April 14, 1959 S. F. RIZZO 2,882,023

HEAT ECONOMIZER FOR SMALL UNITS

Filed Nov. 30, 1955 2 Sheets-Sheet 1

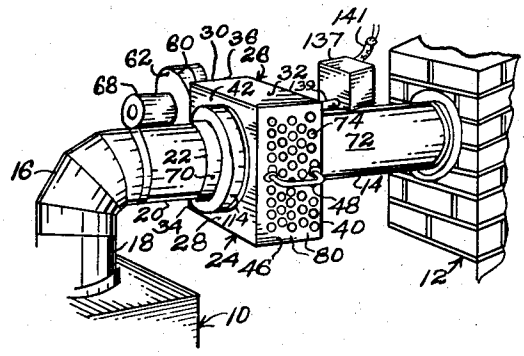

Fig. 1

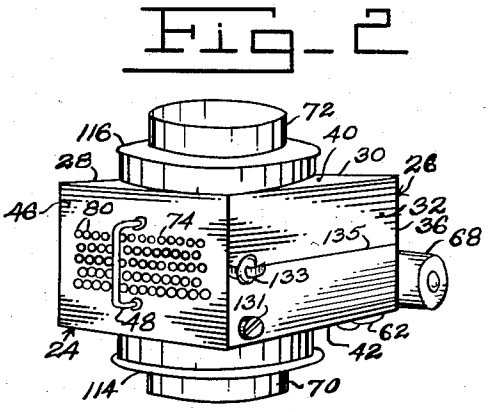

Fig. 2

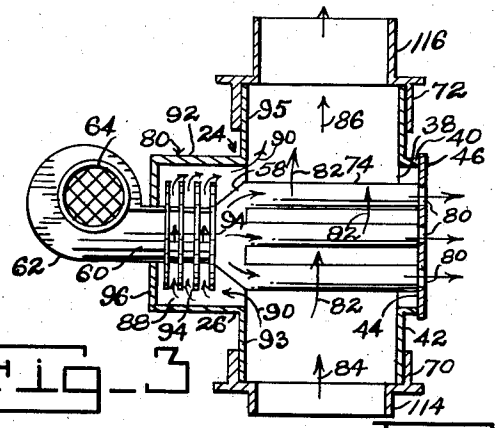

Fig. 3

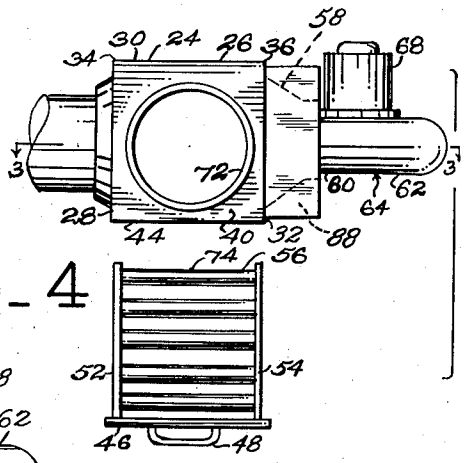

Fig. 4

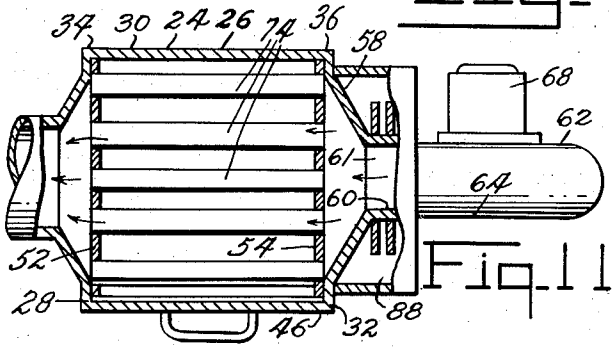

Fig. 11

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HEAT ECONOMIZER FOR SMALL UNITS

