D are positioned in the lower forward portion of the casing 31 adjacent the panel 47.

The boiler B is provided centrally thereof with a products of combustion flue 56 which connects to a discharge flue 57. The flue 57 extends to the right hand end wall of the casing 31, as viewed in Figure 2, and then passes through the right hand lower corner of the condenser chamber 37 and discharges at the rear portion of the casing 32 outside the limits thereof.

Referring now to Figure 3 there is illustrated a segment of the boiler-analyzer structure. A suitable combustible fuel burner, such as a gas burner H, is positioned to discharge products of combustion into the boiler combustion tube 55. The projecting end of the tube 56 and the burner H are encased in a sealed sheet metal housing 58 which is secured to the boiler structure in any suitable manner. The housing 58 is provided with a hand opening and closure 59 to allow access to the burner for adjustment and the like. Gas is supplied to the burner H through a conduit 60 which enters the casing 58 through a sealing grommet 61. Combustion air is supplied to the interior of the casing 58 by a conduit 62 which extends from the casing 58 to the exterior of the projecting portion 32 of the cabinet 31 adjacent to and directly beside the products of combustion discharge flue 57. Both primary and secondary air for the burner H are drawn from the exterior through the conduit 62 into the chamber 58 where they serve to support the combustion of the fuel issuing from the burner.

The apparatus will be controlled either manually or by a suitable automatic control mechanism not shown. The control mechanism will govern the energization of the circulating motor M and the supply of fuel to the burner H.

Referring now again to Figure 5 the apparatus is there illustrated in its operative position with the portion 32 of the casing projecting rearwardly over the sill 70 of a window forming portion of the walls 71 of a building. The lower sash of the window 72 rests upon the upper surface of the casing 32. Suitable gaskets may be provided to insure an air seal between the cas-

ing 32 and the elements of the window. Also collapsible side wings may be provided if desired on the casing 32 in order that the same will seal windows of varying width.

Thus, as the apparatus is illustrated in Figure 5 the heat rejecting portions of the apparatus are positioned in a portion of the casing which projects rearwardly thereof through the window opening to the atmosphere outside the space being conditioned. Likewise the products of combustion discharge flue and the air inlet conduit for the burner extend through the portion 32 of the casing and open exteriorly thereof to the atmosphere outside the space being conditioned. A small amount of outside air is brought in through the louvres 33 beneath the panel 38, passes through the main body of the casing 31 and then passes through the louvres 49 and the panel 47 to admix with the room air being circulated across the evaporator E. If desired, a suitable damper, such as a slide damper, may be provided on the panel 47 to control the opening 49 and thus regulate the quantity of outside air which is permitted to mix with the room air being circulated across the evaporator.

The frame 54 of the apparatus includes a forwardly projecting base portion 75, 76, see Figure 2, which supports the boiler-analyzer burner assembly to which it is suitably secured by any desired means, not shown.

The present invention provides an effective heat operated portable air conditioning unit. By the particular refrigerating system disclosed the over-all dimensions of the apparatus are reduced to an extent such that they will fit readily within a cabinet having a vertical dimension small enough to allow the same to be positioned beneath the window of a residence or to be positioned upon a standard with a portion of the cabinet structure extending through the window to position the heat dissipating portions of the apparatus without the space being conditioned.

In accordance with the present invention a single power operated unit is provided which circulates an inside air stream over the evaporator and sets up an air circulation within the space being conditioned and also induces a circulation of atmospheric air through a U-shaped path of flow in which the atmospheric air picks up the heat of absorption from the absorber and then the heat of condensation from the condenser and is ultimately returned to the exterior.

The arrangement of the heater for the generator, the products of combustion flue and the air supply conduit are of particular significance. The products of combustion are discharged to the outside of the space being conditioned where they will not tend to foul the air with odorous combustion products and will not tend to heat the air within the space being conditioned. Likewise the air supplied to the combustion device is outside air, thereby avoiding use of conditioned air and also completely protecting the burner against pressure differentials which may exist between the space being conditioned and the outside.

There will frequently be a significant pressure differential between the space being conditioned and the atmosphere. If the burner receives air for combustion from the space being conditioned, this pressure differential will cause the products of combustion to discharge into the space being conditioned, or will blow out the flame on the burner or suck the flame off the burner into the combuston tube, all of which conditions create

an explosion hazard and also may cause discharge of toxic gases into the space being conditioned. With the present arrangement, however, the pressure of the air supplied to the burner H is always the same as the static pressure prevailing in the combustion tube 56 of the boiler as the products of combustion are discharged into exactly the same region from which the combustion air is supplied to the apparatus, so that pressure differentials between the atmosphere and the space undergoing conditioning, fluctuations in pressure caused by wind and the like will have no effect whatsoever upon the burner which will operate with the steady flame and steady output of heat independently of the above noted variables and will provide absolute protection against flame extinguishment, creation of explosion hazards and will also insure that toxic products will not be discharged into the conditioned air stream or into the space to be conditioned.

While only one embodiment of the invention has been shown and described herein, it is apparent that various changes may be made in the arrangement and construction of parts without departing from the spirit of the invention or the scope of the annexed claims.

