June 1, 1926. 1,587,277

J. E. BOLLING

AIR HUMIDIFYING AND CLEANING APPARATUS

Filed April 24, 1923 4 Sheets-Sheet 1

Fig. 1.

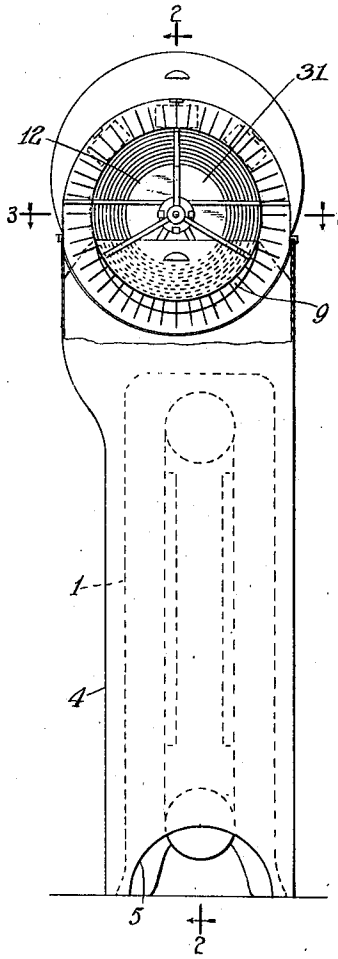



Fig. 2.

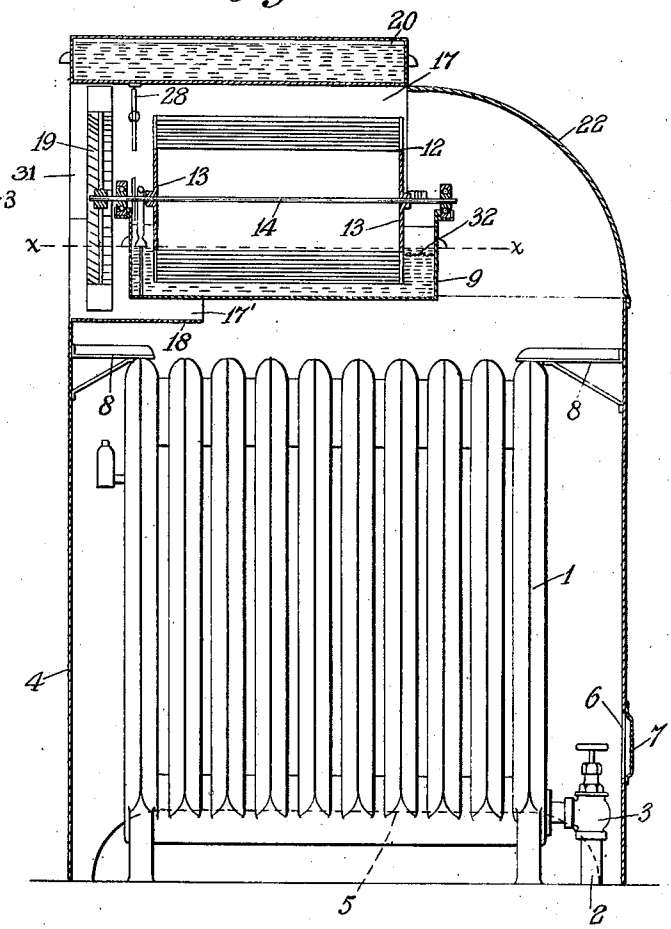
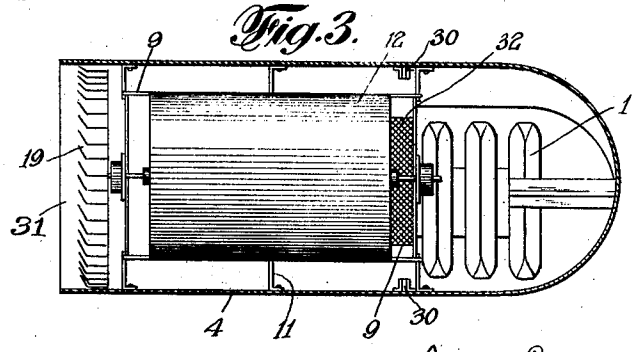



Fig. 3.




Inventor

John Eden Bolling

By his Attorneys

Howson Howson & Whittaker

June 1, 1926. 1,587,277

J. E. BOLLING

AIR HUMIDIFYING AND CLEANING APPARATUS

Filed April 24, 1923 4 Sheets-Sheet 2

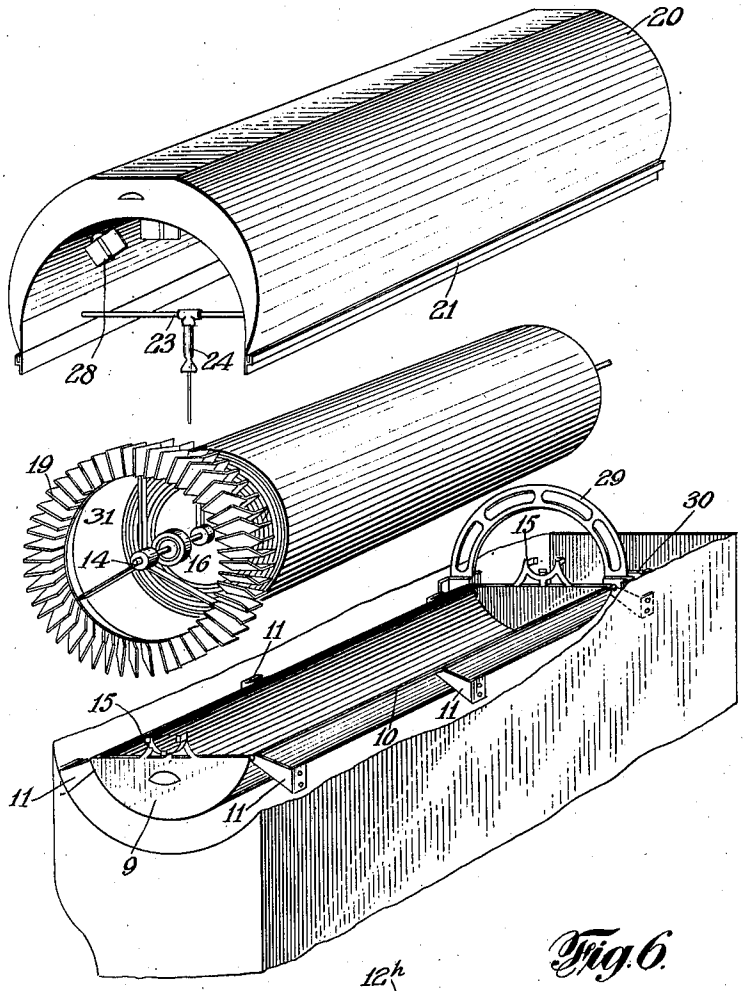



Fig. 4.

