June 6, 1933. G. BLUEMEL 1,913,019

AIR HEATER

Filed Aug. 6, 1930 2 Sheets-Sheet 1

Fig. 3

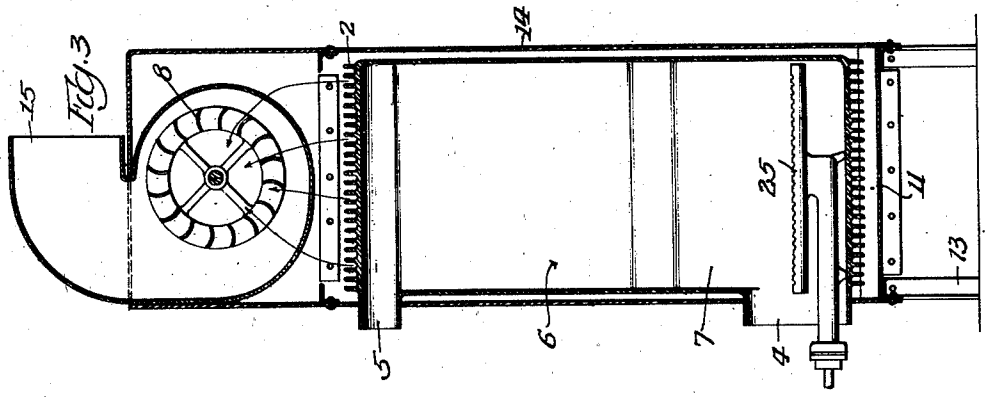


Fig. 2

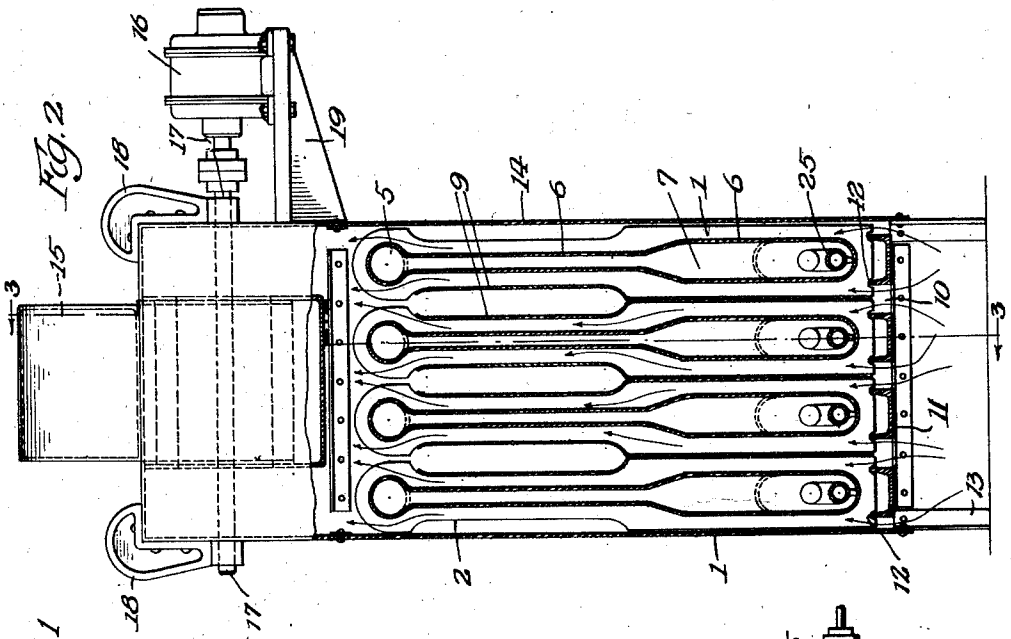
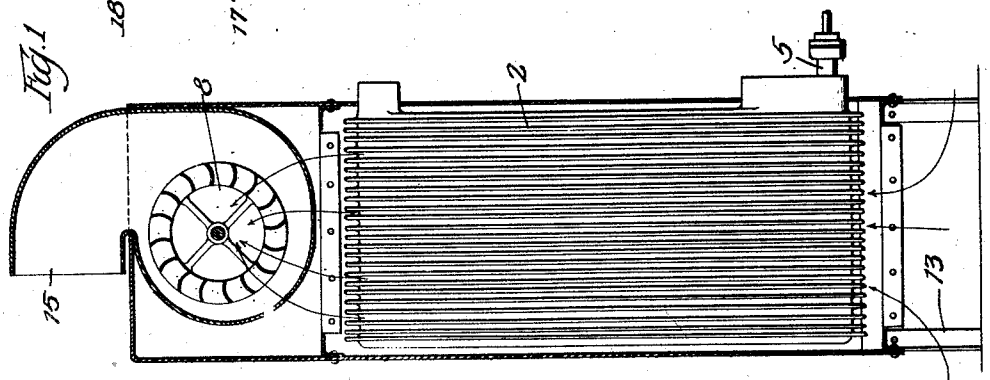


