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EQUALIZING DUCT FOR HARDENING ROOMS

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2 Sheets-Sheet 1

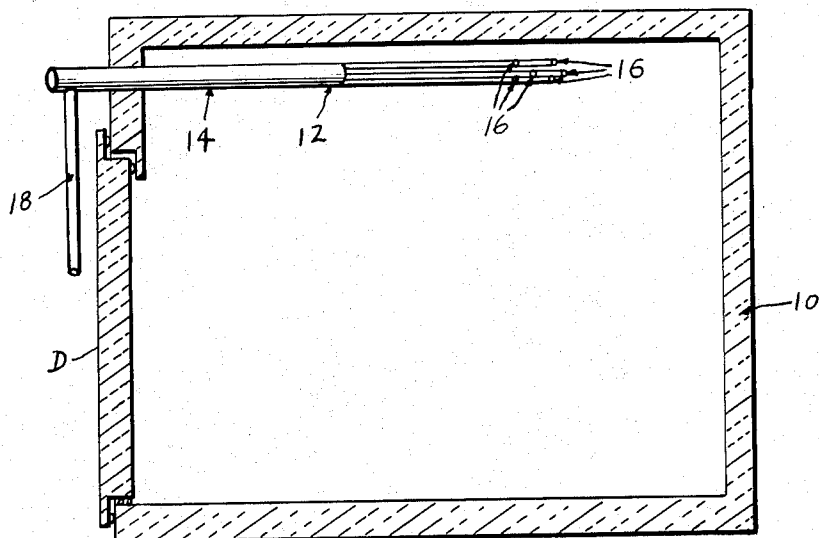


FIG. 1

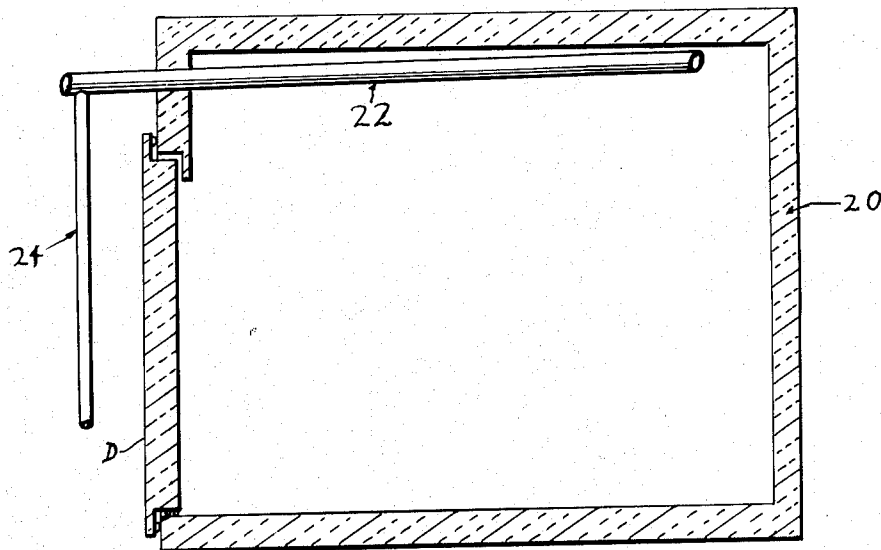


FIG. 2

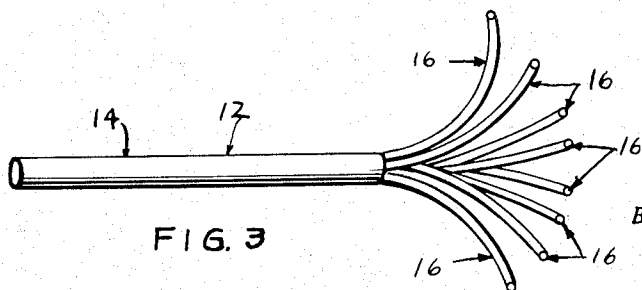


FIG. 3

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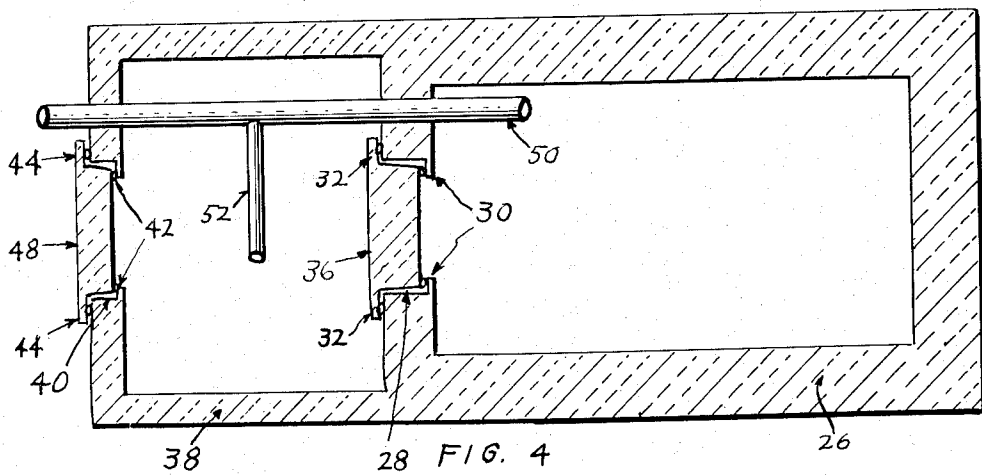
