

Jan. 30, 1945.

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2,368,115

HUMIDIFYING APPARATUS

Filed March 12, 1942

3 Sheets-Sheet 1

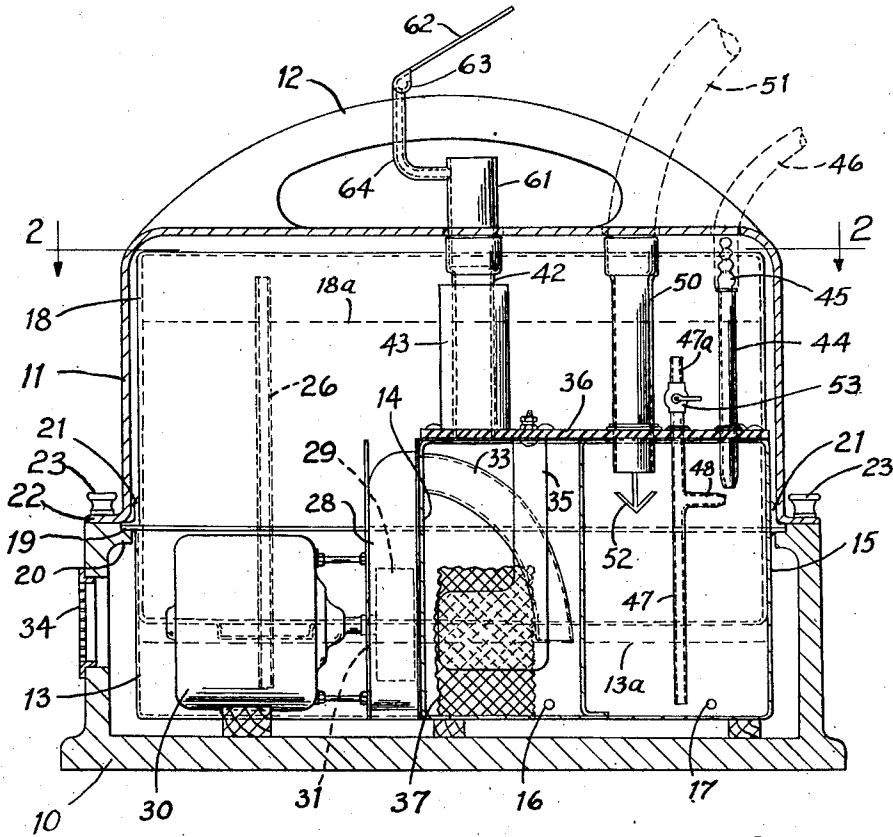


Fig. 1