Fig. 1



Inventor
Gustave Bluemel
By Rummler, Rummler & Woodworth
Attys

June 6, 1933. G. BLUEMEL 1,913,019

AIR HEATER

Filed Aug. 6, 1930 2 Sheets-Sheet 2

Fig. 5

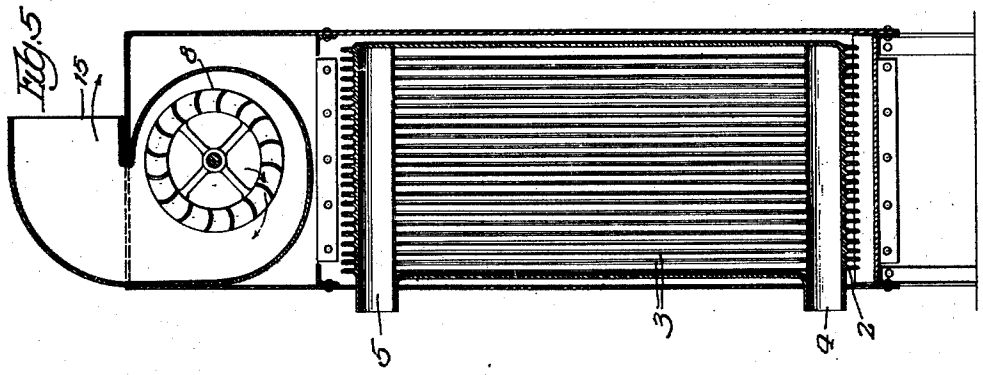


Fig. 4

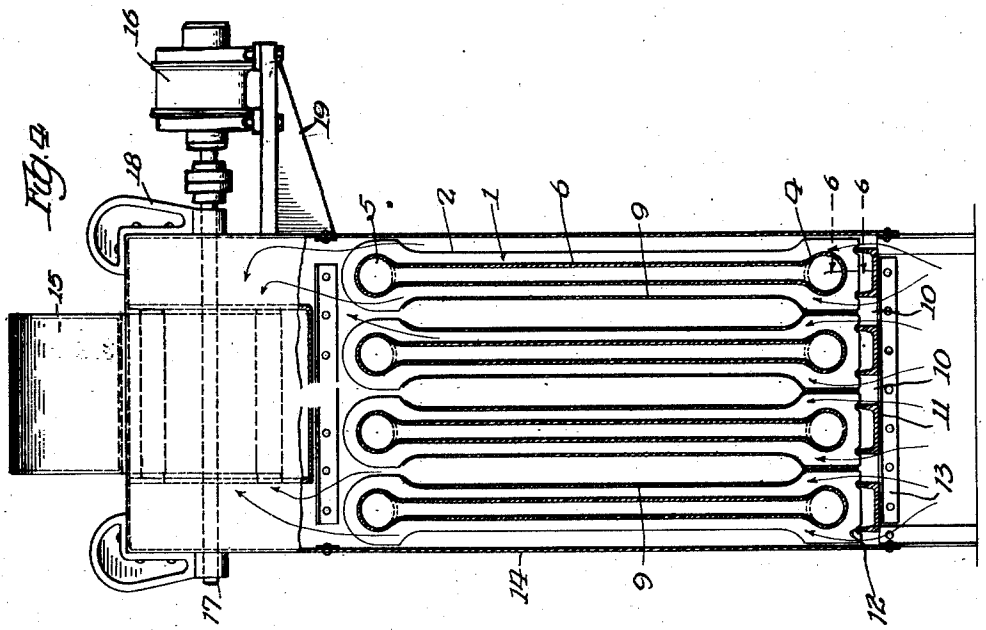
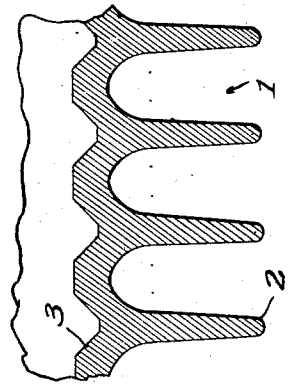


