

Jan. 19, 1937.

R. V. HEUSER

2,067,920

DRYING APPARATUS

Filed Feb. 6, 1935

2 Sheets-Sheet 1

Fig. 1.

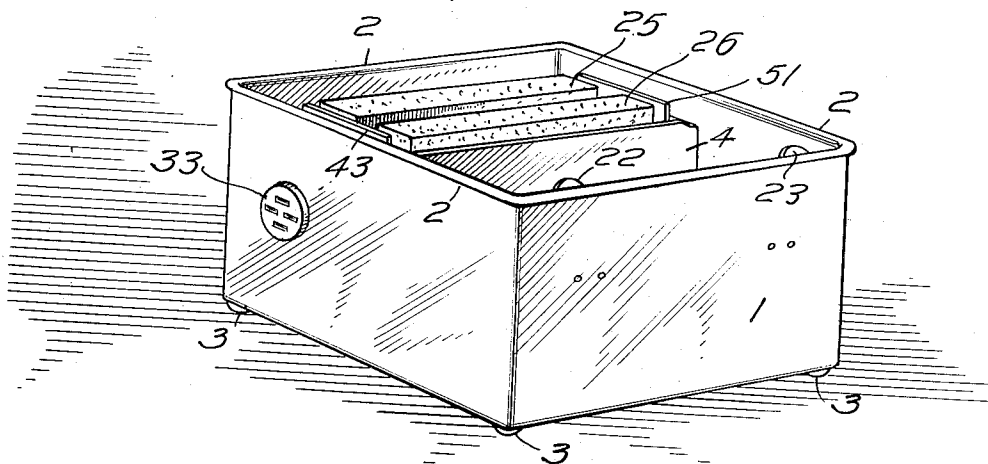
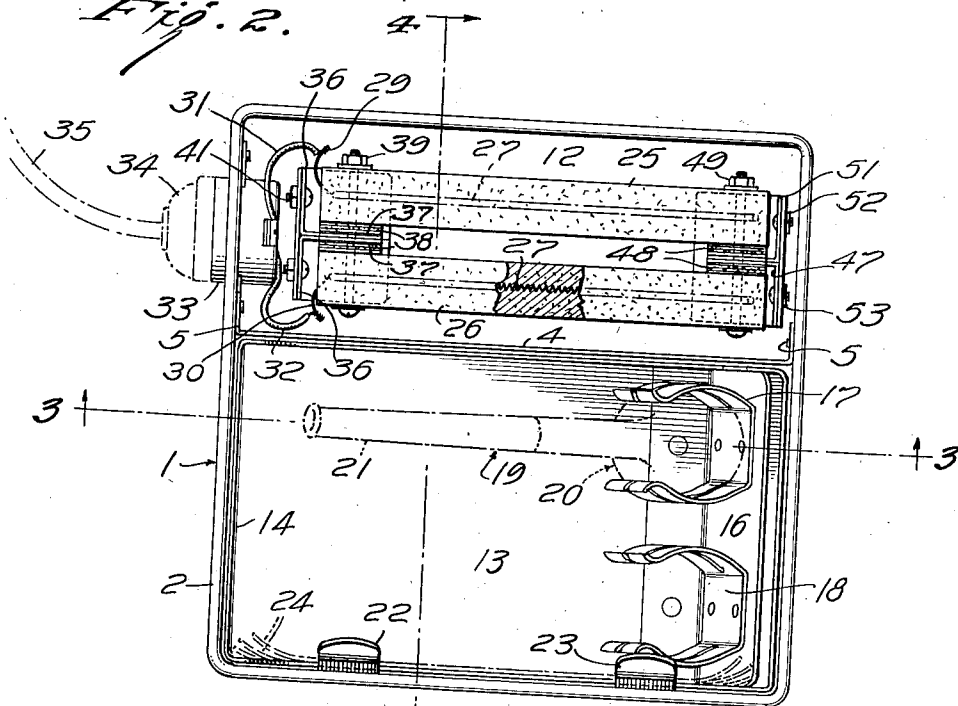


Fig. 2.