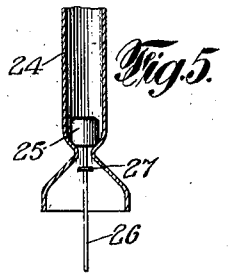
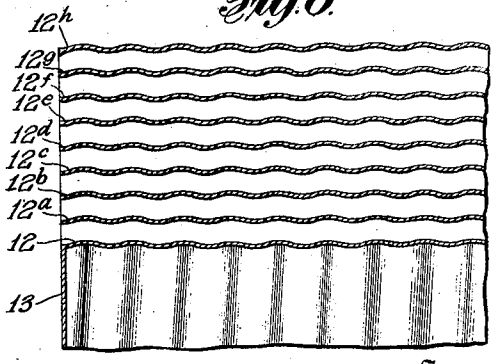



Fig. 5.

Fig. 6.




Inventor

John Ecton Bolling

By his Attorney

Louis Prevost Whitaker

June 1, 1926. 1,587,277

J. E. BOLLING

AIR HUMIDIFYING AND CLEANING APPARATUS

Filed April 24, 1923 4 Sheets-Sheet 3

Fig. 7.

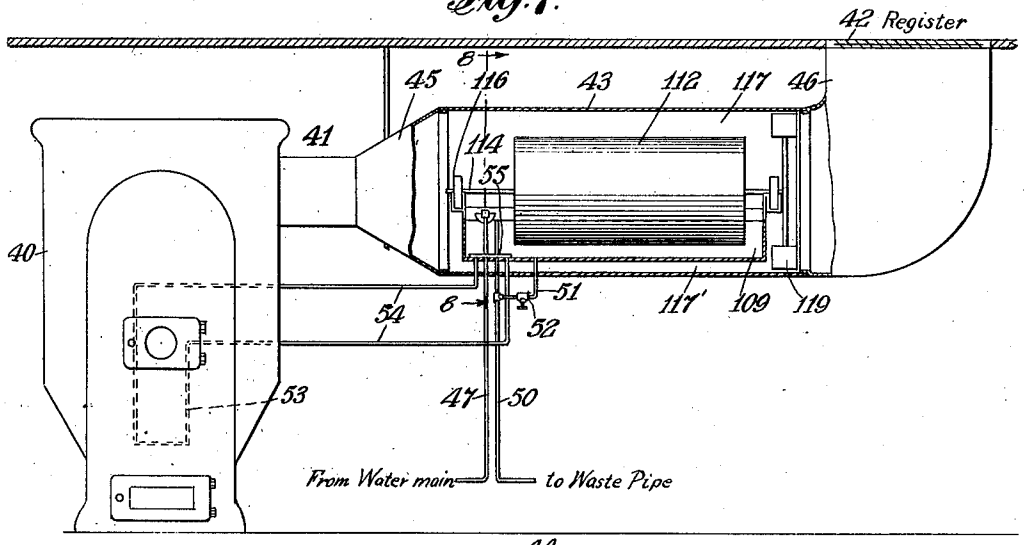



Fig. 8.

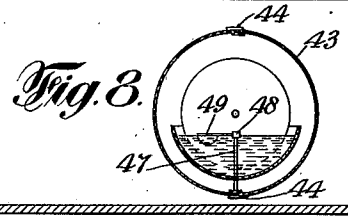



Fig. 9.

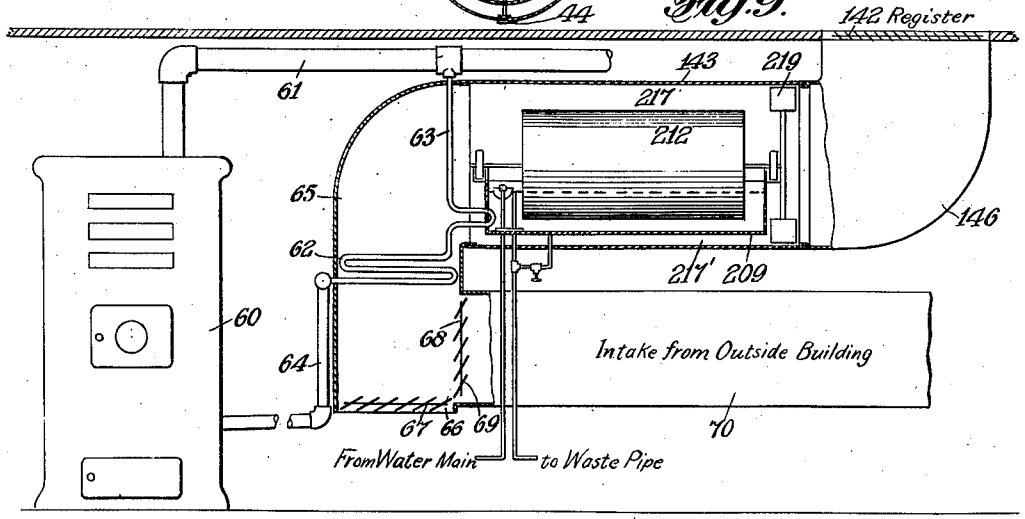
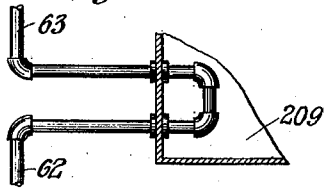



Fig. 10.




Inventor
John Estew Bolling
By his Attorney
Louis Prevost Chutaux

June 1, 1926. 1,587,277

J. E. BOLLING

AIR HUMIDIFYING AND CLEANING APPARATUS

Filed April 24, 1923 4 Sheets-Sheet 4

Fig. 11.

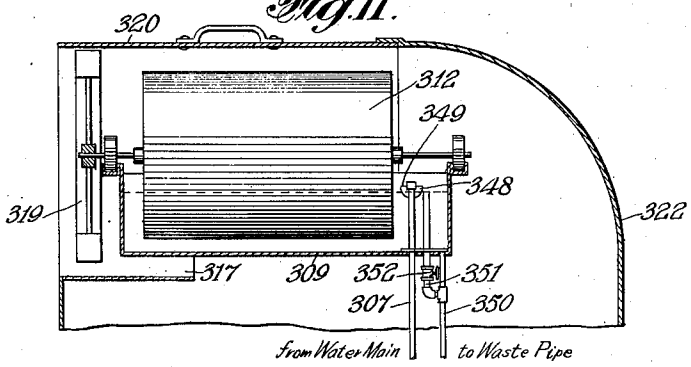



Fig. 12.

