July 17, 1956 F. A. RYDER 2,754,816

SEALED HEATER VENTING AND COMBUSTION AIR SUPPLY SYSTEM

Filed March 27, 1952 2 Sheets-Sheet 1

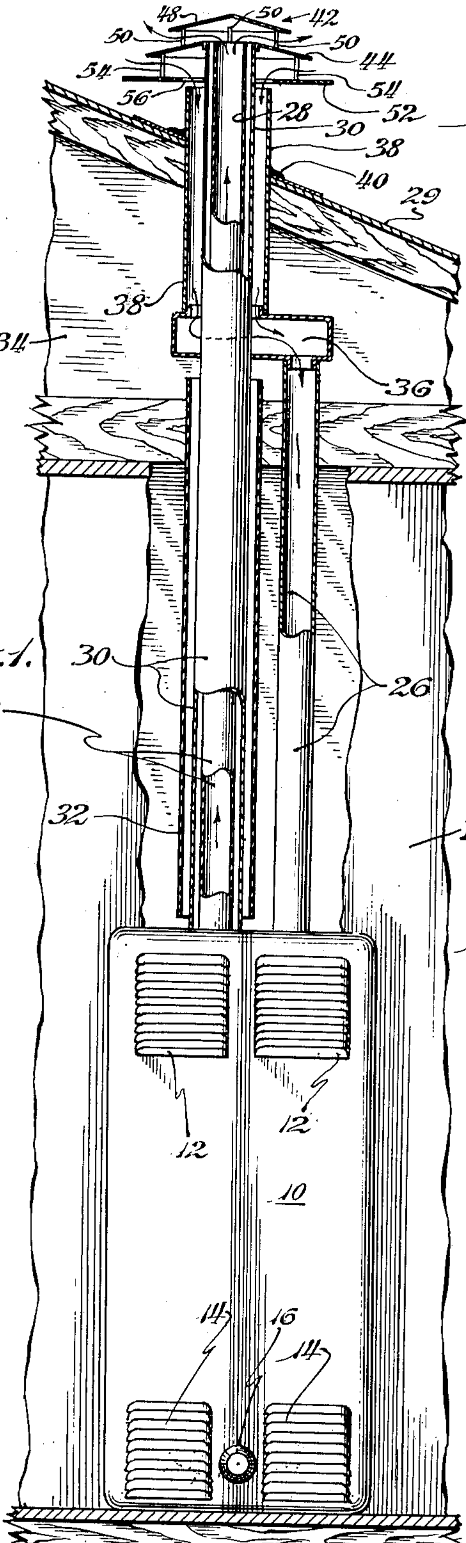

Fig. 1.

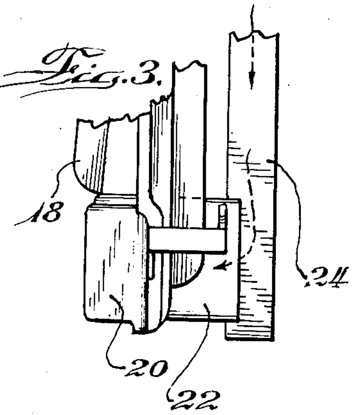

Fig. 3.

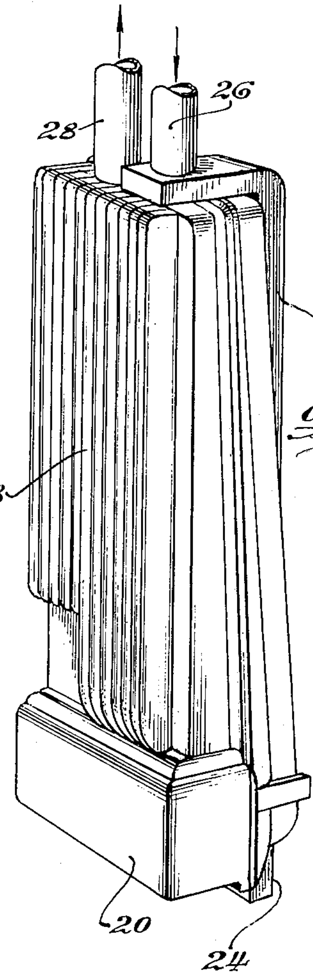

Fig. 2.