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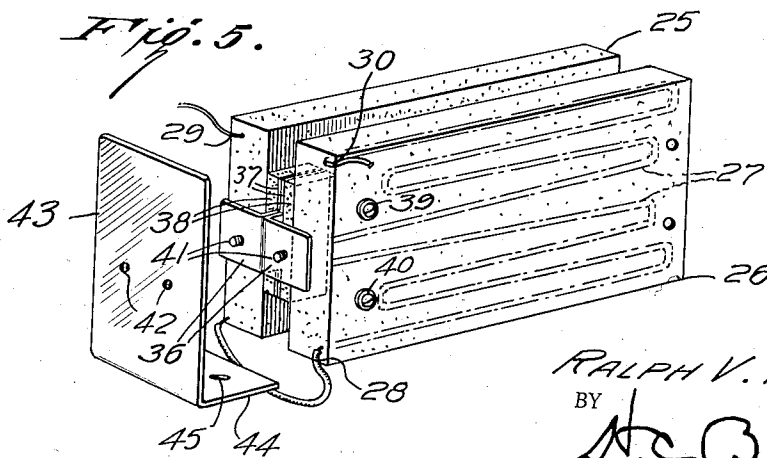
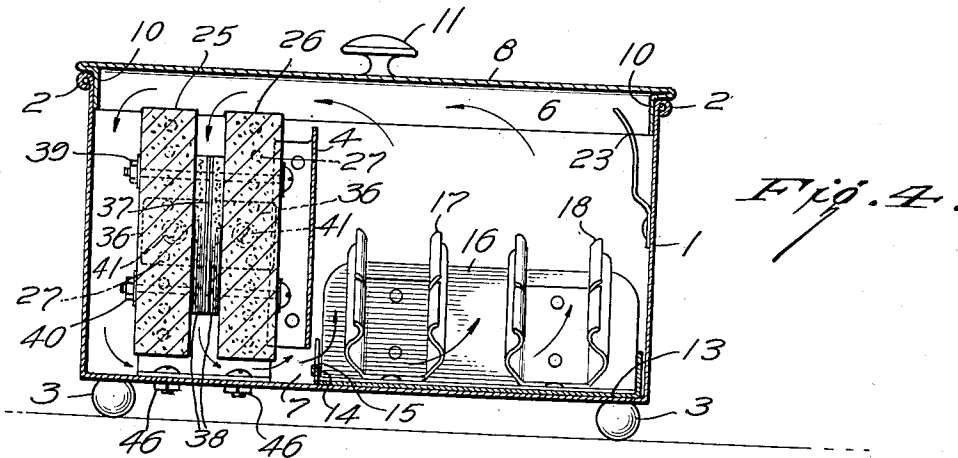
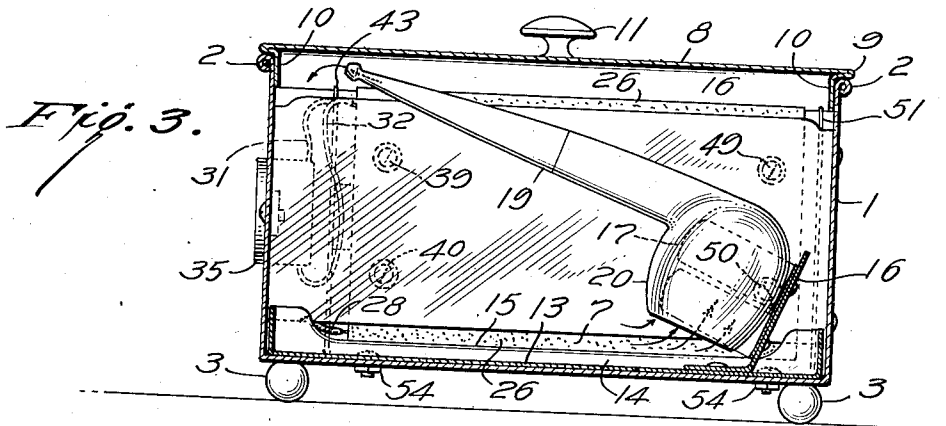
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2 Sheets-Sheet 2



