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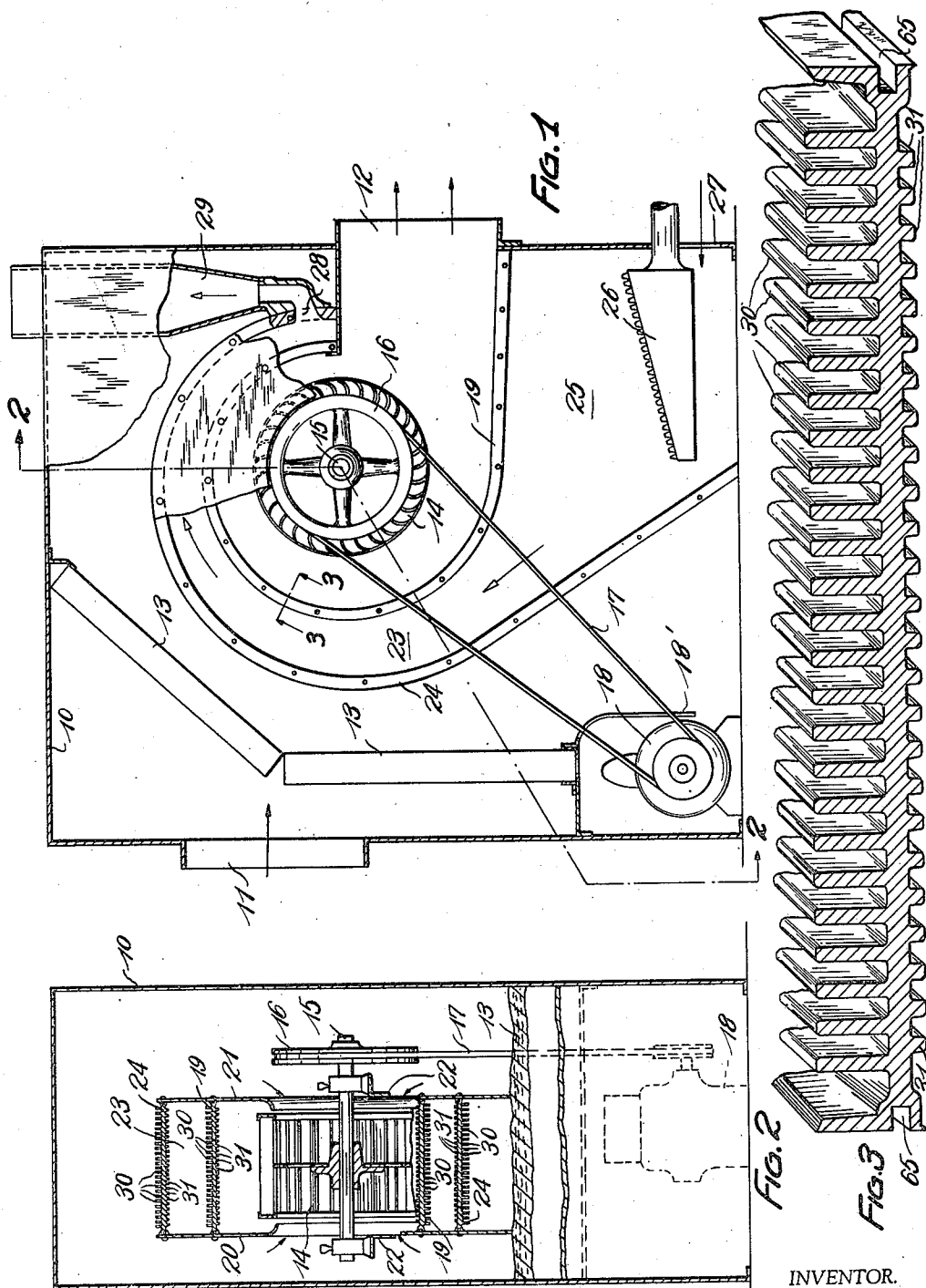
F. R. HIGLEY