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Fig. 4.

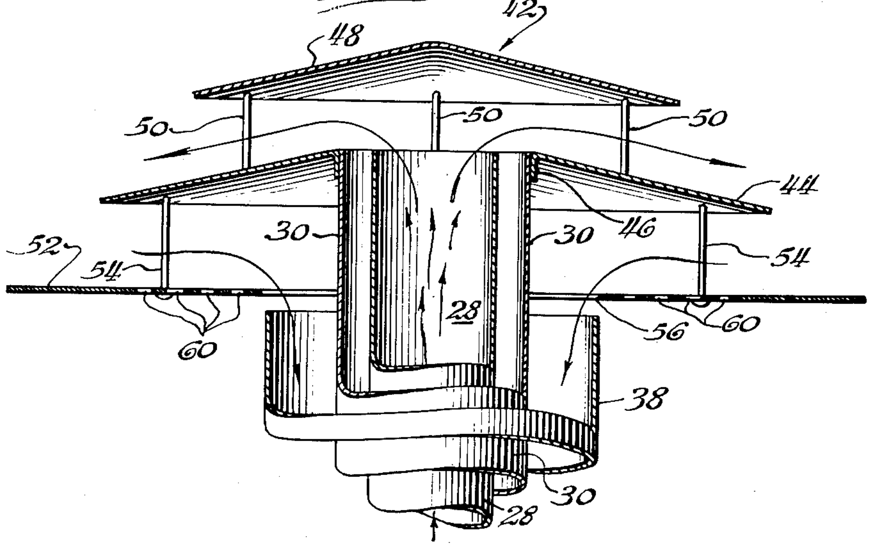
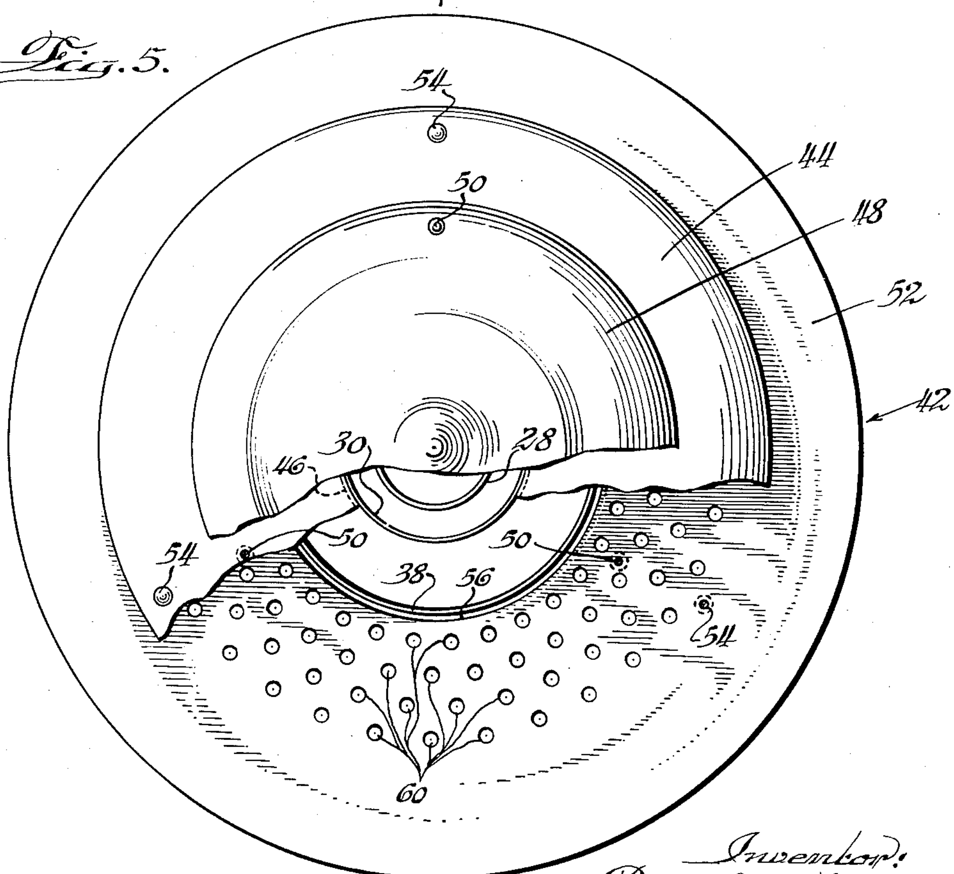


Fig. 5.



