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HAIR DRYING APPARATUS

2,478,393

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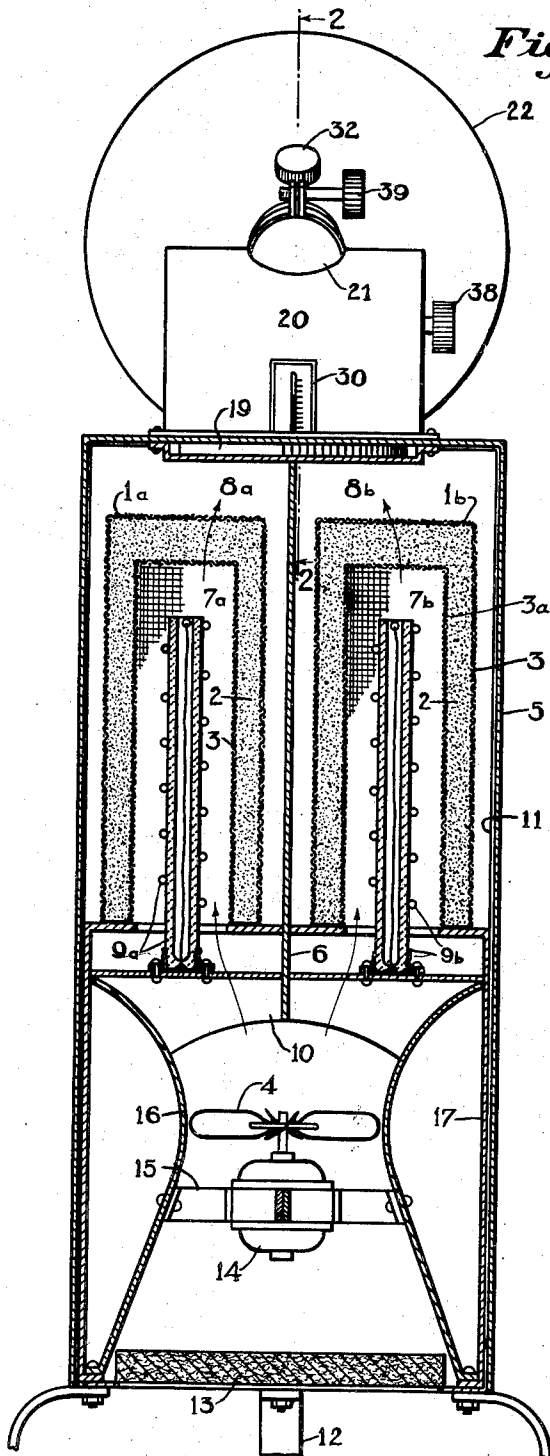
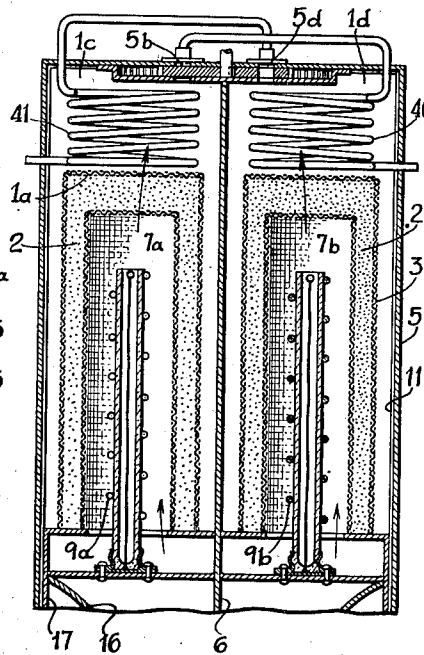


Fig. 7.



