

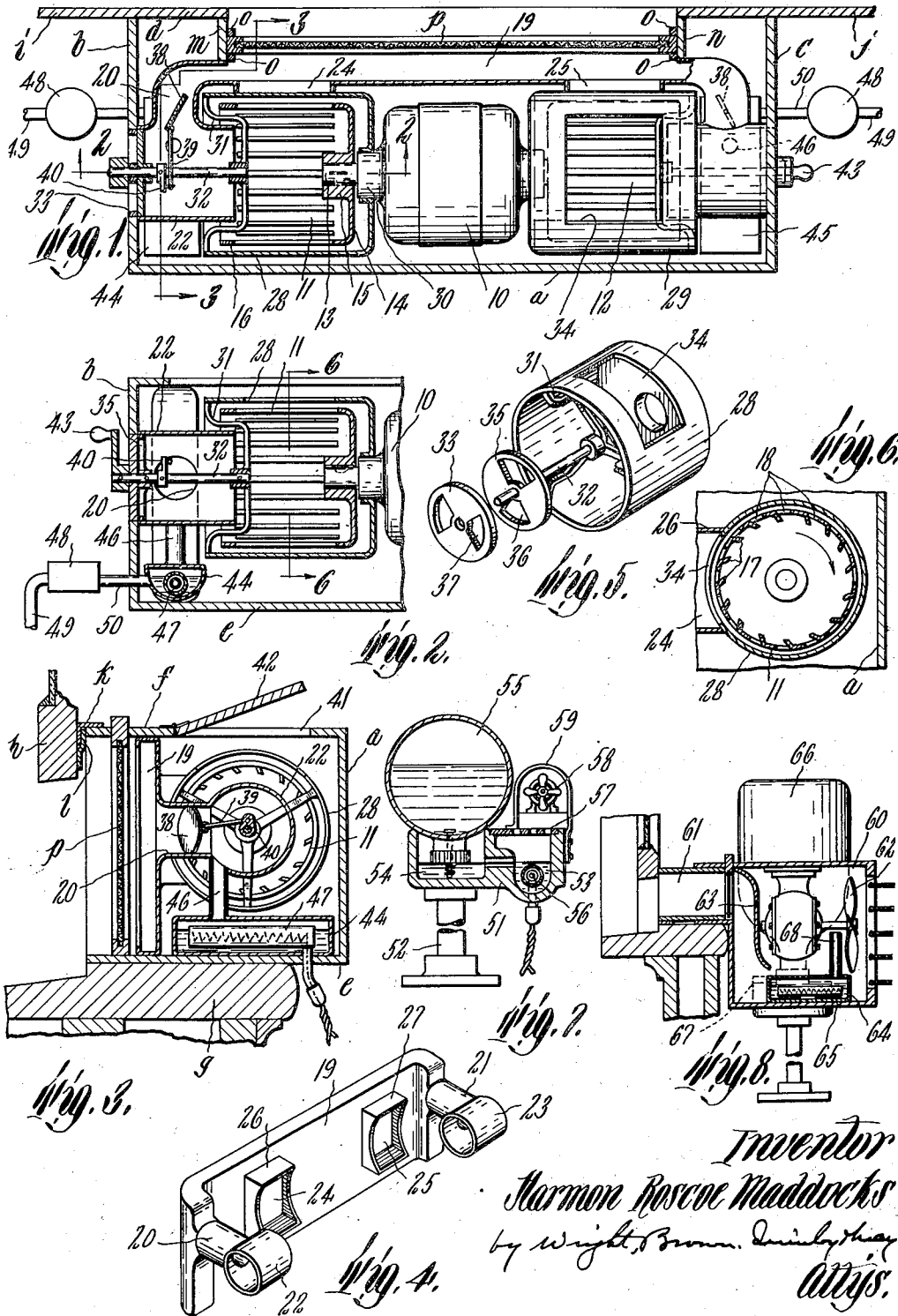
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AIR CONDITIONING APPARATUS