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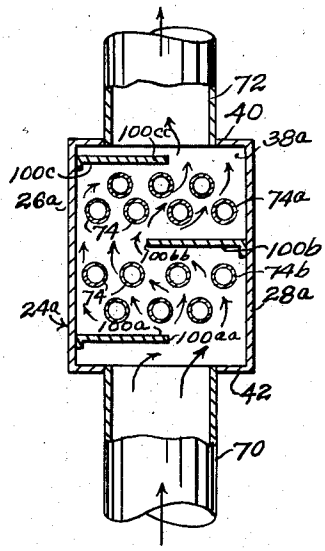

Fig_5

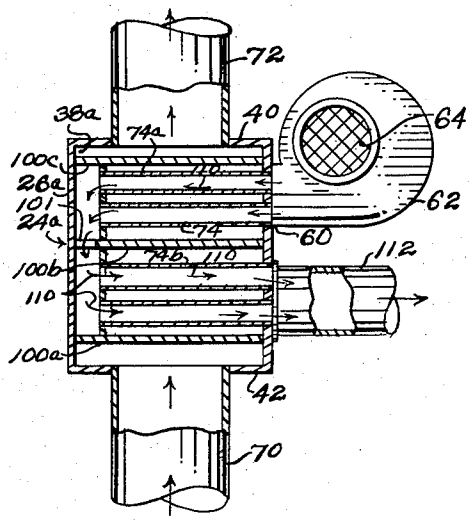

Fig_6

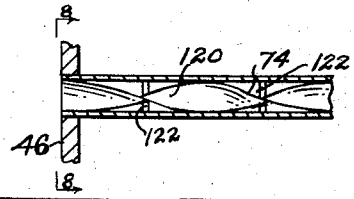

Fig_7

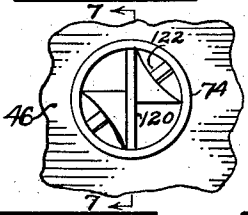

Fig_8

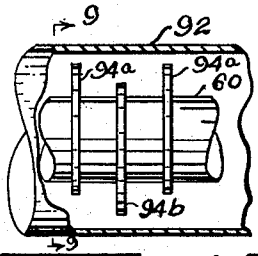

Fig_10

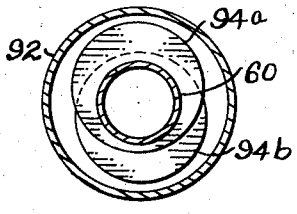

Fig_9

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HEAT ECONOMIZER FOR SMALL UNITS

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Application November 30, 1955, Serial No. 549,995

6 Claims. (Cl. 257—2)

This invention relates to improvements in heating devices and heat economizers and the like.

An object of the invention is to provide a novel and improved device which may be attached to or used in connection with a furnace or the like, for extracting heat from the hot gases on the way to the chimney, for use as desired.

Another object of the invention is to provide a novel and improved device which may be installed in the smoke stack of a heating system, so as to allow the hot chimney gases from a furnace to flow through the main casing of the device, while clean air to be warmed is piped through the interior of the main casing by means of interior ducts, thus extracting heat from the hot gases to warm the clean air, the heated air being moved through its own ducts by means of an inducer fan or blower.

A further object of the invention is to provide a novel and improved heat economizer which reclaims from the flue gases, a large part of the heat contained therein, which would otherwise be wasted up the chimney, and which economizer has novel construction for separating the hot flue gases from the clean air to be warmed or heated in the economizer casing, while at the same time permitting optimum heat extraction without interference with the normal operation of the furnace.

Still another object of the invention is to provide a novel and improved furnace accessory, which employs waste heat extracted from the flue gases, to heat a separate stream of clean air, which is piped either into the basement, or to one or more rooms or parts of a building, or a garage or the like, to heat the same, supplementing the usual heat from radiators supplied by the regular heating system of the building, while not adding to the heating burden normally loading the furnace.