2,330,122

HEATING APPARATUS

Filed Feb. 9, 1940

3 Sheets-Sheet 1



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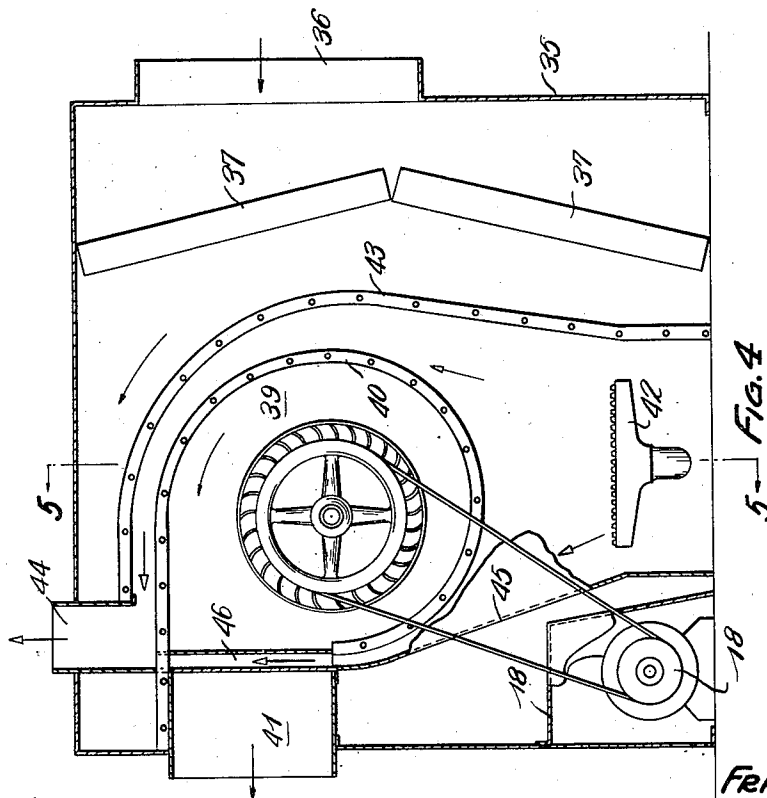
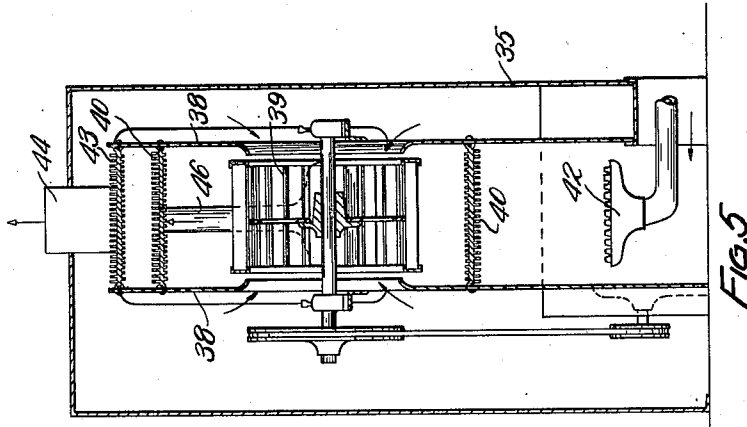