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AIR CONDITIONING APPARATUS

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This invention relates to apparatus of the type which operate to draw outdoor air into a room within a building, and modify the condition of the air in its passage. The main object of the invention is to furnish a machine of this character so compact in construction and dimensions as to occupy but a minimum of space adjacent to a window sash, without projecting objectionably or appreciably inward from the wall; and withal so efficient as to pass as much air as is furnished by much bulkier apparatus, and humidify the air adequately at the same time, besides filtering it. Another object is to make the apparatus equally efficient for expelling air from the room to the outside as for bringing in the outer air. Still another object is to make available, not only for use with novel apparatus by which the foregoing objects are accomplished, but other apparatus, new or old, as well, an improved mode of delivering water vapor to the air-propelling means of such apparatus whereby to effect a more efficient humidification of the air and distribution of humidified air through the room.

Apparatus capable of fulfilling the foregoing objects constitute the invention, illustrative embodiments of which are shown in the accompanying drawing.

In the drawing,—

Fig. 1 is a horizontal section of an illustrative apparatus containing the principles of the invention;

Fig. 2 is a vertical section of the left hand end of this apparatus taken on line 2—2 of Fig. 1;

Fig. 3 is a cross section taken on line 3—3 of Fig. 1;

Fig. 4 is a perspective view of the intake conduit which embodies certain features of the invention;

Fig. 5 is a perspective view of a valve assembly by which the direction of air flow and the quantity of air delivered may be governed;

Fig. 6 is a detail cross section taken on line 6—6 of Fig. 2;

Fig. 7 is a vertical section showing a modified form of apparatus containing some of the principles of this invention;

Fig. 8 is a vertical section of another form of apparatus containing a generic feature of the present invention which involves efficient introduction of the water vapor into the stream of air-propelled by the fan or blower element of the apparatus.

Like reference characters designate the same parts wherever they occur in all the figures.

At the outset it may be observed that the present drawing is intended to show the essential principles of the invention in operative combination, but make no attempt to show structural details of the factors, such as the external

casing, which, although essential to the proper functioning of the machine, yet involve nothing original with me and may be widely and extensively varied at the will of the structural designer, without affecting these essential principles.

The parts designated by reference characters *a*, *b*, *c*, *d*, *e* and *f*, represent the structural members of a casing, adapted to be set on a window sill or ledge *g*, (as shown in Fig. 3), partly across the space between such ledge and the lower rail *h* of the raised bottom sash of the window. Associated with the casing in extension of its rear wall *d*, are wings *i* and *j* which may be adjustable in length to extend from the casing ends *b* and *c* to the side members of the window frame so as to cover and block all of the window opening except that across which the casing proper extends. These parts may be made of any material and fabricated in any manner suitable for the purpose, according to the will of the designer and using the common knowledge of artisans, and the knowledge already available to the public in the construction of air filtering and conditioning means applicable to window openings. The casing, its wings, and the window sash are preferably provided with sealing means to prevent leakage of air between them and the sash; such means being conveniently made of interlocking sheet metal strips *k* and *l*, shown sectionally in Fig. 3.

In the rear wall *d* of the casing is an opening nearly as long as the casing, and as high, which is bounded by walls *m* and *n*, provided with upright guides *o* in which is fitted a filter *p* which protrudes through a slot in the top wall *f* of the casing, so that it may be readily inserted and removed. Such filter is conveniently constructed of a frame across which is stretched a fine meshed fabric; although it may be of any other character suitable for permitting air to pass through it and excluding dust and the like. The length in the front and rear direction of the entrance opening bounded by the walls *m* and *n* is made as short as possible consistently with the provision of sufficient space to contain the filter and permit its removal in the manner just described; in order that the over-all width in the same direction of the casing may be kept small. By slight modifications of the design, this last named dimension may be made smaller than that shown in the present drawing.

