Feb. 22, 1966 J. H. EUBANKS 3,236,226

COMBINED AIR AND WATER HEATERS

Filed May 28, 1963 4 Sheets-Sheet 1

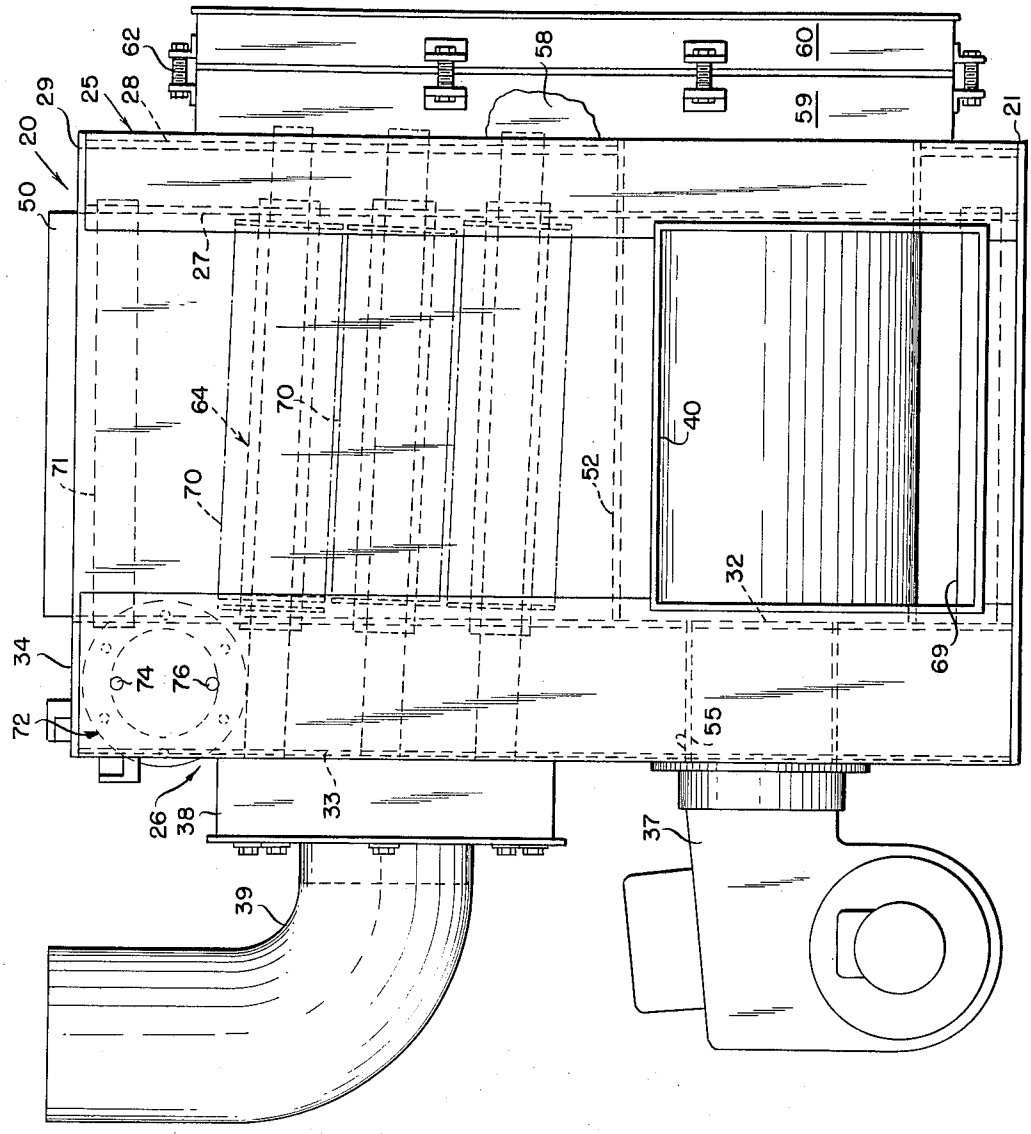


Fig. 1

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COMBINED AIR AND WATER HEATERS