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DRYING APPARATUS

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4 Claims. (Cl. 34—26)

This invention relates to drying devices, more particularly devices intended and adapted to operate at room temperatures. It also relates to a method of drying which is particularly adaptable to the operation of desiccators and other small scale drying devices. The method may be employed advantageously for drying smokers' pipes. This novel application embodies all of the main features of my invention and it may serve, therefore, as an illustration in explaining the working principle and vital elements of construction of the drying devices falling within the concept of my invention.

With pipe smokers the enjoyment of the smoke depends to a large extent on the availability of a clean and dry pipe. It is customary with many a smoker to use his pipes in rotation in order that they may dry in a rack or open receptacle in the course of a day or several days. The drying of pipes in a warm place or on a heated surface is impracticable because ill smelling decomposition products result in this manner and the smoke is bitter and disagreeable for some time afterward. During the warmer seasons when the relative humidity of the atmosphere out-of-doors as well as in-doors is comparatively high the drying of the pipes progresses, of course, more slowly and also less completely.

The present invention is designed to overcome the difficulties heretofore encountered, and to provide a method of and apparatus for drying which will be simple, effective and readily applied. My invention is especially advantageous in humid, muggy, summer weather and in tropical climates. It effectively absorbs not only moisture but also unsavory odors issuing from the pipe when not in use.

It is thus another object of the invention to provide a suitable receptacle or depository for the pipes not in use, whereby the air within the room in which the pipes are kept is prevented from becoming vitiated by the odors emanating from the pipes. The same receptacle may be used also for housing in an orderly manner the pipe cleaners, a pipe reamer, and other accessories, if desired.

In practicing my invention I provide a square or rectangular container standing on short feet. The interior is divided by a partition which extends short of both top and bottom of the container, into a drying chamber and an absorbent chamber. The former is provided with a removable tray which has clips to hold one or more pipes, which are preferably in an inverted position with the mouthpiece more elevated than the bowl,

and clips are provided to hold pipe cleaners. Alternatively the clips intended for holding the pipes may be attached directly to the wall of the drying chamber, which arrangement would facilitate the inserting and withdrawing of the pipes from the resilient clips or holders. This arrangement is feasible since any condensate or residue discharged from the inverted pipes would fall upon the removable tray underneath and consequently the container proper could always be maintained in a neat condition. In the second chamber are one or more plates of highly adsorbent material, preferably having resistance wires embedded therein and these are connected to a socket which is secured to one of the sides of the container. When the adsorbent material is nearly spent it is reactivated by electric heating. The plates are in a vertical position to facilitate the circulation of air.

When ready to use the apparatus, the pipe is cleaned and placed in an inverted position in the tray. The cover is put in place and a circulation of air sets in, which removes from the pipe moisture and empyreumatic odors and gases, such as SO_2 , NH_3 , H_2S , CO_2 , phenolic bodies, etc. The container may be made of wood, synthetic resins or other compositions, but more generally of metal, such as copper, brass, aluminum, chromium steel, German-silver, gunmetal, galvanized iron, etc. After the absorbent material has nearly lost its capacity for adsorbing moisture, the current is turned on for a short time, say twenty minutes, with the cover removed, thereby driving off the adsorbed substances and reactivating the adsorbent. The feet assist in maintaining the container in a comparatively cool condition during and after reactivating by allowing convection currents of air to be set up all around the device. If desired, the drying of the pipes may be hastened by disconnecting the bowl from the stem. For realizing this augmented drying effect special clips attached to the wall above the tray may be employed, the pipe stems being in a more or less vertical position.