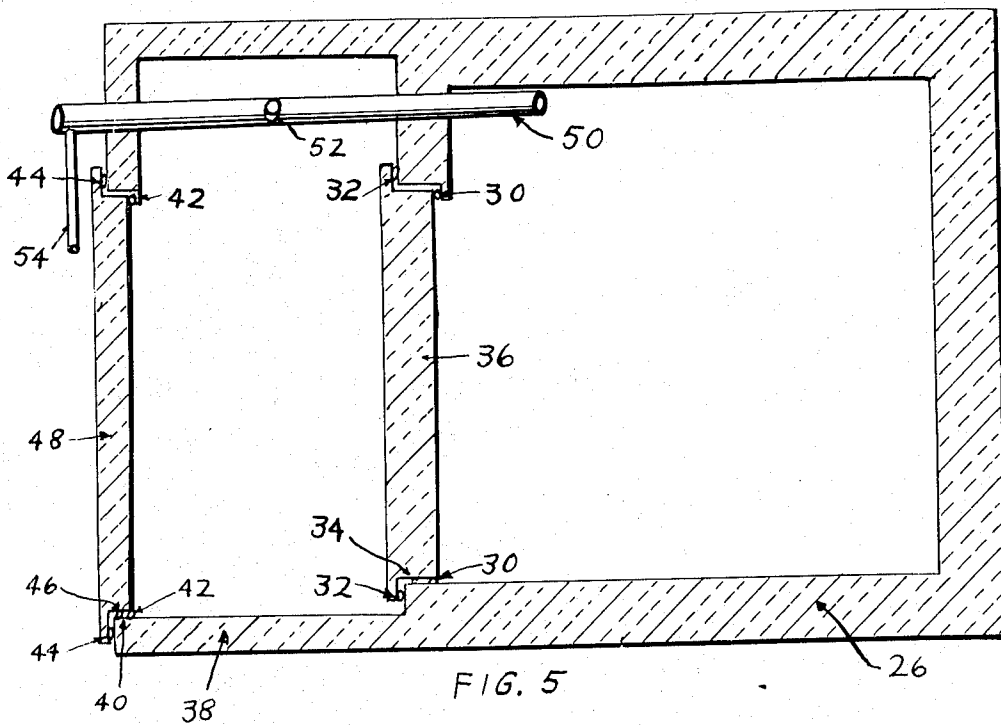
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EQUALIZING DUCT FOR HARDENING ROOMS

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4 Claims. (Cl. 62—89)

This invention relates to improvements in refrigerated rooms. More particularly, this invention relates to an improved apparatus for controlling the action which humidified air can have upon the walls and ceilings of refrigerated rooms.

