Nov. 8, 1938. H. WARR 2,135,547

COMBINED COMBUSTION CHAMBER AND HEAT EXCHANGER

Filed Jan. 23, 1937 2 Sheets-Sheet 1

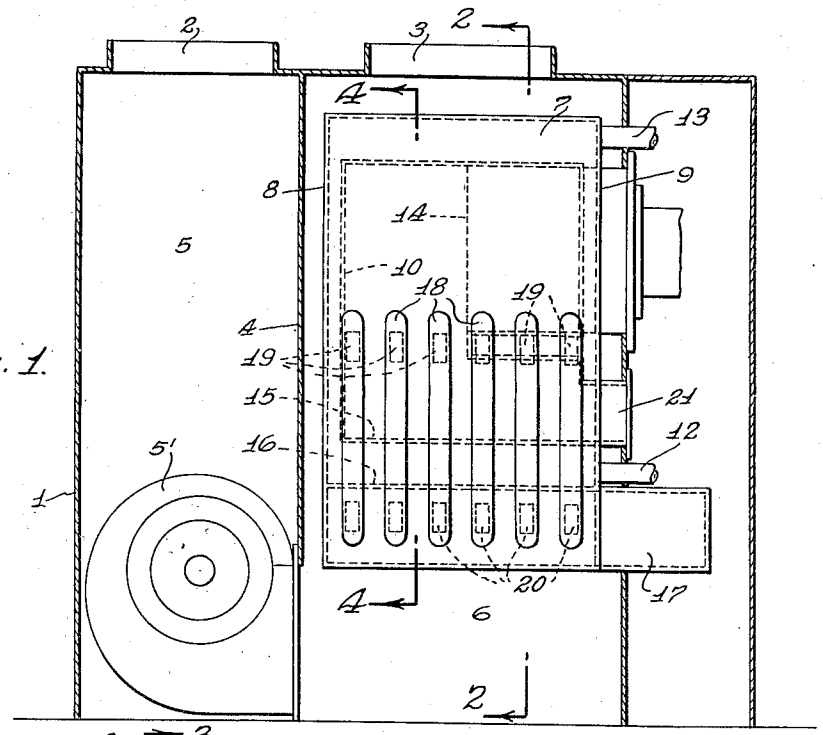


Fig. 1.

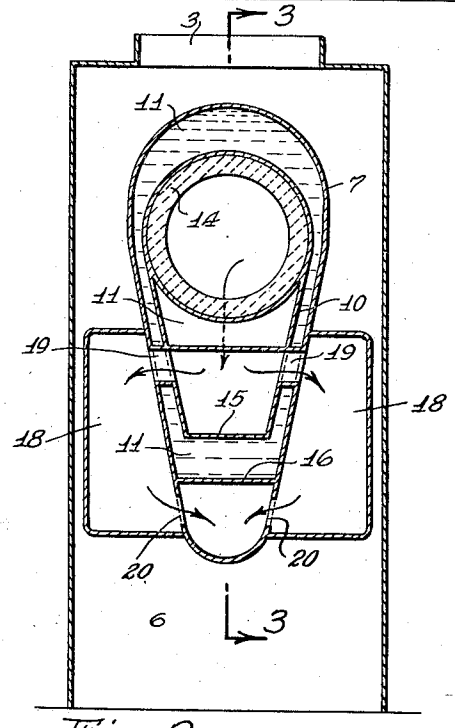


Fig. 2.

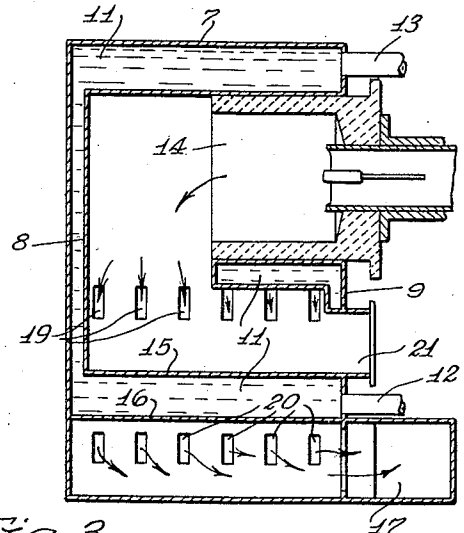


Fig. 3.