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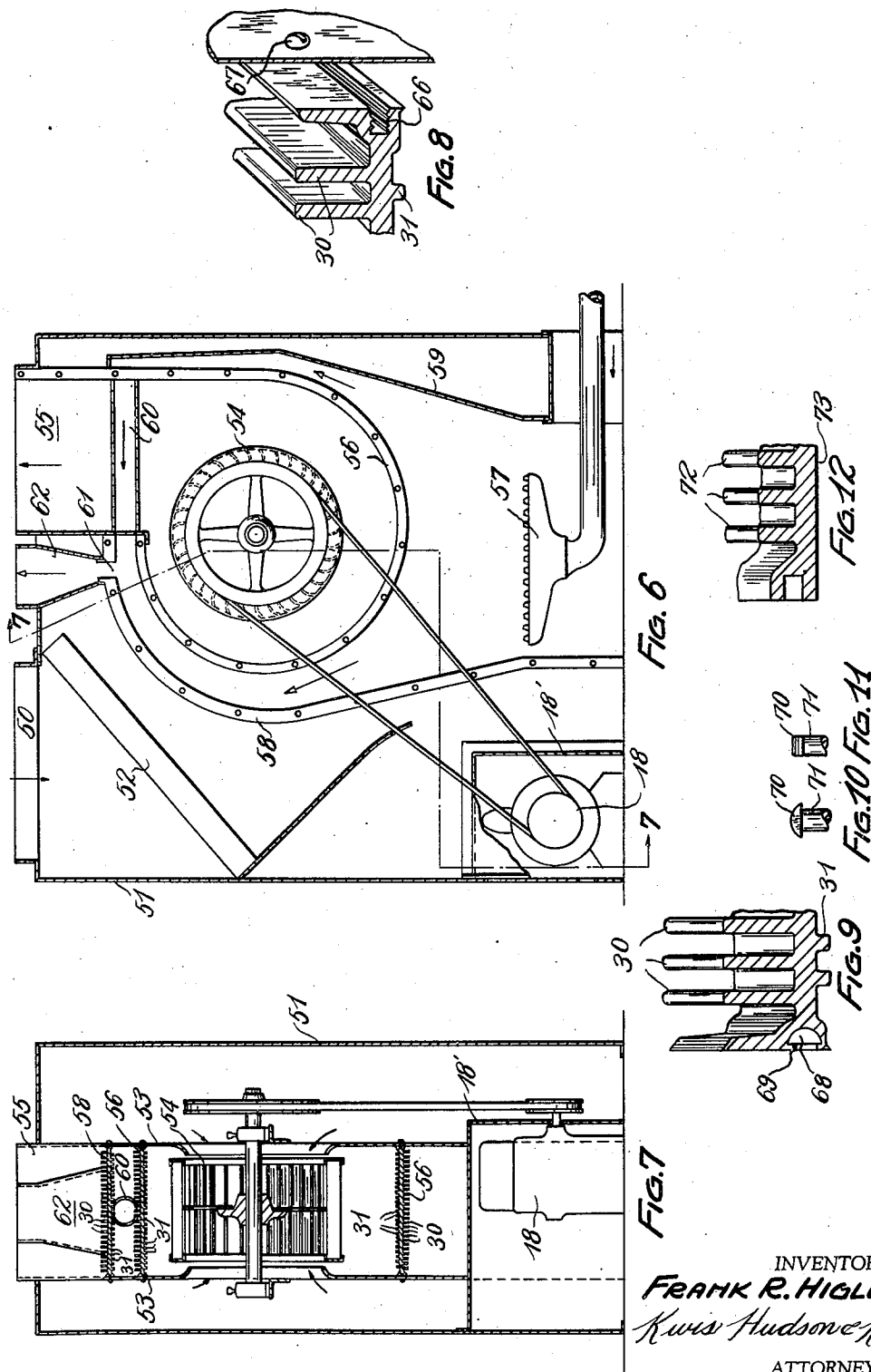
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3 Sheets-Sheet 3



