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INDOOR SMOKE REMOVAL SYSTEM

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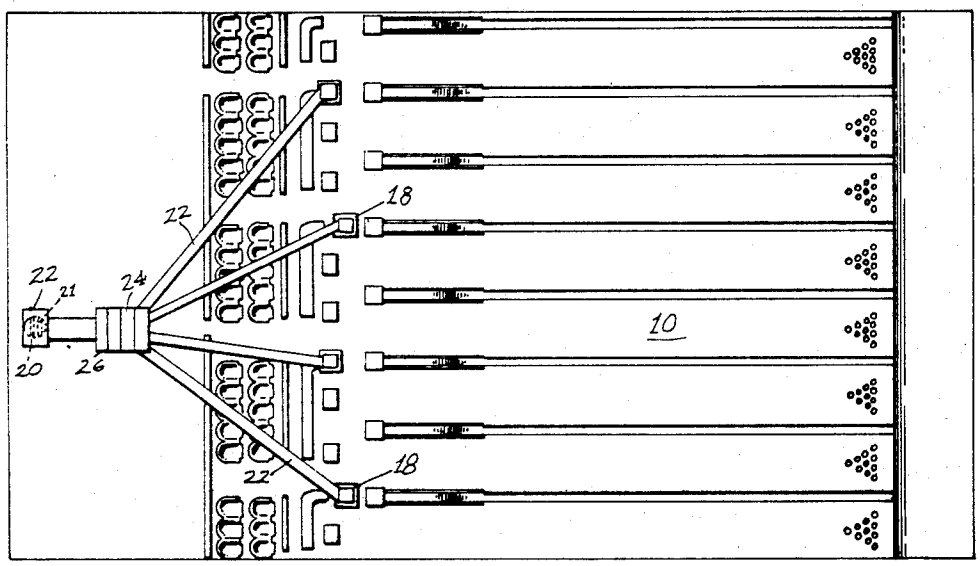


Fig. 1

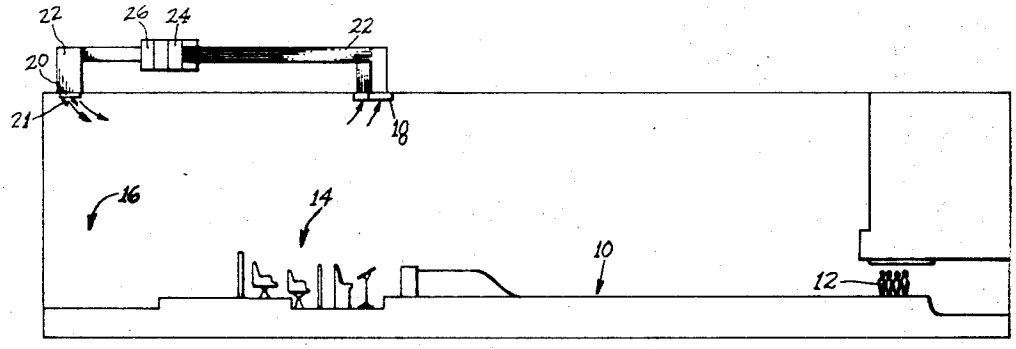


Fig. 2

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INDOOR SMOKE REMOVAL SYSTEM

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ABSTRACT OF THE DISCLOSURE

System having a ceiling inlet over the primary smoke source, and a remote clean air outlet in the ceiling, and a blower and air cleaning system providing limited air flow between the outlet and the inlet.

Background of the invention

This invention relates to an indoor air cleaning system, and has great and particular utility in the elimination and removal of tobacco smoke from commercial installations such as bowling alleys and the like.

The system of this invention includes an electronic air cleaner or precipitator of the type generally in use for related purposes. However, by virtue of the combination as set out hereinafter, the instant invention accomplishes the general objectives set out above with the utilization of one-third to one-half the equipment size and power heretofore required.

That is, existing systems are currently designed for convenient installation as part of a complete heating and/or air conditioning system. In such installations, the air cleaning unit must be sized to accommodate the capacity of the entire system.

It is a primary object of the instant invention to provide a more efficient air cleaning system for such installations, and at the same time to drastically reduce the size, cost and capacity of the air cleaning equipment.

Summary

Briefly considered, the instant invention contemplates the provision of a smoke removal system which is separate and distinct from the heating and/or air conditioning systems in the building being served. By locating the inlets and outlets of the system, and by carefully controlling the air flow therebetween, applicants have provided both a more efficient system, as well as one which can be installed and operated at a lower cost.

The air inlets of the system will be generally located at specific, predetermined points in the area being serviced. These points will correspond to the primary smoke sources within the area.

The clean air outlets for the system will be located remote from the inlets, and will be arranged and equipped to direct air flow in a relatively thin layer adjacent the ceiling of the installation, toward the air inlets.

Description of the drawing

FIGURE 1 is a generally schematic showing of one application of the system of this invention.

FIGURE 2 is a cross sectional view along the line 2—2 of FIGURE 1.

Description of the preferred embodiment

As previously indicated, the instant invention has great and particular utility in connection with large indoor areas such as, for example, bowling alleys. Accordingly, the following description will be primarily in terms as such an application of the invention.