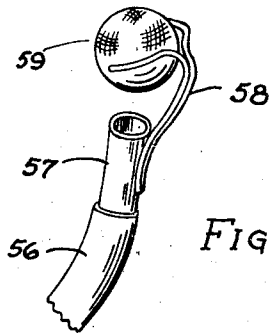


FIG. 6

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3 Sheets-Sheet 2

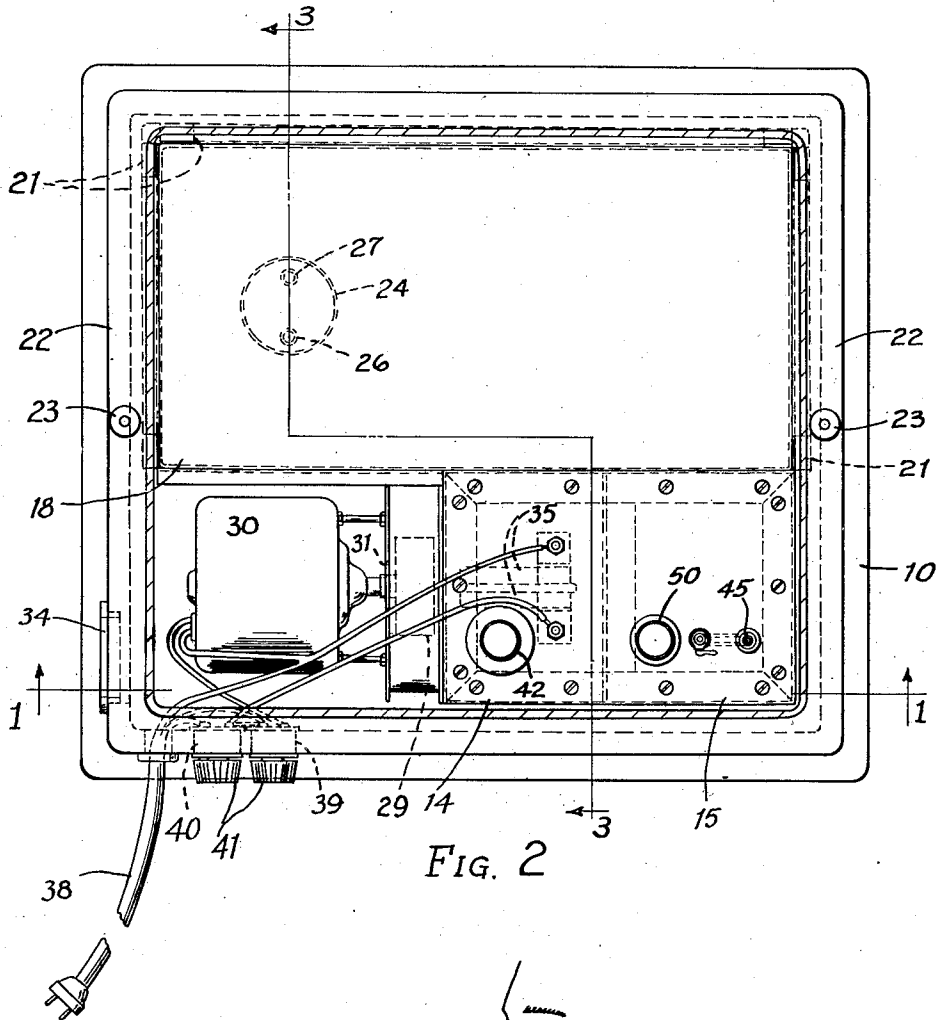


FIG. 2

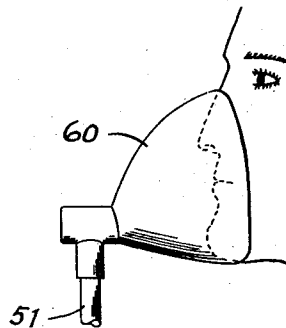


FIG. 5.