Still a further object of the invention is to provide a novel and improved heat economizer of the type described, in which there is a main housing through which the flue gases flow, and a separable frame supporting a large number of fresh air ducts or pipes of relatively small diameter to lie across the interior path of the hot flue gases, an inducer fan being used to move the fresh air through the pipes so as to become well heated from the hot gases, the frame with its pipes being readily removable from the main housing for inspection, cleaning, and servicing, without need for special tools or the like, with special interior constructional features for adding to the efficiency of heat extraction by the device as needed.

Another object of the invention is to provide a novel and improved heat economizer of the character described, which is simple in design, inexpensive to manufacture, is readily installed in most smoke pipes for its intended use, and which is efficient and economical in reclamation of waste heat.

These and other objects and advantages of the invention will become apparent from the following description of a preferred embodiment thereof, as illustrated in the accompanying drawings, forming a part hereof, and in which,

Figure 1 is a perspective view showing the novel and improved heat economizer unit installed in the smoke pipe or flue of a building furnace and chimney.

Figure 2 is a perspective view showing the heat economizer unit apart from the furnace and chimney, the view showing the device with its main axis in a vertical orientation.

Figure 3 is a sectional elevational schematic view taken substantially on plane 3—3 of Figure 4.

Figure 4 is an exploded view in plan of the device shown in Figure 3, the removable air-tube array being shown removed from the main housing for clarity of illustration.

Figure 5 is a sectional elevational view showing a modified form of the invention, the plane of the view being taken at right angles to the axes of the air-tubes, and showing use of multiple baffles for increasing heat transfer efficiency.

Figure 6 is a right side elevational view of the device shown in Figure 5, the view being partly sectional vertically to illustrate the construction.

Figure 7 is a sectional elevational detail view of one of the heating tubes for air conduction, taken substantially on plane 7—7 of Figure 8, showing use of spiral or twisted air guiding core for enhancing heat transfer efficiency.

Figure 8 is a left end elevational view of the parts shown in Figure 7, in fragment.

Figure 9 is a transverse sectional elevational detail view taken substantially on plane 9—9 of Figure 10, and showing a modified form of the invention, with reference to the by-pass area.

Figure 10 is a left side elevational view of the device shown in Figure 9, the view being partly broken out to show the interior construction.

Figure 11 is a plan view similar to Figure 4, but showing the parts in assembled relation, the view being broken out partly for illustration of the interior construction.

In connection with the use of furnaces for heating buildings, by means of fuel such as coal, oil, or the like, it is found that a large amount of the heat energy available from the combustion of the fuel is wasted in the hot gases which pass up the chimney. Thus it has been found in some installations, that the temperature in the smoke pipe leading out of the furnace and to the chimney, is as great as about 750 degrees Fahrenheit, indicating that considerable waste heat is present in the flue gases. The present device is intended for the purpose of reclaiming or saving some of this heat, by abstracting it from the hot flue gases and using it to heat some portion of the building, directly or indirectly, thus complementing the usual heating effort of the radiators of the heating system, and thus increasing the total heating efficiency of the system.

In order to do this, it must be understood that care must be taken not to place in the path of the hot flue gases, an intensely cold massive body, such as a hot water jacket, which might cool the flue gases unduly, and interfere with normal chimney operation, and hence with the operation of the boiler itself. Further, if such an undue cold load is placed in contact with the hot gases, there would be a tendency to form large carbon deposits, soot and the like, which would defeat the purpose of the device. Accordingly, the present invention provides means for abstracting waste heat from the flue gases, without overcooling them, so that optimum heat transfer is obtained. This is accomplished by interposing in the path of the hot flue gases, a large number of relatively small diameter fresh air heating pipes or ducts, through which air to be heated is forced by means of a fan or blower, so that the thus heated air, resulting from contact of the hot flue gases with the pipes, is available either for piping to some room of the building, or for heating the basement or furnace room, or otherwise as desired.

