Nov. 26, 1935. R. W. KRUSE 2,022,116

WARM AIR FURNACE

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FIG. 1

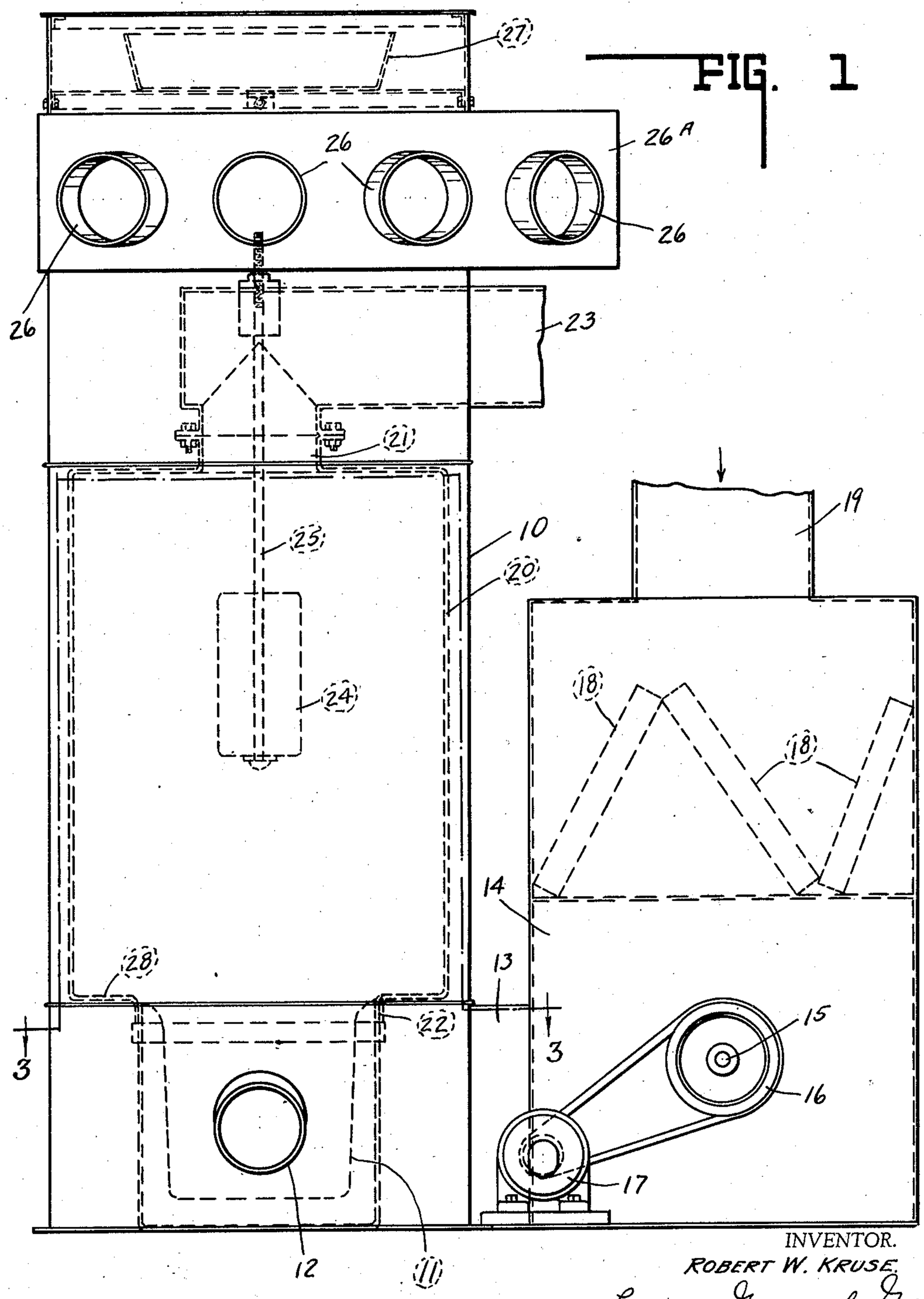

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FIG. 2

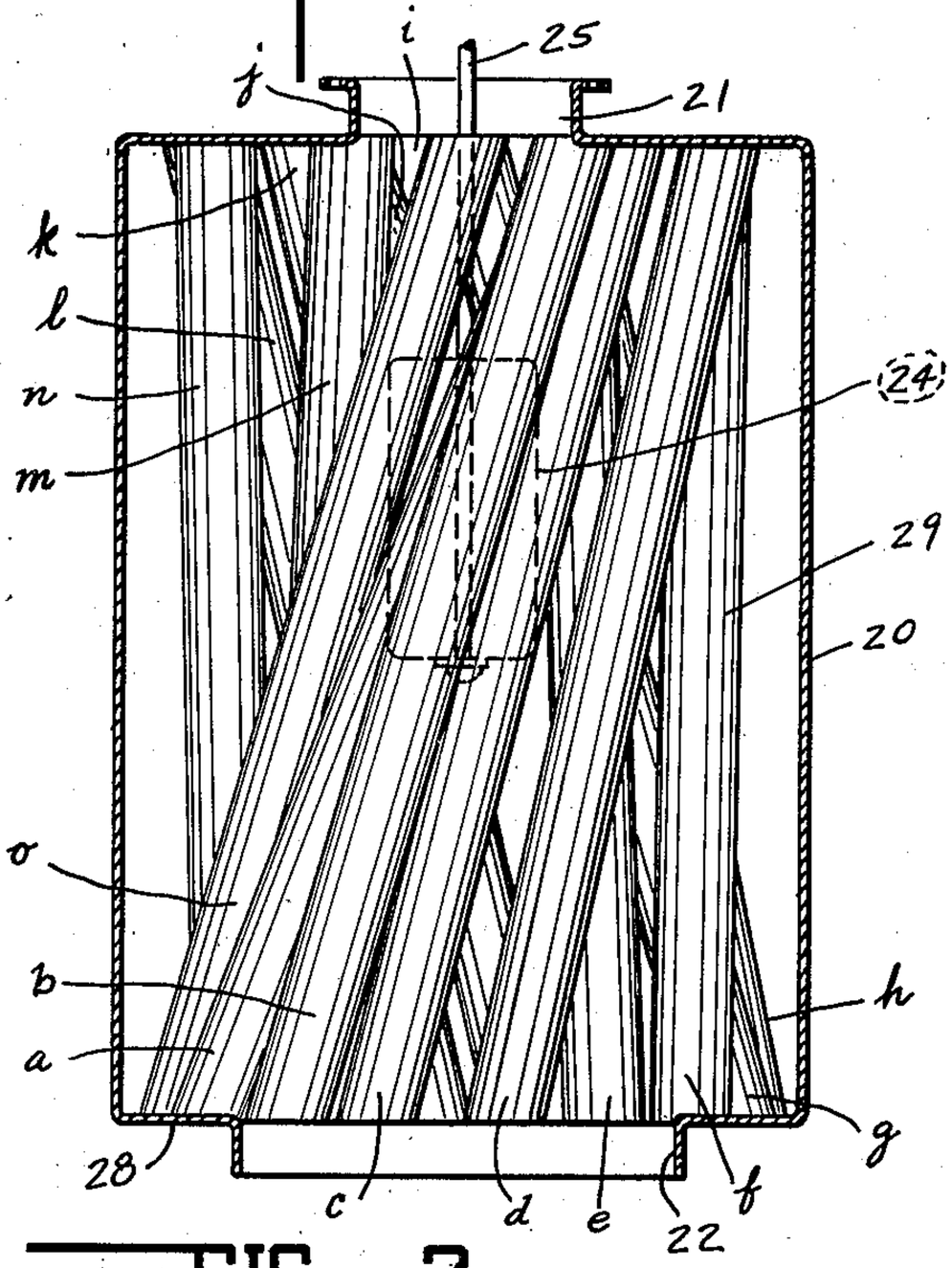


FIG. 4