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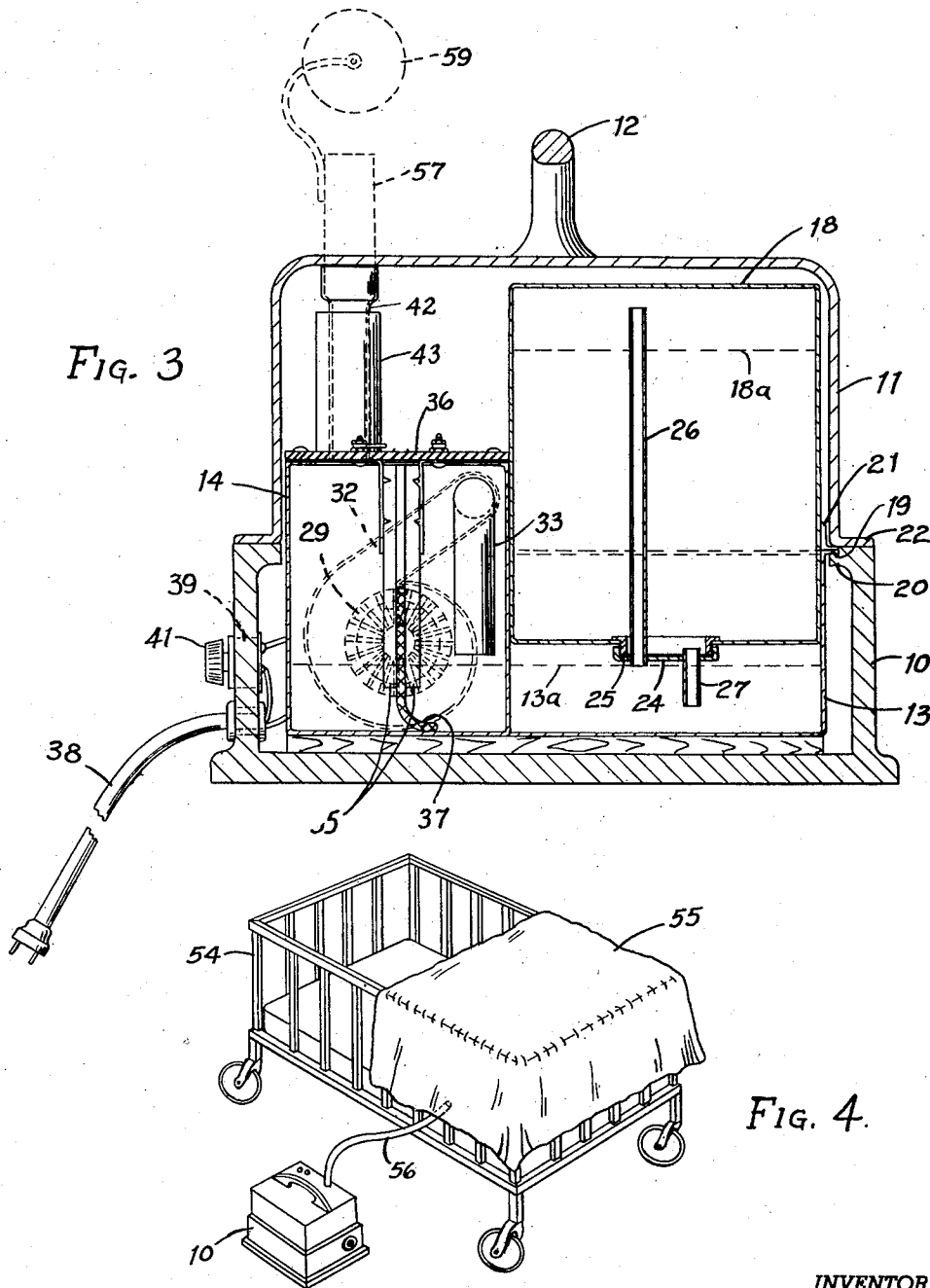
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3 Sheets-Sheet 3



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HUMIDIFYING APPARATUS

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11 Claims. (Cl. 219-40)

This invention relates to humidifying apparatus and is particularly concerned with devices for circulating and humidifying air or other gases.

A primary object of the invention is the provision of a unit which will produce instantly a flow of air having a high degree of humidification and at the same time, having a moderately elevated temperature. With apparatus according to the present invention the humidified air may be circulated in a room to cause general humidification of the air. Alternatively the apparatus may be used to direct the highly humidified and warmed air into an enclosed space for special purposes such as for breathing by patients having certain types of respiratory ailments including, for example, croup or asthma. The quality of the air and vapor mixture which may be produced by the apparatus of the present invention is well suited for this purpose.

The apparatus of the present invention is also suitably adapted for the vaporization of other liquids besides water. Aerosols, such as glycerine and propylene glycol, may be vaporized and mixed with air in the apparatus. Aerosols vaporize only at comparatively high temperatures, propylene glycol requiring approximately 370° F. Also aerosols are non-conductors so that they must be mixed with an electrolyte for vaporization. It is an object, therefore, of the present invention to provide apparatus which will vaporize aerosols (when suitably mixed with an electrolyte) and distribute the vapor throughout the air. This is especially beneficial for use in operating or sick rooms where the vaporized aerosol effectively sterilizes the air due to its bactericidal action.