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2 Sheets-Sheet 2

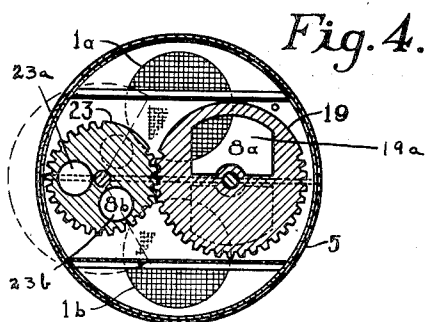
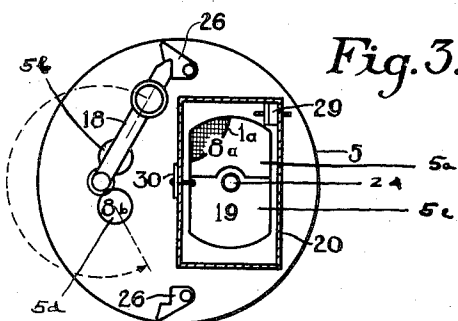
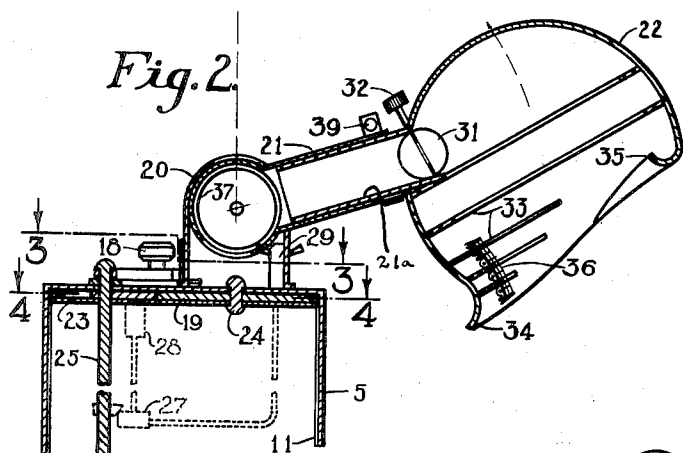
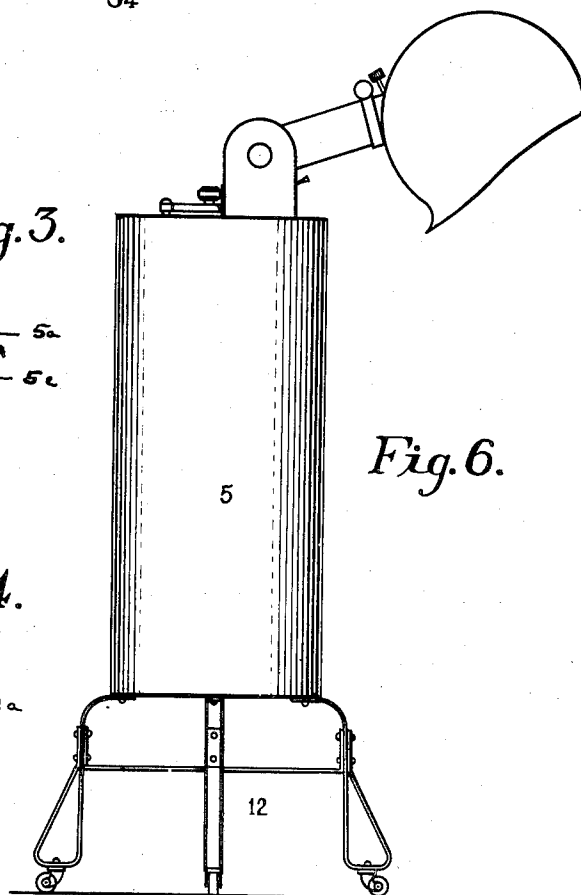
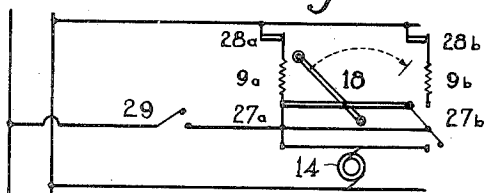


Fig. 5.



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HAIR DRYING APPARATUS

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6 Claims. (Cl. 34—80)

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This invention relates to apparatus for drying hair, and more particularly to apparatus for heating and dehydrating air which is to be directed upon hair to be dried.

