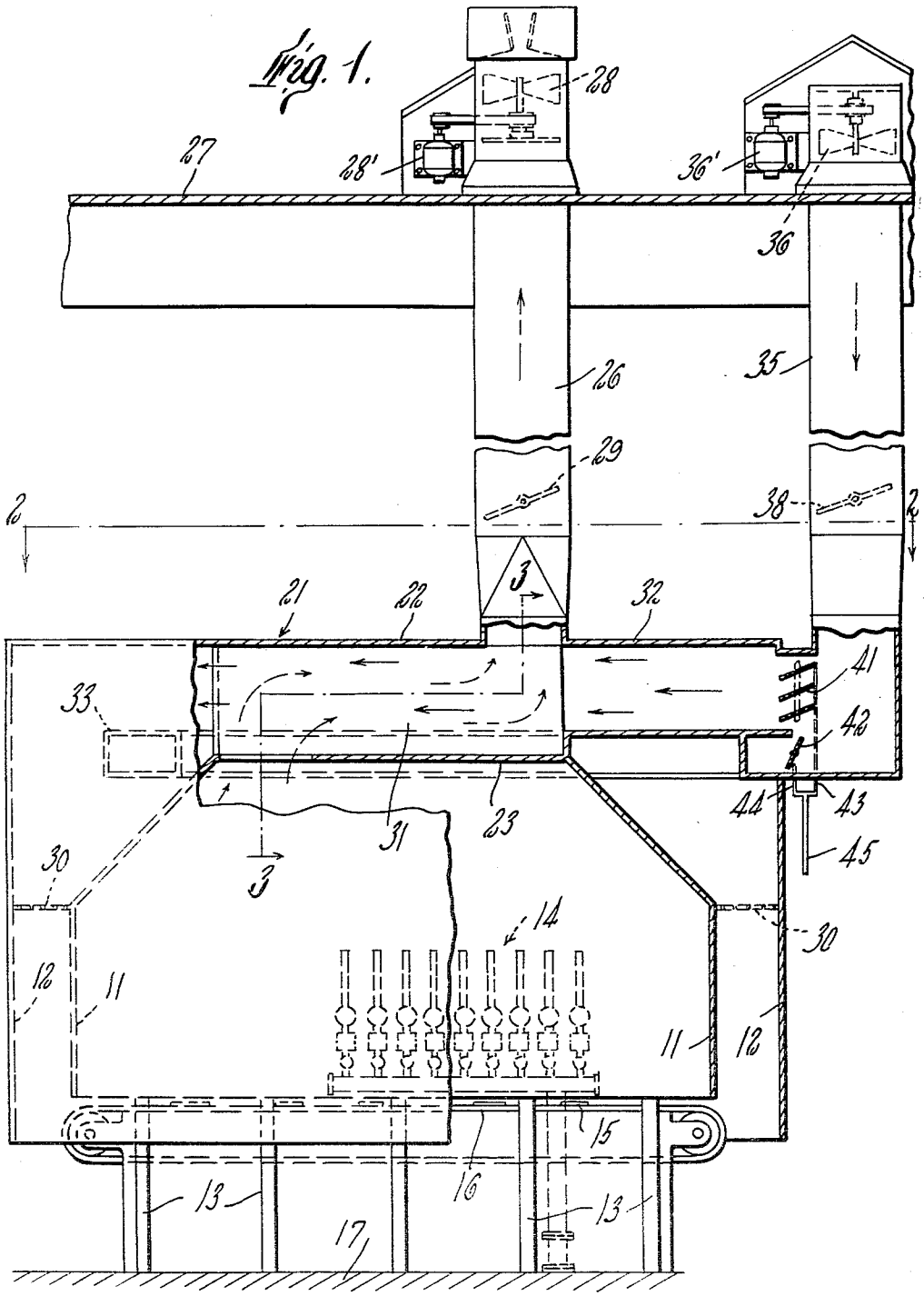
May 31, 1960 G. B. GERRISH 2,938,714

HOODED EXHAUST SYSTEM

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Fig. 1.