Filed May 28, 1963 4 Sheets-Sheet 2

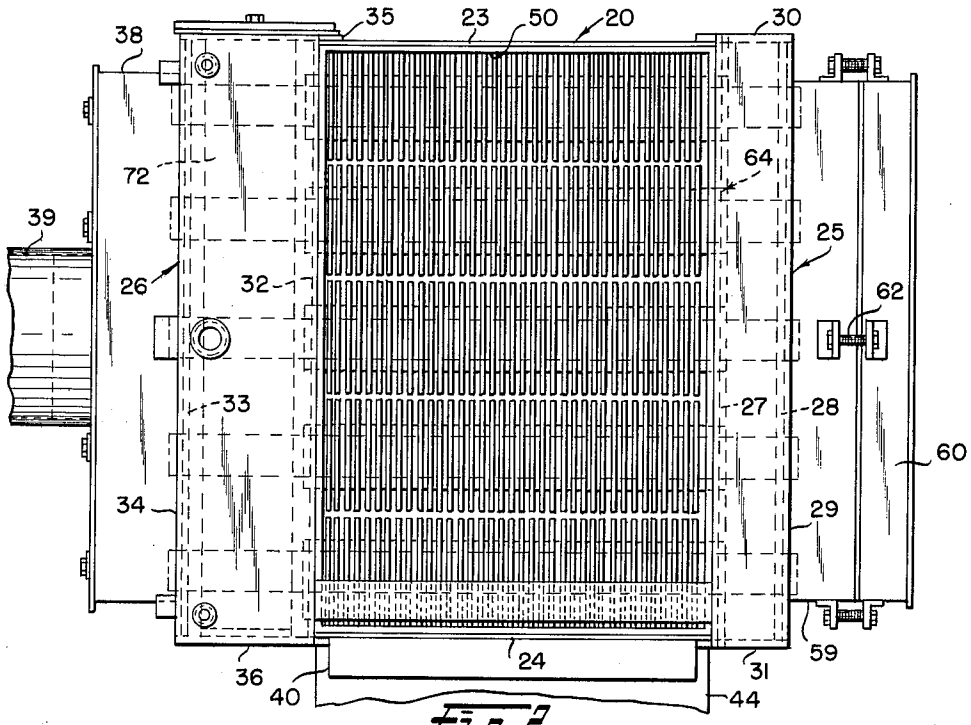


Fig. 2

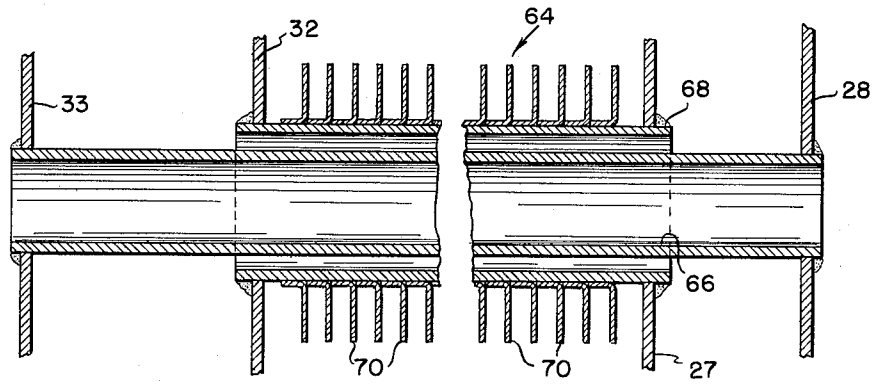


Fig. 3

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COMBINED AIR AND WATER HEATERS