It is therefore an object of the present invention to provide an improved apparatus for controlling the action which humidified air can have upon the walls and ceilings of refrigerated rooms.

In many instances it is desirable or necessary to maintain within certain rooms of a structure conditions of temperature and humidity which are quite different from ambient conditions of temperature and humidity. For example, it is necessary, in ice cream hardening rooms, frozen food storage rooms, ice storage rooms and the rooms in cold storage warehouses, to maintain temperatures well below average ambient temperatures. The establishment and maintenance of the desired temperatures and the desired relative humidities within such rooms can pose serious problems. For example, the reduced temperature of the air in refrigerated rooms makes certain that when any air leaks into those rooms, as by infiltrating through the walls and ceilings of those rooms, it will cool to its dew point and deposit some of the moisture which it carries in the inner portions of the walls or ceilings. The deposited moisture will be troublesome; causing the plaster to fall away in some instances, causing the mortar to crumble in other instances, rotting wooden studding and beams in still other instances, and decreasing the ability of the rooms to maintain the desired temperature and humidity levels. All of this is, of course, objectionable. The present invention obviates this objection by providing an apparatus which prevents the depositing, by infiltrating air, of moisture in the walls and ceilings of refrigerated rooms. It is therefore an object of the present invention to provide an apparatus which will prevent the depositing, by infiltrating air, of moisture in the walls and ceilings of refrigerated rooms.

The infiltration of air through the walls and ceilings of refrigerated rooms is due to the creation of reduced pressures within those rooms when the air within those rooms cools and experiences a reduction in volume. Despite the use of elaborate seals in, and the profuse application of sealing compounds to, the walls and ceilings of refrigerated rooms the infiltration of air will continue. The present invention obviates all such infiltration through the walls and ceilings of a refrigerated room by providing a pressure-equalizing duct that places the atmosphere within the refrigerated room in direct communication with the atmosphere external of that room. When such a duct is provided, there will be no pressure differential between the inner and outer faces of the walls and ceiling of the refrigerated room; and air infiltration will not occur in the absence of such a pressure differential. When air infiltration is prevented in this manner, the deposition of moisture in the walls and ceilings of refrigerated rooms is no longer a problem. It is there-

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fore an object of the present invention to provide a pressure-equalizing duct that places the atmosphere within a refrigerated room in direct communication with the atmosphere external of that room.

The pressure-equalizing duct provided by the present invention will frequently be elongated and will usually be made of material which is a good thermal conductor. The thermal conductivity of that duct coats with the elongation of that duct to cool any air, which may pass inwardly through that duct, to its dew point. As a result, any air passing through that duct will deposit its moisture in that duct rather than in the walls and ceiling of the refrigerated room. It is therefore an object of the present invention to provide an elongated, pressure-equalizing duct of thermal-conducting material for use with refrigerated rooms.

Where the temperature within the refrigerated room is close to the freezing level, it is desirable to form the pressure-equalizing duct so it has small diameter, large-surface-to-volume-ratio extensions which project outwardly from the duct. The resulting surface-to-volume-ratio of the device makes certain that all of the air passing through the duct deposits its moisture. It is therefore an object of the present invention to provide a duct for refrigerated rooms which has a number of small diameter, large-surface-to-volume-ratio extensions projecting outwardly therefrom.