Beauty shop operators are generally of the opinion that present methods for drying hair constitute at best a long and unpleasant operation. In the unit type of dryer in common use today, there normally is located within the hood and closely adjacent the head of the person whose hair is being dried, an electric heater, a motor and fan which attempt to dry the hair by intense agitation thereof and by the application of as much heat as the beauty shop patron is willing to undergo. The same air in present dryers is recirculated continuously within the hood and normally becomes nearly as saturated with moisture as the hair itself. This delays the hair drying process by an unnecessary amount.

Hair drying apparatus heretofore proposed have normally employed heating elements, usually electric, which allegedly dry the air simultaneously with the heating thereof. Certain types of moisture adsorbing material have been used in some types of hair dryers previously employed, but it is believed that the combination of heating elements and moisture adsorbing materials of said types previously employed have been ineffective to secure optimum results and have subjected the person undergoing such treatments to undue discomfort, and to procedures which were unduly lengthy.

According to the present invention, an apparatus for drying the hair is provided which will eliminate the above noted difficulties or reduce them to insignificance.

Various further and more specific objects, features and advantages of the invention are clearly apparent from the detailed description given below taken in connection with the accompanying drawings which form a part of this specification and illustrate, by way of example, preferred arrangements of apparatus for carrying out the invention. The invention consists in such novel combinations of features as may be shown and described in connection with the equipment herein disclosed.

In the drawings:

Fig. 1 is a rear elevation partly in section illustrating a hair drying apparatus embodying the present invention;

Fig. 2 is a side elevation of the upper portion

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of the device shown in Fig. 1 taken along line 2—2 of Fig. 1;

Fig. 3 is a section taken along line 3—3 of Fig. 2;

Fig. 4 is a section taken along line 4—4 of Fig. 2;

Fig. 5 is a diagram of the electric circuits employed in the apparatus;

Fig. 6 is a side elevation of the embodiment shown in Fig. 1; and

Fig. 7 is a schematic view of a second embodiment of the present invention.

The present invention is adapted for circulating around a person's hair dehydrated air which has been thoroughly cleaned and conditioned for the purpose of safe and rapid hair drying with complete comfort to the person during the drying operation. The novel apparatus does not employ extremely high temperatures to accomplish this result but achieves a rapid hair drying with complete comfort by a novel method of heating the air within intermediate temperature ranges, and by thoroughly dehumidifying the air.

Referring to the drawings in further detail, the novel hair drying apparatus is constituted by a hood member 22 and a blower or fan 4 which may be driven by an electric motor 14. The blower 4 is preferably disposed within the throat of a venturi 16. A suitable supporting bracket 15 may be provided for the motor 14, said bracket, for example, being attached to the Venturi member 16.

Interposed between the fan 4 and the hood 22 is a relatively stationary dehydrating device which is constituted by a pair of desiccant chambers 1c and 1d which, for example, may be semi-cylindrical in conformation and which may be formed within a housing or cabinet 5 of cylindrical shape as shown in Fig. 6. The desiccant chambers 1c and 1d may be separated by a vertical partition 6 (Fig. 1) thereby constituting said chambers in semi-cylindrical shape.

Air which is sucked into the apparatus by the fan 4 is forced to pass through a filter 13 (Fig. 1) at the inlet of the venturi 16 and thereafter the air is distributed to desiccant chambers 1c and 1d and is forced therethrough to the atmosphere or to the hood in a manner to appear hereinafter.

In the form shown in Fig. 1, novel means are provided for imparting a hair drying heat to the air which is directed to the hood through the intermediary of a moisture adsorbing agent which releases the heat of adsorption in moisture-laden air and which simultaneously dries the air. The

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air is directed through one desiccant chamber to the hood and through one or more other chambers to the atmosphere whereby the other desiccant units are rejuvenated or reactivated in a manner to appear more fully hereinafter. The novel heating and drying action is accomplished by interposing a sufficient quantity of moisture adsorbing agent such as silica gel in the air stream which is directed to the hood.

