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AIR CONDITIONING SYSTEMS
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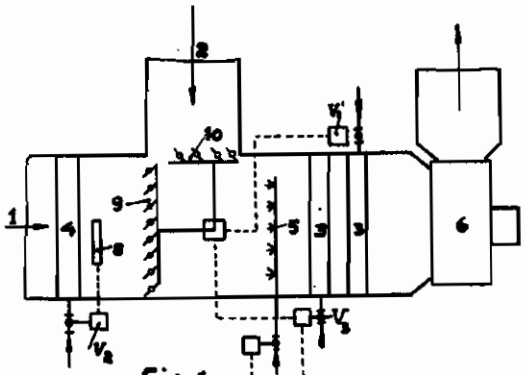

Fig. 1

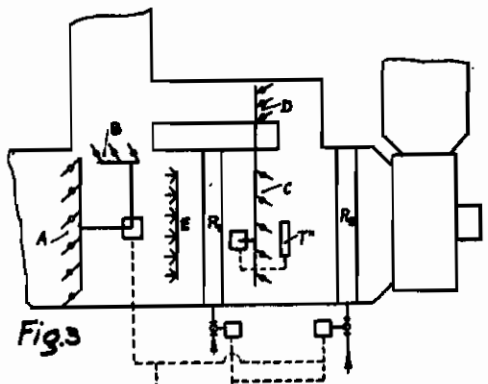

Fig. 3

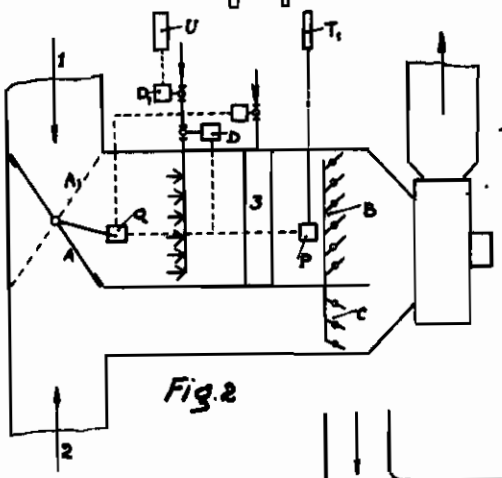

Fig. 2

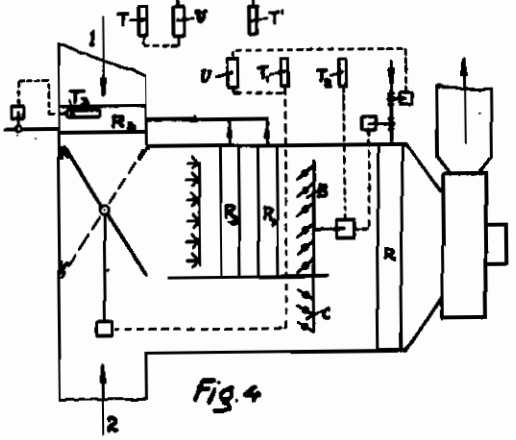

Fig. 4

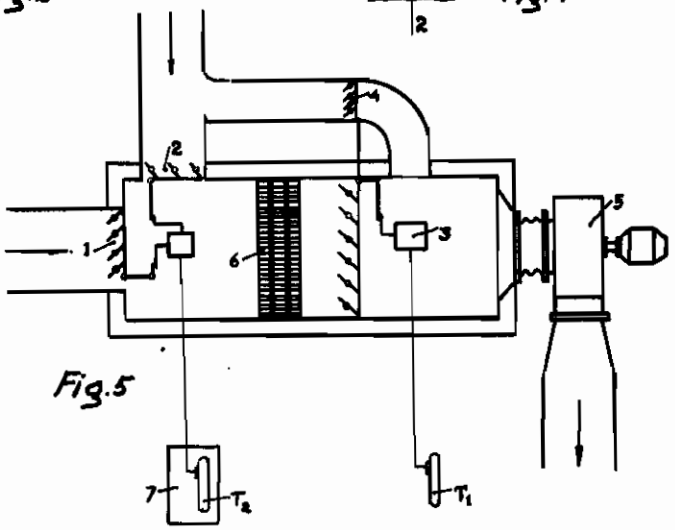

Fig. 5

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AIR CONDITIONING SYSTEMS

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This invention relates to air conditioning systems, or rather systems destined to provide, not only for the desired temperature and humidity in living rooms, but also for the conditions of the air purity requested by the hygiene.