Fig. 6



Inventor
Gustave Bluemel
By Rummler, Rummler & Woodworth
Atty

Patented June 6, 1933 1,913,019

UNITED STATES PATENT OFFICE

GUSTAVE BLUEMEL, OF CHICAGO, ILLINOIS, ASSIGNOR TO DRYING SYSTEMS, INC., OF CHICAGO, ILLINOIS, A CORPORATON OF ILLINOIS

AIR HEATER

Application filed August 6, 1930. Serial No. 473,349.

This invention relates to the transferring of heat from one gas to another, for instance heat from the products of combustion or other heating medium to air.

It is customary in this art, where high temperature air is required for industrial purposes, such as in processes of drying various materials, to provide heat interchangers having long and tortuous paths for the fluids between which the heat passes. Such arrangements result in some loss in efficiency, due to turbulence in the fluids created by bends in the fluid conducting channels, excessive size and cost. There are also losses in many such devices due to the possibility therein of stratification of the fluids or differences in pressure at various points in the fluid conduits.

An object of the present invention is to provide a construction wherein the heating and heated mediums, to a great extent, may be caused to flow through the heater without turbulence or stratification and through a comparatively shorter path while still exposed to large areas of heat transferring surfaces.

Another object of the invention is to provide a construction wherein a plurality of heat interchanger units are arranged side by side, each unit having a plurality of outwardly projecting fins disposed parallel to the flow of the heated and heating mediums and spacer plates arranged on each side of each unit, whereby a high velocity of the medium to be heated is created at the colder upper portion of each unit.

A further object of the invention is to provide for rapid transmission of heat in large quantities from one medium to another, with a reduction in the resistance to the flow of the two mediums over that occurring in constructions now commonly in use and consequently with a saving in the cost of creating the flow of the fluids between which the heat is transferred.

It is also a purpose of the invention to provide a multiple unit heater designed for an indefinite number of like units, each having an individual gas or oil burner, wherein the units may be assembled side by side to make a heater of any desired capacity; to provide ribbed heat-transferring surfaces wherein the ribs are entirely parallel to both the flow of the heating medium on one side, and the flow of the heated medium on the other side, and improvements in construction which result in the heated mediums closely following the heat-radiating surfaces of the heat interchanger.

The purposes of the invention may be accomplished by means of either of the two forms shown in the drawings. Of these two forms, Figures 1, 2 and 3 show an arrangement for transferring the heat of combustion occurring within separate units of the apparatus, to a heat-receiving medium, such as air. Figures 4 and 5 represent a variation designed for transmitting to a heat receiving medium, the heat from hot air or products of combustion delivered to the apparatus.

Figure 1 is a side view of the heater unit with the casing thereof shown in section.

Fig. 2 is a front view with parts of the heater shown in section.

Fig. 3 is a sectional view taken on the line 3—3 of Figure 2, except that the blower on the top of the heater is shown by full lines.

Fig. 4 is a front view partly in section of a modified form of the heater as designed without burners for the purpose of extracting heat from any heated medium, such as hot air or the products of combustion from a furnace and transmitting the heat to a gaseous medium.

Fig. 5 is a sectional view to illustrate the construction of one unit of the heater shown in Fig. 4, the blower on the top being indicated by full lines.

Fig. 6 is an enlarged sectional detail illustrating the form of ribs employed on any one unit of the heater.

It is evident that the most efficient heat-transmitting arrangement is one that will transmit the greatest amount of heat with the least resistance offered to the flow of the heat and the two fluids from one to the other of which the heat is transmitted. Also the quantity of the heat transmitted varies with

the temperature difference between the two fluids, the velocity thereof, the conductivity of the walls separating the fluids, and the extent of exposed area of such separating walls.