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Nov. 8, 1938. H. WARR 2,135,547

COMBINED COMBUSTION CHAMBER AND HEAT EXCHANGER

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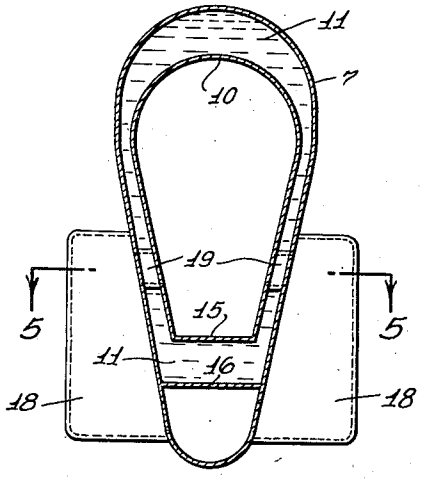


Fig. 4.

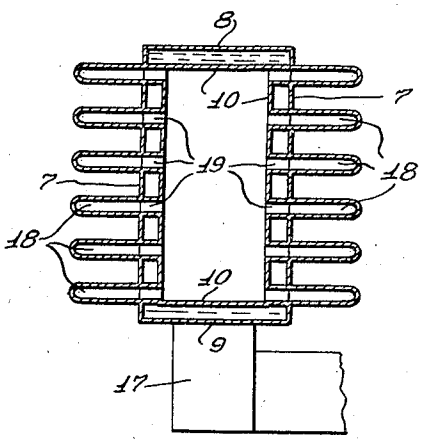


Fig. 5.

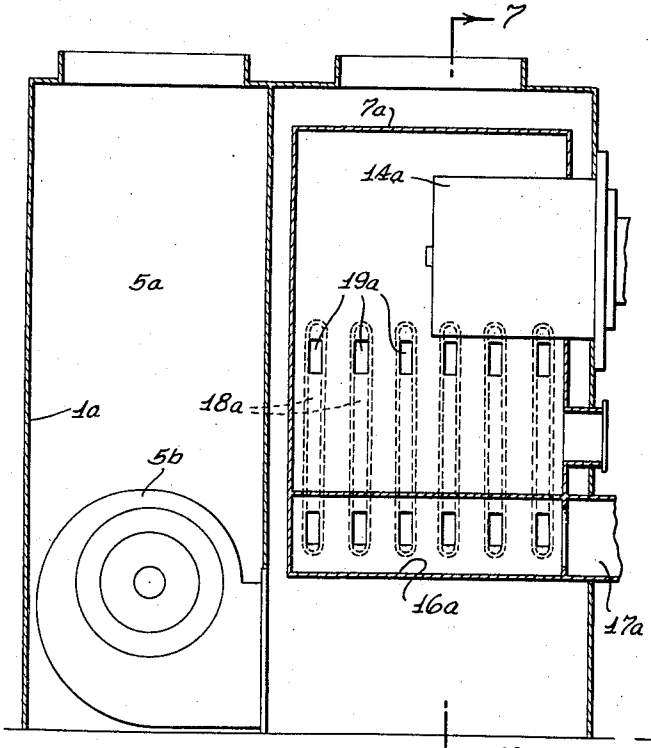


Fig. 6.

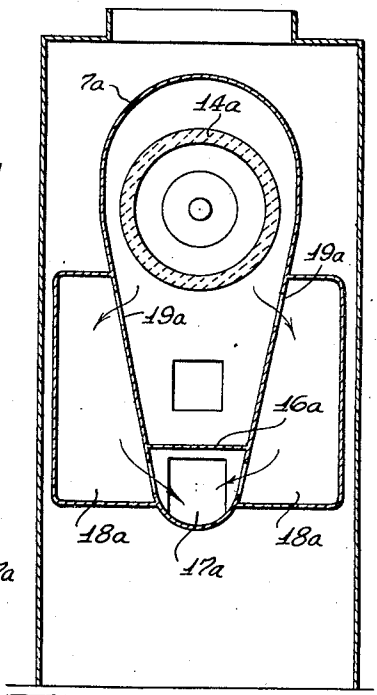


Fig. 7.

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COMBINED COMBUSTION CHAMBER AND HEAT EXCHANGER

Harold Warr, Detroit, Mich.