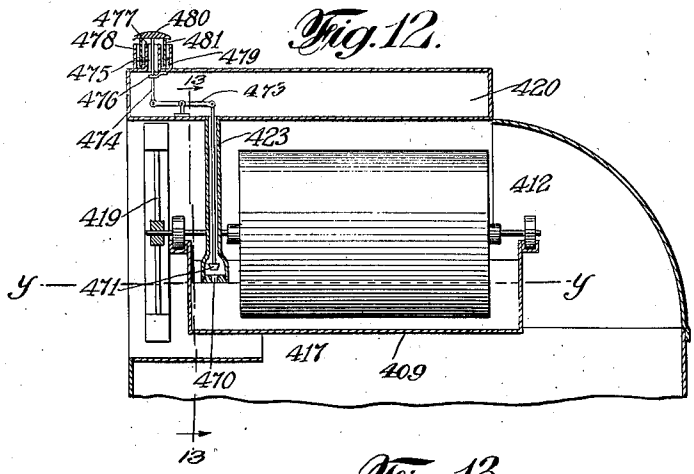
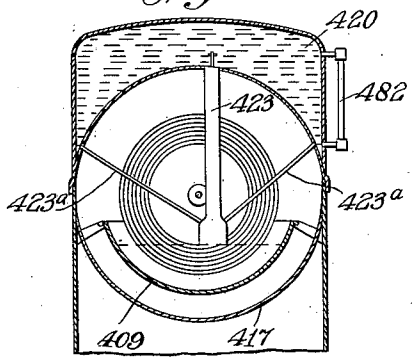



Fig. 13.




Inventor
John Ester Bolling
By his Attorney
Louis Pelzer Whitaker

Patented June 1, 1926. 1,587,277

# UNITED STATES PATENT OFFICE.

JOHN ESTEN BOLLING, OF NEWARK, NEW JERSEY.

## AIR HUMIDIFYING AND CLEANING APPARATUS.

Application filed April 24, 1923. Serial No. 634,313.

My invention consists in the novel features hereinafter set forth reference being had to the accompanying drawings, which illustrate several forms in which I have contemplated embodying the invention, selected by me for purposes of illustration, and the said invention is fully disclosed in the following description and claims.

My invention consists in apparatus for humidifying, cleansing and heating the air in an enclosed space, and is adapted more particularly for use in connection with rooms, apartments or buildings for residential purposes or offices, the object being to insure that the rooms shall be supplied with cleaned air at such temperatures and of such relative humidity as to be conducive to the greatest degree to health and comfort. With all systems of artificial heating of rooms, apartments and buildings, it is recognized by the persons occupying the spaces so heated that the air is lacking in the required percentage of moisture necessary for health and comfort and also that the air contains a relatively large amount of finely divided solid particles of foreign matter, dust, lint, carbonaceous matter, and the like, which is extremely objectionable from the standpoint of health, and also is deposited on the furniture, walls and draperies within such spaces.

It is also recognized that in order to insure health and comfort, the air should contain approximately forty to fifty per cent of the amount of moisture which it is capable of absorbing at the temperature of the air. The problem of supplying such a high state of relative humidity in residential and office spaces is an extremely difficult one on account of the limitations which are necessarily imposed upon the constructors of such apparatus. For such purposes it is impracticable to employ power driven air circulating fans, for the reason that the operation of such devices involves objectionable noise, and also a considerable item of expense. The surface evaporation from receptacles containing water disposed within the spaces referred to, has proven wholly inadequate as the surfaces exposed are relatively small and the evaporation therefrom will not supply more than a minute fraction of the desired moisture to the air, and further such surface evaporation mechanism does not remove the dirt and foreign matter from the air to any material extent.

The object of my invention is to provide an extremely simple and inexpensive apparatus capable of being used in connection with the ordinary heating appliances in general use, in which relatively large movable surfaces are maintained in a wet condition so as to promote rapid and very extensive evaporation therefrom, such surfaces being supplied with water heated to facilitate evaporation and being continuously supplied to such surface by moving the latter through and in contact with the heated water, the power necessary to operate the moving parts of the mechanism being supplied entirely by a current or currents of air heated by convection from the normal heating mechanism, and the water being heated either by the heated air, or directly from the heating apparatus itself, or both, the parts being constructed and operated so as to actually supply the desirable relative humidity of substantially from forty to fifty per cent of the moisture which the air at the temperature maintained in the space or room is capable of absorbing, while at the same time eliminating from the air, passing through the apparatus, practically all the particles of foreign matter carried therein and ultimately treating substantially all the air in the room.

The apparatus is so constructed that it may be readily cleaned to remove all the dirt and foreign matter collected while a plentiful supply of water for evaporating purposes is maintained at all times. I prefer to so construct the apparatus that a portion only of the air heated by convection is utilized for the purpose of driving the actuating means for operating the apparatus, which portion is carried around the evaporating mechanism while the main portion of the air is carried through and in intimate contact with the evaporating mechanism and humidified to the point of approximate saturation, issuing from the apparatus and diffusing with the diverted portion of the air and atmosphere of the room so as to produce a resultant humidity of approximately forty to fifty percent of saturation at the temperature maintained. My invention also contemplates the use of dampers or other controlling mechanism for the diverted air current which effects the operation of the mechanism so that the apparatus may be operated at the most desirable speed

for the particular heating mechanism employed and so that the smallest amount of air possible may be diverted for purposes of power actuation. My improved apparatus is so constructed and arranged that in case of a fall of temperature, as in extremely cold weather, which would otherwise tend to cause condensation of moisture from the air, as upon the window panes, the action of the apparatus will automatically respond to such condition as the air acted upon by the heating mechanism, will enter at lower temperature and pass at lower temperature through the humidifying mechanism, and will therefore not absorb so much moisture as when it is heated to higher temperatures, the effective utility of the heat being in such case expended more in raising the temperature than increasing the humidity, and thus enabling the apparatus to automatically respond to variations of temperature resulting from the prevailing season and climate in which the apparatus is employed. The amount of humidifying action is always in direct proportion to the amount of heating accomplished, so that the relative humidity is practically constant, and a fall of temperature will be accompanied by a consequential fall of moistening effect, the relative humidity remaining substantially at all times within the desirable limits. Consequently, the heating apparatus cannot establish that condition of dryness which would otherwise exist where the requisite amount of moisture is absent from the air, which is not only injurious to health and the cause of much discomfort to the occupants of the room, but which also is extremely deleterious to the furniture and the building itself if it is a wooden building. The injurious effects of dry heated air on fine cabinet work, musical instruments, such as pianos, etc., and other articles of furniture, are well known, and where my improved apparatus is used, these injurious effects cannot occur as long as the water supply is maintained to the humidifying apparatus, whether the room is occupied or unoccupied during the night or the day, and regardless of whether the temperature is high or low.