Silica gel is a prepared form of silicon dioxide having an extremely porous structure. It is made by mixing predetermined concentrations of an acid, such as sulphuric acid, and a soluble silicate like sodium silicate (water glass), and allowing the mixture, known as the hydrosol, to set to a jelly-like mass called hydrogel. The product takes its name from its condition as a colloid at this stage of its manufacture. After setting, the hydrogel is broken into small lumps and thoroughly washed to remove excess acid and the salts resulting from the reaction. The washed hydrogel is then dried, crushed and screened to the desired particle size and given a final activation.

Silica gel is a most inert, rugged material, its hardness being about Number 5 in Moh's mineralogical scale, or slightly softer than ordinary window glass. Due to these characteristics it is an extremely durable product and neither erodes nor dusts while in service or while being regenerated. The action of silica gel in adsorbing vapors is purely physical, and there is no change in the size or shape of the particles as it becomes saturated. Likewise, no corrosive or injurious compounds are given off as is usually the case when chemical absorption takes place. Even when saturated, the particles of silica gel feel and appear perfectly dry.

An idea of the area of the pore surface of silica gel may be obtained from the way it acts in the adsorption of vapors. It is known that every solid is capable of adsorbing gas or vapor on its surface to some degree, and that the weight adsorbed depends upon the nature and extent of the surface. Normal commercial silica gel will adsorb approximately 50% of its weight of water from saturated air, and from this it has been estimated that one cubic inch of silica gel contains pores having a surface of about 50,000 square feet. Silica gel with this enormous internal surface and infinite number of small diameter capillaries attracts vapors, condenses them, and holds them as liquids in the pores or capillaries, thus being an excellent example of the physical phenomena known as surface and capillary adsorption.

The weight of any compound adsorbed on silica gel depends upon its partial pressure in the original gas mixture, the temperature of the silica gel and of the gas mixture, the surface tension of the condensed liquid, its ability to wet the pore surfaces, the volume and shape of the pores. In practice, at temperatures normally experienced, silica gel has been found to adsorb large quantities of liquids having boiling points over 50° F. and to release them readily when the gel is heated to about 300° F. Included in this classification is water.

When water vapor is adsorbed on silica gel or a similar adsorbent, heat is liberated equivalent to the latent heat of evaporation of the adsorbed liquid plus an additional amount of heat, known as the heat of wetting. The sum of the latent heat plus the heat of wetting is known as the heat

of adsorption. During the phenomenon of adsorption it might be said that the latent heat of a vapor is transformed into sensible heat which is dissipated into the adsorbent, the metal of the adsorbent container, and the stripped air or gas mixture, resulting in a rise in temperature. In practice, the temperature rise in the dehydrated air caused by the adsorption heat is approximately 10° F. for each grain of moisture removed per cubic foot of air at atmospheric pressure.

The commercial product has the appearance of clear crushed quartz. For the purposes of this apparatus 3 to 16 mesh silica gel may be employed.

After use, silica gel containing water may be regenerated by subjecting it to an elevated temperature, which operation is known as activation or regeneration. The processes of adsorption and activation are completely reversible, so it is possible to use silica gel for an unlimited number of times without loss in efficiency or capacity. Activation may be accomplished by placing the silica gel in an oven for several hours or by blowing hot air through it until no more moisture is given off. A temperature of between 300° F. and 350° F. is recommended for economical operation; however, in some instances temperatures as low as 250° F. may be used.

Said silica gel is employed in the present apparatus in sufficient quantity to heat the air to a hair drying temperature. Each desiccant unit preferably comprises a hollow cylindrical outer screen container 3 having one end preferably open to the air stream and the other end closed. An analogous but smaller inner screen container 3a comprises the inner retaining surface and the silica gel is packed between 3 and 3a. The desiccant units are designated 1a and 1b on the left and right, respectively. The phenomenon of adsorption is so controlled in this apparatus as to provide novel results.

In continuing with the description of the drier it will be seen from the illustrations that the device is so arranged mechanically that the important physiological requirements of efficient drying are obtained with a high degree of simplicity.