I claim:

1. Air conditioning apparatus comprising a casing; an absorption refrigerating system associated with said casing comprising an evaporator, a condenser, an absorber, a generator and a fluid circulator connected in circuit; said refrigerating system being so constructed and arranged that the condenser, evaporator and absorber all have parts thereof positioned at substantially the same elevation; a combustible fuel burner for supplying heat to said generator; means for producing a flow of air to be conditioned over said evaporator; means for producing a flow of atmospheric air over said condenser and said absorber; means for discharging waste products of combustion to the atmosphere; and means for protecting said burner from air pressure fluctuations.

2. Air conditioning apparatus comprising a cabinet having a portion arranged to be supported from the floor of a room to be air conditioned and a portion arranged to project through a window opening of the room to be air conditioned; means within said cabinet providing a passageway for air to be conditioned and a passageway for cooling air in said projecting portion; a heat operated refrigerating system in said cabinet including a heat operated part, a cooling unit in said passageway for air to be conditioned and a heat rejecting part in said passageway for cooling air; a fuel burner arranged to apply heat to said heat operated part; a flue passing through said projecting portion of said cabinet and arranged to discharge products of combustion which have heated said heat operated part to the atmosphere; and a duct passing through said projecting portion of said cabinet and arranged to convey atmospheric air to said fuel burner.

3. Portable air conditioning apparatus comprising a casing having a first portion adapted to be positioned within a space to be conditioned and a second portion adapted to extend through a window into the exterior atmosphere, a heat operated refrigerating apparatus associated with said casing including a cooling unit in said first portion and heat rejecting means in said second portion, means for circulating air to be conditioned

through said first portion of said casing and outside air through said second portion of said casing, a combustible fuel burner for applying heat to said refrigerating apparatus, and means extending through said second portion of said casing for conveying atmospheric air to said fuel burner and for discharging waste products of combustion to the exterior atmosphere, said apparatus being so constructed and arranged that said last mentioned means opens to the exterior atmosphere away from the direct path of flow of air through said second portion of said casing.

4. Portable air conditioning apparatus comprising a casing having a first portion adapted to be positioned within a space to be conditioned and a second portion adapted to extend through a window into the exterior atmosphere, a heat operated refrigerating apparatus associated with said casing including a cooling unit in said first portion and heat rejecting means in said second portion, means for circulating air to be conditioned through said first portion of said casing and outside air through said second portion of said casing, means providing a path of flow of outside air into said second portion and through said casing into the space being air conditioned, a combustible fuel burner for applying heat to said refrigerating apparatus positioned in the path of flow of said air flowing from said second portion into the said space, means extending through said second portion of said casing for conveying atmospheric air to said fuel burner and for discharging waste products of combustion to the exterior atmosphere, and means arranged to prevent air flowing from said second portion into said space from flowing into said burner air supply and products of combustion disposal means.

5. Air conditioning apparatus comprising a housing structure including means forming a passageway for air to be conditioned and means forming a passageway for air to and from the exterior of the space to be conditioned; a heat operated air conditioning system associated with said casing including heat transfer parts in each of said air passageways and a part to be heated positioned in said housing outside said air passageways; a combustible fuel burner for heating said heated part; a protective structure sealed from both said air passageways enclosing said fuel burner and arranged to pass products of combustion of said fuel burner in heating relationship with said heated part of said system, said sealed protective structure including means for conducting air from the exterior of the space to be conditioned to said fuel burner and means for discharging waste products of combustion to the exterior of the space to be conditioned in a region having substantially the same air pressure as that prevailing at the inlet to said means for conducting exterior air to said fuel burner.

6. Air conditioning apparatus comprising a housing structure including means forming a passageway for air to be conditioned and means forming a passageway for air to and from the

exterior of the space to be conditioned; a heat operated refrigerating system associated with said housing including a cooling device in said conditioned air passageway, a heat rejecting device in said exterior air passageway and a part to be heated positioned in said housing outside said air passageways; a combustible fuel burner for heating said part to be heated; a protective structure sealed from both said air passageways enclosing said fuel burner and arranged to pass products of combustion of said fuel burner in heating relationship with said heated part of said system, said sealed protective structure including means for conducting air from the exterior of the space to be conditioned to said fuel burner and means for discharging waste products of combustion to the exterior of the space to be conditioned in a region having substantially the same air pressure as that prevailing at the inlet to said means for conducting exterior air to said fuel burner.

7. Air conditioning apparatus comprising a housing structure including means forming a passageway for air to be conditioned and means forming a passageway for air to and from the exterior of the space to be conditioned; a heat operated absorption refrigerating system associated with said housing including an evaporator in one of said air passageways, a heat rejecting part in the other of said air passageways, and a generator positioned in said housing outside said air passageway; a combustible fuel burner for heating said generator; a protective structure sealed from both said air passageways enclosing said fuel burner and arranged to pass products of combustion of said fuel burner in heating relationship with said generator, said sealed protective structure including means for conducting air from the exterior of the space to be conditioned to said fuel burner and means for discharging waste products of combustion to the exterior of the space to be conditioned in a region having substantially the same air pressure as that prevailing at the inlet to said means for conducting exterior air to said fuel burner.

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