The invention relates more particularly to a method that is adapted to obtain in an economical way the desired conditions of the air purity, the efficiency of the system varying according to the number of persons that pollute the air.

It is known that, if the temperature and humidity that control the changing of the warmth of the human body have to be maintained within opportunely chosen limits by means of a good system, it is not less important to maintain the air in conditions of the necessary purity, without useless wastage.

The common systems with automatic control generally used, consider but the control of the first two elements and neglect the third one completely, referring for this one to the most requested exigencies; and consequently it happens, for instance, that in rooms that may be empty or crowded, many systems with automatic control maintain certainly the conditions of temperature and inner humidity, but do not control the air enough in a uniform way, a control that has to account essentially for the principal reason of the air pollution, which is produced by the persons. The means that allow to obtain this purity in dwelling rooms are:

(1) The filtration that has the purpose of restraining the particles that remain in suspension and which may be independent of the number of the persons and therefore does not require any automatic control.

(2) The washing of the air to extract and restrain from it certain substances emitted by the persons that impart them disagreeable smell and confer them other qualities hurtful to people's health, however not well defined.

(3) The air renewal to substitute partially the spoilt inner air with the pure outside air.

It is obvious that, with regard to an economical operation these latter two processes have to vary according to the number of persons; the more the room is frequented, the greater is the necessity of washing and renewing the air and, as the renewal and the air conditioning cause considerable operating expense, it is of greatest importance that this is done in the required measure; the renewing of the air of empty or not much frequented rooms in the same proportions as when the room is crowded is very expensive, whilst, on the other hand, it would be antihygienic, if the renewal in crowded rooms had to be limited too much. The inconveniences that come from intrusting such a regulation to manual operating are obvious, as it is done with the ordinary systems. In my opinion they are greater than those that may come from lack of automatic control of the temperature, because, whilst the variations of this latter are noticed immediately by those that are present, the air pollution is perceived but with great retardation.

The main object of the present invention is to provide for a controlling device, adapted not only to control automatically the inner temperature and the humidity of the rooms, but also to maintain the air purity at the desired degree, by varying the air renewal and the quantity of washed air according to the inner pollution due to the persons or to other causes.

Another object of the invention is to provide for a system that allows to give the precedence to whatever factor interesting the air conditioning: temperature, humidity and purity; and not only that, but it is possible to vary the order of precedence, regulating opportunely the degree of influence of the particular controlling devices on the operation of the system.

And more precisely, the invention relates to a controlling system for an air conditioning system, in which the registers that control the outside air inlet and the recirculated air, are driven by direct or indirect impulses furnished by thermostats or humidostats placed into the rooms to be conditioned, so as to obtain that the air renewal and the quantity of purified air result in proportion to the pollution (for instance the number of persons that are present) and that with both, heated or cooled air systems.

It is evident that the operating of the said controlling system will have to vary according to the fact, if it is question about cooling or heating systems; in fact, the effect of the presence of persons with regard to the temperature is summed up to the one obtained with the system when heating, whilst when cooling said effect results opposed to the one obtained by operating of the system, for which the impulses that drive the opening and the closing of the outside air inlet in a heating system may be generated directly or indirectly by thermostats placed into the room to be conditioned, when the temperature of the latter is rising. With the summer operating, however, the rising of the temperature, caused by the persons, cannot be utilised directly, because this rising cannot be distinguished from the one which is caused by the transmission from out-

side, for which it is necessary in this case to utilize as an impulse giving element the humidity brought in by the persons, or even more rationally as impulse giving conditions may be used those that are established in a standardizing cell having adjustable characteristics of thermic inertia and dispersion, said cell being heated or cooled directly or indirectly with the same means that heat or cool the room to be conditioned.