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HEATING APPARATUS

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8 Claims. (Cl. 126-110)

This invention relates to improvements in heating apparatus, more particularly heating apparatus embodying an air blower, and applying primarily to warm air heating systems.

It is well known in the art that heat transfer from one space, such as a combustion chamber, to another space containing air to be heated, by way of an intervening metal wall, is dependent largely upon two basic conditions: first, the thermal conductivity of the wall itself and second, the velocities of the gases contacting the opposite faces of the wall. Generally, it is the object of this invention to provide a construction utilizing a metal wall of such character and gases moving at velocities such as to function most effectively for the purpose intended.

The usual combustion chamber temperatures are very high as compared with desirable heated air temperatures, and in fact may exceed the melting point of otherwise desirable wall metals. The present invention contemplates employing for such wall a metal of high thermal conductivity so that heat may be conducted from its hotter to its colder surface at a correspondingly high rate, yet wiping the heated air from its colder surface at a rate still higher, so as to maintain the mean wall temperature below the melting point of the wall metal even though the temperature of the gases on its hot side may exceed the melting point of the metal.

With these principles in view the invention contemplates the employment of aluminum or the like as the wall material, disposing the wall as the scroll portion of the housing of a centrifugal blower, so that the radially inward surface of the wall will be wiped throughout its area by the air discharged by the blower wheel, which of course is the air to be heated, the wiping being at maximum air velocity for the entire system of which the apparatus of this invention constitutes the heating unit.

Still more particularly, and of equal importance, the invention contemplates the employment, for the scroll or heat transmitting wall, of an extruded section of aluminum or the like. Such section has substantial advantage over anything heretofore employed in the art. It provides absolute uniformity of section, surfaces on both sides which are perfectly smooth in one direction, that is longitudinally of the scroll, and yet permits complete latitude of deformation in the other direction, thereby lending itself to the formation of longitudinal fins. It promptly oxidizes on its hot surface under exposure to combustion gases but without other depreciation to form a thin film

of relatively low conductivity whereby peak temperatures at isolated locations are avoided and the metal itself is protected against the action of acid in the combustion gases; and, on the cooler side its smooth surface not only offers minimum resistance to wiping flow of air thereover, but remains relatively bright so as to minimize radiant heat loss, which has some importance as will appear. Furthermore, a scroll formed of an extruded section permits of a novel and superior arrangement of mounting between the side plates of the blower housing, which manner of mounting permits some relative freedom for expansion adjustment circumferentially of the scroll while positively maintaining the scroll fixed in radial direction.

It will be observed that the extruded scroll has such curvature in one direction and is so fixed along its curved edges with the side plates between which it is disposed, that there is provided maximum resistance to buckling under temperature differences of either the scroll or side plates.

The invention further contemplates employment not only of the heat conducting scroll described, but also of a second heat transferring wall radially outward from the scroll, so that a flue passage for products of combustion is formed bounded radially between these two walls and longitudinally of the blower axis by the two side plates. Still further, the invention contemplates employment of the same section of the same material for these two walls so that under conditions of expansion and contraction the two blower housing side plates are positively maintained, in parallel relation with each other, against buckling.

Still further, the invention contemplates employment of face characteristics for the extruded section, such that there will be more effective surface area on one face of the section than on the other, and consequently capacity for more rapid heat transfer on one face than on the other. The disposition of the extruded section to present the face of larger effective area either toward or away from the blower wheel depends upon the requirements of the particular design. If, for example, the heat applied to the hot side of the scroll is not too great and the air flow on the cool side is relatively rapid, the greater surface area should be on the side remote from the blower wheel. As the heat applied to the hot side increases however, or the rate of air flow on the cool side decreases, the difference in surface areas on the two sides of the scroll should become less and less. Under certain conditions the effective

surfaces may be equal. Finally, if the heat on the hot side becomes great enough or the air flow rate on the cool side becomes low enough a reversal of the relative areas herein illustrated will be necessary, in other words the extruded section should then be so disposed as to direct the surface of larger effective area toward the blower wheel.

One of the objects of the invention therefore is the provision of heat exchange apparatus of compact form and high efficiency.

Another object is the provision of heating apparatus in which aluminum or other non-ferrous metal of high thermal conductivity and relatively low melting point may be employed as the heat transfer wall.

Another object of the invention is the utilization of the scroll of the blower as the heat exchange wall of a furnace, and the formation of that scroll of aluminum so constituted as to facilitate the wiping of the air film from the scroll wall by the action of the blower.

Another object of the invention is the formation of the scroll of extruded aluminum, suitably ribbed for strength and increased surface.

A further object is the provision of novel means for interconnecting the scroll and the side plates of the blower.