Filed May 28, 1963 4 Sheets-Sheet 3

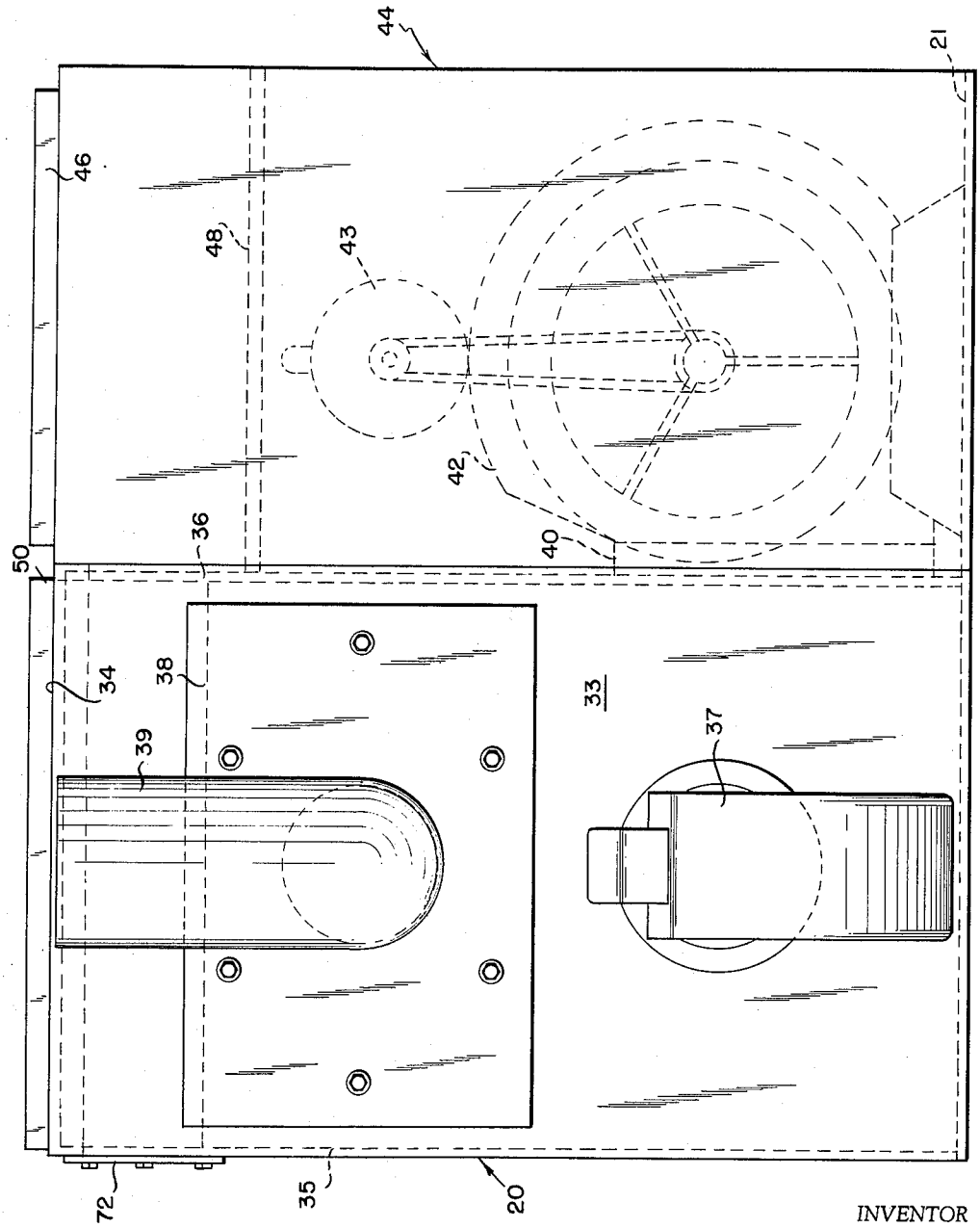


Fig. 3

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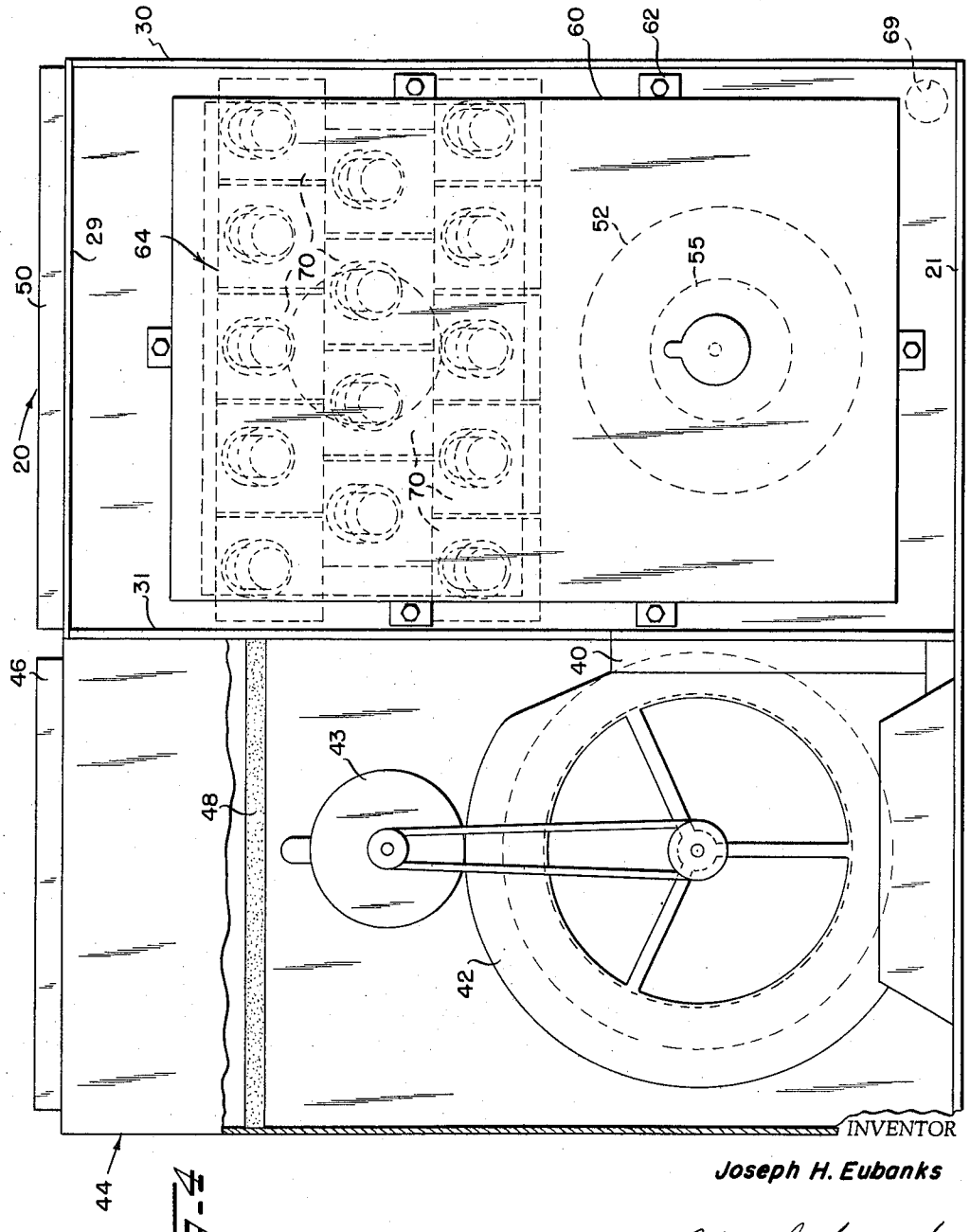


Fig. 4

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3,236,226

COMBINED AIR AND WATER HEATERS

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3 Claims. (Cl. 126—101)

This invention relates to heating systems and more particularly to combined heating systems for supplying from a single source the warm air or water required for space heating and the hot water required for the usual domestic purposes.

While the advantages of combining a furnace and a domestic hot water heater have long been recognized, separate units continue to dominate the market because of the failure of prior proposals to provide an efficient, compact, flexible and inexpensive combined unit.

In many cases the cost of the combined unit has exceeded the total cost of the conventional separate units. Also, in most cases the combined units were not able to supply efficiently the widely varying requirements for warm air and hot water and to accommodate the change in requirements between summer and winter operation.

It is, accordingly, a principal purpose and object of the present invention to provide improved combined air and water heaters which overcome these deficiencies of prior units and which offer increased efficiency and flexibility of operation and yet which are compact and of simplified, durable construction and which can be manufactured, sold and operated at reduced cost.

It is a further object of the present invention to provide improved combined air and water heaters which because of their unique construction eliminate extreme temperature differentials throughout the system thus increasing their service life and increasing their efficiency.

It is also an object of the present invention to provide improved combined air and water heating units which are unusually compact and may thus be installed in a variety of locations within a dwelling.

It is a further object of the present invention to provide improved combined air and water heaters which have an unusual degree of flexibility of operation and which accordingly can be utilized to satisfy all of the requirements for heating systems having widely differing configurations. For example, the novel units herein disclosed may be used in a system in which a portion of the dwelling is heated by forced hot air and the remainder is heated by hot water supplied to conventional radiators or to baseboard heaters or the like.

Additional objects and advantages will become apparent as the description proceeds in connection with the accompanying drawings in which:

FIGURE 1 is a side view of the combined air and water heater unit of the present invention with parts broken away to show interior details;

FIGURE 2 is a top plan view of the unit;

FIGURE 3 is a front view of the unit of FIGURE 1;

FIGURE 4 is a rear view with parts broken away to show interior details; and

FIGURE 5 is an enlarged fragmentary section of one of the combined heat exchanger assemblies employed in the unit.

Referring now more particularly to the drawings, the main heat exchange portion of the combined air-water heater of the present invention is enclosed in a housing **20** of sheet metal construction formed by a bottom wall **21**, and side walls **23** and **24** welded or otherwise suitably secured together.