In order to understand clearly the nature of the invention, and the best means for carrying it out, reference may now be had to the drawings, in which like numerals denote similar parts throughout the several views.

As shown, there is a furnace generally indicated at **10** which is connected to the chimney **12** by any duct means, such as the smoke pipe **14**, suitable bends being provided as at **16** to allow the riser **18** to interconnect with the horizontal portion **20** of the pipe **14**. As the hot gases are flowing from the furnace **10** to the chimney **12**, at a temperature in the vicinity of about 750 degrees Fahrenheit, or thereabouts, the present device is interposed as at a break **22** in the smoke pipe or flue, for abstracting a large part of this waste heat from the gases, so that it may be expected that the temperature of the gases leaving the device **24** may be reduced to about 350 degrees Fahrenheit, or thereabouts.

In order to accomplish this, the device **24** is provided with a main housing **26**, formed with side walls **28**, **30** and **32**, interconnected at edges **34** and **36**, to form a chamber at **38**, with end walls **40** and **42** closing the chamber **38** at the top and bottom as seen in Figure 2, or at the entrance and exit ends as seen in Figure 1. It is thus apparent that the chamber **38** is open at one side **44**, so that a separate closure must be provided thereat. For this purpose there is provided a removable side wall or door **46** which fits over the opening thus formed in the main chamber **38**, and is equipped with a handle **48** extending from door **46**, to permit readily pulling the door open or closing same.

As seen best in Figure 4, the drawer door **46** has a pair of side walls **52** and **54** secured at their inwardly disposed edges to a rear wall **56**, a tapered air inlet duct being formed as at **58** to receive air blown therein by the outlet **60** of the centrifugal fan housing **62**, which pulls air in through its air induction opening **64**, from any suitable source, such as through duct **66** or the like, to be warmed in the device. The fan housing **62** is provided with a suitable fan inside the housing, which is driven by means of a motor **68** connected by wires to a source of electric power.

It is thus apparent that the fan **62** is capable of drawing air to be heated, from any suitable source, such as the basement, furnace room, garage, storage room, or other space, moving it through the main housing **38**, and after it is heated, blowing it back, through suitable ducts, if removed from the furnace room, to heat said remote rooms. To extract heat from the furnace gases which enter the device **24** at **70**, and leave it at **72**, there are provided a number of heating tubes **74**, heading into the walls **46** and **56** respectively, and guided by the taper ducts or connectors, **58**, it being observed that the air is thus blown through the heat absorbing tubes **74** which lie across the path of the hot flue gases, without actual contact of the fresh air in the tubes **74** with the hot flue gases. As a result, the air in the tubes **74** becomes heated up to a considerable temperature, as it is blown by fan **62** through the tubes **74**, and is then blown out through the openings **80** through which the tubes **74** pass out of the header wall **46**, and thus through any suitable delivery duct or pipe **82** connected therewith for delivery of the heated air to another room, garage, attic, or the like by means of such duct **82**, although, if the heat is to be used in the furnace room or basement, then such duct **82** will normally not be needed. However, where the fresh heated air is to be piped to some distant room, garage, greenhouse, or the like, then ductwork will be considered necessary so that there will be no interference with the general heating system of the house or building.

The interspacing of the air tubes **74** is so chosen as to provide minimal air stream interference in regard to the moving hot gases of the furnace output **10**, yet permitting optimum abstraction of heat from the hot gases by means of the air tubes **74**, and without direct interconnection of the flue with the fresh air in the ducts **74**. Thus there is permitted a variation in the air speed of movement by fan **62**, regardless of the speed of movement of the hot air gases in the flue **14**.

Looking at Figures 1 and 2, it is seen that there is quite a large number of such fresh air tubes **74** carried by and opening at one end upon the end wall **46**, such tubes being relatively small in diameter, yet sufficiently spaced to permit free passage of flue gases therepast. As shown in Figure 3, however, in view of the large number of such fresh air tubes **74** shown, and due to unusual temperature and condensation conditions, after a substantial period of time, there may be some formation of soot or carbon on the tubes **74**. In this event, there is provided means for passage of the hot flue gases therepast nevertheless, through a by-pass chamber **88** defined by an end casing **80**.