An important feature of the design is that the plates are mounted edgewise, face to face, whereby dissipation of water is assisted by the wafting of air currents over the surface of the plates. Both plates have sufficient clearance from the bottom and the cover to provide good convection of the air currents both during the reactivation and during the adsorbing stage. For the same reason the partition plate does not reach to the bottom nor up to the cover. Its main function is to reflect the heat from the

plates and to cause cool air to be drawn in at the bottom opening from the pipe compartment, keeping the latter cool during the heating operation. Consequently the pipes need not be removed during the reactivation. A temperature of 175° to 200° C. is usually sufficient for reactivation. No harm is done in leaving the electric current on for a long time in the reactivation since the temperature does not rise higher after a certain point has been reached, as a result of increased air circulation taking place in proportion to the heat input. In other words, the temperature of the plates after, say, forty minutes or longer would not be materially higher than after, say, twenty minutes. This feature lends safety to the operation of the device.

To permit of the cooling of the plates when the activation is completed, the cover is left open for about twenty or thirty minutes more, after which the device may be used continuously for two to four weeks, depending on atmospheric conditions and frequency of inserting "wet" pipes, etc.

The above detailed use of my invention for drying pipes is merely illustrative of a wide field of other applications. For instance, it may be used to preserve certain food products such as salt, sugar, flour, crackers, cereals, cookies, zwieback and other toasted preparations, in a crisp and palatable condition.

While it is true that the modern domestic electric refrigerators might be used for drying purposes, usually their use is confined to the cooling of perishable food products as their storing capacity is rather restricted. Moreover, certain food products should be dry and crisp, but not cold when served, and it is unavoidable that cold products would cause moisture to be precipitated on them in humid weather, thereby defeating the very object desired.

Aside from employing my drying device for keeping the diverse culinary commodities in a satisfactory and sanitary condition, it also will be serviceable as a receptacle for storing certain materials which are impaired in efficacy or quality by moisture, as for example tooth brushes, matches, playing cards, table ware, etc.

In chemical laboratories desiccators are employed to prevent the reabsorption of moisture by substances which have been dried at elevated temperatures so that they may be weighed at ordinary temperatures. Such desiccators are also used frequently for drying substances which are unstable at elevated temperatures. In the past such devices have been charged with anhydrous calcium chloride, concentrated sulphuric acid and the like. When these materials lost their effectiveness they were replaced by fresh materials as it was not practical to reconvert them to the active state. More recently granular adsorbents, such as activated alumina have been suggested for desiccators, but their reactivation after removal from the desiccators is troublesome and they have the same defect in common with other granular desiccating agents.

Because of the fact that in the desiccators now most commonly used, the space provided for the crucibles, dishes, trays, and the like, is above that used for housing the desiccating agent, such devices were relatively inefficient for the reason that the dry air sinks to the bottom and envelops the desiccant, thus tending to blanket the same and limiting the effect to that produced by diffusion. When placing granular desiccating agents above the materials to be dried

other difficulties are encountered and this arrangement is found feasible only in very small desiccators. These shortcomings inherent in present day desiccators have been overcome in my invention which is an improvement not only in the constructional features thereof but also enlarges to a marked degree their field of usefulness.

Desiccating devices permitting convenient reactivation, as embodied in my invention, may be used also in hospitals, or by physicians, surgeons and dentists for maintaining surgical dressings, absorbent cotton, gauzes, etc., in a dry and aseptic condition, and also for surgical instruments to prevent them from rusting or tarnishing. They may be used as desiccators for all purposes with or without provision for a vacuum.