An important feature of the apparatus is that during the drying cycle the dehydrating compound not only (1) removes moisture, but (2) adds warmth to the air which provides an exceptionally efficient and comforting hair drying effect. To create the necessary flow of air for operation of all the functions of the device only one blower unit is required to operate the system.

It will be noted in Fig. 1 that a plurality of these adsorbing cylinders are employed so that the cycle of operational use of the apparatus will be continuous, that is, while one cylinder is providing dry warm air for the purpose intended another cylinder will be undergoing reactivation for succeeding use.

In the form of the invention illustrated in Fig. 1, said two chambers 1c and 1d employed are substantially identical. Air which is directed upward by the blower fan 4 freely enters spaces 7a and 7b within cylinders 1a and 1b respectively and is forced through the adsorbent material 2 and into the spaces 8a and 8b respectively.

Heating elements 9a and 9b are preferably concentrically located within the cylinders and in the spaces 7a and 7b and are held in position by a supporting means 10. Elements 9a and 9b are connected to a suitable source of electric energy (not shown) as indicated in Fig. 5. Each

heating element is automatically operated only for the purpose of reactivation of the drying agent 2.

The cabinet 5 may be lined with a heat insulating material 11 such as asbestos so as to restrict heat losses from the system. The entire apparatus is attached to a base section 12 which provides support and portability.

Air to be processed first enters the system through said filter 13 where all traces of dust, lint and other foreign matter are removed.

An inner casing 17 is shown in Fig. 1 as a support for the apparatus within the cabinet 5, it being contemplated that this outer casing 5 may be readily removable.

In chamber 1c suitable hood and atmospheric orifices are designated by 5a and 5b respectively, and in chamber 1d by 5c and 5d respectively (Fig. 3).

Suitable conduit means, such as telescopically engaged conduits 21 and 21a are provided for placing said hood orifices in communication with the hood.

The conduits 21, 21a may be angularly shifted, preferably in a vertical plane, in a conventional hood elbow or socket portion 23. A bearing sleeve 37 may be provided for guiding angular movement of members 21, 21a in a vertical plane.

Suitable synchronously operated valves are provided for opening and closing said orifices 5a and 5c comprising a rotary valve 19 (Fig. 4) having a valve orifice 19a adapted for registering with either orifice 5a or 5c, thus opening the hood orifice in register therewith but closing the hood orifice not in register. Valve 19 is rotatably mounted upon a shaft or pivot 24. A second rotary valve 23 mounted upon and for rotation with a shaft 25 is adapted for opening and closing atmospheric orifices 5b and 5d. Valve 23 has orifices 23a and 23b formed therein (Fig. 4), so positioned that in one operating position the atmospheric orifice 5d is open and 5b is closed, and in the other operating position orifice 5d is closed and 5b is open.

The valves 19 and 23 are operatively associated by means of meshing gear teeth on their peripheries. Both are controlled by a handle 18 which is rigidly attached to shaft 25.

The association of valves 19 and 23 is such that at any given time when the atmospheric orifice of one chamber is closed the atmospheric orifice of the other chamber is open, and only one of the orifices (atmospheric and hood) is open at a time in any one chamber. Consequently, the hood orifice is closed in that cylinder having an open atmospheric orifice, and vice versa.

One cycle of operation of the equipment will be described and will be illustrated by the indicated position of manually operated control lever 18 located on the top of the cabinet 5. Due to the action of the fan 4 the air enters the cabinet and is cleaned of foreign matter by means of filter 13. The air which is forced through cylinder 1a is dried and warmed by the adsorbent 2 as it enters space 8a.

The dehumidified air passes through valve 19 and orifice 5a thence through hood elbow 23 and telescopic conduit 21, 21a to the hood 22. During this cycle of operation the adsorbent material 2 of cylinder 1b is being reactivated by the heating action of element 9b. The comparatively hot moist air rising into space 8b is exhausted into the atmosphere through valve 23 (orifice 23b) which is directly controlled by lever 18 and which in turn through gear teeth action synchronously

operates valve 19. As indicated by the drawings the flow of air is controlled by a form of rotary sleeve valve action.