It is an object of this invention to provide apparatus which will cause a continuous vaporization of water at a rapid rate by means of a special heating unit and to combine with this a means for mixing air with the vapor in a fashion which will cause acceleration in the vaporization process.

Another object of the invention is the provision of means by which the quality and quantity of the humidified air may be accurately controlled.

When using apparatus according to the present invention for the relief of respiratory disorders as mentioned previously, it is sometimes also desirable to introduce some sort of medication into the air. It is a purpose of the present invention to provide apparatus which may be so used to provide a suitably medicated humidified air mixture. This same apparatus may also be

used for other purposes, such as for example, adding a slight perfumed or incense odor to the air of a room.

It will be obvious from the foregoing discussion of objects that many features of the present invention are adaptable to apparatus for use in commercial air-conditioning. It will also be evident that the features of the present invention are especially valuable in special-purpose apparatus, such as a unit which will develop a vapor mixture suitable for use by doctors, hospitals and the like, for the treatment of patients. It is an object, therefore, to provide a unit of this nature which is compact in form and also contains apparatus for humidifying other gases besides air, such as oxygen. In the administration of oxygen in high concentrations for breathing purposes, the effect of the gas is often such as to cause drying out of the membranes. This effect may create considerable discomfort. By mixing water vapor with the oxygen the harsh effects on the tissues are greatly alleviated. By means of the apparatus of the present invention oxygen or other gases may be suitably humidified in a comparatively simple fashion.

It is an object of the invention to provide a construction for the apparatus described above for humidifying oxygen or other gases so that the same apparatus may be utilized in vaporizing certain other materials such as suitably prepared sulphonamides. Air having a mixture of vapor of this nature is beneficial for medical purposes and is used for breathing by patients afflicted with various respiratory infections including colds, pneumonia, bronchitis, etc.

A specific object of the invention is the provision of an electrode and wick combination for causing rapid vaporization of a liquid. This electrode and wick device also provides a safety feature which automatically breaks the electric circuit when the liquid supply is exhausted so that undue heating of the equipment in the absence of water is avoided.

Another specific object of the invention is the provision of a suitable air-circulating device with means for directing the air over the vaporizing unit in such a fashion as to cause an increased rate of vaporization. When the circuit to the electrodes is completed the liquid is heated locally and vaporization takes place. Upon directing the stream of air over the electrode unit greatly accelerated vaporization occurs. This apparently is due to the carrying off of the vapor formed around the wick and electrode so that formation

of the vapor at the electrodes may occur more rapidly.

Another specific object of the invention is to provide simplified atomization apparatus which may operate with a minimum of clogging action.

How the foregoing and other objects and advantages of the invention are accomplished will be clear from the description of the drawings in which

Figure 1 is a side elevation shown partly in section through a unit according to the present invention, the view being taken along the line 1—1, Figure 2.

Figure 2 is a plan view of the apparatus shown in Figure 1 and taken along the line 2—2, Figure 1.

Figure 3 is a section through a portion of the apparatus taken upon the line 3—3 of Figure 2.

Figure 4 is a view illustrating a specific use for the apparatus of the present invention.

Figure 5 is another view showing a further use which the apparatus may serve.

Figure 6 illustrates an accessory attachment by means of which medicament or the like may be added to the humidified air.

Referring to Figures 1 to 3 it will be seen that the humidifying apparatus used to illustrate the present invention is enclosed in a box or cabinet having a lower part 10 and an upper cover part 11 to which is attached a handle 12. Within the lower part of the cabinet 10 there is positioned a rectangular pan or tank 13 having an open top. Attached to pan 13 at one of its sides are two chambers 14 and 15. These chambers are in sealed association with the tank 13. Holes as indicated at 16 and 17 are provided in the walls of the chambers 14 and 15 near the bottom of the chambers to permit the flow of liquid between the open tank 13 and the chambers 14 and 15 thereby providing means whereby the liquid level in the chambers will be maintained at the liquid level 13a in the tank 13.