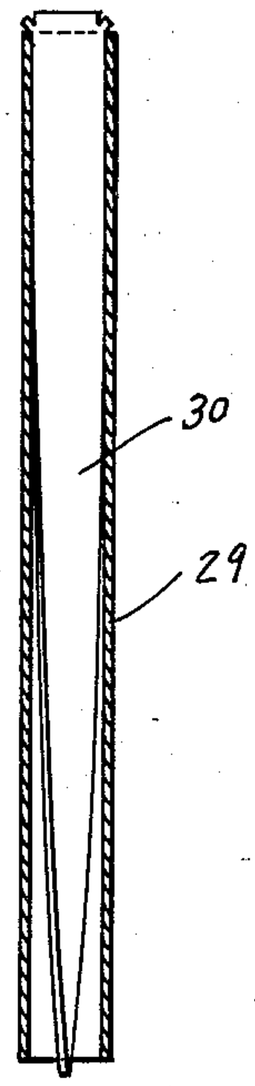


FIG. 3

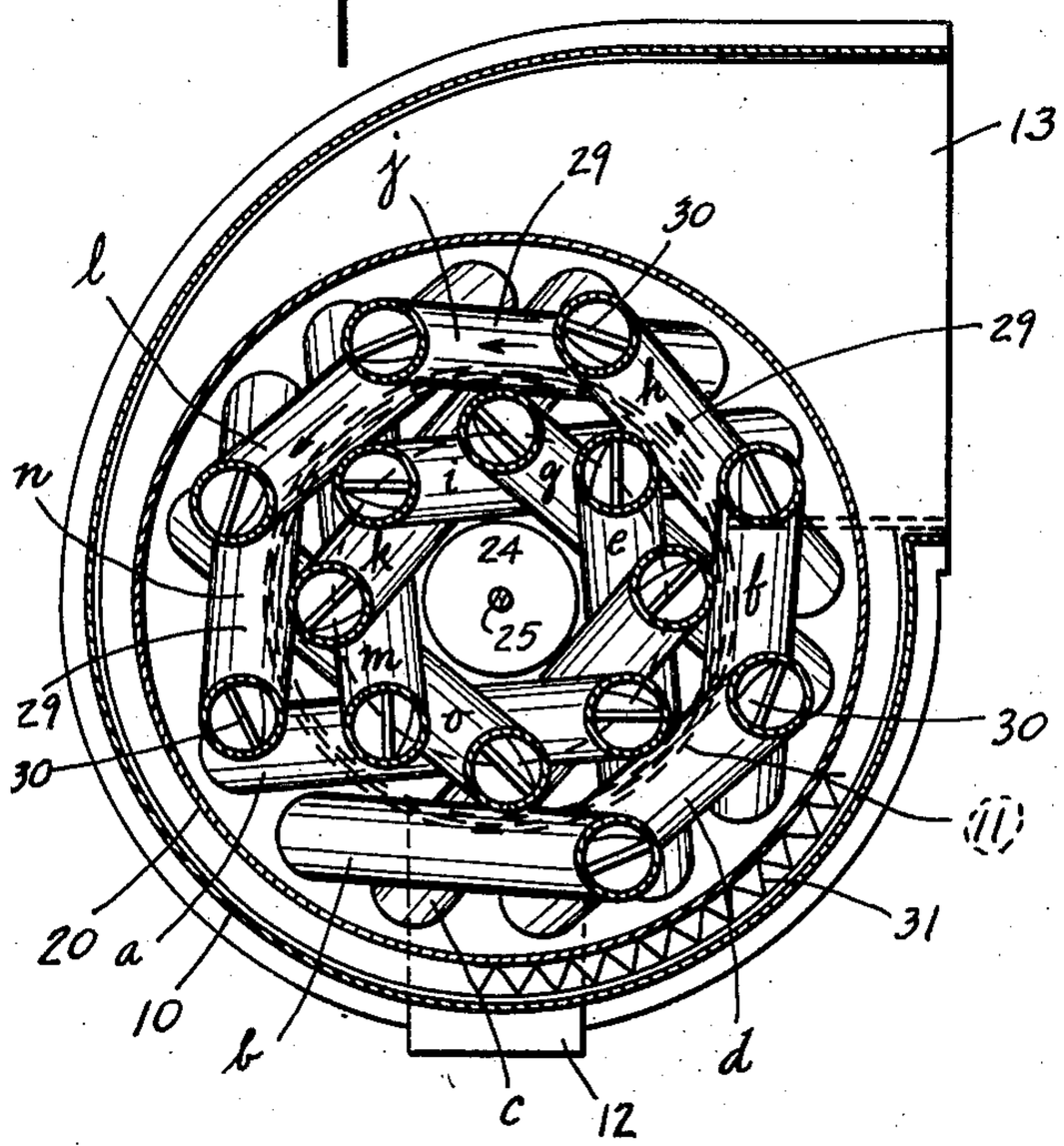
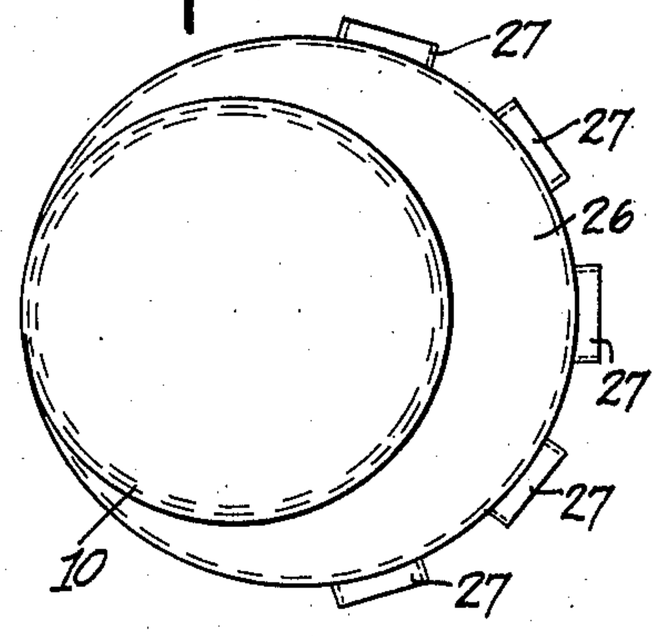