As indicated above it is an important feature of my device that the desiccating medium is employed in the form of plates which are mounted edgewise and parallel to one of the sides of the container. These plates are most conveniently prepared by molding the desiccating agent into the desired shape. Desiccating agents especially suitable for the above purpose are materials substantially insoluble in water and organic solvents and not readily affected by gases and vapors such as would come into consideration here. The efficacy of activated alumina and silica gel for adsorbing moisture and other easily condensable vapors is well known. They are employed industrially mostly in a granular form. However, no satisfactory method has become known for producing molded articles from these desiccating agents. They may be obtained, to be sure, in larger, irregular masses by allowing their hydrogels, after extensive attrition, to contract spontaneously, but this method is unsuitable for making desiccants of definite shapes and dimensions. To be suitable for the above purpose they should not be so dense as to fracture during the rapid dissipation of water or other condensates from the interior to the surface and vice versa.

In pursuing the aim of making use of commercially available silica gel or activated alumina in a granulated form for fashioning durable plates by a molding process considerable difficulties were encountered in finding a suitable binding agent. Organic binders were out of question because they lacked thermal resistivity, and among inorganic binders those had to be eliminated which tended to clog the fine pores of the individual granules. Conglomeration of the particles by heating with a sintering agent also was impracticable as these desiccants are impaired at temperature above approximately 400° C. One of the most suitable binders found for molding granular silica gel was ordinary plaster of Paris, particularly if used in conjunction with a resilient filler of fibrous texture such as mineral wool, asbestos or the like. These fibrous materials not only are effective in increasing to a marked degree the mechanical strength of the molded slabs but they also contribute to their porosity. Sufficient porosity is of particular importance for plates of substantial thickness. Aside from the fact that plaster of Paris is a very inexpensive binding agent it possesses the additional virtue of being convertible, in the course of activating the slabs, to anhydrous calcium sulfate, the so-called "soluble anhydrite". In this anhydrous form calcium sulfate is known to be a potent desiccating agent. Therefore, I utilize the bonding property of calcium sulfate for producing molded compositions which possess

a more extended drying capacity than calcium sulfate alone. For example, if silica gel is used for removing moisture from a confined space up to 15.4 per cent of its initial weight, a slab consisting of equal parts of silica gel and anhydrous calcium sulfate would exhibit an effective range of approximately 11.0 per cent adsorptivity.

Granular activated alumina or silica gel cemented together with the aid of calcium sulfate is so effective that the bond between the individual granules remains permanently firm and durable in repeated adsorptions and re-activations, and more particularly so if a small amount of resilient fibrous filler is incorporated in this composition.

To summarize, by invention comprises, among other features, a formed composition of matter, such as plates, consolidated by a casting or molding process, and consisting of a mixture of two or more adsorbents, of which a least one has been formed from a raw material endowed with hydraulic or cementitious properties, this composition of matter also including, preferably a fibrous heat-resisting filler.

The use of gypsum as a binder is applicable both to silica gel and activated alumina, as well as mixtures of these. A satisfactory mixture for the preparation of plates of good adsorptivity and mechanical strength consists, for example, of 55 parts of activated alumina, minus 80 mesh, 10 parts of mineral wool (or asbestos) and 35 parts of gypsum. The alumina is first thoroughly mixed with the mineral wool (or asbestos) and 40 to 50 parts of water. Finally the gypsum is added and the whole is thoroughly mixed and kneaded together. The thick paste is placed in a mold and moderately compressed with the aid of a plunger provided on its face with ridges which cause a continuous groove of square cross-sectional area to be formed on the side of the plate. The plunger is withdrawn and a helically wound resistance wire coil is laid into the groove thus formed, with its two terminal ends projecting through slots in the side of the mold. The second half of the pasty mixture is then added and the whole charge is subjected to high pressure with a plunger having a smooth face. The mass is thus saturated with water which supplies to the gypsum the water of crystallization required during its setting for developing its maximum binding effect. The pressed plates are kept in a damp room before drying and heating them gradually to a temperature of 250-300° C. for preliminary activation. A portion of the activated alumina may be replaced by silica gel which increases the adsorptive capacity. If activated alumina is entirely replaced by silica gel of the same or somewhat coarser grain size it is advisable to employ a larger proportion of the fibrous filler and/or gypsum.