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SEALED HEATER VENTING AND COMBUSTION AIR SUPPLY SYSTEM

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Application March 27, 1952, Serial No. 278,811

8 Claims. (Cl. 126—307)

The present invention relates generally to the art of heating systems and more particularly to gas heating systems of the sealed type. A sealed gas heater of this general character is shown in the patent to Allen W. Lundstrum, No. 2,160,883.

Heating systems of the sealed type have the distinguishing characteristic that all of the air for combustion is taken in from outside the building and the exhaust gases also pass to a point outside the building, the system being sealed so that it is impossible for the air within the building to become contaminated or otherwise interconnected with the combustion side of the heater. Sealed systems have the further advantage that since they do not use air from within the building either for combustion or for dilution of the exhaust gases, it is not necessary that cold outside air be admitted to the building to take the place of exhausted air. Heating systems of this type are thus distinguished from those more commonly used in which air for combustion is simply taken from the room in which the heater is located and the exhaust passes from the heater to the atmosphere within the space to be heated. Normally the connections are such that the rising exhaust gas is trapped within a downwardly facing open ended pipe or the equivalent and carried through a flue to a point outside the building along with a considerable quantity of the air within the room. Heaters of this latter sort are not particularly sensitive to wind and other atmospheric conditions at the flue outlet in spite of the fact that changes in wind velocity will have the effect of markedly changing the flow rate through the exhaust flue and will frequently cause downdrafts. This is because the heater is not in any real sense connected to the flue.

It will be appreciated, therefore, that heaters of the type forming the subject matter of the present invention although having important advantages nevertheless have the characteristic of being extremely sensitive to any change in pressure at either the combustion air inlet or exhaust openings if this change is not simultaneously duplicated at the other opening. It is a difficult problem, therefore, to provide connections to the atmosphere at both the exhaust and inlet openings in such fashion that changes in the direction and magnitude of the wind will not appreciably affect the flow rate through the heater, since the flow rate is established simply by the convection rate or, in other words, depends upon the temperature of the gases within the heater itself and the vertical length of the outlet flue. This pressure differential between the inlet and outlet of such a heater system, which produces the flow of combustion air therethrough is extremely slight and therefore slight pressure differentials at the inlet and outlet openings of the heater produced by changes in wind velocity will affect the combustion air flow rate very markedly. Sealed heaters are particularly sensitive to conditions which cause downdrafts which will snuff out the pilot even if only of momentary duration. Systems such as that proposed in the before mentioned patent overcome this difficulty by

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over compensation, that is by causing a positive flow of combustion air in the proper direction under all wind conditions. Such systems therefore lose considerably in efficiency when the wind is strong because of excessive combustion air flow.

In view of the above it is one of the objects of the present invention to provide a sealed heating system having connections for both the incoming and outgoing combustion air at a point outside the building to be heated in such fashion that the combustion air convection flow rate through the heater is not disturbed appreciably by changes in wind direction and magnitude at the two outdoor combustion air openings.

Another object of the present invention is to provide a novel fitting or vent and duct system which can be manufactured at low cost and which may be attached to a sealed heater so as to make the combustion air flow rate through the heater substantially insensitive to wind velocity.

Yet another object is to provide an improved venting system and vent fitting which so accurately compensates for wind effects as to make substantial over compensation unnecessary.

Still an additional object is to provide a novel venting system and vent fitting of the above character which prevents reverse flow under all wind conditions without causing excessive flow in the proper direction even under high wind conditions.

