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A. L. SMITH

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HEAT EXCHANGER

Original Filed March 27, 1933

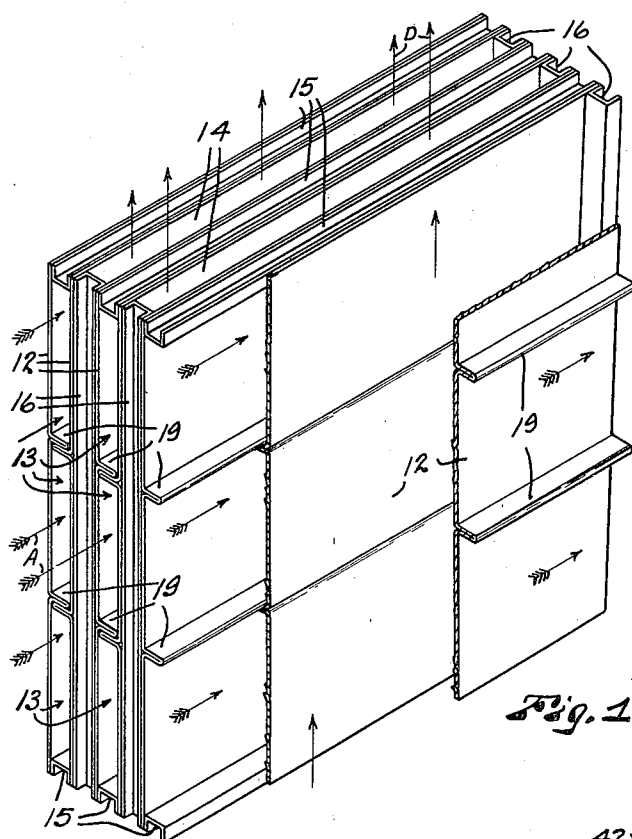


Fig. 1

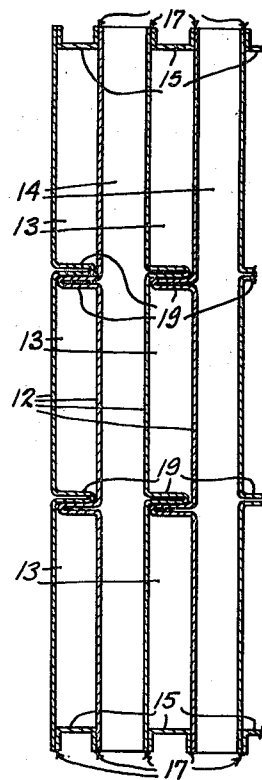


Fig. 2

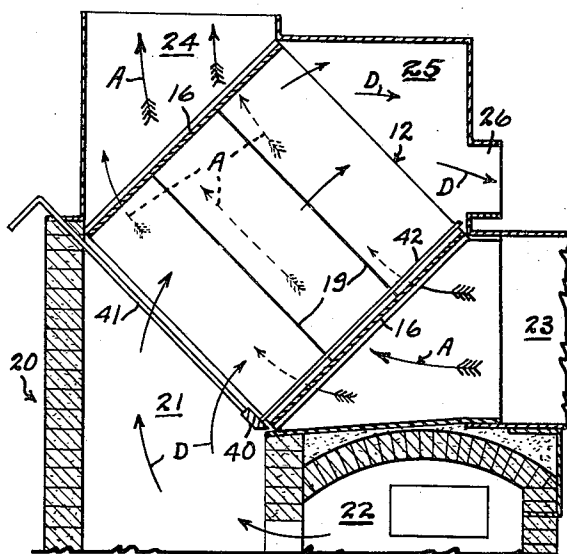


Fig. 3

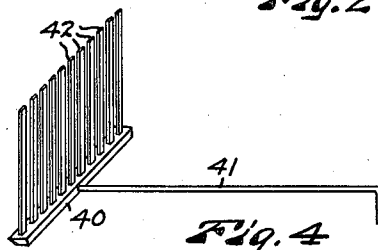


Fig. 4

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HEAT EXCHANGER

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Original application March 27, 1933, Serial No. 662,877. Divided and this application June 27, 1935, Serial No. 28,595

4 Claims. (Cl. 257—245)

My invention relates to a heat exchanger or a heat exchange unit of a form adapted for use in heating systems and this application is a division of my prior application Serial Number 662,877, filed, March 27, 1933, for "Furnaces".

The general object of my invention is to provide a heat exchange unit wherein an interchange of heat between a temperature imparting fluid and a fluid to be tempered may be very quickly and efficiently brought about.

Another important object of my invention is to provide a heat exchange unit which possesses a very large area of heat exchange surface in proportion to the size of said heat exchange unit.

Another important object is to provide a heat exchange unit by which a very large proportion of the heat generated by the combustion of fuel in a furnace, fireplace, stove or the like may be picked up and rendered available for heating purposes.