Referring to the accompanying drawings:—

Fig. 1 represents an end view of one form of apparatus embodying my invention and constructed to be applied to an ordinary radiator heated by steam or hot water.

Fig. 2 represents a vertical sectional view of the apparatus shown in Fig. 1 on line 2—2 thereof, the radiator being shown in elevation.

Fig. 3 represents a horizontal section on line 3—3 of Fig. 1.

Fig. 4 is an enlarged perspective view representing the parts of the apparatus shown in Figs. 1, 2 and 3, in separated relation.

Fig. 5 is a detail view of a form of valve mechanism for controlling the inlet from the water supply tank.

Fig. 6 is an enlarged detail sectional view illustrating the construction of the rotating evaporating surfaces or cylinders which I find it convenient to employ.

Fig. 7 is a more or less diagrammatic representation of an embodiment of my invention showing it applied to an air heating furnace.

Fig. 8 is a transverse sectional view of the apparatus shown in Fig. 7, taken on line 8—8 looking in the direction of the arrows.

Fig. 9 is a view similar to Fig. 7 showing the apparatus applied to an indirect steam or hot water heating system.

Fig. 10 is a detail view showing the connections to the water pan for heating the same, illustrated diagrammatically in Fig. 9.

Fig. 11 is a view partly in section of a slightly modified form of apparatus for use in connection with an ordinary radiator in which the water pan is permanently mounted and provided with suitable pipes and valves for maintaining the water level and flushing the pan in situ.

Fig. 12 is a partial sectional view of a slightly modified form of water tank or reservoir for use with the radiator type of apparatus which can be readily filled in situ, without disturbing the apparatus.

Fig. 13 represents a sectional view of the tank shown in Fig. 12.

Referring to the form or embodiment of my invention illustrated in Figs. 1 to 6 inclusive, 1 represents an ordinary steam or hot water radiator supplied by pipe, 2, under the control of valve, 3, (or valves) in a well known or usual manner. 4, represents an enclosing casing surrounding the radiator and provided with suitable apertures or cut-away portions, 5, adjacent to the floor or lower portion of the radiator for the purpose of admitting air from the surrounding room or space to the interior of the casing. The casing may be conveniently provided with a hand opening, 6, adjacent to the valve (or valves), said opening being provided with a hinged closure, 7, normally closing the same. The upper portion of the casing may also be provided with suitable brackets, indicated at 8, for engaging the radiator and steadying the casing. Above the radiator the casing is provided with a water pan or receptacle, indicated at 9, which may be conveniently formed with a bead or rolled edge, 10, arranged to rest upon and be supported by suitable brackets, 11, within the casing, so that the water pan may be removed at any time and thoroughly rinsed or cleansed under a faucet, or otherwise. In connection with the water pan, I employ a rotary hu-

midifying mechanism consisting of a plurality of concentric cylinders spaced a short distance from each other so as to provide air passages between the outer face of one cylinder and the inner face of the next outer cylinder. The central cylinder, indicated at 12, see Fig. 6, is preferably closed at each end by heads, 13, and is provided with a longitudinal shaft, 14, and the remaining cylinders are open at the ends and are supported with respect to each other and to the shaft in any suitable or desired manner, as by spiders, spacing devices, or otherwise, so arranged as to afford minimum obstruction to the passages between the cylinders. These cylinders may be plain cylinders, as indicated in Fig. 1, or they may be and preferably are provided with corrugations extending spirally around the same, as indicated in Fig. 6, and are preferably eight or nine in number, although the precise number is immaterial and will depend upon the capacity and size of the apparatus. The exterior open end cylinders are indicated in Fig. 6 as $12^a$, $12^b$, $12^c$, $12^d$, etc. The object of providing the cylinders with spiral corrugations is to effect a slight forward propulsion of the water longitudinally of the water pan as the cylinders are rotated therein to effect movement of the dust particles eliminated from the air and collected in the water toward one end of the cylinder, so as to allow them to settle to the bottom of the pan and prevent the contamination of the air which might otherwise result by passing it over the accumulated particles of foreign matter after the device has been in operation sometime. The cylinders 12—$12^h$, constitute what I shall hereafter term the rotor and these are submerged in water in the pan, 9, to a level indicated by the dotted line $x$—$x$ in Fig. 2, that is to say a level slightly above the lowest point in the surface of the innermost cylinder, the intent being that the surfaces of all of the cylinders shall be maintained in wet condition at all times by the rotation of the rotor. Means are provided, as hereinafter pointed out, for maintaining this water level and also for operating the rotor. I prefer to provide means for readily detaching the rotor and its actuating propeller so that it also may be thoroughly washed under a faucet or otherwise, to remove any adhering particles of dust or foreign matter from time to time. This may be accomplished in many ways, but in the present instance I have shown the water pan, 9, provided at each end with a suitable bracket, indicated at 15, adapted to receive a usual form of ball bearing, 16, which is carried by the shaft, 14, at each end of the rotor.

In order to have the rotor move at the slowest possible speed so as not to waste energy in driving it beyond the necessities of the apparatus, and also for the purpose of employing a propelling device of large diameter, I prefer to so arranged the apparatus that the air which passes through the spaces between the cylinders in contact with the wetted surfaces thereof is not used to drive the rotor, and I divert a small portion of the air, as hereinafter explained, and carry it through a passage, indicated at 17, between the outermost cylinder, $12^h$, and the surrounding casing which in this instance is partly supplied by the inner surface of the water reservoir adjacent to the upper and lateral portions of the rotor and which is formed by a stationary shield, 18, located above the radiator adjacent to the outlet of the casing and below the water pan, and providing passage 17′ between it and the pan. The shaft, 14, is provided with a wind wheel, or propellor, 19, the blades of which are arranged in a circle of larger diameter than the cylinder, $12^h$, of the rotor, said blades being in alignment longitudinally with the substantially annular passage 17—17′, before described, the parts being so constructed that the air heated by convection from the radiator will pass in large part through the spaces between the cylinder to the rotor, a portion only of the heated air passing through the passage 17—17′, and coming in contact with the blades of the wind wheel or propeller, effecting a slow revolution of the rotor. Suitable means are provided for maintaining the water in the pan, 9, at the proper water level. In the case of a radiator device such as is shown in these figures, it is ordinarily not practical to connect the same with water service pipes and sewer connections, and I therefore provide where this is not practical, a detachable water reservoir which is preferably of the form shown in Fig. 4, and forms the upper portion of the casing or housing of the apparatus being conveniently made of substantially crescent shape in cross section, although any other form may be employed. The lower edges of the reservoir, 20, will be provided with suitable flanges, 21, to engage and be supported upon the casing, 4, and a curved hood, indicated at 22, is provided at one end of the casing to enclose the space above the radiator at that end of the apparatus and to direct the convection air current into the portion, 17, of the propeller actuating air passage and the humidifying air passages between the cylinders of the rotor. Suitable handles may be provided on the water reservoir and on the water tank to facilitate lifting the parts when separating and assembling the same. The water reservoir, 20, is preferably entirely closed, except for an outlet pipe, indicated at 23, extending across adjacent to its lowest portion, as indicated in Figs. 1, 2 and 4, and provided with a delivery and filling tube, 24, adapted to ex-