The means for inducing entrance of outdoor air and delivering the air into the room consists of an electric motor *10*, and two blower or fan elements *11* and *12*. These latter are placed adjacent to the opposite ends of the motor and are secured respectively to the corresponding ends of the motor armature shaft *13*. They are identical.

tical with one another in the present illustration, and a description of one will suffice for both.

Essentially the blower or fan is a sheet metal cup having an end wall 14, reinforced by a central, apertured hub 15 in which the end of the motor shaft is keyed; and having also cylindrical side walls 16. The end opposite to the wall 14 is wholly open. Slits are cut in the side walls extending longitudinally from points near the end wall to points near the rim of the open end, which are joined at their ends to short circumferential slits. The segments of metal thus partially severed are bent inward, substantially as shown in Fig. 6, to form a multiplicity of vanes 17. In other words, vanes are formed by partially severing and striking inward portions of the side walls in a zone which includes a large proportion of the length of the fan. The spaces 18 formed by striking down the vanes form openings through which air may pass. The vanes are arranged in a generally radial relationship to the fan, but are preferably not exactly radial; being arranged at such an obtuse angle with respect to the intact portions of the wall 16 from which they respectively spring, as will best promote outward flow of air when the fan is rotated in the direction which advances the vane edge foremost. With reference to the showing in Fig. 6, this direction of rotation is clockwise.

A fan of this character, when rotated at high speed expels air from its interior space by a combination of the air cutting action of its vanes and centrifugal force, and is capable of creating a substantial difference of air pressure between the spaces inside and outside of its cylindrical wall, whereby it may induce air flow through its open end and build up a substantial pressure in a closed enveloping space.

Fans having the characteristics of that just described may be constructed or fabricated otherwise than according to the specific method described; as, for instance, by casting or by assembly of separate vanes or blades with a suitable framework, etc. For brevity of description in the balance of this specification and in the claims, I will designate it as a "blast fan"; and this term is to be understood and construed as meaning an air propeller having substantially the characteristics of that here described, whatever its specific details of construction may be.

Air is conducted to the open outer ends of the two blast fans by an intake manifold 19, the major part of which is a double walled conduit of substantially equal height with the casing and of narrow width in the front to rear direction, having an opening in its rear wall substantially coextensive with the intake opening at the rear of the casing. Its ends are curved forwardly near the ends of the casing, and join forwardly extending conduits 20 and 21, which in turn open into tubes 22 and 23 which are axially aligned in the long dimension of the casing and in alignment with the axis of the motor and blast fans. The inner ends of these tubes may project more or less into the open outer ends of the respective blast fans, while their outer ends extend to the end walls b and c respectively of the casing and register with openings in such end walls for a purpose presently described. In the inner wall of the conduit 19 are openings 24 and 25 in the same zones as the vanes of the respective fans. These openings are surrounded by rectangular frames 26 and 27 respectively, the extremities of which are shaped to fit the exterior of cylindrical housings 28 and 29, which envelop the blast fans.

The housings 28 and 29 are provided to control the delivery of air from the blast fans and, in conjunction with other valve means, to effect a reversal of air flow, so that the fans may be caused either to deliver outdoor air into the room, or to expel vitiated air from the room. Referring to the structure at the left hand end of the apparatus, the housing 28 is a cylindrical cup generally similar to the fan 11, but of larger dimensions. Its end wall is adjacent to the motor and has a rotative bearing on the boss 30 of the motor casing through which the armature shaft protrudes. Its opposite open end is connected by a spider or frame 31 with a shaft 32 which extends through and has a rotative bearing in the center of a disk 33 (Fig. 5) which is fitted into an aperture in the end wall b of the casing. As here shown, the spider 31 is offset into the open end of the blast fan 11 in order to permit entrance thereto of the tube 22. The housing 28 has a single opening 34 in its side in the same zone with the blades of the fan, which is adapted to be placed, by rotation of the housing, either above the fan or at the rear side of the fan in register with the opening 24 in the intake conduit 19. It may be noted that the openings 24 and 34, and the dimensions of the frame 26, are so correlated that, when the opening in the housing is registered with the opening in the intake conduit, it is completely surrounded by the frame 26.