Another object is to provide a heat exchange unit in which the travel of the fluid to be tempered is in a direction substantially at right angles to the direction of travel of the temperature imparting fluid, thus making it possible, where this heat exchange unit is incorporated in a furnace, to pick up such a large proportion of the heat from the heated gases that the temperature of said heated gases at the location of discharge from the heat exchange unit is lower than the temperature of the air in the air take-off conduit.

Another important object of the invention is to provide a heat exchange unit of the type herein disclosed in which suitable partitions are formed by folds in the sheet metal of which the walls of the heat exchange unit are constructed, said partitions affording expansion means which prevents buckling of the said walls due to changes of temperature, and said partitions providing additional heat radiating surface and further serving to divide the air circulation spaces into passageways, whereby more efficient heat exchange is obtained.

Another object is to provide a simple and efficient cleaner means in combination with a heat exchanger of this type.

Other and more specific objects will be apparent from the following description taken in connection with the accompanying claims.

In the drawing, Figure 1 is a fragmentary perspective view, with parts broken away, of a heat exchange unit constructed in accordance with my invention.

Fig. 2 is a sectional view, on a larger scale than

Fig. 1, showing one manner of ribbing heat exchange walls to afford expansion to said walls, to reinforce and strengthen the walls and to afford partition or baffle means in the passageways adjacent to said walls.

Fig. 3 is a fragmentary vertical sectional view of a furnace showing a preferred installation of my heat exchange unit.

Fig. 4 is a detached perspective view of a cleaner or scraper device embodied in this heat exchanger.

Like reference numerals designate like parts throughout the several views.

Referring to Figs. 1, 2, and 3, I show a heat exchange unit embodying a plurality of, preferably rectangular, substantially parallel heat conductive walls 12 which are spaced apart a short distance to afford two sets of passageways 13 and 14 respectively therebetween, the passageways of said two sets being alternately positioned and extending at right angles to each other. Closure members 15 are provided at two opposite edges of the passageways 13 and other closure members 16 are provided at the opposite edges of the passageways 14. These closure members are preferably in the form of small channel bars turned with their channel sides outwardly and the walls may be of sheet metal and may be welded to said channel bars, as at 17, preferably near the outer edges of the side flanges of said channel bars, thereby forming a unitary structure which is fluid and gas tight. By positioning the closure members 15 at the two sides of the passageways 13 which are at right angles to the two sides of passageways 14 at which the closure members 16 are positioned I obtain two sets of passageways 13 and 14 respectively which extend at right angles to each other. This affords an ideal heat exchange unit which makes it possible to permit a gravity circulation of a temperature imparting fluid or agent through one set of passageways and a gravity circulation of a fluid or agent which is being tempered through the other set of passageways. It is also adaptable to a forced circulation of either or both of the fluids. By thus causing the two different fluids or agents to travel through the passageways 13 and 14 in directions at substantially right angles to each other I am able to more than equalize the temperature of the two fluids as hereinafter explained and thus to obtain a higher heat exchange efficiency than it is possible to obtain by causing the two fluids to travel substantially parallel with each other. The narrow passageways 13 and 14 further serve to bring a large

amount of the fluids in both sets of passageways into direct contact with the relatively great area of thin heat conductive walls thereby contributing to the high efficiency of this heat exchange unit.

The heat exchange unit may be very quickly and easily built up at a relatively low cost in almost any sheet metal shop by welding the walls or plates 12 to the channel shaped edge members 15 and 16.

The walls 12 of the heat exchange unit are provided at one or more locations with horizontally extending ribs 19 preferably formed by bending. These ribs 19 stiffen and reinforce the walls 12 and also act as horizontal partitions or baffle means for dividing the air passageways into horizontal compartments. This tends to prevent the air which is passing through these compartments from rising to the top of the unit as it is heated, a thing I have found in practice that it will do. These ribs 19 further act as expansion means and permit the walls 12 to expand and contract without buckling when they are subjected to changes of temperature. Said ribs 19 also provide more heat radiating metal surface or area in the air passageways 13. I have shown these partitions only in the air passageways 13 but may also provide them in the hot gas passageways 14, provided the cleaner means, hereinafter described, is omitted.

The channel shaped edge closure members 15 and 16 are preferably turned with their side flanges outwardly as shown in the drawing. This is of especial advantage along edges which are exposed to the direct action of heated gases and flame as it provides an air pocket along these edges which has been found to be effective in preventing damage to these channel members by the heat and has further been found to offer less resistance to the upward flow of hot gases than would be offered by flat surfaces flush with the edges of the walls 12 in this location. When the channel members 15 and 16 are thus turned with the flanges outwardly it allows the side plates 12 to be welded along the edge portions of the flanges as indicated by 17 and for this reason affords more flexibility at the location of the weld and tends to prevent the side plates from breaking loose along the weld.

In Fig. 3 I have shown a preferred installation of my heat exchange unit in a furnace. In this figure 20 designates a furnace having a heat exchange unit installed in an inclined position in the upper portion thereof, the arrangement of the heat exchange unit being such that the two sets of passageways 13 and 14 extend at angles of approximately forty-five degrees relative to the vertical or horizontal, it having been found that approximately this angular position is productive of the best gravity circulation of both heated gases and air. The furnace 20 has a chamber 21 positioned below the heat exchange unit and in communication with one set of passageways 14. This chamber 21 preferably communicates with a combustion chamber 22.