The ends of the housing **20** are formed by a pair of headers, **25** and **26** which extend over the full width and

height of the housing and are welded to the bottom wall **21**. The header **25** comprises inner and outer walls **27** and **28**, top wall **29** and side walls **30** and **31** which form extensions of the housing side walls **23** and **24**, the walls preferably being welded to form a water tight structure. The header **26** is of similar construction and includes inner and outer walls **32** and **33**, a top wall **34** and side walls **35** and **36**.

Secured to the lower portion of end wall **33** of the header **26** is a combustion unit **37** which, in the present instance is an oil burner. A flue collector **38** leading to a smoke pipe **39** is also mounted on the wall **33** above the oil burner **37**. The side wall **24** of the housing has a lower shrouded opening **40** for connection to the outlet scroll of a fan **42** driven by a motor **43**, the fan and motor being mounted in a housing **44** extending vertically in side-by-side relation with the housing **20**. The upper end of the fan housing is connected to the conventional return air ducts (not shown) through an opening **46**. The usual replaceable filter **48** is positioned in the housing **44** in the path of the incoming air. The top of the main housing **20** is provided with a central opening **50** for connection to the warm air delivery ducts (not shown) which lead to the several rooms of the dwelling. The air delivered by the fan **42** passes through the opening **40** and around a combustion tube **52** then upwardly across the heat exchange apparatus to be described, through a rectangular passage formed by the side walls **23** and **24** and inner walls of the headers **25** and **26**.

The combustion tube **52**, which is cylindrical, is welded at one end to the header wall **32** in surrounding relation with an intermediate tube **55** which extends through header **26** and connects the burner **37** to the interior of the combustion tube **52** and is welded to the header walls **32** and **33**. The opposite end of the combustion tube **52** extends through header **25** and is welded to the header walls **27** and **28**.

The combustion tube **52** opens into a collector chamber or gas reversal chamber **58** formed by a rectangular sheet metal structure **59** welded to the outer header wall **28**. The gas reversal chamber is closed by a cover **60** detachably secured by clamps **62** to the sheet metal annulus **59**. The cover **60** is preferably lined or filled with an insulating refractory material.

The principal heat exchange area within the heater of the present invention is provided by a series of identical fire tube, water tube assemblies, each of which is indicated generally at **64**. As best shown in FIGURE 5, each of these assemblies comprises an inner fire tube **66**, the opposite ends of which are supported by and welded to the header walls **28** and **33**, respectively. Thus, these fire tubes **66** connect the gas reversal chamber **58** with the collector **38** to provide a path for the hot combustion products produced by the burner **37**. The fire tubes **66** are surrounded by water tubes **68**, the opposite ends of which are supported by and welded to the inner header walls **27** and **32**. Thus, the annular spaces between the water tubes **68** and the fire tubes **66** provide a series of paths for connecting the two water filled headers **25** and **26**. It will be noted that the heat exchanger assemblies **64** are each inclined slightly to promote convection flow from right to left as viewed in FIGURE 1. The headers **25** and **26** are also connected by lower and upper conduits **69** and **71**.

To increase the heat exchange capacity of the units **64**, they are provided with a series of thin sheet metal rectangular fins **70** which are press fitted onto the outer periphery of the water tubes **68**. The fins are of rectangular configuration and are so dimensioned that they occupy substantially the entire air passage above the combustion tube **52**.

The supply of domestic hot water is obtained by an immersion coil **72** which extends substantially entirely across the header **26**. The immersion coil is provided with the usual inlet and outlet connections **74** and **76**, respectively, for connection to the hot water lines of the dwelling. While the immersion heater is shown positioned at the upper end of the header **26**, it may also be mounted between the tube **55** and the lowermost of the heat exchanger assemblies **64** or may be mounted below the tube **55**, depending on the requirements of the particular installation involved.

To assure maximum efficiency of operation and to provide sufficient hot water or sufficient hot air without excessive heating of the air or of the water, separate controls are provided for the burner **37** and the fan **42**. More specifically, the burner **37** is controlled solely in response to the temperature of the water, preferably sensed by an aquastat which is positioned in the header **26** adjacent the immersion coil **72**. The operation of the fan **42**, on the other hand, is controlled by a room thermostat positioned in the usual location in the dwelling. Accordingly, the volume of water filling both the headers and the heat exchange unit **64** is constantly maintained at or very close to a predetermined temperature which is sufficient to satisfy the demand for hot water or for hot air up to the rated capacity of the unit. When the room thermostat calls for additional heat the fan **42** is put into operation to cause the air to circulate over the fins **70**, the water tubes **68**, and the inner surfaces of the headers **25** and **26**. The total area of these heat exchange surfaces is more than adequate to heat the air thus circulated to the required temperature. The temperature of the water required to produce the desired air temperature is entirely compatible with the temperature required to satisfy the needs for domestic hot water.