A valve disk 35 is secured to shaft 32 close beside the stationary disk 33, and is provided with sector shaped openings 36 which are placeable by rotation into or out of register with openings 37 in the latter disk. These openings are respectively so arranged as to register when opening 34 registers with opening 24, and to obstruct one another when the opening 34 is in the uppermost position and the imperforate side of housing 28 closes opening 24.

A valve 38 of the butterfly type is mounted across the conduit 20 and is coupled by a link 39 with an arm 40 on shaft 32, so proportioned and located as to open the valve 38 widely when the openings 36 and 37 are closed, and close the valve 38 when openings 36 and 37 register with one another.

An opening is formed at 41 in the top wall of the casing over fan 11 for emission of air, which is shown here as fitted with a cover 42 for protection of the interior parts. This cover is opened of course when the apparatus is in use to deliver outside air into a room. Means of suitable character, not shown but well understood to all skilled in the art, may be provided to retain the cover in an inclined position at any desired angle.

It will be understood from the foregoing description that when shaft 32 is turned by its crank 43 to place the various valve means in the position shown in the drawing, (that is, with the housing opening 34 between the fan and casing outlet 42, closing opening 24; valve 38 open; and valve openings 36 and 37 out of register), the fan will draw air from outside the window through the filter p and intake conduit, and deliver the air upwardly through the casing outlet and into the room. But when the shaft is turned through an angle of about 90° to bring the housing opening 34 into register with the opening 24 in the conduit, valve 38 will be closed and valve openings 36 and 37 registered, whereby the fan will draw air from the room and expel it to the outside. Whether it propels air either into or out of the room, the fan always rotates in the same direction, and it always draws air axially into 75

its interior space and expels the air circumferentially.

The housing 29 and associated valves and operating means at the right of the apparatus are the same as those above described. Each is shiftable by its own operating handle 43 independently of the other, whereby if desired a better circulation of air may be effected by blowing it into the room with one fan and pulling it out with the other.

The air is humidified in coming into the room by vaporizing chambers 44 and 45, containing water, and located in the bottom of the casing near its opposite ends. The chamber 44 is closed except for a tube 46 which rises from its upper side to a junction with the intake conduit members 20 and 22 adjacent to the junction of the latter (Fig. 3). Thus the tube 46 delivers vapor at or near the point where the greatest rapidity of air flow occurs. If desired it may be extended to a termination near the center of the stream passing through the conduit 20; but I do not consider such extension to be necessary. The water in the chamber 44 is heated and rapidly evaporated by an electric heating unit 47 of known character, and preferably of a length and external diameter great enough to occupy a substantial proportion of the interior of the chamber. The conducting wires to this unit may be led into the chamber as shown in Fig. 3, or suitably otherwise.

Water is constantly fed to the chamber 44 at the rate necessary to maintain a constant level in the chamber nearly or wholly submerging the heating unit. I have shown in Figs. 1 and 2 diagrammatically a pump 48 connected to lift water through a pipe 49 from a tank or container located at any convenient point, and deliver it through a pipe 50 to the evaporating chamber. An electrically operated pump known as the Autopulse, which is a commercial apparatus available on the market, is suitable for this purpose; but any one of a number of other automatic pumps may be used for the purpose; or the water may be fed by gravity from a container of the level regulating fountain type. Like provisions are made for supplying water to the chamber 45 and vaporizing it.

The combination hereinbefore described is both compact and efficient. Fans of the type shown, with axial intake and peripheral delivery, are able to move large quantities of air without dissipation of energy in useless whirling of the air and creation of obstructive eddies. Thus fans of such small transverse dimensions may be used, and arranged in axial alignment with the motor, transverse to the direction of air delivery, that the apparatus may be made small enough in its front to rear dimension to be supported on a window sill, without projecting into the room, either at all beyond the inner edge of the sill, or to an objectionable extent. An apparatus having a width of six inches is able to pass enough air for satisfactorily ventilating and humidifying an ordinary room. Considerable variation in the capacity of the machine may be made by lengthening the apparatus, increasing both its length and height, without changing its front to rear width.