The operation of the system is as follows: the conditions of the cell and of the room to be conditioned are adjusted, when the room is empty, so that the same temperature is established within them; this may be obtained by arranging the cell position opportunely and regulating its thermic inertia, the transmitting coefficient of the walls and the amount or the temperature of the heating or cooling fluid.

In the room to be conditioned a thermostat is placed, which, by driving the registers, the valves and similar, maintains the temperature in the room constant; under these conditions the temperature in the cell has the same value, if the room is empty or little frequented, but if sensible heat is brought in for causes that do not happen in the cell, as this is the case with crowds, the temperature in the cell will have an inferior value, due to the preliminary adjustment, for which this less temperature may be utilized as impulse giving element for the automatic renewal control, as the decrease is the greater the greater is the crowd. Therefore the drive of the register of the outside air inlet may be obtained by means of a thermostat placed into the cell, so that, if the temperature in the cell is decreasing under a certain value corresponding about with the temperature of the room, the renewal from outside is augmented; the renewal control may be obtained also by an impulse due to the difference between the temperature of the room and that of the cell.

It is evident that this latter system that utilizes the standardizing cell, may be applied, not only for the control of a summer system, but also for a winter system.

In order that the invention may be more fully understood, there are described by way of example and with the aid of the accompanying drawings some constructive forms the invention may assume.

Fig. 1 is a typical diagram of a heating and conditioning system with gradual or "modulated" control, according to the invention.

Fig. 2 is an analogue diagram, but with a controlling system having two positions, according to the method "on and off."

Fig. 3 is a diagram of a conditioning system adapted to operate in the summer season, as it has to be provided for the cooling of the air and with a system of gradual control.

Fig. 4 is an analogue diagram to Fig. 3, but with controlling system having two positions.

Fig. 5 is a diagram of a conditioning system utilizing the standardizing cell.

Referring first to conditioning systems combined with winter heating systems, and particularly to Fig. 1: 1 is the outside air inlet, 2 is the circulating air inlet, 3 and 4 are the heating apparatus, 5 is the air washer and 6 the ventilator. The automatic control is obtained as follows: 7 is a thermostat that controls by means of the valve V3 the heating fluid inlet (water or vapor) into the heating apparatus 3, 8 is a thermostat that controls by means of the valve V2 the inlet of the same fluid into the foreheating apparatus 4, so that the heated air of this one has always a determined temperature, for instance 15° C, somewhat inferior to that of the room. The valve V3 that drives the heating apparatus 3 when the heating fluid inlet is the most open, for deficiency of temperature in the room, moves the registers 9 and 10 that control the outside air inlet and the recirculation, by means of a contact or relay, so that the first is closed and the second open, and at the same time it closes the washing device (for inst. nozzles) of the washer 5. This operation of the register may be driven, rather than by a supplementary contact, in another way, direct or indirect by the temperature of the room, also with gradual or so called "modulated" control.

If the desired temperature has been reached in the room, for inst. 20° C, the registers 9 and 10 are moved in the inverse sense, through which the outside air begins to enter again, and the temperature of the air flowing into the room is reduced automatically in this way. If the room is empty, there is a renewal minimum from outside, as the room is going to get cool more quickly, as soon as the renewal has begun. If, however, there is a crowd, the temperature (of 18° C for inst.), at which the register 9 that controls the renewal from outside is closed, is reached more or less quick, according to the smaller or greater number of persons; and then the renewal is controlled automatically, according to the crowd; but not only that, but the influence of the persons is the greater the higher is the outside temperature, for which reason the renewal augments with this latter, renewal which answers to a hygienic and operation economical criterion.

In the above described system the temperature receives the precedence with regard to the air renewal and the washing. And the control of the humidity may have the precedence over the washing, if, as in Fig. 1, the opening of said washing device is driven also by the humidostat U placed into the conditioning room.