Application January 23, 1937, Serial No. 122,031

4 Claims. (Cl. 126—101)

The present invention relates to a combined combustion chamber and heat exchanger for furnaces and, although it is particularly adapted for oil burning furnaces, it may also be used in furnaces of the gas burning type.

The primary object of the present invention is to provide a combined combustion chamber and heat exchanger for furnaces of the hot air type wherein the air to be heated is circulated upwardly through the furnace casing, said combined combustion chamber and heat exchanger embodying a novel arrangement of flues through which the burned gases are circulated downwardly prior to exhausting the same through a stack. In such an arrangement, the direction of circulation of the burned gases is opposite to the direction of circulation of the air to be heated. Thus, the temperature difference between the burned gases and the air to be heated at any point in their relative circulation is always widely variant, or in other words, the air to be heated contacts the lowest temperature zone of the heat exchanger and as the temperature of the air is raised it circulates to a zone of higher temperature. By so controlling the relative circulation of the burned gases and the air to be heated a highly efficient, rapid transfer of heat from the gases to the air takes place. In other words, the invention utilizes the known principle that the rapidity of heat transfer increases proportionately to the difference in temperatures between the two gases.

Another object of the invention is to provide a combined combustion chamber and heat exchanger, embodying the characteristics above referred to, and having a surface contour such as to increase the efficiency of the action wherein heat is transferred from the burned gases to the air to be heated. That is to say, the contour of the present unit is so designed that it varies the speed of the air stream, causing the air to flow at a comparatively low rate at the lower temperature regions, and at a faster rate at the higher temperature regions. The slow movement of air permits the heat to be extracted from the burned gases at the zone of final circulation, just prior to their exhaust into the smoke stack, and materially reduces the amount of waste heat.

A further object of the present invention is to provide a combined unit of the character above referred to embodying an exceedingly large heat radiating area streamlined whereby there is no tendency for the boundary layer of air to flow away from the surfaces thereof. In other words, the unit is so formed that the air flows uniformly past the same and extracts heat from the entire radiating surface thereof. The tendency for the air to flow away from the heating surface and the dead air spots resulting from such a tendency is done away with and the heat transfer action is, in this respect also, rendered more efficient.

A still further object of the present invention is to provide a combined combustion chamber and heat exchanger having the characteristics outlined above and also embodying a water jacket. The purpose of the water jacket is two fold in that it provides means for heating water for circulation through radiators and also in that the water tends to retain heat. In providing a source for hot water, as well as hot air, the invention makes possible a dual heating plant so that, by way of example, certain rooms of a dwelling may be heated with hot air while other rooms may be heated with hot water. This is especially desirable where the hot air is re-circulated through the furnace inasmuch as certain rooms, the kitchen for example, may be heated with hot water and cooking odors etc. need not be carried by the heated air to other parts of the dwelling.

A further advantage results from the presence of the heated water in the water jacket, especially in furnaces having automatic controls operated in response to varying temperature conditions. When such controls operate to temporarily shut off the oil burner the source of heat immediately becomes inactive and the air circulated through the heating system, usually by a fan or blower or even by gravity, causes a comparatively cool stream of air to be discharged into the rooms. With the water present, however, its heat tends to temper the air stream so that the temperature thereof does not change too abruptly.

With the above and other ends in view the invention consists in matters hereinafter described with reference to the accompanying drawings, in which

Figure 1 is a vertical section through a furnace casing, illustrating the present unit in elevation;

Figs. 2 and 4 are sections taken respectively, on lines 2—2 and 4—4 of Fig. 1;

Fig. 3 is a section taken on the line 3—3 of Fig. 2;

Fig. 5 is a section taken on the line 5—5 of Fig. 4;

Fig. 6 is a vertical section illustrating a modified unit, and

Fig. 7 is a section taken on the line 7—7 of Fig. 6.

Like characters of reference are employed throughout to designate corresponding parts.

Referring first to the embodiment shown in Figs. 1 to 5, the numeral 1, designates a furnace casing having openings 2 and 3 in the top thereof and a vertical partition 4 located in a plane between the two openings. The furnace casing is thus divided into two sections, designated 5 and 6, and a blower 5' is disposed in the section 5 for drawing air inwardly through the opening 2 and forcing such air beneath the partition 4, through the section 6 and out the opening 3. The casing section 5, as will be obvious to those skilled in the art, is designed for the reception of an air filtering or conditioning device, but inasmuch as such air conditioning apparatus forms no part of the present invention it has not been shown here.

