Sept. 18, 1956 W. J. CALDWELL 2,763,195

AIR CONDITIONING OF ENTRANCE AREAS

Filed July 16, 1951 2 Sheets-Sheet 1

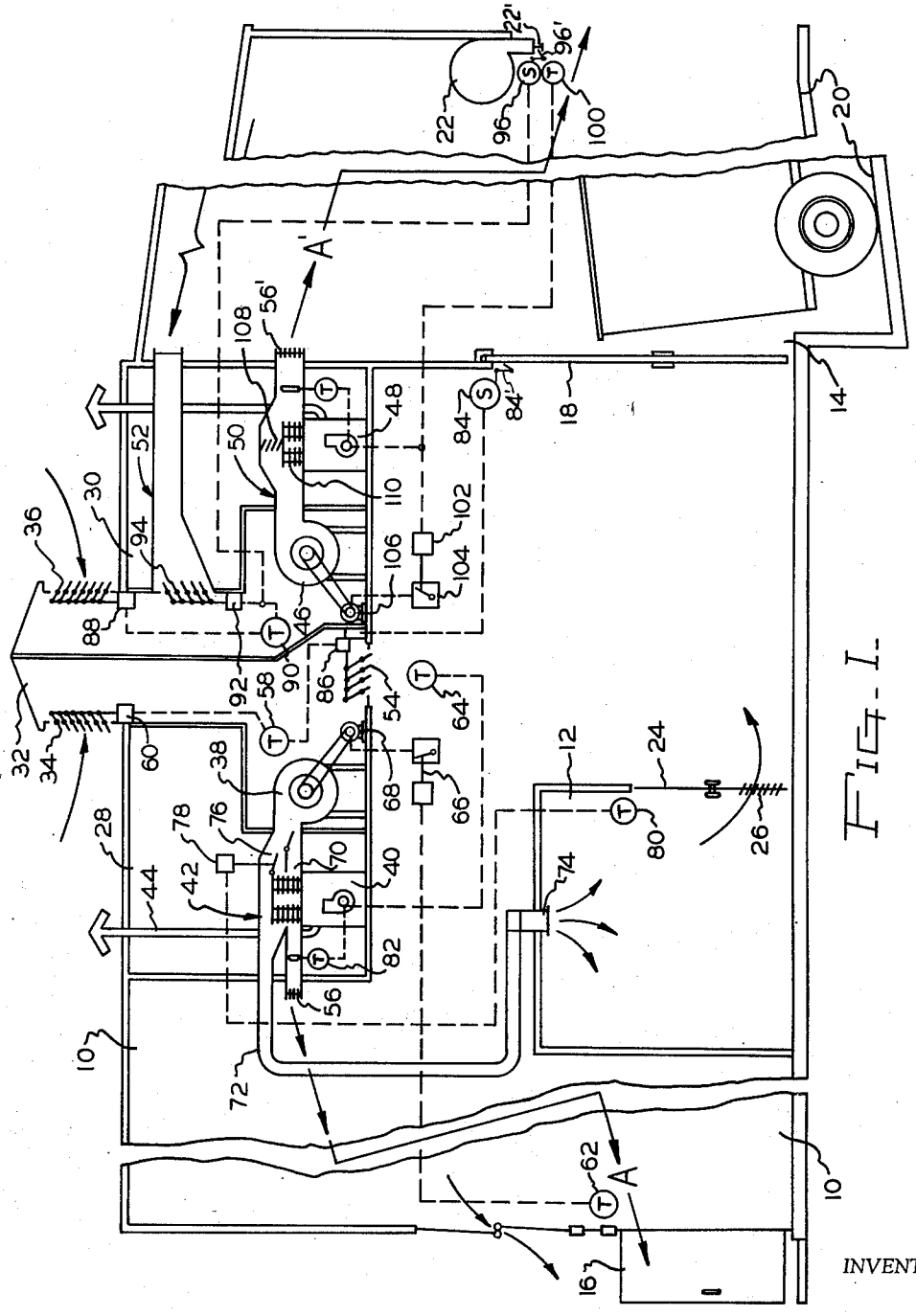

FIG. 1.

