A. R. KLEIN.

METHOD OF SUPPLYING AIR TO INTERIORS.

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1,296,968. Patented Mar. 11, 1919.

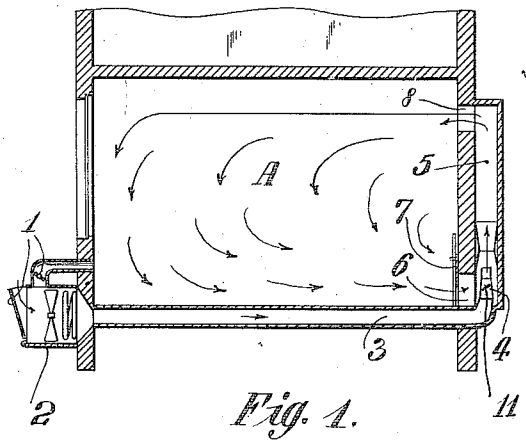


Fig. 1.

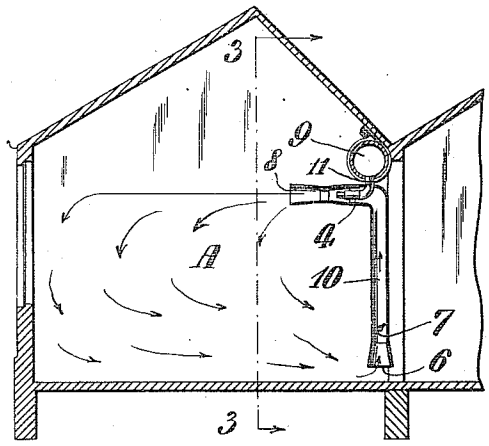


Fig. 2.

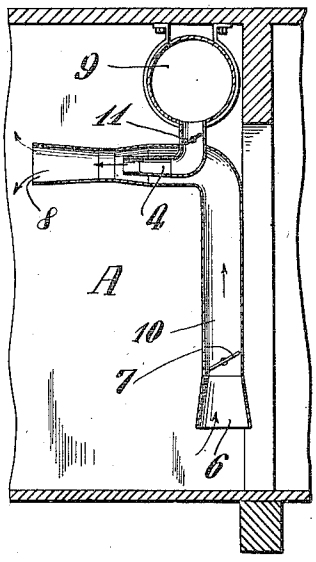


Fig. 4.

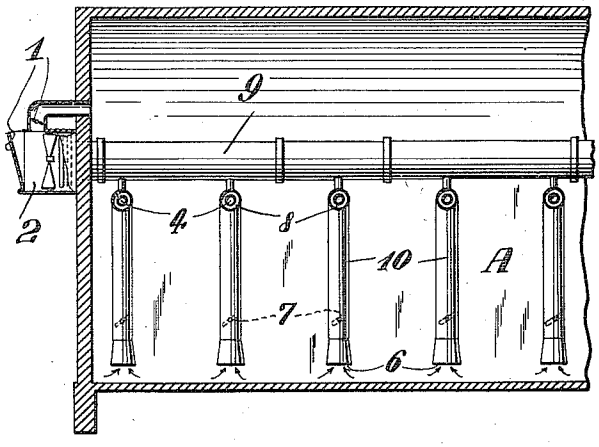


Fig. 3.

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METHOD OF SUPPLYING AIR TO INTERIORS.

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To all whom it may concern:

Be it known that I, ALBERT R. KLEIN, a subject of the Emperor of Germany, residing at and whose post-office address is 336 West 88th street, city, county, and State of New York, have invented certain new and useful Improvements in Methods of Supplying Air to Interiors; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

For ventilating and heating or cooling interiors, such as large offices, hospitals, schools, auditoriums, mills, workshops, etc., it is customary to use the blast system, by which currents of air are discharged into one zone of the interior, usually above the heads of the occupants, and in some cases drawn out or discharged at desirable places. In this way, the air of the interior may be changed frequently and the fresh air may be conditioned, if desired, to the desired temperature, humidity and purity. Furthermore, when the air is drawn out from the interior, it may form part of the fresh air, thereby reducing the size of the heating apparatus required during cold weather, and it may then be recirculated either with or without being purified.