In the casing section 6 is mounted the combined combustion chamber and heat exchanger comprised of sheet metal shapes welded together. The combustion chamber and heat transfer comprises an outer shell 7 which when viewed from one direction, as in Fig. 2 for instance, is pear shaped, and when viewed at right angle to Fig. 2, as in Fig. 3, has vertical, parallel end walls 8 and 9. An inner shell 10, shaped similarly to the outer shell, is provided within the outer shell, the inner and outer shells being relatively proportioned whereby a space 11 is provided therebetween for the reception of water. As shown more clearly in Fig. 3, water may enter the space 11 through the pipe line 12 and may leave the same through the pipe line 13.

Extending into the upper portion of the inner shell 10 is a refractory bowl 14 containing an oil burner. Inasmuch as the oil burner forms no novel part of the invention and burners are already known to the art, the same has not been shown in detail here.

In the outer shell 7, spaced beneath the bottom wall 15 of the inner shell, is a horizontal dividing wall 16 and a duct 17, which leads to the stack (not shown), is connected to the outer shell beneath the dividing wall 16. Secured to the outer shell 7 and extending laterally with respect thereto, are a plurality of comparatively slender, spaced apart flues 18. The upper ends of the flues are connected with the interior of the inner shell 10 by passages 19, and the lower ends of the flues are connected with the interior of the outer shell, beneath the horizontal dividing wall 16, by ports 20. The inner shell 10 has an extension 21 opening through the wall 9 and providing means of access to the interior of the inner shell for cleaning purposes.

When combustion takes place in the upper portion of the inner shell 10 the burned gases are circulated therefrom downwardly to the passages 19, through the flues 18 and ports 20 to the lower portion of the outer shell 7, beneath the horizontal dividing wall 16. From the lower portion of the outer shell 7 the burned gases pass through the duct 17 to the stack. The air circulated through the casing section 6 by the blower 5' first contacts the lower portion of the outer shell 7 adjacent the duct 17. The air then circulates upwardly, around the shell 7 and between the flues 18 and is finally discharged from the casing 1 through the opening 3. Due to the shape of the shell 7, the air circulates at a slower rate adjacent the lower region of the shell than at the top and because the air is at its lowest temperature when it contacts with the lower region the heat transfer from the burned gases to the air takes place rapidly.

Two conditions are thus present which tend to increase the efficiency of the heat exchange. The air moves slowly at the bottom region of the shell 7, which obviously is at a lower temperature than the top region due to the distance it is disposed from the point of combustion. The air in moving slowly provides sufficient time for a heat transfer to take place. The other condition is to have the air contact the coolest portion of the shell while the air is in its coolest condition so that a difference in temperature is present which facilitates a rapid heat transfer and permits extraction of practically all available heat from the burned gases. If the reverse condition were present, that is if the air contacted the hottest part of the heat exchanger first, by the time it reached the cooler region of the heat exchanger its temperature would be raised to a degree nearer that of the heat exchanger and due to the fact that the two agents would be nearer the same temperature the heat transfer would be slower.

Due also to the pear shape of the heat exchanger and combustion chamber the air circulated by the blower 5' does not tend to flow away from the surface of the shell 7. A uniform movement of air over the entire surface of the shell is thus provided and dead air spaces which result when the boundary layer of air tends to flow away from the heat exchanger is done away with and a maximum amount of heat is transferred.

The water present in the space 11 may be circulated through conventional radiators for heating purposes. This water will tend to retain considerable heat, and in the event that the burner is operated intermittently as in the case where thermostatic controls are provided therefor, the temperature of the air circulated through the casing section 6 will be slightly raised in temperature. The air stream, therefore, instead of being circulated at a comparatively cool temperature, will be tempered.

Referring to the embodiment shown in Figs. 6 and 7, it will be noted that the inner shell 10 is done away with and no provision is present for heating water or tempering the air stream when the burner is not in operation. With this type of combustion and heat exchanger it is contemplated that the automatic controls used therewith will be of the type which render the blower inoperative simultaneously with the burner.