For example I may provide a composition containing 50 parts (by weight) of silica gel of a grain size of minus 60-100 mesh, 15 parts of asbestos of comparatively short length of fibers (say $\frac{1}{4}$ in. to $\frac{3}{4}$ in.) and 35 parts of gypsum. The asbestos is first triturated with 100 parts of water into the form of a pulp. The silica gel is added and thoroughly distributed in the pulp, the gypsum added and the whole kneaded together to a homogeneous paste, which is placed into a plate-mold permitting extrusion of surplus water and the material compressed subsequent to the insertion of the heating coil, as explained previously. The water mechanically retained in the mass serves advantageously in supplying the gypsum

with more than the two mols of crystal water required by it for the complete setting action. The resulting slab after activation shows a smooth surface and fine-pored texture as well as a good mechanical strength and high adsorptivity.

In the accompanying drawings constituting a part hereof, and in which like reference characters indicate like parts,

Fig. 1 is a perspective view of an apparatus made in accordance with my invention with the 10 cover removed.

Fig. 2 is a plan view thereof with the cover removed.

Fig. 3 is a vertical cross-sectional view taken along the line 3-3 of Fig. 2.

Fig. 4 is a vertical cross-sectional view taken along the line 4-4 of Fig. 2, and

Fig. 5 is a perspective view showing the construction of the drying plates and mounting thereof.

The device consists essentially of a container 1 having a rolled top edge 2 and short feet 3 at the corners thereof. A vertical partition 4 extends across the inside of the container and is secured to opposite sides thereof by rivets 5, dividing the container into two chambers. The partition is spaced a substantial distance 6 from the top of the container and a similar distance 7 from the bottom of the container so as to allow circulation of air between the two chambers. A 30 cover 8 has a flange 9 resting upon edge 2 and has a depending skirt 10 fitting closely to the inside of the container. Suitable handle 11 is secured to the cover.

The chamber 12 formed by partition 4 contains 35 the drying element and chamber 13 is intended to receive the articles to be dried. In the latter chamber is a tray 14, the side 15 thereof adjacent to the partition 4 being so short as to admit the free passage of air. An angle plate 16 is secured to the tray and clips 17 and 18 for holding pipes 19 are secured thereto. The bowl 20 of the pipe is inserted in the clip in an inverted position so that the stem or mouthpiece 21 is at a higher level. This accomplishes the result that when 45 a pipe is in position moisture and other liquid impurities flow away from the mouth piece and are removed through the bowl of the pipe. Clips 22 and 23 in chamber 13 serve as a means for holding pipe cleaners 24.

In the desiccating chamber 12 are a pair of 50 plates 25 and 25 placed in a vertical position and having therein coils 27 of suitable resistance wire and which may be enamel-coated to resist certain fumes, the coils on the two plates 55 being connected in series by wire 28. The terminals 29 and 30 thereof are joined to wires 31 and 32, respectively, the free ends of which are connected to socket 33 in the wall of container. A plug 34 having wiring 35 connected to a source of current is adapted to be inserted in socket 33.

A pair of angle plates 36 have their inner portions 37 interposed between asbestos plates 38, the elements 37 and 38 constituting a spacer between plates 25 and 26 and bolts 39 and 40 pass 65 through the structure to hold the parts together. Bolts 41 pass through plates 36 and through openings 42 in the vertical portion of plate 43. An angular portion 44 thereof constituting the base is secured to the bottom of the container by 70 bolts 46 passing through openings 45.

In a similar manner the opposite end of plates 25 and 26 are secured together. Angle plates 47 have one side thereof interposed between two asbestos plates 48 and the assembly of plates is 75

held together by bolts 49 and 50. To angle plate 51 corresponding to plate 43 is secured the plate 47 by bolts 52 and 53. The base of plate 51 is secured to the bottom of the container by bolts 54.