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HOODED EXHAUST SYSTEM

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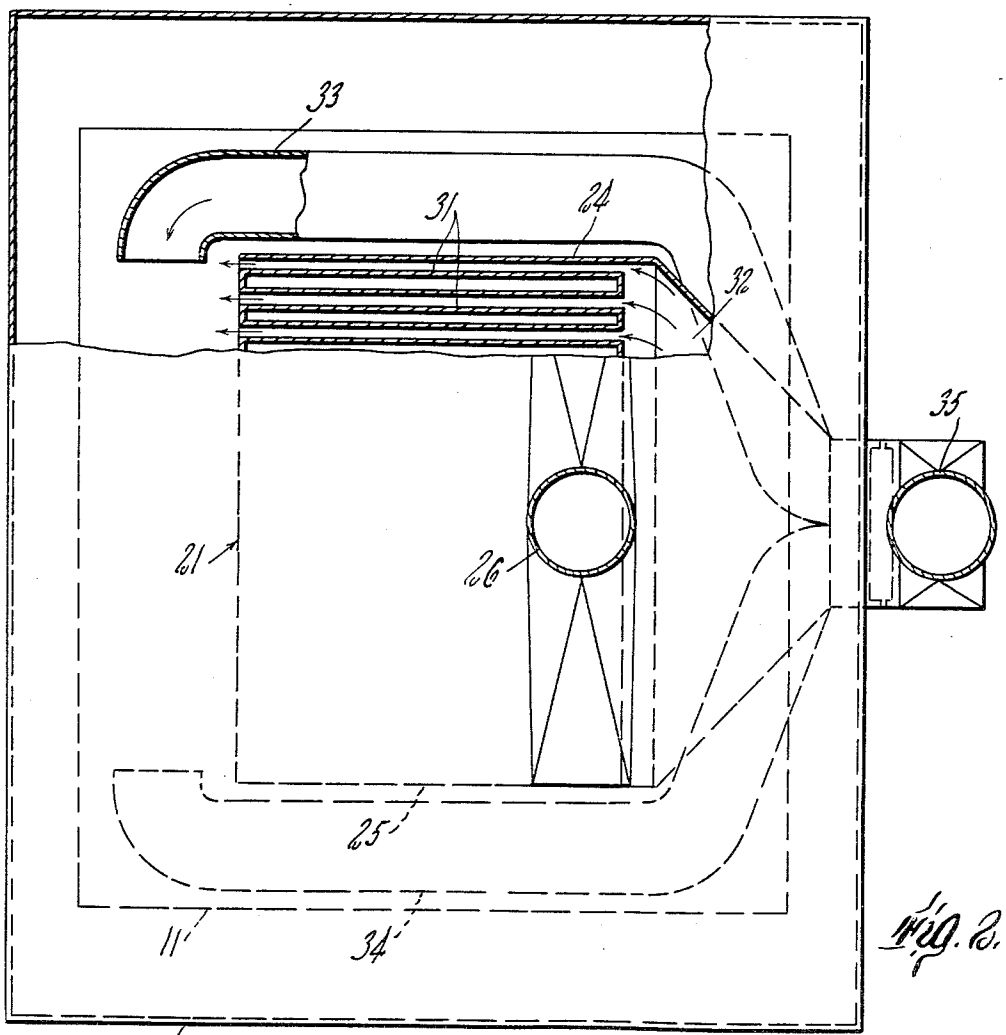


Fig. 2.

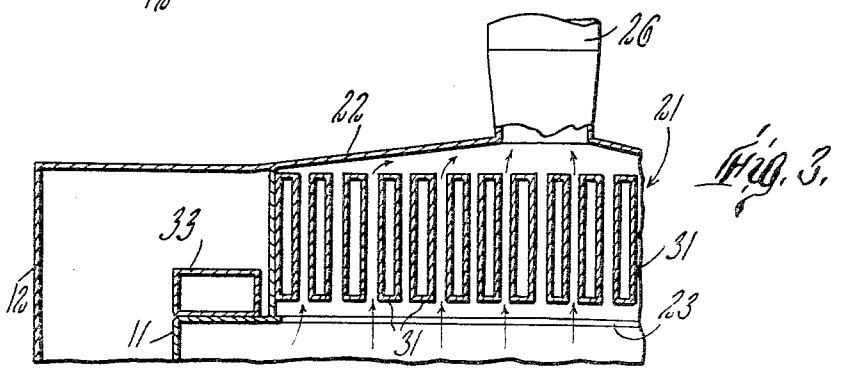


Fig. 3.