Still another object is to provide a novel vent of the above type which may be used above the building roof, thereby making it feasible to place the heater away from an outside wall.

Yet another object is to provide a novel roof vent which prevents downdrafts even though there are downward air currents upon the vent, thus making it unnecessary to place the vent above the highest roof point as is customary.

Other objects and advantages will become apparent from the following description of a preferred embodiment of my invention which is illustrated in the accompanying drawings.

In the drawings, in which similar characters of reference refer to similar parts throughout the several views—

Fig. 1 is a front view of a heater of the general type to which the vent and duct system of the present invention may be attached to advantage. This heater is shown recessed within an interior wall of a building and a portion of the building structure associated therewith is shown in section. The venting system for the heater is shown partly in longitudinal vertical section and partly in elevation;

Fig. 2 is a perspective view of a portion of the interior mechanism of the heater;

Fig. 3 is an end view of the lower portion of the heater showing the venting system connected thereto;

Fig. 4 is a longitudinal medial sectional view of the heater outside vent and the duct work connected thereto; and

Fig. 5 is a top view of the vent illustrated in Fig. 4 with portions thereof broken away so as better to disclose the underlying portions of the device.

Referring to Fig. 1 of the drawings, it will be seen that a typical heater of the type to which the present invention is well adapted to be used consists of the cabinet 10 which encloses mechanism recessed within an inside building wall 11. This cabinet has hot ventilating air outlet louvres 12 near the upper end thereof, while inlet louvres 14 and a control knob 16 are located near the lower end of the heater casing. Heaters of this general character are well known, a similar one being described in the beforementioned patent, and the following brief discussion of the heater construction is therefore primarily for the purpose of orientation since the present invention is not directed to the specific structure of the heater itself.

By referring to Fig. 2 of the drawings it will be seen that there is a case **10**, which may be recessed within an interior wall of the building with inlet and outlet ventilating air louvres **14** and **12** respectively located in the two rooms bounded by the same wall. Within this case there is a heat exchanger **18** around which air circulates by convection between the ventilating air inlet openings **14** and the outlet openings **12**. This heat exchanger is hollow and is sealed and is provided with burner mechanism housed within a casing **20** at its lower end. This casing **20** is connected at one side by means of a spud **22** with an upwardly extending generally rectangular sheet metal plenum chamber or duct **24** the upper end of which extends horizontally over the top of the heat exchanger and there connects with a vertically extending combustion air inlet duct **26**. The exhaust from the heat exchanger **18** is conveyed from the top thereof by way of a vertical duct **28** in side by side side relationship to the inlet duct **26**. With this arrangement, air for combustion cannot enter or leave the combustion space within the heat exchanger except by way of the ducts **26** and **28**.

The outlet duct **28** as best shown in Fig. 1 extends directly to the roof of the building **29** by way of the space within the wall within which the heater is located and the attic space above this wall. This duct **28** is enclosed within a concentric pipe **30** the lower end of which rests against the top of the heater while the upper end extends through the roof of the building to the same height as the exhaust duct **28**. The annular space between these ducts is of relatively small order and is for the purpose of providing an insulating column of dead air as will appear presently. A still larger concentric sleeve **32** extends from a point slightly above the casing **10** to the space within the attic **34**. It therefore permits cooling air to circulate by convection around the pipe **30** and also prevents wood or other inflammable substances from coming against the surface of the pipe **30**.

The inlet duct consists of a lower portion **26** which extends from the heater upwardly into the attic and at a point somewhat above the upper end of the sleeve **32** is connected to a plenum chamber **36** which surrounds the pipe **30**. The chamber **36** is in turn connected to an upwardly extending upper inlet duct portion **38** which is concentric with the pipe **30**. This duct portion **38** extends through the roof of the building into a position somewhat below the upper ends of the pipes **30** and **28**. Almost all of the ductwork described above can be fabricated from low cost stovepipe if desired. When the system is installed, suitable flashing **40** is provided around the inlet duct **38** so as to prevent water seepage through the roof.

