Sept. 9, 1930. G. H. PHELPS ET AL 1,775,173

AIR HEATER

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Fig. 1.

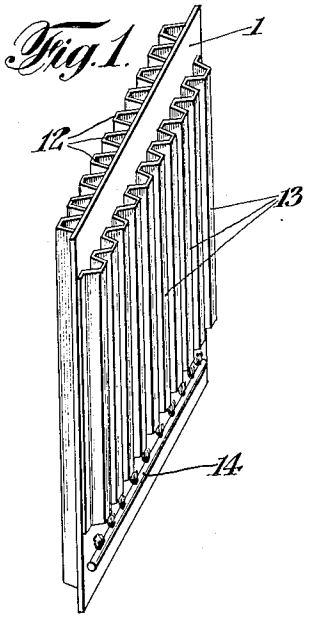


Fig. 2.

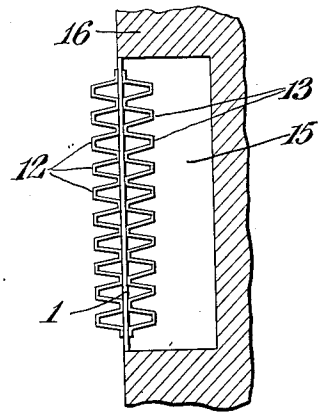


Fig. 3

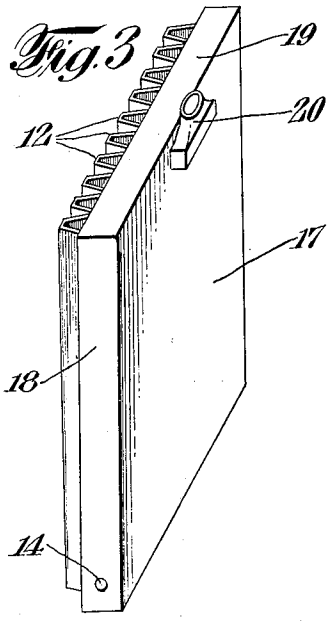
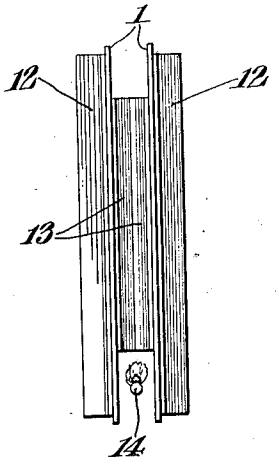


Fig. 4.



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Fig. 5.

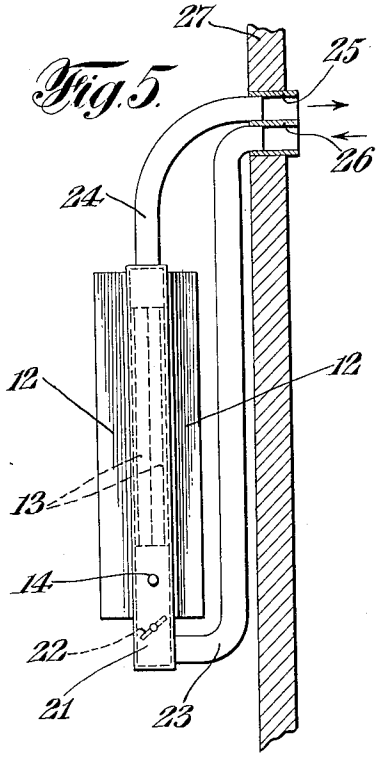


Fig. 6.

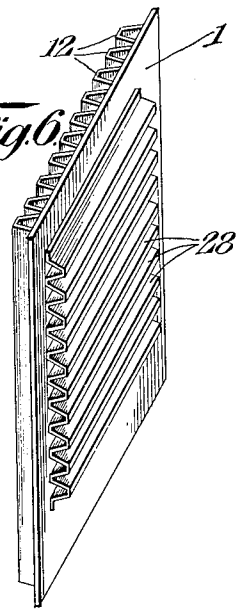


Fig. 7.