It is also desirable to provide paths for the fluids which will insure their wiping over large areas of separating walls and to avoid the use of sharp bends which may cause eddy-currents or undesirable changes in fluid pressure. The wall thickness should be the minimum consistent with the kind of material employed. Also the heater should be designed to avoid stratification of the mediums when passing therethrough.

The heater construction illustrated complies with these requirements by the use of a plurality of like, separable units, each of comparatively simple construction in which the heating and heated mediums are caused to wipe over large areas of heat-transferring surfaces which are greatly enlarged on the heated medium side, by the use of radiating ribs and on the opposite side by grooves, both of which run parallel to the direction of flow of both fluids. The heater units are assembled side by side to provide narrow flat passageways for the heated medium between the units, and preferably on the top of the assemblage of units, is a blower for drawing the heated medium upwardly between the units.

When the air is drawn upwardly between the units it flows parallel with the products of combustion or other heating medium However, in some uses of this heater, it is desirable to cause the air which is heated to flow oppositely to the direction of flow of the products of combustion or other heating medium from which the heat is extracted. This may be provided for without other change than in the location of the blower and conduit connections therefor. The most characteristic feature of this heater is the parallel unit arrangement whereby broad parallel heat transferring surfaces are wiped over by thin wide, sheet-like columns of the heating and heated mediums at comparatively high velocity. The heat radiating fins and depressions in the separate units of the heater also are parallel to the flow of the products of combustion and the heated air. At the areas where the heat transfer takes place, there are no turns or bends in the apparatus which will interfere with uniform flow of the heating medium and the heated air.

Referring to the drawings, Figs. 1, 2 and 3, the heater shown comprises a plurality of separable and removable heat transferring elements 1, each of which is a casting having a large number of longitudinally extending heat radiating fins 2. The outline of the fins follows the contour of the wall of the unit as may be seen from Figure 2, a cross section of which wall is shown enlarged by Figure 6.

The inner surface of the wall is provided with corrugations running parallel with the fins 2 in order to increase the inner surface area of the unit without obstructing the passage of the products of combustion therethrough. These corrugations are provided for by the grooves 3 formed in the casting. Each casting is closed except for an inlet 4 and an outlet 5, the latter leading to an exhaust stack.

A gas burner 25 is shown in Figures 1, 2 and 3 at the bottom of each heater unit 1 and inserted through the opening 4. The side walls 6 of each unit are shown further apart at the lower portion thereof than at the upper portion, in order to provide a combustion chamber 7 of suitable capacity for permitting complete combustion without interference. At the upper half of each unit, the walls 6 are close together so as to permit the combustion gases to come in contact therewith and rapidly lose heat through the walls.

Each unit carries, at its upper extremity, an enlarged head or header portion which serves the purpose of holding the resistance of the gas flow to a minimum at the point where all the gases collect in their upward travel and are discharged horizontally. The enlarged head or header further serves to create an even draft, or flow, all along the upper discharge slot and thus prevent stratification of the products of combustion.

The air which is drawn upwardly between the units, by means of the blower 8, is divided into a plurality of streams between the fins 2 and follows the outer surfaces of walls 1, directed by sheet metal plates 9 which bear against the outer edge of the fins 2 and which are formed to follow the outline thereof. The plates 9 receive heat by radiation and conduction from the heater units and assist in delivering the heat to the currents of air. The air enters the spaces between the heating units at the bottom of the heater passing upwardly through the spaces 10 between horizontal U-bars 11 which support the heater units 1. At the bottom edge of the fins 2 are recesses 12 which fit over the flanges of the U-bars 11. The latter are in turn supported at their ends by the fixed angle bars 13.

The assemblage of heater units is surrounded by a casing 14 which prevents leakage of air from the heater. The air is delivered to a receiving conduit attached to the outlet end 15 of the blower. The blower is driven by an electric motor 16 coupled to the blower shaft 17, the bearings of which are supported by brackets 18 attached to casing 14. The motor supporting bracket 19 is also secured to the casing 14.

In the construction illustrated by Figures

4 and 5, like reference numerals are applied to the parts corresponding to the parts shown in Figures 1 to 3. The form of heater shown in Figures 4 and 5 differs from the latter by not having provision for a combustion chamber or increased wall spacing at the lower end of each unit. It is designed to receive products of combustion or other medium heated outside of the heat interchanger.