Control lever 18 is held in either of two operating positions by a spring actuated locking device 26. In addition to controlling the flow of the conditioned air the control lever 18 also, through its rotation of shaft 25, controls the switches 27a and 27b (Fig. 5) which operate the blower motor 14 and selected activating heating element 9a or 9b. Thermostatic heater control elements 28a and 28b may be located near respective activation exhaust ports in the top of the cabinet 5 which are uncovered by valve 23 so as automatically to turn off the heating element when the hot moist air being exhausted reaches an elevated temperature, for example, between 225-250° F. indicating that the dehydrating material 2 has been completely reactivated and is ready to supply dry air to the hood 22 when the control 18 is manually moved to its alternate position, thus affording continuous use of the apparatus for its primary purpose. A switch 29 (Figs. 2 and 5) may be incorporated into the apparatus and operatively associated with hood 22 so that when the hood is moved downward into its operating position the apparatus will be energized. Features such as this are to insure economical operation of the system.

A direct reading thermometer 30 indicates the temperature of the dry warm air on its way to the drying hood 22. The actual control of temperature and humidity is achieved through balancing various characteristics of the system, including the following:

- (1) The pressure and volume capacity of the blower fan 4;
- (2) The quantity and characteristics of the dehydrating material 2;
- (3) The shape of the container 3 exposed to the air flow;
- (4) The size of the exhaust openings through the valves 19 and 23 which in turn proportion the air flow supplied to the cylinders 1a and 1b for the drying and reactivation cycles of the operation;
- (5) The heat output of the activation heaters 9a and 9b and their relation to the time duration of each cycle;
- (6) The number of hoods (if more than one) that will be supplied from one cabinet.

It is contemplated that a cycle be considered the time required for one drying operation (in the order of from 15 to 30 minutes) and that the control lever 18 be shifted to its alternate position just prior to each hair drying operation or cycle.

Empirical formulas are employed for determining the proper amount of silica gel to be employed. For example, the present hair drier may dry air at a rate of 100 C. F. M.

To illustrate the operating principle of this apparatus, the following conditions are assumed:

- | | | |
|---|-------------------|-----|
| (a) Volume of air to be dried | _____ C. F. M. | 100 |
| (b) Length of adsorption period | _____ hours | 1½ |
| (c) Dry bulb temperature of wet air | _____ °F. | 70 |
| (d) Dew point of wet air | _____ °F. | 59 |
| (e) Relative humidity of wet air | _____ per cent. | 70 |
| (f) Moisture content of wet air, grains | _____ per cu. ft. | 5.6 |
| (g) Dew point of dry air desired | _____ °F. | 7 |
| (h) Moisture content of dry air, grains | _____ per cu. ft. | 2 |
| (i) Moisture removal, grain per cu. ft. | _____ | 5.2 |

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The absorption of 5.2 grains of water vapor per cu. ft. results in a rise of about $10 \times 5.2 = 52^\circ$ F. in the temperature of the dehydrated air. (10° rise per grain of water absorbed per cu. ft.). The dried air will rise to 122° F.

The weight of water to be absorbed from 100 C. F. M. in $\frac{1}{2}$ hr. is:

$$\frac{5.2 \times 100 \times (60 \times \frac{1}{2})}{7000} = 2.23 \text{ pounds}$$

The weight of silica gel required to adsorb this weight of water is:

$$\frac{2.23}{.15} = 14.9 \text{ lbs.}$$

The volume of this weight of silica gel is about $\frac{1}{8}$ cu. ft. (.346). Assuming the area of the desiccant bed to be one square foot, the depth must be about 4 inches.

The apparatus as designed will carry no mechanical vibration or noise to the hood and thus will eliminate annoyance to the person undergoing treatment.