The water vaporizing elements of the apparatus, by their small volume and great efficiency, supply adequate vapor for satisfactory humidification without involving increase in the dimensions of the apparatus to accommodate them, and without requiring the addition of obstruc-

tive projections. An important factor making for efficiency of the vaporizer is the small volume of water which it holds in contact with the heating element, and the maintenance of the water level such that the heating unit is barely, possibly only partly, submerged. The apparatus is also most efficient in expelling vitiated air, smoke, and odors, from the room by virtue of the valve and conduit combination which directs the air flow in either direction without requiring the rotative direction of the fan to be reversed. In this combination the housings 28 and 29 are considered as valves.

A portable air humidifying apparatus which involves some of the new features of the invention is shown in Fig. 7. This comprises a base 51 mounted on a support 52 of any suitable character, and containing a heating chamber 53 communicating with a reservoir 54 in which is inserted the neck of an inverted bottle or the like 55 containing water. The water level in the chamber 53 and reservoir 54 is determined by the height at which the mouth of the bottle is located, and is determined so that the heating unit 55 is slightly or partially submerged. The reserve water supply of this apparatus illustrates one of the means previously referred to by which water may be fed by gravity to the vaporizers of the apparatus first described, and maintained therein at constant level. Over the top of the vaporizing chamber, which may be enlarged in width as shown, or contracted, or maintained of uniform width, if desired, and may be of any desired length in the dimension perpendicular to the plane of the drawing, is placed a perforated plate 57. An electric fan 58 of conventional character is mounted on the wall of the base at one end of the heating chamber and arranged to direct a stream of air longitudinally over the chamber. A guard 59 embraces the fan, and may be of imperforate material extended to any desired length over the vaporizing chamber, whereby it is adapted to confine the air delivered from the fan into a stream having a definite direction over the chamber.

Fig. 8 illustrates the application of the humidifier principles of this invention to air conditioning apparatus of a different design. Here a casing or cabinet 60 is supported from the floor of a room adjacent to a window opening and connected by an air conduit 61 with the opening between the raised lower sash and sill of the window. An electric fan 62 is suspended from the top wall of the casing, and a guide 63 deflects the incoming air below the motor of the fan. A vaporizing chamber 64 substantially like that shown in Figs. 1, 2 and 3, and containing an electric heating unit 65, is mounted on the bottom of the casing and is constantly supplied with water, maintained at constant level, from an inverted bottle 66 at one side of the casing 60, the mouth of which enters a reservoir 67, connected with the vaporizing chamber substantially as shown in Fig. 7. A delivery pipe 68 rises from the vaporizing chamber back of the fan to a point near the axis thereof, so as to deliver vapor to the middle of the air stream delivered by the fan, whereby the vapor is efficiently distributed throughout the stream, and consequently through the air of the room.

What I claim and desire to secure by Letters Patent is:

1. An air conditioning apparatus comprising a casing of dimensions adapting it to be supported

entirely on a window sill and having a rear opening to register with the space between said sill and the raised adjacent window sash, a blast fan rotatably mounted in said casing with its axis in the length dimension thereof, the casing having also an outlet opening for discharge of air into the room, a conduit leading from said rear opening to the open end of the blast fan, a water vaporizer in the casing having communication with said conduit for passage of water vapor to the interior of the conduit, an electric heating unit in said vaporizer, and means for rotating the fan.

2. An air conditioning apparatus comprising a casing, a blast fan rotatably mounted in said casing with its axis in the length dimension thereof, the casing having an inlet opening in one side and an outlet opening in another side, a conduit leading from said inlet opening to the open end of the blast fan, an enclosed water vaporizing chamber in the casing of substantially smaller horizontal dimensions than the casing, having a restricted vapor conducting passage opening into said conduit, a heating unit in said chamber, feed means for delivering water to said chamber and maintaining a substantially uniform water level therein, and means for rotating the fan.