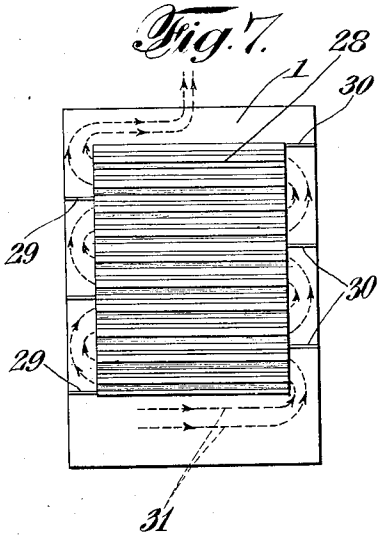
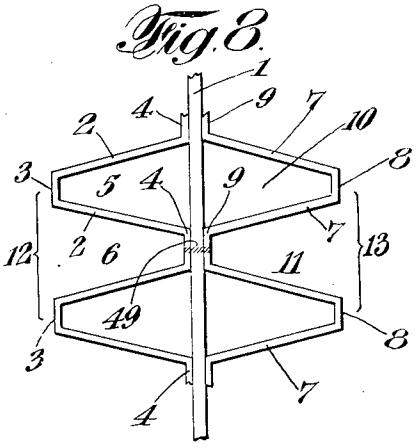


Fig. 8.



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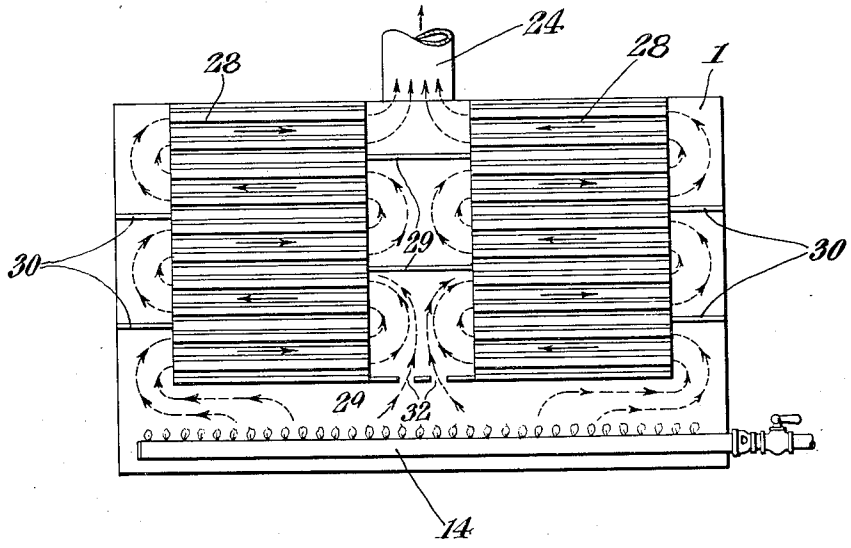
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AIR HEATER

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Fig. 9.



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UNITED STATES PATENT OFFICE

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AIR HEATER

Application filed October 19, 1928. Serial No. 313,474.

In certain previous applications we have described a type of radiators in which corrugated sheets of thin metal, copper preferably, are applied to a pipe or chamber for steam or hot water or to an electric heating element and from flues and passages in which the air is heated and rises and is circulated throughout the room to be heated. Such radiators have a high efficiency and can be manufactured economically. Similar principles are employed according to the present invention, using a hot gas as the heating medium. The accompanying drawings illustrate embodiments of the invention.

Fig. 1 is a perspective view omitting the casing.

Fig. 2 is a plan of the heater located in a fireplace.

Fig. 3 is a perspective of the same arranged for connection to a discharge pipe for the used gas.

Fig. 4 is an end elevation of a modification.

Fig. 5 is a side elevation of the heater of Fig. 4 mounted for use.

Fig. 6 is a perspective of the interior of a modified type.

Fig. 7 is a rear elevation of a slightly different construction.

Fig. 8 is an enlarged detail.

