Dec. 31, 1957 E. A. FIELD 2,818,060

DRAFT AND SMOKE CONTROL SYSTEM FOR A FURNACE

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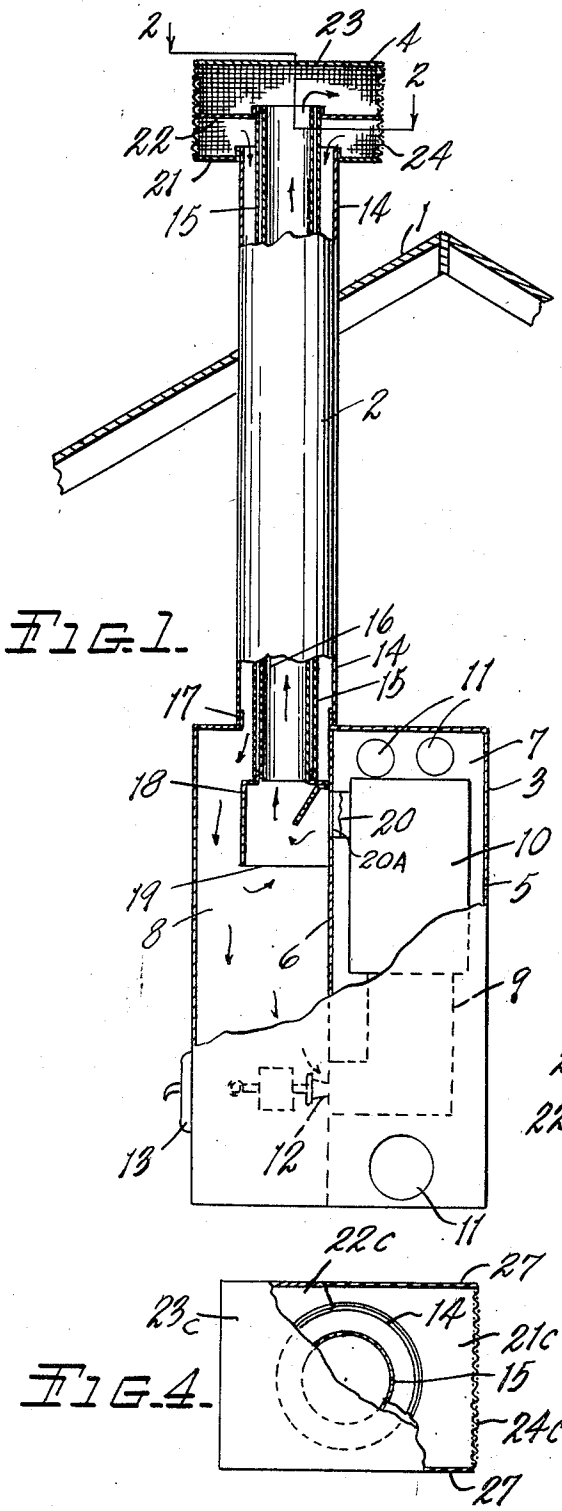



FIG. 1.

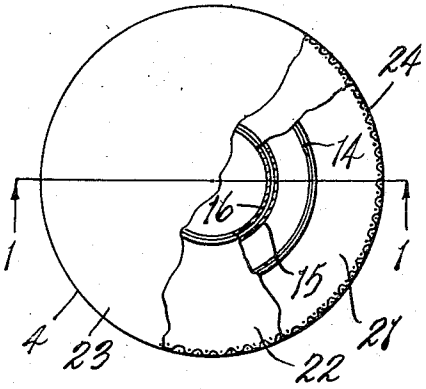



FIG. 2.

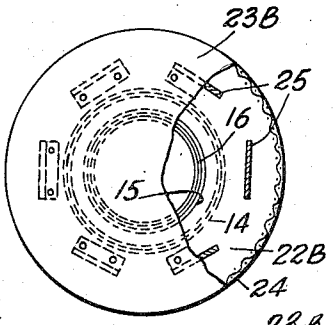



FIG. 5.