Thus normally any hot flue gases will flow in the direction of arrows **82** shown in Figure 3, over the outside of the tubes **74**, and from arrow **84** to arrow **86** and thence to the chimney. However, should any of the passages between the pipes **74** become obstructed, then there is provided a bypass chamber **88**, through which the obstructed gases may flow in the direction of arrows **90**, as seen in Figure 3. The bypass chamber **88** is provided with walls **92** and end wall **96**, formed to allow entry of fan outlet duct **60** therethrough. While the hot flue gases may normally flow in the direction of arrows **82** in Figure 3, it is seen that they may also flow in the direction of arrows **90** through the bypass chamber **88** when needed. To aid in extracting hot temperatures from the flue gases, I provide a number of fins or vanes **94**, which extend out of the fan outlet **60**, thus permitting the hot flue gases which flow in the direction of arrows **90** in Figure 3, to add to the heat conveyed from the gases to the fresh air in the pipes in the bypass **88**. Thus there is a marked addition to the ultimate efficiency of heat transfer in view of this added fin area in the bypass **88**.

It must be understood that where the bypass **88** is employed, as in Figure 3, such area should be kept free of obstruction to avoid blockage with soot and carbon deposits, and for such purpose, there is provided a differential offset positioning of the various discs **94** seen in the views in the bypass. Thus as seen in Figures 9 and 10, the heat extraction discs **94*a*** of the bypass may be adjustably turnable so as to be eccentrically disposed alternatively, so that one set as at **94*a*** is vertically offset from center of the pipe **60**, while the other set as at **94*b*** is vertically downwardly offset as in Figures 9 and 10. This permits free movement of flue gases at all times through the device from inlet pipe **70** to outlet pipe **72**, either directly through in the directions of arrows **82**, or through the bypass in the direction of arrows **90**. At the same time, there is a maximum intermixture of hot flue gas with surface of the fins shown, and thus transfer of heat therebetween, due to the multifarious paths of movement of the gases.

Figures 5 and 6 show another modified form of the invention, in which baffle walls are employed for further enhancing the heat interchange while in the main housing. Here there is a number of plane baffles or walls **100*a***, **100*b*** and **100*c***, the baffles **100*c*** and **100*a*** extending out of the wall **26*a***, while the baffle **100*b*** extends out of the wall **28*a***, substantially midway therebetween, their inner edges **100*aa***, **100*bb***, and **100*cc*** being situated as shown in the views, to force the hot flue gases to flow in the undulating path indicated by the arrows, for optimum heat transfer. Figure 6 shows how the flow of air to be heated is arranged so that there is counterflow movement, with optimum heat transfer, the cool air being drawn in by the fan **62** and moving in the direction of the arrows **110** to the fresh air outlet duct **112** which may be coupled by suitable piping to a room to be heated thereby, such as a garage, store-room, attic, etc., or basement.

To permit of easy assembly of the main housing **26** to the various sections of the smoke pipe or flue **14**, there are provided a pair of couplings **114** and **116** or adapters, which are of a sufficient inside diameter at their larger ends to fit over the smoke inlet **93** and smoke outlet **95**, as seen in Figure 3, and to interfit with the smoke pipes **20** and **14** respectively in the manner of Figure 1, as needed, being reduced accordingly thereat. It is understood that the couplings **114** and **116** may also be made eccentric, so as to interfit conveniently with offset sections of the smoke pipe as found to exist, by turning them about their axes for such purpose.