Prior systems of this kind have several objectionable feature. In discharging heated air into the interior, provision must be made to compel the air to pass through the zone of occupancy in which the occupants are located. If the air is discharged near the floor level to meet this requirement, the rising currents produce drafts and introduce other discomforts, unless uneconomically low velocity and temperature are employed which, however, render the system expensive in first cost and in operation owing to the unduly large size of the conduits and the conditioning apparatus. In resorting to the usual overhead blast system to reduce the size of the apparatus and the cost of operation, the tendency of the heated air to rise from the inlets is overcome in some measure by forcing it downwardly by high velocity from the inlets located but little above the heads of the occupants. However, even where the inlets are located twelve to eighteen feet above the floor, as is usual in industrial buildings, the velocity into the interior should not ordinarily exceed 300 feet per minute, and the temperature at the inlets should not ordinarily exceed 120° F., for otherwise the air currents are too strong and too hot for comfort. To avoid these conditions, the air is sometimes withdrawn from the interior near the floor level so as to being about an effective circulation and change of the air within the zone of occupancy, but this additional feature necessitates return conduits of large size extending back to the source of the system and in some cases additional fans, thereby again increasing the first cost of installation and the cost of operation.

My invention embodies a method of ventilating, or ventilating and heating or cooling interiors, applicable to the blast system in such manner as to retain the advantages of that system and to remove the prior objections to cost or else to strong air currents and uncomfortable hot or cold blasts in the zone of occupancy in both large and small interiors, and it permits the use of conditioning, circulating and distributing systems which are considerably reduced in size and less expensive in operation. I attain these objects broadly by tempering just prior to entry into the interior, considerably heated or cooled fresh air with other air from the interior, and discharging the mixed air into the interior; and in the preferred method within my invention, the current of fresh air having comparatively high velocity or comparatively high pressure, or both, is caused to induce a regulated quantity of air from one zone, usually the lower zone near the floor of the interior, to a place of mixture with the fresh air near the inlet to another zone of the interior, usually an upper zone thereof above the heads of the occupants. In the application of this preferred method to large interiors, the current of fresh air is sub-divided, inducing separate air currents from one zone of the interior to places of mixture, and the mixtures are discharged at separated places into another zone of the interior. In heating systems, the fresh air may have a considerably higher temperature than formerly because it is mixed with a large volume of cooler air from the interior just prior to entry into the interior, and the velocity of the fresh air to the place of mixture, or the pressure, or both, may be considerably higher than formerly because its velocity or

pressure is reduced by the other air which mixes with it; thereby reducing the size and cost of the circulating, conditioning and distributing systems on account of the higher velocity and temperature of the fresh air, and more particularly on account of the fact that a large proportion of the air discharged into the interior does not pass through the main part of the distributing system, but is conducted by comparatively short ducts substantially to the place of entry to the interior. The reduced size of the apparatus naturally decreases the heat losses and thereby further improves the operation of the system. The same general improvements are realized in cooling systems also, wherein cooled, purified and humidified air is discharged into the interior during warm weather.

In addition to the foregoing economies effected by tempering the fresh air just prior to entry into the interior with a large volume of air having the temperature of the interior, the preferred method herein disclosed effects improved ventilation and uniformity of heating and cooling in the zone of occupancy by taking the tempering air from the lower zone of the interior, thereby drawing the mixed air entering the room in a downward direction throughout the zone of occupancy without causing discomforting currents. Furthermore, the use of fans for drawing the air from the one zone of the interior and forcing it to the place or places of mixture with the fresh air is avoided in my preferred method by causing the fresh air to induce suitable currents of air from that zone into mixture with it.

The accompanying drawings illustrate in elevation, two embodiments suitable for carrying out the preferred method of operation within my invention. In these drawings,

Figure 1 represents a transverse section of an interior having wall and floor conduits for directing an air current thereinto;

Fig. 2 represents in transverse section, and Fig. 3 in longitudinal section, an industrial shop provided with hanging flues for directing the air currents thereinto; and

Fig. 4 is a larger view of the injector shown in the flues of Figs. 2 and 3.