The construction and operation of the second embodiment is identical to the first described embodiment with the one exception that no water space is provided. As in the first case, air is circulated through the section 5a of the furnace casing 1a by a blower 5b, and contacts with the surface of a combined combustion chamber and heat exchanger 7a. Combustion takes place in the refractory bowl 14a and the burned gases are circulated downwardly through passages 19a and flues 18a to the lower portion of the shell 7a, beneath the horizontal dividing wall 16a. The burned gases are exhausted from the lower region of the shell 7a through a duct 17a.

Although a specific embodiment of the invention has been illustrated and described it will be understood that various changes may be made within the scope of the appended claims without departing from the spirit of the invention, and such changes are contemplated.

What I claim is:—

1. A combined combustion chamber and heat exchanger comprising an outer shell having substantially parallel end walls and side walls converging downwardly and united at top and bot-

tom by rounded portions, an inner shell substantially corresponding in shape to said outer shell and disposed therein, said inner shell having substantially parallel end walls spaced from the end walls of the outer shell and downwardly converging side walls spaced from the side walls of the outer shell, the upper ends of the inner shell side walls being united by a rounded portion and the lower ends of said side walls being united by a transverse wall spaced substantially from the bottom rounded portion of the outer shell, a transverse partition spaced beneath said transverse wall and dividing the outer shell into a water chamber of which the inner shell comprises the inner defining wall, a plurality of flues connected to the inner shell at points substantially spaced above said transverse wall and to the outer shell at points beneath the transverse partition, a flue connected to the outer shell beneath said transverse partition, and means for conveying water to and from the space between the inner and outer shells.

2. A combined combustion chamber and heat exchanger comprising an outer shell having substantially parallel end walls and side walls converging downwardly and united at top and bottom by rounded portions, an inner shell substantially corresponding in shape to said outer shell and disposed therein, said inner shell having substantially parallel end walls spaced from the end walls of the outer shell and downwardly converging side walls spaced from the side walls of the outer shell, the upper ends of the inner shell side walls being united by a rounded portion and the lower ends of said side walls being united by a transverse wall spaced substantially from the bottom rounded portion of the outer shell, a transverse partition spaced beneath said transverse wall and dividing the outer shell into a water chamber of which the inner shell comprises the inner defining wall, a plurality of flues connected to the inner shell at points substantially spaced above said transverse wall and to the outer shell at points beneath the transverse partition, a flue connected to the outer shell beneath said transverse partition, means for conveying water to and from the space between the inner and outer shells, and means adjacent the top of said shells extending through the space between said shells and projecting into the inner shell for the reception of a fuel burner.

3. A combined combustion chamber and heat exchanger comprising an outer shell having substantially parallel end walls and side walls converging downwardly and united at top and bottom by rounded portions, an inner shell substantially corresponding in shape to said outer shell and disposed therein, said inner shell having substantially parallel end walls spaced from the end walls of the outer shell and downwardly converging side walls spaced from the side walls of the outer shell, the upper ends of the inner shell side walls being united by a rounded portion and the lower ends of said side walls being united by a transverse wall spaced substantially from the bottom rounded portion of the outer shell, a transverse partition spaced beneath said transverse wall and dividing the outer shell into a water chamber of which the inner shell comprises the inner defining wall, a plurality of flues connected to the inner shell at points substantially spaced above said transverse wall and to the outer shell at points beneath the transverse partition, a flue connected to the outer shell beneath said transverse partition, means for conveying water to and from the space between the inner and outer shells, and an integral formation on the inner shell extending through the space between the shells and opening through the outer shell for providing access to the inner shell for cleaning purposes.

4. A combined combustion chamber and heat exchanger comprising two shells similar in shape and disposed one within the other with a space therebetween, each shell having downwardly converging side walls and the inner shell having a transverse bottom wall spaced substantially from the bottom of the outer shell, a transverse partition in the outer shell spaced from the bottom thereof and from said transverse wall, means in the inner shell opening through the outer shell for the reception of a fuel burner, a plurality of flues connected with the inner shell at their upper ends and at their lower ends with the outer shell beneath said transverse partition, and a flue outlet means connected with the outer shell beneath said transverse partition.

HAROLD WARR.