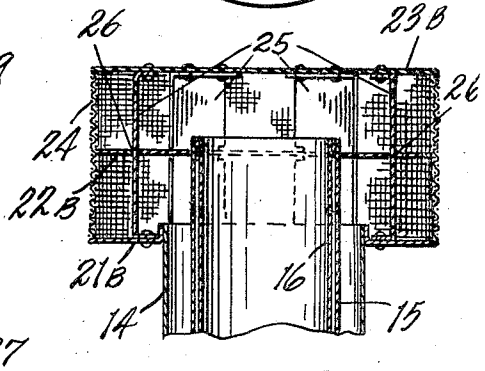



FIG. 3.




FIG. 4.

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# DRAFT AND SMOKE CONTROL SYSTEM FOR A FURNACE

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9 Claims. (Cl. 126—307)

This invention relates to improvements in draft and smoke control system for a furnace. The principal objects of this invention are:

First, to provide a novel means for introducing combustion air into and axhausting combustion gases from a furnace without mixing air from the building with the air burned in the furnace and the gases exhausted out the chimney.

Second, to provide a novel form of air supply and smoke discharge system for a furnace which will eliminate back drafts through the smoke pipe into the furnace.

Third, to provide a furnace with air inlet and smoke outlet passages entirely sealed around the furnace whereby products of combustion or gaseous fuel cannot escape into the building in which the furnace is installed.

Fourth, to provide a heating system which eliminates loss of heat due to warm air from the building being drawn out through the chimney.

Fifth, to provide a furnace installation which is adequately supplied with combustion air regardless of the construction of the building in which the furnace is installed and regardless of the operation of appliances such as ventilating fans in the building.

Other objects and advantages of the invention will be apparent from a consideration of the following description and claims. The drawings, of which there is one sheet, illustrate three highly practical forms of the air supply and smoke discharge system as applied to a furnace installed in a building.

Fig. 1 is a fragmentary elevational view of a furnace and associated chimney installed in a building, the building being indicated conventionally and fragmentarily and portions of the furnace and chimney being broken away in vertical cross section.

Fig. 2 is a fragmentary horizontal cross sectional view taken along the plane of the broken line 2—2 in Fig. 1.

Fig. 3 is a fragmentary vertical cross sectional view through a first modified form of the chimney cap.

Fig. 4 is a top plan view partially broken away in horizontal cross section of a second modified form of chimney cap.

Fig. 5 is a top plan view, partially broken away in section of the cap shown in Fig. 3.

In Fig. 1 a building, such as a dwelling, is indicated conventionally by portions of its roof at 1. A chimney 2 extends downwardly through the roof to a furnace indicated generally at 3. For reasons which will appear as the description of the furnace and chimney progresses the location of the furnace within the building is immaterial. A chimney cap indicated generally at 4 coacts with the chimney and the furnace as will be described in greater detail.

The furnace consists of an entirely closed or sealed casing 5 having a partition wall 6 dividing the furnace into a plenum chamber 7 and an inlet enclosure 8. Positioned within the plenum chamber is a combustion chamber 9 connected to and communicating with a heat exchange chamber 10. Air to be heated passes through the plenum



chamber 7 between ducts 11 under the influence of either forced or gravity air flow. The details of construction of the combustion chamber, plenum chamber, heat exchange chamber and warm air circulating system form no part of the present invention and so are not disclosed in greater detail.

Positioned in the lower portion of the inlet enclosure 8 is a burner 12 that projects into the bottom of the combustion chamber 9. The furnace is more advantageously adapted for use of a gas burner such as is illustrated but can be used to advantage with oil or even solid fuel burning furnaces. It will be understood that the burner 12 incorporates structure common to all burners for introducing primary combustion air into the combustion chamber. Secondary air as required is also admitted in the usual way either through the burner or appropriate draft openings not illustrated. A door 13 in the casing permits access to the burner for service but is closed and substantially sealed during operation of the burner and the furnace.