The temperature of the heating fluid feeding the heating apparatus 3 and 4 is controlled automatically or by hand, in a well known way, according to the outside temperature.

To reduce the temperature of the air coming in from outside, when the renewal is augmented automatically, the heating of the radiator can be interrupted completely or partially. In this latter case the radiator is divided into two sections, the one being driven directly by the thermostat that is in the room, and the other, for inst., by a supplementary contact connected with the register 9.

The diagram of Fig. 2 is like that of Fig. 1, but it shows a system where the registers may assume only two positions: on and off; 1 is the inlet of the outside air; 2 is the inlet of the recirculated air; 3 is the heating apparatus; 4 is the ventilator; T' is the thermostat placed into the room, which drives the two registers B and C, and at the same time it controls the register A, the efficiency of the heating apparatus 3 and the washing device. These latter may be driven, not only by the thermostat T' through the valve D, but also by the humidostat U through the valve D_1.

The operation of this system is as follows: when the temperature of the room sinks under a certain predetermined point (for inst. 18° C), the thermostat T_1 opens the register B and closes the register C, bringing contemporarily the regis-

ter A into the position A_1, whilst the washing device gets closed. So, the outside air does no longer enter and the temperature of the room augments. If, for inst., the 20° C are overpassed, the thermostat T_1 will move the register A, in order to let in the outside air, whilst B gets closed partially and C opened. The valve D, also driven by T_1, sets the washing again in efficiency, whilst the engine Q reduces the action of the heating apparatus 3 at a minimum.

It is obvious that, if the room is crowded, its temperature rises rapidly and the outside air inlet will be kept open nearly continuously, so that the air in the room is maintained very clean.

In the system represented in Fig. 3, which is adapted to summer conditioning, A is the register that controls the entrance of the outside air; B is the register that controls the entrance of the circulating air; T is the thermostat placed into the conditioning room, which drives the register A and B; T' is an analogue thermostat (that may be also not distinguished from T) that controls the quantity of cooling fluid flowing to the cooling apparatus R_1, and T'' is a thermostat, placed as indicated in the figure, that drives the registers C and D, in order to maintain the temperature of the cooled air constant. The humidostat U, placed as well into the room, may drive also the registers A and B and control the heating apparatus R2 like the thermostat T'.

As the temperature of the room exceeds the predetermined limit, the thermostat T closes the register A and opens the register B of the circulated air, whilst T' brings the operation of the cooling apparatus R_1 to a maximum, and the thermostat T'' maintains the temperature of the cooled air constant, controlling in this way the absolute air humidity.

So, humidity is given the precedence with regard to temperature, which is of particular importance for the summer systems. To give the precedence to temperature, it suffices to interchange the operation between the two thermostats T' and T''. The thermostat T'' that maintains the temperature of the cooled air constant, may be substituted by another one that keeps the temperature of the water at the discharge of the cooling apparatus, constant.

The air washing is done in a known, independent and continuous way, by means of a suitable device (nozzles etc.).

When the lowest preestablished temperature is reached in the room (for inst. 25° C), the registers A and B may be driven also by the humidostat U and precisely if the air is very humid (for inst. a relative humidity above 55%), the humidostat U is tending to open the register A and to close the register B and allows the operation of the heating apparatus R2 that has to dry the air. If, however, the temperature limit is hardly reached, the thermostat T' keeps still open the cooling fluid inlet into the apparatus R_1 and blocks the drive of the heating apparatus R2, which the humidostat U was going to drive.