FIG. 5



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WARM AIR FURNACE

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4 Claims. (Cl. 126—109)

This invention relates to a heat transfer plant, and particularly to a so-called warm air furnace. It is particularly adaptable for installations in residences, store rooms and the like.

The principal feature of the invention resides in the arrangement of the air passages and tubes for rendering maximum heating efficiency with a minimum of space and expense in construction and installation. By reason of the construction herein disclosed, the same heating efficiency is obtained in a furnace having substantially half the diameter of an ordinary warm air furnace. This is advantageous wherein space for accommodating a furnace is at a premium. It also adds to the appearance of the furnace wherein the bulkiness of the usual warm air furnace is reduced to a compact, relatively small structure.

Another advantage resulting from the relatively small and compact structure resides in the ability of transporting a furnace, removing it and reinstalling it in other locations. Thus, the lessee of a store room or residence may install a furnace of this character, and, upon moving to another location, may readily transport it.

The above advantages are accomplished by the provision of a plurality of angularly disposed air tubes mounted in "swirling" relation to the combustion chamber, coupled with air swirling fins extending therethrough and a baffle for causing the hot gases from the burner to spread and pass upwardly about the angularly disposed air tubes. Air is projected by means of a blower through said tubes which gives it a "swirling" action, bringing it in direct contact with the heated walls of the tubes which in turn have a maximum surface exposed to the hot gases, as will be hereinafter more specifically described.

Other objects and features of the invention will be readily understood from the accompanying drawings and the following description and claims:

Fig. 1 is a front elevation of the furnace showing the combustion chamber in dotted lines associated with an air conditioning box connected with the intake. Fig. 2 is a central vertical section through the combustion chamber showing the air tubes in elevation. Fig. 3 is a section taken on the line 3—3 of Fig. 1. Fig. 4 is a central vertical section through an air tube with a baffle plate mounted therein. Fig. 5 is a plan view looking down on the furnace header.

In the drawings, there is illustrated a furnace having a relatively tall, cylindrical warm air casing 10. In the bottom thereof there is a fire box 11 having an opening 12 through which the usual oil burner may extend (not illustrated) for generating heat in the usual and prescribed manner. The bottom portion of the casing surrounds the fire box in substantially spaced relation thereto and is connected tangentially to an air intake passage 13 as illustrated in Fig. 3, said passage connecting with a blower chamber of an air conditioning housing 14. Said blower chamber is provided with the usual blower (not illustrated) mounted on a shaft 15 and driven by a pulley 16 from an electric motor 17. Air is drawn into said chamber and forced through the passage 13 through air conditioning filters 18 from an air intake 19.