The chimney 2 is of double walled construction consisting of an outer tubular sleeve 14 positioned in radially spaced relation around an inner smoke flue 15. Where desired a further corrosion resistant liner such as a vitreous enameled tube 16 may be provided within the smoke pipe 15. Chimneys of double and triple wall construction are commonly available as prefabricated articles but are used to cool the inner flue and permit installation near combustible material.

The lower end of the tubular sleeve 14 rests on the top of the casing 5 and opens into the inlet enclosure 8 through a flanged opening 17 in the casing. The smoke flue 15 projects into the inlet enclosure 8 and rests on a smoke hood 18 mounted on the partition wall 6. The physical location of the chimney directly vertically over the furnace 3 is not essential and it will be appreciated that the chimney 2 may have angled or horizontal reaches connecting the vertical portion with a laterally displaced furnace. The connections between the chimney and the furnace may also be made in the sides of the casing 5 and smoke hood 18. The smoke flue opens into the top of the hood and the bottom of the hood is open to the inlet enclosure as at 19. A smoke pipe 20 communicates through an opening 20A between the top of the heat exchange chamber 10 through the partition 6 and the smoke hood 18 above the open lower side 19 of the hood so that smoke and products of combustion issuing from the combustion chamber through the smoke pipe 20 are directed into the smoke hood but escape upwardly through the smoke flue due to the natural draft of heated gas before spilling downwardly through the bottom of the smoke hood. In some installations, particularly high capacity oil and coal fired furnaces, the hood need not open to the inlet chamber.

The chimney cap 4 at the top of the chimney 2 consists of a lower circular baffle 21 secured around the top of the tubular sleeve 14. A second circular baffle 22 is secured around the upper end of the smoke flue 15 in vertically spaced relation above the baffle 21 due to the extension or projection of the smoke flue above the upper end of the sleeve. A third circular baffle 23 is positioned in spaced relation above the baffle 22. All three baffles 21, 22 and 23 are of approximately the same dimension and are interconnected by the cylindrical screen 24 that functions to support the top baffle 23 and prevent birds from nesting between the baffles and in the top of the chimney.

In the operation of the furnace and the chimney both primary and secondary combustion air is drawn in radially between the lower two baffles 21 and 22 and descends through the annular space between the sleeve 14 and smoke flue 15 into the inlet enclosure 8. Primary combustion air is then drawn from the inlet enclosure into the combustion

chamber by operation of the burner in the usual manner of operation of the burner and secondary air is admitted to the fire in the usual manner from the same enclosure. Some air from the inlet enclosure may be recirculated upwardly through the open underside of the smoke hood **18** into the smoke flue **15** under the influence of the rising products of combustion and the natural draft in the smoke pipe. The products of combustion rise through the smoke flue and are discharged between the upper two baffles **22** and **23** as will be understood. Since both the inlet for combustion air and the outlet of the products of combustion are positioned in the same atmospheric area around the chimney cap **4** there can be no externally created pressure differential between the inlet and the outlet ends of the furnace and chimney system due to such variable factors as wind direction and velocity and the furnace will operate at all times directly and solely under the influence of the natural draft created by the hot gases rising through the smoke flue **15**. There can be no down drafts created in the smoke flue **15** because any external pressure source such as the wind will act equally on the inlet to the sleeve **14** and on the outlet from the smoke pipe **15**. This is of particular advantage when the burner **12** is a gas burner and is provided with a small pilot light which might be snuffed out by the back draft.

The system prevents the escape of partially burned products of combustion or unburned fuel gas into the building **1** because the casing **5** is sealed and because there can be no back drafts through the smoke flue as was explained above. No warmed air is drawn from the interior of the building and permitted to escape through the smoke flue **15** so that the heating system as a whole operates with improved efficiency. No amount of variation in the interior construction of the building or change in interior pressure such as might be created by operation of a ventilating fan can change the static pressure at the inner end of the smoke flue **15** so the flow of combustion gases through the smoke flue **15** can not be accidentally reversed to fill the building with smoke.