In the wall and floor conduit system of Fig. 1, fresh air is drawn by a fan from the outside of the interior, or from the inside, or from both the outside and inside, in amounts regulated by the valves or dampers 1, and is forced through a water spray or other cleansing or humidifying apparatus and into contact with the heating or cooling apparatus, all of which apparatus, including the fan, is indicated by the reference 2. The fresh air then passes through the floor conduit 3 and through the injector 4 or other device suitable for inducing a current of air into the wall conduit 5 through the outlet 6 controlled by the regulating valve or damper 7. The fresh air and the air drawn from the lower zone of the interior A through the outlet 6 mix at the end of the injector 4 just prior to entry of the mixture into the upper zone of the interior at the inlet 8.

In the flue system of Figs. 2 and 3, the fresh air, drawn from the outside, or from the inside, or from both places, in amounts regulated by the valve or damper 1, is forced by a fan through the conditioning apparatus as in Fig. 1, and thence through the overhead distributing flue 9. In the case of a large interior, the current of fresh air in the distributing flue 9 is sub-divided at a suitable number of places throughout the room and each sub-divided current is directed through an injector 4, thereby inducing separate currents of air through the vertical flues 10 which extend from the lower zone of the interior to the places of mixture with the fresh air just prior to entry of the mixture into the interior. The mixtures are then directed into the upper zone of the interior A at separated places, as may also be the case in Fig. 1.

In both systems hereinbefore described, the air from the lower zone of the interior should preferably enter the outlets 6 at four feet or less above the floor level, and the mixed air should preferably be directed into the upper zone of the interior above the heads of the occupants, that is, six to eighteen feet above the floor level, depending upon the purpose of the interior and the number of inlets 8, and also upon other conditions well known in the art. The air drawn through the outlets 6 from the lower zone of the interior, aids materially in producing a downward movement of the mixed air from the inlets 8, thereby reducing the velocity of entry necessary for overcoming the natural tendency of the heated air to rise to the ceiling, and it also effects more uniformly distributed ventilation and heating or cooling of the air in the zone between the floor and the inlets 8.

By means of the valves or dampers 1, 7 and 11, the temperature, velocity, humidity and other characteristics of the mixtures directed into the interior may be nicely varied in the system of Figs. 1 and 2, and the frequency of change of the air in the zone of occupancy may be varied by changing the proportions of the fresh air and the air drawn through the outlets 6. Ordinarily, one-half to nine-tenths of the mixture will be supplied from the lower zone of the interior, while the proportional amounts taken from the outside and the inside to make up the fresh air will depend upon the outside temperature and other well known conditions.

As a result of the fact that a compara-

tively large volume of air from the interior is mixed with the fresh air just prior to entry into the interior, the temperature of the fresh air may be considerably different from the temperature of the mixture entering the interior, and the velocity or pressure, or both, may be considerably higher than of the mixture. In fact, in heating interiors in accordance with my invention, the temperature of the fresh air may considerably exceed 120° F., which was formerly considered as the upper limit of temperature in ordinary blast systems; likewise the prior limit of velocity of the fresh air of 300 feet per minute in ordinary blast systems may be considerably exceeded on account of the reduction of velocity occurring just prior to entry into the interior, and the effect of the current of air drawn from the interior. The temperature to which the air is cooled, when the system is used for cooling interiors, may be as low as 40° F., and the temperature to which the air is heated, when the system is used for heating interiors, may be as high as 1,000° F., on account of the mixture with the cooled or heated air of a comparatively large volume of air from the interior just prior to entry into the interior, as aforesaid. Also the pressure given to the air may be one-fiftieth of an ounce to four ounces, and the velocity may be one hundred feet per minute to ten thousand feet per minute, depending upon the conditions obtaining in the system. These characteristic differences considerably cheapen the entire circulating, conditioning and distributing systems, and also reduce the cost of operation to a marked degree. The air in the zone of occupancy may be changed more frequently than heretofore, even where return conduits were installed, because the air is drawn from the interior through a comparatively short duct extending substantially to the place of discharge into the interior, instead of extending from the interior to the source of the system as heretofore.