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HOODED EXHAUST SYSTEM

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1 Claim. (Cl. 257—309)

This invention relates to the exhausting of undesirable products of combustion or other heated gases from local drying or heat generating areas located within larger plant areas. This application is a continuation-in-part of my earlier copending application Serial No. 627,361, filed December 10, 1956 and now abandoned.

Serious difficulties are often presented by irregularities in air circulation and air consumption inevitably resulting from the introduction of equipment which, for comfort, safety, or other reasons, must be hooded or otherwise connected to an exhaust leading outside the air conditioned area. In case of oxygen consuming equipment, such as flame heaters, a considerable load may be placed upon the air supply for the area. This problem is aggravated by the practice of exhausting air to reduce flue gas temperatures and to prevent the gases from escaping into the area. If replacement air is supplied by leakage or direct entry from the outside atmosphere, a considerable load will be placed in cold weather, upon the normal inside heating equipment or in warmer weather upon the normal inside air conditioning unit. Also undesirable drafts will be created regardless of the outside temperature. The air conditioning and heating installations cannot readily be changed for optimum operation if machine locations are changed or additional air consuming units are installed in the general area. The amount of make-up air supplied is a very significant factor in the cost of installing and operating heating and air conditioning systems and is therefore usually kept to a minimum.

Another difficulty arising from attempts to supply air consuming equipment with air from a confined area is that the equipment will tend to operate at different temperature levels depending upon the temperature of the ambient air. For example, if a window is opened in winter, through which air flows to a heat treating unit, such as a furnace, baker or oven, the unit will tend to operate at a lower temperature level and thus non-uniform cooking, drying or other heating of the product being treated may result. Increased fuel consumption will certainly result if the operation is under automatic control. To further complicate matters, many processes operate more efficiently with air at a temperature above the normal comfort conditions maintained in the general area.

It is therefore an object of this invention to provide an air supply to an individual, or group of individual, air attracting units within a localized area of a general plant space, which supply is dependent on the general space air supply and is so controlled with respect to the air demand of the unit that the unit will operate without drawing on or spilling air into the general area.

It is another object of this invention to supply replacement air at a selected temperature having a lower limit determined by the maximum temperature of the outside source of air and an upper limit determined by the amount of heat liberated by the equipment or process involved.

Since auxiliary air according to my invention is obtained from outside the general area, and preferably from outside the plant or other confined space, I encounter the problem of the outside air temperature being non-uniform. Hence I incorporate in my system means for preheating the intake of outside air to a temperature at

which the equipment is adapted to operate most efficiently. Such temperature is maintained regardless of the outside temperature (within reasonable limits), so that the equipment will produce accurate and uniform results. This is of considerable importance where exact time temperature exposures of products are essential, as they usually are for plastic cures. Also considerable fuel is saved by the recapturing of a portion of the heat in the exhaust gases which would otherwise be wasted.

Accordingly, a still further object of my invention is to provide in such auxiliary air supply apparatus, means for insuring that, regardless of the temperature of the outside air within reasonable limits, the temperature of the air fed to the air consuming equipment or unit shall remain reasonably constant.