Fig. 3 illustrates a first modified form of chimney cap in which the top baffle **23B** is supported from the bottom baffle **21B** by six angularly spaced deflector plates **25**. The lower baffle plate **21** is secured to the top of the chimney sleeve **14** in the same manner as in Fig. 1 and the middle baffle **22B** is slotted to pass the plates **25** and the plates are notched as at **26** to receive and support the intermediate plate. As in the first form of the chimney cap a cylindrical screen **24** surrounds the baffles to exclude birds. The function of the upright plates **25** is to break up or diffuse the air flow of wind directed between the horizontal baffles. Particularly in the case of a downwardly inclined wind current such as might deflect from an adjacent high building, the undiffused air stream may build up a slight pressure in the chimney. While this pressure would be about equal in both the flue **16** and sleeve **14** it might be objectionable as causing leaks from the casing **5** and combustion chamber **10**. There may even be a slight pressure differential created between the upper ends of the inner smoke flue and the outer inlet passage because wind currents passing between the upper two horizontal baffles relatively unobstructed while the same volume of air flowing between the lower two baffles meets the obstruction of the inner smoke flue and tends to build up a slight dynamic pressure that is transmitted down the inlet passage. When the velocity is cut down this does not occur. A similar diffusing action can be obtained by substituting an expanded metal mesh for the screen **24**. Expanded mesh blocks 40 to 50% of the area of the mesh and breaks up air streams so as not to create air currents into the flues.

Fig. 4 illustrates a second modified form of chimney cap in which the bottom baffle **21C** is rectangular in shape and mounted on the top end of the sleeve **14**. Opposite side edges of the baffle plate **21C** are turned upwardly in side plates **27** that connect with and support the middle baffle **22C** and the cover plate **23C**. The smoke flue **15** projects upwardly and is connected to the middle baffle **22C** while the cover **23C** is spaced above the middle baffle as in the other forms of the chimney cap. The open ends of the chimney cap between the side walls **27** are closed by screens **24C** and the chimney cap operates as the other forms of the cap to insure equal pressure conditions at the upper end of the smoke flue and at the upper end of the inlet sleeve **14**.

Having thus described the invention, what is claimed as new and is desired to be secured by Letters Patent is:

1. A furnace and smoke pipe installation for a fluid fuel burner in a building comprising a combustion chamber, a smoke pipe connected to said combustion chamber, a chimney communicating with said smoke pipe and extending exteriorly of said building, a sleeve spaced around said chimney and forming an inlet duct from the exterior to the interior of said building, a first substantially imperforate flat baffle around the upper end of said sleeve and substantially sealed thereto, a second flat baffle around the upper end of said chimney and spaced above said first baffle, and a third flat baffle spaced above and over said second baffle, and a screen connecting said baffles to prevent the entry of birds therebetween, said baffles being of equal size and forming adjacent areas of entry to said inlet and said chimney subject to equal external pressure conditions.

2. A furnace and smoke pipe installation for a fluid fuel burner in a building comprising a combustion chamber, a smoke pipe connected to said combustion chamber, a chimney communicating with said smoke pipe and extending exteriorly of said building, a sleeve spaced around said chimney and forming an inlet duct from the exterior to the interior of said building, a first substantially imperforate flat baffle around the upper end of said sleeve and substantially sealed thereto, a second flat baffle around the upper end of said chimney and spaced above said first baffle, and a third flat baffle spaced above and over said second baffle, said baffles being of equal size and forming adjacent areas of entry to said inlet and said chimney subject to equal external pressure conditions.

3. A furnace and smoke pipe installation for a fluid fuel burner in a building comprising a combustion chamber, a smoke pipe connected to said combustion chamber, a chimney communicating with said smoke pipe and extending exteriorly of said building, a sleeve spaced around said chimney and forming an inlet duct from the exterior to the interior of said building, a first substantially imperforate flat baffle around the upper end of said sleeve and substantially sealed thereto, a second flat baffle around the upper end of said chimney and spaced above said first baffle, and a third flat baffle spaced above and over said second baffle, said baffles forming adjacent areas of entry to said inlet and said chimney subject to equal external pressure conditions.