The inlet and outlet vent fitting is indicated generally by the numeral **42** and is attached to the upper end of the pipe **30**. This structure is illustrated in greater detail in Fig. 4 where the vent fitting **42** and the upper portions of the pipes are shown drawn to larger scale. From this figure it will be seen that the concentric pipe or ducts **28**, **30** and **38** extend into a position well above the roof of the building with the two inner ducts **28** and **30** rising to the same height and these two being approximately two and one-half inches or so above the upper end of the outer duct **38**. All of these ducts are supported sufficiently rigidly with respect to each other in any suitable fashion, and the vent fitting is carried by the upper end of the intermediate duct **30**. It comprises a convex frusto-conical sheet metal deflector **44** which has a circular periphery and which is extruded downwardly as at **46** at its center so that this extrusion fits the outside surface of the intermediate duct **30**. It may be secured thereto in any suitable manner such as by sheet

metal screws for instance. This deflector may be considered as a disc the periphery of which slopes downwardly with respect to the central portion at an angle of approximately 12½°. In the specific example shown it has an external diameter of approximately ten inches whereas the intermediate insulating tube **30** to which it is fitted is approximately three inches in diameter. The upper end of the outlet pipe **28** is flush with the top surface of the deflector **44** and is protected by a sheet metal top member **48** which is circular in outline and generally conical in form. The angle of the cone is such that the top and deflector surfaces are approximately parallel, that is, the conical surfaces slope downwardly from the apex at an angle of approximately 12½°. It is axially aligned with the deflector, is approximately seven and one-half inches in diameter and is supported approximately one and one-quarter inches above the deflector by several sheet metal brackets **50** which are spot welded or otherwise suitably attached to the top surface of the deflector **44** and the lower surface of the top member **48**.

An air intake baffle member **52** is disc-shaped and is supported in a horizontal position below the deflector **44** by several sheet metal brackets **54** spot welded or otherwise suitably attached between these members. The brackets are of such length that the air intake baffle is approximately one and one-quarter inches below the outer edge of the intermediate deflector **44**. The central portion of the ar intake baffle **52** is cut away to form a circular opening **56** which surrounds the tube **30** and is vertically spaced about one-quarter inch above the top of the air intake duct **38**. In the present example this hole **56** is approximately five and three-eighths inches in diameter and is somewhat larger than the external diameter of the air intake tube **38** which in the present instance is about five inches.

The annular zone of the air intake baffle plate immediately surrounding the opening **56** is perforated to provide a multiplicity of holes **60** approximately three-sixteenths inch in diameter extending therethrough. These holes are symmetrically arranged along concentric center lines approximately one-half inch apart with the first or innermost row of holes being spaced outwardly from the edge of the opening **56** about one quarter of an inch. Altogether there are in the specific device shown one hundred twenty-six of these holes arranged in four rows. A suitable arrangement is to put thirty holes in the innermost row, thirty-one in the second row, thirty-two in the third and thirty-three in the fourth.

In the above description of a particular embodiment of the invention specific dimensions have been given for the purpose of illustration only and their use should not, therefore, be considered as limitative of the invention. The particular device shown and described is intended for use with a heater of about 50,000 B. t. u. per hour capacity and should preferably be scaled upwardly or downwardly for larger or smaller heaters.

The device and system function in the following manner:

The annular space between the exhaust tube **28** and the insulating tube **30** is substantially sealed at its lower end and therefore contains air which for all practical purposes does not circulate. The dead air space thus formed aids in keeping the exhaust gases hot until they reach the outlet vent and therefore prevents condensation. One advantage of this is that no diluting air need be added to the exhaust in order to avoid condensation and therefore the efficiency of the heating system can be higher inasmuch as warm ventilating air need not be taken from the heated building for the purpose of avoiding condensation within the exhaust duct as is customary.

The sleeve **32** is spaced from the insulating duct **30** and is open at both ends so as to provide for circulation of air therethrough from top to bottom, thus insuring that the external surface of the insulating ducts **32** will not rise to a temperature very much above room level. It therefore effectively protects the structure of the building against being heated to an unsafe level and of course prevents anything from coming into contact with the considerably warmer duct **30**.