Features of the hood 22 are of themselves worthy of special note. It is not contemplated to use a circulating fan or heater within the hood itself or in close proximity to a person's head and scalp as is customary in the majority of driers now in use. Instead air entering hood 22 from conduit 21 under considerable pressure flow is deflected into a circulatory motion within the hood by the butterfly valve 31 which is arranged either to operate automatically or under manual control knob 32. Its purpose is to distribute the air as desired within the hood. Guide vanes 33 further control the pattern of the air circulation. A fresh supply of warm dry air is constantly being fed to the hood which after considerable circulation and after having removed its share of moisture from the hair is exhausted outward at the convex exit 34 at the rear of the hood. The front edge of the hood has a concave lip 35 which further directs effective circulation of the air. The vanes within the hood may be changed from time to time to the varying style of coiffures to effect any desired circulation of the air.

A head support 36 of a wire net or any suitable loose knit construction is mounted on the lower vanes within the rear of the hood and serves to add a comfort feature for the patron.

Complete versatility of movement of the hood 22 is provided. Rotation in the vertical plane may be guided by bearing sleeve 37 as above mentioned and may be locked in position by a clamp knob 38. The telescopic adjustments of conduit 21 may be maintained by the clamping knob and means 39.

A second embodiment of the invention is shown in Fig. 7 wherein the atmospheric outlets or orifices 5b and 5d are respectively connected to coils 40 and 41 in chambers 1d and 1c respectively.

It may be desirable to supplement the heat imparted to the dried air in the manner set forth above by employing the heat used to reactivate the desiccant. Means for accomplishing this are shown schematically in Fig. 7 wherein the atmospheric outlets or orifices 5b and 5d are respectively connected to coils 40 and 41 which are located within chambers 1d and 1c respectively, preferably intermediate the respective desiccant and hood orifice.

While the invention has been described with respect to preferred embodiments, it will be understood by those skilled in the art after under-

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standing the invention that various changes and modifications may be made without departing from the spirit and scope of the invention and it is intended therefore in the appended claims to cover all such changes and modifications.

What is claimed as new and is desired to be secured by Letters Patent is:

1. In apparatus of the class described, a drying hood, air blower means, a pair of desiccant chambers, a pair of desiccant units, each unit being mounted in respective of said chambers, a pair of heating elements, each element being associated with respective of said units, each of said chambers having hood and atmospheric outlets, valve means for closing a hood outlet in one selectable chamber and opening the hood outlet in the other chamber, valve means for simultaneously opening the atmospheric outlet in the selected chamber and closing the atmospheric outlet in the other chamber, means for actuating respective of said heating elements in response to opening of respective of said atmospheric outlets, a pair of atmospheric outlet heating conduits mounted in respective of said chambers, the conduit of a first chamber being connected to the atmospheric outlet of the other chamber, and the conduit of said other chamber being connected to the atmospheric outlet of the first chamber.

2. In a hair drier apparatus, the combination with a drying hood, of air blower means, a pair of desiccant chambers each containing silica gel in sufficient quantity to dry and heat moist air at room temperature passing therethrough to a hair drying temperature between about 100° to 140° F., said chambers each having a hood outlet and an atmospheric outlet and being fixedly positioned between said hood and said blower, a valve unit for said hood outlets comprising an angularly shiftable element including a cover member adapted for angular movement into covering relationship to one of said atmospheric outlets at a time, a valve structure for said atmospheric outlets including an angularly shiftable element for opening one of said atmospheric outlets at a time, mechanism for operatively connecting said angularly shiftable elements whereby the atmospheric outlet of each chamber is opened during the period that the hood outlet thereof is closed and the hood outlet is opened during the period the atmospheric outlet is closed, a pair of heating elements associated with corresponding of said desiccant chambers for reactivating moisture laden silica gel, and means for energizing respective of said heating elements in response to the opening of the atmospheric outlet in respective of said chambers.