While the device has been described as an air heater it is of course useful for the purpose of transferring heat between different mediums, either for the purpose of increasing or decreasing the temperature of one or the other of said mediums. In the operation of either form of the construction illustrated the heating and heated mediums are compelled to flow in parallel paths either in the same direction or in opposite directions according to the conditions of use of the apparatus. The medium such as products of combustion which flows through units 1, due to the formation of these units is maintained in sheet like form so as to cover a large area of heat absorbing surface. Aside from the general form of each unit this area is increased by the channels 3, Figure 6. The heat receiving medium, such as air, is forcibly blown or drawn parallel to the flow of the products of combustion. Due to the plates 9 bearing against the outer edges of the fins 2, the heat receiving medium is compelled to travel between the fins and these plates and is thereby divided into a plurality of streams surrounded by heat conducting surfaces.

Details of the constructions herein illustrated and described may be varied without departing from the invention as defined by the following claims.

I claim:

1. A heat interchanger comprising conduit forming walls which are arranged to provide a sheet form passageway and an inlet at one end and an outlet at the other end, fins formed on the outside of said walls and parallel in the direction between the inlet and outlet, said walls also being formed to provide an enlarged space therebetween at one end of the heat interchanger.

2. A heat interchanger comprising conduit forming walls which are arranged to provide a sheet form passageway and an inlet at one end and an outlet at the other end, fins formed on the outside of said walls and parallel in the direction between the inlet and outlet, said walls also being formed to provide an enlarged space therebetween at one end of the heat interchanger, and guide plates on the outer edge of said fins to form therewith conducting channels for the medium to which heat is to be transmitted through said fins.

3. A heat interchanger comprising a plurality of separable units located side by side, each unit being formed by end walls and by parallel side walls closely associated to provide a wide sheet like conduit which is closed except for an inlet at one end and an outlet at the other end, parallel fins extending from the exterior of said side walls, recesses in the bottom of said fins and a supporting structure for said units having flanges engaging said fins at said recesses.

4. An air heater comprising a housing, a plurality of separable metal heat interchanger units, each unit being formed by end walls and by parallel side walls closely associated to provide a wide sheet-like conduit which is closed except for an inlet at one end and an outlet at the other end, a widened chamber at the inlet end of said unit, an enlarged header portion at the outlet end of said unit, fins disposed on the outside of said unit parallel to the flow of heat interchanging mediums, spacer plates disposed on the outside of said unit in contact with the edges of said fins, means for causing a flow of air through the passages defined by said fins and said spacer plates, and means for accelerating the flow of a heating medium through said unit.

5. An air heater comprising a housing, a plurality of separable metal heat interchanger units, each unit being formed by end walls and by parallel side walls closely associated to provide a wide sheet-like conduit which is closed except for an inlet at one end and an outlet at the other end, a widened chamber at the inlet end of said unit, an enlarged header portion at the outlet end of said unit, a plurality of fins disposed on the outside of said unit parallel to the flow of heat interchanging mediums, a groove on the inside of said unit directly opposite each fin and parallel thereto, spacer plates disposed on the outside of said unit in contact with the edges of the said fins, means for causing a flow of air through the passages defined by said fins and spacer plates, and means for accelerating the flow of a heating medium through said unit.

6. A heat interchanger comprising a plurality of separable units located side by side, each unit being formed by end walls and by parallel side walls closely associated to provide a wide sheet-like conduit which is closed except for an inlet at one end and an outlet at the other end, parallel fins extending from the exterior of said side walls, a groove on the interior of said side walls directly opposite each fin and parallel thereto, spacer plates between the units, and means for causing a medium the temperature of which is to be changed to flow between said fins and spacer plates.

7. A heat interchanger comprising conduit forming walls which are arranged to provide a sheet form passageway having an

inlet at one end and an outlet at the other end, fins formed on the outside of said walls and parallel in the direction between the inlet and outlet, and a groove on the interior of said side walls directly opposite each fin and parallel thereto to maintain a substantially uniform thickness for the entire side wall surface.

Signed at Chicago this 30th day of July 1930.

GUSTAVE BLUEMEL.