Air may be admitted to the passageways 13 of the heat exchange unit through a cold air intake conduit 23 and taken off through a warm air take-off conduit 24, as indicated by arrows A. The hot gases enter the passageways 14 from the chamber 21 and after traveling said passageways may pass into a chamber 25 and be discharged through a smoke pipe or flue 26, as indicated by darts D.

As a means for keeping the walls of the hot gas

passageways clean and free from soot, I preferably provide a cleaner Figs. 3 and 4, embodying a cross bar 40 movably supported immediately below the heat exchange unit and connected with an operating bar or handle 41 which extends out through a side of the furnace housing. Fingers or cleaning members 42 are secured to the cross bar 40, and extend into the hot gas passageways. The bearing of handle 41 in the furnace housing may support the cleaner. Grasping handle 41 and moving the fingers of the cleaner back and forth in the hot gas passageways will dislodge soot which may adhere to the walls of said passageways thus permitting such soot to drop down into the lower furnace chambers or to pass out through the flue. This affords a very quickly and easily operated cleaning means which encourages frequent cleaning. It will be noted that all surfaces of this heat pick up unit which are exposed to the accumulation of soot are substantially vertical whereby the tendency to collect soot is minimized and also that the heat exchange unit is positioned so that soot which does adhere to these surfaces and is dislodged therefrom will drop down out of the heating unit.

By the use of this heat exchange unit in a furnace, it is possible to raise the temperature of the air which issues from the heat exchange unit above the temperature of the gases which are discharging from said heat exchange unit. The reason that this is possible is because the air to be heated is supplied at all elevations to the air passageways. The lowermost strata of this air becomes highly heated and the ascending gases correspondingly cooled. These gases being cooled as they rise are constantly coming in contact with walls over which cooler air of the upper strata in the air spaces is flowing with the result that this cooler air picks up heat from the gases which could not be picked up by the warmer air in the lower portion of the air spaces thus cooling the gases considerably below the temperature of the warmer air. When the air passes out of the air spaces into the air take off conduit 24 warmer and cooler strata of this air immediately commingle and mix with the result that the discharging warm air has a higher temperature than the discharging cooled gases. This tendency is accentuated by the use of the baffles or partitions 19 in the air spaces.

The foregoing description and accompanying drawing clearly disclose a preferred embodiment of my invention but it will be understood that this disclosure is merely illustrative and that such changes in the invention may be made as are fairly within the scope and spirit of the following claims.

I claim:

1. A heat exchange unit embodying a plurality of spaced apart heat conductive sheet metal walls forming two sets of passageways therebetween, said walls having reinforcing folds provided therein, said reinforcing folds extending into said passageways thereby forming partition and deflector means in said passageways; means closing the passageways of each set at two opposite sides, the closed sides of one set of passageways being positioned at approximately right angles to the closed sides of the other set of passageways.

2. In a heat exchange unit, a plurality of spaced apart substantially parallel sheet metal walls having passageways therebetween; expansion and reinforcing ribs in said walls comprising integral doubled portions substantially per-

pendicular to said walls extending from one side to another of said walls in spaced apart relation, said ribs protruding into alternate passageways and providing partition and deflector means in said alternate passageways; closure means at the sides of the passageways into which the ribs project extending in the same general direction as the ribs; and other closure means at the sides of the other passageways positioned at approximately right angles to said ribs and to said first mentioned closure means.

3. In a heat exchange unit of the class described, a plurality of substantially rectangular substantially parallel sheet metal walls supported in spaced apart relation providing therebetween passageways; closure means provided at opposite edges of alternate passageways; other closure means provided at opposite edges of the passageways between said first mentioned passageways, said first mentioned closure means and said last mentioned closure means being positioned along edges at substantially right angles to each other providing between said walls two sets of fluid passageways extending generally at right angles to each other; expansion and reinforcing ribs in said walls comprising integral doubled portions substantially perpendicular to

said walls protruding into said passageways providing partition and deflector means in said passageways, said ribs extending in the same general direction as the closure means at the sides of the passageways in which said ribs are positioned.

4. In a heat exchange unit, a plurality of substantially parallel sheet metal walls spaced apart providing passageways therebetween; closure means at opposite edges of alternate passageways; other closure means at opposite edges of the passageways between said first mentioned passageways, said first mentioned closure means and said last mentioned closure means being positioned along edges at substantially right angles to each other; a cross bar movably supported at one side of said heat exchange unit, bar moving means connected with said cross bar; and a plurality of cleaner members on said cross bar extending into alternate passageways in relatively close proximity to said walls and movable reciprocally with said cross bar to clean said walls, the length of the cleaner members being substantially equal to the width of the walls whereby substantially the entire area of the walls will be cleaned by the cleaner members.

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