The typical bowling house may be considered as generally rectangular in shape, including a plurality of bowling alleys **10** arranged parallel to one another. The pin setting machines or other equipment **12** will generally be disposed at one end of the building. At the opposite end of the alleys will be the scoring tables, ball racks, benches for participants, and perhaps a small spectator gallery, indicated generally at **14**. Beyond the gallery will be the entrance foyer or concourse **16** which may include a refreshment stand or the like.

Such a bowling house will generally be provided with an air conditioning and/or heating system appropriate to the climate involved, and to other factors such as the number of persons using the facility, exposure, and the like. It is well understood in the art that these various factors can be taken into account in order to determine the quantity of heating and/or air conditioning needed for the area involved.

Also according to the prior art, smoke removal would be accomplished by providing an electronic air cleaning unit which operates in conjunction with, and in fact part of this greater system.

By way of example, a typical bowling house will have on the order of 6,000 cubic feet of air per lane. A bowling house with 24 lanes will therefore have approximately 144,000 cubic feet of air. In a typical installation in or around the State of Ohio, approximately 40 to 50 tons of air conditioning would be required for such a volume. As is well known in the art, there is a very direct relationship between air flow and quantity of air conditioning involved, such that 40 to 50 tons of air conditioning would require an air flow of 16,000 to 20,000 cubic feet per minute.

It will be readily apparent that if the electronic air cleaning system is employed as a part of the air conditioning system, this equipment must be of sufficient capacity to handle this air flow.

The instant invention contemplates the removal of smoke and the like from the bowling alley by employing a separate air cleaning system. According to this invention, the inlets **18** for smoke filled air will be disposed substantially over the primary smoke source. In accordance with the foregoing comments, and in terms of a bowling alley specifically, the primary smoke source will be above the scoring tables and benches for participants.

The fresh air outlets **20** of the contemplated system will be disposed remote from the inlets, and will include the diffusers **21** to direct a flow of clean air toward the smoke inlets. In the case of a bowling alley, the clean air outlets will generally be disposed in the ceiling of the house over the concourse **16** of the building.

Interconnected between the smoke inlet and the clean air outlets will be a system including conventional ducts schematically shown at **22** or passages, an electronic air cleaner schematically shown at **24**, and a blower schematically shown at **26**.

In the preferred embodiment of the invention, the air cleaner utilized will be the conventional two stage electrostatic precipitator with removable cells. The air cleaner does not form a part of this invention, per se, and will not be described in detail in this specification.

The blower in the system of this invention will be of a size and capacity to provide a limited circulation of air between the clean air outlets and the smoke inlets. It is believed that the circulation provided is in a relatively thin layer closely adjacent the ceiling of the room.

Empirical investigations have developed that this system requires the use of only one-third to one-half of the air flow of a properly sized air conditioning system.

Referring back to the exemplary bowling house described earlier (one which requires 16,000 to 20,000 c.f.m. in the air conditioning system), an installation according to this invention would require an air flow of only 6,000 to 7,500 c.f.m. As related to the total volume of air in the room, it will be apparent that the total air flow per min-

ute is less than 7% of the total volume of air in the area serviced by the system.

It will be recalled that the smoke inlets are to be disposed in the ceiling of the room substantially over the primary smoke source. In the preferred embodiment of the invention, the smoke inlets will be staggered in the ceiling so that approximately half of the inlets will be disposed directly over the primary smoke source, while the other half of the smoke inlets will be disposed beyond the primary smoke source with respect to the clean air outlets located as described above. This staggering of the smoke inlets takes into account both the direct rise of smoke from the source, as well as the circulation in the thin layer near the ceiling of such rising smoke by the blower and outlets described above.

The embodiment of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A bowling center having a ceiling, a plurality of lanes, a spectator area at one end of said lanes and bowling pins at the other end of said lanes and a heating and air conditioning system operatively associated with said bowling center for heating and conditioning the air in said bowling center, and a smoke removal system separate and distinct from said heating and air conditioning system, said smoke removal system comprising:

(a) a two stage electrostatic precipitator having an inlet and an outlet;

(b) a plurality of air inlets disposed in said ceiling in a relatively narrow zone over said spectator area, each said inlet operatively associated with said ceiling in such a manner that smoke ladened air passes through said inlets from said bowling center;

(c) first conduit means operatively associated with said air inlets and said precipitator inlet for conducting smoke ladened air which passes from said bowling center through said air inlets to the inlet of said precipitator;

(d) at least one clean air outlet disposed in said ceiling remote from said inlets and operatively associated with said ceiling so that air passes through and from said outlet into said bowling center;

(e) second conduit means operatively associated with said air outlet and said precipitator outlet for conducting clean air from said precipitator to and through said outlet and into said bowling center;

(f) diffuser means operatively associated with said outlet and directing air flowing from said outlet toward said inlets only in a layer below and adjacent to said ceiling for creating a layer of moving air below and adjacent to said ceiling; and

(g) blower means having a capacity to move not more than 7% of the volume of air in said bowling center per minute, said blower means being constructed and arranged to provide air flow successively from said bowling center through said inlets, then from said inlets through said first conduit means to the inlet of said precipitator, then from said precipitator inlet through said precipitator to said precipitator outlet, then from said precipitator outlet through said second conduit means to and through said outlet and into said bowling center; then from said outlet to said inlets only in a layer below and adjacent to said ceiling.

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