Because of the transition section **38**, the several ducts at the upper end where they pass through the roof of the building can be arranged in concentric relation whereas the inlet and outlet ducts connected to the heater may be spaced in side by side relationship where they pass within the wall of the building, thereby permitting these ducts to be arranged within a thinner wall. This is significant because most walls are constructed upon two-by-four framing and it is important, therefore, that the ducts passing vertically within the walls do not exceed the spacing available. It is worthy of note in this connection that the use of the intermediate tube **30** surrounding the innermost duct **28** and the side by side exhaust and inlet lower ducts insures against the cold air passing downwardly through the inlet duct **38** having any considerable cooling effect upon the exhaust gases. As pointed out previously this is important so as to insure that the products of combustion do not condense until the flue gases have left the vent fitting **42**. The arrangement of the upper portions of the ducts does, however, cause some heat to be exchanged to the inlet air and this helps to promote stable combustion.

Under still air conditions, products of combustion rise up the innermost tube **28** and pass outwardly evenly in all directions around the cap member **48**. Conversely, air for combustion is drawn inwardly in all directions through the space between the baffle **52** and the deflector **44** and passes downwardly within the annular space provided between the duct **28** and the insulating tube **30**. There is ample space between the inlet and outlet passages through the vent fitting to prevent mixing of the products of combustion with the incoming air. This is partly because the incoming air moves principally in a radially inwardly direction, whereas products of combustion pass around the edge of the roof member **42** with an upward component inasmuch as these hot gases have less density than the surrounding air. Under conditions of wind when the wind is blowing from any angle, excepting from directly above, that is, in a downwardly direction, the exhaust products will leave the device at one side whereas the incoming air will pass inwardly at the opposite side. Nevertheless the inlet and outlet are in such close proximity to each other that the static pressure created by the wind is substantially the same at both openings and thus there is little tendency for up-drafts and no tendency for down-drafts due to wind velocity. Tests have shown that this is true regardless of the direction of the wind up to winds of whole gale force. At extremely high wind velocities, that is of the order of sixty miles an hour or so, there is some tendency for the carbon dioxide concentration in the flue gases to drop slightly, but the concentration does not fall lower than approximately five percent and this compares extremely favorably with the concentration of about eight and one-half per cent which is obtainable when the system is operating in still air. The change in air flow through the system, therefore, under these extreme wind conditions is almost negligible, but is sufficiently in the right direction to insure against down drafts which might extinguish the pilot.

Rarely does the wind ever blow straight downwardly, but even under these conditions the top member **48** protects the outlet opening and therefore shields the exhaust duct against down-drafts. The top member also helps to prevent rain water or snow getting into either the inlet or outlet duct members. Of course when the wind is directly downwardly or has a strong downward component exhaust products are forced downwardly over the edge of the deflector **44** and it might be thought that they would under some conditions mix appreciably with the inlet

air. It has been found, however, that the annular space between the air intake baffle **52** and the air intake tube **38** permits air to flow upwardly to the center of the space between the baffle and the deflector. Under these conditions the perforations **60** prevent their being too great a pressure differential between the upper and lower surfaces of the baffle **52** at the region about its center. Because the adjacent surfaces of the members **48** and **44** are parallel, no venturi effect is produced at the outlet opening of the vent when the wind blows therethrough. The members **44** and **52** together, however, produce a very slight reverse venturi effect at the inlet opening and thus an extremely slight but appreciable positive pressure is produced in the inlet duct relative to the outlet under high wind conditions. Because of the fact that the products of combustion reach the vent at a comparatively high temperature, the vent stays warm enough to prevent an accumulation of sonw or ice thereon which might otherwise interfere with air flow through the device. Also rain water cannot reach the outlet because of the cap **48** and any which might otherwise accumulate upon the horizontal surface of the baffle **52** and run inwardly so as to fall through the opening **56** into the inlet pipe **38** is prevented from so doing because the diameter of the hole **56** is sufficiently larger than the diamter of the duct **38** to permit water to drip through the baffle opening outside the edge of the duct **38**. Water also of course drains through the holes **60** and falls away harmlessly.