4. A furnace and smoke pipe installation for a burner comprising a combustion chamber, means forming a smoke outlet from said combustion chamber, a chimney communicating with said smoke outlet and extending to an elevated position above said chamber, a sleeve spaced around said chimney and forming an inlet duct to deliver combustion air to said chamber, a first substantially imperforate flat baffle around the upper end of said sleeve and substantially sealed thereto, a second flat baffle around the upper end of said chimney and spaced above said first baffle, and a third flat baffle spaced above and over said second baffle, said baffles forming adjacent areas of entry to said inlet and said chimney subject to equal external pressure conditions.

5. In combination with a furnace having an air inlet and a smoke outlet, a double walled chimney extending to an external position in the atmosphere, the walls of said chimney forming an air inlet passage communicating with said inlet and a smoke flue connected to the

outlet of the furnace, spaced flat horizontal imperforate baffles on the tops of the inner and outer walls of said chimney and above the inner of said walls defining flat horizontal passages to the upper ends of said inlet passage and said flue from the same pressure area around the upper end of said chimney, and upright baffles spaced angularly around said chimney between said horizontal baffles and spaced inwardly from the periphery of said horizontal baffles to break up air streams directed between said horizontal baffles, the lower two baffles being substantially sealed to the ends of the inner and outer walls with which they are associated.

6. In combination with a furnace having an air inlet and a smoke outlet, a double walled chimney extending to an external position in the atmosphere, the walls of said chimney forming an air inlet passage communicating with said inlet and a smoke flue connected to the outlet of the furnace, spaced flat horizontal imperforate baffles on the tops of the inner and outer walls of said chimney and above the inner of said walls defining flat horizontal passages to the upper ends of said inlet passage and said flue from the same pressure area around the upper end of said chimney, and upright baffles spaced angularly around said chimney between said horizontal baffles to break up air streams directed between said horizontal baffles, the lower two baffles being substantially sealed to the ends of the inner and outer walls with which they are associated.

7. In combination with a furnace having a primary air inlet and a smoke outlet, a double walled chimney extending to an external position in the atmosphere, the outer wall of said chimney forming the outside of an air inlet passage communicating with said inlet, the inner wall of said chimney being spaced from the outer wall and forming a smoke flue communicating with the outlet of the furnace, and spaced flat imperforate baffles on the tops of the inner and outer walls of said chimney and above said flue defining flat horizontal passages to the upper ends of said inlet passage and said flue completely therearound and from the same pressure area around the upper end of said chimney, the lower two baffles being substantially sealed to the ends of the inner and outer walls with which they are associated.

8. A furnace and smoke flue installation for a burner in a building comprising a combustion chamber, a smoke pipe connected to said combustion chamber, a chimney communicating with said smoke pipe and extending exteriorly of said building, a sleeve spaced around said chimney and forming the outside of an inlet duct from the exterior to the interior of said building, a first substantially imperforate flat baffle around the upper end of said sleeve and substantially sealed thereto, a second flat baffle around the upper end of said chimney and spaced above said first baffle, a third flat baffle spaced above and over said second baffle, said baffles being horizontal and parallel and forming adjacent areas of entry to said inlet and said chimney subject to equal external pressure conditions, and spaced upright baffles secured between said first three baffles around the upper end of said chimney.

9. A furnace and smoke flue installation for a burner in a building comprising a combustion chamber, a plenum chamber enclosing said combustion chamber, a smoke pipe connected to said combustion chamber and extending exteriorly of said plenum chamber, a burner being arranged to maintain a fire in said combustion chamber, a chimney communicating with said smoke pipe and extending exteriorly of said building, a sleeve spaced around said chimney and forming the outside of an inlet duct from the exterior to the interior of said building, an enclosure surrounding and connecting the inner end of said inlet with the outer end of said burner, a first substantially imperforate flat baffle around the upper end of said sleeve and substantially sealed thereto, a second baffle around the upper end of said chimney and spaced above said first baffle, a third baffle spaced above and over said second baffle, said baffles forming adjacent areas of entry to said inlet and said chimney subject to equal external pressure conditions, and spaced upright baffle means secured between said first three baffles partially obstructing air flow between the baffles equally around the upper end of said chimney.



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