In order to assure a supply of liquid sufficient to last for a considerable period of operation, there is provided a closed reservoir or tank 18 having a cross sectional shape similar to that of tank 13 but slightly smaller to permit reservoir 18 to have its lower portion project inside the tank 13. A flange 19 is provided on the tank 13 to rest upon the ledge 20 of the base cabinet 10 and support it in its proper relative position. Brackets 21 are provided on the reservoir 18 to also support it at its proper position with respect to the tank 13. A flange 22 is shown on the upper cabinet unit 11, which flange is adapted to contact the brackets 21 and securely retain all the parts in proper relative position in the cabinet. Thumb screws 23 are used to permit quick attachment of the upper cabinet part 11.

By means of this cabinet construction the parts of the humidifying unit are given adequate protection, while at the same time ready access for adjustment or refilling of the reservoir is provided. To fill the reservoir the thumb screws 23 are removed and the cabinet part 11 lifted off. The reservoir 18 may then be lifted out and the screw cap 24 removed to permit filling the reservoir. After filling the reservoir the screw cap is replaced, there being a gasket 25 to provide a positive seal between the reservoir and the cap. In the cap 24 there is supported a tube 26 which projects only a very small distance outside the cap but which has a length inside the cap sufficient to reach close to the top of the reservoir. Another short tube 27 is also mounted in the cap

24 which tube projects a short distance inside and outside the cap as illustrated. With this arrangement the reservoir maintains a constant level in the tank 13 as long as there is water remaining in the reservoir 18. When the water level in the tank 13 falls below the outlet of the tube 26 air is admitted to the reservoir 18 through the tube 26. Consequently liquid flows out of the reservoir through the tube 27 until the water level in tank 13 again closes the opening of tube 26 when flow ceases. With this arrangement the water flows smoothly from the reservoir to the tank without the gurgling noise and sudden release of a considerable amount of water which occurs when only a single opening is used in a feed of this nature. The water levels are indicated at 13a and 18a.

In order to provide a supply of humidified air there is shown a small blower unit indicated at 28 and having a blower 29 driven by the electric motor 30. The blower 29 is of the centrifugal type having an inlet at 31 near the center of the blower 29. The air is conducted through the channel 32 and enters the chamber 14 through a pipe 33 which leads from the upper portion of the chamber 14 to a point close to the water level where the air is discharged into the chamber. A screened opening 34 is provided in the cabinet 10 to permit air to be drawn from outside the cabinet by the blower.

To provide accelerated evaporation of the water in the chamber 14 a pair of specially shaped electrodes 35 are mounted in the chamber. The electrodes are fastened by means of suitable clips or fittings to the cover 36 which closes in the top side of the chambers 14 and 15. The electrodes 35 are preferably made of carbon and are provided with enlarged flattened surfaces, part of which may project below the water level in the chamber 14. A porous wick member 37 is supplied to fit between the carbon electrodes 35 and project down to the bottom of the chamber 14. This wick member 37 has a large area in contact with the electrodes 35.

Electric current to supply the motor and electrodes is brought into the unit by the cord 38. Two switches 39 and 40 are provided to control the current to the motor and the electrodes respectively. These switches are of the rheostat type by means of which a variable control for the current is provided by turning the knobs 41. In this way the speed of the blower may be altered to allow the quantity of air delivered to be varied. Also by controlling the current to the electrodes the rate of vaporization of water may also be varied.

The wick 37 rapidly picks up water from the bottom part of the chamber 14 and provides a large area of concentrated moisture between the two electrodes 35. This moisture causes completion of the electrical circuit and the water between the electrodes is heated with consequent rapid vaporization from the upper portion of the wick. The passage of the air over the heated wick and the region where vaporization is occurring most rapidly carries away the water vapor quickly and causes a further increase in the rate of vaporization. The air thus receives a high concentration of humidity and then passes out of chamber 14 through the tube 42 where it may be emitted to the open air or carried off in a tube depending upon the purpose for which the unit is being operated. Insulation 43 is provided around the tube 42 to prevent condensation while the air is passing therethrough.