Other objects and features of novelty will appear as I proceed with the description of those embodiments of the invention which, for the purposes of the present application, I have illustrated in the accompanying drawings, in which

Fig. 1 is a diagrammatic side view, partly in section, of a warm air furnace embodying the invention.

Fig. 2 is a transverse sectional view taken substantially on the line 2—2 of Fig. 1.

Fig. 3 is a detail sectional view on a larger scale showing a section of extruded aluminum scroll wall.

Figs. 4 and 5 are views similar to Figs. 1 and 2, illustrating a modified form of the invention.

Figs. 6 and 7 are similar views of still another modification of the invention.

Fig. 8 is a detail perspective view partly in section illustrating one means for attaching the scroll to a side plate of the blower.

Fig. 9 is a detail view of the scroll with a modified form of groove along its edge adapted to accommodate bolts as fastenings.

Figs. 10 and 11 are fragmental views at right angles to each other illustrating a bolt with a flattened head adapted to be used with the scroll of Fig. 9.

Fig. 12 is a detail view of a modified form of scroll wall.

In Figs. 1 and 2 of the drawings the casing of a warm air furnace is indicated at 10. The intake for cold air is shown at 11 and the outlet for heated air at 12. Air filters 13 may be employed if desired, through which the air must pass before entering the furnace proper. Within the casing and spaced from the side walls thereof I mount a blower wheel 14 of conventional design comprising a shaft 15 upon which is mounted a pulley 16 driven by a belt 17 from an electric motor 18, over which there is a guard 18' to protect it from the heat. The fan is enclosed partially by a scroll 19 which terminates at or is connected with the warm air outlet 12. The scroll 19, which may be of a width somewhere between six inches and twelve inches, is attached at its edges to blower side plates 20 and 21 which preferably extend down to the base

of the casing. Angle bars 22 upon which the bearings for shaft 15 are carried may be attached to these side plates.

The blower assembly includes a conductor or flue 23 for hot gases, the inner wall of which is constituted by the scroll 19 and the side walls by the side plates 20 and 21 of the blower. The remaining or outer wall 24 is secured between the side plates 20 and 21 and is curved throughout at least a portion of its length so as to confine the hot gases to a path adjacent the scroll 19. The lower end of this outer wall however extends down to the base of the casing, forming with the lower part of scroll 19, the side plates of the blower and the bottom and one end of casing 10, a combustion chamber 25 in which is located a burner 26. An intake for air to support combustion is provided at 27. A suitable vent 28 is provided at the opposite end of the conductor 23 with which a pipe 29 leading to a chimney is connected.

The two strips from which the scroll 19 and wall 24 are built are preferably identical in cross section and made of the same non-ferrous metal, although this is not necessarily the case. The scroll 19 is obviously the more vital element of the invention, and the wall 24 could be a strip of ordinary ferrous sheet metal if for reasons of economy in first cost it should appear desirable to make it so. However, in accordance with the preferred form of the invention, not only the scroll 19 but also the wall 24 are made of an extruded aluminum strip curved to the desired form. As illustrated in Fig. 3 this strip may have relatively high ribs 30 on one side and lower ribs 31 on the other side, the ribs of one surface lying opposite the grooves of the other surface. The latter arrangement has the advantage that expansion and contraction due to temperature changes tends to be localized in the individual corrugations of the strip rather than to cause bowing of the strip as a whole in a transverse direction. The ribs also strengthen the strip in the manner of corrugations in sheet metal. A further function of the ribs however is to increase the surface exposed to the air currents on one side of the strip and to the hot gases on the other side thereof, thereby increasing the rate of heat transfer, the height of the ribs being proportioned to fit the requirements of the case.

In the embodiment illustrated I arrange the extruded strip for scroll 19 so as to present the high ribs 30 on the outer side and the lower ribs 31 on the inner side. The high ribs, having large surfaces, absorb heat rapidly. On the inner side of scroll 19 the ribs present relatively less surface because it is assumed that the air flowing over these ribs is moving very rapidly and is capable of removing heat therefrom at least as rapidly as it can accumulate therein.