Figures 7 and 8 show how further enhancement may be obtained of the heat transfer by means of an inducement of radial outcasting of the fresh air which flows through the fresh air pipes **74**. This is accomplished by means of an insert or core **120**, which may be formed of a bar of metal which is twisted spirally about its axis, that is, about the axis of the tube **74**, being supported therein centrally in any suitable manner, as by means of ribs **122** radially interconnecting the bar **120** with the tube **74**. By use of the spirally wound ribbon **120**, the fastly moving air through ducts **74**, is cast outwardly toward and in contact with the tube **74** itself, thus aiding in heat transfer to a greater extent than otherwise, since there is no relatively cold air core in the tube.

Although the invention has been described in specific terms, it will be understood that various changes may be made in size, shape, materials and arrangement without departing from the spirit and scope of the invention as claimed. Figure 1 shows how the thermostatic switch **137** is mounted right on the main housing **26** by means of tube **139** which carries the thermostatic bi-metal element inside housing **26**, wires **141** connecting the switch and blower fan **68** to the power lines, to turn on and off the fan, responsive to temperature in housing **26**. The wall **46** with its bank of heating tubes **74** is slidable on ribs and grooves jointly carried as at **135** by the wall **46** and side walls like **32** of housing **26**, and a latch is shown at **133** for locking wall **46** in place. A cleanout plug **131** permits insertion of vacuum and blowing means to clean out the interior as needed without disassembly.

I claim:

1. A heat economizer comprising a main housing, a first furnace connection port for connecting said housing to a furnace to receive hot flue gases therefrom to flow inside said main housing, said housing having a main chamber to receive said gases, a chimney connection outlet port for connecting said main housing chamber to a chimney or the like, a first wall in said main housing having a fresh air discharge opening formed therein, a second removably supported wall in said main housing opposite said first wall and having a plurality of fresh air intake openings formed therein, a plurality of fresh air conducting and heating tubes carried by said second wall and connected at their first ends with said fresh air intake openings to receive fresh air to be heated therethrough, said array of second wall and its plurality of fresh air conducting and heating tubes being constructed and arranged for insertion of said heating tubes into said main housing chamber to lie across the path of said hot flue gases, while, when so inserted, said heating tubes have their second ends registered with said fresh air discharge opening in said first wall of said housing, for discharging heated air therethrough, impelling means disposed in the path of flow of said fresh air for inducing its flow through said heating tubes, and handle means constructed and arranged for inserting and removing said movable wall and its bank of heating tubes.

2. The construction according to claim 1, wherein there is a bypass housing forming an extension of said main housing chamber and connected therewith, so that excessive flue gas flow from the furnace is bypassed through said bypass housing around said bank of heating tubes and avoiding them, whereby sufficient total flow path is always present in the event of blockage of the path over and around said heating tubes.

3. The construction according to claim 2, wherein in said bypass housing there is an extension duct connecting said impeller fan with said bank of heating tubes, and adjustably positionable heat absorbing fin means carried by said extension duct for absorbing heat from the bypassed flue gases to heat said fresh air.

4. The construction according to claim 2, wherein in said bypass housing there is an extension duct connecting said impeller fan with said bank of heating tubes, and heat absorbing fins carried by said extension duct for absorbing heat from said bypassed flue gases to heat said fresh air, said fins being eccentrically mounted on said extension duct, and adjustably turnable, so that they may be alternately variably oriented angularly, to provide optimum free passage for flue gases while avoiding stoppage due to soot gathering on said fins.

5. The construction according to claim 1, wherein there is a thermally responsive switch interposed in the circuit of said impeller fan means for opening and closing said circuit, said switch including a thermally responsive switching element extending inside said main chamber for reacting to the temperature therein, whereby upon its reaching a predetermined temperature, said switch closes, turning on said impeller fan to draw heat from said hot flue gases.

6. The construction according to claim 1, wherein there is a cleanout port formed through said main housing, to provide access to the interior of said main chamber, closure means normally closing said port, and openable at a low elevation thereof to allow insertion through said port of both blowing and suction apparatus for cleaning said main chamber, and said contents thereof without need for removing said heating tubes.

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