Extending above the fire box there is a cylindrical combustion chamber 20 of steel with a flue opening 21 centrally disposed in the top thereof and a fire opening 22 centrally disposed in the bottom end surrounding the top of the fire box. The flue opening 21 is connected with a flue or smoke pipe 23 which extends laterally through the upper wall of the furnace and supports a baffle block 24 suspended in the center of the fire box by a rod 25.

Mounted above the flue in the upper projecting portion of the casing, there is an eccentric header 26 of greater diameter than the casing, from which the warm air leader pipes 27 project. The eccentric header incorporates the advantageous effect of a leader pipe, while providing a greater circumferential area for the pipe connections.

The purpose and advantage of the eccentric header 26 is to permit the leader pipes 27 to be grouped on one side of the furnace wherein it is desired, the said pipes extending in substantially one direction therefrom. This is particularly applicable to installations wherein the furnace is placed at the rear of a store room or in a corner thereof and it is not feasible to extend the leader pipes from about its entire periphery. In such installations, greater efficiency is acquired by arranging the header eccentric of the furnace as disclosed, so that the hot air generated therein will be drawn to one side of the furnace and set up a steady flow in that direction. This arrangement not only accentuates the delivery of the warm air from one side of the furnace as is desirable in such installations, but permits of a greater number of lead pipes being connected with the one side thereof.

As illustrated herein, the bottom ledge or flange of the combustion chamber, indicated at 28 and surrounding the opening 22, is provided with a plurality of circular openings or holes located concentrically thereabout, there being provided a

total of fifteen of such holes illustrated herein. The corresponding ledge or top of the combustion chamber is provided with seven outer holes and eight inner holes arranged concentrically, as illustrated in Fig. 3.

The holes in the bottom and top of the combustion chamber are connected by air tubes **29**, said tubes being formed of the usual heat-conducting material and welded within their respective holes so as to provide an air-tight passage from under the combustion chamber through the top. As illustrated in Figs. 2 and 3, said tubes are arranged at an angle about the central portion of the combustion chamber, leaving an opening of approximately the diameter of the baffle block **24**. The direction of the angular position of the tubes is arranged to give the air passing therethrough a swirling motion in the same direction as initiated by the tangential air duct **13**. This will be noted from the arrangement of the tubes as indicated by arrows in Fig. 3.

Each tube is provided with a twisted or spiral baffle plate **30**, as illustrated in Fig. 4, for causing the air passing upwardly along the angularly disposed tubes to be twisted or swirled therein.

The combustion chamber is spaced inwardly from the casing by a corrugated spacer **31** extending therebetween through which air is caused to pass between the outer surface of the combustion chamber and the casing for insulating the combustion chamber from the casing and causing the former to remain relatively cool.

The individual air tubes have been indicated by letter in respect to their relative position, as shown in Figs. 2 and 3, the fifteen tubes being lettered *a* to *o*, inclusive. It will be noted that they are relatively spaced to provide room for sixteen tubes, one being left out to allow space for the hot water coil, not illustrated herein. Thus, the lower ends of the tubes *o* and *a* are substantially spaced apart for the reception therebetween of such coil.

Every alternate tube leads from the bottom of the combustion chamber to the outer series of openings in the top thereof while the intermediate tubes lead from the single series of openings in the bottom of the combustion chamber to the inner series of openings at the top thereof.

In operation, heat is generated in the fire box by any suitable type of oil burner, the flame and hot gases extending upwardly through the opening **22** within the combustion chamber. Said hot gases are therein capable of spreading out to the full diameter of the combustion chamber surrounding the air tubes **29**. The baffle block **24** forces the spreading of the hot gases and prevents their passing directly through the center of the combustion chamber between the tubes to the flue.

After spreading throughout the combustion chamber and around the tubes, passing the baffle block, the hot gases are then permitted to escape through the flue **23**, the heat conducted thereby having been largely expended upon the tubes and the top portion of the flue within the upper part of the casing.