The upper end of tube 42 is suitably shaped to receive a tubular member 61 through which the air and vapor mixture passes. An inclined plate 62 is supported in position above the outlet of tube 61. By means of plate 62 the mixture may be directed in any desired direction. Plate 62 also causes any condensed water globules which may be in the vapor to adhere to the plate. In this way a vapor of improved quality is produced. The plate 62 is shaped at the lower end to form a trough or gutter as indicated at 63. A small tube 64 is used as the support for plate 62, the lower end of tube 64 being connected to tube 61. By this construction the liquid that adheres to plate 62 is collected in trough 63 and carried back through tubular members 64 and 61 so that the liquid is returned to the chamber 14. It will be evident that the deflector plate unit is removable so that its use is optional.

The heating caused by the electrodes produces the water vapor at a considerably elevated temperature. The mixture of air and water vapor which is delivered through the tube 42 may be controlled to a temperature approximately 110-120° F. This temperature is ideal for medical uses since it is slightly higher than body temperature.

As mentioned above the moisture in the wick causes completion of the circuit between the electrodes. This arrangement provides an automatic safety device for the apparatus in the event that all the water is evaporated. Should this occur the heat causes drying out of the wick. The dry wick will not conduct the electrical current so that the circuit is broken and the carbon electrodes no longer generate heat. This, therefore, prevents damage to the parts in close proximity to the electrodes which might otherwise occur due to excessive heat in the absence of water. The blower may remain operating even after the circuit to the electrodes is broken, but causes only a circulation of air.

As mentioned in the objects, other liquids besides water may obviously be used to advantage in the circulating and vaporizing apparatus. One such specific use is the vaporization and distribution of aerosols. In order to cause vaporization of these substances they may be mixed with an electrolyte to complete the electric circuit between the electrodes. The apparatus is especially well suited for use with substances of this nature since the high resistance electrodes create the temperature rise required to satisfactorily vaporize aerosols. In some cases vaporization at temperatures as high as 370° F. and up are necessary. The circulating action produced by the blower causes rapid dispersion of the vaporized aerosols throughout the air of a room, so that the air is rapidly and effectively disinfected. The action of the aerosols is such that it tends to condense on the bacteria in the air. It is most effective when the air has a humidity of about 40 to 50%. If desired, therefore, two units might be used, one for producing suitable humidity of the air and the other for producing the vaporized aerosol.

In order to permit the use of the present apparatus for special purposes such as might be required by hospitals, doctors or first aid stations, a second chamber with a special humidifying device is provided. This second chamber is illustrated at 15 and contains an inlet pipe 44 having a corrugated terminal 45 suitable for the connection of a rubber hose such as is indicated by dotted outline at 46. The hose 46 is attached

to the source of supply of the particular gas to be humidified. The most common gas used with this device is oxygen in which case the hose 46 is connected to an oxygen tank or oxygen generator. The oxygen to be humidified is brought into the chamber 15 through the pipe 44 with considerable velocity. The atomizing device consists of a tube 47 which extends nearly to the bottom of the chamber 15 and a horizontal branch tube 48 which is located with its open end close to the end of pipe 44 in position so that the incoming gas will cause liquid to be drawn up through the tube 47 and mixed with the gas supply after the fashion of an atomizer. The atomizer preferably is directed downwardly so that any globules of liquid remaining will be forced into the surface of the liquid in chamber 15 and thus be separated from the mixture.

A large diameter pipe 50 leads from the upper portion of the chamber 15 to an opening in the cover 11 through which a flexible pipe or hose 51 may be inserted to carry off the humidified oxygen or other gas. A deflector plate 52 may be mounted at the bottom end of the pipe 50 to further assure that no liquid droplets are carried out with the humidified gas. The humidified gas may be conducted to any point desired, such as an oxygen tent or an oxygen mask.