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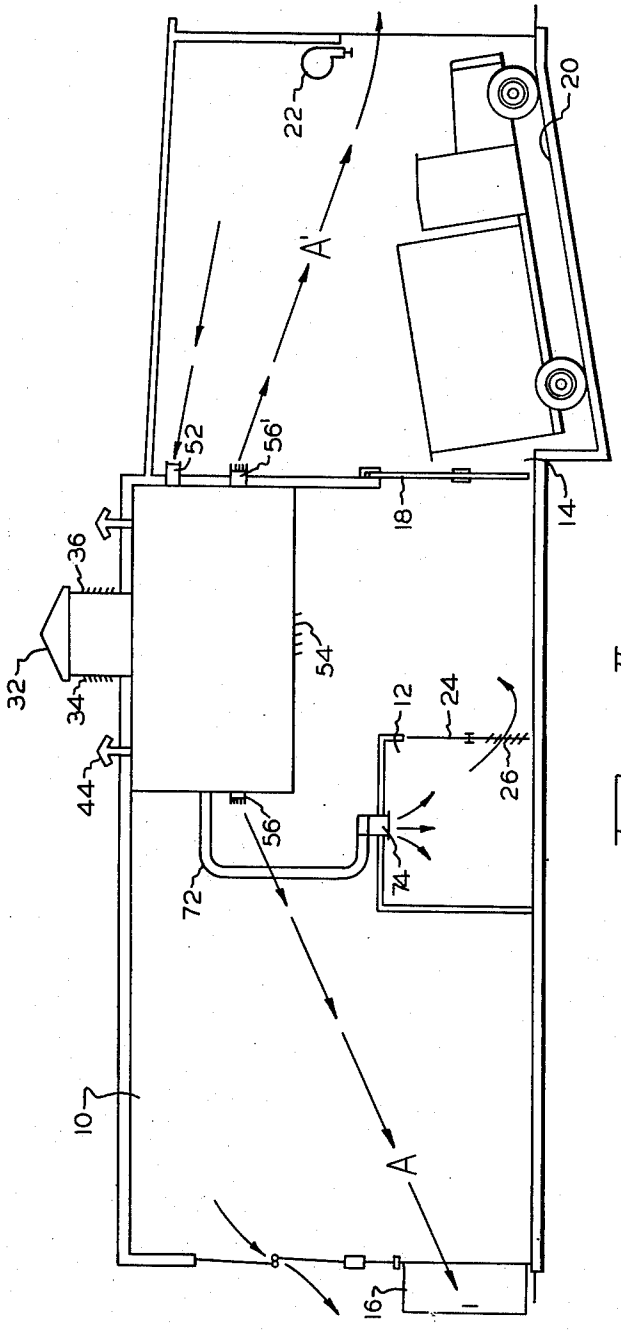

FIG. II.

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AIR CONDITIONING OF ENTRANCE AREAS

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Application July 16, 1951, Serial No. 237,046

3 Claims. (Cl. 98—33)

This invention relates to air conditioning systems and in particular to the air conditioning of buildings which include entrances, such as the doors of vehicle loading docks adjacent to warehouses, which are continually in use and the exhaust gases from vehicles in which loading docks, as well as the tendency for infiltration at the door areas, gives rise to special problems if efficient air conditioning is to be insured.

As distinct from the conventionally employed low velocity air conditioning systems, the present system is concerned with the pressurized high velocity air control system disclosed in co-pending application, Serial No. 187,258, filed September 28, 1950.

It is an object of the present invention to provide an improved air conditioning system employing pressurized high velocity air which efficiently takes care of tendencies for air infiltration at entrances.

It is another object of the invention to provide an air conditioning system in which the relative proportioning of outside fresh air to circulated return air, in a pressurized high velocity air conditioning system, is automatically brought under control to yield the required air conditioning for varying conditions arising in a conditioned building space due to entrances and the generation of gases within the building from sources, such as the exhaust from automobiles, independent of the pressurized conditioning air.

Yet another object of the invention is to provide a pressurized high velocity air conditioning system which combines a heat generator, pressure blower and air flow duct assembly in a compact and efficient manner.

These and further objects and advantages of the invention residing in an arrangement and combination of parts will be clear from consideration of the following description with reference to the accompanying drawings in which:

Fig. I is a schematic view of a typical layout in accordance with the invention as applied to the air conditioning of warehouses (a central portion of which has been broken away) and an adjacent vehicle loading dock, and

Fig. II is a similar view to Fig. I but showing the entire building structure, with the targeting of the air streams A and A′ from the air control nozzles to the building entrances.

In the drawings there is illustrated a typical layout according to the invention, as applied to a single story building providing a warehouse **10**, with an interior office **12**, and an adjacent loading dock **14**. The warehouse is shown with an exit door **16**, and an interior door **18**, providing access to the loading dock **14**, this being shown with a truck ramp **20** and exit door **22** and the interior office being shown with a door **24** having an air grille **26**.