In the operation of hardening rooms, where the temperature level is quite low, the sealing of doors is a serious problem. The refrigerated air in the hardening room will normally be of varying density; the refrigerated air adjacent the ceiling of the room being less dense than atmospheric air, and the refrigerated air adjacent the floor of the room being more dense than atmospheric air. As a result, atmospheric air will tend to leak inwardly from the ante-room past the seals at the tops of doors, and refrigerated air will tend to leak outwardly into the ante-room past the seals at the bottoms of doors. The inwardly leaking atmospheric air will contain moisture in the form of vapor, and that moisture will condense as it cools to the temperature level maintained within the hardening room. The condensed moisture will then freeze; and in many instances will freeze the doors in closed position. The problem is so severe that crow bars or pry bars are often used to pry open the doors of hardening rooms after they have been left closed over night. This, of course, is hard on the doors as well as the operators of the rooms. The present invention avoids any and all freezing of the doors of hardening rooms by providing a pressure-equalizing duct between the interiors of the hardening room and the ante-room at a level close to or above the top of the inter-connecting door. This duct will equalize the pressures in the two rooms at or above the level of the top of the inter-connecting door, and will thus keep atmospheric air from leaking inwardly past the seals of the door; consequently, there will be no occasion for atmospheric air to pass inwardly between the seals and the door jamb and deposit moisture. Refrigerated air may leak outwardly between the seals and the door jamb, but that air will become progressively warmer and able to carry more, rather than less, moisture. It is therefore an object of the present invention to provide a pressure-equalizing duct between the hardening room and ante-room at or above the level of the inter-connecting door.

Where desired, the pressure-equalizing duct provided between the hardening room and the ante-room can be extended through the ante-room to the outside. Where this is done, and where an outlet is provided in that duct in the ante-room, that duct can serve the dual purpose of preventing air infiltration into the ante-room and the

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hardening room while also preventing the freezing of the doors. It is therefore an object of the present invention to provide a duct which extends from a hardening room through the ante-room to the outside, and which has an outlet in the ante-room.

The moisture that is deposited within the elongated, pressure-equalizing duct must be conducted away. This is most conveniently done by pitching the duct so its inner end is higher than its outer end, but it can be done by providing a drain at the inner end of that duct. In either case, the moisture is condensed and led way from the interior of the room.

Other and further objects and advantages of the present invention should become apparent from an examination of the drawing and accompanying description.

In the drawing and accompanying description several preferred embodiments of the present invention are shown and described but it is to be understood that the drawing and accompanying description are for the purpose of illustration only and do not limit the invention and that the invention will be defined by the appended claims.

In the drawing:

Fig. 1 is a cross sectional, side view through a refrigerated room showing one form of apparatus provided by the present invention to control air infiltration,

Fig. 2 is a cross sectional side view through a refrigerated room showing another form of apparatus provided by the present invention to prevent air infiltration,

Fig. 3 is a plan view of the apparatus shown in Fig. 1,

Fig. 4 is a cross sectional plan view through a hardening room and an ante-room showing one form of apparatus provided by the present invention to prevent freezing of doors while also controlling air infiltration,

Fig. 5 is a cross sectional, side view through the rooms shown in Fig. 4.

Referring to the drawing in detail, the numeral 10 denotes schematically a refrigerated room having insulated walls as indicated in the drawing which room is operated at temperature levels close to freezing. This room will be suitably provided with a door D and with a refrigeration system, not shown. An elongated pressure-equalizing duct that is installed in the wall of the room is denoted generally by the numeral 12. This duct has a large diameter portion 14 mounted in the wall of the room 10 and has a number of small diameter, large-surface-to-volume ratio extensions 16 secured to the inner end thereof. The extensions 16 communicate with the interior of the large diameter portion 14 of the duct 12 and are mounted on the inner end of the large diameter portion 14 in such a way that air cannot pass through the large diameter portion 14 except by passing through the extensions 16. The extensions 16 are bent away from the large diameter portion 14 so they can contact different portions of the air within the room 10. The duct 12 is inclined to the horizontal and is so inclined that its inner end is above its outer end. Consequently, any moisture condensing in the large diameter portion 14 or the extensions 16 will respond to the action of gravity and run down to the outer end of the large diameter portion 14 of duct 12. A vertically directed pipe 18 is secured to the lower end of the duct 12 and that pipe will be directed to a suitable sewage connection.