The temperature of the heated reservoir of the water will be reduced whenever the fan **42** operates or when domestic water is used. Under these circumstances the burner will operate to restore the heat level of the water in the two headers.

Because of the substantially constant temperature of the components, the deterioration which occurs in the usual warm air furnace in summer is entirely eliminated. Also extreme temperature differentials, which are unavoidably encountered in the usual warm air furnace, are eliminated because of the water backing of the surfaces which are exposed to the highest temperatures.

The entire unit is unusually compact. For example, a unit having a 100,000 B.t.u. capacity, which is sufficient for the normal three bedroom house, is only 30 inches high and about 40 inches long. Within this relatively small envelope the capacity can be varied as desired by adding or deleting one or more of the heat exchange assemblies **64**.

Because of the relatively large reservoir of heated water, this water can be used for space heating as well as for heating water for domestic requirements. For example, in one level houses of the ranch type, the runs of the warm air ducts are so long that it is difficult to insure an adequate supply of warm air to rooms which are remote from the heating unit. In such a case these difficult to heat rooms can be served by a hot water system, for example, radiant baseboard heating or a full radiant system. Thus the unit can be tailored exactly to meet unusual as well as conventional requirements with little or no added cost.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiment is therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What is claimed and desired to be secured by Letters Patent is:

1. A combined air and water heater comprising a housing having essentially vertical side walls and end walls and an essentially horizontal top wall, means forming water filled headers extending the full width and height of said end walls inwardly thereof, the inner walls of said headers and said side walls forming an air passage connecting an opening in one of said side walls and an opening in said top wall, a burner carried by one of said end walls for supplying heated combustion products, means forming a gas reversal chamber adjacent the opposite end wall, a combustion tube assembly extending through each of said headers and across said air passage connecting said burner and said gas reversal chamber, a fan for forcing air through said passage and over a portion of said combustion tube assembly, a plurality of heat exchangers extending across said air passage between said headers, said heat exchangers each having a water tube connecting the interior of one header to the interior of the other header, and each heat exchanger having a fire tube extending through said headers through which the combustion products pass from said gas reversal chamber to a smoke pipe.

2. A combined air and water heater comprising a housing having essentially vertical side walls and end walls and an essentially horizontal top wall, means forming water filled headers extending the full width and height of said end walls inwardly thereof, the inner walls of said headers and said side walls forming an air passage connecting an opening in one of said side walls and an opening in said top wall, a burner carried by one of said end walls for supplying heated combustion products, means forming a gas reversal chamber adjacent the opposite end wall, a combustion tube assembly extending through said headers and across said air passage connecting said burner and said gas reversal chamber, a fan for forcing air through said passage and over a portion of said combustion tube assembly, a plurality of heat exchangers extending across said air passage between said headers, said heat exchangers having a water tube connecting the interior of one header to the interior of the other header and each heat exchanger having a fire tube extending through said water tube concentrically thereof and extending through said headers into said gas reversal chamber, the combustion products passing through said fire tube from said gas reversal chamber to a smoke pipe, and a plurality of fins carried by the outer surface of each of the said water tubes and substantially filling said air passage.

3. A combined air and water heater comprising a housing having side walls, water filled headers extending the full width and height of said housing and forming the ends thereof, the inner walls of said headers and said side walls forming an air passage, means forming a gas reversal chamber at the outer side of one of said heaters, a plurality of heat exchangers extending across said air passage between said headers, said heat exchangers each having a water tube connecting the interior of one header to the interior of the other header, and each heat exchanger having a fire tube positioned within and extending through said water tube and through said headers, one end of said fire tubes communicating with said gas reversal chamber and the other end of said fire tubes communicating with a smoke pipe, a burner for supplying heated combustion products, a combustion tube assembly extending through each of said headers and into said gas reversal chamber and connecting said burner to said gas reversal chamber, a plurality of heat exchanger fins carried by said water tubes externally thereof, a fan for forcing air through said air passage over a portion of said combustion tube assembly and over said heat exchanger fins and said water tubes.

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