In the case of the wall 24 the high ribs 30 are arranged externally, considered with respect to the conductor 23 through which the hot gases flow. In the illustrated embodiment air in contact with the outer surface of the wall is moving slowly under the suction drag of the blower, instead of rapidly as in the discharge from the blower. On the inner side of the wall facing the hot gases in conductor 23 those gases impart heat to the wall. It should not absorb heat as readily as its outer surface gives off heat to the slowly moving air, because of course it is desirable that the temperature of the wall be prevented from approaching too closely the melting point of the metal used in its construction. Hence I arrange

the high ribs on the outer surface and the lower ribs on the inner surface.

In the modification illustrated in Figs. 4 and 5 the construction of the furnace is like that of Figs. 1 and 2 in most essential particulars. The air to be heated enters the casing 35 at 36, passes through filters 37 and around the blower side plates 38 into the ends of the hollow wheel 39, being discharged from the wheel centrifugally against a scroll 40 and being delivered through outlet 41. Products of combustion rise from burner 42 and flow upwardly on one side of scroll 40 between that scroll and an outer wall 43 and out through stack 44. Scroll 40 is formed of extruded aluminum and wall 43 is also preferably formed of the same material. A part of the hot gases also flow upwardly along the other side of scroll 40 between that scroll and a transverse sheet metal wall 45 interposed between the two side plates 38. This part of the conductor for hot gases is connected by means of one or more small pipes 46 with stack 44, the pipe or pipes 46 extending through the air delivery part of the blower.

Still another modified form of furnace is illustrated in Figs. 6 and 7, this type being designed primarily to be placed upon the floor of a basement, whereas the two previously described embodiments are preferably attached to the ceiling of a basement or other room. In the present embodiment the return air flows downwardly at 50 into the furnace casing 51, through an air filter 52, around side plates 53 of the blower into the ends of the hollow wheel 54, from which it is discharged centrifugally and passes out through the upwardly directed exit 55. A scroll 56, preferably of extruded aluminum, is used. Part of the hot gases from burner 57 flows upwardly between scroll 56 and an outer wall 58, also made preferably of extruded aluminum. The rest of the gases flow upwardly on the opposite side of scroll 56 between that scroll and a sheet metal guard 59 interposed between the side plates 53 of the blower, the gases traveling thence through one or more horizontal pipes 60 into the upper end of the space between scroll 56 and wall 58, all of the gases leaving by way of exit 61 and stack 62.

As illustrated in Fig. 3 I may provide grooves 65 in the two side edges of the extruded metal strips forming the radially separated walls of the flue. The width of these grooves is such that screws of a given diameter when driven through holes in the blower side plates will enter the grooves and form their own threads in the relatively soft metal of the strips, thereby effectively connecting the strips and the side plates. As a modification of this type of fastening I may provide small ribs or teeth 66 facing inwardly from the walls of the grooves, see Fig. 8, the teeth on one side of the groove being staggered with respect to those on the opposite side and so placed that screws 67 with a properly proportioned thread will engage the teeth on the two sides of the groove, the teeth thereby taking the place of ordinary threaded sockets. The teeth are formed of course in the extruding operation.

In Fig. 9 I have illustrated still another form of edge groove 68 having a constricted mouth 69 of a width just sufficient to accommodate the flattened head 70 of a bolt 71. Such bolts can be inserted through holes in the side plates of the blower, and when the heads are within the groove beyond the constricted mouth 69 they may be

turned through an angle of 90°, whereupon they are locked in place. The fastening is then completed by screwing nuts onto the exposed ends of the bolts.