The warehouse **10** has an overhead room structure defining a room space **28** and an adjacent room space **30**. Each said room space is in communication with a fresh air ventilator roof chamber **32** having fresh air dampers **34**, serving the room space **28**, and fresh air dampers **36**, serving the room space **30**.

Mounted within the room space **28** there is a pressure vane blower **38**, serving the warehouse **10**, operatively associated with a heat generator **40** and duct system, indicated generally at **42**, the generator having a flue **44**.

Mounted in the room space **30** there is a pressure vane blower **46**, serving the loading dock **14**, operatively associated with a heat generator **48** and duct system, indicated generally at **50**, **52** and having an associated air flow control nozzle **56′**.

As is fully disclosed in the said co-pending application Serial No. 187,258, entrance conditions, at the exit doors **16** and **22**, are controlled by pressurizing the building spaces **10** and **14** and directing high velocity conditioned air streams toward these doors, as indicated by the arrows A and A′.

In the warehouse **10**, the pressure vane blower **38** operates to draw in a mixture of outside air, through the dampers **34**, and return air, through dampers **54**, and forces it through the heating tubes of the heat generator **40** and thence through air control nozzles **56** into the warehouse **10**.

58 indicates a mixed air thermostat and **60** is a damper control motor. The relative amount of outside air employed to return air is dictated by the thermostat **58**. The fresh air dampers **34** are so linked to the control motor **60** that even when there is no demand for outside air by thermostat **58** the fresh air dampers **34** are opened sufficiently to admit the amount of outside air required to pressurize the warehouse **10**, the actual amount admitted being dependent upon the leakage characteristics of the building structure.

62 indicates a thermostat located at the warehouse exit door **16** and **64** indicates a master thermostat associated with the heat generator **40** and positioned in the return air stream entering the return air dampers **54**. The thermostat **64** functions to control the heat input to the heat generator by controlling the heat generator in conventional manner, whereas the thermostat **62** functions to actuate a damper motor **66** linked to the speed controller of the variable speed fan motor **68** so as to control the motor speed, and hence the operation of the pressure vane blower **38**, to insure that the required warehouse pressurization and jet velocity (from the nozzles **56**) are maintained to meet the prevailing demand. Thus were cold air to blow through the door **16** into the warehouse, it would strike the thermostat **62** and cause an increase in pressurization and jet velocity until the entering draft was offset. Since the system employed (as disclosed in the said co-pending application) produces uniform temperature diffusion, the return air forms an accurate index of the overall building temperature and can be employed as an actuating medium for the control thermostat **64**.

The duct **42** is shown in the form of a duct **70** leading to the nozzles **56** and another duct **72**, a part of which traverses part of the heater tubes of the heat generator **40** and which duct **72** leads to a centrifugal nozzle **74** in the ceiling of the interior office **12**. The duct system **70** and **72** is brought under the control of a splitter damper **76** actuated by a motor **78**, in turn controlled by a thermostat **80** in the office **12**. The arrangement is such that the relative amount of air by-passed into the duct **72** is controlled by the thermostat **80**, motor **78** and splitter damper **76**, the latter having a damper controlling the amount of air delivered to the heat generator from the pressure vane blower **38**.

82 is a low-limit thermostat located in the heater outlet side of the duct **70** and linked to the heater control to prevent cold air being delivered through the nozzles **56** in the event that the main control thermostat **64** fails for any reason, or is satisfied by the return air stream temperature.

Turning now to the conditioning of the loading dock

14, located at the communication door 18 there is a trip switch 84 having a suitable actuator 84' engaging with the door 18, which is mounted so as to be moved to one position, when the door 18 is fully opened, and to the reverse position, when the door is closed. This switch 84 is connected in circuit with the motor 60 and another motor 86, the motor 60 controlling the fresh air dampers 34 and the motor 86 controlling the return air dampers 54. The connection is such that when the door 22 is opened and switch 84 is tripped, the motor 86 functions to close the return air dampers 54 completely and the fresh air dampers 34 are opened. In this condition, all of the air driven into the warehouse 10 has no other avenue of escape except through the doors 16 and 18, if opened, the pressurized flow of which air to these possible entrances counteracts any inflow tendencies therethrough.

Motor 60 and motor 86 operate concurrently from the dictates of the mixed air thermostat 58, but in opposition to one another, such that the return air dampers 54 close when the fresh air dampers 34 open, and vice versa.