Fig. 9 is a rear elevation of a modification.

Where steam or hot water is used for the heating medium as in previous applications, it is sufficient to use a comparatively small tube or vessel therefor. But for efficient use of gas it should be brought into contact with a larger surface. For this purpose a corrugated sheet of thin copper or an equivalent arrangement of fins on large area is provided for abstracting heat from the gas and transmitting it to the extended surface of flues or fins forming the air passages.

The two extended area structures are mounted on opposite sides of a plate 1 of thin sheet copper. Other metals may be used for this plate as well as other parts of the heater. On the outer face of the plate 1 (see Fig. 8) is a sheet corrugated to form vertical fins 2 connected at their alternate outer edges by plates 3 and at their inner edges by plates 4 so as to form vertical flues 5 which are closed in cross-section and passages 6 which are closed on three sides but open at the outer side. On the back face of the plate 1 is a similar sheet of corrugated metal providing fins 7 connected by plates 8 and 9 to form closed flues 10 and channels 11.

The air circulating and heating structure is indicated as a whole by the numeral 12, and the gas heated structure by the numeral 13. The latter is made somewhat shorter than the former to allow space above for passage of the exhaust gas to an escape flue and at the bottom for an inlet for hot gas if such gas be brought from a distant source. The apparatus is designed for use however with a burner consisting of a pipe 14 applied directly beneath the heating passages and perforated at intervals along the top for ignition of the gas.

The parts may be united in various ways as for example by welding the parts 4 and 9 together through the plate 1, as indicated at 49 in Fig. 8; or by means of straps applied to opposite sides of the registering plates 4 and 9 and welded to each other at intervals through these plates and the supporting plate 1, as described in detail in our previous applications.

Fig. 2 shows the structure of Fig. 1 set in the face of the fireplace 15, with the plate 1 substantially flush with the inner face of the wall 16. The burnt gas will thus pass up the chimney, and the air will be heated and circulated through the room. According to Fig. 3 the heating gas side of the radiating structure is enclosed by a face plate 17, and side plates 18 and a top plate 19 attached as shown to the edges of the supporting plate 1. The casing is open or perforated at the bottom to admit air for combustion and communicates at the top with an outlet pipe 20.

Fig. 4 illustrates a design in which there are two units like that of Fig. 1 with the corrugated plates 13 placed back to back. The whole may be mounted on a wall or supported on legs, and the same is true of all the other designs illustrated.

Fig. 5 illustrates a suitable arrangement of flues and connections for use where there is no chimney convenient. Below the burner

14 there is a manifold 21 from which air may pass through a damper or regulating device 22 to the burner above. An inlet flue 23 conducts fresh air to the manifold. From the space above the gas passages an outlet pipe 24 carries off the burnt gases. A box 25 with a longitudinal partition 26 dividing it into two horizontal passages extends through the wall 27. The passages communicate with the air inlet 23 and the gas outlet 24 respectively. There is an advantage in having the outer ends of these two passages close together. Any tendency of the wind to blow into the outlet flue is balanced by an equal tendency to blow into the inlet flue, and thus approximate equilibrium is maintained at the flame. This makes the blowing out of the flame extremely unlikely. Also it prevents any burned or unburned gas from escaping into the room since the flame and combustion space are entirely cut off from the room and are open only to the outside air. Many variations of the structure can be designed which will cause any wind, or pressure from the outside air to be substantially equal in both the flues.

Air and gas connections as described may be used with any of the heaters referred to herein.

According to Fig. 6 the fins or corrugated structure 28 for contact with the gas are arranged horizontally. The burner in this case will be mounted to supply the heating gas at one side and the flue arranged to take it off at the opposite side.

Fig. 7 shows a modification of this idea in which baffles 29 at one side are staggered with respect to baffles 30 at the opposite side. The heating gas may be supplied from a remote source or from a burner in the bottom and will take the sinuous course indicated by the dotted lines 31, escaping at the top. The casing, and the arrangements for admitting air and exhausting burnt gas are substantially the same for Figs. 6 and 7 as for the other figures. The welding connections are similar to those in Fig. 8, the welds being made where the horizontal straps and plates at one side of the support 1 cross the vertical straps and plates at the other side.