To aid others in practicing my invention I have described a specific embodiment thereof, but it will be appreciated that variations may be made therefrom without departing from the scope of my invention.

Having described my invention, what I claim as new and useful and desire to secure by Letters Patent of the United States is:

1. Wind compensating vent means comprising, in combination, inlet and outlet duct means of different size having outer ends disposed concentrically to each other to define an air passageway therebetween, the outer end of the smaller duct means extending beyond the outer end of the larger duct means, a frusto conical deflector member connected to the outer end of the smaller duct means in a position beyond the end of the larger duct means with the projected conical apex of said deflector being located beyond the end of said smaller duct means and at substantially the center line thereof, a conical top member supported outwardly of said deflector member to provide an annular slot of substantially constant width between said members communicating with said smaller duct means, a baffle plate supported inwardly of said deflector but outwardly of the end of said larger duct means, said baffle plate having a central opening therethrough larger than the end of said larger duct means, and said baffle plate being perforated to provide a plurality of small openings extending therethrough, said small openings being located in an annular zone substantially immediately outwardly of said central opening.

2. Wind compensating vent means, comprising, in combination, generally vertical inlet and outlet duct means of different size having outer ends disposed concentrically to each other to define an air passageway therebetween, the outer end of the smaller duct means extending beyond the outer end of the larger duct means, a frusto-conical deflector member connected to the smaller of said duct means in a position upwardly of the end of the larger duct means with the projected conical apex of said deflector being located beyond the end of said smaller duct means and at substantially the center line thereof, a conical top member smaller in diameter than said deflector supported above said deflector member to provide an annular slot of substantially constant width between said members communicating with said smaller duct means, a baffle plate larger in diameter than said deflector supported below said deflector but above the end of said larger duct means,

said baffle plate having a central opening therethrough larger than the end of said larger duct means, and said baffle plate being perforated to provide a plurality of small openings extending therethrough, said small openings being located in an annular zone substantially immediately outwardly of said central opening.

3. In a device of the type described for use in a building having walls and a roof with a wall type sealed heater having side by side combustion air inlet and outlet openings, an outlet duct adapted to extend vertically from a position above the roof of the building downwardly to the heater for connection with the outlet opening, a second larger duct concentric with said outlet duct and extending substantially from end to end thereof and forming an annular space around said outlet duct, said annular space being substantially sealed transversely at least one place along the length thereof, a third still larger concentric duct extending upwardly from a position above but closely adjacent the lower end of said second duct to a position well below the upper end of said second duct, said third duct and said second duct forming an annular space open at both ends, an inlet duct portion adapted to extend from the heater inlet opening upwardly in side by side relationship with said outlet duct, a second inlet duct portion extending from a position slightly below the upper end of said outlet duct to a position somewhat above the upper end of said third duct, said last mentioned inlet duct portion being concentric with and larger than said second duct, and connecting means connecting the two portions of said inlet duct above the upper end of said third duct, a frusto-conical deflector connected to the upper end of said second duct, a conical top member disposed above said deflector to provide with the latter an annular slot communicating with said outlet duct, an intake baffle plate supported below said deflector but above the upper end of said inlet duct, said baffle plate having a central opening therethrough larger than the upper end of said inlet duct, and said baffle plate being perforated to provide a plurality of small openings extending therethrough, said openings being formed in an annular zone immediately outwardly of said central opening.

4. In a device of the type described for use with a wall type sealed heater having side by side combustion air inlet and outlet openings disposed in a wall of a building having a roof thereon, an outlet duct adapted to extend vertically downward from a position above the roof of the building for connection with the heater outlet opening, a second larger duct concentric with said outlet duct and extending substantially from end to end thereof to form an annular space therearound, said annular space being substantially sealed transversely at at least one place along the length thereof, a third still larger concentric duct extending upwardly from a position above but closely adjacent to the lower end of said second duct to a position well below the upper end of said second duct, said third duct and said second duct forming an annular space therebetween open at both ends, an inlet duct portion adapted to connect with the heater inlet opening and extending upwardly in side by side relationship with said outlet duct, a second inlet duct portion extending from a position slightly below the upper end of said outlet duct downwardly to a position above the upper end of said third duct, the last said inlet duct portion being concentric with and larger than said second duct, interconnecting means forming the upper terminus of said first mentioned inlet duct portion and connecting the two portions of said inlet duct above the upper end of said third duct, and a wind compensating fitting forming inlet and outlet passages providing communication between the atmosphere and the upper ends of said inlet and outlet ducts.