3. An air conditioning apparatus comprising a casing adapted to be placed on a window sill and having an intake opening at its rear side adapted to be registered with the space between such window sill and the raised lower sash of the window, an electric motor, and a blast fan connected to the armature shaft of said motor, arranged with the axis of the fan and shaft substantially parallel to the side in which said opening is located, a conduit leading from said inlet opening into the open end of the blast fan, an outlet opening from another side of the casing, an opening in the end of the casing registering with the terminal section of said conduit for communication therethrough to the interior of the blast fan, a valve element surrounding the blast fan and having a port in its side, an opening in the intake conduit in position to register with said port when the latter valve element is in a certain position, and to be closed by the valve element when the latter is turned to a different position, a valve in position to open and close said end opening of the casing, a shut off valve in the conduit between the terminal section thereof and the last named conduit opening, and valve operating means correlated to shift all of said valves so as respectively to open communication exclusively from the inlet to the outlet of the casing through the conduit and fan, and to open exclusively communication from the end opening of the casing to the fan and thence through the conduit to the rear opening of the casing.

4. An apparatus for passing air into or out of a room comprising a casing adapted to be placed removably, and supported, on a window sill, having an inlet opening for outer air, a discharge opening for delivery of air into the room, and a third opening for intake of air from the room, an air propeller, and a motor for rotating it in the casing, a conduit within said casing leading from the air intake opening to the propeller and having branch communication with said third casing opening, a shut off valve in said conduit between the intake opening and fan, a valve controlling the third casing opening, valve means for open-

ing and closing a communication between the conduit and the space into which the propeller discharges air, and means for operating said valves in unison to cause the propeller either to project air into the room from out of doors, or vice versa.

5. An air forwarding apparatus comprising a casing adapted to be placed removably on a window sill in front of a window opening, a blast fan, means for rotating said fan, and combined air intake, discharge, conducting means, and valve means all in said casing, operable either to cause the fan to draw air from the outside and discharge it into the room, or to withdraw air from the room and discharge it to the outside, while the fan rotates in the same direction.

6. An air propelling apparatus comprising a casing, a motor having a drive shaft located in said casing, a blast fan secured to said shaft with its open end directed away from the motor, a housing surrounding the blast fan and having an end opening at relatively the same end as the end opening of the fan, and a port in its side, a conduit leading from an inlet opening in the side of the casing, having a wall beside the housing with an opening therein, and extending across the rim of the housing and blast fan, having a terminal section opening both to the interior of the blast fan and to the end of the casing in register with an opening in such end, means for rotating the housing so as to place its port into and out of register with the side opening in the adjacent conduit wall, such port being open to the interior of the casing when out of register with said conduit wall opening, and correlated valve means for respectively, and simultaneously, closing the conduit at a point between such opening and the terminal section and opening the communication between the terminal section and end aperture of the casing when the housing port registers with the contiguous conduit opening, and reversing the condition of the other valves when the housing is so turned as to close off such opening.

7. An air conditioning device for use within a room comprising the combination with an air propeller, of a vaporizing chamber having an outlet arranged to deliver vapor into the stream of air propelled by the propeller, the chamber itself being out of such stream, a heating unit having a heating surface occupying a substantial part of the interior space of said chamber and having a temperature high enough to cause nearly instantaneous steam generation from the water in the chamber put in operation at room temperature, and water supplying means adapted to feed water continuously to said chamber and maintain a water level therein substantially but barely submerging the unit.

8. An air conditioning apparatus comprising a casing of dimensions adapting it to be supported entirely on a window sill and having a rear opening to register with the space between such sill and the raised adjacent window sash, a motor having a rotatable shaft mounted in said casing, blast fans secured to opposite ends of said shaft also within the casing, a conduit leading from said rear opening of the casing to opposite ends thereof and into the interior of the two blast fans, and openings in a side of the casing other than its rear side in position to emit air delivered from the respective fans.

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