I have further found that when such preheating is provided not from an independent outside source, but from a heat exchanger coupled with the unit exhaust system, a balanced intake and exhaust can be maintained so as not to effect, other than by radiation and product heat, the general area air supply, regardless of variations in the outside air temperature. The result is that once the desired amount of air flow through the unit has been provided for, there is no need to adjust the intake or exhaust, assuming a constant rate of heat generation by the unit. The reason lies in the heat exchanger wherein heat is transferred to the incoming air. If there is a constant volume of air input, such as can be obtained with a fan and damper arrangement adjusted so that the fan will impel say 10,000 cubic feet per minute into the system; and if the same weight of air is exhausted as is taken in, through the use for example of another constant volume fan and damper arrangement, the desired balance will obtain even though the volume of exhaust air moved by the other fan must be substantially larger (say 13,500 cubic feet per minute) to take account of the expansion of the exhaust air that has taken place as a result of the heat generated in the unit and absorbed by the exhaust air. This is true in spite of the fact that the weight of air taken in varies according to its temperature because the heat gain and the heat loss in the exchanger are equal. In practice the weight of exhausted products of combustion is also taken into account but this is relatively small. The excess of air in the exhaust caused by changes in resistance to flow of air in the heat exchanger ducts when the temperature of the intake drops, is so small (approximately 6 percent maximum under extreme winter conditions) that it has been disregarded.

The novel features of the invention, together with further objects and advantages thereof, will become apparent from the following detailed description and the drawings to which it refers.

In the drawings:

Fig. 1 is a view in elevation of the hooded exhaust system according to the invention with portions broken away to show certain parts more clearly; and

Figs. 2 and 3 are sectional views taken on lines 2—2 and 3—3, respectively, of Fig. 1.

With reference now to the drawings, it will be observed that the exhaust system according to the invention includes an inner hood 11 and an outer hood 12. Structural members, such as 13, are provided to support the hoods above a unit 14 which is the source of the hot gases to be exhausted. By way of example, there has been illustrated a heat-curing unit for products 15, including a conveyor 16 to transport them. The unit rests on the floor 17 of a plant area or the like which also provides a footing for the member 13. As shown, the inner hood comes down to approximately the level of the conveyor while the outer hood extends somewhat lower, but still substantially above the level of the floor.

Disposed in the stream of the hot gases at what might be termed the throat of the inner hood is a heat exchanger **21**, defined exteriorly by walls **22** through **25**. These walls form a chamber which leads from the hood to an exhaust duct **26**. The exhaust duct in turn passes through the roof **27** of the plant or other structure wherein the unit is located. There is an axial fan **28** mounted within the section of the exhaust ductwork that extends above the roof and there is a damper **29** near the inlet end thereof to control the flow of air. Fan **28** is driven by a motor **28'**.

The heat exchanger includes, in addition to the chamber-defining walls **22–25**, a series of rectangular tubes **31**. The tubes are arranged side-by-side with their broader walls adjacent one another, that is, effectively on end, so that the hot gases, in order to escape, must pass between them. The tubes themselves communicate between a transistional duct section **32** and the part of the region between the inner and outer hoods which is located above an air distribution baffle **30**. Specifically the tubes discharge into the upper part of this region where it occupies the largest volume, owing to the fact that the upper portion inner hood **11** is necked down. Discharging into this same mixing region adjacent the tubes **31** are ducts **33** and **34** leading from a point adjacent the inlet end of the duct section **32** and passing around on opposite sides of the heat exchanger. At a common junction, duct section **32**, and ducts **33**, **34** are connected to an inlet duct **35**, which communicates with the outside atmosphere through the roof **27**. A fan **36** is provided to draw air from the atmosphere into the duct **35** and a motor **36'** serves to drive this fan. There is also a damper **38** in the duct **35** near the point where it joins the ducts **33**, **34** and the duct section **32** in order to control the flow of air to the latter. To apportion the flow between the duct section **32** on the one hand and the ducts **33** and **34** on the other, there are provided dampers **41** and **42**. When dampers **41** are closed, they seal off the mouth of the duct section **32** leading to the heat exchanger tubes **31**. When damper **42** is closed, it seals off the mouth of ducts **33**, **34** which provide a direct path to the region between the hoods. Dampers **41** and **42** are adapted to operate in tandem by means of control arms **43**, and **44**, respectively, joined to a common actuating member **45**. Accordingly, these dampers provide a ready means for controlling the temperature of the intake air and preferably they are arranged to be operated by a positional control motor (not shown) which responds automatically to changes in temperature of the blended air blown into the hood region between the inner and outer hoods.