In humidifying apparatus for a gas such as oxygen difficulty is often encountered due to the rapid oxidation of certain materials which may come in contact with the humidified gas. Thus metals oxidize much more rapidly in the presence of oxygen and the oxide formed often creates trouble because of the clogging up of holes used in supplying the oxygen or water. In order to reduce trouble from this source to a minimum the present invention utilizes a material for the construction of the humidifying device parts which is little affected by the moisture and oxygen, such as stainless steel or glass. Further, a simple means is provided for quickly clearing out any particles of oxidized material which may become lodged in the supply tubes 47 or 48 through which the liquid for mixing with the incoming oxygen passes. A valve 53 is provided at the upper end of tube 47 outside the chamber 15. During normal operation the valve 53 remains closed as shown. In order to blow out the tubes 47 and 48, the lid 11 of the cabinet is removed and the oxygen tube 46 is attached to the upper end 47a of the pipe 47. The valve 53 is then opened to permit oxygen under pressure to pass through the tubes 47 and 48 and force out any accumulated oxide deposits.

The atomizer apparatus just described is also well adapted for mixing the vapors of other liquids besides water with various gases. For example a valuable use for this apparatus is the vaporizing of a sulphonamide which may be placed in the chamber 15 in liquid or semi-liquid form. Air is then forced through the atomizer. This mixture of air and sulphonamide vapor is beneficial when used for breathing purposes in the treatment of colds, sinus disorders, pneumonia and other respiratory infections.

Some of the special purposes for which the humidifying devices of the present invention may be used together with the supplemental apparatus for assisting in such uses are illustrated in Figures 4, 5 and 6.

Figure 4 illustrates the manner in which the device may be used for supplying air having a very high humidity to a croup tent. This same arrangement may be used also as an oxygen tent.

As illustrated, where the patient is a child, a child's crib 54 is used and a blanket 55 covers a portion of the crib in order to isolate the air which the patient must breathe, from the air of the room. The tube 56 connects to the humidifying unit illustrated at 10. In this fashion the air supplied to the patient may be given a very high moisture content at a suitable temperature.

If desired, a medicament can be added to the air delivered to the croup tent. This is done by the use of such a device as illustrated in Figure 6. A pipe 57 is provided which fits into the tube 56 to form a sort of nozzle. Attached to the pipe 57 is a light frame member 58 on which is supported a ball 59 made of porous material such as, for example, copper or steel wool. By dipping the ball 59 into the medicament it retains a considerable amount and provides a means by which this medicament may be picked up by the humidified air as it passes over the ball 59.

The apparatus illustrated in Figure 6 may also be used to distribute a perfume or incense odor to the air of a room. This use is illustrated in Figure 3 by the dotted outline where it will be seen that the pipe 57 may be set in place directly above the outlet opening from the chamber 14. In this case the ball 59 is saturated with a solution of the perfume to be distributed, which perfume is mixed with the circulating air and distributed throughout the air of the room.

Figure 5 shows a mask device by means of which the humidified oxygen may be administered for breathing purposes. The humidified gas is conveyed from the chamber 15 through the tube 51 to the mask device 60. This device fits over the patient's face in a fashion to cover the mouth and nose. As previously mentioned oxygen having a high moisture content has been found to be less irritating to the membranes than dry oxygen.

The apparatus illustrated in Figure 5 may also be used as an inhaler for moist warm air which may be delivered from chamber 14. Used in this fashion the apparatus has been found to aid in the relief of certain respiratory ailments. A mask, as illustrated in Figure 5, is also suitable for use in breathing air having vaporized sulphanilamide as described previously.

It will be obvious that the vaporizing and circulating unit and the atomizer or direct vaporizer portion of the unit may be separated to make two separate pieces of apparatus if desired. As illustrated in the drawings, however, the two devices form a compact piece of equipment which is particularly desirable for certain purposes as previously discussed.