In the operation of the refrigerated room 10, the air within the room will be cooled to a temperature at or below freezing. The cooling of the air will cause it to decrease in volume and thus create a reduced pressure within the room 10, including that portion adjacent the ceiling thereof. Air will move inwardly through the duct 12 to equalize that pressure, and as that air moves through the thin-walled metal portion 14 and the thin-walled extensions 16, that air will be cooled until it approaches the temperature of air within the room 10. In experiencing the decrease in temperature, the air will lose its ability to carry moisture and that moisture will condense within the large diameter portion 14 or the extensions 16.

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This condensed moisture will then run down toward the outer end of the duct 12. As that moisture reaches the pipe 18 it will enter that pipe and be drained away.

It is not necessary that the pressure equalizing duct 12 be inclined so the condensed moisture drains out of the room to the pipe 18. If desired, a pipe 18 could be provided for each of the inner ends of the extensions 16, and the pressure equalizing duct could be inclined so its inner end and the extensions 16 were below its outer end. However, the cost of providing a pipe 18 for each of the extensions 16 makes the alternate arrangement too expensive and cumbersome. Moreover, the duct 12 need not be mounted in the wall of the room, it could extend through the ceiling; and in such a case a drain would be connected to its lower end.

The numeral 20 denotes schematically a room which is held at temperatures well below the freezing point. This room will be equipped with a door and with a refrigeration system, not shown. An elongated, pressure-equalizing duct 22 is mounted in one of the walls of the room 20 adjacent the ceiling of that room. This duct is not provided with large-surface-to-volume ratio extensions; but the temperature differential between the air which will pass inwardly through the duct 22 will be so much higher than the very low temperatures within the room 20 that the greatly increased surface provided by those extensions is not needed. The heat in the air passing through duct 22 will be absorbed rapidly enough by the refrigerated air in the room to reduce the temperature of the incoming air so that most of the moisture carried by the air, in excess of saturation at the temperature of the room, will be deposited in duct 22. The lower the temperature maintained within the room 20 the less the surface required for the duct 22. The duct 22 is inclined so condensed moisture will run down to the outer end of that duct and be conducted away to a suitable sewage connection by the vertically directed pipe 24.

In the case of both refrigerated rooms 10 and 20, the provision of the elongated, pressure-equalizing ducts will effectively prevent all infiltration of air through the walls and ceilings of those rooms. As a result there will be no opportunity for air to infiltrate through the walls and ceilings of the rooms and deposit its moisture as it is cooled to its dew point. In this way, the apparatus provided by the present invention avoids loosening of plaster walls, crumbling of mortar, rotting of wooden beams and studding, and reductions in the ability of the rooms to maintain the desired humidity and temperature level.

In refrigerated rooms wherein high relative humidity is not objectionable, the pressure-equalizing ducts can be short rather than elongated. However, the duct must be long enough to project a short distance inwardly from the wall of the room. Where this is done, there will be no opportunity for air passing inwardly through the duct to deposit its moisture at the surface of the wall and run down along that wall. Any deposited moisture can be taken care of by inclining the duct outwardly and downwardly, or by providing a suitable drain.

Figs. 4 and 5 show a hardening or quick cooling room 26 having insulated walls as indicated in the drawing and which is provided with a doorway 28 and an insulated door 36 positioned therein, also as shown in the drawing. That doorway has a gasket 30 of usual form and configuration; and the gasket 30 coacts with the gasket 32, wiping strips 34 at the bottom of the door 36, and the door itself to substantially seal the atmosphere within the room 26 from the atmosphere within the ante-room 38. This will provide essentially static air conditions within the room 26 when the door 36 is closed. It is recognized however that no matter how well the gaskets 30 and 32 and the wiping strips 34 are made, they will be unable to prevent all infiltration of air past them. The air will usually infiltrate inwardly into the room 26 past the upper ends of the gaskets 30 and 32 and will then flow outwardly from the room 26

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past the lower ends of the gaskets 30 and 32. As the air infiltrates into the room 26 past the upper ends of the gaskets 30 and 32, it will be cooled to its dew point and will permit its moisture to condense. This condensed moisture will quickly freeze and will freeze the door 36 closed. In some instances it has been found necessary to use a crow bar or a pry bar to force open the doors 36 of hardening or quick cooling rooms. There also may be some air leakage which may occur through the insulated walls of the room 26 as previously mentioned.