The two motors 60 and 86 are controlled independently of the desires of the thermostat 58, which is removed from the motor control circuit when switch 84 is actuated to the operating position.

Provision is made, with respect to the loading dock 14 to deal with exhaust gases from the vehicles accommodated therein. With the conventional low pressure conditioning systems, the heavy exhaust gases generated by the vehicles settle and may produce dangerous atmosphere concentrations at breathing level by virtue of this stratification. With the high velocity and pressurized system herein employed, however, and disclosed in the said co-pending application, the mixing of the total air mass in a given room space is so complete that this stratification cannot occur since the energy imposed on the mass is a relatively much greater force than that of the different densities of the gas and air otherwise tending to cause stratification. It thus becomes only necessary to introduce an amount of outside air directly proportional to the amount of exhaust gases generated by the vehicles to effect a safe dilution thereof. This is effected through the medium of a motor 88 initially adjusting the fresh air dampers 36 so as to introduce the necessary amount of air at the lowest speed of the blower 46, with the maximum number of vehicles operating in the loading docks with the door 22 closed. This amount of air would certainly be less than that corresponding to the total number of trucks accommodated in the loading dock, based upon the assumption that only those vehicles would be left running which were either just entering or about to leave the dock and that when the door 22 is closed the vehicle motors would mostly be shut off, as during protracted loading periods.

The motor 88 is shown linked to a thermostat 90, motor 92 controlling the return air dampers 94 to the return air duct 52, and to a trip switch 96 located at the door 22 (there being one such switch for each door, if more than one is present).

The switch 96 having a suitable actuator 96' which is so adapted that when the door 22 is opened the switch is actuated by the door portion 22' to cause the return air dampers 94 to close, through over-operation of motor 92, so that all the pressurized air supplied to the dock 14 is constrained to flow through the open door 22. In this way, if the door 22 is normally closed only a nominal amount of fresh air is supplied. Further if the door 22 is only casually opened, as to quickly accommodate an arriving or leaving vehicle, the time the door is opened would probably be of such short duration that the damper control motors 88 and 92 would be given insufficient time in which to complete their cycle so that the normal fresh air supply would not be unduly disturbed. If, however, the door 22 was left open for a sufficient length of time the switch 96 would function, as stated, to close the return air dampers 94 and cause fresh air to be admitted through the dampers 36.

100 indicates a thermostat located at the door 22 and in circuit with motor 102, motor speed controller 104 and the variable speed motor 106 to the pressure blower 46.

108 indicates a damper control in the pressurized air duct 50 which, when opened, enables friction to air flow by the heater tubes 110 to be overcome when, as in summer, heat from the generator 48 is not required.

In Fig. II there is clearly shown the effect of the nozzles 56, 56' in directing the pressurized air, target-wise, as indicated by the arrows A and A' against the entrances 16 and 22. These nozzles, therefore, are properly designed to target the air streams against said entrances.

Having thus described my invention what I claim as new and wish to protect by Letters Patent is as follows:

1. In an air conditioning system, the combination with a building space having an entrance with adjustable closure means, of air pressurizing blower means having an inlet connection to the atmosphere outside of said building space, duct means connected between said air pressurizing means and said building space to conduct high velocity air toward said entrance, said building space including return air flow means, and a pair of separate control means each operatively connected with said pressurizing means and said return air flow means, respectively, to control the pressurization of said building space in compensating relation to the tendency for air infiltration at said entrance, at least one of said control means being actuatable by the adjustment of said closure means.

2. In an air conditioning system for a building space having an entrance and adjustable closure means therefor, the combination of air pressurizing and circulating means, duct means associated with said first means including a fresh air inlet and a return for conducting pressurized air to and from said space, fresh air and return damper means in said inlet and return, switch means located adjacent said entrance in said space, means interconnecting said switch means with said fresh air and said return air damper means to control the opening and closing thereof under the influence of air infiltration through said entrance regulated by said adjustable closure means, and means for discharging air into the space at high velocity and toward such entrance.

3. In an air conditioning system, the combination with a building space having an entrance, with door closure means therefor, of air pressurizing blower means having a first air inlet duct opening into the interior of said space and a second air inlet duct opening to the outside atmosphere, a fresh air inlet damper in said second duct, a return air damper in said first duct, motor means for actuating said dampers, said fresh air inlet damper controlling the volume of fresh air admitted to said pressurization means, switch means at said entrance area connected in circuit with said motor means and said door closure means to control the actuation of said motors consequent upon the opening and closing of said door closure means, and for discharging air into the space at high velocity and toward such entrance.

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