The reason for creating a substantial pressure throughout the fresh air inlet system is to insure that fresh make-up air does not become contaminated by the hot exhaust gases. This pressure, coupled with the partial vacuum in the hood created by the exhaust fan, insures that any leak in the tubes will result in fresh air being blown out of them rather than toxic gases entering.

In operation, let it be assumed first that the dampers **41** are completely closed and the damper **42** is open. As a consequence, all the fresh air drawn in by the intake fan bypasses the heat exchanger and enters the space between the inner and outer hoods by way of the ducts **33** and **34**. From there it is sucked up through the inner hood, passed around the source of heat **14**, and expelled through the roof by the exhaust fan. If the temperature of the outside air decreases and if the intake fan has a constant volume characteristic, assuming for the moment that damper **41** is kept closed, the weight of air drawn in by the fan **36** will increase. However, there will be a like decrease in the temperature of the exhaust air, and a like increase in the weight of air expelled by the exhaust fan, so that the system

remains in balance. Now if the dampers **41** and **42** are adjusted to cause some of the inlet air to flow through the heat exchanger, the temperature of the air entering the inner hood will increase. That is to say, the air heated by the heat exchanger will mix with the unheated air passed by the ducts, producing a net temperature rise. This will not change the balance between the weight of air drawn in and the weight of air expelled from the system, since the amount of heat transferred to the incoming air is substantially equal to that extracted from the exhaust air. Accordingly, conventional fans and impellers of fixed constant volume rating can be employed, and the dampers **41** and **42** adjusted at will, without disturbing the balance between intake and exhaust. The same is true, of course, if these dampers are adjusted automatically so as to maintain constant the temperature of the air entering the inner hood. This being so, once the system has been balanced, at no time does the system draw upon or expel air into the surrounding plant area.

Although the invention has been described in connection with a single preferred embodiment, those skilled in the art will appreciate that this embodiment can be modified in various ways without departing from the spirit and scope of the invention. Therefore the invention should not be deemed to be limited to the details of what has been described herein, but rather it should be deemed to be limited only by the scope of the appended claim.

What is claimed is:

An air conservation system for a large confined space having a relatively small air attracting unit in a localized area in constant communication in normal operation of the unit with the large confined space, comprising a double-walled hood overlying the localized area of the air attracting unit, the inner hood encompassing the area of air exhaustion from said unit, an exhaust duct leading from said inner hood, an exhaust fan in said exhaust duct, heat exchanger tubes interposed between said inner hood and said exhaust duct, the outer hood encompassing an area surrounding said first hood, an air intake duct leading from a source of air supply outside of said confined space to said heat exchanger tubes and communicating beyond said exchanger with the space between the double walls of said hood, a bypass from said intake around said heat exchanger tubes, a fan in said intake, means in said intake duct and means in said exhaust duct which are preset in relation to each other for controlling the rate of gas flow induced by operation of said fans in said intake and exhaust ducts to supply air from said intake to said unit at a rate by weight which, when added to the weight of any gas products originating in said unit is substantially equivalent to the rate by weight of gas expelled through said exhaust duct by said exhaust fan to prevent air in the large confined space from entering the air attracting unit and to prevent air in the air attracting unit from entering the large confined space, damper means disposed in the paths of the air which passes through said heat exchanger tubes and bypass, and means to move said damper means synchronously in opposite senses to selectively apportion the air which passes through said exchanger tubes and bypass respectively without affecting the amount of air flow induced by said fans in said intake and exhaust.

References Cited in the file of this patent

UNITED STATES PATENTS

1,582,892	Beadle	May 4, 1926
2,072,833	Baird et al.	Mar. 2, 1937
2,355,671	Naeher et al.	Aug. 15, 1944
2,521,866	Ott	Sept. 12, 1950

FOREIGN PATENTS

393,378	Great Britain	June 8, 1933