tend into the water pan and have its lower end at the water level when the parts are in operative position. For convenience in handling the apparatus, I prefer to provide the tube, 24, with a valve, 25, provided with a projection stem, 26, which extends below the mouth of the pipe, 24, to such a distance that it will come in contact with the bottom of the water pan and raise the valve slightly so as to open it when the parts are in operative position so that the water will flow from the reservoir 20, into the water pan, as may be necessary to maintain the water level in the pan. When the pan is lifted off for cleaning the machine or filling the water reservoir, the valve will close the pipe, 25, and prevent the water from dripping on the floor, and the reservoir may be filled by simply inverting it and pouring water into the filling pipe, 24, at which time the valve will be in open position and will be held by a collar or enlargement, 27, on the stem, 26.

I prefer to provide means to adjust the amount of air used for the purpose of operating the wind wheel or propeller, and this may be accomplished in many ways. For example, I have shown in Figs. 1 and 2, a series of small dampers, indicated at 28, which are pivotally supported in any desired manner and project inwardly from the inner surface of the water reservoir. These dampers may be turned by hand so as to present more or less of their surfaces in the path of the air currents, and thus regulate the amount of air flowing through the passage, 17—17′. In Figs. 3 and 4 I have also shown another damper construction which consists of a segmental piece of sheet metal, indicated at 29, adapted to be fitted detachably in brackets, 30, secured to the upper part of the casing, and provided with holes which may be of any desired size. A plurality of these damper plates may be made with holes whose combined area will bear different proportion to the area of the plate, and one or another of these plates may be inserted in the brackets, 30, according to the requirements of the particular apparatus and the radiator with which it is employed. I wish it to be understood that these dampers may be dispensed with altogether in some instances if they are not required, but that these or equivalent damper mechanism can be employed when desired, and will in such cases, perform a useful function in enabling the quantity of air diverted for purposes of operating the rotor to be adjusted in accordance with the requirement of the particular apparatus and radiator used.

In the operation of the apparatus hereinbefore described the air of the room will enter the radiator casing, 4, through the apertures, 5, at the bottom, and being heated, will rise, thus imparting a certain velocity to the air current, by convection. Portions of the air will pass between the cylinders of the rotor in contact with the wetted surfaces thereof, the water in the pan, 9, being maintained at a relatively high temperature by radiation from the radiator, and by contact with the heated air currents passing around the pan, so that the air which passes between the cylinders will absorb moisture substantially to the point of saturation and will issue at the other end of the rotor and pass through the central open portion of the propeller and out of the casing through an aperture, 31. All particles of dust, lint, dirt carbonaceous and other foreign matter contained in the air will tend to be deposited on the surfaces of the cylinders, and as the rotor is in constant motion, will be carried down to and below the surface of the water so as to be washed from the surfaces and separated therefrom while the surfaces of the rotor are maintained at all times with a film of moisture thereon in the best condition for evaporation. Where the spirally corrugated cylinders are employed, the water will be given an endwise movement through the tank by the rotation of the rotor, which will tend to carry the dirt collected in the water to one end of the tank and free it in large measure from the cylinders.

In some instances instead of corrugating the cylinders, I may provide them with a spiral wire or spiral rib, soldered or otherwise secured thereto, or to certain of said cylinders, as the exterior cylinder, if desired.

Portions of the current of air set in motion by convection from the radiator will, as before stated, be diverted and carried through the passage, 17—17′, around the exterior of the rotor and brought directly into engagement with the blades of the wind wheel or propeller, to operate the rotor, this quantity of air being subject to adjustment by means of damper mechanism, as before stated. This air will be humidified and cleansed to a certain extent, as a considerable quantity of it will come in contact with the exterior cylinder, $12^h$, and it will issue from the cylinder, 31, and be diffused with the saturated air into the surrounding atmosphere so that the continued operation of the apparatus, which will be noiseless and require no application of power or other attention, will maintain the desired relative humidity of the atmosphere, and at the same time will in a very short time eliminate practically all dirt, lint, carbon and other foreign matter, leaving it in the best condition for health and comfort. As before stated, the device is practically automatic in adapting itself to the difference between moderate weather and extremely cold weather. In cold weather, the air which is to be heated by the radiator will naturally enter the casing at a lower temperature than usual and the heat taken up from the radiator will not raise it

to as high a temperature, so that as it passes through the humidifying apparatus, it will absorb less moisture and consequently the relative humidity will remain practically constant under variations in the temperature of the air, without objectionable condensation, which would otherwise result. In some instances it has been found desirable to provide the water pan, 9, with a small screen, indicated at 32 in Figs. 2 and 3, slightly below the water level, to assist in preventing the accumulation of dust on the surface of the water. As the device operates, the upper portions of the water will be gradually propelled toward the delivery end of the machine within the water pan, and will return adjacent to the bottom of the pan, and as the water rises at the inner end of the pan, it will pass through the screen, 32, and any floating particles will have a tendency to collect below the screen and remain until they become sufficiently wetted with moisture to be deposited on the bottom of the pan. At proper intervals the parts will be separated, as indicated in Fig. 4, to enable the rotor to be thoroughly washed and to enable the water pan to be emptied of all collected dirt and foreign matter, and thoroughly washed, after which the parts can be readily and quickly reassembled. This insures pure and healthful moist air at all times.

Figs. 7 and 8 of the drawing illustrate an embodiment of my invention which may be conveniently made where the room or space, the air of which is to be treated, is heated by a hot air furnace and in which it is desirable to locate the air treating apparatus in the cellar or furnace room. In these figures, 40, is a hot air furnace of the usual or preferred construction provided with a hot air duct, 41, for supplying heated air through a register, 42, to a room or apartment. The figures show a convenient arrangement for the purpose of applying my invention under these circumstances. 43 represents a drum or casing formed conveniently in halves and connected together by detachable catches, 44, of any preferred construction, the casing being supported at one end by a conical head, 45, connected with the hot air flue, 41, and supported in any convenient way and the casing is supported at the opposite end by an angle pipe, 46, the discharge end of which is connected with the register, 42. Within the casing, 43, is supported the water pan, 109, constructed in the same manner as heretofore described, the rotor 112, mounted on the shaft, 114, provided with the propeller or wind wheel, 119, and detachably mounted by means of the ball bearings, 116, supported in brackets secured to the pan, all of said parts being constructed substantially as heretofore described with reference to Figs. 1 to 6. A passage, 117—117′ substantially surrounds the rotor and pan, permitting a certain portion of the air to be diverted for the purpose of operating the fan or propeller, while the remaining portion of the air passes between the cylinders of the rotor as heretofore described. In this case, by reason of the fact that the device will be located conveniently with respect to water main and sewer connections, the water level in the pan may be maintained automatically by means of a supply pipe, 47, provided with the usual float valve, 48, and float, 49, see Fig. 8, which is arranged to close the pipe, 47, when the proper water level is reached in the pan. The pan is also provided with an overflow pipe, 50, which may be connected with a bucket or other receptacle if a sewer connection is not practical. The pipe, 50, terminates inside of the pan at the water level. In order to provide means for flushing out and thoroughly cleansing the pan of all dirt, I prefer to provide additional outlet pipe, 51, extending from the bottom of the pan and conveniently connected to the pipe, 50, and provided with a valve, 52, which will normally be closed, but which may be opened when desired to run large quantities of water into the pan and flush it out for cleaning purposes.