From the foregoing it will be seen that I have invented improved apparatus for humidifying air or other gases. Of particular importance is the provision of apparatus which produces a circulation of warmed air to which has been added a vaporized liquid. With my device no delay is experienced as the vaporizing and warming process begins immediately the circuits to the electrodes and the blower motor are completed. The atomizing apparatus for special vaporization or humidification purposes, such as for use with oxygen gas, and the vaporization of sulphonamides, also provides a simple and reliable mechanism that is of particular value. The particular arrangement of the parts of the unit illustrated is also of importance since it provides a compact and versatile unit which is complete with its own water supply.

I claim:

1. For a vaporizing device, a receptacle adapt-

ed to contain liquid in the lower part, a pair of flattened electrodes, a flattened wick element adapted to lie between said electrodes and project into the portion of said receptacle where liquid is stored, a blower unit adapted to force an air stream into said receptacle around said electrodes, and an outlet from said receptacle.

2. For a humidifier unit, a mixing chamber having its lower portion adapted to hold a supply of liquid, a pair of carbon electrodes mounted in said chamber, a wick element positioned to contact said electrodes and also project into the lower portion of said chamber, an air circulating device arranged to force air into said chamber, and an outlet from said chamber.

3. Humidifying apparatus including a closed reservoir for retaining a supply of liquid, a chamber, means for supplying liquid from said reservoir to said chamber, means for governing the level of the liquid in said chamber, an electrode and wick unit in said chamber, a blower device adapted to circulate air directly through said chamber.

4. Humidifying apparatus including a closed reservoir for retaining a supply of liquid, a chamber, means for supplying liquid from said reservoir to said chamber, means for governing the level of the liquid in said chamber, a pair of carbon electrodes having a wick element therebetween, said element being positioned so that a portion extends below the normal liquid level, a blower-fan and ducting arranged to cause air to be forced through said chamber whereby the air is mixed with vapor and an opening to permit the humidified air to be passed to the outside of said apparatus.

5. A humidifier unit including a closed chamber, means for providing a controlled water level in said chamber, an electrode and wick device located in said chamber for causing rapid local vaporization, a fan for supplying air directly to said chamber and means for controlling the rate of vaporization.

6. A humidifier unit including a closed chamber, means for providing a controlled water level in said chamber, an electrode and wick device located in said chamber for causing rapid local vaporization, a fan for supplying air directly to said chamber and means for controlling the speed of said fan.

7. A vaporizer device having a mixing chamber, a pair of electrodes in said chamber, a wick element in contact with said electrodes, a blower and a duct adapted to circulate air directly through said mixing chamber, means to vary the speed of said blower and means to vary the electrical current to said electrodes.

8. A vaporizer device having an enclosed mixing chamber, means for supplying liquid to said chamber, an electrode and wick unit mounted in said chamber, means to supply air to said chamber including a blower and a pipe, said pipe being mounted inside said chamber with the outlet positioned to direct the airflow past said wick and electrode unit.

9. A humidifying unit incorporating a primary evaporating and mixing chamber having provision for a supply of liquid in the lower portion thereof, a pair of closely spaced plate-like electrodes mounted in said chamber and adapted to vaporize the liquid adjacent the electrodes, said electrodes being operable for vaporizing purposes by virtue of liquid contact to complete the circuit, a blower-fan having a duct leading therefrom into the portion of said cham-

ber above the liquid supply whereby all the air circulated by said blower-fan is passed through said chamber and an outlet from said chamber whereby the air and vapor mixture is carried outside the humidifying unit.

10. For a humidifier unit, a mixing chamber having its lower portion adapted to hold a supply of liquid, a pair of plate-like electrodes mounted in close parallelism in said chamber in a position with a portion of the electrodes below normal liquid level, an air circulating device arranged to force air into said chamber, and an outlet from said chamber.

11. A humidifier unit having a chamber with

provision for liquid in the lower part thereof, a pair of parallel flat plate electrode members mounted in said chamber with their lower portion below normal liquid level whereby the liquid serves to complete the electric circuit, a blower-fan arranged to draw air from outside said chamber and force it directly through said chamber and around said electrodes at a pressure higher than the pressure of the outside air, and an outlet from said chamber to allow the air and liquid vapor mixture to escape to the outside.

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