If there are no persons after a certain time, there will be noted a sinking either of the humidity or of the temperature in the room; in the first case the humidostat U tends to close the register A of the outside air and to open that of the recirculated air, and at the same time to hinder the heating of R2. If then the temperature sinks below a certain limit, the thermostat T' will limit the cooling fluid inlet and allows the operation of the heating apparatus R2, which, however, cannot work, being prevented from by the humidostat U, whenever there is lacking humidity (as it happens when there are no persons); if, however, there would be a crowd, the humidity degree of the cooled air being maintained constant by the thermostat T'', the humidity and the temperature would augment in the room; to keep this latter constant, provides the thermostat T'', augmenting the passage of the cooling fluid through the cooling apparatus. In consequence of the augmented humidity the humidostat U will move the registers A and B, in order to augment the outside air renewal; but it may happen that, for inst., the heating fails in the room due to the heat interchange with outside or to the heat supply of the illumination; then, the humidity degree determined by the thermostat T'' would no longer be suitable, but then the heating apparatus R2 starts, driven by T', if the temperature of the room is always under the predetermined point and the humidity is somewhat higher. With these dispositions the desired effect is obtained.

In order to make the system more sensitive and to hasten the return to the interchange position, when there is lacking inner humidity, and to economise refrigerating fluid, when the humidity is high, there may be provided for an indirect drive of the thermostat T'', which controls the humidity degree, so that this latter rises when the humidity in the room is low and falls when it is high. The control may be obtained by means of either two position registers or gradually moving registers; with this accessory control, however, the proportion of the washed air is decreased in case of considerable inner humidity.

The diagram of Fig. 4 shows a system like Fig. 3, but its registers have but two positions; on and off; R1 R2 R3 are various cooling apparatus, whereof the first two with parallel connection, whilst the third has series connection and cools but the outer air. The control is such as to keep constant the temperature of the water leaving the cooling apparatus. At a determined inner temperature in the room, for inst. 25° C, at the beginning of the operation, the inner temperature of the room being above the prescribed, the thermostat T1 closes the outside air inlet and opens the circulating air inlet, and at the same time B remains open and C closed. The room gets cooler unto the determined temperature (25° C); then the thermostat lets enter the outer air in the desired measure, whilst B remains open and C closed; if the humidity is high, it does not happen anything else; if the humidity is low, the outside air inlet is closed. When a temperature of 24° C, for inst., is reached, B is partially closed and C is opened. If the humidity is high, which means the presence of many persons, then the heating apparatus R opens, and the outside air inlet remains open. It is to note that, when this latter is opened, the temperature in the cooling apparatus R1 R2 sinks and the humidity degree of the air sinks automatically. If the humidity of the room is low, the radiator R does not get heated, and the outside air inlet remains closed until the humidity does not rise and falls again into the precedent cycle with renewal from outside.

All the described controls solve the problem when the potentiality of the system is sufficient. Nevertheless it may happen that conditions of exceptional climate and minor efficiency of the system appear, through which this latter may result insufficient. In such a case it may be convenient to reduce the renewal from outside, for which purpose a supplementary control may be used, with whieh, as the inside temperature exceed

the desired value, the outside air inlet is limited, independently of the other controls, by means of a register driven by a thermostat.

In Fig. 5 is shown a diagram of a conditioning system utilizing a standardizing cell 7, in which the heating (or the cooling) is obtained with the same fluids that heat (or cool) the room to be conditioned. 1 is the outside air inlet, 2 that of the recirculated air; 6 is the air heating (or cooling) element; T' is the thermostat placed into the room to be conditioned, which maintains its temperature constant (in the case of the figure this is reached by controlling the two registers 3 and 4); 7 is the standardizing cell that is heated or cooled by means of the same fluids that heat or cool the room: they may be either the air pushed by the ventilator 5 or the fluid traversing the heating or cooling apparatus 6. T2 is a thermostat placed into the cell 7 that controls the opening of the two registers 1 and 2, so that, if the temperature in the cell is tending to sink, the register 1 tends to get more open and the register 2 to get closed, with a gradual movement that may be driven, for instance, by an electrical or pneumatical device.

Though in the foregoing description have been described and shown some concrete forms, which the systems, being object of the present invention, may assume, it is understood, however, that different modifications may be brought to them, by those who are expert in this art, without for that departing from the scope and spirit of the present invention.

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