Where a heater of considerable length and capacity is desired, the arrangement of Fig. 9 is preferable. Roughly speaking it duplicates the corrugated plates 28 of Fig. 7 on the gas side of the intermediate plate 1. By arranging the fins in two separate sets in this way, the paths of the gases are kept comparatively short. Where extra long passages are provided there is a tendency for the lowermost passages to become overheated compared with those above it. This is avoided by the two units of Fig. 9 placed end to end, with the hot gas divided into two streams of half length and of opposite directions as indicated by the arrows.

The term "extended area structure" is used to define a structure which is corrugated, finned or similarly shaped so as to present a surface which is materially greater than the area of a flat projection of the structure; thus providing a comparatively large contact surface with air or gas within a limited space or rectilinear distance.

A heater 2 as long as that of Fig. 9 has twice the capacity, but has the same length of travel of the hot gas in each pass as in the case of Fig. 7. To further reduce overheating of the bottom fin, the bottom center baffle 29 has openings 32 through it which allow part of the gas to pass directly to the second pass of the heater, that is without going previously through the first pass.

A heater of greater length and of more hot gas units 28 can be made in the same way, the only additional requirements being a manifold outlet to bring the discharge gases together and lead them to a common flue.

The plate which separates the air from the gas is not necessarily a flat plate as illustrated. It may, for example, be corrugated to provide channels for the air on one side and the gas on the other. Also the shape and construction of the extended area structures for the gas and for the air may be varied in a number of ways.

The walls of the passages are formed in part by the intermediate plate so that the latter is heated on one side directly by contact with the gas and also by conduction from the other walls of the passages, and at the other side the air is heated directly by contact with the plate as well as by contact with the remaining walls of the air passages. The area of contact with the air is greater than that of contact with the heating gases. This makes for efficiency; the air extracting the heat practically to the limit of the distance to which it can be conducted through the metal.

Various modifications may be made by those skilled in the art without departing from the invention as defined in the following claims.

What we claim is:

1. An air heater comprising a plate, vertical fins on one face of said plate forming vertical flues for heating air and inducing a strong upward draft of such heated air and fins on the opposite side of the plate forming passages for a heating gas the fins at the opposite sides being united to each other through the plate.

2. An air heater comprising a supporting plate, a corrugated plate applied to one face thereof with the corrugations vertical so as to heat the air and induce a rapid upward draft of air and a corrugated plate applied to the opposite side of the supporting plate and adapted to be heated by hot gas and to

transmit heat through the supporting plate to the opposite corrugated plate.

3. An air heater comprising a plate of conducting metal at one side of which are a number of parallel passages for a hot gas, means for supplying hot gas to said passages, the walls of said passages being formed in part by said plate so that the latter is heated directly on one side by contact with the gas and also by conduction from the remaining walls of said passages, and at the other side of which are similar passages through which the air to be heated is caused to pass, the walls of which are formed in part by said plate so that the air is heated directly by contact therewith and also by contact with the remaining walls of said passages.

4. An air heater comprising a plate of conductive metal at each side of which are a number of parallel passages for a hot gas and for the air to be heated respectively, means for supplying hot gas to the passages at one side for causing the air to be heated to pass through the passages at the other side, the area of contact of the air being substantially greater than that of the hot gas.

5. An air heater comprising a plate, vertical fins on one face of said plate forming passages for heating and circulating air and horizontal fins on the opposite side of the plate forming passages for a heating gas, said horizontal fins being in a plurality of separate units alongside of each other.

6. An air heater of the character described having air passages with entrance and exit openings in the room to be heated and having combustion air inlet and gas outlet pipes leading from the heater to the outer air at points closely adjacent to each other so as to maintain approximate equilibrium of pressures in said pipes.

In witness whereof, we have hereunto signed our names.

GEORGE H. PHELPS.
THOMAS E. MURRAY, JR.