In Fig. 12 is shown one modification of an extruded metal strip that may be employed, this strip having ribs 72 on one side and a flat surface 73 on the opposite side. When this strip is used for the scroll member the smooth surface is directed inwardly, assuming that the other factors of design are the same as in the embodiment herein disclosed. The smooth surface is also directed inwardly when used for the outer wall. The ribs in each case therefore are on the outer side just as the higher ribs are on the outer side in the scroll and wall previously described, it being the purpose in all instances in which a blower is involved to provide more rapid transfer of heat from the flue through the inner wall thereof than through the outer wall.

While in the drawings I have shown the scroll defining the inner side of the flue or conductor for hot gases and the wall defining the outer side of the flue as made up entirely of extruded section, it will be appreciated that the length of such extruded section in one or both of these walls may be decreased if desired, the balance of the walls being constructed of sheet metal or other relatively low cost material. Such short extruded sections of course call for a relatively high degree of heating in order to maintain the desired efficiency of the apparatus.

In each of the modifications illustrated the air intake is so arranged that upon entering the casing the air is directed against the hottest portions of the outer wall 24, 43 or 58, as the case may be, this being a matter of primary importance where such outer wall is formed of metal of low melting point, as is preferred.

Having thus described my invention, I claim:

1. In apparatus of the character described, a volute heat exchanger wall formed of extruded aluminum having integral longitudinal fins.

2. In heating apparatus, a volute wall formed of extruded aluminum having integral longitudinal fins on at least one surface thereof, and means for conducting combustion gases over the outer surface of the volute wall in a direction longitudinally thereof.

3. In heating apparatus, a blower wheel adapted to receive air to be heated axially and deliver it centrifugally, a scroll for said wheel, means for heating said scroll externally, said scroll being formed of extruded aluminum having longitudinal grooves in its edges, ferrous metal side plates, and fastenings extending through said side plates into said grooves for holding the scroll in assembled relation with the side plates.

4. In heating apparatus, a blower wheel adapted to receive air to be heated axially and deliver it centrifugally, a scroll for said wheel, means for heating said scroll externally, said scroll being formed of extruded aluminum, said scroll having longitudinal grooves in its edges, ferrous metal side plates, and screws extending through said side plates into said grooves, the diameter of the screws being greater than the width of the grooves whereby the screws form their own threads in the scroll.

5. In heating apparatus, a blower wheel adapted to receive air to be heated axially and deliver it centrifugally, a scroll for said wheel, means for heating said scroll externally, said scroll being formed of extruded aluminum, said scroll

having longitudinal grooves in its edges, small teeth running along the sides of the grooves, ferrous metal side plates, and screws extending through said side plates into said grooves, the threads of the screws engaging said teeth in the manner of screws engaging threaded openings.

6. In heating apparatus, a blower wheel adapted to receive air to be heated axially and deliver it centrifugally, a scroll for said wheel, means for heating said scroll externally, said scroll being formed of extruded aluminum, said scroll having longitudinal grooves in its edges with constricted mouths, ferrous metal side plates having holes therethrough opposite the edges of said scroll, and bolts having flattened heads adapted to be inserted through said holes and through the constricted mouths of said grooves and then rotated 90° whereby the bolts are locked against withdrawal.

7. In heating apparatus, a volute wall, an outer wall spaced from said volute wall and partly enclosing the periphery thereof, said volute and outer walls being formed of high heat conducting, high expansion metal, a pair of side wall members of high strength metal,

fastenings between said side wall members and the edges of said volute and outer walls and the said side wall members permitting elongation of the volute and outer wall, said side wall members extending across the edges of said volute and one of them having an opening for admitting air to the apparatus, means for causing products of combustion to pass between the volute and outer walls, and a blower wheel within the volute wall, whereby air is caused to flow at high speed over the inner surface of said volute and out of the apparatus.

8. In heating apparatus, a volute wall, an outer wall partially encircling said volute wall, both of said volute and outer walls being formed of high heat conducting, high expansion metal, high strength metal side plates joined to the side edges of said volute and outer walls to provide therebetween a conductor for combustion gases, said volute and outer walls having longitudinal grooves in their edges and said side walls having fastenings extending into said grooves permitting expansion and contraction of the volute and outer walls lengthwise.

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