The numerous air tubes afford a substantial radiating surface for the conduction of heat to the air passing through the tubes, and their angular relation to the upward movement of the gases affects a baffle which increases the efficiency of heat interchange over such types of radiating surfaces as extend directly in the line with the flow of hot gases.

This angular or swirling arrangement of the tubes further acts to create a swirling action of the hot gases so as to pass evenly about the entire peripheral surface of the air tubes whereby the outer sides thereof are heated to substantially the same extent as the inner sides, or, in other words, the entire surface of the tube is evenly heated by the gases. Coupled with this effect upon the exchange of heat, the current of air entering the casing tangentially effects its swirling action in the direction of the angular arrangement of the tubes so that the air is equally distributed throughout the fifteen tubes herein illustrated instead of passing more readily through the nearer tubes than the more remote tubes.

In addition thereto, the spiral or twisted baffles **30** extending longitudinally within the tubes cause the air passing therethrough to be twisted during its passage so as to increase the quantity of air coming into direct contact with the heat conducting wall of the tube. The air thus forcibly swirled upwardly through the tubes is discharged from the top of the combustion chamber into the upper part of the casing in a highly heated condition for eventual discharge from the top of the furnace through the radially disposed leader pipes.

The swirling action created as above described has the further effect of causing an even distribution of warm air about the entire periphery of the upper portion of the furnace so as to cause a corresponding equal distribution in its discharge therefrom.

By reason of the multiple air passage formed by the corrugated spacer **31** between the combustion chamber and casing, the exposed surface of the furnace is maintained relatively cool, resulting in a minimum loss of heat and controlled discharge from the upper portion thereof.

The invention claimed is:

1. A warm air furnace comprising a fire box, a cylindrical combustion chamber, a cylindrical casing enclosing and extending above and below said combustion chamber to form an air heating chamber adjacent thereto, a plurality of air tubes extending through said combustion chamber communicating through the top and bottom thereof with said air heating chamber, said tubes being spirally arranged about the axis of said combustion chamber to cause a spiral motion of the air passing therethrough, and means for forcing air into said casing tangentially thereof for entering said tubes at the angle of their disposition whereby the air will be uniformly distributed therethrough.

2. A warm air furnace comprising a vertically disposed cylindrical combustion chamber having central openings formed in the end walls for receiving and discharging heated gases, a fire box communicating with and below the bottom opening, a flue for discharging said gases communicating with and above said chamber, said combustion chamber also having a series of openings concentrically arranged about said central openings, a plurality of spirally arranged air tubes extending from the bottom to the top of said combustion chamber and connecting the lower series of openings with their respective upper series in offset relation, a cylindrical casing enclosing and extending from below said combustion chamber to a position thereabove and spaced therefrom to form an air heating chamber, and means for forcing air into the bottom portion of said casing tangentially to said series of openings to cause the air to be

uniformly distributed to the respective openings and tubes connected therewith.

3. A warm air furnace comprising a vertically disposed cylindrical combustion chamber having central openings formed in the end walls for receiving and discharging heated gases, a fire box communicating with the under side of said chamber, a flue for discharging said gases communicating with the upper side thereof, said combustion chamber having a single series of openings concentrically arranged about the lower end of the chamber, and a double series of openings concentrically arranged about the upper end thereof, a plurality of spirally arranged air tubes extending from the lower to the upper end of said chamber, each of said tubes connecting a lower concentric opening with one of the upper concentric openings in offset relation, every other tube being connected with one series of upper concentric openings, and every other tube with the other series thereof, and means for causing air to pass through said tubes.

4. A warm air furnace comprising a fire box, a cylindrical combustion chamber, a cylindrical casing enclosing said combustion chamber to form an air heating chamber adjacent thereto, means for causing air to pass through said air heating chamber, an annular header of greater diameter than said air heating chamber and positioned eccentrically thereof to provide an overhanging section, a plurality of warm air pipes grouped together and communicating with the overhanging section of said header, and means for causing a whirling motion of the air passing into said header for discharge through the overhanging portion thereof and the communicating group of air pipes.

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