The water in the pan is heated to facilitate evaporation in two ways, first by the hot air passing around the pan, and secondly directly from the furnace by means of a water back, 53, connected with circulation pipes, 54 and 55, the latter of which is located within the pan. The operation of the device will be the same as has been heretofore described.

In Fig. 9 I have shown another embodiment of my invention which may be conveniently installed where indirect radiation from a steam or hot water furnace is employed as the heating unit, and is caused to heat air supplied to the room or space. In this figure, 60, represents a steam or hot water heater provided with a main steam or hot water supply pipe, 61. 62 represents a radiator or coil of any desired size or form which may be single or multiple, according to the quantity of air to be heated. This radiator is connected by means of a pipe, 63, with the supply pipe, 61, and by a return pipe, 64, to the boiler. The radiator is enclosed in a casing, indicated at 65, to which air is preferably admitted in two ways. The casing is shown as provided with an inlet aperture, 66, having the usual controlling louvers, 67, for regulating the quantity of air passing through the same, and this aperture admits air from the interior of the building into the casing, 65, the casing also being provided with another inlet aperture, 68, provided with adjustable louvers, 69, and connected by a pipe, 70,

with the air outside of the building. By regulating the louvers the desired proportion of cold fresh air from the exterior atmosphere and warm recirculated air within the building can be accurately regulated. The casing, 65, is connected to an angle casing, 146, and register, 142, by a drum, 143, or casing, constructed exactly in the same manner as heretofore described with reference to the drum, 43, and within the drum is installed the humidifying and cleaning apparatus comprising the water pan, 209, the rotor, 212, detachably mounted and provided with propelling wind wheel, 219, all constructed and operating as hereinbefore described. In this instance the water in the pin is heated by carrying the pipe, 63, for the radiator (or a branch therefrom) into the interior of the pan, and of course will also be heated by the hot air passing from the radiator around the pan and rotor through the passage, 217—217'.

The water will be supplied and maintained at the desired level in exactly the same manner as heretofore described in respect to Figs. 7 and 8, and the same parts are illustrated in Fig. 9 and have been given numerals corresponding to those used in Figs. 7 and 8, increased by 100. The operation of the apparatus illustrated in Fig. 9 will be readily understood, and it is unnecessary to recapitulate it in detail.

The heating of the water supplied to the humidifying device, in accordance with my invention, is a very important feature of the invention and it accomplishes two valuable results. In the first place, it facilitates evaporation and the consequent operation of the machine in supplying the necessary moisture to the air, but further than this it so increases the capacity of the apparatus that a comparatively small apparatus may be employed to satisfactorily and efficiently humidify the air in comparatively large enclosed spaces where apparatus of much greater size would be required if provision was not made for directly heating the water. This is particularly important in the application of the apparatus in dwelling houses and apartments where it is not practical to use bulky apparatus, and it also enables me to provide an efficient apparatus at very low cost. It will also be understood that additional heating means for the water, such as the water back or heating coil previously described, are not employed and the heating of the water is accomplished solely by the heat of the air passing around and over the water pan. The humidifying apparatus will necessarily be of greater size and proportions than where the auxiliary heating means for directly heating the water is employed, in order to secure the same capacity. It will therefore be seen that the adequate heating of the water has a direct influence upon the efficiency of the apparatus and also the economy in space and material in its construction.

It will be understood that in the radiator type of apparatus illustrated in Figs. 1 to 6, inclusive, instead of having the water pan removable and supplied by means of a water reservoir, the tank may be permanently secured to the radiator casing and provided with pipes for maintaining the water level and flushing the pan, substantially as shown in Figs. 7 and 8 and 9. Such a construction is shown in Fig. 11. In this figure the water pan, indicated at 309, is permanently mounted in the casing of the radiator and is provided with a water supply pipe, 307, having the usual float valve, 348, and float, 349, for closing the supply pipe when the proper water level is reached in the pan. 350 illustrates the waste pipe, which is conveniently carried to and connected with a sewer connection or house waste pipe, and 351, illustrates the flushing pipe extending from the bottom of the pan and connected to the waste pipe, 350, and provided with a normally closed valve, 352. These pipe connections can be made with any suitable pipes of small diameter, such, for example, as small copper tubing which may be carried around the base board, to the water main and waste pipe respectively, so as to be inconspicuous. In Fig. 11, 312, represents the rotor, and 319, the propeller or wind wheel, detachably mounted as hereinbefore described, but in this instance the water reservoir is dispensed with and the upper portion of the radiator casing is closed by means of a detachable semi-cylindrical hood, 320, which encloses the working apparatus and which may be removed when it is desired to take out the rotor and propellor at suitable intervals for cleaning the same.

In Figs. 12 and 13 I have illustrated another slight modification of my invention, in which the water reservoir shown in Figs. 1 to 6 inclusive for use with the radiator type of apparatus, is provided with a filling aperture on its upper surface so that it may be filled in situ, without disturbing the reservoir or any other part of the apparatus. In this figure, 420, represents the removable water reservoir which is constructed substantially in the same manner as shown in Figs. 1 to 6, except in respect to the means for introducing and discharging the water. In this instance the reservoir is provided with a central discharge pipe, 423, the lower end of which terminates at the water level in the water pan, the water level being indicated by the dotted line, $y$—$y$, and the water pan being indicated at 409. The pipe, 423, is also connected with lateral pipes, 423$^a$, extending to