The ante-room 38 has a gasket 42 adjacent the doorway 40. That gasket coacts with the gasket 44, the wiping strip 46 and the door 48 to substantially seal the atmosphere within the ante-room 38 from the atmosphere outside of that room. Once again however the gaskets 42 and 44, the wiping strips 46, and the door 48 cannot effectively prevent all infiltration of air.

The infiltration of air into the insulated areas is effectively prevented by the elongated, pressure-equalizing duct 50 with its outlet 52 in the ante-room 38. This duct will permit air to pass inwardly into the ante-room 38 through the outlet 52 and into the room 26 directly. The incoming air will act to equalize the pressures within those rooms with the pressures outside of those rooms; and in doing so will prevent infiltration of air through the ceilings and walls of those rooms as well as past the gaskets at the doors. This result is achieved by the free and unobstructed movement of sufficient air into the rooms 38 and 26 through the pressure equalizing duct 50 to compensate completely for all decreases in air pressure within said rooms, resulting from decreases in the volume of air within said rooms due to the cooling of the air in the rooms and due to leakage of air outwardly from portions of the rooms disposed below the duct 50 through the insulated walls and around the access doors 36 and 48. The incoming air will be cooled by having the heat therein absorbed by the cooled atmosphere within the ante-room 38 and then the hardening room 26. The outlet 52 provides a large surface-to-volume-ratio for the air passing into the ante-room 38. This large-surface-to-volume ratio is necessary because the temperature differential between the incoming air and the air within the ante-room 38 is not very great. Any moisture that condenses within the duct 50 or the outlet 52 will run down to the pipe 54 which will be suitably connected to a sewage connection. Where this construction is used, the doors can open freely irrespective of how long the rooms are left closed. Moreover, all infiltration of air into the rooms through the walls and around the doors is prevented. In these two ways, the present invention protects the doors themselves and also protects

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the walls and ceilings of the rooms from deleterious action of moisture carried in by infiltrating air.

Whereas several preferred embodiments of the present invention have been shown and described in the drawing and accompanying description it should be apparent to those skilled in the art that various changes may be made in the form of the invention without affecting the scope thereof.

What I claim is:

1. In a refrigerated room having insulated walls and an access door leading into said room, providing essentially static air conditions within the room when the door is closed, except for air leakage which may occur through the insulated walls and around the access door, apparatus to direct the flow of air into said room to prevent the ingress of moisture-laden air through the insulated surfaces and around the access door comprising air inletting means including a duct having a free and unobstructed passageway therein leading into said room adjacent to the ceiling thereof, said air inletting means being of sufficient size for the free movement of sufficient air into said room to compensate completely for all decreases in air pressure within said room resulting from decreases in the volume of air within said room due to cooling of the air in the room and due to the leakage of air outwardly from portions of the room disposed below said air inletting means through the insulated walls and around said access door.

2. In a refrigerated room, the combination of claim 1 in which the duct is disposed in a side wall of said room adjacent to the ceiling thereof and extends from the exterior of said room into the interior thereof and is inclined downwardly as it passes through the wall from within said room.

3. In a refrigerated room, the combination of claim 2 in which the duct extends beyond the interior surface of the room.

4. In a refrigerated room, the combination of claim 1 in which there is an anteroom connected to said refrigerated room and in which the duct is disposed in a side wall of said refrigerated room adjacent to the ceiling thereof and extends from the interior of said refrigerated room into said anteroom and opens into each of said rooms.

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