3. In a hair drier apparatus, the combination with a drying hood, of air blower means, a pair of desiccant chambers each containing silica gel in sufficient quantity to dry and heat moist air passing therethrough to a hair drying temperature between about 100° to 140° F., said chambers each having a hood outlet and an atmospheric outlet and being fixedly positioned between said hood and said blower, a valve unit for said hood outlets comprising a plate element angularly shiftable about an axis perpendicular thereto and having a perforation therein adapted for movement into register with one of said hood outlets at a time, a valve structure for said atmospheric outlets comprising a second plate member mounted for angular movement also about an axis perpendicular thereto and in co-

operation with the first mentioned plate element, the plate element for the atmospheric outlets having a plurality of openings therein so arranged that when one atmospheric outlet is in register with one of said perforations the other atmospheric outlet is closed, mechanism for operatively connecting said angularly shiftable plate elements whereby angular movement of one produces a predetermined angular movement in the other and whereby movement of said hood outlet plate element to open a hood outlet in one chamber is accompanied by a movement of said atmospheric outlet plate element to close the atmospheric outlet in the same chamber, a pair of heating elements associated individually with respective of said chambers, and means for energizing respective of said heating elements in response to the opening of the atmospheric outlet in respective of said chambers.

4. In a hair drying apparatus, the combination with a drying hood, of air blower means, a pair of desiccant chambers each containing silica gel in sufficient quantity to dry and heat moist air passing therethrough to a hair drying temperature between about 100° to 140° F., said chambers each having a hood outlet and an atmospheric outlet and being fixedly positioned between said blower means and said hood, conduit means for interconnecting said hood outlets with said hood, a pair of heating elements operatively associated with the silica gel in respective of said chambers, a valve unit for said hood outlets comprising an angularly shiftable element including a cover member adapted for angular movement into covering relationship to one of said hood outlets at a time, a valve unit for said atmospheric outlets, including an angularly shiftable element for opening one of said atmospheric outlets at a time, mechanism for operatively connecting said angularly shiftable elements whereby the hood outlet in a selected chamber is opened simultaneously with the opening of the atmospheric outlet in the other chamber, means for energizing respective of said heating elements in response to the opening of the atmospheric outlet in respective of said chambers, and means for communicating heat from the energized of said heating elements to the hood connected chamber.

5. In a hair drier apparatus, the combination with a drying hood, of air blower means, a pair of desiccant chambers each containing silica gel in sufficient quantity to dry and heat moist air passing therethrough to a hair drying temperature between about 100° to 140° F., said chambers each having a hood outlet and an atmospheric outlet and being fixedly positioned between said hood and said blower, a valve unit for said hood outlets comprising a plate element angularly shiftable about an axis perpendicular thereto and having a perforation therein adapted for movement into register with one of said hood outlets at a time, a valve structure for said atmospheric out-

lets comprising a second plate member mounted for angular movement also about an axis perpendicular thereto and in cooperation with the first mentioned plate element, the plate element for the atmospheric outlets having a plurality of openings therein so arranged that when one atmospheric outlet is in register with one of said perforations the other atmospheric outlet is closed, mechanism for operatively connecting said angularly shiftable plate elements whereby angular movement of one produces a predetermined angular movement in the other and whereby movement of said hood outlet plate element to open a hood outlet in one chamber is accompanied by a movement of said atmospheric outlet plate element to close the atmospheric outlet in the same chamber, a pair of heating elements associated individually with respective of said chambers, means for energizing respective of said heating elements in response to the opening of the atmospheric outlet in respective of said chambers, and means for communicating heat from the energized of said heating elements to the hood connected chamber.

6. In a hair drying apparatus having passage means for directing air toward the head of a user, air blower means, a pair of desiccant chambers, a pair of desiccant units, each unit being mounted in respective of said chambers, a pair of heating elements, each element being associated with respective of said units, each of said chambers having hood and atmospheric outlets, valve means for closing a hood outlet in one selectable chamber and opening the hood outlet in the other chamber, valve means for simultaneously opening the atmospheric outlet in the selected chamber and closing the atmospheric outlet in the other chamber, means for actuating respective of said heating elements in response to opening of respective of said atmospheric outlets, a pair of atmospheric outlet heating conduits mounted in respective of said chambers, each of said conduits being in direct communication with the atmosphere at one extremity thereof, the conduit of a first chamber being connected to the atmospheric outlet of the other chamber, and the conduit of said other chamber being connected to the atmospheric outlet of the first chamber.

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