the lower portions of the reservoir, slightly above the lowest portion so as to avoid discharging sediment in the pan. At the lower end of the discharge pipe, 423, is a valve seat, 470, adapted to be engaged by the valve, 471, at the lower end of a valve stem, 472, for closing the pipe, 423. The upper end of the valve stem is connected by a pivoted lever, 473, with a vertical rod, 474, which extends up through a filling orifice, 475, and is held in position by a suitable guide, 476. The filling orifice is provided with a tubular collar, 477, which is in turn surrounded by an exterior collar, 478, to form an annular well which is filled with mercury, indicated at 479. The parts forming the mercury well should be made of a metal not attacked by mercury, such as nickel, for example. A weighted closure, consisting of a weight, 480, and tubular portion, 481, is provided for closing the water inlet, so as to make an absolutely air tight seal, the tubular portion, 481, being of proper diameter to enter the well between the concentric collars 477—478, and the upper portion of the closure is adapted to engage the rod, 474, and depress the same, which effects the lifting of the valve stem, 472, and opens the valve, 471. It will be readily understood that in order to fill the reservoir it is only necessary to lift off the closure, 480—481, and pour water into the reservoir through the filling aperture, 475. The removal of the closure permits the valve, 471, to seat by gravity and prevent the flooding of the water pan. This arrangement will be found especially convenient where the apparatus is installed in a room in a dwelling house or office at some distance from the water supply and makes it unnecessary to remove the water receptacle or otherwise disturb the apparatus for the purpose of renewing the water supply. If desired, an ordinary gauge, indicated at 482, may be provided on the water reservoir, so that the amount of water in the reservoir can be ascertained by a glance at the apparatus.

Where my improved apparatus is used in connection with a hot air furnace, as shown in Figs. 7 and 8, it will be understood that the humidifying device may be located in a single air supply pipe from the furnace and may supply sufficient moisture for the air of the entire building, or for a particular room, as preferred, and other pipes from the hot air heater may or may not be supplied with the humidifying apparatus, as preferred, or found desirable. In some instances, however, the humidifying device may be located within the dome of the hot air furnace, so that all of the heated air delivered from the furnace by any of the conducting pipes will be supplied with the desired moisture content. In the form of apparatus illustrated in Figs. 9 and 10, for use in connection with steam or hot water heating plants, it will be understood that the apparatus shown in these figures may be made of such capacity as to supply the necessary humidity to the air for the entire house or apartment heated by the furnace, and heat will be supplied from the furnace to the usual radiators located in the several rooms, which operate merely as heating surfaces, as usual.

It will be further understood that a humidifying device of the type shown in Figs. 1 to 6 of the drawings, provided with a water reservoir, may also be readily adapted for use in connection with any ordinary hot air register, where a hot air heating system is employed. In such case the humidifying apparatus would be enclosed in a substantially cylindrical casing, the upper portion of which would be formed by the removable water receptacle and the rear end of the casing would be connected preferably at one side with the hot air register, which would support one end of the casing, and the other end could be readily supported by a wall or floor bracket or support. In this case all the air issuing from the register would pass through the casing in the same manner and with the same effective operation as the hot air rising from the radiator shown in Figs. 1 and 2.

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

1. In an apparatus for humidifying air, the combination with a casing having an air inlet and constructed so as to be supported in conjunction with a heating apparatus so arranged as to heat air entering from the surrounding atmosphere, said casing having a discharge opening for cleaned heated air, a rotary humidifying device within said casing provided with spaced evaporating surfaces of large area located in the path of the air so heated by the heating device and entering through the air inlet, means for supplying water in a thin film to said evaporating surfaces, and a rotary propelling device connected to the humidifying device and located operatively with respect to the air inlet so as to be rotated solely by the motion of the air imparted by heat alone without the intervention of power operated means.

2. In an apparatus for humidifying air, the combination with a casing having an air inlet and constructed so as to be supported in conjunction with a heating apparatus so arranged as to heat air entering from the surrounding atmosphere, said casing having a discharge opening for cleaned heated air, a rotary humidifying device within said casing provided with spaced evaporating surfaces of large area located in the path of the air so heated by the heating device and entering through the air inlet, means for supplying

water in a thin film to said evaporating surfaces, a rotary propelling device connected to the humidifying device and located operatively with respect to the air inlet so as to be rotated solely by the motion of the air imparted by heat alone without the intervention of power operated means, and means for supporting the humidifying and propelling devices in the casing whereby they may be removed and the adhering solid matter collected from the atmosphere effectively removed therefrom.

3. In an apparatus for humidifying air, the combination with a casing having an air inlet constructed so as to be supported in conjunction with a heating apparatus so arranged as to heat air entering from the surrounding atmosphere, said casing having a discharge opening for cleaned heated air, a rotary humidifying device within said casing provided with spaced evaporating surfaces of large area located in the path of the air so heated by the heating device and entering through the air inlet, means for supplying water in a thin film to said evaporating surfaces, a rotary propelling device connected to the humidifying device and located operatively with respect to the air inlet so as to be rotated solely by the motion of the air imparted by heat alone without the intervention of power operated means, means for supporting the humidifying and propelling devices in the casing whereby they may be removed and the adhering solid matter collected from the atmosphere effectively removed therefrom, the means for supplying the film of water to the evaporating surfaces comprising a water pan removably supported in the casing and surrounding portions of the humidifying device.

4. In an apparatus for humidifying and cleaning air, the combination with a casing provided with air inlet and discharge openings, a rotary humidifying device within the casing provided with spaced evaporating surfaces of large area located in the path of the air, a water pan within said casing in the path of the air, said humidifying device adapted to be partially submerged in said pan, a rotary propelling member operated by the movement of air through said casing and operatively connected with said humidifying device and means for inducing a movement of air through said casing, said air passing around the water pan and controlling the temperature thereof.

5. In an apparatus for humidifying and cleaning air, the combination of a casing with air inlet and discharge openings, a water pan removably mounted in the casing, brackets carried by said pan, a shaft removably mounted in said brackets, a humidifying device carried by and rotatable with said shaft and provided with spaced evaporating surfaces of large area, said surfaces being adapted to be partially submerged within the water in said pan and a rotary propelling member connected with the shaft for operating the humidifying device together with means for inducing a current of air through said casing against said surfaces, and means for supplying water to and maintaining it at a predetermined level in said pan.

6. In an apparatus for humidifying air, the combination of a casing provided with air inlet and discharge openings, a rotary humidifying device within the casing provided with spaced cylindrical surfaces of large area, means for supplying water in a thin film to said evaporating surfaces, a rotary propelling device operatively connected with said humidifying device and provided with blades arranged in a path outside of the circumference of the outermost cylinder, and means for inducing a current of air through said casing together with means for diverting a portion of the air around the humidifying device and into engagement with the blades of the propelling member.

7. In an apparatus for humidifying and cleaning air, the combination of the casing provided with air inlet and discharge openings, a rotary humidifying device within said casing provided with spaced evaporating surfaces of large area, means for supplying water at all times in a thin film to said evaporating surfaces, a rotary propelling member operatively connected with the humidifying device and provided with a circular series of blades concentric with the axis of the humidifying device, but located at a greater distance from the axis than the evaporating surfaces of the humidifying device and means for inducing a current of air through said casing.