5. In a device of the type described for use in a roofed building with a sealed combustion heater having combustion air inlet and outlet openings, ductwork adapted to extend to a position above the building roof and including two ducts of different size terminating at the upper end of said ductwork in concentric relationship, the smaller of said ducts being adapted for connection to the heater outlet opening and extending upwardly beyond the larger duct, means adapted to connect said larger duct to the heater inlet opening, a frusto-conical deflector connected to the upper end of said smaller duct, a conical top member supported above said deflector to provide with the latter an annular slot communicating with said smaller duct, an intake baffle plate supported below said deflector but above the upper end of said larger duct, said baffle plate having a central opening therethrough larger than the upper end of said larger duct, and said baffle plate being perforated to provide a plurality of small openings extending therethrough, said small openings being located in an annular zone substantially immediately outward of said central opening.

6. In a device of the type described for use with a sealed heater having combustion air inlet and outlet openings disposed in the wall of a building having a roof thereon, an outlet duct adapted to connect to the heater outlet opening and extend vertically to a position above the building roof, a larger duct concentric with said outlet duct and extending upwardly from a position above but closely adjacent the lower end thereof to a position well below the upper end of said outlet duct, said concentric duct forming an annular space around said outlet duct open at both ends, a lower inlet duct portion adapted to connect with the heater inlet opening and extend upwardly to the vicinity of the upper end of said larger duct, an upper inlet duct portion extending from a position slightly below the upper end of said outlet duct to a position somewhat above the upper end of said larger duct, said upper inlet duct portion being concentric with and larger than said outlet duct, interconnecting means connecting the upper and lower portions of said inlet duct above the upper end of said larger duct, a convex deflector connected to the upper end of said outlet duct, a convex top member supported above said deflector to provide therewith an annular slot communicating with said outlet duct, an intake baffle plate supported below said deflector but above the upper end of said inlet duct, said baffle plate having a central opening therethrough larger than the upper end of said inlet duct, and said baffle plate being perforated to provide communication between the top and bottom thereof in an annular zone located substantially immediately outward of said central opening.

7. Wind compensating vent means, comprising, in combination, inlet and outlet duct means of different size having outer ends disposed concentrically to each other to define an air passageway therebetween, the outer end of the smaller duct means extending outwardly of the outer end of the larger duct means, a convexo-concave deflector member connected to the end of the smaller of said duct means in a position beyond the end of the larger duct means with the convex surface outermost, a convexo-concave top member supported outwardly of said deflector member to provide therewith an annular slot of substantially constant width communicating with said smaller duct means, a generally flat baffle plate larger in diameter than said deflector member and supported inwardly of said deflector member but outwardly of the end of said larger duct means in generally perpendicular relation to the latter, and said baffle plate having a central opening therethrough larger than the end of said larger duct means.

8. A wind compensating vent fitting for connection to the outer ends of concentric inlet and outlet duct means of different size defining an air passageway therebetween and arranged with the outer end of the smaller duct means extending beyond the outer end of the larger duct means, comprising, a convexo-concave deflector member adapted for connection with the outer end of the smaller duct means in generally perpendicular relation thereto, with the convex surface outermost, a convexo-concave top member smaller in diameter than said deflector supported

on said deflector member in spaced relation thereto to provide therewith an annular slot of substantially constant width for communication with the smaller duct means, a generally flat baffle plate larger in diameter than said deflector and supported on said deflector in inwardly spaced relation thereto for disposal beyond the outer end of the larger duct means, said baffle plate having a central opening therein adapted to form an annular radial opening with the adjacent end of said larger duct means, and said baffle plate being perforated to provide communication between the surfaces thereof in an annular zone located substantially immediately outwardly of said central opening.

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