In most cases the air from the interior will be drawn from the lower zone, and the mixture will be discharged into the upper zone, because this produces more effective distribution in the interior. However, in some cases, such as theaters, it may be preferable to draw the air from the upper zone and discharge the mixture into the lower zone.

It is apparent that any suitable form of injector may be used for my purpose, or the air from the interior may, if desired, be forced to the place of mixture with the fresh air by means of fans. Also, if desired, the air drawn from the interior may be cleansed or conditioned before mixture with the fresh air, or it, together with the fresh air, may be cleansed or conditionel after mixture. Furthemore, the air drawn from one interior may be mixed with fresh air and discharged into another interior.

Having thus described my invention, what I claim is:

1. The method of supplying air to interiors and of effecting circulation of such air through the zone of occupancy, which comprises withdrawing air from the interior into a suitable conduit, combining therewith a current of fresh air and discharging the resulting mixture into the interior, the current of fresh air being caused to effect the withdrawal of the air from the interior and to induce the circulation thereof through the conduit and into the interior, and the air being withdrawn and introduced at different levels so that circulation thereof is effected through the zone of occupancy.

2. The method of modifying the condition and temperature of the air of interiors and of effecting circulation thereof through the zone of occupancy, which comprises withdrawing air from the interior into a suitable conduit, discharging a jet of fresh air into said conduit at a temperature differing greatly from the temperature of the air withdrawn and thereby effecting intermixture of the withdrawn air and of the fresh air and inducing circulation of the withdrawn air through the conduit, and discharging the resulting mixture into the interior at a different level from the level of withdrawal, the intermixture of the withdrawn air and of the fresh air resulting in a modification of the temperature of the withdrawn air, and the levels of withdrawal and introduction of the air being such as to cause circulation through the zone of occupancy.

3. The method of supplying air to interiors and of effecting circulation of such air through the zone of occupancy, which comprises withdrawing air from near the bottom of the interior into a suitable conduit extending to a higher level substantially above the zone of occupancy, discharging a jet of fresh air into said conduit and thereby effecting intermixture of the withdrawn air and of the fresh air and inducing circulation of the withdrawn air through the conduit, and discharging the resulting mixture into the interior at a higher level so that the air is circulated through the zone of occupancy in its return to the level of withdrawal.

4. The method of supplying air to interiors and of effecting circulation of such air through the zone of occupancy, which comprises withdrawing air from the interior at a plurality of different places into a series of conduits, combining therewith in each of the conduits a current of fresh air and discharging the resulting mixtures into the

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interior at a corresponding number of different places, the currents of fresh air introduced into the conduits being caused to effect the withdrawal of the air from the interior and to induce the circulation thereof through the conduits and into the interior at a plurality of different places, and the air being withdrawn and reintroduced at different levels so that circulation thereof is effected through the zone of occupancy at a plurality of different places in the interior.

5. The method of supplying air to interiors by the blast system, which consists in subjecting fresh air to directed movement to a point just prior to entry into the interior, then subjecting the fresh air to an injector action, and thereby drawing into mixture with it a comparatively large volume of air from the interior, discharging the mixture into the interior in a substantially horizontal direction, and causing the pressure and the suction produced by the injector devices upon the air drawn from the interior to be effective upon opposite sides of the zone of accupancy of the interior and at points substantially in vertical alinement, thereby producing a continuous circulation of air in a vertical direction through the zone of occupancy of the interior.

6. The method of supplying air to interiors by the blast system, which consists in subjecting fresh air to directed movement to a point just prior to entry into the interior, at that point mixing the fresh air with a comparatively large volume of air from the interior, discharging the mixture of fresh air and air from the interior into the interior in a substantially horizontal direction, and supplying the air from the interior required for the mixture by air withdrawn from the interior at a point on the side of the zone of occupancy opposite that at which the mixture is discharged into the interior, and substantially in vertical alinement therewith, thereby causing a continuous circulation of the air in a vertical direction through the zone of occupancy of the interior.

In testimony whereof I affix my signature.

ALBERT R. KLEIN.