8. In an apparatus for humidifying and cleaning air, the combination of a casing with air inlet and discharge apertures, a rotary humidifying device within the casing provided with spaced evaporating surfaces of large area, located in the path of the air, means for supplying water at all times in a thin film to said evaporating surfaces, a rotary propelling member operatively connected with the humidifying device and provided with blades located out of the path of the air currents passing over said evaporating surfaces of the humidifying device, means for diverting a portion of the air passing through the casing around the humidifying device and into contact with the blades of the propelling member to effect the operation thereof, means for inducing a current of air through the casing, to effect the rotation of said propelling member and the humidifying device, and dampers arranged within the casing for regulating the amount of air so diverted for operating the rotary propelling member.

9. In an apparatus for humidifying and cleaning air, the combination of a casing provided with air inlet and discharge apertures, a water pan within the casing, a rotary humidifying device comprising a plurality of concentric cylinders adapted to be partially submerged within the water in said pan, means for supplying water to the pan and maintaining it at a predetermined level therein, a rotary propel ing device operated by the movement of air through the casing, operatively connected with said humidifying device, certain of the cylinders of said humidifying device being provided with spirally arranged projections for conveying dirt deposited in the water, lengthwise of the water pan, and means for inducing a current of air through said casing.

10. In an apparatus for humidifying and cleaning air, the combination of a casing provided with air inlet and discharge apertures, a rotary humidifying device within the casing provided with spaced evaporating surfaces, said humidifying device being rotatably and detachably supported within the casing, a water pan detachably supported below the humidifying device in such position that the evaporating surfaces of the latter are partially submerged when the device is in operation, means for supplying water to said pan and for maintaining it at a predetermined level therein, a rotary propeling member operatively connected with the humidifying device and operated by the passage of air through the casing, said casing having removable portions whereby said pan and humidifying device may be removed from the casing for cleaning.

11. In an apparatus for humidifying and cleaning air, the combination of a casing provided with air inlet and discharge apertures, a water pan detachably supported within said casing, a rotary humidifying device detachably mounted in the casing and provided with spaced evaporating surfaces of large area in the path of the air passing through said casing, said evaporating surfaces extending within the water pan, a removable reservoir above the humidifying device provided with a discharge pipe extending into the water pan and terminating at the water level to be maintained therein, whereby said parts may be removed from the casing for cleaning and for refilling the water reservoir, and a rotary propelling member operated by the movement of air through the casing, operatively connected with the rotary humidifying device.

12. In an air humidifying and cleaning apparatus, the combination of a casing provided with air inlet and discharge apertures, a water pan within the casing, means for supplying water to the water pan and maintaining it at a predetermined level therein, a rotary humidifying device provided with spaced evaporating surfaces of large area, a supporting shaft for said humidifying device detachably and rotatably mounted within said casing in such position that the evaporating surfaces of the humidifying device will be partially submerged in the water in said pan, a rotary propelling member mounted on said shaft for driving the same, said casing having removable portions to permit the removal of the humidifying device and propelling member for cleaning.

13. In an air humidifying and cleaning apparatus, the combination of a casing provided with air inlet and discharge apertures, a water pan within the casing, means for supplying water to the water pan and maintaining it at a predetermined level therein, a rotary humidifying device provided with spaced evaporating surfaces of large area, a supporting shaft for said humidifying device detachably and rotatably mounted within the casing in such position that the evaporating surfaces of the humidifying device will be partially submerged in the water in said pan, a rotary propelling member mounted on said shaft for driving the same, said casing having removable portions to permit the removal of the humidifying device and propelling member for cleaning, and means for draining the water pan without removing it.

14. In an air humidifying and cleaning apparatus, the combination of a casing provided with air inlet and discharge apertures, a water pan within the casing, means for supplying water to the water pan and maintaining it at a predetermined level therein, a rotary humidifying device provided with spaced evaporating surfaces of large area, a supporting shaft for said humidifying device detachably and rotatably mounted within the casing in such position that the evaporating surfaces of the humidifying device will be partially submerged in the water in said pan, a rotary propelling member mounted on said shaft for driving the same, said casing having removable portions to permit the removal of the humidifying device and propelling member for cleaning, said water pan being provided with means for circulating therethrough a heating medium for the purpose of heating the water in the pan and facilitating the evaporation thereof from the said evaporating surfaces.

15. In an apparatus for humidifying and cleaning air, the combination with a casing provided with air inlet and discharge apertures, a water pan detachably supported within the casing, a rotary humidifying device detachably mounted within the casing and provided with spaced surfaces of large area extending within the water pan and below the water level therein, a water reservoir for the water pan having a vacuum discharge system, including a discharge pipe

extending into the water pan and terminating at the water level to be maintained therein, said water receptacle having a filling aperture whereby it may be filled in situ, and means for sealing said water aperture.

16. In an apparatus for humidifying and cleaning air, the combination with a casing provided with air inlet and discharge apertures, a water pan detachably supported within the casing, a rotary humidifying device detachably mounted within the casing and provided with spaced evaporating surfaces of large area, extending within the water pan and below the water level therein, a water reservoir for the water pan having a vacuum discharge system, including a discharge pipe extending into the water pan and terminating at the water level to be maintained therein, said water receptacle having a filling aperture whereby it may be filled in situ, a closure for the filling aperture, a mercury seal for said closure, a valve seat in the discharge pipe, a controlling valve above said seat adapted to close by gravity, a valve stem connected to said valve, a valve operating rod extending through the filling aperture into position to be engaged by the closure thereof when in operative position, and connections between said rod and said valve stem for holding the valve in open position when said closure is in operative position.

17. In an air humidifying apparatus, the combination of a casing provided with air inlet and discharge openings, a rotatable humidifying element within the casing, a propelling device therefor, means for supplying a film of water to the evaporating surfaces of said humidifying device, and means for heating and passing a current of air through said casing and imparting motion to said propelling device, said heated air constituting the sole means for operating said propelling device, the speed of operation of the humidifying element being automatically regulated and directly proportional to the quantity of heat delivered to the air.

18. In an air humidifying apparatus, the combination of a casing provided with air inlet and discharge openings, a rotary cylinder mounted within the casing and provided with an evaporating surface of large area, a propelling device for said humidifying element, means for heating air and thereby causing convection currents which pass through the casing and impinge upon the evaporating surfaces and propelling means, said currents of air forming the only means for effecting the rotation of the propelling device and thereby the humidifying element, and means for supplying a film of water to the evaporating surface, the speed of rotation of said humidifying element and the amount of humidification being directly proportional to the amount of heat delivered to the air.

In testimony whereof I affix my signature.

JOHN ESTEN BOLLING.