5 For certain purposes it is desirable to have means present for indicating the condition of the adsorbent to show whether it requires reactivation. I may provide a simple indicator in the drying device by utilizing the increase in weight 10 of the adsorbent as a gauge for registering the state of exhaustion of the plates.

For example, a thin, tubular piece or one or more thin plates of the adsorbent (the same in composition as the adsorbent plates) may be 15 counterbalanced on a lever swinging on a supporting fulcrum or held by a spring. The lever has an arm to which a dial plate is fastened, allowing the marks "0, $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$ and full charge" to be viewed through a window in the drying 20 chamber. The increase in the weight of the cylinder due to its adsorption of H_2O is of course proportional to that of the plates. If, for example, the cylinder has gained 1.0 g. in weight this might correspond to a completion of the ad- 25 sorption stage and the mark "0" would appear in front of the window. Then re-activation would be in order.

Although I have described my invention setting forth but a single practical embodiment 30 thereof, my invention is not at all limited thereto as it may be embodied in numerous forms. The details of construction and arrangement of the parts thereof may be changed within the spirit of my invention. The uses for my device are 35 many and those set forth herein were for illustration only and they should not be considered as limiting the invention. My invention is to be construed broadly except as limited by the claims appended hereto.

40 What I claim is:—

1. An apparatus for drying comprising an enclosed chamber, a plate of non-deliquescent desiccating material mounted along a side of said 45 chamber and spaced therefrom, the sides of said plate being open to the air, a partition between said plate and another portion of said chamber, said partition extending short of the top and bottom of said chamber, said plate and said other 50 portion being on the same plane, the difference in specific gravity of dry and humid air causing a natural circulation of air between said plate and said other portion, an electrical heating element embedded in said plate, the latter comprising molded adsorbent material taken from 55 the class consisting of silica gel and activated alumina with a binder of gypsum which after heating acquires adsorbent properties and having therein a heat resistant fibrous filler, said plate being mounted on a support allowing move-

ment thereof on expansion and contraction due to temperature changes.

2. An apparatus for drying comprising an enclosed chamber, a plate of non-deliquescent desiccating material mounted along a side of said 5 chamber and spaced therefrom, the sides of said plate being open to the air, a partition between said plate and another portion of said chamber, said partition extending short of the top and bot- 10 tom of said chamber, said plate and said other portion being on the same plane, the difference in specific gravity of dry and humid air causing a natural circulation of air between said plate and said other portion, an electrical heating element embedded in said plate, the latter comprising 15 molded adsorbent material, said plate being mounted on a support allowing movement thereof on expansion and contraction due to temperature changes.

3. An apparatus for drying comprising an enclosed chamber, a plate of non-deliquescent desiccating material mounted along a side of said 20 chamber and spaced therefrom, the sides of said plate being open to the air, means within said chamber adjacent said plate and between said plate and another portion of said chamber and 25 adapted to allow a circulation of air between said plate and portion, said means extending short of the top and bottom of said chamber, said plate and said other portion being on the same plane, 30 the difference in specific gravity of dry and humid air causing a natural circulation of air between said plate and said other portion, an electrical heating element embedded in said plate, 35 the latter comprising molded adsorbent material, said plate being mounted on a support allowing movement thereof on expansion and contraction due to temperature changes.

4. An apparatus for drying comprising an enclosed chamber, a plate of non-deliquescent desiccating material mounted along a side of said 40 chamber and spaced therefrom, the sides of said plate being open to the air, a partition between said plate and another portion of said chamber, said partition extending short of the top and bot- 45 tom of said chamber, said plate and said other portion being on the same plane, the difference in specific gravity of dry and humid air causing a natural circulation of air between said plate and said other portion, an electrical heating element 50 embedded in said plate the latter comprising molded adsorbent material, said plate being mounted on a support allowing movement thereof on expansion and contraction due to temperature 55 changes, said support including an upstanding member having its base fixed in said chamber, and a second member fixed to said plate and secured to said upstanding member.

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